2013 Cassini/CAPS
Cassini Plasma Spectrometer

CAPS STANDARD DATA PRODUCTS AND ARCHIVE VOLUME SOFTWARE INTERFACE SPECIFICATION

(CAPS Archive Volumes SIS)
SIS ID: IO-AR-017

Version 3.1

rev. June 25, 2013

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Approved:

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List Of Tables:

1. Preface

This document describes the contents and types of volumes belonging to all of the CAPS data sets.

1.1. Distribution List

Table 1: Distribution List

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1.2. Document Change Log

Table 2: Document Change History

Change	Date	Affected Portions
Update version 1.17	05/2010	All
Updates include Missing Constant values and a change to TOF format.	05/2010	All
Included Higher Order Data Products. Updated sections for missing constants, etc	6/2013	
Changed Data set id for ELS moments & spacecraft potential	6/25/2013	3.3

1.3. TBD Items

Items that are currently still to be specified:

Table 3: TBD Items		
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Detached FMT or not?	Section 4.5.1	17/18
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1.4. Acronyms and Abbreviations

Table 4: Acronyms and Abbreviations	
Acronym	Definition
ASCII	American Standard Code for Information Interchange
CAPS	CAssini Plasma Spectrometer
CD-R	Compact Disc - Recordable Media
CD-ROM	Compact Disc - Read-Only Memory
DAT	Binary data file for Planetary Data System
DVD	Digital Versatile Disc
ELS	Electron Spectrometer
ELS 3DMOMT	Electron Moment
EVT	Ion Mass Spectrometer Event Mode Data Product
FMT	Format file for Planetary Data System
GB	Gigabyte(s)
IBS	Ion Beam Spectrometer
ION MOMT	Ion Moment – made from Singles Data (SNG)
IMS	Ion Mass Spectrometer

Table 4: Acronyms and Abbreviations	
Acronym	Definition
ISO	International Standards Organization
JPL	Jet Propulsion Laboratory
LBL	Label file for Planetary Data System
LOG	Ion Mass Spectrometer's Logical Data Product
MB	Megabyte(s)
NSSDC	National Space Science Data Center
PDB	Project Database
PDS	Planetary Data System
PNG	Portable Network Graphic. A bit-mapped graphics format
PPI	Planetary Data System, Planetary Plasma Interactions Node
SCPOT	Electron Spectrometer Spacecraft Potential
SDVT	Science Data Validation Team
SNG	Ion Mass Spectrometer Singles Data Product
SIS	Software Interface Specification
TBD	To Be Determined
TOF – LEF / TOFLEF	Time of Flight – Linear Electric Field
TOF – ST / TOFST	Time of Flight – Straight Through

1.5. Glossary

Archive – An archive consists of one or more Data Sets along with all the documentation and ancillary information needed to understand and use the data. An archive is a logical construct independent of the medium on which it is stored.

Archive Volume - An Archive Volume is a single physical media (CDROM, DVD, 9-track tape, etc.) used to permanently store files within the PDS archive. Archive Volumes may only be created on media approved by the PDS as meeting archive quality standards.

Archive Volume Set – A collection of one or more Archive Volumes used to store a single Data Set or collection of related Data Sets.

Catalog Information – High-level descriptive information about a Data Set (e.g., mission description, spacecraft description, instrument description), expressed in Object Description Language (ODL), which is suitable for loading into a PDS catalog.

Data Product – A labeled grouping of data resulting from a scientific observation, usually stored in one file. A product label identifies, describes, and defines the structure of the data. An example of a Data Product is a planetary image, a spectral table, or a time series table.

Data Set – A Data Set is a collection of Data Products from a single instrument that have a common data processing level, together with supporting documentation and ancillary files.

Standard Data Product – A Data Product generated in a predefined way using well-understood procedures, processed in "pipeline" fashion. Data Products that are generated in a non-standard way are sometimes called *special Data Products*.

2. Introduction

2.1. Content Overview

The Cassini Plasma Spectrometer (CAPS) aboard the Cassini spacecraft is an instrument comprised of three different sensors: the Electron Spectrometer (ELS), the Ion Mass Spectrometer (IMS), and the Ion Beam Spectrometer (IBS). The primary focus of CAPS's mission is Saturn science, but data was taken at Earth and Jupiter as well as interplanetary space.

The CAPS instrument is a complex instrument that produces large amounts of data. We archive un-calibrated, calibrated, and higher order data files to the PDS.

CAPS is archiving three data sets: un-calibrated, calibrated, and higher-order. Each data set is archived on a separate volume. The un-calibrated data set is archived with some very basic calibration procedures. These procedures may be updated, but the higher order data volume and files contain the very latest in calibration information. There are several different types of data products in each data set. The ELS and IBS sensors each produce their own data product. The IMS sensor generates several different data products including Event Mode (EVN), two Time of Flight data products that are archived in the same file (TOF), a singles data product (SNG), a logicals data product (LOG), and an ion data product (ION). In addition, we have an actuator data product (ACT) and an ancillary data product (ANC). The calibrated data set is currently being defined, but will include calibrated files for the electron spectrometer and the ion neutral mass spectrometer. Full details of the contents of volume and individual descriptions of the file types will be included TBD (soon). Higher order data are derived quantities from the electron spectrometer and the IMS sensor singles and TOF data products. These products are electron and ion moments and spacecraft potential.

Most CAPS data products are collected on 32-second cycles (called A-cycles). IMS Time-of-Flight (TOF) data products are a collection of A-cycles (called B-cycles). Each B-cycle represents one-full time of flight – energy spectrum. The number of A-cycles per B-cycle varies depending upon the data rate of the instrument, due to data volume limitations. In version 4.0 (and later) of CAPS flight software, the IBS sensor data are collected on a fixed 8 A-cycle collection period (called a C-cycle). One goal with our archive format is for the differences in data rate and flight software version to be transparent to the end user.

The data products mentioned are briefly described in Table 5 below, including the data set in which they are included and the maximum data volume of each different data type (per day). Each sensor's data is written to a separate file, and the format of each file will be discussed in detail in section 5.2, and Table 21 through Table 29.

Table 5: Spacecraft Science Data Products in CAPS Data Sets

Sensor	Data Set Type	Maximum (MB / Day)	Sensor Total (MB / Day)
ELS	Un-calibrated	103.821	322.549
	Calibrated	216.228	

Table 5: Spacecraft Science Data Products in CAPS Data Sets			
Sensor	**Data Set Type**	**Maximum (MB / Day)**	**Sensor Total (MB / Day)**
	Higher Order (3DMOMT)	0.4	
	Higher Order (SCPOT)	2.1	
IBS	Un-calibrated	315.170	591.527
	Calibrated	276.357	
IMS TOF	Un-calibrated	1.32544	2.782
	Calibrated (TOFLEF)	0.728	
	Calibrated (TOFST)	0.728	
IMS ION	Un-calibrated	381.541	829.959
	Calibrated	448.418	
IMS SNG	Un-calibrated	51.9104	118.509 4
	Calibrated	66.598	
ACT	Un-calibrated	0.360489	0.360489
ANC	Un-calibrated	0.37594	0.37594
IMS LOG	Un-calibrated	46.7194	46.7194
EVN	Un-calibrated	12.198	12.198
IMS SNG & IMS TOF	Higher Order (ION_MOMT)	0.2	0.2

2.2. Scope

This specification applies to all archive volumes containing CAPS data products for the duration of its mission.

2.3. Applicable Documents

Planetary Science Data Dictionary Document, August 28, 2002, Planetary Data System, JPL D-7116, Rev. E.

Planetary Data System Data Preparation Workbook, February 1995, JPL D-7669, Part 1, Version 3.1.

Planetary Data System Standards Reference, August 1, 2003, JPL D-7669, Part 2, Version 3.6.

Cassini/Huygens Program Archive Plan for Science Data, PD 699-068, JPL D-159576

Young, David T., et al., *Cassini Plasma Spectrometer Investigation*, *Space Science Reviews*, **114**, 1-112 (2004).

Wilson, R.J. et al., PDS User's Guide for Cassini Plasma Spectrometer (CAPS), 2012. Links to the docx and pdf versions are located at the PDS Planetary Plasma Interactions (PPI) Node CAPS Data Archive website: http://ppi.pds.nasa.gov/search/view/?id=pds://PPI/COCAPS_1SAT/DOCUMENT//CAPS_USER_GUIDE/CAPS_PDS_USER_GUIDE_V1_00

2.4. Audience

This specification is intended for researchers and analysts who wish to understand the format and content of the CAPS PDS data product archive collection. Typically, these individuals would be software engineers, data analysts, or planetary scientists.

3. Archive Volume Generation

3.1. Data Production and Transfer Methods

The CAPS standard product archive collections are produced by the CAPS instrument team in cooperation with the PDS Planetary Plasma Interactions (PPI) Node at the University of California, Los Angeles (UCLA). The CAPS team is funded by NASA through the Cassini Project office and the PPI activities are funded by the NASA Planetary Data System.

The CAPS team has produced the individual data files and the associated detached PDS labels for each of the standard data products defined in section 2.1 above. For the un-calibrated data, there are up to 4 files per product, per day. The files are split into 6 hour periods, with full B-cycles appearing in the file in which the B-cycle starts. This implies that a few A-cycles at the start of each file may be in the previous 6-hour block file. However, this implies multi-sensor analysis by assuring that all the data obtained at a given time is in the file with the same time stamp. The A and B cycle numbers are the same for all data products, i.e. if an A-cycle of ELS data is missing, the A-cycle numbers in the ELS file will skip the appropriate number. Additionally, if there are no A-cycles for a given time period then there is **not** a gap in the A-cycle number count.

Un-calibrated data files are flat, binary data files, with a fixed series of values repeated as many times as necessary. The files contain data taken at all rates during the period. If data are collapsed in elevation, counts are given for the lowest elevation of the collapsed sample and all other elevations contain fill values. The fill values as specified in the label files are different for the data products due to differences in maximum values. If the data are collapsed in energy or azimuth, this are indicated by the first and last energy step and azimuth values. This implies that an A-cycle of data contains a variable number of rows, depending on the data rate. The format of the data can be found in section 5.2, and Table 21 through Table 29.

Data are ftp'd to an agreed to location within the PDS ftp system. PPI assembles the data products into archive volumes so that each volume contains the interval of data from each data set in multiples of 5 day periods (or only 1 day if 5 days will not fit). The CAPS team delivers data to PDS/PPI on a quarterly basis.

Calibrated data files are also flat, binary data files, derived from the Un-calibrated files and following the same rules regarding fill values, collapses of data and period of time a file contains. Data records have been grouped in to all energies that are sampled in one voltage sweep, and data taken during calibration runs or at low voltages have been set to fill values to avoid them being used for science. The counts per accumulation of un-calibrated data have been converted to counts per second, cross talk corrected if appropriate, and dead time corrected where possible. Further information on the processing and format of this calibrated data can be found in section 5.3, and Table 30 throughTable 35.

Higher Order data consists of electron and ion moments, each in separate files. Each file has a corresponding detached label, which contains the format of the data. Additionally, a separate file is submitted for spacecraft potential that has been generated from the Cassini CAPS ELS sensor. Data is delivered in separate folders within the higher order directory. Higher Order data files are fixed length ASCII files. Electron moments and spacecraft potential are supplied at a 32 second cadence, which is the cadence of an instrument cycle (called an A-cycle). Ion moment data is supplied on a B-cycle cadence (either 256, 512, or 1024 seconds – predefined multiples of a single instrument cycle). The format of the higher order data can be found in section 5.4, and Table 36 through Table 38.

Calibrated data will consist of electron spectrometer and ion mass spectrometer files. Additional information regarding the volume and its contents will be supplied within TBD.

3.2. Archive Volume Creation and Validation Methods

The archive validation procedure described in this section applies to volumes generated during all phases of the mission. PPI collects the data files and labels provided by the CAPS team onto archive volumes. Each archive volume contains all CAPS data available (either un-calibrated or higher order) for the time interval covered by the archive volume. Once all of the data files, labels, and ancillary data files are organized onto an archive volume, PPI adds all of the PDS required files (AAREADME, INDEX, ERRATA, etc.) and produces the physical media, which are then validated.

Data is validated using the PDS peer review process. The peer review panel consists of members of the instrument team, the PPI and Central Nodes of the PDS, and at least two outside scientists actively working in the field of magnetospheric physics, especially those working with low energy ion and electron measurements. The PDS personnel are responsible for validating that the archive volume(s) are fully compliant with PDS standards. The instrument team and outside science reviewers are responsible for verifying the content of the data set, the completeness of the documentation, and the usability of the data in its archive format. Because of the large volume of the CAPS data, the peer review panel seeks to validate the process by which the data products are produced rather than the data products themselves. This is accomplished in two phases. First, a specimen volume is created and manually reviewed for proper structure and completeness of documentation along with the current reference volume. Once the specimen volume is validated, PPI develops software to validate that subsequent data volumes comply with PDS standards. After the volume creation software is complete, a volume created by this process is reviewed again, this time considering all facets of volume usefulness. Any deficiencies in the archive volume are recorded as liens against the product by the review panel. After all liens placed against the product or the product generation software are resolved, automated production and validation can begin. Peer review is performed on both CAPS archive volumes.

All of the archive files contained on these volumes are verified through the use of the data by the instrument team. Archive un-calibrated data products are used on a daily basis to generate browse spectrograms. In addition, selected periods in all modes are examined in depth by the science team as part of science and research activities. If an error is found, the response will depend on the source of the error. If the error is in the automation software that produced the data product, the error will be fixed and the data product will be reproduced. If there is a correctable error in a data file, the file will be replaced and a new archive volume will be created. If an error in a data file is uncorrectable (i.e., an error in the downlink data file) the error will be described in the cumulative errata file that is included on each volume in the volume set.

3.3. Labeling and Identification

Each CAPS standard data product archive volume bears a unique volume identifier (volume_id) of the form COCAPS_1nnn for CAPS un-calibrated data with calibration information, COCAPS_2kkk for CAPS calibrated data, and COCAPS_5mmm for CAPS higher order data where CO identifies the spacecraft (Cassini Orbiter), CAPS identifies the instrument, and kkkk, nnn, and mmm are sequential numbers assigned to each volume. The volume_id is used as the label for the physical medium on which the data are stored.

CAPS PDS data set names will conform to the format: CASSINI ORBITER EARTH/JUP/SAT/SW CAPS UNCALIBRATED V<major version>.<minor version> for un-calibrated data. For calibrated data, the data set name will be CASSINI ORBITER EARTH/JUP/SAT/SW CAPS CALIBRATED V<major version>.<minor version>. For higher order data the data set name for ion moments will be CASSINI ORBITER SAT/SW CAPS DERIVED ION MOMENTS V<major version>.<minor version>, for electron moments it will be CASSINI ORBITER SAT/SW CAPS DERIVED ELECTRON MOMENTS V<major version>.<minor version>, and for spacecraft potential it will be CASSINI ORBITER SAT/SW CAPS DERIVED SC POTENTIAL V<major version>.<minor version>.

PDS data set identifiers (dsid) are abbreviated versions of the data set names formed according to the PDS formation rule for the DATA_SET_ID keyword (see Section 6 of the PDS Standards Reference). For example, the dsids for the 1.0 version of the CAPS data sets are CO-E/J/S/SW-CAPS-2-UNCALIBRATED-V1.0, CO-E/J/S/SW-CAPS-3-CALIBRATED-V1.0,
CO-S/SW-CAPS-5-DDR-ION-MOMENTS-V1.0,
CO-E/J/S/SW-CAPS-5-DDR-ELE-MOMENTS-V1.0,
and
CO-E/J/S/SW-CAPS-5-DDR-SC-POTENTIAL-V1.0.

Table 6: Relationship Between Data Sets, Standard Data Product Types, and Archive Volumes

Data Set ID	Product Type	Product Volume Files
CO-E/J/S/SW-2-UNCALIBRATED-V1.0	ELS	ELS_199923000_U1.DAT
	IBS	IBS_199923000_U1.DAT
	IMS Ions (ION)	ION_199923000_U1.DAT
	IMS Singles (SNG)	SNG_199923000_U1.DAT
	IMS Logicals (LOG)	LOG_199923000_U1.DAT

	IMS TOF (TOF)	TOF_199923000_U1.DAT
	Actuator (ACT)	ACT_199923000_1.DAT
	Ancillary (ANC)	ANC_199923000_U1.DAT
	IMS Event Mode (EVN)	EVN_199923000_U1.DAT
CO-E/J/S/SW-3-CALIBRATED-V1.0	ELS	ELS_200400100_V01.DAT
	IBS	IBS_200400100_V01.DAT
	IMS Ions (ION)	ION_200400100_V01.DAT
	IMS Singles(SNG)	SNG_200400100_V01.DAT
	IMS TOF LEF (TOFLEF)	TOFLEF_200400100_V01.DAT
	IMS TOF ST (TOFST)	TOFST_200400100_V01.DAT
	TBD	TBD
CO-E/J/S/SW-CAPS-5-DDR-ELE-MOMENTS-V1.0	ELS Electron Moments	ELS_3DMOMT_YYYYDOY_00.TAB
CO-E/J/S/SW-CAPS-5-DDR-SC-POTENTIAL-V1.0	ELS Spacecraft Potential	ELS_SCPOT_YYYYDOY_00.TAB
CO-S/SW-CAPS-5-DDR-ION-MOMENTS-V1.0	Singles Ion Moments	ION_MOMT_YYYYDOY_01.TAB

4. Archive Volume Contents

This section describes the contents of the CAPS standard product archive collection volumes, including the file names, file contents, file types, and organizations responsible for providing the files. The complete directory structure is shown in Appendix A. All the ancillary files described herein appear on each CAPS archive volume, except where noted. Based on the type of archive volume, the DATA contents will be contain either un-calibrated data, calibrated data, or higher order data. All other directory contents will remain the same, though the higher order data volume will have the most up-to-date calibration documentation and will not contain the ancillary data.

4.1. Root Directory Contents

The following files are contained in the root directory (for either volume), and are produced by the PPI Node at UCLA. With the exception of the hypertext file and its label, all of these files are required by the PDS Archive Volume organization standards.

Table 7: Root Directory Contents

File Name	File Contents	Provided By
AAREADME.TXT	This file completely describes the Volume organization and contents (PDS label attached).	PPI
AAREADME.HTM	Hypertext version of AAREADME.TXT (top level of HTML interface to the Archive Volume).	PPI
AAREADME.LBL	A PDS detached label that describes AAREADME.HTM.	PPI
ERRATA.TXT	A cumulative listing of comments and updates concerning all CAPS Standard Data Products on all CAPS Volumes in the Volume set published to date.	PPI
VOLDESC.CAT	A description of the contents of this Volume in a PDS format readable by both humans and computers.	PPI

4.2. INDEX Directory Contents

The following files are contained in the INDEX directory and are produced by the PDS PPI Node. The INDEX.TAB file contains a listing of all data products on the archive volume. In addition, there is a cumulative index file (CUMINDEX.TAB) file that lists all data products in the CAPS archive volume set to date. The index and index information (INDXINFO.TXT) files are required by the PDS volume standards. The index tables include both required and optional columns. The cumulative index file is also a PDS requirement; however, this file may not be reproduced on each data volume if its size grows so large as to affect where volume boundaries lie. An online and web accessible cumulative index file will be maintained at the PPI Node while archive volumes are being produced.

Table 8: Index Directory Contents		
File Name	**File Contents**	**Provided By**
INDXINFO.TXT	A description of the contents of this directory	PPI
INDEX.TAB	A table listing all CAPS Data Products on this Volume	PPI
INDEX.LBL	A PDS detached label that describes INDEX.TAB	PPI

4.3. DOCUMENT Directory Contents

The document directory contains documentation that is considered to be either necessary or simply useful for users to understand the archive data set. These documents are not necessarily appropriate for inclusion in the PDS catalog. Documents may be included in multiple forms (ASCII, PDF, MS Word, HTML with image file pointers, etc.). PDS standards require that any documentation deemed required for use of the data be available in some ASCII format. HTML and PostScript are acceptable as ASCII formats in addition to plain text.

There is a separate directory for each document that is to be archived. Each of the document directories includes the document in hypertext (ASCII) and the document in another format (i.e. .DOC or .PDF). There is also a single label file that describes all the different formats of the included documents.

The following files are contained in the DOCUMENT directory and are produced or collected by the PPI Node.

Table 9: Document Directory Contents		
File Name	**File Contents**	**Provided By**
DOCINFO.TXT	A description of the contents of this directory and all subdirectories.	PPI
CAPS_SIS	Directory containing the CAPS archive SIS	CAPS
CAPS_CALIB	Directory containing information regarding calibration	CAPS
Other Documents	Additional documents describing data processing, etc.	CAPS, PPI
Other Document labels	Detached PDS labels for any additional documents	CAPS, PPI

The following files are contained in the DOCUMENT/CAPS_SIS directory.

Table 10: Document/CAPS_SIS Directory Contents

File Name	File Contents	Provided By
CAPS_ARCHIVE_SIS.HTM	The Archive Volume SIS (this document) as hypertext	CAPS, PPI
CAPS_ARCHIVE_SIS.DOC	The Archive Volume SIS (this document) in Microsoft Word format	CAPS
CAPS_ARCHIVE_SIS.ASC	The Archive Volume SIS (this document) in ASCII format	CAPS, PPI
CAPS_ARCHIVE_SIS.LBL	A PDS detached label that describes VOLSIS.ASC, VOLSIS.HTM and VOLSIS.DOC.	CAPS, PPI

The following files are contained in the DOCUMENT/CAPS_CALIB directory.

Table 11: Document/CAPS_CALIB Directory Contents

File Name	File Contents	Provided By
CAPS_BASIC_CALIB_PROCEDURES.HTM	The CAPS Basic Calibration Procedures document as hypertext	CAPS, PPI
CAPS_BASIC_CALIB_PROCEDURES.DOC	The CAPS Basic Calibration Procedures document in Microsoft Word format	CAPS
CAPS_BASIC_CALIB_PROCEDURES.ASC	The CAPS Basic Calibration Procedures document in ASCII format	CAPS, PPI
CAPS_BASIC_CALIB_PROCEDURES.LBL	A PDS detached label that describes VOLSIS.ASC, VOLSIS.HTM and VOLSIS.DOC.	CAPS, PPI

4.4. CATALOG Directory Contents

The completed PDS templates in the CATALOG directory provide a top-level understanding of the Cassini/CAPS mission and its data products. The information necessary to create the files is provided by the CAPS team and formatted into standard template formats by the PPI Node. The files in this directory are coordinated with PDS data engineers at both the PPI and the PDS Central Nodes.

Table 12: Catalog Directory Contents		
File Name	**File Contents**	**Provided By**
CATINFO.TXT	A description of the contents of this directory	PPI
CO_CAPS_UNCALIBRATED_DS.CAT	PDS Data Set catalog description of all the CAPS un-calibrated level 2 data files	CAPS
CO_CAPS_CALIBRATED_DS.CAT	PDS Data Set catalog description of all the CAPS calibrated level 3 data files	CAPS
CO_CAPS_DERIVED_DS.CAT	PDS Data Set catalog description of all the CAPS higher order level 5 data files	CAPS
INSTHOST.CAT	PDS instrument host (spacecraft) catalog description of the Cassini spacecraft	Cassini Project
CO_CAPS_INST.CAT	PDS instrument catalog description of the CAPS instrument	CAPS
MISSION.CAT	PDS mission catalog description of the Cassini mission	Cassini Project
CO_CAPS_PERS.CAT	PDS personnel catalog description of CAPS Team members and other persons involved with generation of CAPS Data Products	CAPS
CO_CAPS_REF.CAT	CAPS-related references mentioned in other *.CAT files	CAPS
PROJREF.CAT	Mission-related references mentioned in other *.CAT files	Cassini Project

4.5. DATA (Standard Products) Directory Contents and Naming Conventions

The DATA directory contains the following sub-directories, based upon the archive volume: UNCALIBRATED, CALIBRATED, or HIGHERORDER. For un-calibrated data products, there are sub-directories of the form YYYYDDD. Each YYYYDDD subdirectory contains 1 day of data, for all data types. Similarly, the calibrated data products have sub-directories of the form YYYYDDD. For higher order data products, the HIGHERORDER directory contains three (3) subdirectories, one for each type of data: SCPOT, ELEMOMT, and IONMOMT. In each of these subdirectories, data are broken down into YYYY directories. For calibrated data products, the directory structure is still TBD.

4.5.1. **Required Files**

The DATA directory contains a file named DATAINFO.TXT that is an ASCII text description of the directory and subdirectory contents. Every file in the DATA path of an Archive Volume must be described by a PDS label, hence all files in the DATA directory have external (detached) labels. Detached PDS label files have the same root name as the file they describe but have the suffix ".LBL". In the UNCALIBRATED/YYYYDDD subdirectories, an external format file (.FMT) is included for each data type. In the HIGHERORDER/YYYY subdirectories, the format information is contained within the detached label file itself. In the CALIBRATED subdirectories, it has not yet been decided if there will be an attached or detached labels.

4.5.2. **File Naming Conventions**

Un-calibrated data products have names of the following form:

<sensor>_YYYYDDDHH_<DataType><V>.DAT

where

YYYYDDDHH is the start year, day of year, and hour of the data

sensor is the 3 letter code chosen from the following list:

ELS, IBS, ION, SNG, TOF, LOG, ACT, EVN, and ANC

DataType is a one (1) letter descriptor for the type of data, where C = calibrated and U = un-calibrated.

V is the data version number of the data product.

HH has valid values of 00, 06, 12, and 18, as data files are 6 hours in duration.

There is one exception to the un-calibrated data naming convention listed above. Given that the actuator (ACT) data product is both calibrated and un-calibrated, the <DataType> identifier is dropped. Actuator files conform to the following naming convention: ACT_YYYYDDDHHH_<V>.DAT.

Not every combination of sensor and DataType is a valid filename. Valid combinations can be determined by using the information contained in Table 5.

When data is updated within a specific type of format the data version number is incremented. When more than nine versions are required, the characters a-z are used to represent further versions.

Calibrated data products have names of the following form:

<ProductType>_YYYYDOYHH_V<vv>.DAT

where

YYYYDOYHH is the start year, day of year, and hour of the data

ProductType is IBS, ELS, ION, SNG, TOFLEF, and TOFST

vv is the version number

Higher order data files have the following form:

<ProductType>_YYYYDOY_<vv>.TAB

where

YYYYDOY is the start year and day of year of the data

ProductType is ELS_3DMOMT, ELS_SCPOT, or ION_MOMT, and

vv is the version number.

The naming convention for calibrated data products is still TBD.

4.5.3. **DATA/UNCALIBRATED/YYYYDDD Directory Contents**

Un-calibrated data files starting on YYYYDDD from all sensors are stored in the DATA/UNCALIBRATED/YYYYDDD directory. Each directory will contain one day of data. Each sensor can have up to 4 files for the day and each sensor file can contain up to 6 hours of data. The file naming convention is described in Section 4.5.2. Every data file in the directory has a detached PDS label with the same root name as the file they describe but have the suffix ".LBL". In addition, there is a brief ASCII text file (INFO.TXT) that describes the DATA/UNCALIBRATED/YYYYDDD directory contents, which are listed in Table 13. In addition, each YYYYDDD directory has its own set of format files. NOTE: Files are only available if data of the appropriate type (during the 6 hour block in question) is available. Also, we do not take very much event mode data (EVN), so these files are not available very frequently.

Table 13: YYYYDDD UNCALIBRATED Data Directory Contents

File Name	File Contents	Provided By
DATAINFO.TXT	Brief description of directory contents and naming conventions.	PPI
ELS*.DAT	ELS sensor data files.	CAPS
ELS*.LBL	PDS label for ELS sensor files of same base name.	CAPS
IBS*.DAT	IBS sensor data files.	CAPS
IBS*.LBL	PDS label for IBS sensor files of same base name.	CAPS
SNG*.DAT	IMS Singles (SNG) sensor data files.	CAPS
SNG*.LBL	PDS label for SNG files of same base name.	CAPS
LOG*.DAT	IMS Logicals (LOG) data files.	CAPS
LOG*.LBL	PDS label for LOG files of same base name.	CAPS
ION*.DAT	IMS Ions (ION) data files.	CAPS
ION*.LBL	PDS label for ION files of same base name.	CAPS
TOF*.DAT	IMS Time of Flight (TOF) data files.	CAPS

TOF*.LBL	PDS label for TOF files of same base name.	CAPS
ACT*.DAT	Actuator (ACT) data files.	CAPS
ACT*.LBL	PDS label for ACT files of same base name.	CAPS
ANC*.DAT	Ancillary (ANC) data files.	CAPS
ANC*.LBL	PDS label for ANC files of same base name.	CAPS
EVN*.DAT	Event Mode (EVN) data files.	CAPS
EVN*.LBL	PDS label for EVN files of same base name.	CAPS
ELS_U3.FMT	PDS format file containing the data file structure for the ELS file format.	CAPS
IBS_U3.FMT	PDS format file containing the data file structure for the IBS file format.	CAPS
SNG_U3.FMT	PDS format file containing the data file structure for the SNG file format.	CAPS
LOG_U3.FMT	PDS format file containing the data file structure for the LOG file format.	CAPS
ION_U3.FMT	PDS format file containing the data file structure for the ION file format.	CAPS
TOF_U3.FMT	PDS format file containing the data file structure for the TOF file format.	CAPS
ACT_3.FMT	PDS format file containing the data file structure for the ACT file format.	CAPS
ANC_U3.FMT	PDS format file containing the data file structure for the ANC file format.	CAPS
EVN_U3.FMT	PDS format file containing the data file structure for the EVN file format.	CAPS

4.5.4. **DATA/CALIBRATED/YYYYDDD Directory Contents**

Calibrated data files starting on YYYYDDD from all product types are stored in the DATA/CALIBRATED/YYYYDDD directory. Each directory will contain one day of data. Each product type can have up to 4 files for the day and each product type file can contain up to 6 hours of data. The file naming convention is described in Section 4.5.2. Every data file in the directory has a detached PDS label with the same root name as the file they describe but have the suffix ".LBL". In addition, there is a brief ASCII text file (INFO.TXT) that describes the DATA/CALIBRATED/YYYYDDD directory contents, which are listed in Table 13. In addition, each YYYYDDD directory has its own set of format files. NOTE: Files are only available if data of the appropriate type (during the 6 hour block in question) is available in the uncalibrated directory for the same 6 hour interval. For instance, a SNG calibrated file will exactly overlap the time period of the uncalibrated equivalent SNG file. The uncalibrated TOF data contained two different sets of TOF data, LEF and ST: these now have separate calibrated files.

Table 14: YYYYDDD CALIBRATED Data Directory Contents		
File Name	**File Contents**	**Provided By**
DATAINFO.TXT	Brief description of directory contents and naming conventions.	PPI
ELS*.DAT	ELS sensor product files.	CAPS
ELS*.LBL	PDS label for ELS sensor files of same base name.	CAPS
IBS*.DAT	IBS sensor product files.	CAPS
IBS*.LBL	PDS label for IBS sensor files of same base name.	CAPS
ION*.DAT	IMS Ions (ION) product files.	CAPS
ION*.LBL	PDS label for ION files of same base name.	CAPS
SNG*.DAT	IMS Singles (SNG) sensor product files.	CAPS
SNG*.LBL	PDS label for SNG files of same base name.	CAPS
TOFLEF*.DAT	IMS Linear Electric Filed Time of Flight (TOFLEF) product files.	CAPS
TOFLEF*.LBL	PDS label for TOFLEF files of same base name.	CAPS
TOFST*.DAT	IMS Straight Through Time of Flight (TOFST) product files.	CAPS
TOFST*.LBL	PDS label for TOFST files of same base name.	CAPS
ELS_*.FMT	PDS format file containing the data file structure for the ELS file format.	CAPS
IBS_*.FMT	PDS format file containing the data file structure for the IBS file format.	CAPS
ION_*.FMT	PDS format file containing the data file structure for the ION file format.	CAPS
SNG_*.FMT	PDS format file containing the data file structure for the SNG file format.	CAPS
TOFLEF_*.FMT	PDS format file containing the data file structure for the TOFLEF file format.	CAPS
TOFST_*.FMT	PDS format file containing the data file structure for the TOFST file format.	CAPS

4.5.5. **DATA/HIGHERORDER/SCPOT/YYYY Directory Contents**

Higher order data files for spacecraft potential starting within the year, YYYY, are stored in the DATA/HIGHERORDER/SCPOT/YYYY directory. Each directory contains one year of data. Each type of higher order file can have only 1 file for a given day and can contain up to 24 hours of data. The file naming convention is described in Section 4.5.2. Every data file in the directory has a detached PDS label with the same root name as the file they describe but have the suffix ".LBL". The detached label file includes the format of the file. In addition, there is a brief ASCII text file (DATAINFO.TXT) that describes the DATA/HIGHERORDER/SCPOT/YYYY directory contents, which are briefly listed in Table 15.

Table 15: HIGHERORDER/SCPOT/YYYY Data Directory Contents

File Name	File Contents	Provided By
DATAINFO.TXT	Brief description of directory contents and naming conventions.	PPI
ELS_SCPOT*.TAB	ELS spacecraft potential files.	CAPS
ELS_SCPOT*.LBL	PDS label for ELS spacecraft potential files of same base name.	CAPS

4.5.6. **DATA/HIGHERORDER/ELEMOMT/YYYY Directory Contents**

Higher order data files for ELS moments starting within the year, YYYY, are stored in the DATA/HIGHERORDER/ELEMOMT/YYYY directory. Each directory contains one year of data. Each type of higher order file can have only 1 file for a given day and can contain up to 24 hours of data. The file naming convention is described in Section 4.5.2. Every data file in the directory has a detached PDS label with the same root name as the file they describe but have the suffix ".LBL". The detached label file includes the format of the file. In addition, there is a brief ASCII text file (INFO.TXT) that describes the DATA/HIGHERORDER/ELEMOMT/YYYY directory contents, which are briefly listed in Table 16.

Table 16: HIGHERORDER/ELEMOMT/YYYY Data Directory Contents

File Name	File Contents	Provided By
DATAINFO.TXT	Brief description of directory contents and naming conventions.	PPI
ELS_3DMOMT*.TAB	ELS Moments files.	CAPS
ELS_3DMOMT*.LBL	PDS label for ELS Moments files of same base name.	CAPS

4.5.7. **DATA/HIGHERORDER/IONMOMT/YYYY Directory Contents**

Higher order data files for ion moments starting within the year, YYYY, are stored in the DATA/HIGHERORDER/IONMOMT/YYYY directory. Each directory contains one year of data. Each type of higher order file can have only 1 file for a given day and can contain up to 24 hours of data. The file naming convention is described in Section 4.5.2. Every data file in the directory has a detached PDS label with the same root name as the file they describe but have the suffix ".LBL". The detached label file includes the format of the file. In addition, there is a brief ASCII text file (INFO.TXT) that describes the DATA/HIGHERORDER/IONMOMT/YYYY directory contents, which are briefly listed in Table 17.

Table 17: HIGHERORDER/IONMOMT/YYYY Data Directory Contents

File Name	**File Contents**	**Provided By**
DATAINFO.TXT	Brief description of directory contents and naming conventions.	PPI
ION_MOMT*.TAB	IMS Singles ion moment files.	CAPS
ION_MOMT*.LBL	PDS label for IMS Singles ion moment files of same base name.	CAPS

4.5.8. **DATA/CALIBRATED Directory Contents**

The DATA/CALIBRATED directory contents are still TBD, but will include calibrated data products, their label files, and a DATAINFO.TXT file.

Table 18: DATA/CALIBRATED Directory Contents

File Name	**File Contents**	**Provided By**
DATAINFO.TXT	Brief description of directory contents and naming conventions.	PPI
*.DAT or *.TAB	Calibrated Data Products.	CAPS
*.LBL	Label files for Calibrated Data Products.	CAPS

4.6. CALIB Directory Contents

Given that we are archiving data to 2 different volumes, the contents of the CALIB directory include the following information for the un-calibrated archive volume. Please note that the documentation for CAPS basic calibration procedures can be found in the DOCUMENT/CAPS_CALIB directory.

Table 19: CALIB Directory Contents		
File Name	**File Contents**	**Provided By**
CALINFO.TXT	A description of the contents of this directory and all subdirectories.	PPI
SAMPLE_DATA	A directory that contains a sample input data file, additional files needed for the calibration process, and a sample output file.	CAPS
ELS_ENERGY_ARRAY.TAB	The ELS Sweep Table calibration data	CAPS
ELS_ENERGY_ARRAY.LBL	A PDS detached label that describes ELS_ENERGY_ARRAY.TAB	CAPS
ELS_GEOM_FACTOR.TAB	The ELS Geometric Factor matrix (see label for full description)	CAPS
ELS_GEOM_FACTOR.LBL	A PDS detached label that describes ELS_GEOM_FACTOR.TAB	CAPS
ELS_SWEEP_TABLE_ALL_VER.TAB	The ELS Sweep Table for all CAPS data	CAPS
ELS_SWEEP_TABLE_ALL_VER.LBL	A PDS detached label that describes ELS_SWEEP_TABLE_ALL_VER.TAB	CAPS
IBS_SWEEP_V0_V1_V2.TAB	The IBS Sweep Table for versions 0, 1, and 2 of the CAPS data	CAPS
IBS_SWEEP_V0_V1_V2.LBL	A PDS detached label that describes IBS_SWEEP_V0_V1_V2.TAB	CAPS
IBS_SWEEP_V3.TAB	The IBS Sweep Table for version 3 of the CAPS data	CAPS
IBS_SWEEP_V3.LBL	A PDS detached label that describes IBS_SWEEP_V3.TAB	CAPS
IMS_SWEEP_TABLE_0_V0_V1_V2.TAB	The IMS Sweep Table number 0 for versions 0, 1, and 2 of the CAPS data	CAPS
IMS_SWEEP_TABLE_0_V0_V1_V2.LBL	A PDS detached label that describes IMS_SWEEP_TABLE_0_V0_V1_V2.TAB	CAPS
IMS_SWEEP_TABLE_16.TAB	The IMS Sweep Table number 16 for all versions of CAPS data. The sweep table has been used for calibrations.	CAPS
IMS_SWEEP_TABLE_16.LBL	A PDS detached label that describes IMS_SWEEP_TABLE_16.TAB	CAPS

IMS_SWEEP_TABLE_15.TAB	The IMS Sweep Table number 15 for all versions of CAPS data. This sweep table is used only during some Titan flyby periods (less than 1400km)	CAPS
IMS_SWEEP_TABLE_15.LBL	A PDS detached label that describes IMS_SWEEP_TABLE_15.TAB	CAPS
IMS_SWEEP_TABLE_255.TAB	The IMS Sweep Table number 255 for all versions of CAPS data. This sweep table was used only once, and has been replaced by #15.	CAPS
IMS_SWEEP_TABLE_255.LBL	A PDS detached label that describes IMS_SWEEP_TABLE_255.TAB	CAPS
ION_AND_GROUPTABLE_NAMING.DOC	Contains the definitions of the group table naming and ion naming in Microsoft Word format	CAPS
ION_AND_GROUPTABLE_NAMING.PDF	Contains the definitions of the group table naming and ion naming in Adobe Acrobat format	CAPS
ION_AND_GROUPTABLE_NAMING.LBL	A PDS detached label that describes the documents ION_AND_GROUPTABLE_NAMING.*	CAPS

4.6.1. **CALIB/SAMPLE_DATA Directory Contents**

This directory contains a sample input file, any additional files necessary for the calibration process, and a sample output file. The goal of files in this directory is to provide data users an example against which to test their calibration routines, which were developed according to the CAPS BASIC CALIB PROCEDURES document (which can be found in DOCUMENT/CAPS_CALIB). Please note that the output includes first order calibration, and not the second order corrections that are currently being worked.

4.7. EXTRAS Directory Contents

The EXTRAS directory contains an EXTRINFO.TXT file that contains a description of the contents of this directory. Additional files include example software to read the CAPS un-calibrated data files, open the necessary calibration files, calibrate the data, and write them out. Example software for generating the CAPS browse spectrograms is also provided.

4.8. BROWSE Directory Contents

The BROWSE directory contains browse spectrogram plots that are not intended for publication. Browse spectrograms starting on YYYYDDD from all sensors are stored in the BROWSE/YYYYDDD directory. Each directory contains one day of data. Each sensor can have up to 4 spectrograms for the day and can contain up to 6 hours of data. The file naming convention is described in Section 4.5.2, with a .PNG extension to specify the file format. Every data file in the directory has a detached PDS label with the same root name as the file they describe but have the suffix ".LBL". In addition, there is a brief ASCII text file (INFO.TXT) that describes the BROWSE/YYYYDDD directory contents, which are listed in Table 20: YYYYDDD BROWSE Directory Contents. NOTE: Files are only available if data from the appropriate type (during the 6 hour block in question) is available. We do not plot ancillary data.

Table 20: YYYYDDD BROWSE Directory Contents

File Name	**File Contents**	**Provided By**
DATAINFO.TXT	Brief description of directory contents and naming conventions.	PPI
ACT*.PNG	Actuator plot in PNG format	CAPS
ACT*.LBL	PDS label for actuator PNG formatted file of same base name	PPI
ELS*.PNG	ELS plot in PNG format	CAPS
ELS*.LBL	PDS label for ELS PNG formatted file of same base name	PPI
IBS*.PNG	IBS plots in PNG format	CAPS
IBS*.LBL	PDS label for IBS PNG formatted file of same base name	PPI
ION*.PNG	IMS ION plots in PNG format	CAPS
ION*.LBL	PDS label for IMS ION PNG formatted file of same base name	PPI
LOG*.PNG	IMS logicals plot in PNG format	CAPS
LOG*.LBL	PDS label for IMS Logicals PNG formatted file of same base name	PPI
SNG*.PNG	IMS singles plot in PNG format	CAPS
SNG*.LBL	PDS label for IMS Singles PNG formatted file of same base name	PPI
TOF*.PNG	IMS TOF plot in PNG format	CAPS
TOF*.LBL	PDS label for IMS TOF PNG formatted file of same base name	PPI

Since we will archive our calibrated files on a separate volume, the UNCALIBRATED volume does not contain a DATA/CALIBRATED directory. When ready, the calibration data will be available in the DATA/CALIBRATED directory. On the calibrated archive volume, the CALIB directory contains files that are used in the calibration process. The files include only text files and tables. Any other calibration files are included in the DOCUMENT/CAPS_CALIB directory. Contents are still TBD and will be specified under Section 4.5.8 when the calibration volume is ready.

5. Archive Volume Format

This section describes the format of CAPS standard product archive volumes. Data that comprise the CAPS standard product archives are formatted in accordance with Planetary Data System specifications [Planetary Science Data Dictionary, 2002; PDS Data Preparation Workbook, 1995; PDS Standards Reference, 2002].

5.1. File Formats

The following section describes file formats for the kinds of files contained on Archive Volumes. For more information, see the PDS Standards Reference.

5.1.1. **Document File Formats**

Document files with the .TXT suffix exist in all directories. They are ASCII files with embedded PDS labels. All document files contain variable-length, 80-byte maximum records, with a carriage return character (ASCII 13) in the 79th byte and a line feed character (ASCII 10) in the 80th byte. This allows the files to be read by the MacOS, DOS, Windows, UNIX, OS2, and VMS operating systems.

However, the documents in the reference volume contain formatting and figures that cannot be rendered as pure ASCII text. These documents are provided in formats that support graphics, such as HTML, MS Word, PDF, etc. The PDS requirement that all documentation critical to the understanding of the data set be provided in ASCII text form is met by the inclusion of HTML formatted documents.

5.1.2. **Catalog File Formats**

Catalog files (suffix .CAT) exist in the Root and Catalog directories. They are formatted in an object-oriented structure consisting of sets of 'keyword = value' declarations. All files are ASCII and conform to the same structure standards (line length, line terminator) as the PDS label files described in the previous section.

5.1.3. **PDS Label File Formats**

All data files in the CAPS Standard Product Archive Collection have PDS labels [Planetary Science Data Dictionary; PDS Standards Reference]. These labels are all detached from the data files (same file name prefix, .LBL suffix).

A PDS label, whether embedded or detached from its associated file, provides descriptive information about the associated file. The PDS label is an object-oriented structure consisting of sets of 'keyword = value' declarations. The object that the label refers to (e.g., TABLE, STRUCTURE, etc.) is denoted by a statement of the form:

^object = location

in which the carat character (^, also called a pointer in this context) indicates where to find the object. In a PDS label, the location denotes the name of the file containing the object, along with the starting record or byte number, if there is more than one object in the file. For example:

^HEADER = ("98118.TAB",1)

^TABLE = ("98118.TAB",1025 <BYTES>)

indicates that the HEADER object begins at record 1 and that the TABLE object begins at byte 1025 of the file 98118.TAB. The file 98118.TAB must be located in the same directory as the detached label file.

Below is a list of the possible formats for the ^object definition in labels in this product.

^object = n

^object = n <BYTES>

^object = "filename.ext"

^object = ("filename.ext", n)

^object = ("filename.ext", n <BYTES>)

where

n is the starting record or byte offset of the object, counting from the beginning of the file (record 1, byte 1),

<BYTES> indicates that the number given is in units of bytes (the default is records),

filename is the up-to-8-character, alphanumeric upper-case file name,

ext is the up-to-3-character upper-case file extension.

All CAPS detached labels conform to the requirement of less than 80-byte per line, including the carriage return character (ASCII 13) and the line feed character (ASCII 10). The RECORD_TYPE of all the labels is STREAM.

5.1.4. **DATA/UNCALIBRATED File Formats – Binary Tables**

All of the un-calibrated data files for CAPS are binary tables of data (.DAT suffix). Data files can be found in the YYYYDDD directories, which are located in DATA/UNCALIBRATED. Missing data are filled with appropriate (and documented) fill values. The table format for each sensor is described by a detached PDS label of the same base name as the file, but with an .LBL extension. A description of the data file contents and structure for the standard data set data products can be found Section 5.2. The format for the detached labels and format files can be found in Appendix B. PDS Labels & Format Files for Standard UNCALIBRATED Data Products.

5.1.5. **DATA/CALIBRATED File Formats – Binary Tables**

All of the calibrated data files for CAPS are binary tables of data (.DAT suffix). Data files can be found in the YYYYDDD directories, which are located in DATA/CALIBRATED. Missing data are filled with appropriate (and documented) fill values. The table format for each sensor is described by a detached PDS label of the same base name as the file, but with an .LBL extension. A description of the data file contents and structure for the standard data set data products can be found Section 5.2. The format for the detached labels and format files can be found in Appendix C. PDS Labels & Format Files for Standard CALIBRATED Data Products.

5.1.6. **DATA/HIGHERORDER File Formats – Fixed Field ASCII**

All of the HIGHERORDER data files for CAPS are fixed-field ASCII files with a .TAB suffix. Data files can be found in the YYYY directories, which are located in DATA/HIGHERORDER/ELEMOMT, DATA/HIGHERORDER/IONMOMT, or DATA/HIGHERODRER/SCPPT. Missing data are filled with appropriate (and documented) fill values. The table format for each higher order product is described by a detached PDS label of the same base name as the file, but with an .LBL extension. The format file for each type of higher order product is included in the detached label. A description of the data file contents and structure for the standard data set data products can be found in Section 5.4. The format for the detached label and format file can be found in Appendix D. PDS Labels & Format Files for Standard HIGHERORDER Data Products.

5.2. CAPS Standard UNCALIBRATED Data Product Descriptions

The following sections describe the content and structure of each of the standard data products within the UNCALIBRATED level 2 CAPS data set.

5.2.1. **CAPS ELS Data Product Format**

The data product format for ELS is listed in Table 21 below. The fill value for ELS data is 65535 (hex value FFFF).

Table 21: CAPS ELS UNCALIBRATED Data File Contents and Structure

Column Name	Type	Length (bytes)	Range	Description
B cycle number	Unsigned Integer	2	[1,340]	B cycle number from the start of day, a value of 65535 indicates no B-cycle data is available
A cycle number	Unsigned Integer	2	[1,2732]	A cycle number from the start of day. Fill Value: 65535
Time	Float	8	[-7.1×10^7, 1.5×10^9]	Start time of A cycle, sec. from J2000 (barycentric dynamic time). Fill Value: 10×10^9
Telemetry mode	Unsigned Integer	1	[1,136]	Logical telemetry rate and mode: 1 = 250bps, 2 = 500bps, 4 = 1kbps, 8

Table 21: CAPS ELS UNCALIBRATED Data File Contents and Structure				
				= 2kbps, 16 = 4kbps, 32 = 8kbps, 64 = 16kbps, 130 = 500bps solar wind, 132 = 1 kbps solar wind, 136 = 2kbps solar wind. Fill Value: 255
Collapse flag	Unsigned Integer	1	[0,131]	Collapse flag indicates collapse by average (0), sum (1), average with in-flight dead-time correction (2), sum with in-flight dead-time correction (3), or snapshot portion (4). For snapshot, full collapse information is gained by adding to 4 (so snapshot portion can be 4, 5, 6, or 7 depending upon the collapse). If the most significant bit is 1 (giving a starting value of 128), it will indicate no HK was available. Fill Value: 255
Offset time	Unsigned Integer	2	[0,32000]	Milliseconds from start of A cycle. Fill Value: 65535
First Energy Step	Unsigned Integer	2	[1,63]	Min energy step in collapsed data Fill Value: 65535
Last Energy Step	Unsigned Integer	2	[1,63]	Max energy step in collapsed data Fill Value: 65535
First Azimuth Value	Unsigned Integer	2	[1,16]	Min azimuth value in collapsed data Fill Value: 65535
Last Azimuth Value	Unsigned Integer	2	[1,16]	Max azimuth value in collapsed data Fill Value: 65535
Data, Elevation 1	Unsigned Integer	2	[0,65504]	Counts in elevation 1: Fill: 65535
Data, Elevation 2	Unsigned Integer	2	[0,65504]	Counts in elevation 2: Fill: 65535
Data, Elevation 3	Unsigned Integer	2	[0,65504]	Counts in elevation 3: Fill: 65535
Data, Elevation 4	Unsigned Integer	2	[0,65504]	Counts in elevation 4: Fill: 65535
Data, Elevation 5	Unsigned Integer	2	[0,65504]	Counts in elevation 5: Fill: 65535
Data, Elevation 6	Unsigned Integer	2	[0,65504]	Counts in elevation 6: Fill: 65535
Data, Elevation 7	Unsigned Integer	2	[0,65504]	Counts in elevation 7: Fill: 65535
Data, Elevation 8	Unsigned Integer	2	[0,65504]	Counts in elevation 8: Fill: 65535

5.2.2. **CAPS IBS Data Product Format**

The data product format for CAPS IBS is listed in Table 22 below. The fill value for IBS data is 65535 (hex value FFFF).

Table 22: CAPS IBS UNCALIBRATED Data File Contents and Structure				
Column Name	**Type**	**Length (bytes)**	**Range**	**Description**
B cycle number	Unsigned Integer	2	[1,340]	B cycle number from start of day, a value of 65535 indicates no B-cycle data is available
A cycle number	Unsigned Integer	2	[1,2732]	A cycle number from the start of day. Fill: 65535
Time	Float	8	[-7.1×10^7, 1.5×10^9]	Start time of C cycle, sec. from J2000 (barycentric dynamic time). Fill: 10×10^9
Telemetry mode	Unsigned Integer	1	[1,136]	Logical telemetry rate and mode: 1 = 250bps, 2 = 500bps, 4 = 1kbps, 8 = 2kbps, 16 = 4kbps, 32 = 8kbps, 64 = 16kbps, 130 = 500bps solar wind, 132 = 1 kbps solar wind, 136 = 2kbps solar wind. Fill: 255
IBS mode/submode	Unsigned Integer	1	[0,254]	IBS mode and submode flag: 0 = Standard Sweep Collapse, 1 = Standard Sweep Snapshot, 2 = Solar Wind Search, 3 = Solar Wind Track, 4 = Magnetosphere Search, 5 = Magnetosphere Survey, 6 = Calibration Mode, 7-255 = spare. Fill: 255
Offset time	Unsigned Integer	4	[1,256000]	Milliseconds from start of C cycle Fill: 400000
First Energy Step	Unsigned Integer	2	[1,852]	Min energy step in collapsed data (index into the energy table) Fill: 65535
Last Energy Step	Unsigned Integer	2	[1,852]	Max energy step in collapsed data (index into the energy table) Fill: 65535
First Azimuth Value	Unsigned Integer	2	[1,128]	Min azimuth value in collapsed data Fill: 65535
Last Azimuth Value	Unsigned Integer	2	[1,128]	Max azimuth value in collapsed data Fill: 65535
Data, Fan 1	Unsigned Integer	2	[1,65504]	Counts in fan 1. Fill: 65535
Data, Fan 2	Unsigned Integer	2	[1,65504]	Counts in fan 2. Fill: 65535
Data, Fan 3	Unsigned Integer	2	[1,65504]	Counts in fan 3. Fill: 65535

5.2.3. CAPS IMS ION Data Product Format

The data product format for CAPS IMS ION is listed in Table 23 below. The fill value for IMS Ion data is 28671 (hex value 6FFF).

Table 23: CAPS UNCALIBRATED IMS ION Data File Contents and Structure				
Column Name	**Type**	**Length (bytes)**	**Range**	**Description**
B cycle number	Unsigned Integer	2	[1,340]	B cycle number from start of day, a value of 65535 indicates no B-cycle data is available
A cycle number	Unsigned Integer	2	[1,2732]	A cycle number from the start of day, a value of 65535 indicates that no A-cycle header information was available
Time	Float	8	[$-7.1x10^7$, $1.5x10^9$]	Start time of A cycle, sec. from J2000 (barycentric dynamic time) Fill: $10x10^9$
Telemetry mode	Unsigned Integer	1	[1,136]	Logical telemetry rate and mode: 1 = 250bps, 2 = 500bps, 4 = 1kbps, 8 = 2kbps, 16 = 4kbps, 32 = 8kbps, 64 = 16kbps, 130 = 500bps solar wind, 132 = 1 kbps solar wind, 136 = 2kbps solar wind. Fill: 255
Spare	Unsigned Integer	1	0	Spare bits to keep on even byte boundaries. Fill: 0
Offset time	Unsigned Integer	2	[1,32000]	Milliseconds from start of A cycle Fill: 65535
First Energy Step	Unsigned Integer	2	[1,63]	Min energy step in collapsed data Fill: 65535
Last Energy Step	Unsigned Integer	2	[1,63]	Max energy step in collapsed data Fill: 65535
First Azimuth Value	Unsigned Integer	2	[1,8]	Min azimuth value in collapsed data Fill: 65535
Last Azimuth Value	Unsigned Integer	2	[1,8]	Max azimuth value in collapsed data Fill: 65535
Sam Ion number	Unsigned Integer	2	[0,65534]	SAM ion number[1]. Fill: 65535
Data, Elevation 1	Integer	2	[-32,27650]	Counts in elevation 1 (**):Fill 28671
Data, Elevation 2	Integer	2	[-32,27650]	Counts in elevation 2 (**):Fill 28671
Data, Elevation 3	Integer	2	[-32,27650]	Counts in elevation 3 (**):Fill 28671
Data, Elevation 4	Integer	2	[-32,27650]	Counts in elevation 4 (**):Fill 28671
Data, Elevation 5	Integer	2	[-32,27650]	Counts in elevation 5 (**):Fill 28671
Data, Elevation 6	Integer	2	[-32,27650]	Counts in elevation 6 (**):Fill 28671

[1] The SAM Ion number shall uniquely identify the ion and the group table used by SAM. This shall be based on a table generated and kept on the ground, and will not be the ion number used inside SAM software (which represents different species in different group tables) nor the ion number in the current CDF files (which represents the order in which ions are selected and passed on by CPU2, and which depends on the group table and ion selection index.)

Table 23: CAPS UNCALIBRATED IMS ION Data File Contents and Structure				
Column Name	**Type**	**Length (bytes)**	**Range**	**Description**
Data, Elevation 7	Integer	2	[-32,27650]	Counts in elevation 7 (**):Fill 28671
Data, Elevation 8	Integer	2	[-32,27650]	Counts in elevation 8 (**):Fill 28671

(**): Note that due to on-board spacecraft de-convolution routines used to estimate the number of counts from a particular species, a combination of low counts and background noise can cause the de-convolution routine to give negative numbers.

5.2.4. **CAPS IMS SNG Data Product Format**

The data product format for CAPS IMS Singles (SNG) is listed in Table 24 below. The fill value for Singles data is 65535 (hex value FFFF).

Table 24: CAPS UNCALIBRATED IMS Singles Data File Contents and Structure				
Column Name	**Type**	**Length (bytes)**	**Range**	**Description**
B cycle number	Unsigned Integer	2	[1,340]	B cycle number from the start of day, a value of 65535 indicates no B-cycle data is available
A cycle number	Unsigned Integer	2	[1,2732]	A cycle number from the start of day, a value of 65535 indicates that no A-cycle header information was available
Time	Float	8	[-7.1×10^7, 1.5×10^9]	Start time of A cycle, sec. from J2000 (barycentric dynamic time) Fill: 10×10^9
Telemetry mode	Unsigned Integer	1	[1,136]	Logical telemetry rate and mode: 1 = 250bps, 2 = 500bps, 4 = 1kbps, 8 = 2kbps, 16 = 4kbps, 32 = 8kbps, 64 = 16kbps, 130 = 500bps solar wind, 132 = 1 kbps solar wind, 136 = 2kbps solar wind. Fill: 255
Spare	Unsigned Integer	1	0	Spare byte to have even byte boundaries. Fill: 0
Offset time	Unsigned Integer	2	[1,32000]	Milliseconds from start of A cycle Fill: 65535
First Energy Step	Unsigned Integer	2	[1,63]	Min energy step in collapsed data Fill: 65535
Last Energy Step	Unsigned Integer	2	[1,63]	Max energy step in collapsed data

Table 24: CAPS UNCALIBRATED IMS Singles Data File Contents and Structure				
				Fill: 65535
First Azimuth Value	Unsigned Integer	2	[1,8]	Min azimuth value in collapsed data Fill: 65535
Last Azimuth Value	Unsigned Integer	2	[1,8]	Max azimuth value in collapsed data Fill: 65535
Data, Elevation 1	Unsigned Integer	2	[0,27500]	Counts in elevation 1. Fill 65535
Data, Elevation 2	Unsigned Integer	2	[0,27500]	Counts in elevation 2. Fill 65535
Data, Elevation 3	Unsigned Integer	2	[0,27500]	Counts in elevation 3. Fill 65535
Data, Elevation 4	Unsigned Integer	2	[0,27500]	Counts in elevation 4. Fill 65535
Data, Elevation 5	Unsigned Integer	2	[0,27500]	Counts in elevation 5. Fill 65535
Data, Elevation 6	Unsigned Integer	2	[0,27500]	Counts in elevation 6. Fill 65535
Data, Elevation 7	Unsigned Integer	2	[0,27500]	Counts in elevation 7. Fill 65535
Data, Elevation 8	Unsigned Integer	2	[0,27500]	Counts in elevation 8. Fill 65535

5.2.5. **CAPS IMS LOG Data Product Format**

The data product format for CAPS IMS Logicals (LOG) is listed in Table 25 below. The fill value for Logical Data is 65535 (hex FFFF).

Table 25: CAPS IMS Logicals UNCALIBRATED Data File Contents and Structure

Column Name	Type	Length (bytes)	Range	Description
B cycle number	Unsigned Integer	2	[1,340]	B cycle number from the start of day, a value of 65535 indicates no B-cycle data is available
A cycle number	Unsigned Integer	2	[1,2732]	A cycle number from the start of day, a value of 65535 indicates that no A-cycle header information was available
Time	Float	8	[-7.1×10^7, 1.5×10^9]	Start time of A cycle, sec. from J2000 (barycentric dynamic time) Fill: 10×10^9
Telemetry mode	Unsigned Integer	1	[1,136]	Logical telemetry rate and mode: 1 = 250bps, 2 = 500bps, 4 = 1kbps, 8 = 2kbps, 16 = 4kbps, 32 = 8kbps, 64 = 16kbps, 130 = 500bps solar wind, 132 = 1 kbps solar wind, 136 = 2kbps solar wind. Fill: 255
TDC log selection	Unsigned Integer	1	[0,3]	TDC selectable logical definition 0 = (Logical 13: Start CFD Singles, Logical 14: Stop CFD Singles), 1 = (Logical 13: Acquisition, Logical 14:

Table 25: CAPS IMS Logicals UNCALIBRATED Data File Contents and Structure				
				Deadtimes), 2 = (Logical 13: Single TOF events, Logical 14: Double TOF events), 3 = (Logical 13: Data strobes, Logical 14: Resets). Fill: 255
Offset time	Unsigned Integer	2	[1,32000]	Milliseconds from start of A cycle Fill: 65535
First Energy Step	Unsigned Integer	2	[1,63]	Min energy step in collapsed data Fill: 65535
Last Energy Step	Unsigned Integer	2	[1,63]	Max energy step in collapsed data Fill: 65535
First Azimuth Value	Unsigned Integer	2	[1,8]	Min azimuth value in collapsed data Fill: 65535
Last Azimuth Value	Unsigned Integer	2	[1,8]	Max azimuth value in collapsed data Fill: 65535
LEF Stops	Unsigned Integer	2	[0,27500]	LEF stop counts: Fill: 65535
ST Stops	Unsigned Integer	2	[0,27500]	ST stop counts: Fill: 65535
Timeouts	Unsigned Integer	2	[0,27500]	Timeout events: Fill: 65535
Total Events	Unsigned Integer	2	[0,27500]	Total events (generated by SAM for dead time). Fill: 65535
Logical 13	Unsigned Integer	2	[0,27500]	TDC selectable logical 13. Fill: 65535
Logical 14	Unsigned Integer	2	[0,27500]	TDC selectable logical 14. Fill: 65535

5.2.6. **CAPS IMS TOF Data Product Format**

The data product format for CAPS IMS Time of flight (TOF) is listed in Table 26 below. The fill value for IMS TOF and ST data is 4294967295 (hex value FFFFFFFF).

Table 26: CAPS IMS TOF UNCALIBRATED Data File Contents and Structure

Column Name	Type	Length (bytes)	Range	Description
B cycle number	Unsigned Integer	2	[1,340]	B cycle number from the start of day
Time	Float	8	[-7.1×10^7, 1.5×10^9]	Start time of B cycle, sec. from J2000 (barycentric dynamic time) Fill: 10×10^9
Telemetry mode	Unsigned Integer	1	[1,136]	Logical telemetry rate and mode: 1 = 250bps, 2 = 500bps, 4 = 1kbps, 8 = 2kbps, 16 = 4kbps, 32 = 8kbps, 64 = 16kbps, 130 = 500bps solar wind, 132 = 1 kbps solar wind, 136 =

Table 26: CAPS IMS TOF UNCALIBRATED Data File Contents and Structure				
				2kbps solar wind. Fill: 255
Collapse Flag	Unsigned Integer	1	[0,5]	Flags indicating collapse and Bcycle Duration. 0=average, 256s duration; 1=sum, 256s duration; 2=average, 512s duration; 3=sum, 512s duration; 4=average, 1024s duration, 5=sum, 1024s duration. Fill: 255
ST start channel	Unsigned Integer	2	[0,1535]	Start ST TOF channel Fill value: 2048
ST interval	Unsigned Integer	1	[1,4]	ST TOF bin interval 1 = each word is taken starting at the Start channel. 2 = Every other word is taken starting at the Start channel. 4 = Every fourth word is taken starting at the Start Channel. 0 = Fill Value implying housekeeping is not available
ST energy collapse	Unsigned Integer	1	[0,3]	ST energy collapse option 0 = sum adjacent energies, 1 = take even energies, 2 = take odd energies, 3 = TBA. Fill: 255
LEF start channel	Unsigned Integer	2	[0,1535]	Start LEF TOF channel Fill value: 2048
LEF interval	Unsigned Integer	1	[1,4]	LEF TOF bin interval 1 = each word is taken starting at the Start channel. 2 = Every other word is taken starting at the Start channel. 4 = Every fourth word is taken starting at the Start Channel. 0 = Fill Value implying housekeeping is not available
LEF energy collapse	Unsigned Integer	1	[0,3]	LEF energy collapse option 0 = sum adjacent energies, 1 = take even energies, 2 = take odd energies, 3 = TBA. Fill: 255
Energy Step	Unsigned Integer	2	[1,32]	Energy step in collapsed data Fill: 65535
Data, ST TOF bin 1	Unsigned Integer	4	[0, 3268027]	Counts in ST TOF bin 1. Fill 4294967295
Data, ST TOF bin 2	Unsigned Integer	4	[0, 3268027]	Counts in ST TOF bin 2 Fill 4294967295
…	Unsigned Integer	4x509	[0, 3268027]	Counts in ST TOF bins 3 – 511 Fill 4294967295

Table 26: CAPS IMS TOF UNCALIBRATED Data File Contents and Structure				
Data, ST TOF bin 512	Unsigned Integer	4	[0, 3268027]	Counts in ST TOF bin 512 Fill 4294967295
Data, LEF TOF bin 1	Unsigned Integer	4	[0, 3268027]	Counts in LEF TOF bin 1 Fill 4294967295
Data, LEF TOF bin 2	Unsigned Integer	4	[0, 3268027]	Counts in LEF TOF bin 2 Fill 4294967295
…	Unsigned Integer	4x509	[0, 3268027]	Counts in LEF TOF bins 3 – 511 Fill 4294967295
Data, LEF TOF bin 512	Unsigned Integer	4	[0, 3268027]	Counts in LEF TOF bin 512 Fill 4294967295

5.2.7. **CAPS ACT Data Product Format**

The data product format for the CAPS actuator is listed in Table 27 below. The fill value for actuator data is –999.0. Actuator data products are considered to be both calibrated and un-calibrated data products. In order to accommodate this, we lose the <DataType> in the filename (as described in section 4.5.2).

Table 27: CAPS ACT Data File Contents and Structure (both Calibrated & Un-calibrated)				
Column Name	**Type**	**Length (bytes)**	**Range**	**Description**
B cycle number	Unsigned Integer	2	[1,340]	B cycle number from the start of day, a value of 65535 indicates no B-cycle data is available
A cycle number	Unsigned Integer	2	[1,2732]	A cycle number from the start of day Fill: 65535
Time	Float	8	[$-7.1\text{x}10^7$, $1.5\text{x}10^9$]	Start time of A cycle, sec. from J2000 (barycentric dynamic time) Fill: $10\text{x}10^9$
Data, Actuator angle 1	Float	4	[-115,115]	Actuator angle at time + 0 sec Fill: -999
Data, Actuator angle 2	Float	4	[-115,115]	Actuator angle at time + 1 sec Fill: -999
…	Float	4x29	[-115,115]	Actuator angle (offset times of 2 – 30 sec) Fill: -999
Data, Actuator angle 32	Float	4	[-115,115]	Actuator angle at time + 31 sec Fill: -999

5.2.8. **CAPS ANC Data Product Format**

The data product format for the ancillary data product is listed in Table 28 below. There are no standard fill values for these items.

Table 28: CAPS ANC UNCALIBRATED Data File Contents and Structure

Column Name	Type	Length (bytes)	Range	Description
B cycle number	Unsigned Integer	2	[1,340]	B cycle number from the start of day, a value of 65535 indicates no B-cycle data is available
A cycle number	Unsigned Integer	2	[1,2732]	A cycle number from the start of day Fill: 65535
Time	Float	8	[-7.1×10^7, 1.5×10^9]	Start time of A cycle, sec. from J2000 (barycentric dynamic time) Fill: 10×10^9
SCLK	Unsigned Integer	4	[0,3.0×10^9]	Start time of A cycle, spacecraft clock Fill: 10×10^9
Spacecraft/Saturn position [x]	Float	4	[-9.46×10^{12}, 9.46×10^{12}]	J2000 [km]: Saturn-centered Fill: 10×10^{12}
Spacecraft/Saturn position [y]	Float	4	[-9.46×10^{12}, 9.46×10^{12}]	J2000 [km]: Saturn-centered Fill: 10×10^{12}
Spacecraft/Saturn position [z]	Float	4	[-9.46×10^{12}, 9.46×10^{12}]	J2000 [km]: Saturn-centered Fill: 10×10^{12}
Spacecraft/Saturn velocity v_x	Float	4	[-3×10^5, 3×10^5]	J2000 [km/s]: relative to Saturn Fill: 5×10^5
Spacecraft/Saturn velocity v_y	Float	4	[-3×10^5, 3×10^5]	J2000 [km/s]: relative to Saturn Fill: 5×10^5
Spacecraft/Saturn velocity v_z	Float	4	[-3×10^5, 3×10^5]	J2000 [km/s]: relative to Saturn Fill: 5×10^5
Spacecraft/Sun position [x]	Float	4	[-9.46×10^{12}, 9.46×10^{12}]	J2000 [km]: Sun-centered Fill: 10×10^{12}
Spacecraft/Sun position [y]	Float	4	[-9.46×10^{12}, 9.46×10^{12}]	J2000 [km]: Sun-centered. Fill: 10×10^{12}
Spacecraft/Sun position [z]	Float	4	[-9.46×10^{12}, 9.46×10^{12}]	J2000 [km]: Sun-centered Fill: 10×10^{12}
Spacecraft/Sun velocity v_x	Float	4	[-3×10^5, 3×10^5]	J2000 [km/s]: Relative to the Sun Fill: 5×10^5
Spacecraft/Sun velocity v_y	Float	4	[-3×10^5, 3×10^5]	J2000 [km/s]: Relative to the Sun Fill: 5×10^5
Spacecraft/Sun velocity v_z	Float	4	[-3×10^5, 3×10^5]	J2000 [km/s]: Relative to the Sun Fill: 5×10^5
Spacecraft orientation [xx]	Float	4	[-1,1]	Component of rotation matrix to J2000. Fill value = 2.
Spacecraft orientation [xy]	Float	4	[-1,1]	Component of rotation matrix to J2000. Fill value = 2.

Table 28: CAPS ANC UNCALIBRATED Data File Contents and Structure				
Spacecraft orientation [xz]	Float	4	[-1,1]	Component of rotation matrix to J2000. Fill value = 2.
Spacecraft orientation [yx]	Float	4	[-1,1]	Component of rotation matrix to J2000. Fill value = 2.
Spacecraft orientation [yy]	Float	4	[-1,1]	Component of rotation matrix to J2000. Fill value = 2.
Spacecraft orientation [yz]	Float	4	[-1,1]	Component of rotation matrix to J2000. Fill value = 2.
Spacecraft orientation [zx]	Float	4	[-1,1]	Component of rotation matrix to J2000. Fill value = 2.
Spacecraft orientation [zy]	Float	4	[-1,1]	Component of rotation matrix to J2000. Fill value = 2.
Spacecraft orientation [zz]	Float	4	[-1,1]	Component of rotation matrix to J2000. Fill value = 2.
ELS quality flag	Unsigned Integer	1	[0,7]	Missing data and good/bad checksum 0=Everything OK, 1 = Missing Data, 2 = Bad Checksum, 3 = Missing Data & Bad Checksum, 7 = No Data (4,5,6 not valid)
IBS quality flag	Unsigned Integer	1	[0,7]	Missing data and good/bad checksum 0=Everything OK, 1 = Missing Data, 2 = Bad Checksum, 3 = Missing Data & Bad Checksum, 7 = No Data (4,5,6 not valid)
IMS Ion quality flag	Unsigned Integer	1	[0,7]	Missing data and good/bad checksum 0=Everything OK, 1 = Missing Data, 2 = Bad Checksum, 3 = Missing Data & Bad Checksum, 7 = No Data (4,5,6 not valid)
IMS TOF LEF quality flag	Unsigned Integer	1	[0,7]	Missing data and good/bad checksum 0=Everything OK, 1 = Missing Data, 2 = Bad Checksum, 3 = Missing Data & Bad Checksum, 7 = No Data (4,5,6 not valid)
IMS TOF ST quality flag	Unsigned Integer	1	[0,7]	Missing data and good/bad checksum 0=Everything OK, 1 = Missing Data, 2 = Bad Checksum, 3 = Missing Data & Bad Checksum, 7 = No Data (4,5,6 not valid)
IMS Logicals quality flag	Unsigned Integer	1	[0,7]	Missing data and good/bad checksum 0=Everything OK, 1 = Missing Data, 2 = Bad Checksum, 3 = Missing Data & Bad Checksum, 7 = No Data (4,5,6 not valid)
IMS Singles quality flag	Unsigned Integer	1	[0,7]	Missing data and good/bad checksum 0=Everything OK, 1 = Missing Data, 2

Table 28: CAPS ANC UNCALIBRATED Data File Contents and Structure				
				= Bad Checksum, 3 = Missing Data & Bad Checksum, 7 = No Data (4,5,6 not valid)
Actuator quality flag	Unsigned Integer	1	[0,7]	Missing data and good/bad checksum 0=Everything OK, 1 = Missing Data, 2 = Bad Checksum, 3 = Missing Data & Bad Checksum, 7 = No Data (4,5,6 not valid)
Actuator Status Bits (all 32 of them)	Unsigned Integer	32	[0,8]	Status bits for the actuator data product. These are represented as 32 bytes with the following values: 0 = Everything is OK 4 = Limit Switch has been hit at +108 degrees 8 = Limit Switch has been hit at -108 degrees 16 = Data not available (data is only available in 16, 8, 4, and 2 kbps modes)
TLM Version	Unsigned Integer	1	[0,15]	Telemetry Mode version number Fill: 255
FSW Major version	Unsigned Integer	1	[0,255]	To build the flight software version number: Major.SubMajor.Minor.SubMinor. For example: 3.1.0.2. Fill: 255
FSW Sub-Major version	Unsigned Integer	1	[0,255]	See description for FSW Major version Fill: 255
FSW Minor version	Unsigned Integer	1	[0,255]	See description for FSW Major version Fill: 255
FSW Sub-Minor version	Unsigned Integer	1	[0,255]	See description for FSW Major version Fill: 255
Spacecraft pointing type	Unsigned Integer	1	[0,2]	0 = no pointing available, 1 = pointing based on predicts, 2 = pointing based on reconstructs
Telemetry rate and mode	Unsigned Integer	1	[1,136]	Logical telemetry rate and mode: 1 = 250bps, 2 = 500bps, 4 = 1kbps, 8 = 2kbps, 16 = 4kbps, 32 = 8kbps, 64 = 16kbps, 130 = 500bps solar wind, 132 = 1 kbps solar wind, 136 = 2kbps solar wind. Fill: 255
IBS Sweep Table & Index Table Numbers	Unsigned Integer	1	[0,250]	The upper 4 bits are the IBS index table, and the lower 4 bits are the IBS sweep table number. (fill 0xFF)
IBS Background, Fan 1	Unsigned Integer	2	[0,60000]	IBS Background counts in fan 1 (fill 0xFFFF)
IBS Background, Fan 2	Unsigned Integer	2	[0,60000]	IBS Background counts in fan 2 (fill 0xFFFF)

Table 28: CAPS ANC UNCALIBRATED Data File Contents and Structure				
IBS Background, Fan 3	Unsigned Integer	2	[0,60000]	IBS Background counts in fan 3 (fill 0xFFFF)
IBS starting energy	Unsigned Integer	2	[1,852]	IBS starting energy step number (fill 0xFFFF)
IBS Subcycle	Unsigned Integer	1	[0,7]	IBS subcycle counter (A cycle in C cycle) (fill 0xFF)
IBS compression ratio	Unsigned Integer	1	[1,32]	Uncompressed/compressed length. This ratio is calculated on the ground from information in the IBS header and rounded down to the nearest integer. (fill 0x0)
IBS Peak Fan	Unsigned Integer	1	[1,3]	Fan containing the IBS peak (1^{st} in the C cycle). (fill 0x4)
IBS Peak A cycle	Unsigned Integer	1	[1,8]	A cycle number (1^{st} in the C cycle). (fill 0x9)
IBS Peak Sweep	Unsigned Integer	1	[1,16]	IBS peak energy sweep or azimuth (1^{st} in the C cycle). (fill 0x0)
IBS Peak Energy Step	Unsigned Integer	1	[0,255]	IBS peak energy step (1^{st} in the C cycle). (fill 0x0)
IBS Threshold Run Length	Unsigned Integer	2	[0,255]	Run length compression threshold (fill 0xFFFF)
IMS sweep table number	Unsigned Integer	1	[0,255]	IMS Sweep table number Fill: 240
TDC Single Select	Unsigned Integer	1	[0,3]	Determines how singles 13 and 14 are set (these are also Logical 13 and Logical 14): **<u>Value</u>: <u>Single 13</u> <u>Single 14</u>** 0 Start CFD Stop CFD 1 Acquisition Error Deadtimes 2 Single TOF's Double TOF's 3 Data Strobes Resets Fill: 255
IMS logicals selection	Unsigned Integer	2	[4096,27416]	The TDC logicals selection is a bitmap: Bits 15-13: IMS Logical 1 Bits 12-10: IMS Logical 2 Bits 9-7: IMS Logical 3 Bits 6-4: IMS Logical 4 Bits 3-0: Unused Logical selection decoder: 0 = Unused 1 = LEF Stop 2 = ST Stop 3 = Timeouts 4 = Total Events (As used in SAM dead time correction) 5 = Logical 13 6 = Logical 14

Table 28: CAPS ANC UNCALIBRATED Data File Contents and Structure				
				7 = Unused NOTE: Logical 13 and 14 are set with 82TDC_ENG_SING. See previous column. Fill: 65535
SAM/CPU2 status flags	Unsigned Integer	1	[0,255]	Bitmap: Bit 7 is most significant bit. 7 = CPU2/SAM mode change 6 = Background data 5 = Ion deadtime compensation 4 = SAM LEF enable 3 = SAM molecule enable 2 = SW/HW binning 1-0 = HW binning LUT index.
SAM Ion selection index	Unsigned Integer	1	[0,255]	SAM ion selection index
SAM Ion group table	Unsigned Integer	2	[0,65534]	SAM group table ID number Fill or missing: 65535
ELS_MCP_ADJ	Float	4	[0.0,3700.0]	ELS High voltage adjust (Volts). FILL value is –1.0
IBS_CEM_DAC	Float	4	[-4000.0,0.0]	IBS CEM High Voltage Digital to Analog Converter (Volts). FILL value is 1.0
HVU1_RET_DAC	Float	4	[0,16.0]	HVU1 Retarding High Voltage Digital to Analog Converter (kVolts). FILL is –1.0
HVU1_ACC_DAC	Float	4	[-16.0,0.0]	HVU1 Accelerating High Voltage Digital to Analog Converter (kVolts). FILL is 1.0
HVU2_ST_DAC	Float	4	[-3600.0,0.0]	HVU2 ST MCP Digital to Analog Converter (Volts). FILL is 1.0
HVU2_LEF_DAC	Float	4	[-2400.0,0.0]	HVU2 LEF MCP Digital to Analog Converter (Volts). FILL is 1.0

5.2.9. CAPS EVN Data Product Format

The data product format for the CAPS IMS event mode data is listed in Table 29 below. No fill values are necessary. Data rows exist only if data are present.

Table 29: CAPS EVN UNCALIBRATED Data File Contents and Structure

Column Name	Type	Length (bytes)	Range	Description
B cycle number	Unsigned Integer	2	[1,340]	B cycle number from the start of day, a value of 65535 indicates no B-cycle data is available
A cycle number	Unsigned Integer	2	[1,2732]	A cycle number from the start of day Fill: 65535

Table 29: CAPS EVN UNCALIBRATED Data File Contents and Structure				
Time	Float	8	[-7.1x10^7, 1.5x10^9]	Start time of B cycle, sec. from J2000 (barycentric dynamic time) Fill: 10x10^9
Offset time	Unsigned Integer	2	[0,32000]	Milliseconds from start of A cycle Fill: 65535
Energy Step	Unsigned Integer	2	[1,63]	Energy Step. Fill: 65535
Azimuth Value	Unsigned Integer	2	1	Azimuth Value. In this case, the value is always 1 (CPU2 samples the first sweep of every other A cycle. Included here for clarity and useful when used in combination with ION data). Fill: 65535
Elevation	Unsigned Integer	1	[1,8]	Elevation or Sector ID. Fill: 255
TOF type	Unsigned Integer	1	[0,254]	ST/LEF and single/dual event flag 0 = ST, first or single event 1 = LEF, first or single event 2 = ST, second event of a dual event 3 = LEF, second event of a dual event 4 – 254 = Spare Fill: 255
TOF	Unsigned Integer	2	[1,2048]	Event's Time of Flight. The particle's TOF channel. Fill: 65535

5.3. CAPS Standard CALIBRATED Data Product Descriptions

The following sections describe the content and structure of each of the standard data products within the CALIBRATED level 2 CAPS data set.

5.3.1. CAPS ELS Data Product Format

The data product format for ELS is listed in Table 30 below.

Table 30: CAPS ELS CALIBRATED Data File Contents and Structure				
Column Name	**Type**	**Length (bytes)**	**Range**	**Description**
UTC	**DATE**	**21**	**[1999-004T00:00:00.000, 2012-**	UTC timestamp, of format yyyy-dddTHH:MM:SS.sss where yyyy = year, ddd = day of

Table 30: CAPS ELS CALIBRATED Data File Contents and Structure				
			155T00:00:00.000]	year, HH = hour, MM = minute, SS.sss = decimal seconds to millisecond resolution. Value calculated via SPICE from spacecraft clock time.
DEAD_TIME_METHOD	**LSB_UNSIGNED_INTEGER**	**1**	**[0, 2]**	Dead Time Correction Method 0 = None: Data has not been Dead Time corrected. 1 = On ground (using quantized values). 2 = In flight, corrected prior to any bin summing and prior to quantization for downlink (ELS only). 255 = Unknown.
TELEMETRY	**LSB_UNSIGNED_INTEGER**	**2**	**[250, 16000]**	Telemetry Downlink Rate (bps). (Independent of Solar Wind Modes) Expected values are 250, 500, 1000, 2000, 4000, 8000, 16000
DT	**PC_REAL**	**4**	**[2, 32]**	Duration of Record (seconds)
ACCUMULATION_TIME	**PC_REAL**	**252**	**[0.0234375, 0.75]**	ACCUMULATION_TIME of each bin (seconds)
DATA	**PC_REAL**	**2016**	**[0, 1000000]**	ELS data of each bin (Counts per second) Counts per accumulation have been (in order): -Maybe Dead time corrected (See DEAD_TIME_METHOD) -Moved to middle of quantization bin -Converted to counts/second. -Maybe Dead time corrected (See DEAD_TIME_METHOD)
DIM1_E	**PC_REAL**	**252**	**[0, 29000]**	1st Dimension of DATA: Energy - center value (eV/q). Upper and lower limits are given by the objects DIM1_E_UPPER and

Table 30: CAPS ELS CALIBRATED Data File Contents and Structure				
				DIM1_E_LOWER.
DIM1_E_UPPER	**PC_REAL**	**252**	**[0, 29000]**	1st Dimension of DATA: Energy - upper limit (eV/q). See DIM1_E for description.
DIM1_E_LOWER	**PC_REAL**	**252**	**[0, 29000]**	1st Dimension of DATA: Energy - lower limit (eV/q). See DIM1_E for description.
DIM2_THETA	**PC_REAL**	**32**	**[-80,80]**	2nd Dimension of DATA: Spacecraft Theta - center value. Spacecraft Theta (degs) is analogous to latitude on a sphere. In spacecraft xyz co-ords: +z is equivalent to theta = +90 degs -z is equivalent to theta = -90 degs (The communication dish is directed along -z) xy-plane at z=0 is equivalent to theta = 0 The 8 anodes break down to thetas of: Anode 1 covers the range +60 to +80 degs Anode 2 covers the range +40 to +60 degs Anode 3 covers the range +20 to +40 degs Anode 4 covers the range 0 to +20 degs Anode 5 covers the range -20 to 0 degs Anode 6 covers the range -40 to -20 degs Anode 7 covers the range -60 to -40 degs Anode 8 covers the range -80 to -60 degs
DIM2_THETA_UPPER	**PC_REAL**	**32**	**[-80,80]**	2nd Dimension of DATA: Spacecraft Theta - upper limit. See DIM2_THETA for

Table 30: CAPS ELS CALIBRATED Data File Contents and Structure				
				description.
DIM2_THETA _LOWER	**PC_REAL**	**32**	**[-80, 80]**	2nd Dimension of DATA: Spacecraft Theta - lower limit. See DIM2_THETA for description.
DIM3_PHI	**PC_REAL**	**4**	**[155, 385]**	3rd Dimension of DATA: S/C Phi - representative value. Spacecraft Phi (degs) is analogous to longitude on a sphere. In spacecraft xyz co-ords: +x is equivalent to phi = 0 degs +y is equivalent to phi = 90 degs -x is equivalent to phi = 180 degs -y is equivalent to phi = 270 degs +x is equivalent to phi = 360 degs +y is equivalent to phi = 450 degs The Phi angle varies because of actuator motion, BUT this is NOT the same as actuator angle (ACT) from the level 2 CAPS data: Phi = 270 – ACT This is not a center value but a representative one. Center values are the mid-points between the upper and lower limits, in such cases the upper and lower values are the first and last points of that range: Center value = (lower + upper)/2 In this case the actuator goes back and forth, slows at the edges, such that a mid-point could be lower than both the first and last points if the actuator changed direction during that interval. Phi angles are calculated every

Table 30: CAPS ELS CALIBRATED Data File Contents and Structure

				second from the start to the end of the intervals duration and then: Representative value = mean(phi angles) The lower limit value = min(phi angles) The upper limit value = max(phi angles)
DIM3_PHI_UPPER	**PC_REAL**	**4**	**[155, 385]**	3rd Dimension of DATA: S/C Phi - upper limit. See DIM3_PHI for description.
DIM3_PHI_LOWER	**PC_REAL**	**4**	**[155, 385]**	3rd Dimension of DATA: S/C Phi - lower limit. See DIM3_PHI for description.
SC_POS_R	**PC_REAL**	**4**	**[0, 200]**	Cassini radial distance from Saturn. The non-cruise part of the mission is below 200 Rs. (1 Rs = 60268.0 km) [Values may be greater than VALID_MAX during cruise to Saturn before primary mission.]
SC_POS_LAT	**PC_REAL**	**4**	**[-90, 90]**	Cassini Latitude above Saturn. (0 = Equatorial)
SC_POS_LOCAL_TIME	**PC_REAL**	**4**	**[0, 24]**	Cassini Local Time from Saturn. 00 = Midnight 06 = Dawn 12 = Noon 18 = Dusk
SC_POS_SATURN_J2000XYZ	**PC_REAL**	**12**	**[-12×10^6, 12×10^6]**	Cassini position from Saturn in J2000 cartesian co-ordinates [x,y,z] (units km). [Values may be outside of VALID_MIN/MAX range (~199Rs) during cruise to Saturn before primary mission.]

Table 30: CAPS ELS CALIBRATED Data File Contents and Structure				
SC_VEL_SATURN_J2000XYZ	**PC_REAL**	**12**	**[-40, 40]**	Cassini Velocity with respect to Saturn in J2000 cartesian co-ordinates [Vx,Vy,Vz] (units km/s).
SC_VEL_ANGULAR_J2000XYZ	**PC_REAL**	**12**	**[-1, 1]**	Cassini Angular Velocity in cartesian co-ordinates [AVx,AVy,AVz] (units radians/s). (This is calculated with the SPICE ckgpav command where ref=J2000. SPICE defines it as 'This is the axisabout which the reference frame tied to the instrument is rotating in the right-handed sense')
SC_TO_J2000	**PC_REAL**	**36**	**[-1, 1]**	Rotation matrix from spacecraft co-ordinates to J2000 This is a 3x3 matrix, expressed here as a 1x9 stream. If the 1D stream is [a,b,c, d,e,f, g,h,i] then the 2D matrix is [a,b,c d,e,f g,h,i]
J2000_TO_RTP	**PC_REAL**	**36**	**[-1, 1]**	Rotation matrix from J2000 co-ordinates to RTP, where RTP is Saturn centered right handed R-Theta-Phi. This is a 3x3 matrix, expressed here as a 1x9 stream. If the 1D stream is [a,b,c, d,e,f, g,h,i] then the 2D matrix is [a,b,c d,e,f g,h,i]"
AUX_ELS_MCP_ADJ	**PC_REAL**	**4**	**[0, 3700]**	ELS High Voltage multichannel plate (mcp).

5.3.2. **CAPS IBS Data Product Format**

The data product format for CAPS IBS is listed in Table 31 below.

Table 31: CAPS IBS CALIBRATED Data File Contents and Structure

Column Name	Type	Length (bytes)	Range	Description
UTC	**DATE**	**21**	**[1999-004T00:00:00.000, 2012-155T00:00:00.000]**	UTC timestamp, of format yyyy-dddTHH:MM:SS.sss where yyyy = year, ddd = day of year, HH = hour, MM = minute, SS.sss = decimal seconds to millisecond resolution. Value calculated via SPICE from spacecraft clock time.
DEAD_TIME_METHOD	**LSB_UNSIGNED_INTEGER**	**1**	**[0, 2]**	Dead Time Correction Method 0 = None: Data has not been Dead Time corrected. 1 = On ground (using quantized values). 2 = In flight, corrected prior to any bin summing and prior to quantization for downlink (ELS only). 255 = Unknown.
TELEMETRY	**LSB_UNSIGNED_INTEGER**	**2**	**[250, 16000]**	Telemetry Downlink Rate (bps). (Independent of Solar Wind Modes) Expected values are 250, 500, 1000, 2000, 4000, 8000, 16000
DT	**PC_REAL**	**4**	**[2, 32]**	Duration of Record (seconds)
ACCUMULATION_TIME	**PC_REAL**	**1020**	**[0.00683594, 0.21875]**	ACCUMULATION_TIME of each bin (seconds)

DATA	**PC_REAL**	**3060**	**[0, 1000000]**	IBS data of each bin (Counts per second) Counts per accumulation have been (in order): -Moved to middle of quantization bin -Converted to counts/second. -Maybe Dead time corrected (See DEAD_TIME_METHOD) -Cross talk corrected.
DIM1_E	**PC_REAL**	**1020**	**[0, 54000]**	1st Dimension of DATA: Energy - center value (eV/q). Upper and lower limits are given by the objects DIM1_E_UPPER and DIM1_E_LOWER.
DIM1_E_UPPER	**PC_REAL**	**1020**	**[0, 54000]**	1st Dimension of DATA: Energy - upper limit (eV/q). See DIM1_E for description.
DIM1_E_LOWER	**PC_REAL**	**1020**	**[0, 54000]**	1st Dimension of DATA: Energy - lower limit (eV/q). See DIM1_E for description.

DIM2_THETA	**PC_REAL**	**12**	**[-75, 75]**	2nd Dimension of DATA: Spacecraft Theta - center value. Spacecraft Theta (degs) is analogous to latitude on a sphere. In spacecraft xyz co-ords: +z is equivalent to theta = +90 degs -z is equivalent to theta = -90 degs (The communication dish is directed along -z) xy-plane at z=0 is equivalent to theta = 0 The 3 anodes break down to thetas of: Anode 1 is all fill values Anode 2 covers the range -75 to +75 degs Anode 3 is all fill values Anode 2 for IBS has nearly the same field of view as anodes 1-8 for SNG/ELS. The 3 IBS anodes are not parallel, but in a cross-fan geometry, where anodes 1 and 3 are offset from anode 2 by +/- 30 degrees (see CAPS instrument paper). Because of this odd geometry, only anode 2 details are provided, and users can apply the constant cross-fan offset for theta & phi of anodes 1 and 3 to their data.
DIM2_THETA_ UPPER	**PC_REAL**	**12**	**[-75, 75]**	2nd Dimension of DATA: Spacecraft Theta - upper limit. See DIM2_THETA for description.
DIM2_THETA_L OWER	**PC_REAL**	**12**	**[-75, 75]**	2nd Dimension of DATA: Spacecraft Theta - lower limit. See DIM2_THETA for description.

DIM3_PHI	**PC_REAL**	**4**	**[155, 385]**	3rd Dimension of DATA: S/C Phi - representative value. Spacecraft Phi (degs) is analogous to longitude on a sphere. In spacecraft xyz co-ords: +x is equivalent to phi = 0 degs +y is equivalent to phi = 90 degs -x is equivalent to phi = 180 degs -y is equivalent to phi = 270 degs +x is equivalent to phi = 360 degs +y is equivalent to phi = 450 degs The Phi angle varies because of actuator motion, BUT this is NOT the same as actuator angle (ACT) from the level 2 CAPS data: Phi = 270 – ACT This is not a center value but a representative one. Center values are the mid-points between the upper and lower limits, in such cases the upper and lower values are the first and last points of that range: Center value = (lower + upper)/2 In this case the actuator goes back and forth, slows at the edges, such that a mid-point could be lower than both the first and last points if the actuator changed direction during that interval. Phi angles are calculated every second from the start to the end of the intervals duration and then: Representative value = mean(phi angles) The lower limit value = min(phi angles) The upper limit value = max(phi angles) The upper limit value = max(phi angles) For IBS, this is Phi of anode 2 only. See Theta description for offset for anodes 1 and 3.

DIM3_PHI_UPPER	**PC_REAL**	**4**	**[155, 385]**	3rd Dimension of DATA: S/C Phi - upper limit. See DIM3_PHI for description.
DIM3_PHI_LOWER	**PC_REAL**	**4**	**[155, 385]**	3rd Dimension of DATA: S/C Phi - lower limit. See DIM3_PHI for description.
SC_POS_R	**PC_REAL**	**4**	**[0, 200]**	Cassini radial distance from Saturn. The non-cruise part of the mission is below 200 Rs. (1 Rs = 60268.0 km) [Values may be greater than VALID_MAX during cruise to Saturn before primary mission.]
SC_POS_LAT	**PC_REAL**	**4**	**[-90, 90]**	Cassini Latitude above Saturn. (0 = Equatorial)
SC_POS_LOCAL_TIME	**PC_REAL**	**4**	**[0, 24]**	Cassini Local Time from Saturn. 00 = Midnight 06 = Dawn 12 = Noon 18 = Dusk
SC_POS_SATURN_J2000XYZ	**PC_REAL**	**12**	**[-12×10^6, 12×10^6]**	Cassini position from Saturn in J2000 cartesian co-ordinates [x,y,z] (units km). [Values may be outside of VALID_MIN/MAX range (~199Rs) during cruise to Saturn before primary mission.]
SC_VEL_SATURN_J2000XYZ	**PC_REAL**	**12**	**[-40, 40]**	Cassini Velocity with respect to Saturn in J2000 cartesian co-ordinates [Vx,Vy,Vz] (units km/s).
SC_VEL_ANGULAR_J2000XYZ	**PC_REAL**	**12**	**[-1, 1]**	Cassini Angular Velocity in cartesian co-ordinates [AVx,AVy,AVz] (units radians/s). (This is calculated with the SPICE ckgpav command where ref=J2000. SPICE defines it as 'This is the axisabout which the reference frame tied to the instrument is rotating in the right-handed sense')

SC_TO_J2000	**PC_REAL**	**36**	**[-1, 1]**	Rotation matrix from spacecraft co-ordinates to J2000 This is a 3x3 matrix, expressed here as a 1x9 stream. If the 1D stream is [a,b,c, d,e,f, g,h,i] then the 2D matrix is [a,b,c d,e,f g,h,i]
J2000_TO_RTP	**PC_REAL**	**36**	**[-1, 1]**	Rotation matrix from J2000 co-ordinates to RTP, where RTP is Saturn centered right handed R-Theta-Phi. This is a 3x3 matrix, expressed here as a 1x9 stream. If the 1D stream is [a,b,c, d,e,f, g,h,i] then the 2D matrix is [a,b,c d,e,f g,h,i]"
AUX_IBS_CEM_DAC	**PC_REAL**	**4**	**[-4000, 0]**	IBS High Voltage channel-electron multiplier (cem).

5.3.3. **CAPS IMS ION Data Product Format**

The data product format for CAPS IMS ION is listed in Table 32 below.

Table 32: CAPS CALIBRATED IMS ION Data File Contents and Structure

Column Name	Type	Length (bytes)	Range	Description
UTC	**DATE**	**21**	**[1999-004T00:00:00.000, 2012-155T00:00:00.000]**	UTC timestamp, of format yyyy-dddTHH:MM:SS.sss where yyyy = year, ddd = day of year, HH = hour, MM = minute, SS.sss = decimal seconds to millisecond resolution. Value calculated via SPICE from spacecraft clock time.

DEAD_TIME_METHOD	**LSB_UNSIGNED_INTEGER**	**1**	**[0, 2]**	Dead Time Correction Method 0 = None: Data has not been Dead Time corrected. 1 = On ground (using quantized values). 2 = In flight, corrected prior to any bin summing and prior to quantization for downlink (ELS only). 255 = Unknown.
TELEMETRY	**LSB_UNSIGNED_INTEGER**	**2**	**[250, 16000]**	Telemetry Downlink Rate (bps). (Independent of Solar Wind Modes) Expected values are 250, 500, 1000, 2000, 4000, 8000, 16000
DT	**PC_REAL**	**4**	**[4, 32]**	Duration of Record (seconds)
ACCUMULATION_TIME	**PC_REAL**	**252**	**[0.0546875, 1.75]**	ACCUMULATION_TIME of each bin (seconds)
DATA	**PC_REAL**	**2016**	**[0, 1000000]**	ION data of each bin (Counts per second) Counts per accumulation have been (in order): -Moved to middle of quantization bin -Converted to counts/second. -Maybe Dead time corrected (See DEAD_TIME_METHOD) -Cross talk corrected.
DIM1_E	**PC_REAL**	**252**	**[0, 51000]**	1st Dimension of DATA: Energy - center value (eV/q). Upper and lower limits are given by the objects DIM1_E_UPPER and DIM1_E_LOWER.
DIM1_E_UPPER	**PC_REAL**	**252**	**[0, 51000]**	1st Dimension of DATA: Energy - upper limit (eV/q). See DIM1_E for description.
DIM1_E_LOWER	**PC_REAL**	**252**	**[0, 51000]**	1st Dimension of DATA: Energy - lower limit (eV/q). See DIM1_E for description.

DIM2_THETA	**PC_REAL**	**32**	**[-80, 80]**	2nd Dimension of DATA: Spacecraft Theta - center value. Spacecraft Theta (degs) is analogous to latitude on a sphere. In spacecraft xyz co-ords: +z is equivalent to theta = +90 degs -z is equivalent to theta = -90 degs (The communication dish is directed along -z) xy-plane at z=0 is equivalent to theta = 0 The 8 anodes break down to thetas of: Anode 1 covers the range +60 to +80 degs Anode 2 covers the range +40 to +60 degs Anode 3 covers the range +20 to +40 degs Anode 4 covers the range 0 to +20 degs Anode 5 covers the range -20 to 0 degs Anode 6 covers the range -40 to -20 degs Anode 7 covers the range -60 to -40 degs Anode 8 covers the range -80 to -60 degs
DIM2_THETA_UPPER	**PC_REAL**	**32**	**[-80, 80]**	2nd Dimension of DATA: Spacecraft Theta - upper limit. See DIM2_THETA for description.
DIM2_THETA_LOWER	**PC_REAL**	**32**	**[-80, 80]**	2nd Dimension of DATA: Spacecraft Theta - lower limit. See DIM2_THETA for description.

DIM3_PHI	**PC_REAL**	**4**	**[155, 385]**	3rd Dimension of DATA: S/C Phi - representative value. Spacecraft Phi (degs) is analogous to longitude on a sphere. In spacecraft xyz co-ords: +x is equivalent to phi = 0 degs +y is equivalent to phi = 90 degs -x is equivalent to phi = 180 degs -y is equivalent to phi = 270 degs +x is equivalent to phi = 360 degs +y is equivalent to phi = 450 degs The Phi angle varies because of actuator motion, BUT this is NOT the same as actuator angle (ACT) from the level 2 CAPS data: Phi = 270 – ACT This is not a center value but a representative one. Center values are the mid-points between the upper and lower limits, in such cases the upper and lower values are the first and last points of that range: Center value = (lower + upper)/2 In this case the actuator goes back and forth, slows at the edges, such that a mid-point could be lower than both the first and last points if the actuator changed direction during that interval. Phi angles are calculated every second from the start to the end of the intervals duration and then: Representative value = mean(phi angles) The lower limit value = min(phi angles) The upper limit value = max(phi angles)

DIM3_PHI_UPPER	**PC_REAL**	**4**	**[155, 385]**	3rd Dimension of DATA: S/C Phi - upper limit. See DIM3_PHI for description.
DIM3_PHI_LOWER	**PC_REAL**	**4**	**[155, 385]**	3rd Dimension of DATA: S/C Phi - lower limit. See DIM3_PHI for description.
SC_POS_R	**PC_REAL**	**4**	**[0, 200]**	Cassini radial distance from Saturn. The non-cruise part of the mission is below 200 Rs. (1 Rs = 60268.0 km) [Values may be greater than VALID_MAX during cruise to Saturn before primary mission.]
SC_POS_LAT	**PC_REAL**	**4**	**[-90, 90]**	Cassini Latitude above Saturn. (0 = Equatorial)
SC_POS_LOCAL_TIME	**PC_REAL**	**4**	**[0, 24]**	Cassini Local Time from Saturn. 00 = Midnight 06 = Dawn 12 = Noon 18 = Dusk
SC_POS_SATURN_J2000XYZ	**PC_REAL**	**12**	**[-12×10^6, 12×10^6]**	Cassini position from Saturn in J2000 cartesian co-ordinates [x,y,z] (units km). [Values may be outside of VALID_MIN/MAX range (~199Rs) during cruise to Saturn before primary mission.]
SC_VEL_SATURN_J2000XYZ	**PC_REAL**	**12**	**[-40, 40]**	Cassini Velocity with respect to Saturn in J2000 cartesian co-ordinates [Vx,Vy,Vz] (units km/s).
SC_VEL_ANGULAR_J2000XYZ	**PC_REAL**	**12**	**[-1, 1]**	Cassini Angular Velocity in cartesian co-ordinates [AVx,AVy,AVz] (units radians/s). (This is calculated with the SPICE ckgpav command where ref=J2000. SPICE defines it as 'This is the axisabout which the reference frame tied to the instrument is rotating in the right-handed sense')

SC_TO_J2000	**PC_REAL**	**36**	**[-1, 1]**	Rotation matrix from spacecraft co-ordinates to J2000 This is a 3x3 matrix, expressed here as a 1x9 stream. If the 1D stream is [a,b,c, d,e,f, g,h,i] then the 2D matrix is [a,b,c d,e,f g,h,i]
J2000_TO_RTP	**PC_REAL**	**36**	**[-1, 1]**	Rotation matrix from J2000 co-ordinates to RTP, where RTP is Saturn centered right handed R-Theta-Phi. This is a 3x3 matrix, expressed here as a 1x9 stream. If the 1D stream is [a,b,c, d,e,f, g,h,i] then the 2D matrix is [a,b,c d,e,f g,h,i]"
AUX_HVU2_ST_DAC	**PC_REAL**	**4**	**[-3600, 0]**	High Voltage Unit 2 (HVU2) Straight Through multichannel plate (mcp).
AUX_HVU2_LEF_DAC	**PC_REAL**	**4**	**[-2400, 0]**	High Voltage Unit 2 (HVU2) Linear Electric Field multichannel plate (mcp).
ION_MASS_RANGE	**LSB_UNSIGNED_INTEGER**	**2**	**[1, 32]**	Mass range of ions, lower and upper given in that order. If no range, then lower = upper. Range will have same charge, see ION_CHARGE.
ION_CHARGE	**LSB_UNSIGNED_INTEGER**	**1**	**[1, 3]**	Charge of ions in ION_MASS_RANGE.
SPARE	**LSB_UNSIGNED_INTEGER**	**1**	**[0, 0]**	SPARE byte - should be zero. Only here to meet PDS requirement to start byte words on even numbers of bytes.

5.3.4. **CAPS IMS SNG Data Product Format**

The data product format for CAPS IMS Singles (SNG) is listed in Table 33 below.

Table 33: CAPS CALIBRATED IMS Singles Data File Contents and Structure

Column Name	Type	Length (bytes)	Range	Description
UTC	**DATE**	**21**	**[1999-004T00:00:00.000, 2012-155T00:00:00.000]**	UTC timestamp, of format yyyy-dddTHH:MM:SS.sss where yyyy = year, ddd = day of year, HH = hour, MM = minute, SS.sss = decimal seconds to millisecond resolution. Value calculated via SPICE from spacecraft clock time.
DEAD_TIME_METHOD	**LSB_UNSIGNED_INTEGER**	**1**	**[0, 2]**	Dead Time Correction Method 0 = None: Data has not been Dead Time corrected. 1 = On ground (using quantized values). 2 = In flight, corrected prior to any bin summing and prior to quantization for downlink (ELS only). 255 = Unknown.
TELEMETRY	**LSB_UNSIGNED_INTEGER**	**2**	**[250, 16000]**	Telemetry Downlink Rate (bps). (Independent of Solar Wind Modes) Expected values are 250, 500, 1000, 2000, 4000, 8000, 16000
DT	**PC_REAL**	**4**	**[4, 32]**	Duration of Record (seconds)
ACCUMULATION_TIME	**PC_REAL**	**252**	**[0.0546875, 1.75]**	ACCUMULATION_TIME of each bin (seconds)
DATA	**PC_REAL**	**2016**	**[0, 1000000]**	SNG data of each bin (Counts per second) Counts per accumulation have been (in order): -Moved to middle of quantization bin -Converted to counts/second. -Maybe Dead time corrected (See DEAD_TIME_METHOD)

Table 33: CAPS CALIBRATED IMS Singles Data File Contents and Structure				
				-Cross talk corrected.
DIM1_E	**PC_REAL**	**252**	**[0,51 000]**	1st Dimension of DATA: Energy - center value (eV/q). Upper and lower limits are given by the objects DIM1_E_UPPER and DIM1_E_LOWER.
DIM1_E_UPPER	**PC_REAL**	**252**	**[0, 51000]**	1st Dimension of DATA: Energy - upper limit (eV/q). See DIM1_E for description.
DIM1_E_LOWER	**PC_REAL**	**252**	**[0, 51000]**	1st Dimension of DATA: Energy - lower limit (eV/q). See DIM1_E for description.
DIM2_THETA	**PC_REAL**	**32**	**[-80, 80]**	2nd Dimension of DATA: Spacecraft Theta - center value. Spacecraft Theta (degs) is analogous to latitude on a sphere. In spacecraft xyz co-ords: +z is equivalent to theta = +90 degs -z is equivalent to theta = -90 degs (The communication dish is directed along -z) xy-plane at z=0 is equivalent to theta = 0 The 8 anodes break down to thetas of: Anode 1 covers the range +60 to +80 degs Anode 2 covers the range +40 to +60 degs Anode 3 covers the range +20 to +40 degs Anode 4 covers the range 0 to +20 degs Anode 5 covers the range -20 to 0 degs Anode 6 covers the range -40 to -20 degs Anode 7 covers the range -60 to

Table 33: CAPS CALIBRATED IMS Singles Data File Contents and Structure				
				-40 degs Anode 8 covers the range -80 to -60 degs
DIM2_THETA_UPPER	**PC_REAL**	**32**	**[-80, 80]**	2nd Dimension of DATA: Spacecraft Theta - upper limit. See DIM2_THETA for description.
DIM2_THETA_LOWER	**PC_REAL**	**32**	**[-80, 80]**	2nd Dimension of DATA: Spacecraft Theta - lower limit. See DIM2_THETA for description.
DIM3_PHI	**PC_REAL**	**4**	**[155, 385]**	3rd Dimension of DATA: S/C Phi - representative value. Spacecraft Phi (degs) is analogous to longitude on a sphere. In spacecraft xyz co-ords: +x is equivalent to phi = 0 degs +y is equivalent to phi = 90 degs -x is equivalent to phi = 180 degs -y is equivalent to phi = 270 degs +x is equivalent to phi = 360 degs +y is equivalent to phi = 450 degs The Phi angle varies because of actuator motion, BUT this is NOT the same as actuator angle (ACT) from the level 2 CAPS data: Phi = 270 – ACT This is not a center value but a representative one. Center values are the mid-points between the upper and lower limits, in such cases the upper and lower values are the first and last points of that range: Center value = (lower +

Table 33: CAPS CALIBRATED IMS Singles Data File Contents and Structure				
				upper)/2 In this case the actuator goes back and forth, slows at the edges, such that a mid-point could be lower than both the first and last points if the actuator changed direction during that interval. Phi angles are calculated every second from the start to the end of the intervals duration and then: Representative value = mean(phi angles) The lower limit value = min(phi angles) The upper limit value = max(phi angles)
DIM3_PHI_UPPER	**PC_REAL**	**4**	**[155, 385]**	3rd Dimension of DATA: S/C Phi - upper limit. See DIM3_PHI for description.
DIM3_PHI_LOWER	**PC_REAL**	**4**	**[155, 385]**	3rd Dimension of DATA: S/C Phi - lower limit. See DIM3_PHI for description.
SC_POS_R	**PC_REAL**	**4**	**[0, 200]**	Cassini radial distance from Saturn. The non-cruise part of the mission is below 200 Rs. (1 Rs = 60268.0 km) [Values may be greater than VALID_MAX during cruise to Saturn before primary mission.]
SC_POS_LAT	**PC_REAL**	**4**	**[-90, 90]**	Cassini Latitude above Saturn. (0 = Equatorial)
SC_POS_LOCAL_TIME	**PC_REAL**	**4**	**[0, 24]**	Cassini Local Time from Saturn. 00 = Midnight 06 = Dawn 12 = Noon 18 = Dusk

Table 33: CAPS CALIBRATED IMS Singles Data File Contents and Structure				
SC_POS_SATURN_J2000XYZ	**PC_REAL**	**12**	**[-12x10^6, 12x10^6]]**	Cassini position from Saturn in J2000 cartesian co-ordinates [x,y,z] (units km). [Values may be outside of VALID_MIN/MAX range (~199Rs) during cruise to Saturn before primary mission.]
SC_VEL_SATURN_J2000XYZ	**PC_REAL**	**12**	**[-40, 40]**	Cassini Velocity with respect to Saturn in J2000 cartesian co-ordinates [Vx,Vy,Vz] (units km/s).
SC_VEL_ANGULAR_J2000XYZ	**PC_REAL**	**12**	**[-1, 1]**	Cassini Angular Velocity in cartesian co-ordinates [AVx,AVy,AVz] (units radians/s). (This is calculated with the SPICE ckgpav command where ref=J2000. SPICE defines it as 'This is the axisabout which the reference frame tied to the instrument is rotating in the right-handed sense')
SC_TO_J2000	**PC_REAL**	**36**	**[-1, 1]**	Rotation matrix from spacecraft co-ordinates to J2000 This is a 3x3 matrix, expressed here as a 1x9 stream. If the 1D stream is [a,b,c, d,e,f, g,h,i] then the 2D matrix is [a,b,c d,e,f g,h,i]
J2000_TO_RTP	**PC_REAL**	**36**	**[-1, 1]**	Rotation matrix from J2000 co-ordinates to RTP, where RTP is Saturn centered right handed R-Theta-Phi. This is a 3x3 matrix, expressed here as a 1x9 stream. If the 1D stream is [a,b,c, d,e,f, g,h,i] then the 2D matrix is

Table 33: CAPS CALIBRATED IMS Singles Data File Contents and Structure				
				[a,b,c d,e,f g,h,i]"
AUX_HVU2_ST_DAC	**PC_REAL**	**4**	**[-3600, 0]**	High Voltage Unit 2 (HVU2) Straight Through multichannel plate (mcp).

5.3.5. **CAPS IMS TOFLEF Data Product Format**

The data product format for CAPS IMS Linear Electric Field Time of flight (TOF) is listed in Table 34 below.

Table 34: CAPS IMS TOFLEF CALIBRATED Data File Contents and Structure				
Column Name	**Type**	**Length (bytes)**	**Range**	**Description**
UTC	**DATE**	**21**	**[1999-004T00:00:00.000, 2012-155T00:00:00.000]**	UTC timestamp, of format yyyy-dddTHH:MM:SS.sss where yyyy = year, ddd = day of year, HH = hour, MM = minute, SS.sss = decimal seconds to millisecond resolution. Value calculated via SPICE from spacecraft clock time.
DEAD_TIME_METHOD	**LSB_UNSIGNED_INTEGER**	**1**	**[0, 2]**	Dead Time Correction Method 0 = None: Data has not been Dead Time corrected. 1 = On ground (using quantized values). 2 = In flight, corrected prior to any bin summing and prior to quantization for downlink (ELS only). 255 = Unknown.
TELEMETRY	**LSB_UNSIGNED_INTEGER**	**2**	**[250, 16000]**	Telemetry Downlink Rate (bps). (Independent of Solar Wind Modes) Expected values are 250, 500, 1000, 2000, 4000, 8000, 16000

Table 34: CAPS IMS TOFLEF CALIBRATED Data File Contents and Structure				
DT	**PC_REAL**	**4**	**[256, 1024]**	Duration of Record (seconds)
ACCUMULATION_TIME	**PC_REAL**	**128**	**[3.5, 28]**	ACCUMULATION_TIME of each bin (seconds)
DATA	**PC_REAL**	**65536**	**[0, 1000000]**	TOFLEF data of each bin (Counts per second) Counts per accumulation have been (in order): -Moved to middle of quantization bin -Converted to counts/second. -Maybe Dead time corrected (See DEAD_TIME_METHOD) For TOFLEF data, it is possible a very high count rate could dead time correct to negative counts. If so, all TOF channels at that energy are set to fill.
DIM1_E	**PC_REAL**	**128**	**[0, 51000]**	1st Dimension of DATA: Energy - center value (eV/q). Upper and lower limits are given by the objects DIM1_E_UPPER and DIM1_E_LOWER.
DIM1_E_UPPER	**PC_REAL**	**128**	**[0, 51000]**	1st Dimension of DATA: Energy - upper limit (eV/q). See DIM1_E for description.
DIM1_E_LOWER	**PC_REAL**	**128**	**[0, 51000]**	1st Dimension of DATA: Energy - lower limit (eV/q). See DIM1_E for description.
DIM2_THETA	**PC_REAL**	**4**	**[-80, 80]**	2nd Dimension of DATA: Spacecraft Theta - center value. Spacecraft Theta (degs) is analogous to latitude on a sphere. In spacecraft xyz co-ords: +z is equivalent to theta = +90 degs -z is equivalent to theta = -90 degs

Table 34: CAPS IMS TOFLEF CALIBRATED Data File Contents and Structure				
				(The communication dish is directed along -z) xy-plane at z=0 is equivalent to theta = 0 Just 1 anode for TOF data: Anode 1 covers the range -80 to +80 degs This 1 TOF anode covers the same field of view as all 8 SNG anodes.
DIM2_THETA_UPPER	**PC_REAL**	**4**	**[-80, 80]**	2nd Dimension of DATA: Spacecraft Theta - upper limit. See DIM2_THETA for description.
DIM2_THETA_LOWER	**PC_REAL**	**4**	**[-80, 80]**	2nd Dimension of DATA: Spacecraft Theta - lower limit. See DIM2_THETA for description.
DIM3_PHI	**PC_REAL**	**4**	**[155, 385]**	3rd Dimension of DATA: S/C Phi - representative value. Spacecraft Phi (degs) is analogous to longitude on a sphere. In spacecraft xyz co-ords: +x is equivalent to phi = 0 degs +y is equivalent to phi = 90 degs -x is equivalent to phi = 180 degs -y is equivalent to phi = 270 degs +x is equivalent to phi = 360 degs +y is equivalent to phi = 450 degs The Phi angle varies because of actuator motion, BUT this is NOT the same as actuator angle (ACT) from the level 2 CAPS data: Phi = 270 – ACT This is not a center value but a representative one. Center values are the mid-points between the upper and lower limits, in such cases

Table 34: CAPS IMS TOFLEF CALIBRATED Data File Contents and Structure				
				the upper and lower values are the first and last points of that range: Center value = (lower + upper)/2 In this case the actuator goes back and forth, slows at the edges, such that a mid-point could be lower than both the first and last points if the actuator changed direction during that interval. Phi angles are calculated every second from the start to the end of the intervals duration and then: Representative value = mean(phi angles) The lower limit value = min(phi angles) The upper limit value = max(phi angles)
DIM3_PHI_UPPER	**PC_REAL**	**4**	**[155, 385]**	3rd Dimension of DATA: S/C Phi - upper limit. See DIM3_PHI for description.
DIM3_PHI_LOWER	**PC_REAL**	**4**	**[155, 385]**	3rd Dimension of DATA: S/C Phi - lower limit. See DIM3_PHI for description.
DIM4_TOF	**PC_REAL**	**2048**	**[0, 0.0000016007812 5]**	4th Dimension of DATA: Time Of Flight - center value.
DIM4_TOF_UPPER	**PC_REAL**	**2048**	**[0, 0.0000016007812 5]**	4th Dimension of DATA: Time Of Flight - upper limit. See DIM4_TOF for description.
DIM4_TOF_LOWER	**PC_REAL**	**2048**	**[0, 0.0000016007812 5]**	4th Dimension of DATA: Time Of Flight - lower limit. See DIM4_TOF for description.
SC_POS_R	**PC_REAL**	**4**	**[0, 200]**	Cassini radial distance from Saturn.

Table 34: CAPS IMS TOFLEF CALIBRATED Data File Contents and Structure				
				The non-cruise part of the mission is below 200 Rs. (1 Rs = 60268.0 km) [Values may be greater than VALID_MAX during cruise to Saturn before primary mission.]
SC_POS_LAT	**PC_REAL**	**4**	**[-90, 90]**	Cassini Latitude above Saturn. (0 = Equatorial)
SC_POS_LOCAL_TIME	**PC_REAL**	**4**	**[0, 24]**	Cassini Local Time from Saturn. 00 = Midnight 06 = Dawn 12 = Noon 18 = Dusk
SC_POS_SATURN_J2000XYZ	**PC_REAL**	**12**	**[-12×10^6, 12×10^6]**	Cassini position from Saturn in J2000 cartesian co-ordinates [x,y,z] (units km). [Values may be outside of VALID_MIN/MAX range (~199Rs) during cruise to Saturn before primary mission.]
SC_VEL_SATURN_J2000XYZ	**PC_REAL**	**12**	**[-40, 40]**	Cassini Velocity with respect to Saturn in J2000 cartesian co-ordinates [Vx,Vy,Vz] (units km/s).
SC_VEL_ANGULAR_J2000XYZ	**PC_REAL**	**12**	**[-1, 1]**	Cassini Angular Velocity in cartesian co-ordinates [AVx,AVy,AVz] (units radians/s). (This is calculated with the SPICE ckgpav command where ref=J2000. SPICE defines it as 'This is the axisabout which the reference frame tied to the instrument is rotating in the right-handed sense')
SC_TO_J2000	**PC_REAL**	**36**	**[-1, 1]**	Rotation matrix from spacecraft co-ordinates to J2000 This is a 3x3 matrix, expressed here as a 1x9 stream. If the 1D stream is [a,b,c, d,e,f, g,h,i]

Table 34: CAPS IMS TOFLEF CALIBRATED Data File Contents and Structure				
				then the 2D matrix is [a,b,c d,e,f g,h,i]
J2000_TO_RTP	**PC_REAL**	**36**	**[-1, 1]**	Rotation matrix from J2000 co-ordinates to RTP, where RTP is Saturn centered right handed R-Theta-Phi. This is a 3x3 matrix, expressed here as a 1x9 stream. If the 1D stream is [a,b,c, d,e,f, g,h,i] then the 2D matrix is [a,b,c d,e,f g,h,i]"
AUX_HVU2_ST_DAC	**PC_REAL**	**4**	**[-3600, 0]**	High Voltage Unit 2 (HVU2) Straight Through multichannel plate (mcp).
AUX_HVU2_LEF_DAC	**PC_REAL**	**4**	**[-2400, 0]**	High Voltage Unit 2 (HVU2) Linear Electric Field multichannel plate (mcp).

5.3.6. **CAPS IMS TOFST Data Product Format**

The data product format for CAPS IMS Straight Through Time of flight (TOF) is listed in Table 35 below.

Table 35: CAPS IMS TOFST CALIBRATED Data File Contents and Structure				
Column Name	**Type**	**Length (bytes)**	**Range**	**Description**
UTC	**DATE**	**21**	**[1999-004T00:00:00.000, 2012-155T00:00:00.000]**	UTC timestamp, of format yyyy-dddTHH:MM:SS.sss where yyyy = year, ddd = day of year, HH = hour, MM = minute, SS.sss = decimal seconds to millisecond resolution. Value calculated via SPICE from spacecraft clock time.

Table 35: CAPS IMS TOFST CALIBRATED Data File Contents and Structure				
DEAD_TIME_METHOD	**LSB_UNSIGNED_INTEGER**	**1**	**[0, 2]**	Dead Time Correction Method 0 = None: Data has not been Dead Time corrected. 1 = On ground (using quantized values). 2 = In flight, corrected prior to any bin summing and prior to quantization for downlink (ELS only). 255 = Unknown.
TELEMETRY	**LSB_UNSIGNED_INTEGER**	**2**	**[250, 16000]**	Telemetry Downlink Rate (bps). (Independent of Solar Wind Modes) Expected values are 250, 500, 1000, 2000, 4000, 8000, 16000
DT	**PC_REAL**	**4**	**[256, 1024]**	Duration of Record (seconds)
ACCUMULATION_TIME	**PC_REAL**	**128**	**[3.5, 28]**	ACCUMULATION_TIME of each bin (seconds)
DATA	**PC_REAL**	**65536**	**[0, 1000000]**	TOFST data of each bin (Counts per second) Counts per accumulation have been (in order): -Moved to middle of quantization bin -Converted to counts/second. -Maybe Dead time corrected (See DEAD_TIME_METHOD) For TOFST data, it is possible a very high count rate could dead time correct to negative counts. If so, all TOF channels at that energy are set to fill.
DIM1_E	**PC_REAL**	**128**	**[0, 51000]**	1st Dimension of DATA: Energy - center value (eV/q). Upper and lower limits are given by the objects DIM1_E_UPPER and DIM1_E_LOWER.

Table 35: CAPS IMS TOFST CALIBRATED Data File Contents and Structure				
DIM1_E_UPPER	**PC_REAL**	**128**	**[0, 51000]**	1st Dimension of DATA: Energy - upper limit (eV/q). See DIM1_E for description.
DIM1_E_LOWER	**PC_REAL**	**128**	**[0, 51000]**	1st Dimension of DATA: Energy - lower limit (eV/q). See DIM1_E for description.
DIM2_THETA	**PC_REAL**	**4**	**[-80, 80]**	2nd Dimension of DATA: Spacecraft Theta - center value. Spacecraft Theta (degs) is analogous to latitude on a sphere. In spacecraft xyz co-ords: +z is equivalent to theta = +90 degs -z is equivalent to theta = -90 degs (The communication dish is directed along -z) xy-plane at z=0 is equivalent to theta = 0 Just 1 anode for TOF data: Anode 1 covers the range -80 to +80 degs This 1 TOF anode covers the same field of view as all 8 SNG anodes.
DIM2_THETA_UPPER	**PC_REAL**	**4**	**[-80, 80]**	2nd Dimension of DATA: Spacecraft Theta - upper limit. See DIM2_THETA for description.
DIM2_THETA_LOWER	**PC_REAL**	**4**	**[-80, 80]**	2nd Dimension of DATA: Spacecraft Theta - lower limit. See DIM2_THETA for description.
DIM3_PHI	**PC_REAL**	**4**	**[155, 385]**	3rd Dimension of DATA: S/C Phi - representative value. Spacecraft Phi (degs) is analogous to longitude on a sphere. In spacecraft xyz co-ords: +x is equivalent to phi = 0 degs +y is equivalent to phi = 90 degs -x is equivalent to phi = 180 degs

Table 35: CAPS IMS TOFST CALIBRATED Data File Contents and Structure				
				-y is equivalent to phi = 270 degs +x is equivalent to phi = 360 degs +y is equivalent to phi = 450 degs The Phi angle varies because of actuator motion, BUT this is NOT the same as actuator angle (ACT) from the level 2 CAPS data: Phi = 270 – ACT This is not a center value but a representative one. Center values are the mid-points between the upper and lower limits, in such cases the upper and lower values are the first and last points of that range: Center value = (lower + upper)/2 In this case the actuator goes back and forth, slows at the edges, such that a mid-point could be lower than both the first and last points if the actuator changed direction during that interval. Phi angles are calculated every second from the start to the end of the intervals duration and then: Representative value = mean(phi angles) The lower limit value = min(phi angles) The upper limit value = max(phi angles)
DIM3_PHI_UPPER	**PC_REAL**	**4**	**[155, 385]**	3rd Dimension of DATA: S/C Phi - upper limit. See DIM3_PHI for description.

Table 35: CAPS IMS TOFST CALIBRATED Data File Contents and Structure				
DIM3_PHI_LOWER	**PC_REAL**	**4**	**[155, 385]**	3rd Dimension of DATA: S/C Phi - lower limit. See DIM3_PHI for description.
DIM4_TOF	**PC_REAL**	**2048**	**[0, 0.0000016007812 5]**	4th Dimension of DATA: Time Of Flight - center value.
DIM4_TOF_UPPER	**PC_REAL**	**2048**	**[0, 0.0000016007812 5]**	4th Dimension of DATA: Time Of Flight - upper limit. See DIM4_TOF for description.
DIM4_TOF_LOWER	**PC_REAL**	**2048**	**[0, 0.0000016007812 5]**	4th Dimension of DATA: Time Of Flight - lower limit. See DIM4_TOF for description.
SC_POS_R	**PC_REAL**	**4**	**[0, 200]**	Cassini radial distance from Saturn. The non-cruise part of the mission is below 200 Rs. (1 Rs = 60268.0 km) [Values may be greater than VALID_MAX during cruise to Saturn before primary mission.]
SC_POS_LAT	**PC_REAL**	**4**	**[-90, 90]**	Cassini Latitude above Saturn. (0 = Equatorial)
SC_POS_LOCAL_TIME	**PC_REAL**	**4**	**[0, 24]**	Cassini Local Time from Saturn. 00 = Midnight 06 = Dawn 12 = Noon 18 = Dusk
SC_POS_SATURN_J2000XYZ	**PC_REAL**	**12**	**[$-12x10^6$, $12x10^6$]**	Cassini position from Saturn in J2000 cartesian co-ordinates [x,y,z] (units km). [Values may be outside of VALID_MIN/MAX range (~199Rs) during cruise to Saturn before primary mission.]
SC_VEL_SATURN_J2000XYZ	**PC_REAL**	**12**	**[-40, 40]**	Cassini Velocity with respect to Saturn in J2000 cartesian co-ordinates [Vx,Vy,Vz] (units km/s).

Table 35: CAPS IMS TOFST CALIBRATED Data File Contents and Structure				
SC_VEL_ANGULAR_J2000XYZ	**PC_REAL**	**12**	**[-1, 1]**	Cassini Angular Velocity in cartesian co-ordinates [AVx,AVy,AVz] (units radians/s). (This is calculated with the SPICE ckgpav command where ref=J2000. SPICE defines it as 'This is the axisabout which the reference frame tied to the instrument is rotating in the right-handed sense')
SC_TO_J2000	**PC_REAL**	**36**	**[-1, 1]**	Rotation matrix from spacecraft co-ordinates to J2000 This is a 3x3 matrix, expressed here as a 1x9 stream. If the 1D stream is [a,b,c, d,e,f, g,h,i] then the 2D matrix is [a,b,c d,e,f g,h,i]
J2000_TO_RTP	**PC_REAL**	**36**	**[-1, 1]**	Rotation matrix from J2000 co-ordinates to RTP, where RTP is Saturn centered right handed R-Theta-Phi. This is a 3x3 matrix, expressed here as a 1x9 stream. If the 1D stream is [a,b,c, d,e,f, g,h,i] then the 2D matrix is [a,b,c d,e,f g,h,i]"
AUX_HVU2_ST_DAC	**PC_REAL**	**4**	**[-3600, 0]**	High Voltage Unit 2 (HVU2) Straight Through multichannel plate (mcp).
AUX_HVU2_LEF_DAC	**PC_REAL**	**4**	**[-2400, 0]**	High Voltage Unit 2 (HVU2) Linear Electric Field multichannel plate (mcp).

5.4. CAPS Standard HIGHERORDER Data Product Descriptions

The following sections describe the content and structure of each of the standard data products within the HIGHERORDER level 5 CAPS data set. The format of each different type of higher order data product is included in the following sections.

5.4.1. **CAPS ELS Electron Moment Data Product Format**

The data product format for the ELS electron moment data is listed in Table 36 below. There are no standard fill values for these items, however, fill values are listed for each value. Data are in fixed field, ascii format.

Table 36: CAPS ELS Electron Moment HIGHERORDER Data File Contents and Structure

Column Name	Type	Length (bytes)	Range	Description
Start_Time	Time	17	[1997-228T10:43:00, 2025-001T00:00:00]	Start of the sampling period, spacecraft event time, UTC, in ISOD format to second resolution. ISOD format is: YYYY-DOYTHH:MM:SS. Fill is 2030-001T00:00:00.
End_Time	Time	17	[1997-228T10:43:00, 2025-001T00:00:00]	End of the sampling period, spacecraft event time, UTC, in ISOD format to second resolution. ISOD format is: YYYY-DOYTHH:MM:SS. Fill is 2030-001T00:00:00.
Anode_Used	Integer	1	[1,9]	Anode used to calculate moments. A value of 9 implies multiple anodes were used. Fill value is 0.
Signal_to_Noise	Real	5	[0.00, 10.00]	Signal to noise ratio threshold. Only data values above this threshold go into the moments calculation. Fill is -9.99.
SC_Potential	Real	7	[-100.00, 100.00]	Spacecraft potential (V) during the time period given. The fill value is -999.99.
Density	Real	13	[1.000000E+03, 1.000000E+10]	Density in units of electrons/m^3, summed over all energies. The fill value used is -9.000000E+00.

Temperature	Real	12	[1.000000, 99999.999999]	Temperature (eV), summed over all energies. Fill value used is -9999.000000.
Quality_Factor	Real	7	[0.000, 100.000]	The number of standard deviations, assuming Poisson counting statistics, that the peak of the Maxwellian corresponding to the determined moments lies above the ELS one-count level. The larger the value, the better. The fill value used is -99.000.
SC_Charge_State	Integer	1	[0, 1]	Indicates whether the data is likely to be from a region in which the spacecraft is negatively charged. 0: likely positively charged 1: likely negatively charged Fill is 9.
Penetrating_Radiation	Integer	1	[0,1]	Indicates whether the data is probably from a region in which there is penetrating radiation present. 0: not likely to be present 1: likely to be present Fill is 9.
Density with Penetrating Radiation removed	Real	13	[1.000000E+03, 1.000000E+10]	Density in units of electrons/m^3, summed over all energies, but with penetrating radiation subtracted from the data before moments calculations were made. Fill is -9.000000E+00.
Temperature with Penetrating Radiation removed	Real	12	[1.000000, 99999.999999]	Temperature (eV), summed over all energies, but with penetrating radiation subtracted from the data before moments calculations were made. Fill value used is -9999.000000.
Quality factor with penetrating radiation removed	Real	7	[0.000, 100.000]	The number of standard deviations, assuming Poisson counting statistics, that the peak of the Maxwellian corresponding to the

				determined moments lies above the ELS one-count level, but with penetrating radiation subtracted from the data before moments calculations were made. The larger the value, the better. The fill is -99.000.

5.4.2. **CAPS ELS Spacecraft Potential Data Product Format**

The data product format for the ELS spacecraft potential data is listed in Table 37 below. There are no standard fill values for these items, however, fill values are assigned for each variable. Data are in fixed field, ascii format.

Table 37: CAPS ELS Spacecraft Potential HIGHERORDER Data File Contents and Structure

Column Name	**Type**	**Length (bytes)**	**Range**	**Description**
Start_Time	Time	17	[1997-228T10:43:00, 2025-001T00:00:00]	Start of the sampling period, spacecraft event time, UTC, in ISOD format to second resolution. ISOD format is: YYYY-DOYTHH:MM:SS. Fill is 2030-001T00:00:00.
End_Time	Time	17	[1997-228T10:43:00, 2025-001T00:00:00]	End of the sampling period, spacecraft event time, UTC, in ISOD format to second resolution. ISOD format is: YYYY-DOYTHH:MM:SS. Fill is 2030-001T00:00:00.
Anode_Used	Integer	1	[1,8]	Anode used to assign potential. Fill value is 0.
SC_Potential	Real	7	[-100.0, 100.0]	Spacecraft potential (V) during the time period given. Fill value is -999.99.
Accuracy_Flag	Integer	2	[0,2]	0 = Accurate value derived from ELS data. Value will be accurate to +/- 8.5% as the dE/E of ELS is 17%. 1 = Potential below ELS lowest energy, therefore estimated, use with care. 2 = Accurate value derived from non-ELS data, ie. RPWS

				at periapsis or PE at moon encounters.

5.4.3. **CAPS Ion Moments Data Format**

The data product format for the ion moments is listed in Table 38 below. There are no standard fill values for these items, however, fill values are assigned for each item. Data are in fixed field, ascii format.

Table 38: CAPS Ion Moments HIGHERORDER Data File Contents and Structure

Column Name	Type	Length (bytes)	Range	Description
Time	Time	17	[1997-228T10:43:00, 2025-001T00:00:00]	Start of the sampling period, spacecraft event time, UTC, in ISOD format to second resolution. ISOD format is: YYYY-DOYTHH:MM:SS. Fill is 2030-001T00:00:00.
ION_Method_Flag	Integer	2	[1,4]	Ion Method Flag for calculation of numerical ion moments. Value: meaning 1 : SNG data, TOF-based partition 2 : SNG data, E-based partition 3 : SNG data, hard-wired partition 4 : ION data Fill value is -1.
H+ Density	Real	8	[0.000, 999.9999]	H+ density (ions/cm^3). Please note the difference between a value of 0.000 and -1. The 0.000 corresponds to a valid determination that is just extremely low (and there is no confidence in the actual quantitative value, other than that it is very low), whereas the fill value corresponds to an invalid determination, usually caused by problems in the integration process.
H+ Temperature	Real	9	[0, 99999.999]	H+ temperature (eV). Fill value is -1.

H2+ Density	Real	8	[0.000, 999.9999]	H2+ density (ions/cm^3). Please note the difference between a value of 0.000 and -1. The 0.000 corresponds to a valid determination that is just extremely low (and there is no confidence in the actual quantitative value, other than that it is very low), whereas the fill value corresponds to an invalid determination, usually caused by problems in the integration process.
H2+ Temperature	Real	9	[0, 99999.999]	H2+ temperature (eV). Fill value is -1.
W+ Density	Real	8	[0.000, 999.9999]	W+ density (ions/cm^3). Water-group ions, W+, includes O^+, OH^+, H_2O^+, and H_3O^+. Please note the difference between a value of 0.000 and -1. The 0.000 corresponds to a valid determination that is just extremely low (and there is no confidence in the actual quantitative value, other than that it is very low), whereas the fill value corresponds to an invalid determination, usually caused by problems in the integration process.
W+ Temperature	Real	9	[0, 99999.999]	W+ temperature (eV). Fill value is -1.
Ave V_r	Real	9	[-3000.000, 3000.000]	Weighted average flow velocity (km/s), r component, in Saturn centered spherical coordinates. Fill is -9999.999
Ave V_Φ	Real	9	[-3000.000, 3000.000]	Weighted average flow velocity (km/s), phi component, in Saturn centered spherical coordinates. Fill is -9999.999
Ave V_θ	Real	9	[-3000.000, 3000.000]	Weighted average flow velocity (km/s), theta component, in Saturn centered spherical coordinates. Fill is -9999.999
Average Flow Speed	Real	9	[0, 3000.000]	Weighted average flow speed. Fill is -9999.999.

Quality_Flag	Integer	2	[0, 2]	Value: meaning 0: Not-bad; corotation direction is in the Field of View (FOV) 1: Not-bad; corotation direction not in FOV 2: Bad (the spacecraft is rolling and/or CAPS is not actuating)

5.5. CAPS Standard CALIBRATED Data Product Descriptions

The following section will describe the content and structure of each of the standard data products within the CALIBRATED level 3 CAPS data set. The format of the calibrated data set is currently TBD.

6. Support Staff and Cognizant Persons

Table 39: CAPS Archive Collection Support Staff

	CAPS Team		
Judith D Furman	Southwest Research Institute 6220 Culebra Road San Antonio, TX 78228	210-522-6040	jfurman@swri.edu
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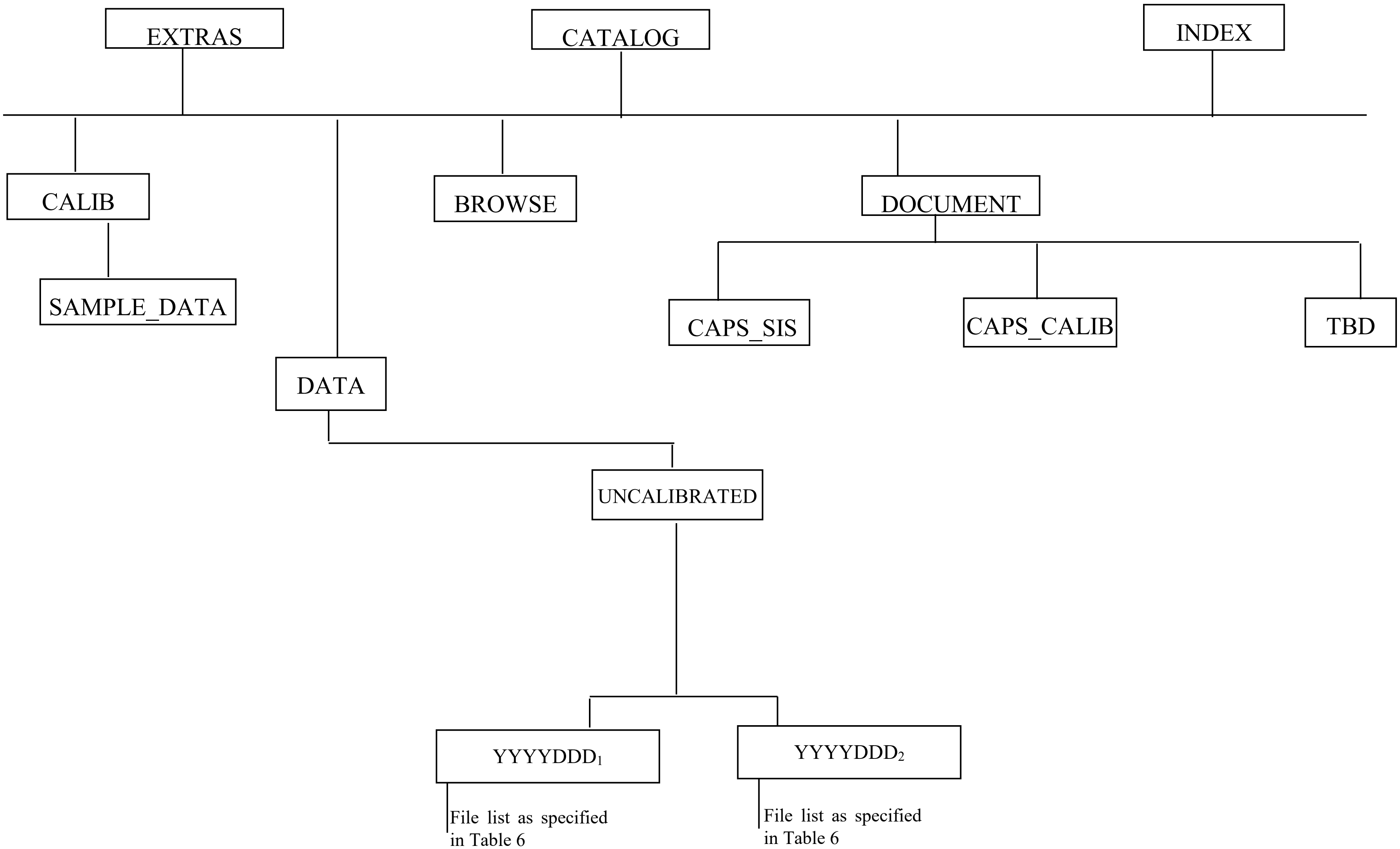
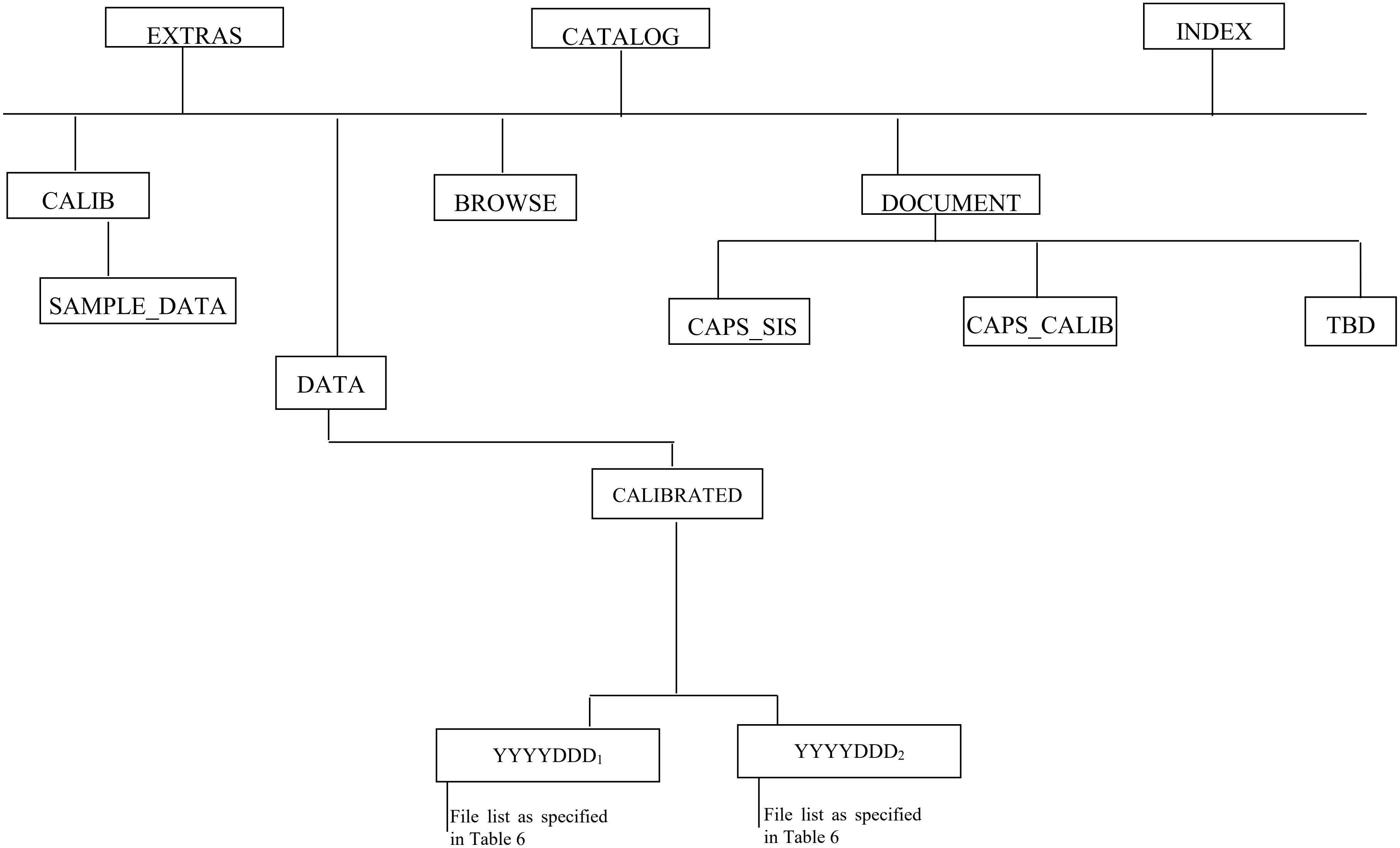
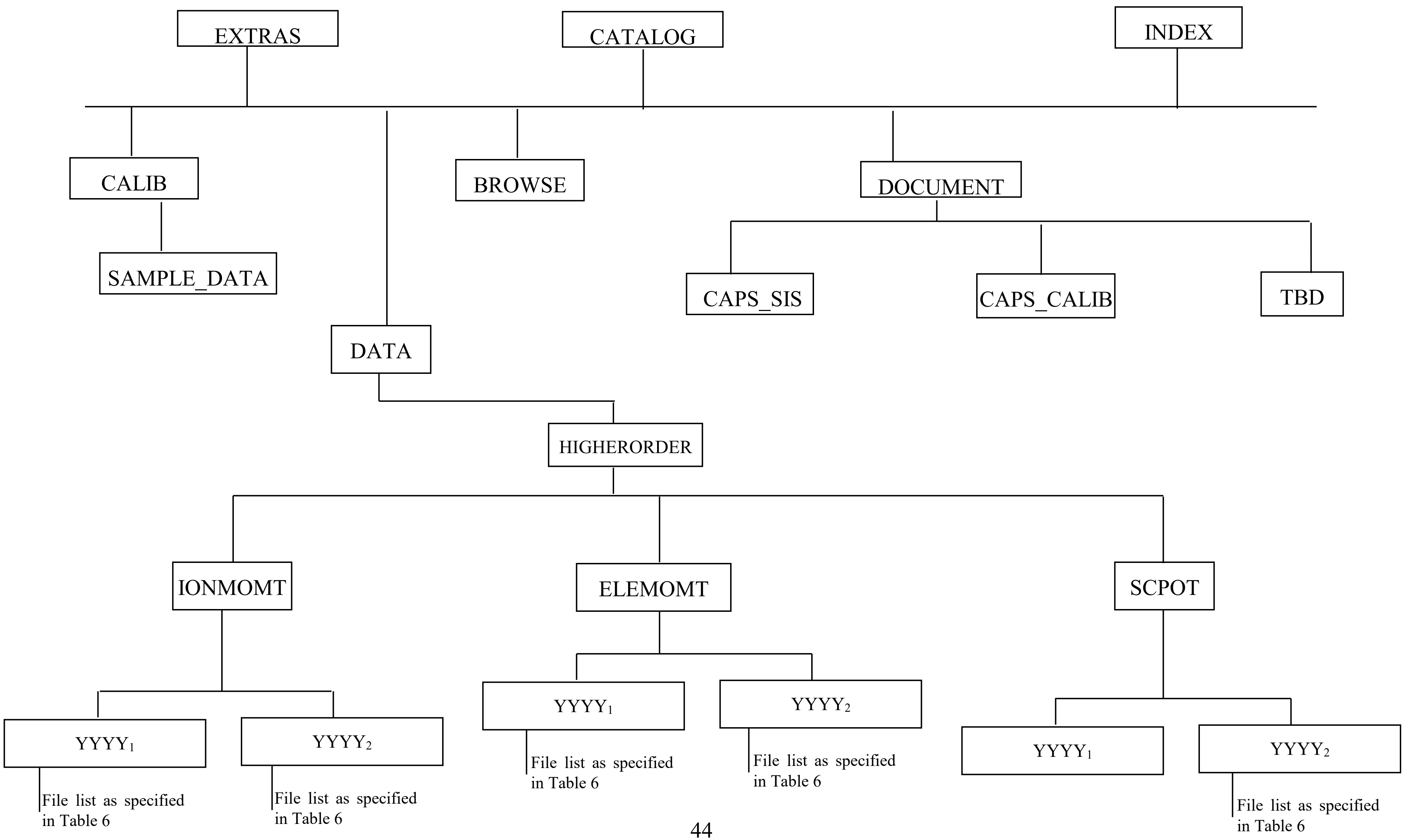
Appendix A. Directory Structure for Archive Volume, COCAPS_1nnn



Directory Structure for Archive Volume, COCAPS_2nnn



Directory Structure for Archive Volume, COCAPS_5mmm



Appendix B. PDS Labels & Format Files for Standard UNCALIBRATED Data Products

ELS_U3.FMT File

```
/* ELS_U3.FMT */
/* Description of the electron spectrometer data table */
OBJECT             = COLUMN
   NAME            = B_CYCLE_NUMBER
   DATA_TYPE       = MSB_UNSIGNED_INTEGER
   START_BYTE      = 1
   BYTES           = 2
   VALID_MINIMUM   = 1
   VALID_MAXIMUM   = 340
   MISSING_CONSTANT = 65535
   DESCRIPTION     = "B cycle number from the start of the day,
                    a value of 65535 indicates no B-cycle data
                    is available"
END_OBJECT         = COLUMN

OBJECT             = COLUMN
   NAME            = A_CYCLE_NUMBER
   DATA_TYPE       = MSB_UNSIGNED_INTEGER
   START_BYTE      = 3
   BYTES           = 2
   VALID_MINIMUM   = 1
   VALID_MAXIMUM   = 2732
   MISSING_CONSTANT = 65535
   DESCRIPTION     = "A cycle number from the start of day"
END_OBJECT         = COLUMN

OBJECT             = COLUMN
   NAME            = TIME
   DATA_TYPE       = IEEE_REAL
   START_BYTE      = 5
   BYTES           = 8
   VALID_MINIMUM   = -7.1x10^7
   VALID_MAXIMUM   = 1.5x10^9
   MISSING_CONSTANT = 10x10^9
   UNIT            = SECOND
   DESCRIPTION     = "Start time of the A cycle, seconds from J2000
                    (barycentric dynamic time).  An A-cycle is the
                    32 second instrument collection cycle."
END_OBJECT         = COLUMN

OBJECT             = COLUMN
   NAME            = TELEMETRY_MODE
   DATA_TYPE       = MSB_UNSIGNED_INTEGER
   START_BYTE      = 13
   BYTES           = 1
   VALID_MINIMUM   = 1
   VALID_MAXIMUM   = 136
   MISSING_CONSTANT = 255
   DESCRIPTION     = "Logical telemetry rate and mode:
                    1   = 250 bps
                    2   = 500 bps
                    4   = 1 kbps
                    8   = 2 kbps
                    16  = 4 kbps
                    32  = 8 kbps
                    64  = 16 kbps
                    130 = 500 bps solar wind
                    132 = 1 kbps solar wind
```

```
                    136 = 2 kbps solar wind"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = COLLAPSE_FLAG
   DATA_TYPE        = MSB_UNSIGNED_INTEGER
   START_BYTE       = 14
   BYTES            = 1
   VALID_MINIMUM    = 1
   VALID_MAXIMUM    = 131
   MISSING_CONSTANT = 255
   DESCRIPTION      = "Flag indicating how data is collapsed:
                    0: average
                    1: sum
                    2: average with in-flight deadtime correction
                    3: sum with in-flight deadtime correction
                    4: snapshot portion
                    NOTE:  For snapshot, full collapse information is
                         gained by adding 4 (so snapshot portion can be
                         4, 5, 6, or 7 depending upon the collapse.
                         The upper bit will be set to 1 when
                         housekeeping is missing."
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = OFFSET_TIME
   DATA_TYPE        = MSB_UNSIGNED_INTEGER
   START_BYTE       = 15
   BYTES            = 2
   VALID_MINIMUM    = 0
   VALID_MAXIMUM    = 32000
   MISSING_CONSTANT = 65535
   UNIT             = MILLISECOND
   DESCRIPTION      = "Milliseconds from start of A cycle"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = FIRST_ENERGY_STEP
   DATA_TYPE        = MSB_UNSIGNED_INTEGER
   START_BYTE       = 17
   BYTES            = 2
   VALID_MINIMUM    = 1
   VALID_MAXIMUM    = 63
   MISSING_CONSTANT = 65535
   DESCRIPTION      = "Minimum energy step in collapsed data"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = LAST_ENERGY_STEP
   DATA_TYPE        = MSB_UNSIGNED_INTEGER
   START_BYTE       = 19
   BYTES            = 2
   VALID_MINIMUM    = 1
   VALID_MAXIMUM    = 63
   MISSING_CONSTANT = 65535
   DESCRIPTION      = "Maximum energy step in collapsed data"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = FIRST_AZIMUTH_VALUE
   DATA_TYPE        = MSB_UNSIGNED_INTEGER
   START_BYTE       = 21
   BYTES            = 2
   VALID_MINIMUM    = 1
```

```
   VALID_MAXIMUM     = 16
   MISSING_CONSTANT  = 65535
   DESCRIPTION       = "Minimum azimuth value in collapsed data"
END_OBJECT           = COLUMN

OBJECT               = COLUMN
   NAME              = LAST_AZIMUTH_VALUE
   DATA_TYPE         = MSB_UNSIGNED_INTEGER
   START_BYTE        = 23
   BYTES             = 2
   VALID_MINIMUM     = 1
   VALID_MAXIMUM     = 16
   MISSING_CONSTANT  = 65535
   DESCRIPTION       = "Maximum azimuth value in collapsed data"
END_OBJECT           = COLUMN

OBJECT               = COLUMN
   NAME              = DATA
   DATA_TYPE         = MSB_UNSIGNED_INTEGER
   START_BYTE        = 25
   UNIT              = COUNTS
   ITEMS             = 8
   ITEM_BYTES        = 2
   BYTES             = 16
   MISSING_CONSTANT  = 65535
   VALID_MINIMUM     = 0
   VALID_MAXIMUM     = 65504
   DESCRIPTION       = "Counts in elevations 1 through 8"
END_OBJECT           = COLUMN
```

Sample ELS Label File: ELS_YYYYDDDHH_U3.LBL

```
PDS_VERSION_ID                 = PDS3
DATA_SET_ID                    = "CO-E/J/S/SW-CAPS-2-UNCALIBRATED-V1.1"

STANDARD_DATA_PRODUCT_ID       = "ELS UNCALIBRATED"
PRODUCT_ID                     = "ELS_201001000_U3"
PRODUCT_TYPE                   = "DATA"
PRODUCT_CREATION_TIME          = 2010-141T20:48

RECORD_TYPE                    = FIXED_LENGTH
RECORD_BYTES                   = 40
FILE_RECORDS                   = 113664

START_TIME                     = 2010-010T00:08:07
STOP_TIME                      = 2010-010T06:05:59
SPACECRAFT_CLOCK_START_COUNT   = "1/1641775909.000"
SPACECRAFT_CLOCK_STOP_COUNT    = "1/1641797381.000"

INSTRUMENT_HOST_NAME           = "CASSINI ORBITER"
INSTRUMENT_HOST_ID             = "CO"
TARGET_NAME                    = {"SATURN"}
INSTRUMENT_NAME                = "CASSINI PLASMA SPECTROMETER"
INSTRUMENT_ID                  = "CAPS"
DESCRIPTION                    = "
    This file contains Cassini CAPS data from the ELS sensor
    acquired at SATURN between
    2010-010T00:08:07.000 and 2010-010T06:05:59.000 (orbit 124)."

MD5_CHECKSUM                   = "94d3f6a361ea4712658758b776aac2ca"
```

```
NOTE                    = "
    The end around carry checksum, with seed 0x55AA,
    of this file is 0x5A20"

^TABLE                  = "ELS_201001000_U3.DAT"
OBJECT                  = TABLE
  INTERCHANGE_FORMAT        = "BINARY"
  ROWS                  = 113664
  COLUMNS                   = 11
  ROW_BYTES                   = 40
  ^STRUCTURE                  = "ELS_U3.FMT"
  DESCRIPTION                 = "
    The file ELS_U3.FMT describes the column structure and content
    of the data file."
END_OBJECT                  = TABLE
END
```

IBS_U3.FMT File

```
 /* IBS_U3.FMT */
/* describes the structure of the IBS Data Table*/
OBJECT             = COLUMN
   NAME            = B_CYCLE_NUMBER
   DATA_TYPE        = MSB_UNSIGNED_INTEGER
   START_BYTE       = 1
   BYTES           = 2
   VALID_MINIMUM    = 1
   VALID_MAXIMUM     = 340
   MISSING_CONSTANT  = 65535
   DESCRIPTION       = "B cycle number from the start of the day,
                  a value of 65535 indicates no B-cycle data
                  is available"
END_OBJECT          = COLUMN

OBJECT             = COLUMN
   NAME            = A_CYCLE_NUMBER
   DATA_TYPE        = MSB_UNSIGNED_INTEGER
   START_BYTE       = 3
   BYTES           = 2
   VALID_MINIMUM    = 1
   VALID_MAXIMUM     = 2732
   MISSING_CONSTANT  = 65535
   DESCRIPTION       = "A cycle number from the start of day"
END_OBJECT          = COLUMN

OBJECT             = COLUMN
   NAME            = TIME
   DATA_TYPE        = IEEE_REAL
   START_BYTE       = 5
   BYTES           = 8
   UNIT            = SECOND
   VALID_MINIMUM    = -7.1x10^7
   VALID_MAXIMUM     = 1.5x10^9
   MISSING_CONSTANT  = 10x10^9
   DESCRIPTION       = "Start time of the A cycle, seconds from J2000
                  (barycentric dynamic time).  An A-cycle is the
                  32 second instrument collection cycle."
END_OBJECT          = COLUMN

OBJECT             = COLUMN
```

```
   NAME             = TELEMETRY_MODE
   DATA_TYPE        = MSB_UNSIGNED_INTEGER
   START_BYTE       = 13
   BYTES            = 1
   VALID_MINIMUM    = 1
   VALID_MAXIMUM    = 136
   MISSING_CONSTANT = 255
   DESCRIPTION      = "Logical telemetry rate and mode:
                  1   = 250 bps
                  2   = 500 bps
                  4   = 1 kbps
                  8   = 2 kbps
                  16  = 4 kbps
                  32  = 8 kbps
                  64  = 16 kbps
                  130 = 500 bps solar wind
                  132 = 1 kbps solar wind
                  136 = 2 kbps solar wind"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = IBS_MODE_SUBMODE
   DATA_TYPE        = MSB_UNSIGNED_INTEGER
   START_BYTE       = 14
   BYTES            = 1
   VALID_MINIMUM    = 0
   VALID_MAXIMUM    = 254
   MISSING_CONSTANT = 255
   DESCRIPTION      = "IBS mode and submode flag:
                  0 = Standard Sweep Collapse
                  1 = Standard Sweep Snapshot
                  2 = Solar Wind Search
                  3 = Solar Wind Track
                  4 = Magnetosphere Search
                  5 = Magnetosphere Survey
                  6 = Calibration Mode
                  7-254 = spare
                  255 = Fill"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = OFFSET_TIME
   DATA_TYPE        = MSB_UNSIGNED_INTEGER
   START_BYTE       = 15
   BYTES            = 4
   UNIT             = MILLISECOND
   VALID_MINIMUM    = 0
   VALID_MAXIMUM    = 256000
   MISSING_CONSTANT = 400000
   DESCRIPTION      = "Milliseconds from start of the IBS collection cycle.
                  An IBS data product is constructed from 16 to 128
                  azimuths of data, with each azimuth representing 2
                  seconds of instrument data collection."
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = FIRST_ENERGY_STEP
   DATA_TYPE        = MSB_UNSIGNED_INTEGER
   START_BYTE       = 19
   BYTES            = 2
   VALID_MINIMUM    = 1
   VALID_MAXIMUM    = 852
   MISSING_CONSTANT = 65535
   DESCRIPTION      = "Minimum energy step in collapsed data.
```

```
                  This is an index into the energy table."
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = LAST_ENERGY_STEP
   DATA_TYPE        = MSB_UNSIGNED_INTEGER
   START_BYTE       = 21
   BYTES            = 2
   VALID_MINIMUM    = 1
   VALID_MAXIMUM    = 852
   MISSING_CONSTANT = 65535
   DESCRIPTION      = "Maximum energy step in collapsed data
                  This is an index into the energy table."
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = FIRST_AZIMUTH_VALUE
   DATA_TYPE        = MSB_UNSIGNED_INTEGER
   START_BYTE       = 23
   BYTES            = 2
   VALID_MINIMUM    = 1
   VALID_MAXIMUM    = 128
   MISSING_CONSTANT = 65535
   DESCRIPTION      = "Minimum azimuth value in collapsed data"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = LAST_AZIMUTH_VALUE
   DATA_TYPE        = MSB_UNSIGNED_INTEGER
   START_BYTE       = 25
   BYTES            = 2
   VALID_MINIMUM    = 1
   VALID_MAXIMUM    = 128
   MISSING_CONSTANT = 65535
   DESCRIPTION      = "Maximum azimuth value in collapsed data"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = DATA
   DATA_TYPE        = MSB_UNSIGNED_INTEGER
   START_BYTE       = 27
   UNIT             = COUNTS
   ITEMS            = 3
   ITEM_BYTES       = 2
   BYTES            = 6
   VALID_MINIMUM    = 1
   VALID_MAXIMUM    = 65504
   MISSING_CONSTANT = 65535
   DESCRIPTION      = "Counts in fans 1 through 3"
END_OBJECT          = COLUMN
```

Sample IBS Label File: IBS_YYYYDDDHH_U3.LBL

```
PDS_VERSION_ID             = PDS3
DATA_SET_ID                = "CO-E/J/S/SW-CAPS-2-UNCALIBRATED-V1.1"

STANDARD_DATA_PRODUCT_ID   = "IBS UNCALIBRATED"
PRODUCT_ID                 = "IBS_201001000_U3"
PRODUCT_TYPE               = "DATA"
PRODUCT_CREATION_TIME      = 2010-141T20:48
```

```
RECORD_TYPE                  = FIXED_LENGTH
RECORD_BYTES                 = 32
FILE_RECORDS                 = 224145

START_TIME                   = 2010-010T00:08:07
STOP_TIME                    = 2010-010T05:57:59
SPACECRAFT_CLOCK_START_COUNT = "1/1641775909.000"
SPACECRAFT_CLOCK_STOP_COUNT  = "1/1641796901.000"

INSTRUMENT_HOST_NAME         = "CASSINI ORBITER"
INSTRUMENT_HOST_ID           = "CO"
TARGET_NAME                  = {"SATURN"}
INSTRUMENT_NAME              = "CASSINI PLASMA SPECTROMETER"
INSTRUMENT_ID                = "CAPS"
DESCRIPTION                  = "
   This file contains Cassini CAPS data from the IBS sensor
   acquired at SATURN between
   2010-010T00:08:07.000 and 2010-010T05:57:59.000 (orbit 124)."

MD5_CHECKSUM                 = "d009ac30bdfda29b1d361fd4937ea863"

NOTE                         = "
   The end around carry checksum, with seed 0x55AA,
   of this file is 0x2A46"

^TABLE                       = "IBS_201001000_U3.DAT"
OBJECT                       = TABLE
 INTERCHANGE_FORMAT          = "BINARY"
 ROWS                        = 224145
 COLUMNS                     = 11
 ROW_BYTES                   = 32
 ^STRUCTURE                  = "IBS_U3.FMT"
 DESCRIPTION                 = "
   The file IBS_U3.FMT describes the column structure and content
   of the data file."
END_OBJECT                   = TABLE
END
```

ION_U3.FMT File

```
 /* ION_U3.FMT */
 /* describes the structure of the IMS ION Data Table*/
 OBJECT             = COLUMN
   NAME             = B_CYCLE_NUMBER
   DATA_TYPE        = MSB_UNSIGNED_INTEGER
   START_BYTE       = 1
   BYTES            = 2
   VALID_MINIMUM    = 1
   VALID_MAXIMUM    = 340
   MISSING_CONSTANT = 65535
   DESCRIPTION      = "B cycle number from the start of the day,
                      a value of 65535 indicates no B-cycle data
                      is available"
 END_OBJECT         = COLUMN

 OBJECT             = COLUMN
```

```
   NAME            = A_CYCLE_NUMBER
   DATA_TYPE       = MSB_UNSIGNED_INTEGER
   START_BYTE      = 3
   BYTES           = 2
   VALID_MINIMUM   = 1
   VALID_MAXIMUM   = 2732
   MISSING_CONSTANT  = 65535
   DESCRIPTION     = "A cycle number from the start of day,
                   a value of 65535 indicates that no A-cycle
                   header information is available"
END_OBJECT         = COLUMN

OBJECT             = COLUMN
   NAME            = TIME
   DATA_TYPE       = IEEE_REAL
   START_BYTE      = 5
   BYTES           = 8
   UNIT            = SECOND
   VALID_MINIMUM   = -7.1x10^7
   VALID_MAXIMUM   = 1.5x10^9
   MISSING_CONSTANT  = 10x10^9
   DESCRIPTION     = "Start time of the A cycle, seconds from J2000
                  (barycentric dynamic time).  An A-cycle is the
                  32 second instrument collection cycle."
END_OBJECT         = COLUMN

OBJECT             = COLUMN
   NAME            = TELEMETRY_MODE
   DATA_TYPE       = MSB_UNSIGNED_INTEGER
   START_BYTE      = 13
   BYTES           = 1
   VALID_MINIMUM   = 1
   VALID_MAXIMUM   = 136
   MISSING_CONSTANT  = 255
   DESCRIPTION     = "Logical telemetry rate and mode:
   1   = 250 bps
                   2   = 500 bps
                   4   = 1 kbps
                   8   = 2 kbps
                   16  = 4 kbps
                   32  = 8 kbps
                   64  = 16 kbps
                   130 = 500 bps solar wind
                   132 = 1 kbps solar wind
                   136 = 2 kbps solar wind"
END_OBJECT         = COLUMN

OBJECT             = COLUMN
   NAME            = SPARE
   DATA_TYPE       = MSB_UNSIGNED_INTEGER
   START_BYTE      = 14
   BYTES           = 1
   VALID_MINIMUM   = 0
   VALID_MAXIMUM   = 0
   MISSING_CONSTANT  = 0
   DESCRIPTION     = "Will contains zeroes"
END_OBJECT         = COLUMN

OBJECT             = COLUMN
```

```
    NAME              = OFFSET_TIME
    DATA_TYPE         = MSB_UNSIGNED_INTEGER
    START_BYTE        = 15
    BYTES             = 2
    VALID_MINIMUM     = 0
    VALID_MAXIMUM     = 32000
    MISSING_CONSTANT  = 65535
    UNIT              = MILLISECOND
    DESCRIPTION       = "Milliseconds from start of A cycle"
  END_OBJECT          = COLUMN

  OBJECT              = COLUMN
    NAME              = FIRST_ENERGY_STEP
    DATA_TYPE         = MSB_UNSIGNED_INTEGER
    START_BYTE        = 17
    BYTES             = 2
    VALID_MINIMUM     = 1
    VALID_MAXIMUM     = 63
    MISSING_CONSTANT  = 65535
    DESCRIPTION       = "Minimum energy step in collapsed data"
  END_OBJECT          = COLUMN

  OBJECT              = COLUMN
    NAME              = LAST_ENERGY_STEP
    DATA_TYPE         = MSB_UNSIGNED_INTEGER
    START_BYTE        = 19
    BYTES             = 2
    VALID_MINIMUM     = 1
    VALID_MAXIMUM     = 63
    MISSING_CONSTANT  = 65535
    DESCRIPTION       = "Maximum energy step in collapsed data"
  END_OBJECT          = COLUMN

  OBJECT              = COLUMN
    NAME              = FIRST_AZIMUTH_VALUE
    DATA_TYPE         = MSB_UNSIGNED_INTEGER
    START_BYTE        = 21
    BYTES             = 2
    VALID_MINIMUM     = 1
    VALID_MAXIMUM     = 8
    MISSING_CONSTANT  = 65535
    DESCRIPTION       = "Minimum azimuth value in collapsed data"
  END_OBJECT          = COLUMN

  OBJECT              = COLUMN
    NAME              = LAST_AZIMUTH_VALUE
    DATA_TYPE         = MSB_UNSIGNED_INTEGER
    START_BYTE        = 23
    BYTES             = 2
    VALID_MINIMUM     = 1
    VALID_MAXIMUM     = 8
    MISSING_CONSTANT  = 65535
    DESCRIPTION       = "Maximum azimuth value in collapsed data"
  END_OBJECT          = COLUMN

  OBJECT              = COLUMN
    NAME              = SAM_ION_NUMBER
    DATA_TYPE         = MSB_UNSIGNED_INTEGER
    START_BYTE        = 25
```

```
    BYTES            = 2
    VALID_MINIMUM     = 0
    VALID_MAXIMUM     = 65535
    DESCRIPTION       = "SAM ion number (identifies ion and group
                 table)"
  END_OBJECT          = COLUMN

  OBJECT              = COLUMN
    NAME             = DATA
    DATA_TYPE         = MSB_INTEGER
    START_BYTE        = 27
    UNIT              = COUNTS
    ITEMS             = 8
    ITEM_BYTES        = 2
    BYTES             = 16
    VALID_MINIMUM     = -32
    VALID_MAXIMUM     = 27650
    MISSING_CONSTANT  = 28671
    DESCRIPTION       = "Counts in elevations 1 through 8 (signed
                 value)"
  END_OBJECT          = COLUMN
```

Sample IMS ION Label File: ION_YYYYDDDHH_U3.LBL

```
PDS_VERSION_ID              = PDS3
DATA_SET_ID                 = "CO-E/J/S/SW-CAPS-2-UNCALIBRATED-V1.1"

STANDARD_DATA_PRODUCT_ID    = "ION UNCALIBRATED"
PRODUCT_ID                  = "ION_201001000_U3"
PRODUCT_TYPE                = "DATA"
PRODUCT_CREATION_TIME       = 2010-141T20:49

RECORD_TYPE                 = FIXED_LENGTH
RECORD_BYTES                = 42
FILE_RECORDS                = 42336

START_TIME                  = 2010-010T00:08:07
STOP_TIME                   = 2010-010T06:05:59
SPACECRAFT_CLOCK_START_COUNT  = "1/1641775909.000"
SPACECRAFT_CLOCK_STOP_COUNT   = "1/1641797381.000"

INSTRUMENT_HOST_NAME        = "CASSINI ORBITER"
INSTRUMENT_HOST_ID          = "CO"
TARGET_NAME                 = {"SATURN"}
INSTRUMENT_NAME             = "CASSINI PLASMA SPECTROMETER"
INSTRUMENT_ID               = "CAPS"
DESCRIPTION                 = "
    This file contains Cassini CAPS Ion data from the IMS sensor
    acquired at SATURN between
    2010-010T00:08:07.000 and 2010-010T06:05:59.000 (orbit 124)."

MD5_CHECKSUM                = "c91403bfde0888687e420949f56e2a30"

NOTE                        = "
    The end around carry checksum, with seed 0x55AA,
    of this file is 0x7DAC"
```

```
^TABLE                    = "ION_201001000_U3.DAT"
OBJECT                    = TABLE
 INTERCHANGE_FORMAT          = "BINARY"
 ROWS                    = 42336
 COLUMNS                    = 12
 ROW_BYTES                    = 42
 ^STRUCTURE                   = "ION_U3.FMT"
 DESCRIPTION                  = "
   The file ION_U3.FMT describes the column structure and content
   of the data file."
END_OBJECT                  = TABLE
END
```

SNG_U3.FMT File

```
 /* SNG_U3.FMT */
 /* describes the structure of the IMS Singles (SNG) Data Table*/
 OBJECT              = COLUMN
   NAME            = B_CYCLE_NUMBER
   DATA_TYPE        = MSB_UNSIGNED_INTEGER
   START_BYTE       = 1
   BYTES           = 2
   VALID_MINIMUM     = 1
   VALID_MAXIMUM     = 340
   MISSING_CONSTANT  = 65535
   DESCRIPTION       = "B cycle number from the start of the day,
                    a value of 65535 indicates no B-cycle data
                    is available"
 END_OBJECT          = COLUMN

 OBJECT              = COLUMN
   NAME            = A_CYCLE_NUMBER
   DATA_TYPE        = MSB_UNSIGNED_INTEGER
   START_BYTE       = 3
   BYTES           = 2
   VALID_MINIMUM     = 1
   VALID_MAXIMUM     = 2732
   MISSING_CONSTANT  = 65535
   DESCRIPTION       = "A cycle number from the start of day,
                    a value of 65535 indicates that no A-cycle
                    header information is available"
 END_OBJECT          = COLUMN

 OBJECT              = COLUMN
   NAME            = TIME
   DATA_TYPE        = IEEE_REAL
   START_BYTE       = 5
   BYTES           = 8
   UNIT            = SECOND
   VALID_MINIMUM     = -7.1x10^7
   VALID_MAXIMUM     = 1.5x10^9
   MISSING_CONSTANT  = 10x10^9
   DESCRIPTION       = "Start time of the A cycle, seconds from J2000
                   (barycentric dynamic time).  An A-cycle is the
                   32 second instrument collection cycle."
```

```
END_OBJECT          = COLUMN

OBJECT             = COLUMN
  NAME            = TELEMETRY_MODE
  DATA_TYPE        = MSB_UNSIGNED_INTEGER
  START_BYTE       = 13
  BYTES           = 1
  VALID_MINIMUM    = 1
  VALID_MAXIMUM    = 136
  MISSING_CONSTANT  = 255
  DESCRIPTION      = "Logical telemetry rate and mode:
                 1   = 250 bps
                 2   = 500 bps
                 4   = 1 kbps
                 8   = 2 kbps
                 16  = 4 kbps
                 32  = 8 kbps
                 64  = 16 kbps
                 130 = 500 bps solar wind
                 132 = 1 kbps solar wind
                 136 = 2 kbps solar wind"
END_OBJECT          = COLUMN

OBJECT             = COLUMN
  NAME            = SPARE
  DATA_TYPE        = MSB_UNSIGNED_INTEGER
  START_BYTE       = 14
  BYTES           = 1
  VALID_MINIMUM    = 0
  VALID_MAXIMUM    = 0
  MISSING_CONSTANT  = 0
  DESCRIPTION      = "Contains zeroes"
END_OBJECT          = COLUMN

OBJECT             = COLUMN
  NAME            = OFFSET_TIME
  DATA_TYPE        = MSB_UNSIGNED_INTEGER
  START_BYTE       = 15
  BYTES           = 2
  UNIT            = MILLISECOND
  VALID_MINIMUM    = 1
  VALID_MAXIMUM    = 32000
  MISSING_CONSTANT  = 65535
  DESCRIPTION      = "Milliseconds from start of A cycle"
END_OBJECT          = COLUMN

OBJECT             = COLUMN
  NAME            = FIRST_ENERGY_STEP
  DATA_TYPE        = MSB_UNSIGNED_INTEGER
  START_BYTE       = 17
  BYTES           = 2
  VALID_MINIMUM    = 1
  VALID_MAXIMUM    = 63
  MISSING_CONSTANT  = 65535
  DESCRIPTION      = "Minimum energy step in collapsed data"
END_OBJECT          = COLUMN

OBJECT             = COLUMN
  NAME            = LAST_ENERGY_STEP
```

```
    DATA_TYPE         = MSB_UNSIGNED_INTEGER
    START_BYTE        = 19
    BYTES             = 2
    VALID_MINIMUM     = 1
    VALID_MAXIMUM     = 63
    MISSING_CONSTANT  = 65535
    DESCRIPTION       = "Maximum energy step in collapsed data"
  END_OBJECT          = COLUMN

  OBJECT              = COLUMN
    NAME              = FIRST_AZIMUTH_VALUE
    DATA_TYPE         = MSB_UNSIGNED_INTEGER
    START_BYTE        = 21
    BYTES             = 2
    VALID_MINIMUM     = 1
    VALID_MAXIMUM     = 8
    MISSING_CONSTANT  = 65535
    DESCRIPTION       = "Minimum azimuth value in collapsed data"
  END_OBJECT          = COLUMN

  OBJECT              = COLUMN
    NAME              = LAST_AZIMUTH_VALUE
    DATA_TYPE         = MSB_UNSIGNED_INTEGER
    START_BYTE        = 23
    BYTES             = 2
    VALID_MINIMUM     = 1
    VALID_MAXIMUM     = 8
    MISSING_CONSTANT  = 65535
    DESCRIPTION       = "Maximum azimuth value in collapsed data"
  END_OBJECT          = COLUMN

  OBJECT              = COLUMN
    NAME              = DATA
    DATA_TYPE         = MSB_UNSIGNED_INTEGER
    START_BYTE        = 25
    UNIT              = COUNTS
    ITEMS             = 8
    ITEM_BYTES        = 2
    BYTES             = 16
    MISSING_CONSTANT  = 65535
    VALID_MINIMUM     = 0
    VALID_MAXIMUM     = 27500
    DESCRIPTION       = "Counts in elevations 1 through 8"
  END_OBJECT          = COLUMN
```

Sample IMS Singles (SNG) Label File: SNG_YYYYDDDHH_U3.LBL

```
PDS_VERSION_ID              = PDS3
DATA_SET_ID                 = "CO-E/J/S/SW-CAPS-2-UNCALIBRATED-V1.1"

STANDARD_DATA_PRODUCT_ID    = "SNG UNCALIBRATED"
PRODUCT_ID                  = "SNG_201001000_U3"
PRODUCT_TYPE                = "DATA"
PRODUCT_CREATION_TIME       = 2010-141T20:49

RECORD_TYPE                 = FIXED_LENGTH
RECORD_BYTES                = 40
FILE_RECORDS                = 42273

START_TIME                  = 2010-010T00:08:07
STOP_TIME                   = 2010-010T06:05:59
SPACECRAFT_CLOCK_START_COUNT  = "1/1641775909.000"
SPACECRAFT_CLOCK_STOP_COUNT   = "1/1641797381.000"

INSTRUMENT_HOST_NAME        = "CASSINI ORBITER"
INSTRUMENT_HOST_ID          = "CO"
TARGET_NAME                 = {"SATURN"}
INSTRUMENT_NAME             = "CASSINI PLASMA SPECTROMETER"
INSTRUMENT_ID               = "CAPS"
DESCRIPTION                 = "
    This file contains Cassini CAPS Singles data from the IMS sensor
    acquired at SATURN between
    2010-010T00:08:07.000 and 2010-010T06:05:59.000 (orbit 124)."

MD5_CHECKSUM                = "df02aa1879e3237b51ef412f960d05b5"

NOTE                        = "
    The end around carry checksum, with seed 0x55AA,
    of this file is 0xA5FA"

^TABLE                      = "SNG_201001000_U3.DAT"
OBJECT                      = TABLE
  INTERCHANGE_FORMAT        = "BINARY"
  ROWS                      = 42273
  COLUMNS                   = 11
  ROW_BYTES                 = 40
  ^STRUCTURE                = "SNG_U3.FMT"
  DESCRIPTION               = "
    The file SNG_U3.FMT describes the column structure and content
    of the data file."
END_OBJECT                  = TABLE
END
```

LOG_U3.FMT File

```
  /* LOG_U3.FMT */
/* describes the structure of the IMS Logicals (LOG) Data Table*/
OBJECT              = COLUMN
   NAME             = B_CYCLE_NUMBER
   DATA_TYPE        = MSB_UNSIGNED_INTEGER
   START_BYTE       = 1
   BYTES            = 2
   VALID_MINIMUM    = 1
   VALID_MAXIMUM    = 340
   MISSING_CONSTANT = 65535
   DESCRIPTION      = "B cycle number from the start of the day,
                    a value of 65535 indicates no B-cycle data
                    is available"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = A_CYCLE_NUMBER
   DATA_TYPE        = MSB_UNSIGNED_INTEGER
   START_BYTE       = 3
   BYTES            = 2
   VALID_MINIMUM    = 1
   VALID_MAXIMUM    = 2732
   MISSING_CONSTANT = 65535
   DESCRIPTION      = "A cycle number from the start of day,
                    a value of 65535 indicates that no A-cycle
                    header information is available"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = TIME
   DATA_TYPE        = IEEE_REAL
   START_BYTE       = 5
   BYTES            = 8
   UNIT             = SECOND
   VALID_MINIMUM    = -7.1x10^7
   VALID_MAXIMUM    = 1.5x10^9
   MISSING_CONSTANT = 10x10^9
   DESCRIPTION      = "Start time of the A cycle, seconds from J2000
                  (barycentric dynamic time).  An A-cycle is the
                  32 second instrument collection cycle."
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = TELEMETRY_MODE
   DATA_TYPE        = MSB_UNSIGNED_INTEGER
   START_BYTE       = 13
   BYTES            = 1
   VALID_MINIMUM    = 1
   VALID_MAXIMUM    = 136
   MISSING_CONSTANT = 255
   DESCRIPTION      = "Logical telemetry rate and mode:
                    1   = 250 bps
                    2   = 500 bps
                    4   = 1 kbps
                    8   = 2 kbps
                    16  = 4 kbps
                    32  = 8 kbps
```

```
                    64  = 16 kbps
                    130 = 500 bps solar wind
                    132 = 1 kbps solar wind
                    136 = 2 kbps solar wind"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = TDC_LOG_SELECTION
  DATA_TYPE         = MSB_UNSIGNED_INTEGER
  START_BYTE        = 14
  BYTES             = 1
  VALID_MINIMUM     = 0
  VALID_MAXIMUM     = 3
  MISSING_CONSTANT  = 255
  DESCRIPTION       = "TDC selectable logical definition, where
                    Value:  Logical 13:          Logical 14:
                     0     Start CFD singles     Stop CFD Singles
                     1     Acquisition Errors    Deadtimes
                     2     Single TOF events     Double TOF events
                     3     Data strobes          Resets"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = OFFSET_TIME
  DATA_TYPE         = MSB_UNSIGNED_INTEGER
  START_BYTE        = 15
  BYTES             = 2
  VALID_MINIMUM     = 1
  VALID_MAXIMUM     = 32000
  MISSING_CONSTANT  = 65535
  UNIT              = MILLISECOND
  DESCRIPTION       = "Milliseconds from start of A cycle"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = FIRST_ENERGY_STEP
  DATA_TYPE         = MSB_UNSIGNED_INTEGER
  START_BYTE        = 17
  BYTES             = 2
  VALID_MINIMUM     = 1
  VALID_MAXIMUM     = 63
  MISSING_CONSTANT  = 65535
  DESCRIPTION       = "Minimum energy step in collapsed data"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = LAST_ENERGY_STEP
  DATA_TYPE         = MSB_UNSIGNED_INTEGER
  START_BYTE        = 19
  BYTES             = 2
  VALID_MINIMUM     = 1
  VALID_MAXIMUM     = 63
  MISSING_CONSTANT  = 65535
  DESCRIPTION       = "Maximum energy step in collapsed data"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = FIRST_AZIMUTH_VALUE
  DATA_TYPE         = MSB_UNSIGNED_INTEGER
```

```
    START_BYTE       = 21
    BYTES            = 2
    VALID_MINIMUM    = 1
    VALID_MAXIMUM    = 8
    MISSING_CONSTANT  = 65535
    DESCRIPTION      = "Minimum azimuth value in collapsed data"
  END_OBJECT         = COLUMN

  OBJECT             = COLUMN
    NAME             = LAST_AZIMUTH_VALUE
    DATA_TYPE        = MSB_UNSIGNED_INTEGER
    START_BYTE       = 23
    BYTES            = 2
    VALID_MINIMUM    = 1
    VALID_MAXIMUM    = 8
    MISSING_CONSTANT  = 65535
    DESCRIPTION      = "Maximum azimuth value in collapsed data"
  END_OBJECT         = COLUMN

  OBJECT             = COLUMN
    NAME             = LEF_STOPS
    DATA_TYPE        = MSB_UNSIGNED_INTEGER
    START_BYTE       = 25
    UNIT             = COUNTS
    BYTES            = 2
    MISSING_CONSTANT  = 65535
    VALID_MINIMUM    = 0
    VALID_MAXIMUM    = 27500
    DESCRIPTION      = "LEF stop counts"
  END_OBJECT         = COLUMN

  OBJECT             = COLUMN
    NAME             = ST_STOPS
    DATA_TYPE        = MSB_UNSIGNED_INTEGER
    START_BYTE       = 27
    UNIT             = COUNTS
    BYTES            = 2
    MISSING_CONSTANT  = 65535
    VALID_MINIMUM    = 0
    VALID_MAXIMUM    = 27500
    DESCRIPTION      = "ST stop counts"
  END_OBJECT         = COLUMN

  OBJECT             = COLUMN
    NAME             = TIMEOUTS
    DATA_TYPE        = MSB_UNSIGNED_INTEGER
    START_BYTE       = 29
    UNIT             = COUNTS
    BYTES            = 2
    MISSING_CONSTANT  = 65535
    VALID_MINIMUM    = 0
    VALID_MAXIMUM    = 27500
    DESCRIPTION      = "Timeout events"
  END_OBJECT         = COLUMN

  OBJECT             = COLUMN
    NAME             = TOTAL_EVENTS
    DATA_TYPE        = MSB_UNSIGNED_INTEGER
    START_BYTE       = 31
```

```
    UNIT              = COUNTS
    BYTES             = 2
    MISSING_CONSTANT  = 65535
    VALID_MINIMUM     = 0
    VALID_MAXIMUM     = 27500
    DESCRIPTION       = "Total events (generated by SAM for dead time)"
  END_OBJECT          = COLUMN

  OBJECT              = COLUMN
    NAME              = LOGICAL_13
    DATA_TYPE         = MSB_UNSIGNED_INTEGER
    START_BYTE        = 33
    UNIT              = COUNTS
    BYTES             = 2
    MISSING_CONSTANT  = 65535
    VALID_MINIMUM     = 0
    VALID_MAXIMUM     = 27500
    DESCRIPTION       = "TDC selectable logical 13, see variable,
                  TDC_LOG_SELECTION to determine which logical
                  is represented in the data."
  END_OBJECT          = COLUMN

  OBJECT              = COLUMN
    NAME              = LOGICAL_14
    DATA_TYPE         = MSB_UNSIGNED_INTEGER
    START_BYTE        = 35
    UNIT              = COUNTS
    BYTES             = 2
    MISSING_CONSTANT  = 65535
    VALID_MINIMUM     = 0
    VALID_MAXIMUM     = 27500
    DESCRIPTION       = "TDC selectable logical 14, see variable,
                  TDC_LOG_SELECTION to determine which logical
                  is represented in the data."
  END_OBJECT          = COLUMN
```

Sample IMS Logicals (LOG) Label File: LOG_YYYYDDDHH_U3.LBL

```
PDS_VERSION_ID                = PDS3
DATA_SET_ID                   = "CO-E/J/S/SW-CAPS-2-UNCALIBRATED-V1.1"

STANDARD_DATA_PRODUCT_ID      = "LOG UNCALIBRATED"
PRODUCT_ID                    = "LOG_201001000_U3"
PRODUCT_TYPE                  = "DATA"
PRODUCT_CREATION_TIME         = 2010-141T20:49

RECORD_TYPE                   = FIXED_LENGTH
RECORD_BYTES                  = 36
FILE_RECORDS                  = 141057

START_TIME                    = 2010-010T00:08:07
STOP_TIME                     = 2010-010T06:05:59
SPACECRAFT_CLOCK_START_COUNT  = "1/1641775909.000"
SPACECRAFT_CLOCK_STOP_COUNT   = "1/1641797381.000"

INSTRUMENT_HOST_NAME          = "CASSINI ORBITER"
```

```
INSTRUMENT_HOST_ID          = "CO"
TARGET_NAME                 = {"SATURN"}
INSTRUMENT_NAME             = "CASSINI PLASMA SPECTROMETER"
INSTRUMENT_ID               = "CAPS"
DESCRIPTION                 = "
    This file contains Cassini CAPS Logicals data from the IMS sensor
    acquired at SATURN between
    2010-010T00:08:07.000 and 2010-010T06:05:59.000 (orbit 124)."

MD5_CHECKSUM                = "c5074119ad07eb2d59c77daf3e1681c8"

NOTE                        = "
    The end around carry checksum, with seed 0x55AA,
    of this file is 0x0571"

^TABLE                      = "LOG_201001000_U3.DAT"
OBJECT                      = TABLE
  INTERCHANGE_FORMAT          = "BINARY"
  ROWS                        = 141057
  COLUMNS                     = 16
  ROW_BYTES                   = 36
  ^STRUCTURE                  = "LOG_U3.FMT"
  DESCRIPTION                 = "
    The file LOG_U3.FMT describes the column structure and content
    of the data file."
END_OBJECT                  = TABLE
END
```

TOF_U3.FMT File

```
  /* TOF_U3.FMT */
  /* describes the structure of the IMS TOF Data Table*/
  OBJECT              = COLUMN
    NAME              = B_CYCLE_NUMBER
    DATA_TYPE         = MSB_UNSIGNED_INTEGER
    START_BYTE        = 1
    BYTES             = 2
    VALID_MINIMUM     = 1
    VALID_MAXIMUM     = 340
    MISSING_CONSTANT  = 65535
    DESCRIPTION       = "B cycle number from the start of the day,
                        a value of 65535 indicates that there is
                        a problem with archive generation"
  END_OBJECT          = COLUMN

  OBJECT              = COLUMN
    NAME              = TIME
    DATA_TYPE         = IEEE_REAL
    START_BYTE        = 3
    BYTES             = 8
    VALID_MINIMUM     = -7.1x10^7
    VALID_MAXIMUM     = 1.5x10^9
    MISSING_CONSTANT  = 10x10^9
    UNIT              = SECOND
    DESCRIPTION       = "Start time of the B cycle, seconds from J2000
                        (barycentric dynamic time).  A B-cycle is the
```

```
                    collection cycle of the Time of Flight data.
                    The duration of the collection cycle is dependant
                    upon the flight software version.  A collection
                    is 256 seconds, 512 seconds, or 1024 seconds.
                    During each 32 second instrument cycle, data is
                    transmitted and then recombined on the ground.
                    For more information, please see the
                    CO_CAPS_UNCALIBRATED_DS.CAT in the CATALOG
                    directory."
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = TELEMETRY_MODE
   DATA_TYPE        = MSB_UNSIGNED_INTEGER
   START_BYTE       = 11
   BYTES            = 1
   VALID_MINIMUM    = 1
   VALID_MAXIMUM    = 136
   MISSING_CONSTANT = 255
   DESCRIPTION      = "Logical telemetry rate and mode:
                    Telemetry mode when data was downlinked.  Gives
                    information regarding how data is currently
                    collapsed.
                    1   = 250 bps
                    2   = 500 bps
                    4   = 1 kbps
                    8   = 2 kbps
                    16  = 4 kbps
                    32  = 8 kbps
                    64  = 16 kbps
                    130 = 500 bps solar wind
                    132 = 1 kbps solar wind
                    136 = 2 kbps solar wind"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = COLLAPSE_FLAG
   DATA_TYPE        = MSB_UNSIGNED_INTEGER
   START_BYTE       = 12
   BYTES            = 1
   VALID_MINIMUM    = 0
   VALID_MAXIMUM    = 1
   MISSING_CONSTANT = 255
   DESCRIPTION      = "Flag indicating collapse in TOF:
                    0: average, 256s Bcycle duration
                    1: sum, 256s Bcycle duration
                    2: average, 512s Bcycle duration
                    3: sum, 512s Bcycle duration
                    4: average, 1024s Bcycle duration
                    5: sum, 1024s Bcycle duration"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = ST_START_CHANNEL
   DATA_TYPE        = MSB_UNSIGNED_INTEGER
   START_BYTE       = 13
   BYTES            = 2
   VALID_MINIMUM    = 0
   VALID_MAXIMUM    = 1535
```

```
    MISSING_CONSTANT  = 2047
    DESCRIPTION       = "Start ST TOF Channel.  NOTE:  There are a total
                    of 2048 channels in flight."
  END_OBJECT          = COLUMN

  OBJECT             = COLUMN
    NAME             = ST_INTERVAL
    DATA_TYPE        = MSB_UNSIGNED_INTEGER
    START_BYTE       = 15
    BYTES            = 1
    VALID_MINIMUM    = 1
    VALID_MAXIMUM    = 4
    MISSING_CONSTANT  = 0
    DESCRIPTION       = "ST TOF bin interval:
                     0 = FILL value implying housekeping information
                       is unavailable.  Check previous of following
                       Bcycle for this information.
                     1 = every word taken starting at the
                       ST_START_CHANNEL
                     2 = every other word is taken starting at the
                       ST_START_CHANNEL
                     4 = every 4th word is taken starting at the
                       ST_START_CHANNEL"
  END_OBJECT          = COLUMN

  OBJECT             = COLUMN
    NAME             = ST_ENERGY_COLLAPSE
    DATA_TYPE        = MSB_UNSIGNED_INTEGER
    START_BYTE       = 16
    BYTES            = 1
    VALID_MINIMUM    = 0
    VALID_MAXIMUM    = 3
    MISSING_CONSTANT  = 255
    DESCRIPTION       = "ST energy collapse option:
                    0 = sum adjacent energies
                    1 = take even energies
                    2 = take odd energies
                    3 = TBA (to be assigned)"
  END_OBJECT          = COLUMN

  OBJECT             = COLUMN
    NAME             = LEF_START_CHANNEL
    DATA_TYPE        = MSB_UNSIGNED_INTEGER
    START_BYTE       = 17
    BYTES            = 2
    VALID_MINIMUM    = 1
    VALID_MAXIMUM    = 1535
    MISSING_CONSTANT  = 2047
    DESCRIPTION       = "Start LEF TOF Channel.  NOTE:  There are a total
                    of 2048 channels in flight."
  END_OBJECT          = COLUMN

  OBJECT             = COLUMN
    NAME             = LEF_INTERVAL
    DATA_TYPE        = MSB_UNSIGNED_INTEGER
    START_BYTE       = 19
    BYTES            = 1
    VALID_MINIMUM    = 1
    VALID_MAXIMUM    = 4
```

```
    MISSING_CONSTANT  = 0
    DESCRIPTION       = "LEF TOF bin interval:
                       0 = FILL value implying housekeping information
                         is unavailable.  Check previous of following
                         Bcycle for this information.
                       1 = every word taken starting at the
                         LEF_START_CHANNEL
                       2 = every other word is taken starting at the
                         LEF_START_CHANNEL
                       4 = every 4th word is taken starting at the
                         LEF_START_CHANNEL"
  END_OBJECT          = COLUMN

  OBJECT              = COLUMN
    NAME              = LEF_ENERGY_COLLAPSE
    DATA_TYPE         = MSB_UNSIGNED_INTEGER
    START_BYTE        = 20
    BYTES             = 1
    VALID_MINIMUM     = 0
    VALID_MAXIMUM     = 3
    MISSING_CONSTANT  = 255
    DESCRIPTION       = "LEF energy collapse option:
                      0 = sum adjacent energies
                      1 = take even energies
                      2 = take odd energies
                      3 = TBA (to be assigned)"
  END_OBJECT          = COLUMN

  OBJECT              = COLUMN
    NAME              = ENERGY_STEP
    DATA_TYPE         = MSB_UNSIGNED_INTEGER
    START_BYTE        = 21
    BYTES             = 2
    VALID_MINIMUM     = 1
    VALID_MAXIMUM     = 32
    MISSING_CONSTANT  = 65535
    DESCRIPTION       = "Energy step in collapsed data"
  END_OBJECT          = COLUMN

  OBJECT              = COLUMN
    NAME              = DATA_ST
    DATA_TYPE         = MSB_UNSIGNED_INTEGER
    START_BYTE        = 23
    ITEMS             = 512
    ITEM_BYTES        = 4
    BYTES             = 2048
    VALID_MINIMUM     = 0
    VALID_MAXIMUM     = 3268027
    MISSING_CONSTANT  = 4294967295
    UNIT              = COUNTS
    DESCRIPTION       = "Counts in ST TOF bins 1 through 512"
  END_OBJECT          = COLUMN

  OBJECT              = COLUMN
    NAME              = DATA_LEF
    DATA_TYPE         = MSB_UNSIGNED_INTEGER
    START_BYTE        = 2071
    ITEMS             = 512
    ITEM_BYTES        = 4
```

```
    BYTES            = 2048
    VALID_MINIMUM     = 0
    VALID_MAXIMUM     = 3268027
    MISSING_CONSTANT  = 4294967295
    UNIT             = COUNTS
    DESCRIPTION      = "Counts in LEF TOF bins 1 through 512"
  END_OBJECT          = COLUMN
```

Sample IMS TOF Label File: TOF_YYYYDDDHH_U3.LBL

```
 PDS_VERSION_ID              = PDS3
DATA_SET_ID                 = "CO-E/J/S/SW-CAPS-2-UNCALIBRATED-V1.1"

STANDARD_DATA_PRODUCT_ID     = "TOF UNCALIBRATED"
PRODUCT_ID                  = "TOF_201001000_U3"
PRODUCT_TYPE                = "DATA"
PRODUCT_CREATION_TIME        = 2010-141T20:49

RECORD_TYPE                 = FIXED_LENGTH
RECORD_BYTES                = 4118
FILE_RECORDS                = 448

START_TIME                  = 2010-010T00:25:10
STOP_TIME                   = 2010-010T05:57:58
SPACECRAFT_CLOCK_START_COUNT  = "1/1641776932.000"
SPACECRAFT_CLOCK_STOP_COUNT   = "1/1641796900.000"

INSTRUMENT_HOST_NAME         = "CASSINI ORBITER"
INSTRUMENT_HOST_ID           = "CO"
TARGET_NAME                 = {"SATURN"}
INSTRUMENT_NAME             = "CASSINI PLASMA SPECTROMETER"
INSTRUMENT_ID               = "CAPS"
DESCRIPTION                 = "
    This file contains Cassini CAPS Time of Flight data from the IMS sensor
    acquired at SATURN between
    2010-010T00:25:10.000 and 2010-010T05:57:58.000 (orbit 124)."

MD5_CHECKSUM                = "d4016b866ca45e497c893392fe6261c8"

NOTE                        = "
    The end around carry checksum, with seed 0x55AA,
    of this file is 0xEE70"

^TABLE                      = "TOF_201001000_U3.DAT"
OBJECT                      = TABLE
 INTERCHANGE_FORMAT          = "BINARY"
 ROWS                       = 448
 COLUMNS                    = 13
 ROW_BYTES                  = 4118
 ^STRUCTURE                 = "TOF_U3.FMT"
 DESCRIPTION                = "
    The file TOF_U3.FMT describes the column structure and content
    of the data file."
END_OBJECT                  = TABLE
END
```

ACT_3.FMT File

```
 /* ACT_3.FMT */
/* describes the structure of the Actuator Data Table*/
OBJECT              = COLUMN
   NAME             = B_CYCLE_NUMBER
   DATA_TYPE        = MSB_UNSIGNED_INTEGER
   START_BYTE       = 1
   BYTES            = 2
   VALID_MINIMUM    = 1
   VALID_MAXIMUM    = 340
   MISSING_CONSTANT = 65535
   DESCRIPTION      = "B cycle number from the start of the day,
                    a value of 65535 indicates no B-cycle data
                    is available"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = A_CYCLE_NUMBER
   DATA_TYPE        = MSB_UNSIGNED_INTEGER
   START_BYTE       = 3
   BYTES            = 2
   VALID_MINIMUM    = 1
   VALID_MAXIMUM    = 2372
   MISSING_CONSTANT = 65535
   DESCRIPTION      = "A cycle number from the start of day"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = TIME
   DATA_TYPE        = IEEE_REAL
   START_BYTE       = 5
   BYTES            = 8
   VALID_MINIMUM    = -7.1x10^7
   VALID_MAXIMUM    = 1.5x10^9
   MISSING_CONSTANT = 10x10^9
   UNIT             = SECOND
   DESCRIPTION      = "Start time of the A cycle, seconds from J2000
                    (barycentric dynamic time).  An A-cycle is the
                    32 second instrument collection cycle"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = DATA
   DATA_TYPE        = IEEE_REAL
   START_BYTE       = 13
   UNIT             = ANGLE
   ITEMS            = 32
   ITEM_BYTES       = 4
   BYTES            = 128
   MISSING_CONSTANT = -999
   VALID_MINIMUM    = -115
   VALID_MAXIMUM    = 115
   DESCRIPTION      = "Actuator angle at start + (item #) seconds,
     where item # is between 0 and 31.
                    TIME"
END_OBJECT          = COLUMN
```

Sample Actuator (ACT) Label File: ACT_YYYYDDDHH_3.LBL

```
PDS_VERSION_ID              = PDS3
DATA_SET_ID                 = {"CO-E/J/S/SW-CAPS-2-UNCALIBRATED-V1.1",
                  "CO-E/J/S/SW-CAPS-3-CALIBRATED-V1.1"}
STANDARD_DATA_PRODUCT_ID    = "ACT"
PRODUCT_ID                  = "ACT_201001000_3"
PRODUCT_TYPE                = "DATA"
PRODUCT_CREATION_TIME       = 2010-141T20:48

RECORD_TYPE                 = FIXED_LENGTH
RECORD_BYTES                = 140
FILE_RECORDS                = 671

START_TIME                  = 2010-010T00:08:07
STOP_TIME                   = 2010-010T06:05:59
SPACECRAFT_CLOCK_START_COUNT  = "1/1641775909.000"
SPACECRAFT_CLOCK_STOP_COUNT   = "1/1641797381.000"

INSTRUMENT_HOST_NAME        = "CASSINI ORBITER"
INSTRUMENT_HOST_ID          = "CO"
TARGET_NAME                 = {"SATURN"}
INSTRUMENT_NAME             = "CASSINI PLASMA SPECTROMETER"
INSTRUMENT_ID               = "CAPS"
DESCRIPTION                 = "
   This file contains Cassini CAPS actuator data
   acquired at SATURN between
   2010-010T00:08:07.000 and 2010-010T06:05:59.000 (orbit 124)."

MD5_CHECKSUM                = "b0d1329c7a43c48fd3b1fb32ff411264"

NOTE                        = "
   The end around carry checksum, with seed 0x55AA,
   of this file is 0x2E7E"

^TABLE                      = "ACT_201001000_3.DAT"
OBJECT                      = TABLE
 INTERCHANGE_FORMAT         = "BINARY"
 ROWS                       = 671
 COLUMNS                    = 4
 ROW_BYTES                  = 140
 ^STRUCTURE                 = "ACT_3.FMT"
 DESCRIPTION                = "
   The file ACT_3.FMT describes the column structure and content
   of the data file."
END_OBJECT                  = TABLE
END
```

EVN_U3.FMT File

```
/* EVN_U3.FMT */
/* describes the structure of the Event Mode Data Table*/
OBJECT              = COLUMN
   NAME             = B_CYCLE_NUMBER
   DATA_TYPE        = MSB_UNSIGNED_INTEGER
   FORMAT           = I2
   START_BYTE       = 1
   BYTES            = 2
   VALID_MINIMUM    = 1
   VALID_MAXIMUM    = 340
   MISSING_CONSTANT = 65535
   DESCRIPTION      = "B cycle number from the start of the day,
                    a value of 65535 indicates no B-cycle data
                    is available"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = A_CYCLE_NUMBER
   DATA_TYPE        = MSB_UNSIGNED_INTEGER
   FORMAT           = I2
   START_BYTE       = 3
   BYTES            = 2
   VALID_MINIMUM    = 1
   VALID_MAXIMUM    = 2732
   MISSING_CONSTANT = 65535
   DESCRIPTION      = "A cycle number from the start of day,
                    a value of 65535 indicates that no A-cycle
                    header information is available"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = TIME
   DATA_TYPE        = IEEE_REAL
   FORMAT           = F8
   START_BYTE       = 5
   BYTES            = 8
   VALID_MINIMUM    = -7.1x10^7
   VALID_MAXIMUM    = 1.5x10^9
   MISSING_CONSTANT = 10x10^9
   UNIT             = SECOND
   DESCRIPTION      = "Start time of the A cycle, seconds from J2000
                    (barycentric dynamic time).  An A-cycle is the
                    32 second instrument collection cycle."
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = OFFSET_TIME
   DATA_TYPE        = MSB_UNSIGNED_INTEGER
   FORMAT           = I2
   START_BYTE       = 13
   BYTES            = 2
   VALID_MINIMUM    = 0
   VALID_MAXIMUM    = 32000
   MISSING_CONSTANT = 65535
   UNIT             = MILLISECOND
```

```
   DESCRIPTION       = "Milliseconds from start of A cycle"
END_OBJECT           = COLUMN

OBJECT               = COLUMN
   NAME              = ENERGY_STEP
   DATA_TYPE         = MSB_UNSIGNED_INTEGER
   FORMAT            = I2
   START_BYTE        = 15
   BYTES             = 2
   VALID_MINIMUM     = 1
   VALID_MAXIMUM     = 63
   MISSING_CONSTANT  = 65535
   DESCRIPTION       = "Energy step"
END_OBJECT           = COLUMN

OBJECT               = COLUMN
   NAME              = AZIMUTH_VALUE
   DATA_TYPE         = MSB_UNSIGNED_INTEGER
   FORMAT            = I2
   START_BYTE        = 17
   BYTES             = 2
   VALID_MINIMUM     = 1
   VALID_MAXIMUM     = 1
   MISSING_CONSTANT  = 1
   DESCRIPTION       = "Azimuth value (always 1)"
END_OBJECT           = COLUMN

OBJECT               = COLUMN
   NAME              = ELEVATION
   DATA_TYPE         = MSB_UNSIGNED_INTEGER
   FORMAT            = I1
   START_BYTE        = 19
   BYTES             = 1
   VALID_MINIMUM     = 1
   VALID_MAXIMUM     = 8
   MISSING_CONSTANT  = 255
   DESCRIPTION       = "Elevation"
END_OBJECT           = COLUMN

OBJECT               = COLUMN
   NAME              = TOF_TYPE
   DATA_TYPE         = MSB_UNSIGNED_INTEGER
   FORMAT            = I1
   START_BYTE        = 20
   VALID_MINIMUM     = 0
   VALID_MAXIMUM     = 254
   MISSING_CONSTANT  = 255
   BYTES             = 1
   DESCRIPTION       = "ST/LEF and single/dual event flag
                 0 = ST, first or single event
                 1 = LEF, first or single event
                 2 = ST, second event of a dual event
                 3 = LEF, second event of a dual event
                 4 - 255 = spare"
END_OBJECT           = COLUMN

OBJECT               = COLUMN
   NAME              = TOF
   DATA_TYPE         = MSB_UNSIGNED_INTEGER
```

```
   FORMAT           = I2
   START_BYTE       = 21
   BYTES            = 2
   VALID_MINIMUM    = 1
   VALID_MAXIMUM    = 2048
   MISSING_CONSTANT  = 65535
   DESCRIPTION      = "Event's Time of Flight Data.
                     The particle's TOF channel."
END_OBJECT          = COLUMN
```

Sample EVN Label File: EVN_YYYYDDDHH_U3.LBL

NOT AVAILABLE YET, AS NO FILES EXIST

ANC_U3.FMT File

```
 /* ANC_U3.FMT */
/* describes the structure of the Ancillary Data Table*/
OBJECT              = COLUMN
   NAME             = B_CYCLE_NUMBER
   DATA_TYPE        = MSB_UNSIGNED_INTEGER
   START_BYTE       = 1
   BYTES            = 2
   VALID_MINIMUM    = 1
   VALID_MAXIMUM    = 340
   MISSING_CONSTANT  = 65535
   DESCRIPTION      = "B cycle number from the start of the day,
                     a value of 65535 indicates no B-cycle data
                     is available"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = A_CYCLE_NUMBER
   DATA_TYPE        = MSB_UNSIGNED_INTEGER
   START_BYTE       = 3
   BYTES            = 2
   VALID_MINIMUM    = 1
   VALID_MAXIMUM    = 2732
   MISSING_CONSTANT  = 65535
   DESCRIPTION      = "A cycle number from the start of day"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = TIME
   DATA_TYPE        = IEEE_REAL
   START_BYTE       = 5
   BYTES            = 8
   VALID_MINIMUM    = -7.1x10^7
   VALID_MAXIMUM    = 1.5x10^9
   MISSING_CONSTANT  = 10x10^9
   UNIT             = SECOND
   DESCRIPTION      = "Start time of the A cycle, seconds from J2000
                     (barycentric dynamic time).  An A-cycle is the
                     32 second instrument collection cycle."
```

```
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = TIME_SCLK
   DATA_TYPE        = MSB_UNSIGNED_INTEGER
   START_BYTE       = 13
   BYTES            = 4
   VALID_MINIMUM    = 0
   VALID_MAXIMUM    = 3.0x10^9
   MISSING_CONSTANT = 10x10^9
   UNIT             = SECOND
   DESCRIPTION      = "Start time of the A cycle, spacecraft clock"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = SC_SATURN_POS_X
   DATA_TYPE        = IEEE_REAL
   START_BYTE       = 17
   BYTES            = 4
   VALID_MINIMUM    = -9.46x10^12
   VALID_MAXIMUM    = 9.46x10^12
   MISSING_CONSTANT = 10x10^12
   UNIT             = KILOMETER
   DESCRIPTION      = "J2000[km]: Saturn-centered Spacecraft X Position"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = SC_SATURN_POS_Y
   DATA_TYPE        = IEEE_REAL
   START_BYTE       = 21
   BYTES            = 4
   VALID_MINIMUM    = -9.46x10^12
   VALID_MAXIMUM    = 9.46x10^12
   MISSING_CONSTANT = 10x10^12
   UNIT             = KILOMETER
   DESCRIPTION      = "J2000[km]: Saturn-centered Spacecraft Y Position"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = SC_SATURN_POS_Z
   DATA_TYPE        = IEEE_REAL
   START_BYTE       = 25
   BYTES            = 4
   VALID_MINIMUM    = -9.46x10^12
   VALID_MAXIMUM    = 9.46x10^12
   MISSING_CONSTANT = 10x10^12
   UNIT             = KILOMETER
   DESCRIPTION      = "J2000[km]: Saturn-centered Spacecraft Z Position"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = SC_SATURN_VELOCITY_VX
   DATA_TYPE        = IEEE_REAL
   START_BYTE       = 29
   BYTES            = 4
   VALID_MINIMUM    = -3x10^5
   VALID_MAXIMUM    = 3x10^5
   MISSING_CONSTANT = 5x10^5
   DESCRIPTION      = "J2000 [km/s]: Relative to Saturn"
```

```
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = SC_SATURN_VELOCITY_VY
   DATA_TYPE        = IEEE_REAL
   START_BYTE       = 33
   BYTES            = 4
   VALID_MINIMUM    = -3x10^5
   VALID_MAXIMUM    = 3x10^5
   MISSING_CONSTANT = 5x10^5
   DESCRIPTION      = "J2000 [km/s]: Relative to Saturn"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = SC_SATURN_VELOCITY_VZ
   DATA_TYPE        = IEEE_REAL
   START_BYTE       = 37
   BYTES            = 4
   VALID_MINIMUM    = -3x10^5
   VALID_MAXIMUM    = 3x10^5
   MISSING_CONSTANT = 5x10^5
   DESCRIPTION      = "J2000 [km/s]: Relative to Saturn"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = SC_SUN_POS_X
   DATA_TYPE        = IEEE_REAL
   START_BYTE       = 41
   BYTES            = 4
   VALID_MINIMUM    = -9.46x10^12
   VALID_MAXIMUM    = 9.46x10^12
   MISSING_CONSTANT = 10x10^12
   UNIT             = KILOMETER
   DESCRIPTION      = "J2000[km]: Sun-centered Spacecraft X Position."
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = SC_SUN_POS_Y
   DATA_TYPE        = IEEE_REAL
   START_BYTE       = 45
   BYTES            = 4
   VALID_MINIMUM    = -9.46x10^12
   VALID_MAXIMUM    = 9.46x10^12
   MISSING_CONSTANT = 10x10^12
   UNIT             = KILOMETER
   DESCRIPTION      = "J2000[km]: Sun-centered Spacecraft Y Position."
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = SC_SUN_POS_Z
   DATA_TYPE        = IEEE_REAL
   START_BYTE       = 49
   BYTES            = 4
   VALID_MINIMUM    = -9.46x10^12
   VALID_MAXIMUM    = 9.46x10^12
   MISSING_CONSTANT = 10x10^12
   UNIT             = KILOMETER
   DESCRIPTION      = "J2000[km]: Sun-centered Spacecraft Z Position."
END_OBJECT          = COLUMN
```

```
OBJECT              = COLUMN
   NAME             = SC_SUN_VELOCITY_VX
   DATA_TYPE        = IEEE_REAL
   START_BYTE       = 53
   BYTES            = 4
   VALID_MINIMUM    = -3x10^5
   VALID_MAXIMUM    = 3x10^5
   MISSING_CONSTANT = 5x10^5
   DESCRIPTION      = "J2000 [km/s]: Relative to the Sun"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = SC_SUN_VELOCITY_VY
   DATA_TYPE        = IEEE_REAL
   START_BYTE       = 57
   BYTES            = 4
   VALID_MINIMUM    = -3x10^5
   VALID_MAXIMUM    = 3x10^5
   MISSING_CONSTANT = 5x10^5
   DESCRIPTION      = "J2000 [km/s]: Relative to the Sun"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = SC_SUN_VELOCITY_VZ
   DATA_TYPE        = IEEE_REAL
   START_BYTE       = 61
   BYTES            = 4
   VALID_MINIMUM    = -3x10^5
   VALID_MAXIMUM    = 3x10^5
   MISSING_CONSTANT = 5x10^5
   DESCRIPTION      = "J2000 [km/s]: Relative to the Sun"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = SC_ORIENT_XX
   DATA_TYPE        = IEEE_REAL
   START_BYTE       = 65
   BYTES            = 4
   VALID_MINIMUM    = -1
   VALID_MAXIMUM    = 1
   MISSING_CONSTANT = 2
   DESCRIPTION      = "XX component of rotation matrix to J2000"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = SC_ORIENT_XY
   DATA_TYPE        = IEEE_REAL
   START_BYTE       = 69
   BYTES            = 4
   VALID_MINIMUM    = -1
   VALID_MAXIMUM    = 1
   MISSING_CONSTANT = 2
   DESCRIPTION      = "XY component of rotation matrix to J2000"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = SC_ORIENT_XZ
   DATA_TYPE        = IEEE_REAL
```

```
   START_BYTE       = 73
   BYTES            = 4
   VALID_MINIMUM    = -1
   VALID_MAXIMUM    = 1
   MISSING_CONSTANT = 2
   DESCRIPTION      = "XZ component of rotation matrix to J2000"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = SC_ORIENT_YX
   DATA_TYPE        = IEEE_REAL
   START_BYTE       = 77
   BYTES            = 4
   VALID_MINIMUM    = -1
   VALID_MAXIMUM    = 1
   MISSING_CONSTANT = 2
   DESCRIPTION      = "YX component of rotation matrix to J2000"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = SC_ORIENT_YY
   DATA_TYPE        = IEEE_REAL
   START_BYTE       = 81
   BYTES            = 4
   VALID_MINIMUM    = -1
   VALID_MAXIMUM    = 1
   MISSING_CONSTANT = 2
   DESCRIPTION      = "YY component of rotation matrix to J2000"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = SC_ORIENT_YZ
   DATA_TYPE        = IEEE_REAL
   START_BYTE       = 85
   BYTES            = 4
   VALID_MINIMUM    = -1
   VALID_MAXIMUM    = 1
   MISSING_CONSTANT = 2
   DESCRIPTION      = "YZ component of rotation matrix to J2000"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = SC_ORIENT_ZX
   DATA_TYPE        = IEEE_REAL
   START_BYTE       = 89
   BYTES            = 4
   VALID_MINIMUM    = -1
   VALID_MAXIMUM    = 1
   MISSING_CONSTANT = 2
   DESCRIPTION      = "ZX component of rotation matrix to J2000"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = SC_ORIENT_ZY
   DATA_TYPE        = IEEE_REAL
   START_BYTE       = 93
   BYTES            = 4
   VALID_MINIMUM    = -1
   VALID_MAXIMUM    = 1
```

```
   MISSING_CONSTANT  = 2
   DESCRIPTION       = "ZY component of rotation matrix to J2000"
END_OBJECT           = COLUMN

OBJECT               = COLUMN
   NAME              = SC_ORIENT_ZZ
   DATA_TYPE         = IEEE_REAL
   START_BYTE        = 97
   BYTES             = 4
   VALID_MINIMUM     = -1
   VALID_MAXIMUM     = 1
   MISSING_CONSTANT  = 2
   DESCRIPTION       = "ZZ component of rotation matrix to J2000"
END_OBJECT           = COLUMN

OBJECT               = COLUMN
   NAME              = ELS_QUALITY_FLAG
   DATA_TYPE         = MSB_UNSIGNED_INTEGER
   START_BYTE        = 101
   BYTES             = 1
   VALID_MINIMUM     = 0
   VALID_MAXIMUM     = 6
   MISSING_CONSTANT  = 7
   DESCRIPTION       = "Missing data and good/bad checksum
                  0 = Everything is OK
                  1 = Missing Data
                  2 = Bad Checksum
                  3 = Both Missing Data & Bad Checksum
                  4,5,6 = Not used
                  7 = No Data"
END_OBJECT           = COLUMN

OBJECT               = COLUMN
   NAME              = IBS_QUALITY_FLAG
   DATA_TYPE         = MSB_UNSIGNED_INTEGER
   START_BYTE        = 102
   BYTES             = 1
   VALID_MINIMUM     = 0
   VALID_MAXIMUM     = 6
   MISSING_CONSTANT  = 7
   DESCRIPTION       = "Missing data and good/bad checksum
                  0 = Everything is OK
                  1 = Missing Data
                  2 = Bad Checksum
                  3 = Both Missing Data & Bad Checksum
                  4,5,6 = Not used
                  7 = No Data"
END_OBJECT           = COLUMN

OBJECT               = COLUMN
   NAME              = ION_QUALITY_FLAG
   DATA_TYPE         = MSB_UNSIGNED_INTEGER
   START_BYTE        = 103
   BYTES             = 1
   VALID_MINIMUM     = 0
   VALID_MAXIMUM     = 6
   MISSING_CONSTANT  = 7
   DESCRIPTION       = "Missing data and good/bad checksum
                  0 = Everything is OK
```

```
                1 = Missing Data
                2 = Bad Checksum
                3 = Both Missing Data & Bad Checksum
                4,5,6 = Not used
                7 = No Data"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = TOF_LEF_QUALITY_FLAG
  DATA_TYPE         = MSB_UNSIGNED_INTEGER
  START_BYTE        = 104
  BYTES             = 1
  VALID_MINIMUM     = 0
  VALID_MAXIMUM     = 6
  MISSING_CONSTANT  = 7
  DESCRIPTION       = "Missing data and good/bad checksum
                0 = Everything is OK
                1 = Missing Data
                2 = Bad Checksum
                3 = Both Missing Data & Bad Checksum
                4,5,6 = Not used
                7 = No Data"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = TOF_ST_QUALITY_FLAG
  DATA_TYPE         = MSB_UNSIGNED_INTEGER
  START_BYTE        = 105
  BYTES             = 1
  VALID_MINIMUM     = 0
  VALID_MAXIMUM     = 6
  MISSING_CONSTANT  = 7
  DESCRIPTION       = "Missing data and good/bad checksum
                0 = Everything is OK
                1 = Missing Data
                2 = Bad Checksum
                3 = Both Missing Data & Bad Checksum
                4,5,6 = Not used
                7 = No Data"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = LOG_QUALITY_FLAG
  DATA_TYPE         = MSB_UNSIGNED_INTEGER
  START_BYTE        = 106
  BYTES             = 1
  VALID_MINIMUM     = 0
  VALID_MAXIMUM     = 6
  MISSING_CONSTANT  = 7
  DESCRIPTION       = "Missing data and good/bad checksum
                0 = Everything is OK
                1 = Missing Data
                2 = Bad Checksum
                3 = Both Missing Data & Bad Checksum
                4,5,6 = Not used
                7 = No Data"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
```

```
   NAME            = SNG_QUALITY_FLAG
   DATA_TYPE       = MSB_UNSIGNED_INTEGER
   START_BYTE      = 107
   BYTES           = 1
   VALID_MINIMUM   = 0
   VALID_MAXIMUM   = 6
   MISSING_CONSTANT  = 7
   DESCRIPTION     = "Missing data and good/bad checksum
                 0 = Everything is OK
                 1 = Missing Data
                 2 = Bad Checksum
                 3 = Both Missing Data & Bad Checksum
                 4,5,6 = Not used
                 7 = No Data"
END_OBJECT         = COLUMN

OBJECT             = COLUMN
   NAME            = ACT_QUALITY_FLAG
   DATA_TYPE       = MSB_UNSIGNED_INTEGER
   START_BYTE      = 108
   BYTES           = 1
   VALID_MINIMUM   = 0
   VALID_MAXIMUM   = 6
   MISSING_CONSTANT  = 7
   DESCRIPTION     = "Missing data and good/bad checksum
                 0 = Everything is OK
                 1 = Missing Data
                 2 = Bad Checksum
                 3 = Both Missing Data & Bad Checksum
                 4,5,6 = Not used
                 7 = No Data"
END_OBJECT         = COLUMN

OBJECT             = COLUMN
   NAME            = ACT_STATUS_BITS
   DATA_TYPE       = MSB_UNSIGNED_INTEGER
   START_BYTE      = 109
   ITEMS           = 32
   ITEM_BYTES      = 1
   BYTES           = 32
   VALID_MINIMUM   = 0
   VALID_MAXIMUM   = 8
   MISSING_CONSTANT  = 16
   DESCRIPTION     = "Actuator Status Bits:
                 0  = Everything is OK
                 4  = Hit the Limit Switch at +108
                 8  = Hit the Limit Switch at -108
                 16 = Data Not Available"
END_OBJECT         = COLUMN

OBJECT             = COLUMN
   NAME            = TLM_VERSION
   DATA_TYPE       = MSB_UNSIGNED_INTEGER
   START_BYTE      = 141
   BYTES           = 1
   VALID_MINIMUM   = 0
   VALID_MAXIMUM   = 3
   MISSING_CONSTANT  = 255
   DESCRIPTION     = "Telemetry mode version number"
```

```
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = FSW_MAJOR_VERSION
  DATA_TYPE         = MSB_UNSIGNED_INTEGER
  START_BYTE        = 142
  BYTES             = 1
  VALID_MINIMUM     = 0
  VALID_MAXIMUM     = 4
  MISSING_CONSTANT  = 255
  DESCRIPTION       = "Flight software major version number.
                To build the full flight software version:
                Major.SubMajor.Minor.SubMinor
                For example: 3.1.0.2"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = FSW_SUBMAJOR_VERSION
  DATA_TYPE         = MSB_UNSIGNED_INTEGER
  START_BYTE        = 143
  BYTES             = 1
  VALID_MINIMUM     = 0
  VALID_MAXIMUM     = 16
  MISSING_CONSTANT  = 255
  DESCRIPTION       = "Flight software sub-major version number.
                To build the full flight software version:
                Major.SubMajor.Minor.SubMinor
                For example: 3.1.0.2"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = FSW_MINOR_VERSION
  DATA_TYPE         = MSB_UNSIGNED_INTEGER
  START_BYTE        = 144
  BYTES             = 1
  VALID_MINIMUM     = 0
  VALID_MAXIMUM     = 16
  MISSING_CONSTANT  = 255
  DESCRIPTION       = "Flight software minor version number.
                To build the full flight software version:
                Major.SubMajor.Minor.SubMinor
                For example: 3.1.0.2"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = FSW_SUBMINOR_VERSION
  DATA_TYPE         = MSB_UNSIGNED_INTEGER
  START_BYTE        = 145
  BYTES             = 1
  VALID_MINIMUM     = 0
  VALID_MAXIMUM     = 16
  MISSING_CONSTANT  = 255
  DESCRIPTION       = "Flight software sub-minor version number.
                To build the full flight software version:
                Major.SubMajor.Minor.SubMinor
                For example: 3.1.0.2"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
```

```
   NAME             = POINTING_TYPE
   DATA_TYPE        = MSB_UNSIGNED_INTEGER
   START_BYTE       = 146
   BYTES            = 1
   VALID_MINIMUM    = 0
   VALID_MAXIMUM    = 2
   MISSING_CONSTANT = 0
   DESCRIPTION      = "Describes the type of pointing we have:
                    0 = no pointing available
                    1 = pointing based on predicts
                    2 = pointing based on reconstructs."
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = TELEMETRY_MODE
   DATA_TYPE        = MSB_UNSIGNED_INTEGER
   START_BYTE       = 147
   BYTES            = 1
   VALID_MINIMUM    = 1
   VALID_MAXIMUM    = 136
   MISSING_CONSTANT = 255
   DESCRIPTION      = "Logical telemetry rate and mode:
                    1   = 250 bps
                    2   = 500 bps
                    4   = 1 kbps
                    8   = 2 kbps
                    16  = 4 kbps
                    32  = 8 kbps
                    64  = 16 kbps
                    130 = 500 bps solar wind
                    132 = 1 kbps solar wind
                    136 = 2 kbps solar wind"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = IBS_SWEEP_TABLE_NUMBER
   DATA_TYPE        = MSB_UNSIGNED_INTEGER
   START_BYTE       = 148
   BYTES            = 1
   VALID_MINIMUM    = 0
   VALID_MAXIMUM    = 240
   MISSING_CONSTANT = 255
   DESCRIPTION      = "IBS sweep table and index table numbers:
                    Upper 4 bits are the IBS index table
                    Lower 4 bits are the IBS sweep table number
                    Fill: 0xFF"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = DATA_IBS_BKGD
   DATA_TYPE        = MSB_UNSIGNED_INTEGER
   START_BYTE       = 149
   UNIT             = COUNTS
   ITEMS            = 3
   ITEM_BYTES       = 2
   BYTES            = 6
   VALID_MINIMUM    = 0
   VALID_MAXIMUM    = 65534
   MISSING_CONSTANT = 65535
```

```
   DESCRIPTION       = "IBS background counts in fans 1 through 3.
                      Fill is 0xFFFF"
END_OBJECT           = COLUMN

OBJECT               = COLUMN
   NAME              = IBS_STARTING_ENERGY
   DATA_TYPE         = MSB_UNSIGNED_INTEGER
   START_BYTE        = 155
   BYTES             = 2
   VALID_MINIMUM     = 1
   VALID_MAXIMUM     = 852
   MISSING_CONSTANT  = 65535
   DESCRIPTION       = "IBS starting energy step number.
                      Fill is 0xFFFF"
END_OBJECT           = COLUMN

OBJECT               = COLUMN
   NAME              = IBS_SUBCYCLE
   DATA_TYPE         = MSB_UNSIGNED_INTEGER
   START_BYTE        = 157
   BYTES             = 1
   VALID_MINIMUM     = 0
   VALID_MAXIMUM     = 7
   MISSING_CONSTANT  = 255
   DESCRIPTION       = "IBS subcycle counter.
                      Fill is 0xFF"
END_OBJECT           = COLUMN

OBJECT               = COLUMN
   NAME              = IBS_COMPRESSION_RATIO
   DATA_TYPE         = MSB_UNSIGNED_INTEGER
   START_BYTE        = 158
   BYTES             = 1
   VALID_MINIMUM     = 1
   VALID_MAXIMUM     = 32
   MISSING_CONSTANT  = 0
   DESCRIPTION       = "ratio: (uncompressed length/compressed length).
                      Calculated on ground from info in the IBS header
                      and rounded down to the nearest integer.
                      Fill is 0"
END_OBJECT           = COLUMN

OBJECT               = COLUMN
   NAME              = IBS_PEAK_FAN
   DATA_TYPE         = MSB_UNSIGNED_INTEGER
   START_BYTE        = 159
   BYTES             = 1
   VALID_MINIMUM     = 1
   VALID_MAXIMUM     = 3
   MISSING_CONSTANT  = 4
   DESCRIPTION       = "Fan containing the IBS peak.
                      Fill is 4"
END_OBJECT           = COLUMN

OBJECT               = COLUMN
   NAME              = IBS_PEAK_ACYCLE
   DATA_TYPE         = MSB_UNSIGNED_INTEGER
   START_BYTE        = 160
   BYTES             = 1
```

```
    VALID_MINIMUM     = 1
    VALID_MAXIMUM     = 8
    MISSING_CONSTANT  = 9
    DESCRIPTION       = "A cycle number containing the IBS peak
                   Fill is 9"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
    NAME            = IBS_PEAK_SWEEP
    DATA_TYPE       = MSB_UNSIGNED_INTEGER
    START_BYTE      = 161
    BYTES           = 1
    VALID_MINIMUM     = 1
    VALID_MAXIMUM     = 16
    MISSING_CONSTANT  = 0
    DESCRIPTION       = "IBS peak energy sweep.
                   Fill is 0"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
    NAME            = IBS_PEAK_STEP
    DATA_TYPE       = MSB_UNSIGNED_INTEGER
    START_BYTE      = 162
    BYTES           = 1
    VALID_MINIMUM     = 1
    VALID_MAXIMUM     = 255
    MISSING_CONSTANT  = 0
    DESCRIPTION       = "IBS peak energy step.
                   Fill is 0"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
    NAME            = IBS_THRESHOLD_RL
    DATA_TYPE       = MSB_UNSIGNED_INTEGER
    START_BYTE      = 163
    BYTES           = 2
    VALID_MINIMUM     = 0
    VALID_MAXIMUM     = 255
    MISSING_CONSTANT  = 65535
    DESCRIPTION       = "IBS Run length compression threshold.
                   Fill is 0xFFFF"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
    NAME            = IMS_SWEEP_TABLE_NUMBER
    DATA_TYPE       = MSB_UNSIGNED_INTEGER
    START_BYTE      = 165
    BYTES           = 1
    VALID_MINIMUM     = 0
    VALID_MAXIMUM     = 255
    MISSING_CONSTANT  = 240
    DESCRIPTION       = "IMS sweep table number.
                  Number 240 will be reserved as a fill value"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
    NAME            = TDC_SINGLE_SELECT
    DATA_TYPE       = MSB_UNSIGNED_INTEGER
    START_BYTE      = 166
```

```
   BYTES            = 1
   VALID_MINIMUM     = 0
   VALID_MAXIMUM     = 3
   MISSING_CONSTANT  = 255
   DESCRIPTION       = "TDC Singles Selection:
                 Value:    Single 13         Single 14
                   0       Start CFD         Stop CFD
                   1       Acquisition Error  Deadtimes
                   2       Single TOF's       Double TOF's
                   3       Data Strobes       Resets"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = IMS_LOGICALS_SELECTION
   DATA_TYPE        = MSB_UNSIGNED_INTEGER
   START_BYTE       = 167
   BYTES            = 2
   VALID_MINIMUM     = 4096
   VALID_MAXIMUM     = 27416
   MISSING_CONSTANT  = 65535
   DESCRIPTION       = "TDC logicals selection:
                 Bits 15-13: IMS Logical 1
                 Bits 12-10: IMS Logical 2
                 Bits 9-7: IMS Logical 3
                 Bits 6-4: IMS Logical 4
                 Bits 3-0: Unused

                 Logical selection decoder:
                 0 = Unused
                 1 = LEF Stop
                 2 = ST Stop
                 3 = Timeouts
                 4 = Total Events (As used in SAM deadtime correction)
                 5 = Logical 13
                 6 = Logical 14
                 7 = Unused
                 NOTE: Logical 13 and 14 are set with 82TDC_ENG_SING.
                 See OBJECT name TDC_SINGLE_SELECT."
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = SAM_CPU2_STATUS_FLAGS
   DATA_TYPE        = MSB_UNSIGNED_INTEGER
   START_BYTE       = 169
   BYTES            = 1
   VALID_MINIMUM     = 0
   VALID_MAXIMUM     = 255
   DESCRIPTION       = "Bit 7 = CPU2/SAM mode change
                    6 = Background data
                    5 = Ion deadtime compensation
                    4 = SAM LEF enable
                    3 = SAM molecule enable
                    2 = SW/HW binning
                  1-0 = HW binning LUT index"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = SAM_ION_SELECTION_INDEX
   DATA_TYPE        = MSB_UNSIGNED_INTEGER
```

```
    START_BYTE       = 170
    BYTES            = 1
    VALID_MINIMUM    = 0
    VALID_MAXIMUM    = 255
    DESCRIPTION      = "SAM Ion selection index number"
END_OBJECT           = COLUMN

OBJECT               = COLUMN
    NAME             = SAM_ION_GROUP_TABLE
    DATA_TYPE        = MSB_UNSIGNED_INTEGER
    START_BYTE       = 171
    BYTES            = 2
    VALID_MINIMUM    = 0
    VALID_MAXIMUM    = 65534
    MISSING_CONSTANT = 65535
    DESCRIPTION      = "SAM group table ID number"
END_OBJECT           = COLUMN

OBJECT               = COLUMN
    NAME             = ELS_MCP_ADJ
    DATA_TYPE        = IEEE_REAL
    START_BYTE       = 173
    BYTES            = 4
    UNIT             = VOLTS
    VALID_MINIMUM    = 0.0
    VALID_MAXIMUM    = 3700.0
    MISSING_CONSTANT = -1.0
    DESCRIPTION      = "ELS High Voltage Adjust. converted using:
                       V = DAC * 58.73.  Where DAC is the digital to
                       analog value transmitted by the instrument in
                       housekeeping."
END_OBJECT           = COLUMN

OBJECT               = COLUMN
    NAME             = IBS_CEM_DAC
    DATA_TYPE        = IEEE_REAL
    START_BYTE       = 177
    BYTES            = 4
    UNIT             = VOLTS
    VALID_MINIMUM    = -4000.0
    VALID_MAXIMUM    = 0.0
    MISSING_CONSTANT = 1.0
    DESCRIPTION      = "IBS CEM (channel-electron multiplier) High Voltage.
                       Converted using:   V = DAC * (-15.68627451).  DAC is
                       the digital to analog value transmitted by the
                       instrument in housekeeping."
END_OBJECT           = COLUMN

OBJECT               = COLUMN
    NAME             = HVU1_RET_DAC
    DATA_TYPE        = IEEE_REAL
    START_BYTE       = 181
    BYTES            = 4
    UNIT             = KILOVOLTS
    VALID_MINIMUM    = 0.0
    VALID_MAXIMUM    = 16.0
    MISSING_CONSTANT = -1.0
    DESCRIPTION      = "HVU1 (high voltage unit 1) Retarding High Voltage,
                       converted using:  kV = DAC * 0.0627451
```

```
                    Where DAC is the digital to analog value transmitted
                    by the instrument in housekeeping."
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = HVU1_ACC_DAC
   DATA_TYPE        = IEEE_REAL
   START_BYTE       = 185
   BYTES            = 4
   UNIT             = KILOVOLTS
   VALID_MINIMUM    = -16.0
   VALID_MAXIMUM    = 0.0
   MISSING_CONSTANT = 1.0
   DESCRIPTION      = "HVU1 (high voltage unit 1) Accelerating High Voltage,
                    converted using:  kV = DAC * -0.0627451
                    Where DAC is the digital to analog value transmitted
                    by the instrument in housekeeping."
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = HVU2_ST_DAC
   DATA_TYPE        = IEEE_REAL
   START_BYTE       = 189
   BYTES            = 4
   UNIT             = VOLTS
   VALID_MINIMUM    = -3600.0
   VALID_MAXIMUM    = 0.0
   MISSING_CONSTANT = 1.0
   DESCRIPTION      = "HVU2 (high voltage unit 2) Straight Through MCP
                    (multichannel plate), converted using:
                        V = DAC * -14.1176
                    Where DAC is the digital to analog value transmitted
                    by the instrument in housekeeping."
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = HVU2_LEF_DAC
   DATA_TYPE        = IEEE_REAL
   START_BYTE       = 193
   BYTES            = 4
   UNIT             = VOLTS
   VALID_MINIMUM    = -2400.0
   VALID_MAXIMUM    = 0.0
   MISSING_CONSTANT = 1.0
   DESCRIPTION      = "HVU2 (high voltage unit 2) Linear Electric Field MCP
                    (multichannel plate), converted using:
                          V = DAC * -9.4118
                    Where DAC is the digital to analog value transmitted
                    by the instrument in housekeeping."
END_OBJECT          = COLUMN
```

Sample Ancillary (ANC) Label File: ANC_YYYYDDDHH_U3.LBL

```
 PDS_VERSION_ID              = PDS3
DATA_SET_ID                  = "CO-E/J/S/SW-CAPS-2-UNCALIBRATED-V1.1"

STANDARD_DATA_PRODUCT_ID     = "ANC UNCALIBRATED"
PRODUCT_ID                   = "ANC_201001000_U3"
PRODUCT_TYPE                 = "DATA"
PRODUCT_CREATION_TIME        = 2010-141T20:48

RECORD_TYPE                  = FIXED_LENGTH
RECORD_BYTES                 = 196
FILE_RECORDS                 = 671

START_TIME                   = 2010-010T00:08:07
STOP_TIME                    = 2010-010T06:05:59
SPACECRAFT_CLOCK_START_COUNT = "1/1641775909.000"
SPACECRAFT_CLOCK_STOP_COUNT  = "1/1641797381.000"

INSTRUMENT_HOST_NAME         = "CASSINI ORBITER"
INSTRUMENT_HOST_ID           = "CO"
TARGET_NAME                  = {"SATURN"}
INSTRUMENT_NAME              = "CASSINI PLASMA SPECTROMETER"
INSTRUMENT_ID                = "CAPS"
DESCRIPTION                  = "
    This file contains Cassini CAPS ancillary data and some
    spacececraft pointing information
    acquired at SATURN between
    2010-010T00:08:07.000 and 2010-010T06:05:59.000 (orbit 124)."
MD5_CHECKSUM                 = "120bd2983382c76702046cccf611869f"

NOTE                         = "
    The end around carry checksum, with seed 0x55AA,
    of this file is 0xB62E"
SPICE_FILE_NAME              = {"SPK: 100209R_SCPSE_10003_10021.bsp",
                           "00: 10006_10011ra.bc",
                           "06: 10006_10011ra.bc",
                           "12: 10006_10011ra.bc",
                           "18: 10011_10016ra.bc",
                           "18: 10006_10011ra.bc"}

^TABLE                       = "ANC_201001000_U3.DAT"
OBJECT                       = TABLE
  INTERCHANGE_FORMAT         = "BINARY"
  ROWS                       = 671
  COLUMNS                    = 63
  ROW_BYTES                  = 196
  ^STRUCTURE                 = "ANC_U3.FMT"
  DESCRIPTION                = "
    The file ANC_U3.FMT describes the column structure and content
    of the data file."
END_OBJECT                   = TABLE
END
```

Appendix C. PDS Labels & Format Files for Standard CALIBRATED Data Products

ELS_V1.FMT File

```
OBJECT              = COLUMN
  NAME              = UTC
  DATA_TYPE         = DATE  /* ASCII character string */
  START_BYTE        = 1
  BYTES             = 21
  VALID_MINIMUM     = 2011-217T00:00:00.001
  VALID_MAXIMUM     = 2018-001T00:00:00.000
  MISSING_CONSTANT  = 0001-001T00:00:00.000
  DESCRIPTION       = "UTC timestamp, of format yyyy-dddTHH:MM:SS.sss
                      where yyyy = year, ddd = day of year,
                      HH = hour, MM = minute,
                      SS.sss = decimal seconds to millisecond resolution.
                      Value calculated via SPICE from spacecraft clock time."
/* RJW, UTC, c, 1, 21 */
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = DEAD_TIME_METHOD
  DATA_TYPE         = LSB_UNSIGNED_INTEGER
  START_BYTE        = 22
  BYTES             = 1
  VALID_MINIMUM     = 0
  VALID_MAXIMUM     = 2
  MISSING_CONSTANT  = 255
  DESCRIPTION       = "Dead Time Correction Method
                        0 = None: Data has not been Dead Time corrected.
                        1 = On ground (using quantized values).
                        2 = In flight, corrected prior to any bin summing and
                            prior to quantization for downlink (ELS only).
                      255 = Unknown."
/* RJW, DEAD_TIME_METHOD, B, 1, 1 */
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = TELEMETRY
  DATA_TYPE         = LSB_UNSIGNED_INTEGER
  START_BYTE        = 23
  BYTES             = 2
  VALID_MINIMUM     =   250
  VALID_MAXIMUM     = 16000
  MISSING_CONSTANT  = 65535
  UNIT              = "bps"
  DESCRIPTION       = "Telemetry Downlink Rate (bps).
                      (Independent of Solar Wind Modes)
                        Expected values are 250, 500,
                        1000, 2000, 4000, 8000, 16000"
/* RJW, TELEMETRY, H, 1, 1 */
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = DT
  DATA_TYPE         = PC_REAL /* i.e. a float in little endian format */
  START_BYTE        = 25
  BYTES             = 4
  VALID_MINIMUM     =  2.0
  VALID_MAXIMUM     = 32.0
  MISSING_CONSTANT  = -1.0
  UNIT              = "SECONDS"
  DESCRIPTION       = "Duration of Record (seconds)"
```

```
/* RJW, DT, f, 1, 1 */
END_OBJECT         = COLUMN

OBJECT            = COLUMN
  NAME            = ACCUMULATION_TIME
  DATA_TYPE        = PC_REAL
  START_BYTE       = 29
  ITEMS           = 63
  ITEM_BYTES       = 4
  BYTES           = 252
  VALID_MINIMUM    = 0.02343750
  VALID_MAXIMUM    = 0.75000000
  MISSING_CONSTANT  = -1
  UNIT            = "SECONDS"
  DESCRIPTION      = "ACCUMULATION_TIME of each bin (seconds)"
/* RJW, ACCUMULATION_TIME, f, 1, 63 */
END_OBJECT         = COLUMN

OBJECT            = COLUMN
  NAME            = DATA
  DATA_TYPE        = PC_REAL
  START_BYTE       = 281
  ITEMS           = 504
  ITEM_BYTES       = 4
  BYTES           = 2016
  VALID_MINIMUM    =       0.0
  VALID_MAXIMUM    = 1000000.0 /* 1e6 general upper limit*/
  MISSING_CONSTANT  =   65535.0
  UNIT            = "COUNTS/SECOND"
  DESCRIPTION      = "ELS data of each bin (Counts per second)
                    Counts per accumulation have been (in order):
                     -Maybe Dead time corrected (See DEAD_TIME_METHOD)
                     -Moved to middle of quantization bin
                     -Converted to counts/second.
                     -Maybe Dead time corrected (See DEAD_TIME_METHOD)"
/* Should be, DATA, f, 3, 63, 8, 1 */
/* RJW, DATA, f, 1, 504 */
END_OBJECT         = COLUMN

OBJECT            = COLUMN
  NAME            = DIM1_E
  DATA_TYPE        = PC_REAL
  START_BYTE       = 2297
  ITEMS           = 63
  ITEM_BYTES       = 4
  BYTES           = 252
  VALID_MINIMUM    =     0.0
  VALID_MAXIMUM    = 29000.0 /* rounded up to whole keV/q */
  MISSING_CONSTANT  = 65535.0
  UNIT            = "eV/q"
  DESCRIPTION      = "1st Dimension of DATA: Energy - center value (eV/q).
                      Upper and lower limits are given by the objects
                      DIM1_E_UPPER and DIM1_E_LOWER."
/* RJW, DIM1_E, f, 1, 63 */
END_OBJECT         = COLUMN

OBJECT            = COLUMN
  NAME            = DIM1_E_UPPER
  DATA_TYPE        = PC_REAL
```

```
  START_BYTE       = 2549
  ITEMS            = 63
  ITEM_BYTES       = 4
  BYTES            = 252
  VALID_MINIMUM    =     0.0
  VALID_MAXIMUM    = 29000.0 /* rounded up to whole keV/q */
  MISSING_CONSTANT  = 65535.0
  UNIT             = "eV/q"
  DESCRIPTION      = "1st Dimension of DATA: Energy - upper limit (eV/q).
                      See DIM1_E for description."
/* RJW, DIM1_E_UPPER, f, 1, 63 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = DIM1_E_LOWER
  DATA_TYPE        = PC_REAL
  START_BYTE       = 2801
  ITEMS            = 63
  ITEM_BYTES       = 4
  BYTES            = 252
  VALID_MINIMUM    =     0.0
  VALID_MAXIMUM    = 29000.0 /* rounded up to whole keV/q */
  MISSING_CONSTANT  = 65535.0
  UNIT             = "eV/q"
  DESCRIPTION      = "1st Dimension of DATA: Energy - lower limit (eV/q).
                      See DIM1_E for description."
/* RJW, DIM1_E_LOWER, f, 1, 63 */
END_OBJECT         = COLUMN


OBJECT             = COLUMN
  NAME             = DIM2_THETA
  DATA_TYPE        = PC_REAL
  START_BYTE       = 3053
  ITEMS            = 8
  ITEM_BYTES       = 4
  BYTES            = 32
  VALID_MINIMUM    =   -80.0
  VALID_MAXIMUM    =    80.0
  MISSING_CONSTANT  = 65535.0
  UNIT             = "Degrees"
  DESCRIPTION      = "2nd Dimension of DATA: Spacecraft Theta - center value.
                     Spacecraft Theta (degs) is analogous to latitude on
                     a sphere. In spacecraft xyz co-ords:
                      +z is equivalent to theta = +90 degs
                      -z is equivalent to theta = -90 degs
                        (The communication dish is directed along -z)
                      xy-plane at z=0 is equivalent to theta = 0
                     The 8 anodes break down to thetas of:
                      Anode 1 covers the range +60 to +80 degs
                      Anode 2 covers the range +40 to +60 degs
                      Anode 3 covers the range +20 to +40 degs
                      Anode 4 covers the range   0 to +20 degs
                      Anode 5 covers the range -20 to   0 degs
                      Anode 6 covers the range -40 to -20 degs
                      Anode 7 covers the range -60 to -40 degs
                      Anode 8 covers the range -80 to -60 degs"
/* RJW, DIM2_THETA, f, 1, 8 */
END_OBJECT         = COLUMN
```

```
OBJECT            = COLUMN
  NAME            = DIM2_THETA_UPPER
  DATA_TYPE       = PC_REAL
  START_BYTE      = 3085
  ITEMS           = 8
  ITEM_BYTES      = 4
  BYTES           = 32
  VALID_MINIMUM   =  -80.0
  VALID_MAXIMUM   =   80.0
  MISSING_CONSTANT  = 65535.0
  UNIT            = "Degrees"
  DESCRIPTION     = "2nd Dimension of DATA: Spacecraft Theta - upper limit.
                    See DIM2_THETA for description."
/* RJW, DIM2_THETA_UPPER, f, 1, 8 */
END_OBJECT        = COLUMN

OBJECT            = COLUMN
  NAME            = DIM2_THETA_LOWER
  DATA_TYPE       = PC_REAL
  START_BYTE      = 3117
  ITEMS           = 8
  ITEM_BYTES      = 4
  BYTES           = 32
  VALID_MINIMUM   =  -80.0
  VALID_MAXIMUM   =   80.0
  MISSING_CONSTANT  = 65535.0
  UNIT            = "Degrees"
  DESCRIPTION     = "2nd Dimension of DATA: Spacecraft Theta - lower limit.
                    See DIM2_THETA for description."
/* RJW, DIM2_THETA_LOWER, f, 1, 8 */
END_OBJECT        = COLUMN


OBJECT            = COLUMN
  NAME            = DIM3_PHI
  DATA_TYPE       = PC_REAL
  START_BYTE      = 3149
  ITEMS           = 1
  ITEM_BYTES      = 4
  BYTES           = 4
  VALID_MINIMUM   =  155.0
  VALID_MAXIMUM   =  385.0
  MISSING_CONSTANT  = 65535.0
  UNIT            = "Degrees"
  DESCRIPTION     = "3rd Dimension of DATA: S/C Phi - representative value.
                   Spacecraft Phi (degs) is analogous to longitude on
                   a sphere. In spacecraft xyz co-ords:
                     +x is equivalent to phi =   0 degs
                     +y is equivalent to phi =  90 degs
                     -x is equivalent to phi = 180 degs
                     -y is equivalent to phi = 270 degs
                     +x is equivalent to phi = 360 degs
                     +y is equivalent to phi = 450 degs
                   The Phi angle varies because of actuator motion,
                     BUT this is NOT the same as actuator angle (ACT)
                     from the level 2 CAPS data: Phi = 270 - ACT
                   This is not a center value but a representative one.
                     Center values are the mid-points between the upper
```

```
                        and lower limits, in such cases the upper and lower
                        values are the first and last points of that range:
                          Center value  = (lower + upper)/2
                      In this case the actuator goes back and forth, slows
                        at the edges, such that a mid-point could be lower
                        than both the first and last points if the acuator
                        changed direction during that interval.
                      Phi angles are calculated every second from the start
                        to the end of the intervals duration and then:
                          Representative value  = mean(phi angles)
                          The lower limit value = min( phi angles)
                          The upper limit value = max( phi angles)"
/* RJW, DIM3_PHI, f, 1, 1 */
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = DIM3_PHI_UPPER
  DATA_TYPE         = PC_REAL
  START_BYTE        = 3153
  ITEMS             = 1
  ITEM_BYTES        = 4
  BYTES             = 4
  VALID_MINIMUM     =   155.0
  VALID_MAXIMUM     =   385.0
  MISSING_CONSTANT  = 65535.0
  UNIT              = "Degrees"
  DESCRIPTION       = "3rd Dimension of DATA: S/C Phi - upper limit.
                        See DIM3_PHI for description."
/* RJW, DIM3_PHI_UPPER, f, 1, 1 */
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = DIM3_PHI_LOWER
  DATA_TYPE         = PC_REAL
  START_BYTE        = 3157
  ITEMS             = 1
  ITEM_BYTES        = 4
  BYTES             = 4
  VALID_MINIMUM     =   155.0
  VALID_MAXIMUM     =   385.0
  MISSING_CONSTANT  = 65535.0
  UNIT              = "Degrees"
  DESCRIPTION       = "3rd Dimension of DATA: S/C Phi - lower limit.
                        See DIM3_PHI for description."
/* RJW, DIM3_PHI_LOWER, f, 1, 1 */
END_OBJECT          = COLUMN


OBJECT              = COLUMN
  NAME              = SC_POS_R
  DATA_TYPE         = PC_REAL
  START_BYTE        = 3161
  BYTES             = 4
  VALID_MINIMUM     =     0.0
  VALID_MAXIMUM     =   200.0
  MISSING_CONSTANT  = 65535.0
  UNIT              = "Saturn Radii"
  DESCRIPTION       = "Cassini radial distance from Saturn.
                      The non-cruise part of the mission is below 200 Rs.
```

```
                     (1 Rs = 60268.0 km)
                     [Values may be greater than VALID_MAX
                     during cruise to Saturn before primary mission.]"
/* RJW, SC_POS_R, f, 1, 1 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = SC_POS_LAT
  DATA_TYPE        = PC_REAL
  START_BYTE       = 3165
  BYTES            = 4
  VALID_MINIMUM    =   -90.0
  VALID_MAXIMUM    =    90.0
  MISSING_CONSTANT = 65535.0
  UNIT             = "Degrees"
  DESCRIPTION      = "Cassini Latitude above Saturn.
                     (0 = Equatorial)"
/* RJW, SC_POS_LAT, f, 1, 1 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = SC_POS_LOCAL_TIME
  DATA_TYPE        = PC_REAL
  START_BYTE       = 3169
  BYTES            = 4
  VALID_MINIMUM    =     0.0
  VALID_MAXIMUM    =    24.0
  MISSING_CONSTANT = 65535.0
  UNIT             = "Hours"
  DESCRIPTION      = "Cassini Local Time from Saturn.
                       00 = Midnight
                       06 = Dawn
                       12 = Noon
                       18 = Dusk"
/* RJW, SC_POS_LOCAL_TIME, f, 1, 1 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = SC_POS_SATURN_J2000XYZ
  DATA_TYPE        = PC_REAL
  START_BYTE       = 3173
  ITEMS            = 3
  ITEM_BYTES       = 4
  BYTES            = 12
  VALID_MINIMUM    = -12000000.0 /* ~ -199 Rs */
  VALID_MAXIMUM    =  12000000.0 /* ~ +199 Rs */
  MISSING_CONSTANT =     65535.0 /* ~ +1.1 Rs */
  UNIT             = "km"
  DESCRIPTION      = "Cassini position from Saturn in J2000 cartesian
                     co-ordinates [x,y,z] (units km).
                     [Values may be outside of VALID_MIN/MAX range (~199Rs)
                     during cruise to Saturn before primary mission.]"
/* RJW, SC_POS_SATURN_J2000XYZ, f, 1, 3 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = SC_VEL_SATURN_J2000XYZ
  DATA_TYPE        = PC_REAL
  START_BYTE       = 3185
```

```
  ITEMS            = 3
  ITEM_BYTES       = 4
  BYTES            = 12
  VALID_MINIMUM    =   -40.0 /* V_mag at SOI near 31 km/s */
  VALID_MAXIMUM    =    40.0
  MISSING_CONSTANT  = 65535.0
  UNIT             = "km/s"
  DESCRIPTION      = "Cassini Velocity with respect to Saturn in J2000
                    cartesian co-ordinates [Vx,Vy,Vz] (units km/s)."
/* RJW, SC_VEL_SATURN_J2000XYZ, f, 1, 3 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = SC_VEL_ANGULAR_J2000XYZ
  DATA_TYPE        = PC_REAL
  START_BYTE       = 3197
  ITEMS            = 3
  ITEM_BYTES       = 4
  BYTES            = 12
  VALID_MINIMUM    =   -1.0 /* General limit */
  VALID_MAXIMUM    =    1.0 /* General limit */
  MISSING_CONSTANT  = 65535.0
  UNIT             = "radians/s"
  DESCRIPTION      = "Cassini Angular Velocity in cartesian co-ordinates
                    [AVx,AVy,AVz] (units radians/s).
                     (This is calculated with the SPICE ckgpav command
                      where ref=J2000.  SPICE defines it as 'This is the
                      axisabout which the reference frame tied to the
                      instrument is rotating in the right-handed sense')"
/* RJW, SC_VEL_ANGULAR_J2000XYZ, f, 1, 3 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = SC_TO_J2000
  DATA_TYPE        = PC_REAL
  START_BYTE       = 3209
  ITEMS            = 9
  ITEM_BYTES       = 4
  BYTES            = 36
  VALID_MINIMUM    =   -1.0
  VALID_MAXIMUM    =    1.0
  MISSING_CONSTANT  = 65535.0
  DESCRIPTION      = "Rotation matrix from spacecraft co-ordinates to J2000
                    This is a 3x3 matrix, expressed here as a 1x9 stream.
                    If the 1D stream is [a,b,c, d,e,f, g,h,i]
                    then the 2D matrix is [a,b,c
                                           d,e,f
                                           g,h,i]"
/* Should be, SC_TO_J2000, f, 2, 3, 3 */
/* RJW, SC_TO_J2000, f, 1, 9 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = J2000_TO_RTP
  DATA_TYPE        = PC_REAL
  START_BYTE       = 3245
  ITEMS            = 9
  ITEM_BYTES       = 4
  BYTES            = 36
```

```
  VALID_MINIMUM     =    -1.0
  VALID_MAXIMUM     =     1.0
  MISSING_CONSTANT  = 65535.0
  DESCRIPTION       = "Rotation matrix from J2000 co-ordinates to RTP,
                    where RTP is Saturn centered right handed R-Theta-Phi.
                    This is a 3x3 matrix, expressed here as a 1x9 stream.
                    If the 1D stream is [a,b,c, d,e,f, g,h,i]
                    then the 2D matrix is [a,b,c
                                           d,e,f
                                           g,h,i]"
/* Should be, J2000_TO_RTP, f, 2, 3, 3 */
/* RJW, J2000_TO_RTP, f, 1, 9 */
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = AUX_ELS_MCP_ADJ
  DATA_TYPE         = PC_REAL
  START_BYTE        = 3281
  BYTES             = 4
  VALID_MINIMUM     =    0.0
  VALID_MAXIMUM     = 3700.0
  MISSING_CONSTANT  =   -1.0
  UNIT              = "VOLTS"
  DESCRIPTION       = "ELS High Voltage multichannel plate (mcp)."
/* RJW, AUX_ELS_MCP_ADJ, f, 1, 1 */
END_OBJECT          = COLUMN
```

Sample ELS Label File: ELS_YYYYDDDHH_V1.LBL

```
PDS_VERSION_ID = PDS3
DATA_SET_ID    = "CO-E/J/S/SW-CAPS-3-CALIBRATED-V1.0"

/* Input File: ELS_2004001_V01.DAT */
/* File written: 2013-09-28T22:23:04 local time*/

STANDARD_DATA_PRODUCT_ID = "ELS CALIBRATED L3"
PRODUCT_ID               = "ELS_200400100_V01"
PRODUCT_TYPE             = "DATA"
PRODUCT_CREATION_TIME    = 2013-271T22:23:04 /* UTC 2013-09-28 */
PROCESSING_LEVEL_ID      = "3"

RECORD_TYPE  = FIXED_LENGTH
RECORD_BYTES = 3284
FILE_RECORDS = 3072

START_TIME                 = 2004-001T00:00:16.363 /* 2004-01-01 */
STOP_TIME                  = 2004-001T06:00:16.222 /* 2004-01-01 */
SPACECRAFT_CLOCK_START_COUNT = "1/1451607769.000"
SPACECRAFT_CLOCK_STOP_COUNT  = "1/1451629369.000"

INSTRUMENT_HOST_NAME = "CASSINI ORBITER"
INSTRUMENT_HOST_ID   = "CO"
TARGET_NAME          = {"SATURN"}
INSTRUMENT_NAME      = "CASSINI PLASMA SPECTROMETER"
INSTRUMENT_ID        = "CAPS"
DESCRIPTION = "This file contains the Level 3 data for CAPS ELS."

MD5_CHECKSUM = "deaf0f7d5f80b989e5271a2f40987496"
```

```
NOTE = "See the PDS CAPS SIS Document for more details on the formats."

^TABLE = "ELS_200400100_V01.DAT"
OBJECT = TABLE
  INTERCHANGE_FORMAT = "BINARY"
  ROWS       = 3072
  COLUMNS    = 24
  ROW_BYTES   = 3284
  ^STRUCTURE  = "ELS_V01.FMT"
  DESCRIPTION = "Describes the structure and content of the data file."
END_OBJECT = TABLE
END
```

IBS_V1.FMT File

```
OBJECT            = COLUMN
  NAME            = UTC
  DATA_TYPE       = DATE  /* ASCII character string */
  START_BYTE      = 1
  BYTES           = 21
  VALID_MINIMUM    = 2011-217T00:00:00.001
  VALID_MAXIMUM    = 2018-001T00:00:00.000
  MISSING_CONSTANT  = 0001-001T00:00:00.000
  DESCRIPTION      = "UTC timestamp, of format yyyy-dddTHH:MM:SS.sss
                  where yyyy = year, ddd = day of year,
                  HH = hour, MM = minute,
                  SS.sss = decimal seconds to millisecond resolution.
                  Value calculated via SPICE from spacecraft clock time."
/* RJW, UTC, c, 1, 21 */
END_OBJECT        = COLUMN

OBJECT            = COLUMN
  NAME            = DEAD_TIME_METHOD
  DATA_TYPE       = LSB_UNSIGNED_INTEGER
  START_BYTE      = 22
  BYTES           = 1
  VALID_MINIMUM    = 0
  VALID_MAXIMUM    = 2
  MISSING_CONSTANT  = 255
  DESCRIPTION      = "Dead Time Correction Method
                   0 = None: Data has not been Dead Time corrected.
                   1 = On ground (using quantized values).
                   2 = In flight, corrected prior to any bin summing and
                      prior to quantization for downlink (ELS only).
                  255 = Unknown."
/* RJW, DEAD_TIME_METHOD, B, 1, 1 */
END_OBJECT        = COLUMN

OBJECT            = COLUMN
  NAME            = TELEMETRY
  DATA_TYPE       = LSB_UNSIGNED_INTEGER
  START_BYTE      = 23
  BYTES           = 2
  VALID_MINIMUM    =   250
  VALID_MAXIMUM    = 16000
```

```
  MISSING_CONSTANT  = 65535
  UNIT             = "bps"
  DESCRIPTION       = "Telemetry Downlink Rate (bps).
                    (Independent of Solar Wind Modes)
                     Expected values are 250, 500,
                     1000, 2000, 4000, 8000, 16000"
/* RJW, TELEMETRY, H, 1, 1 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = DT
  DATA_TYPE        = PC_REAL /* i.e. a float in little endian format */
  START_BYTE       = 25
  BYTES            = 4
  VALID_MINIMUM     =  2.0
  VALID_MAXIMUM     = 32.0
  MISSING_CONSTANT  = -1.0
  UNIT             = "SECONDS"
  DESCRIPTION       = "Duration of Record (seconds)"
/* RJW, DT, f, 1, 1 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = ACCUMULATION_TIME
  DATA_TYPE        = PC_REAL
  START_BYTE       = 29
  ITEMS            = 255
  ITEM_BYTES       = 4
  BYTES            = 1020
  VALID_MINIMUM     = 0.00683594
  VALID_MAXIMUM     = 0.21875000
  MISSING_CONSTANT  = -1
  UNIT             = "SECONDS"
  DESCRIPTION       = "ACCUMULATION_TIME of each bin (seconds)"
/* RJW, ACCUMULATION_TIME, f, 1, 255 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = DATA
  DATA_TYPE        = PC_REAL
  START_BYTE       = 1049
  ITEMS            = 765
  ITEM_BYTES       = 4
  BYTES            = 3060
  VALID_MINIMUM     =      0.0
  VALID_MAXIMUM     = 1000000.0 /* 1e6 general upper limit*/
  MISSING_CONSTANT  =   65535.0
  UNIT             = "COUNTS/SECOND"
  DESCRIPTION       = "IBS data of each bin (Counts per second)
                    Counts per accumulation have been (in order):
                     -Moved to middle of quantization bin
                     -Converted to counts/second.
                     -Maybe Dead time corrected (See DEAD_TIME_METHOD)
                     -Cross talk corrected."
/* Should be, DATA, f, 3, 255, 3, 1 */
/* RJW, DATA, f, 1, 765 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
```

```
  NAME             = DIM1_E
  DATA_TYPE        = PC_REAL
  START_BYTE       = 4109
  ITEMS            = 255
  ITEM_BYTES       = 4
  BYTES            = 1020
  VALID_MINIMUM    =     0.0
  VALID_MAXIMUM    = 54000.0 /* rounded up to whole keV/q */
  MISSING_CONSTANT  = 65535.0
  UNIT             = "eV/q"
  DESCRIPTION      = "1st Dimension of DATA: Energy - center value (eV/q).
                     Upper and lower limits are given by the objects
                     DIM1_E_UPPER and DIM1_E_LOWER."
/* RJW, DIM1_E, f, 1, 255 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = DIM1_E_UPPER
  DATA_TYPE        = PC_REAL
  START_BYTE       = 5129
  ITEMS            = 255
  ITEM_BYTES       = 4
  BYTES            = 1020
  VALID_MINIMUM    =     0.0
  VALID_MAXIMUM    = 54000.0 /* rounded up to whole keV/q */
  MISSING_CONSTANT  = 65535.0
  UNIT             = "eV/q"
  DESCRIPTION      = "1st Dimension of DATA: Energy - upper limit (eV/q).
                     See DIM1_E for description."
/* RJW, DIM1_E_UPPER, f, 1, 255 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = DIM1_E_LOWER
  DATA_TYPE        = PC_REAL
  START_BYTE       = 6149
  ITEMS            = 255
  ITEM_BYTES       = 4
  BYTES            = 1020
  VALID_MINIMUM    =     0.0
  VALID_MAXIMUM    = 54000.0 /* rounded up to whole keV/q */
  MISSING_CONSTANT  = 65535.0
  UNIT             = "eV/q"
  DESCRIPTION      = "1st Dimension of DATA: Energy - lower limit (eV/q).
                     See DIM1_E for description."
/* RJW, DIM1_E_LOWER, f, 1, 255 */
END_OBJECT         = COLUMN


OBJECT             = COLUMN
  NAME             = DIM2_THETA
  DATA_TYPE        = PC_REAL
  START_BYTE       = 7169
  ITEMS            = 3
  ITEM_BYTES       = 4
  BYTES            = 12
  VALID_MINIMUM    =   -75.0
  VALID_MAXIMUM    =    75.0
  MISSING_CONSTANT  = 65535.0
```

```
  UNIT            = "Degrees"
  DESCRIPTION     = "2nd Dimension of DATA: Spacecraft Theta - center value.
                    Spacecraft Theta (degs) is analogous to latitude on
                    a sphere. In spacecraft xyz co-ords:
                     +z is equivalent to theta = +90 degs
                     -z is equivalent to theta = -90 degs
                       (The communication dish is directed along -z)
                     xy-plane at z=0 is equivalent to theta = 0
                    The 3 anodes break down to thetas of:
                      Anode 1 is all fill values
                      Anode 2 covers the range -75 to +75 degs
                      Anode 3 is all fill values
                    Anode 2 for IBS has nearly the same field
                    of view as anodes 1-8 for SNG/ELS.
                    The 3 IBS anodes are not parallel, but in
                    a cross-fan geometry, where anodes 1 and 3
                    are offset from anode 2 by +/- 30 degrees
                    (see CAPS instrument paper). Because of
                    this odd geometry, only anode 2 details
                    are provided, and users can apply the
                    constant cross-fan offset for theta & phi
                    of anodes 1 and 3 to their data."
/* RJW, DIM2_THETA, f, 1, 3 */
END_OBJECT        = COLUMN

OBJECT            = COLUMN
  NAME            = DIM2_THETA_UPPER
  DATA_TYPE       = PC_REAL
  START_BYTE      = 7181
  ITEMS           = 3
  ITEM_BYTES      = 4
  BYTES           = 12
  VALID_MINIMUM   =   -75.0
  VALID_MAXIMUM   =    75.0
  MISSING_CONSTANT  = 65535.0
  UNIT            = "Degrees"
  DESCRIPTION     = "2nd Dimension of DATA: Spacecraft Theta - upper limit.
                     See DIM2_THETA for description."
/* RJW, DIM2_THETA_UPPER, f, 1, 3 */
END_OBJECT        = COLUMN

OBJECT            = COLUMN
  NAME            = DIM2_THETA_LOWER
  DATA_TYPE       = PC_REAL
  START_BYTE      = 7193
  ITEMS           = 3
  ITEM_BYTES      = 4
  BYTES           = 12
  VALID_MINIMUM   =   -75.0
  VALID_MAXIMUM   =    75.0
  MISSING_CONSTANT  = 65535.0
  UNIT            = "Degrees"
  DESCRIPTION     = "2nd Dimension of DATA: Spacecraft Theta - lower limit.
                     See DIM2_THETA for description."
/* RJW, DIM2_THETA_LOWER, f, 1, 3 */
END_OBJECT        = COLUMN


OBJECT            = COLUMN
```

```
  NAME            = DIM3_PHI
  DATA_TYPE        = PC_REAL
  START_BYTE       = 7205
  ITEMS           = 1
  ITEM_BYTES       = 4
  BYTES           = 4
  VALID_MINIMUM    =   155.0
  VALID_MAXIMUM    =   385.0
  MISSING_CONSTANT  = 65535.0
  UNIT            = "Degrees"
  DESCRIPTION      = "3rd Dimension of DATA: S/C Phi - representative value.
                   Spacecraft Phi (degs) is analogous to longitude on
                   a sphere. In spacecraft xyz co-ords:
                     +x is equivalent to phi =   0 degs
                     +y is equivalent to phi =  90 degs
                     -x is equivalent to phi = 180 degs
                     -y is equivalent to phi = 270 degs
                     +x is equivalent to phi = 360 degs
                     +y is equivalent to phi = 450 degs
                   The Phi angle varies because of actuator motion,
                     BUT this is NOT the same as actuator angle (ACT)
                     from the level 2 CAPS data: Phi = 270 - ACT
                   This is not a center value but a representative one.
                     Center values are the mid-points between the upper
                     and lower limits, in such cases the upper and lower
                     values are the first and last points of that range:
                       Center value  = (lower + upper)/2
                   In this case the actuator goes back and forth, slows
                     at the edges, such that a mid-point could be lower
                     than both the first and last points if the acuator
                     changed direction during that interval.
                   Phi angles are calculated every second from the start
                     to the end of the intervals duration and then:
                       Representative value  = mean(phi angles)
                       The lower limit value = min( phi angles)
                       The upper limit value = max( phi angles)
                   For IBS, this is Phi of anode 2 only.  See Theta
                   description for offset for anodes 1 and 3."
/* RJW, DIM3_PHI, f, 1, 1 */
END_OBJECT        = COLUMN

OBJECT            = COLUMN
  NAME            = DIM3_PHI_UPPER
  DATA_TYPE        = PC_REAL
  START_BYTE       = 7209
  ITEMS           = 1
  ITEM_BYTES       = 4
  BYTES           = 4
  VALID_MINIMUM    =   155.0
  VALID_MAXIMUM    =   385.0
  MISSING_CONSTANT  = 65535.0
  UNIT            = "Degrees"
  DESCRIPTION      = "3rd Dimension of DATA: S/C Phi - upper limit.
                     See DIM3_PHI for description."
/* RJW, DIM3_PHI_UPPER, f, 1, 1 */
END_OBJECT        = COLUMN

OBJECT            = COLUMN
  NAME            = DIM3_PHI_LOWER
```

```
  DATA_TYPE        = PC_REAL
  START_BYTE       = 7213
  ITEMS            = 1
  ITEM_BYTES       = 4
  BYTES            = 4
  VALID_MINIMUM    =   155.0
  VALID_MAXIMUM    =   385.0
  MISSING_CONSTANT = 65535.0
  UNIT             = "Degrees"
  DESCRIPTION      = "3rd Dimension of DATA: S/C Phi - lower limit.
                     See DIM3_PHI for description."
/* RJW, DIM3_PHI_LOWER, f, 1, 1 */
END_OBJECT         = COLUMN


OBJECT             = COLUMN
  NAME             = SC_POS_R
  DATA_TYPE        = PC_REAL
  START_BYTE       = 7217
  BYTES            = 4
  VALID_MINIMUM    =     0.0
  VALID_MAXIMUM    =   200.0
  MISSING_CONSTANT = 65535.0
  UNIT             = "Saturn Radii"
  DESCRIPTION      = "Cassini radial distance from Saturn.
                    The non-cruise part of the mission is below 200 Rs.
                    (1 Rs = 60268.0 km)
                    [Values may be greater than VALID_MAX
                    during cruise to Saturn before primary mission.]"
/* RJW, SC_POS_R, f, 1, 1 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = SC_POS_LAT
  DATA_TYPE        = PC_REAL
  START_BYTE       = 7221
  BYTES            = 4
  VALID_MINIMUM    =   -90.0
  VALID_MAXIMUM    =    90.0
  MISSING_CONSTANT = 65535.0
  UNIT             = "Degrees"
  DESCRIPTION      = "Cassini Latitude above Saturn.
                    (0 = Equatorial)"
/* RJW, SC_POS_LAT, f, 1, 1 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = SC_POS_LOCAL_TIME
  DATA_TYPE        = PC_REAL
  START_BYTE       = 7225
  BYTES            = 4
  VALID_MINIMUM    =     0.0
  VALID_MAXIMUM    =    24.0
  MISSING_CONSTANT = 65535.0
  UNIT             = "Hours"
  DESCRIPTION      = "Cassini Local Time from Saturn.
                     00 = Midnight
                     06 = Dawn
                     12 = Noon
```

```
                    18 = Dusk"
/* RJW, SC_POS_LOCAL_TIME, f, 1, 1 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = SC_POS_SATURN_J2000XYZ
  DATA_TYPE        = PC_REAL
  START_BYTE       = 7229
  ITEMS            = 3
  ITEM_BYTES       = 4
  BYTES            = 12
  VALID_MINIMUM    = -12000000.0 /* ~ -199 Rs */
  VALID_MAXIMUM    =  12000000.0 /* ~ +199 Rs */
  MISSING_CONSTANT =     65535.0 /* ~ +1.1 Rs */
  UNIT             = "km"
  DESCRIPTION      = "Cassini position from Saturn in J2000 cartesian
                  co-ordinates [x,y,z] (units km).
                  [Values may be outside of VALID_MIN/MAX range (~199Rs)
                  during cruise to Saturn before primary mission.]"
/* RJW, SC_POS_SATURN_J2000XYZ, f, 1, 3 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = SC_VEL_SATURN_J2000XYZ
  DATA_TYPE        = PC_REAL
  START_BYTE       = 7241
  ITEMS            = 3
  ITEM_BYTES       = 4
  BYTES            = 12
  VALID_MINIMUM    =   -40.0 /* V_mag at SOI near 31 km/s */
  VALID_MAXIMUM    =    40.0
  MISSING_CONSTANT = 65535.0
  UNIT             = "km/s"
  DESCRIPTION      = "Cassini Velocity with respect to Saturn in J2000
                  cartesian co-ordinates [Vx,Vy,Vz] (units km/s)."
/* RJW, SC_VEL_SATURN_J2000XYZ, f, 1, 3 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = SC_VEL_ANGULAR_J2000XYZ
  DATA_TYPE        = PC_REAL
  START_BYTE       = 7253
  ITEMS            = 3
  ITEM_BYTES       = 4
  BYTES            = 12
  VALID_MINIMUM    =    -1.0 /* General limit */
  VALID_MAXIMUM    =     1.0 /* General limit */
  MISSING_CONSTANT = 65535.0
  UNIT             = "radians/s"
  DESCRIPTION      = "Cassini Angular Velocity in cartesian co-ordinates
                  [AVx,AVy,AVz] (units radians/s).
                   (This is calculated with the SPICE ckgpav command
                    where ref=J2000.  SPICE defines it as 'This is the
                    axisabout which the reference frame tied to the
                    instrument is rotating in the right-handed sense')"
/* RJW, SC_VEL_ANGULAR_J2000XYZ, f, 1, 3 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
```

```
  NAME              = SC_TO_J2000
  DATA_TYPE         = PC_REAL
  START_BYTE        = 7265
  ITEMS             = 9
  ITEM_BYTES        = 4
  BYTES             = 36
  VALID_MINIMUM     =    -1.0
  VALID_MAXIMUM     =     1.0
  MISSING_CONSTANT  = 65535.0
  DESCRIPTION       = "Rotation matrix from spacecraft co-ordinates to J2000
                      This is a 3x3 matrix, expressed here as a 1x9 stream.
                      If the 1D stream is [a,b,c, d,e,f, g,h,i]
                      then the 2D matrix is [a,b,c
                                             d,e,f
                                             g,h,i]"
/* Should be, SC_TO_J2000, f, 2, 3, 3 */
/* RJW, SC_TO_J2000, f, 1, 9 */
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = J2000_TO_RTP
  DATA_TYPE         = PC_REAL
  START_BYTE        = 7301
  ITEMS             = 9
  ITEM_BYTES        = 4
  BYTES             = 36
  VALID_MINIMUM     =    -1.0
  VALID_MAXIMUM     =     1.0
  MISSING_CONSTANT  = 65535.0
  DESCRIPTION       = "Rotation matrix from J2000 co-ordinates to RTP,
                      where RTP is Saturn centered right handed R-Theta-Phi.
                      This is a 3x3 matrix, expressed here as a 1x9 stream.
                      If the 1D stream is [a,b,c, d,e,f, g,h,i]
                      then the 2D matrix is [a,b,c
                                             d,e,f
                                             g,h,i]"
/* Should be, J2000_TO_RTP, f, 2, 3, 3 */
/* RJW, J2000_TO_RTP, f, 1, 9 */
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = AUX_IBS_CEM_DAC
  DATA_TYPE         = PC_REAL
  START_BYTE        = 7337
  BYTES             = 4
  VALID_MINIMUM     = -4000.0
  VALID_MAXIMUM     =     0.0
  MISSING_CONSTANT  =     1.0
  UNIT              = "VOLTS"
  DESCRIPTION       = "IBS High Voltage channel-electron multiplier (cem)."
/* RJW, AUX_IBS_CEM_DAC, f, 1, 1 */
END_OBJECT          = COLUMN
```

Sample IBS Label File: IBS_YYYYDDDHH_V1.LBL

```
PDS_VERSION_ID = PDS3
DATA_SET_ID    = "CO-E/J/S/SW-CAPS-3-CALIBRATED-V1.0"
```

```
/* Input File: IBS_2004001_V01.DAT */
/* File written: 2013-09-28T22:23:14 local time*/

STANDARD_DATA_PRODUCT_ID = "IBS CALIBRATED L3"
PRODUCT_ID             = "IBS_200400100_V01"
PRODUCT_TYPE           = "DATA"
PRODUCT_CREATION_TIME    = 2013-271T22:23:14 /* UTC 2013-09-28 */
PROCESSING_LEVEL_ID      = "3"

RECORD_TYPE  = FIXED_LENGTH
RECORD_BYTES = 7340
FILE_RECORDS = 1982

START_TIME                = 2004-001T00:01:20.363 /* 2004-01-01 */
STOP_TIME                 = 2004-001T05:57:04.225 /* 2004-01-01 */
SPACECRAFT_CLOCK_START_COUNT = "1/1451607833.000"
SPACECRAFT_CLOCK_STOP_COUNT  = "1/1451629177.000"

INSTRUMENT_HOST_NAME = "CASSINI ORBITER"
INSTRUMENT_HOST_ID   = "CO"
TARGET_NAME          = {"SATURN"}
INSTRUMENT_NAME      = "CASSINI PLASMA SPECTROMETER"
INSTRUMENT_ID        = "CAPS"
DESCRIPTION = "This file contains the Level 3 data for CAPS IBS."

MD5_CHECKSUM = "71475d6e12b558784746dd2b45b70904"

NOTE = "See the PDS CAPS SIS Document for more details on the formats."

^TABLE = "IBS_200400100_V01.DAT"
OBJECT = TABLE
  INTERCHANGE_FORMAT = "BINARY"
  ROWS        = 1982
  COLUMNS     = 24
  ROW_BYTES   = 7340
  ^STRUCTURE  = "IBS_V01.FMT"
  DESCRIPTION = "Describes the structure and content of the data file."
END_OBJECT = TABLE
END
```

ION_V1.FMT File

```
OBJECT            = COLUMN
  NAME            = UTC
  DATA_TYPE       = DATE  /* ASCII character string */
  START_BYTE      = 1
  BYTES           = 21
  VALID_MINIMUM    = 2011-217T00:00:00.001
  VALID_MAXIMUM    = 2018-001T00:00:00.000
  MISSING_CONSTANT  = 0001-001T00:00:00.000
  DESCRIPTION      = "UTC timestamp, of format yyyy-dddTHH:MM:SS.sss
                 where yyyy = year, ddd = day of year,
                 HH = hour, MM = minute,
                 SS.sss = decimal seconds to millisecond resolution.
                 Value calculated via SPICE from spacecraft clock time."
/* RJW, UTC, c, 1, 21 */
```

```
END_OBJECT         = COLUMN

OBJECT            = COLUMN
  NAME            = DEAD_TIME_METHOD
  DATA_TYPE        = LSB_UNSIGNED_INTEGER
  START_BYTE       = 22
  BYTES           = 1
  VALID_MINIMUM     = 0
  VALID_MAXIMUM     = 2
  MISSING_CONSTANT  = 255
  DESCRIPTION       = "Dead Time Correction Method
                    0 = None: Data has not been Dead Time corrected.
                    1 = On ground (using quantized values).
                    2 = In flight, corrected prior to any bin summing and
                        prior to quantization for downlink (ELS only).
                  255 = Unknown."
/* RJW, DEAD_TIME_METHOD, B, 1, 1 */
END_OBJECT         = COLUMN

OBJECT            = COLUMN
  NAME            = TELEMETRY
  DATA_TYPE        = LSB_UNSIGNED_INTEGER
  START_BYTE       = 23
  BYTES           = 2
  VALID_MINIMUM     =   250
  VALID_MAXIMUM     = 16000
  MISSING_CONSTANT  = 65535
  UNIT            = "bps"
  DESCRIPTION       = "Telemetry Downlink Rate (bps).
                  (Independent of Solar Wind Modes)
                    Expected values are 250, 500,
                    1000, 2000, 4000, 8000, 16000"
/* RJW, TELEMETRY, H, 1, 1 */
END_OBJECT         = COLUMN

OBJECT            = COLUMN
  NAME            = DT
  DATA_TYPE        = PC_REAL /* i.e. a float in little endian format */
  START_BYTE       = 25
  BYTES           = 4
  VALID_MINIMUM     =  4.0
  VALID_MAXIMUM     = 32.0
  MISSING_CONSTANT  = -1.0
  UNIT            = "SECONDS"
  DESCRIPTION       = "Duration of Record (seconds)"
/* RJW, DT, f, 1, 1 */
END_OBJECT         = COLUMN

OBJECT            = COLUMN
  NAME            = ACCUMULATION_TIME
  DATA_TYPE        = PC_REAL
  START_BYTE       = 29
  ITEMS           = 63
  ITEM_BYTES       = 4
  BYTES           = 252
  VALID_MINIMUM     = 0.05468750
  VALID_MAXIMUM     = 1.75000000
  MISSING_CONSTANT  = -1
  UNIT            = "SECONDS"
```

```
  DESCRIPTION       = "ACCUMULATION_TIME of each bin (seconds)"
/* RJW, ACCUMULATION_TIME, f, 1, 63 */
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = DATA
  DATA_TYPE         = PC_REAL
  START_BYTE        = 281
  ITEMS             = 504
  ITEM_BYTES        = 4
  BYTES             = 2016
  VALID_MINIMUM     =       0.0
  VALID_MAXIMUM     = 1000000.0 /* 1e6 general upper limit*/
  MISSING_CONSTANT  =   65535.0
  UNIT              = "COUNTS/SECOND"
  DESCRIPTION       = "ION data of each bin (Counts per second)
                      Counts per accumulation have been (in order):
                       -Moved to middle of quantization bin
                       -Converted to counts/second.
                       -Maybe Dead time corrected (See DEAD_TIME_METHOD)
                       -Cross talk corrected."
/* Should be, DATA, f, 3, 63, 8, 1 */
/* RJW, DATA, f, 1, 504 */
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = DIM1_E
  DATA_TYPE         = PC_REAL
  START_BYTE        = 2297
  ITEMS             = 63
  ITEM_BYTES        = 4
  BYTES             = 252
  VALID_MINIMUM     =     0.0
  VALID_MAXIMUM     = 51000.0 /* rounded up to whole keV/q */
  MISSING_CONSTANT  = 65535.0
  UNIT              = "eV/q"
  DESCRIPTION       = "1st Dimension of DATA: Energy - center value (eV/q).
                       Upper and lower limits are given by the objects
                       DIM1_E_UPPER and DIM1_E_LOWER."
/* RJW, DIM1_E, f, 1, 63 */
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = DIM1_E_UPPER
  DATA_TYPE         = PC_REAL
  START_BYTE        = 2549
  ITEMS             = 63
  ITEM_BYTES        = 4
  BYTES             = 252
  VALID_MINIMUM     =     0.0
  VALID_MAXIMUM     = 51000.0 /* rounded up to whole keV/q */
  MISSING_CONSTANT  = 65535.0
  UNIT              = "eV/q"
  DESCRIPTION       = "1st Dimension of DATA: Energy - upper limit (eV/q).
                       See DIM1_E for description."
/* RJW, DIM1_E_UPPER, f, 1, 63 */
END_OBJECT          = COLUMN

OBJECT              = COLUMN
```

```
  NAME             = DIM1_E_LOWER
  DATA_TYPE        = PC_REAL
  START_BYTE       = 2801
  ITEMS            = 63
  ITEM_BYTES       = 4
  BYTES            = 252
  VALID_MINIMUM    =     0.0
  VALID_MAXIMUM    = 51000.0 /* rounded up to whole keV/q */
  MISSING_CONSTANT = 65535.0
  UNIT             = "eV/q"
  DESCRIPTION      = "1st Dimension of DATA: Energy - lower limit (eV/q).
                      See DIM1_E for description."
/* RJW, DIM1_E_LOWER, f, 1, 63 */
END_OBJECT         = COLUMN


OBJECT             = COLUMN
  NAME             = DIM2_THETA
  DATA_TYPE        = PC_REAL
  START_BYTE       = 3053
  ITEMS            = 8
  ITEM_BYTES       = 4
  BYTES            = 32
  VALID_MINIMUM    =   -80.0
  VALID_MAXIMUM    =    80.0
  MISSING_CONSTANT = 65535.0
  UNIT             = "Degrees"
  DESCRIPTION      = "2nd Dimension of DATA: Spacecraft Theta - center value.
                    Spacecraft Theta (degs) is analogous to latitude on
                    a sphere. In spacecraft xyz co-ords:
                     +z is equivalent to theta = +90 degs
                     -z is equivalent to theta = -90 degs
                        (The communication dish is directed along -z)
                     xy-plane at z=0 is equivalent to theta = 0
                    The 8 anodes break down to thetas of:
                      Anode 1 covers the range +60 to +80 degs
                      Anode 2 covers the range +40 to +60 degs
                      Anode 3 covers the range +20 to +40 degs
                      Anode 4 covers the range   0 to +20 degs
                      Anode 5 covers the range -20 to   0 degs
                      Anode 6 covers the range -40 to -20 degs
                      Anode 7 covers the range -60 to -40 degs
                      Anode 8 covers the range -80 to -60 degs"
/* RJW, DIM2_THETA, f, 1, 8 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = DIM2_THETA_UPPER
  DATA_TYPE        = PC_REAL
  START_BYTE       = 3085
  ITEMS            = 8
  ITEM_BYTES       = 4
  BYTES            = 32
  VALID_MINIMUM    =   -80.0
  VALID_MAXIMUM    =    80.0
  MISSING_CONSTANT = 65535.0
  UNIT             = "Degrees"
  DESCRIPTION      = "2nd Dimension of DATA: Spacecraft Theta - upper limit.
                      See DIM2_THETA for description."
```

```
/* RJW, DIM2_THETA_UPPER, f, 1, 8 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = DIM2_THETA_LOWER
  DATA_TYPE        = PC_REAL
  START_BYTE       = 3117
  ITEMS            = 8
  ITEM_BYTES       = 4
  BYTES            = 32
  VALID_MINIMUM    =   -80.0
  VALID_MAXIMUM    =    80.0
  MISSING_CONSTANT  = 65535.0
  UNIT             = "Degrees"
  DESCRIPTION      = "2nd Dimension of DATA: Spacecraft Theta - lower limit.
                     See DIM2_THETA for description."
/* RJW, DIM2_THETA_LOWER, f, 1, 8 */
END_OBJECT         = COLUMN


OBJECT             = COLUMN
  NAME             = DIM3_PHI
  DATA_TYPE        = PC_REAL
  START_BYTE       = 3149
  ITEMS            = 1
  ITEM_BYTES       = 4
  BYTES            = 4
  VALID_MINIMUM    =   155.0
  VALID_MAXIMUM    =   385.0
  MISSING_CONSTANT  = 65535.0
  UNIT             = "Degrees"
  DESCRIPTION      = "3rd Dimension of DATA: S/C Phi - representative value.
                    Spacecraft Phi (degs) is analogous to longitude on
                    a sphere. In spacecraft xyz co-ords:
                      +x is equivalent to phi =   0 degs
                      +y is equivalent to phi =  90 degs
                      -x is equivalent to phi = 180 degs
                      -y is equivalent to phi = 270 degs
                      +x is equivalent to phi = 360 degs
                      +y is equivalent to phi = 450 degs
                    The Phi angle varies because of actuator motion,
                      BUT this is NOT the same as actuator angle (ACT)
                      from the level 2 CAPS data: Phi = 270 - ACT
                    This is not a center value but a representative one.
                      Center values are the mid-points between the upper
                      and lower limits, in such cases the upper and lower
                      values are the first and last points of that range:
                        Center value  = (lower + upper)/2
                    In this case the actuator goes back and forth, slows
                      at the edges, such that a mid-point could be lower
                      than both the first and last points if the acuator
                      changed direction during that interval.
                    Phi angles are calculated every second from the start
                      to the end of the intervals duration and then:
                        Representative value  = mean(phi angles)
                        The lower limit value = min( phi angles)
                        The upper limit value = max( phi angles)"
/* RJW, DIM3_PHI, f, 1, 1 */
END_OBJECT         = COLUMN
```

```
OBJECT             = COLUMN
  NAME             = DIM3_PHI_UPPER
  DATA_TYPE        = PC_REAL
  START_BYTE       = 3153
  ITEMS            = 1
  ITEM_BYTES       = 4
  BYTES            = 4
  VALID_MINIMUM    =   155.0
  VALID_MAXIMUM    =   385.0
  MISSING_CONSTANT = 65535.0
  UNIT             = "Degrees"
  DESCRIPTION      = "3rd Dimension of DATA: S/C Phi - upper limit.
                     See DIM3_PHI for description."
/* RJW, DIM3_PHI_UPPER, f, 1, 1 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = DIM3_PHI_LOWER
  DATA_TYPE        = PC_REAL
  START_BYTE       = 3157
  ITEMS            = 1
  ITEM_BYTES       = 4
  BYTES            = 4
  VALID_MINIMUM    =   155.0
  VALID_MAXIMUM    =   385.0
  MISSING_CONSTANT = 65535.0
  UNIT             = "Degrees"
  DESCRIPTION      = "3rd Dimension of DATA: S/C Phi - lower limit.
                     See DIM3_PHI for description."
/* RJW, DIM3_PHI_LOWER, f, 1, 1 */
END_OBJECT         = COLUMN


OBJECT             = COLUMN
  NAME             = SC_POS_R
  DATA_TYPE        = PC_REAL
  START_BYTE       = 3161
  BYTES            = 4
  VALID_MINIMUM    =     0.0
  VALID_MAXIMUM    =   200.0
  MISSING_CONSTANT = 65535.0
  UNIT             = "Saturn Radii"
  DESCRIPTION      = "Cassini radial distance from Saturn.
                    The non-cruise part of the mission is below 200 Rs.
                    (1 Rs = 60268.0 km)
                    [Values may be greater than VALID_MAX
                    during cruise to Saturn before primary mission.]"
/* RJW, SC_POS_R, f, 1, 1 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = SC_POS_LAT
  DATA_TYPE        = PC_REAL
  START_BYTE       = 3165
  BYTES            = 4
  VALID_MINIMUM    =   -90.0
  VALID_MAXIMUM    =    90.0
  MISSING_CONSTANT = 65535.0
```

```
  UNIT             = "Degrees"
  DESCRIPTION      = "Cassini Latitude above Saturn.
                    (0 = Equatorial)"
/* RJW, SC_POS_LAT, f, 1, 1 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = SC_POS_LOCAL_TIME
  DATA_TYPE        = PC_REAL
  START_BYTE       = 3169
  BYTES            = 4
  VALID_MINIMUM    =     0.0
  VALID_MAXIMUM    =    24.0
  MISSING_CONSTANT = 65535.0
  UNIT             = "Hours"
  DESCRIPTION      = "Cassini Local Time from Saturn.
                      00 = Midnight
                      06 = Dawn
                      12 = Noon
                      18 = Dusk"
/* RJW, SC_POS_LOCAL_TIME, f, 1, 1 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = SC_POS_SATURN_J2000XYZ
  DATA_TYPE        = PC_REAL
  START_BYTE       = 3173
  ITEMS            = 3
  ITEM_BYTES       = 4
  BYTES            = 12
  VALID_MINIMUM    = -12000000.0 /* ~ -199 Rs */
  VALID_MAXIMUM    =  12000000.0 /* ~ +199 Rs */
  MISSING_CONSTANT =     65535.0 /* ~ +1.1 Rs */
  UNIT             = "km"
  DESCRIPTION      = "Cassini position from Saturn in J2000 cartesian
                    co-ordinates [x,y,z] (units km).
                    [Values may be outside of VALID_MIN/MAX range (~199Rs)
                    during cruise to Saturn before primary mission.]"
/* RJW, SC_POS_SATURN_J2000XYZ, f, 1, 3 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = SC_VEL_SATURN_J2000XYZ
  DATA_TYPE        = PC_REAL
  START_BYTE       = 3185
  ITEMS            = 3
  ITEM_BYTES       = 4
  BYTES            = 12
  VALID_MINIMUM    =   -40.0 /* V_mag at SOI near 31 km/s */
  VALID_MAXIMUM    =    40.0
  MISSING_CONSTANT = 65535.0
  UNIT             = "km/s"
  DESCRIPTION      = "Cassini Velocity with respect to Saturn in J2000
                    cartesian co-ordinates [Vx,Vy,Vz] (units km/s)."
/* RJW, SC_VEL_SATURN_J2000XYZ, f, 1, 3 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = SC_VEL_ANGULAR_J2000XYZ
```

```
  DATA_TYPE        = PC_REAL
  START_BYTE       = 3197
  ITEMS            = 3
  ITEM_BYTES       = 4
  BYTES            = 12
  VALID_MINIMUM    =   -1.0 /* General limit */
  VALID_MAXIMUM    =    1.0 /* General limit */
  MISSING_CONSTANT = 65535.0
  UNIT             = "radians/s"
  DESCRIPTION      = "Cassini Angular Velocity in cartesian co-ordinates
                     [AVx,AVy,AVz] (units radians/s).
                      (This is calculated with the SPICE ckgpav command
                       where ref=J2000.  SPICE defines it as 'This is the
                       axisabout which the reference frame tied to the
                       instrument is rotating in the right-handed sense')"
/* RJW, SC_VEL_ANGULAR_J2000XYZ, f, 1, 3 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = SC_TO_J2000
  DATA_TYPE        = PC_REAL
  START_BYTE       = 3209
  ITEMS            = 9
  ITEM_BYTES       = 4
  BYTES            = 36
  VALID_MINIMUM    =   -1.0
  VALID_MAXIMUM    =    1.0
  MISSING_CONSTANT = 65535.0
  DESCRIPTION      = "Rotation matrix from spacecraft co-ordinates to J2000
                     This is a 3x3 matrix, expressed here as a 1x9 stream.
                     If the 1D stream is [a,b,c, d,e,f, g,h,i]
                     then the 2D matrix is [a,b,c
                                            d,e,f
                                            g,h,i]"
/* Should be, SC_TO_J2000, f, 2, 3, 3 */
/* RJW, SC_TO_J2000, f, 1, 9 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = J2000_TO_RTP
  DATA_TYPE        = PC_REAL
  START_BYTE       = 3245
  ITEMS            = 9
  ITEM_BYTES       = 4
  BYTES            = 36
  VALID_MINIMUM    =   -1.0
  VALID_MAXIMUM    =    1.0
  MISSING_CONSTANT = 65535.0
  DESCRIPTION      = "Rotation matrix from J2000 co-ordinates to RTP,
                     where RTP is Saturn centered right handed R-Theta-Phi.
                     This is a 3x3 matrix, expressed here as a 1x9 stream.
                     If the 1D stream is [a,b,c, d,e,f, g,h,i]
                     then the 2D matrix is [a,b,c
                                            d,e,f
                                            g,h,i]"
/* Should be, J2000_TO_RTP, f, 2, 3, 3 */
/* RJW, J2000_TO_RTP, f, 1, 9 */
END_OBJECT         = COLUMN
```

```
OBJECT              = COLUMN
  NAME              = AUX_HVU2_ST_DAC
  DATA_TYPE         = PC_REAL
  START_BYTE        = 3281
  BYTES             = 4
  VALID_MINIMUM     = -3600.0
  VALID_MAXIMUM     =     0.0
  MISSING_CONSTANT  =     1.0*/
  UNIT              = "VOLTS"
  DESCRIPTION       = "High Voltage Unit 2 (HVU2) Straight Through
                      multichannel plate (mcp)."
/* RJW, AUX_HVU2_ST_DAC, f, 1, 1 */
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = AUX_HVU2_LEF_DAC
  DATA_TYPE         = PC_REAL
  START_BYTE        = 3285
  BYTES             = 4
  VALID_MINIMUM     = -2400.0
  VALID_MAXIMUM     =     0.0
  MISSING_CONSTANT  =     1.0
  UNIT              = "VOLTS"
  DESCRIPTION       = "High Voltage Unit 2 (HVU2) Linear Electric
                      Field multichannel plate (mcp)."
/* RJW, AUX_HVU2_LEF_DAC, f, 1, 1 */
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = ION_MASS_RANGE
  DATA_TYPE         = LSB_UNSIGNED_INTEGER
  START_BYTE        = 3289
  BYTES             = 2
  VALID_MINIMUM     =   1
  VALID_MAXIMUM     =  32
  MISSING_CONSTANT  = 255
  UNIT              = "AMU"
  DESCRIPTION       = "Mass range of ions, lower and upper given.
                      Range will have same charge, see ION_CHARGE."
/* RJW, ION_MASS_RANGE, B, 1, 2 */
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = ION_CHARGE
  DATA_TYPE         = LSB_UNSIGNED_INTEGER
  START_BYTE        = 3291
  BYTES             = 1
  VALID_MINIMUM     =   1
  VALID_MAXIMUM     =   3
  MISSING_CONSTANT  = 255
  UNIT              = "e"
  DESCRIPTION       = "Charge of ions in ION_MASS_RANGE."
/* RJW, ION_CHARGE, B, 1, 1 */
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = SPARE
  DATA_TYPE         = LSB_UNSIGNED_INTEGER
  START_BYTE        = 3292
```

```
  BYTES            = 1
  VALID_MINIMUM    =   0
  VALID_MAXIMUM    =   0
  MISSING_CONSTANT  = 255
  DESCRIPTION      = "SPARE byte - should be zero.
                    Only here to meet PDS requirement to start
                     byte words on even numbers of bytes."
/* RJW, SPARE, B, 1, 1 */
END_OBJECT         = COLUMN
```

Sample ION Label File: ION_YYYYDDDHH_V1.LBL

```
PDS_VERSION_ID = PDS3
DATA_SET_ID    = "CO-E/J/S/SW-CAPS-3-CALIBRATED-V1.0"

/* Input File: ION_2004001_V01.DAT */
/* File written: 2013-09-28T22:23:00 local time*/

STANDARD_DATA_PRODUCT_ID = "ION CALIBRATED L3"
PRODUCT_ID             = "ION_200400100_V01"
PRODUCT_TYPE           = "DATA"
PRODUCT_CREATION_TIME    = 2013-271T22:23:00 /* UTC 2013-09-28 */
PROCESSING_LEVEL_ID      = "3"

RECORD_TYPE  = FIXED_LENGTH
RECORD_BYTES = 3292
FILE_RECORDS = 294

START_TIME                = 2004-001T00:10:56.359 /* 2004-01-01 */
STOP_TIME                = 2004-001T05:43:44.229 /* 2004-01-01 */
SPACECRAFT_CLOCK_START_COUNT = "1/1451608409.000"
SPACECRAFT_CLOCK_STOP_COUNT  = "1/1451628377.000"

INSTRUMENT_HOST_NAME = "CASSINI ORBITER"
INSTRUMENT_HOST_ID   = "CO"
TARGET_NAME         = {"SATURN"}
INSTRUMENT_NAME      = "CASSINI PLASMA SPECTROMETER"
INSTRUMENT_ID        = "CAPS"
DESCRIPTION = "This file contains the Level 3 data for CAPS ION."

MD5_CHECKSUM = "758e1ec2c891c7e49bbb6094e323e157"

NOTE = "See the PDS CAPS SIS Document for more details on the formats."

^TABLE = "ION_200400100_V01.DAT"
OBJECT = TABLE
  INTERCHANGE_FORMAT = "BINARY"
  ROWS        = 294
  COLUMNS     = 28
  ROW_BYTES   = 3292
  ^STRUCTURE  = "ION_V01.FMT"
  DESCRIPTION = "Describes the structure and content of the data file."
END_OBJECT = TABLE
END
```

SNG_V1.FMT File

```
OBJECT            = COLUMN
  NAME            = UTC
  DATA_TYPE       = DATE  /* ASCII character string */
  START_BYTE      = 1
  BYTES           = 21
  VALID_MINIMUM    = 2011-217T00:00:00.001
  VALID_MAXIMUM    = 2018-001T00:00:00.000
  MISSING_CONSTANT  = 0001-001T00:00:00.000
  DESCRIPTION      = "UTC timestamp, of format yyyy-dddTHH:MM:SS.sss
                    where yyyy = year, ddd = day of year,
                    HH = hour, MM = minute,
                    SS.sss = decimal seconds to millisecond resolution.
                    Value calculated via SPICE from spacecraft clock time."
/* RJW, UTC, c, 1, 21 */
END_OBJECT        = COLUMN

OBJECT            = COLUMN
  NAME            = DEAD_TIME_METHOD
  DATA_TYPE       = LSB_UNSIGNED_INTEGER
  START_BYTE      = 22
  BYTES           = 1
  VALID_MINIMUM    = 0
  VALID_MAXIMUM    = 2
  MISSING_CONSTANT  = 255
  DESCRIPTION      = "Dead Time Correction Method
                     0 = None: Data has not been Dead Time corrected.
                     1 = On ground (using quantized values).
                     2 = In flight, corrected prior to any bin summing and
                        prior to quantization for downlink (ELS only).
                    255 = Unknown."
/* RJW, DEAD_TIME_METHOD, B, 1, 1 */
END_OBJECT        = COLUMN

OBJECT            = COLUMN
  NAME            = TELEMETRY
  DATA_TYPE       = LSB_UNSIGNED_INTEGER
  START_BYTE      = 23
  BYTES           = 2
  VALID_MINIMUM    =   250
  VALID_MAXIMUM    = 16000
  MISSING_CONSTANT  = 65535
  UNIT            = "bps"
  DESCRIPTION      = "Telemetry Downlink Rate (bps).
                    (Independent of Solar Wind Modes)
                     Expected values are 250, 500,
                     1000, 2000, 4000, 8000, 16000"
/* RJW, TELEMETRY, H, 1, 1 */
END_OBJECT        = COLUMN

OBJECT            = COLUMN
  NAME            = DT
  DATA_TYPE       = PC_REAL /* i.e. a float in little endian format */
  START_BYTE      = 25
  BYTES           = 4
  VALID_MINIMUM    =  4.0
  VALID_MAXIMUM    = 32.0
  MISSING_CONSTANT  = -1.0
```

```
  UNIT            = "SECONDS"
  DESCRIPTION     = "Duration of Record (seconds)"
/* RJW, DT, f, 1, 1 */
END_OBJECT        = COLUMN

OBJECT            = COLUMN
  NAME            = ACCUMULATION_TIME
  DATA_TYPE       = PC_REAL
  START_BYTE      = 29
  ITEMS           = 63
  ITEM_BYTES      = 4
  BYTES           = 252
  VALID_MINIMUM   = 0.05468750
  VALID_MAXIMUM   = 1.75000000
  MISSING_CONSTANT = -1
  UNIT            = "SECONDS"
  DESCRIPTION     = "ACCUMULATION_TIME of each bin (seconds)"
/* RJW, ACCUMULATION_TIME, f, 1, 63 */
END_OBJECT        = COLUMN

OBJECT            = COLUMN
  NAME            = DATA
  DATA_TYPE       = PC_REAL
  START_BYTE      = 281
  ITEMS           = 504
  ITEM_BYTES      = 4
  BYTES           = 2016
  VALID_MINIMUM   =     0.0
  VALID_MAXIMUM   = 1000000.0 /* 1e6 general upper limit*/
  MISSING_CONSTANT =   65535.0
  UNIT            = "COUNTS/SECOND"
  DESCRIPTION     = "SNG data of each bin (Counts per second)
                    Counts per accumulation have been (in order):
                     -Moved to middle of quantization bin
                     -Converted to counts/second.
                     -Maybe Dead time corrected (See DEAD_TIME_METHOD)
                     -Cross talk corrected."
/* Should be, DATA, f, 3, 63, 8, 1 */
/* RJW, DATA, f, 1, 504 */
END_OBJECT        = COLUMN

OBJECT            = COLUMN
  NAME            = DIM1_E
  DATA_TYPE       = PC_REAL
  START_BYTE      = 2297
  ITEMS           = 63
  ITEM_BYTES      = 4
  BYTES           = 252
  VALID_MINIMUM   =    0.0
  VALID_MAXIMUM   = 51000.0 /* rounded up to whole keV/q */
  MISSING_CONSTANT = 65535.0
  UNIT            = "eV/q"
  DESCRIPTION     = "1st Dimension of DATA: Energy - center value (eV/q).
                     Upper and lower limits are given by the objects
                     DIM1_E_UPPER and DIM1_E_LOWER."
/* RJW, DIM1_E, f, 1, 63 */
END_OBJECT        = COLUMN

OBJECT            = COLUMN
```

```
  NAME             = DIM1_E_UPPER
  DATA_TYPE        = PC_REAL
  START_BYTE       = 2549
  ITEMS            = 63
  ITEM_BYTES       = 4
  BYTES            = 252
  VALID_MINIMUM    =     0.0
  VALID_MAXIMUM    = 51000.0 /* rounded up to whole keV/q */
  MISSING_CONSTANT = 65535.0
  UNIT             = "eV/q"
  DESCRIPTION      = "1st Dimension of DATA: Energy - upper limit (eV/q).
                     See DIM1_E for description."
/* RJW, DIM1_E_UPPER, f, 1, 63 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = DIM1_E_LOWER
  DATA_TYPE        = PC_REAL
  START_BYTE       = 2801
  ITEMS            = 63
  ITEM_BYTES       = 4
  BYTES            = 252
  VALID_MINIMUM    =     0.0
  VALID_MAXIMUM    = 51000.0 /* rounded up to whole keV/q */
  MISSING_CONSTANT = 65535.0
  UNIT             = "eV/q"
  DESCRIPTION      = "1st Dimension of DATA: Energy - lower limit (eV/q).
                     See DIM1_E for description."
/* RJW, DIM1_E_LOWER, f, 1, 63 */
END_OBJECT         = COLUMN


OBJECT             = COLUMN
  NAME             = DIM2_THETA
  DATA_TYPE        = PC_REAL
  START_BYTE       = 3053
  ITEMS            = 8
  ITEM_BYTES       = 4
  BYTES            = 32
  VALID_MINIMUM    =   -80.0
  VALID_MAXIMUM    =    80.0
  MISSING_CONSTANT = 65535.0
  UNIT             = "Degrees"
  DESCRIPTION      = "2nd Dimension of DATA: Spacecraft Theta - center value.
                    Spacecraft Theta (degs) is analogous to latitude on
                    a sphere. In spacecraft xyz co-ords:
                     +z is equivalent to theta = +90 degs
                     -z is equivalent to theta = -90 degs
                       (The communication dish is directed along -z)
                     xy-plane at z=0 is equivalent to theta = 0
                    The 8 anodes break down to thetas of:
                      Anode 1 covers the range +60 to +80 degs
                      Anode 2 covers the range +40 to +60 degs
                      Anode 3 covers the range +20 to +40 degs
                      Anode 4 covers the range   0 to +20 degs
                      Anode 5 covers the range -20 to   0 degs
                      Anode 6 covers the range -40 to -20 degs
                      Anode 7 covers the range -60 to -40 degs
                      Anode 8 covers the range -80 to -60 degs"
```

```
/* RJW, DIM2_THETA, f, 1, 8 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = DIM2_THETA_UPPER
  DATA_TYPE        = PC_REAL
  START_BYTE       = 3085
  ITEMS            = 8
  ITEM_BYTES       = 4
  BYTES            = 32
  VALID_MINIMUM    =   -80.0
  VALID_MAXIMUM    =    80.0
  MISSING_CONSTANT = 65535.0
  UNIT             = "Degrees"
  DESCRIPTION      = "2nd Dimension of DATA: Spacecraft Theta - upper limit.
                     See DIM2_THETA for description."
/* RJW, DIM2_THETA_UPPER, f, 1, 8 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = DIM2_THETA_LOWER
  DATA_TYPE        = PC_REAL
  START_BYTE       = 3117
  ITEMS            = 8
  ITEM_BYTES       = 4
  BYTES            = 32
  VALID_MINIMUM    =   -80.0
  VALID_MAXIMUM    =    80.0
  MISSING_CONSTANT = 65535.0
  UNIT             = "Degrees"
  DESCRIPTION      = "2nd Dimension of DATA: Spacecraft Theta - lower limit.
                     See DIM2_THETA for description."
/* RJW, DIM2_THETA_LOWER, f, 1, 8 */
END_OBJECT         = COLUMN


OBJECT             = COLUMN
  NAME             = DIM3_PHI
  DATA_TYPE        = PC_REAL
  START_BYTE       = 3149
  ITEMS            = 1
  ITEM_BYTES       = 4
  BYTES            = 4
  VALID_MINIMUM    =   155.0
  VALID_MAXIMUM    =   385.0
  MISSING_CONSTANT = 65535.0
  UNIT             = "Degrees"
  DESCRIPTION      = "3rd Dimension of DATA: S/C Phi - representative value.
                    Spacecraft Phi (degs) is analogous to longitude on
                    a sphere. In spacecraft xyz co-ords:
                      +x is equivalent to phi =   0 degs
                      +y is equivalent to phi =  90 degs
                      -x is equivalent to phi = 180 degs
                      -y is equivalent to phi = 270 degs
                      +x is equivalent to phi = 360 degs
                      +y is equivalent to phi = 450 degs
                    The Phi angle varies because of actuator motion,
                      BUT this is NOT the same as actuator angle (ACT)
                      from the level 2 CAPS data: Phi = 270 - ACT
```

```
                    This is not a center value but a representative one.
                      Center values are the mid-points between the upper
                      and lower limits, in such cases the upper and lower
                      values are the first and last points of that range:
                        Center value  = (lower + upper)/2
                    In this case the actuator goes back and forth, slows
                      at the edges, such that a mid-point could be lower
                      than both the first and last points if the acuator
                      changed direction during that interval.
                    Phi angles are calculated every second from the start
                      to the end of the intervals duration and then:
                        Representative value  = mean(phi angles)
                        The lower limit value = min( phi angles)
                        The upper limit value = max( phi angles)"
/* RJW, DIM3_PHI, f, 1, 1 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = DIM3_PHI_UPPER
  DATA_TYPE        = PC_REAL
  START_BYTE       = 3153
  ITEMS            = 1
  ITEM_BYTES       = 4
  BYTES            = 4
  VALID_MINIMUM    =   155.0
  VALID_MAXIMUM    =   385.0
  MISSING_CONSTANT  = 65535.0
  UNIT             = "Degrees"
  DESCRIPTION      = "3rd Dimension of DATA: S/C Phi - upper limit.
                      See DIM3_PHI for description."
/* RJW, DIM3_PHI_UPPER, f, 1, 1 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = DIM3_PHI_LOWER
  DATA_TYPE        = PC_REAL
  START_BYTE       = 3157
  ITEMS            = 1
  ITEM_BYTES       = 4
  BYTES            = 4
  VALID_MINIMUM    =   155.0
  VALID_MAXIMUM    =   385.0
  MISSING_CONSTANT  = 65535.0
  UNIT             = "Degrees"
  DESCRIPTION      = "3rd Dimension of DATA: S/C Phi - lower limit.
                      See DIM3_PHI for description."
/* RJW, DIM3_PHI_LOWER, f, 1, 1 */
END_OBJECT         = COLUMN


OBJECT             = COLUMN
  NAME             = SC_POS_R
  DATA_TYPE        = PC_REAL
  START_BYTE       = 3161
  BYTES            = 4
  VALID_MINIMUM    =     0.0
  VALID_MAXIMUM    =   200.0
  MISSING_CONSTANT  = 65535.0
  UNIT             = "Saturn Radii"
```

```
  DESCRIPTION       = "Cassini radial distance from Saturn.
                      The non-cruise part of the mission is below 200 Rs.
                      (1 Rs = 60268.0 km)
                      [Values may be greater than VALID_MAX
                      during cruise to Saturn before primary mission.]"
/* RJW, SC_POS_R, f, 1, 1 */
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = SC_POS_LAT
  DATA_TYPE         = PC_REAL
  START_BYTE        = 3165
  BYTES             = 4
  VALID_MINIMUM     =   -90.0
  VALID_MAXIMUM     =    90.0
  MISSING_CONSTANT  = 65535.0
  UNIT              = "Degrees"
  DESCRIPTION       = "Cassini Latitude above Saturn.
                      (0 = Equatorial)"
/* RJW, SC_POS_LAT, f, 1, 1 */
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = SC_POS_LOCAL_TIME
  DATA_TYPE         = PC_REAL
  START_BYTE        = 3169
  BYTES             = 4
  VALID_MINIMUM     =     0.0
  VALID_MAXIMUM     =    24.0
  MISSING_CONSTANT  = 65535.0
  UNIT              = "Hours"
  DESCRIPTION       = "Cassini Local Time from Saturn.
                        00 = Midnight
                        06 = Dawn
                        12 = Noon
                        18 = Dusk"
/* RJW, SC_POS_LOCAL_TIME, f, 1, 1 */
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = SC_POS_SATURN_J2000XYZ
  DATA_TYPE         = PC_REAL
  START_BYTE        = 3173
  ITEMS             = 3
  ITEM_BYTES        = 4
  BYTES             = 12
  VALID_MINIMUM     = -12000000.0 /* ~ -199 Rs */
  VALID_MAXIMUM     =  12000000.0 /* ~ +199 Rs */
  MISSING_CONSTANT  =     65535.0 /* ~ +1.1 Rs */
  UNIT              = "km"
  DESCRIPTION       = "Cassini position from Saturn in J2000 cartesian
                      co-ordinates [x,y,z] (units km).
                      [Values may be outside of VALID_MIN/MAX range (~199Rs)
                      during cruise to Saturn before primary mission.]"
/* RJW, SC_POS_SATURN_J2000XYZ, f, 1, 3 */
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = SC_VEL_SATURN_J2000XYZ
```

```
  DATA_TYPE        = PC_REAL
  START_BYTE       = 3185
  ITEMS            = 3
  ITEM_BYTES       = 4
  BYTES            = 12
  VALID_MINIMUM    =   -40.0 /* V_mag at SOI near 31 km/s */
  VALID_MAXIMUM    =    40.0
  MISSING_CONSTANT  = 65535.0
  UNIT             = "km/s"
  DESCRIPTION      = "Cassini Velocity with respect to Saturn in J2000
                   cartesian co-ordinates [Vx,Vy,Vz] (units km/s)."
/* RJW, SC_VEL_SATURN_J2000XYZ, f, 1, 3 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = SC_VEL_ANGULAR_J2000XYZ
  DATA_TYPE        = PC_REAL
  START_BYTE       = 3197
  ITEMS            = 3
  ITEM_BYTES       = 4
  BYTES            = 12
  VALID_MINIMUM    =    -1.0 /* General limit */
  VALID_MAXIMUM    =     1.0 /* General limit */
  MISSING_CONSTANT  = 65535.0
  UNIT             = "radians/s"
  DESCRIPTION      = "Cassini Angular Velocity in cartesian co-ordinates
                   [AVx,AVy,AVz] (units radians/s).
                    (This is calculated with the SPICE ckgpav command
                     where ref=J2000.  SPICE defines it as 'This is the
                     axisabout which the reference frame tied to the
                     instrument is rotating in the right-handed sense')"
/* RJW, SC_VEL_ANGULAR_J2000XYZ, f, 1, 3 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = SC_TO_J2000
  DATA_TYPE        = PC_REAL
  START_BYTE       = 3209
  ITEMS            = 9
  ITEM_BYTES       = 4
  BYTES            = 36
  VALID_MINIMUM    =    -1.0
  VALID_MAXIMUM    =     1.0
  MISSING_CONSTANT  = 65535.0
  DESCRIPTION      = "Rotation matrix from spacecraft co-ordinates to J2000
                   This is a 3x3 matrix, expressed here as a 1x9 stream.
                   If the 1D stream is [a,b,c, d,e,f, g,h,i]
                   then the 2D matrix is [a,b,c
                                          d,e,f
                                          g,h,i]"
/* Should be, SC_TO_J2000, f, 2, 3, 3 */
/* RJW, SC_TO_J2000, f, 1, 9 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = J2000_TO_RTP
  DATA_TYPE        = PC_REAL
  START_BYTE       = 3245
  ITEMS            = 9
```

```
  ITEM_BYTES        = 4
  BYTES             = 36
  VALID_MINIMUM     =    -1.0
  VALID_MAXIMUM     =     1.0
  MISSING_CONSTANT  = 65535.0
  DESCRIPTION       = "Rotation matrix from J2000 co-ordinates to RTP,
                    where RTP is Saturn centered right handed R-Theta-Phi.
                    This is a 3x3 matrix, expressed here as a 1x9 stream.
                    If the 1D stream is [a,b,c, d,e,f, g,h,i]
                    then the 2D matrix is [a,b,c
                                           d,e,f
                                           g,h,i]"
/* Should be, J2000_TO_RTP, f, 2, 3, 3 */
/* RJW, J2000_TO_RTP, f, 1, 9 */
END_OBJECT          = COLUMN

OBJECT            = COLUMN
  NAME            = AUX_HVU2_ST_DAC
  DATA_TYPE       = PC_REAL
  START_BYTE      = 3281
  BYTES           = 4
  VALID_MINIMUM     = -3600.0
  VALID_MAXIMUM     =     0.0
  MISSING_CONSTANT  =     1.0
  UNIT            = "VOLTS"
  DESCRIPTION       = "High Voltage Unit 2 (HVU2) Straight Through
                    multichannel plate (mcp)."
/* RJW, AUX_HVU2_ST_DAC, f, 1, 1 */
END_OBJECT          = COLUMN
```

Sample SNG Label File: SNG_YYYYDDDHH_V1.LBL

```
PDS_VERSION_ID = PDS3
DATA_SET_ID    = "CO-E/J/S/SW-CAPS-3-CALIBRATED-V1.0"

/* Input File: SNG_2004001_V01.DAT */
/* File written: 2013-09-28T22:22:52 local time*/

STANDARD_DATA_PRODUCT_ID = "SNG CALIBRATED L3"
PRODUCT_ID               = "SNG_200400100_V01"
PRODUCT_TYPE             = "DATA"
PRODUCT_CREATION_TIME    = 2013-271T22:22:52 /* UTC 2013-09-28 */
PROCESSING_LEVEL_ID      = "3"

RECORD_TYPE  = FIXED_LENGTH
RECORD_BYTES = 3284
FILE_RECORDS = 539

START_TIME                  = 2004-001T00:00:48.363 /* 2004-01-01 */
STOP_TIME                   = 2004-001T06:00:16.222 /* 2004-01-01 */
SPACECRAFT_CLOCK_START_COUNT = "1/1451607801.000"
SPACECRAFT_CLOCK_STOP_COUNT  = "1/1451629369.000"

INSTRUMENT_HOST_NAME = "CASSINI ORBITER"
INSTRUMENT_HOST_ID   = "CO"
TARGET_NAME          = {"SATURN"}
INSTRUMENT_NAME      = "CASSINI PLASMA SPECTROMETER"
INSTRUMENT_ID        = "CAPS"
```

```
DESCRIPTION = "This file contains the Level 3 data for CAPS SNG."

MD5_CHECKSUM = "f440b6ca297f4c8aa0d91fc8da4eaeb6"

NOTE = "See the PDS CAPS SIS Document for more details on the formats."

^TABLE = "SNG_200400100_V01.DAT"
OBJECT = TABLE
  INTERCHANGE_FORMAT = "BINARY"
  ROWS        = 539
  COLUMNS     = 24
  ROW_BYTES   = 3284
  ^STRUCTURE  = "SNG_V01.FMT"
  DESCRIPTION = "Describes the structure and content of the data file."
END_OBJECT = TABLE
END
```

TOFLEF_V1.FMT File

```
OBJECT             = COLUMN
  NAME             = UTC
  DATA_TYPE        = DATE  /* ASCII character string */
  START_BYTE       = 1
  BYTES            = 21
  VALID_MINIMUM    = 2011-217T00:00:00.001
  VALID_MAXIMUM    = 2018-001T00:00:00.000
  MISSING_CONSTANT  = 0001-001T00:00:00.000
  DESCRIPTION      = "UTC timestamp, of format yyyy-dddTHH:MM:SS.sss
                    where yyyy = year, ddd = day of year,
                    HH = hour, MM = minute,
                    SS.sss = decimal seconds to millisecond resolution.
                    Value calculated via SPICE from spacecraft clock time."
/* RJW, UTC, c, 1, 21 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = DEAD_TIME_METHOD
  DATA_TYPE        = LSB_UNSIGNED_INTEGER
  START_BYTE       = 22
  BYTES            = 1
  VALID_MINIMUM    = 0
  VALID_MAXIMUM    = 2
  MISSING_CONSTANT  = 255
  DESCRIPTION      = "Dead Time Correction Method
                      0 = None: Data has not been Dead Time corrected.
                      1 = On ground (using quantized values).
                      2 = In flight, corrected prior to any bin summing and
                          prior to quantization for downlink (ELS only).
                    255 = Unknown."
/* RJW, DEAD_TIME_METHOD, B, 1, 1 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = TELEMETRY
  DATA_TYPE        = LSB_UNSIGNED_INTEGER
  START_BYTE       = 23
```

```
  BYTES           = 2
  VALID_MINIMUM    =   250
  VALID_MAXIMUM    = 16000
  MISSING_CONSTANT  = 65535
  UNIT            = "bps"
  DESCRIPTION      = "Telemetry Downlink Rate (bps).
                    (Independent of Solar Wind Modes)
                     Expected values are 250, 500,
                     1000, 2000, 4000, 8000, 16000"
/* RJW, TELEMETRY, H, 1, 1 */
END_OBJECT        = COLUMN

OBJECT            = COLUMN
  NAME            = DT
  DATA_TYPE        = PC_REAL /* i.e. a float in little endian format */
  START_BYTE       = 25
  BYTES           = 4
  VALID_MINIMUM    =  256.0
  VALID_MAXIMUM    = 1024.0
  MISSING_CONSTANT  = -1.0
  UNIT            = "SECONDS"
  DESCRIPTION      = "Duration of Record (seconds)"
/* RJW, DT, f, 1, 1 */
END_OBJECT        = COLUMN

OBJECT            = COLUMN
  NAME            = ACCUMULATION_TIME
  DATA_TYPE        = PC_REAL
  START_BYTE       = 29
  ITEMS           = 32
  ITEM_BYTES       = 4
  BYTES           = 128
  VALID_MINIMUM    = 3.50000000
  VALID_MAXIMUM    = 28.00000000
  MISSING_CONSTANT  = -1
  UNIT            = "SECONDS"
  DESCRIPTION      = "ACCUMULATION_TIME of each bin (seconds)"
/* RJW, ACCUMULATION_TIME, f, 1, 32 */
END_OBJECT        = COLUMN

OBJECT            = COLUMN
  NAME            = DATA
  DATA_TYPE        = PC_REAL
  START_BYTE       = 157
  ITEMS           = 16384
  ITEM_BYTES       = 4
  BYTES           = 65536
  VALID_MINIMUM    =      0.0
  VALID_MAXIMUM    = 1000000.0 /* 1e6 general upper limit*/
  MISSING_CONSTANT  = 4294967296 /* not 65535 */
  UNIT            = "COUNTS/SECOND"
  DESCRIPTION      = "TOFLEF data of each bin (Counts per second)
                    Counts per accumulation have been (in order):
                     -Moved to middle of quantization bin
                     -Converted to counts/second.
                     -Maybe Dead time corrected (See DEAD_TIME_METHOD)
                    For TOFLEF data, it is possible a very high count
                    rate could dead time correct to negative counts.
                    If so, all TOF channels at that energy are set
```

```
                    to fill."
/* Should be, DATA, f, 4, 32, 1, 1, 512 */
/* RJW, DATA, f, 1, 16384 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = DIM1_E
  DATA_TYPE        = PC_REAL
  START_BYTE       = 65693
  ITEMS            = 32
  ITEM_BYTES       = 4
  BYTES            = 128
  VALID_MINIMUM    =     0.0
  VALID_MAXIMUM    = 51000.0 /* rounded up to whole keV/q */
  MISSING_CONSTANT = 65535.0
  UNIT             = "eV/q"
  DESCRIPTION      = "1st Dimension of DATA: Energy - center value (eV/q).
                     Upper and lower limits are given by the objects
                     DIM1_E_UPPER and DIM1_E_LOWER."
/* RJW, DIM1_E, f, 1, 32 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = DIM1_E_UPPER
  DATA_TYPE        = PC_REAL
  START_BYTE       = 65821
  ITEMS            = 32
  ITEM_BYTES       = 4
  BYTES            = 128
  VALID_MINIMUM    =     0.0
  VALID_MAXIMUM    = 51000.0 /* rounded up to whole keV/q */
  MISSING_CONSTANT = 65535.0
  UNIT             = "eV/q"
  DESCRIPTION      = "1st Dimension of DATA: Energy - upper limit (eV/q).
                     See DIM1_E for description."
/* RJW, DIM1_E_UPPER, f, 1, 32 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = DIM1_E_LOWER
  DATA_TYPE        = PC_REAL
  START_BYTE       = 65949
  ITEMS            = 32
  ITEM_BYTES       = 4
  BYTES            = 128
  VALID_MINIMUM    =     0.0
  VALID_MAXIMUM    = 51000.0 /* rounded up to whole keV/q */
  MISSING_CONSTANT = 65535.0
  UNIT             = "eV/q"
  DESCRIPTION      = "1st Dimension of DATA: Energy - lower limit (eV/q).
                     See DIM1_E for description."
/* RJW, DIM1_E_LOWER, f, 1, 32 */
END_OBJECT         = COLUMN


OBJECT             = COLUMN
  NAME             = DIM2_THETA
  DATA_TYPE        = PC_REAL
  START_BYTE       = 66077
```

```
  ITEMS            = 1
  ITEM_BYTES       = 4
  BYTES            = 4
  VALID_MINIMUM    =   -80.0
  VALID_MAXIMUM    =    80.0
  MISSING_CONSTANT  = 65535.0
  UNIT             = "Degrees"
  DESCRIPTION      = "2nd Dimension of DATA: Spacecraft Theta - center value.
                    Spacecraft Theta (degs) is analogous to latitude on
                    a sphere. In spacecraft xyz co-ords:
                     +z is equivalent to theta = +90 degs
                     -z is equivalent to theta = -90 degs
                       (The communication dish is directed along -z)
                     xy-plane at z=0 is equivalent to theta = 0
                    Just 1 anode for TOF data:
                      Anode 1 covers the range -80 to +80 degs
                    This 1 TOF anode covers the same field of
                    view as all 8 SNG anodes."
/* RJW, DIM2_THETA, f, 1, 1 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = DIM2_THETA_UPPER
  DATA_TYPE        = PC_REAL
  START_BYTE       = 66081
  ITEMS            = 1
  ITEM_BYTES       = 4
  BYTES            = 4
  VALID_MINIMUM    =   -80.0
  VALID_MAXIMUM    =    80.0
  MISSING_CONSTANT  = 65535.0
  UNIT             = "Degrees"
  DESCRIPTION      = "2nd Dimension of DATA: Spacecraft Theta - upper limit.
                     See DIM2_THETA for description."
/* RJW, DIM2_THETA_UPPER, f, 1, 1 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = DIM2_THETA_LOWER
  DATA_TYPE        = PC_REAL
  START_BYTE       = 66085
  ITEMS            = 1
  ITEM_BYTES       = 4
  BYTES            = 4
  VALID_MINIMUM    =   -80.0
  VALID_MAXIMUM    =    80.0
  MISSING_CONSTANT  = 65535.0
  UNIT             = "Degrees"
  DESCRIPTION      = "2nd Dimension of DATA: Spacecraft Theta - lower limit.
                     See DIM2_THETA for description."
/* RJW, DIM2_THETA_LOWER, f, 1, 1 */
END_OBJECT         = COLUMN


OBJECT             = COLUMN
  NAME             = DIM3_PHI
  DATA_TYPE        = PC_REAL
  START_BYTE       = 66089
  ITEMS            = 1
```

```
  ITEM_BYTES       = 4
  BYTES            = 4
  VALID_MINIMUM    =  155.0
  VALID_MAXIMUM    =  385.0
  MISSING_CONSTANT = 65535.0
  UNIT             = "Degrees"
  DESCRIPTION      = "3rd Dimension of DATA: S/C Phi - representative value.
                     Spacecraft Phi (degs) is analogous to longitude on
                     a sphere. In spacecraft xyz co-ords:
                       +x is equivalent to phi =   0 degs
                       +y is equivalent to phi =  90 degs
                       -x is equivalent to phi = 180 degs
                       -y is equivalent to phi = 270 degs
                       +x is equivalent to phi = 360 degs
                       +y is equivalent to phi = 450 degs
                     The Phi angle varies because of actuator motion,
                       BUT this is NOT the same as actuator angle (ACT)
                       from the level 2 CAPS data: Phi = 270 - ACT
                     This is not a center value but a representative one.
                       Center values are the mid-points between the upper
                       and lower limits, in such cases the upper and lower
                       values are the first and last points of that range:
                         Center value  = (lower + upper)/2
                     In this case the actuator goes back and forth, slows
                       at the edges, such that a mid-point could be lower
                       than both the first and last points if the acuator
                       changed direction during that interval.
                     Phi angles are calculated every second from the start
                       to the end of the intervals duration and then:
                         Representative value  = mean(phi angles)
                         The lower limit value = min( phi angles)
                         The upper limit value = max( phi angles)"
/* RJW, DIM3_PHI, f, 1, 1 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = DIM3_PHI_UPPER
  DATA_TYPE        = PC_REAL
  START_BYTE       = 66093
  ITEMS            = 1
  ITEM_BYTES       = 4
  BYTES            = 4
  VALID_MINIMUM    =  155.0
  VALID_MAXIMUM    =  385.0
  MISSING_CONSTANT = 65535.0
  UNIT             = "Degrees"
  DESCRIPTION      = "3rd Dimension of DATA: S/C Phi - upper limit.
                       See DIM3_PHI for description."
/* RJW, DIM3_PHI_UPPER, f, 1, 1 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = DIM3_PHI_LOWER
  DATA_TYPE        = PC_REAL
  START_BYTE       = 66097
  ITEMS            = 1
  ITEM_BYTES       = 4
  BYTES            = 4
  VALID_MINIMUM    =  155.0
```

```
  VALID_MAXIMUM     =   385.0
  MISSING_CONSTANT  = 65535.0
  UNIT              = "Degrees"
  DESCRIPTION       = "3rd Dimension of DATA: S/C Phi - lower limit.
                    See DIM3_PHI for description."
/* RJW, DIM3_PHI_LOWER, f, 1, 1 */
END_OBJECT          = COLUMN


OBJECT              = COLUMN
  NAME              = DIM4_TOF
  DATA_TYPE         = PC_REAL
  START_BYTE        = 66101
  ITEMS             = 512
  ITEM_BYTES        = 4
  BYTES             = 2048
  VALID_MINIMUM     = 0.0
  VALID_MAXIMUM     = 0.00000160078125 /* 2048 TOF ch. = 1.6e-06*/
  MISSING_CONSTANT  = 65535.0
  UNIT              = "SECONDS"
  DESCRIPTION       = "4th Dimension of DATA: Time Of Flight - center value.
                    "
/* RJW, DIM4_TOF, f, 1, 512 */
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = DIM4_TOF_UPPER
  DATA_TYPE         = PC_REAL
  START_BYTE        = 68149
  ITEMS             = 512
  ITEM_BYTES        = 4
  BYTES             = 2048
  VALID_MINIMUM     = 0.0
  VALID_MAXIMUM     = 0.00000160078125 /* 2048 TOF ch. = 1.6e-06*/
  MISSING_CONSTANT  = 65535.0
  UNIT              = "SECONDS"
  DESCRIPTION       = "4th Dimension of DATA: Time Of Flight - upper limit.
                    See DIM4_TOF for description."
/* RJW, DIM4_TOF_UPPER, f, 1, 512 */
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = DIM4_TOF_LOWER
  DATA_TYPE         = PC_REAL
  START_BYTE        = 70197
  ITEMS             = 512
  ITEM_BYTES        = 4
  BYTES             = 2048
  VALID_MINIMUM     = 0.0
  VALID_MAXIMUM     = 0.00000160078125 /* 2048 TOF ch. = 1.6e-06*/
  MISSING_CONSTANT  = 65535.0
  UNIT              = "SECONDS"
  DESCRIPTION       = "4th Dimension of DATA: Time Of Flight - lower limit.
                    See DIM4_TOF for description."
/* RJW, DIM4_TOF_LOWER, f, 1, 512 */
END_OBJECT          = COLUMN


OBJECT              = COLUMN
```

```
  NAME            = SC_POS_R
  DATA_TYPE       = PC_REAL
  START_BYTE      = 72245
  BYTES           = 4
  VALID_MINIMUM    =    0.0
  VALID_MAXIMUM    =   200.0
  MISSING_CONSTANT  = 65535.0
  UNIT            = "Saturn Radii"
  DESCRIPTION      = "Cassini radial distance from Saturn.
                    The non-cruise part of the mission is below 200 Rs.
                    (1 Rs = 60268.0 km)
                    [Values may be greater than VALID_MAX
                    during cruise to Saturn before primary mission.]"
/* RJW, SC_POS_R, f, 1, 1 */
END_OBJECT        = COLUMN

OBJECT            = COLUMN
  NAME            = SC_POS_LAT
  DATA_TYPE       = PC_REAL
  START_BYTE      = 72249
  BYTES           = 4
  VALID_MINIMUM    =   -90.0
  VALID_MAXIMUM    =    90.0
  MISSING_CONSTANT  = 65535.0
  UNIT            = "Degrees"
  DESCRIPTION      = "Cassini Latitude above Saturn.
                    (0 = Equatorial)"
/* RJW, SC_POS_LAT, f, 1, 1 */
END_OBJECT        = COLUMN

OBJECT            = COLUMN
  NAME            = SC_POS_LOCAL_TIME
  DATA_TYPE       = PC_REAL
  START_BYTE      = 72253
  BYTES           = 4
  VALID_MINIMUM    =    0.0
  VALID_MAXIMUM    =    24.0
  MISSING_CONSTANT  = 65535.0
  UNIT            = "Hours"
  DESCRIPTION      = "Cassini Local Time from Saturn.
                     00 = Midnight
                     06 = Dawn
                     12 = Noon
                     18 = Dusk"
/* RJW, SC_POS_LOCAL_TIME, f, 1, 1 */
END_OBJECT        = COLUMN

OBJECT            = COLUMN
  NAME            = SC_POS_SATURN_J2000XYZ
  DATA_TYPE       = PC_REAL
  START_BYTE      = 72257
  ITEMS           = 3
  ITEM_BYTES      = 4
  BYTES           = 12
  VALID_MINIMUM    = -12000000.0 /* ~ -199 Rs */
  VALID_MAXIMUM    =  12000000.0 /* ~ +199 Rs */
  MISSING_CONSTANT =     65535.0 /* ~ +1.1 Rs */
  UNIT            = "km"
  DESCRIPTION      = "Cassini position from Saturn in J2000 cartesian
```

```
                    co-ordinates [x,y,z] (units km).
                    [Values may be outside of VALID_MIN/MAX range (~199Rs)
                    during cruise to Saturn before primary mission.]"
/* RJW, SC_POS_SATURN_J2000XYZ, f, 1, 3 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = SC_VEL_SATURN_J2000XYZ
  DATA_TYPE        = PC_REAL
  START_BYTE       = 72269
  ITEMS            = 3
  ITEM_BYTES       = 4
  BYTES            = 12
  VALID_MINIMUM    =   -40.0 /* V_mag at SOI near 31 km/s */
  VALID_MAXIMUM    =    40.0
  MISSING_CONSTANT = 65535.0
  UNIT             = "km/s"
  DESCRIPTION      = "Cassini Velocity with respect to Saturn in J2000
                    cartesian co-ordinates [Vx,Vy,Vz] (units km/s)."
/* RJW, SC_VEL_SATURN_J2000XYZ, f, 1, 3 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = SC_VEL_ANGULAR_J2000XYZ
  DATA_TYPE        = PC_REAL
  START_BYTE       = 72281
  ITEMS            = 3
  ITEM_BYTES       = 4
  BYTES            = 12
  VALID_MINIMUM    =    -1.0 /* General limit */
  VALID_MAXIMUM    =     1.0 /* General limit */
  MISSING_CONSTANT = 65535.0
  UNIT             = "radians/s"
  DESCRIPTION      = "Cassini Angular Velocity in cartesian co-ordinates
                    [AVx,AVy,AVz] (units radians/s).
                     (This is calculated with the SPICE ckgpav command
                      where ref=J2000.  SPICE defines it as 'This is the
                      axisabout which the reference frame tied to the
                      instrument is rotating in the right-handed sense')"
/* RJW, SC_VEL_ANGULAR_J2000XYZ, f, 1, 3 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = SC_TO_J2000
  DATA_TYPE        = PC_REAL
  START_BYTE       = 72293
  ITEMS            = 9
  ITEM_BYTES       = 4
  BYTES            = 36
  VALID_MINIMUM    =    -1.0
  VALID_MAXIMUM    =     1.0
  MISSING_CONSTANT = 65535.0
  DESCRIPTION      = "Rotation matrix from spacecraft co-ordinates to J2000
                    This is a 3x3 matrix, expressed here as a 1x9 stream.
                    If the 1D stream is [a,b,c, d,e,f, g,h,i]
                    then the 2D matrix is [a,b,c
                                           d,e,f
                                           g,h,i]"
/* Should be, SC_TO_J2000, f, 2, 3, 3 */
```

```
/* RJW, SC_TO_J2000, f, 1, 9 */
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = J2000_TO_RTP
  DATA_TYPE         = PC_REAL
  START_BYTE        = 72329
  ITEMS             = 9
  ITEM_BYTES        = 4
  BYTES             = 36
  VALID_MINIMUM     =    -1.0
  VALID_MAXIMUM     =     1.0
  MISSING_CONSTANT  = 65535.0
  DESCRIPTION       = "Rotation matrix from J2000 co-ordinates to RTP,
                      where RTP is Saturn centered right handed R-Theta-Phi.
                      This is a 3x3 matrix, expressed here as a 1x9 stream.
                      If the 1D stream is [a,b,c, d,e,f, g,h,i]
                      then the 2D matrix is [a,b,c
                                             d,e,f
                                             g,h,i]"
/* Should be, J2000_TO_RTP, f, 2, 3, 3 */
/* RJW, J2000_TO_RTP, f, 1, 9 */
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = AUX_HVU2_ST_DAC
  DATA_TYPE         = PC_REAL
  START_BYTE        = 72365
  BYTES             = 4
  VALID_MINIMUM     = -3600.0
  VALID_MAXIMUM     =     0.0
  MISSING_CONSTANT  =     1.0
  UNIT              = "VOLTS"
  DESCRIPTION       = "High Voltage Unit 2 (HVU2) Straight Through
                      multichannel plate (mcp)."
/* RJW, AUX_HVU2_ST_DAC, f, 1, 1 */
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = AUX_HVU2_LEF_DAC
  DATA_TYPE         = PC_REAL
  START_BYTE        = 72369
  BYTES             = 4
  VALID_MINIMUM     = -2400.0
  VALID_MAXIMUM     =     0.0
  MISSING_CONSTANT  =     1.0
  UNIT              = "VOLTS"
  DESCRIPTION       = "High Voltage Unit 2 (HVU2) Linear Electric
                      Field multichannel plate (mcp)."
/* RJW, AUX_HVU2_LEF_DAC, f, 1, 1 */
END_OBJECT          = COLUMN
```

Sample TOFLEF Label File: TOFLEF_YYYYDDDHH_V1.LBL

```
PDS_VERSION_ID = PDS3
DATA_SET_ID    = "CO-E/J/S/SW-CAPS-3-CALIBRATED-V1.0"

/* Input File: TOFLEF_2004001_V01.DAT */
```

```
/* File written: 2013-09-28T22:23:31 local time*/

STANDARD_DATA_PRODUCT_ID = "TOFLEF CALIBRATED L3"
PRODUCT_ID             = "TOFLEF_200400100_V01"
PRODUCT_TYPE           = "DATA"
PRODUCT_CREATION_TIME    = 2013-271T22:23:31 /* UTC 2013-09-28 */
PROCESSING_LEVEL_ID      = "3"

RECORD_TYPE  = FIXED_LENGTH
RECORD_BYTES = 72372
FILE_RECORDS = 57

START_TIME                 = 2004-001T00:06:39.360 /* 2004-01-01 */
STOP_TIME                  = 2004-001T05:14:55.241 /* 2004-01-01 */
SPACECRAFT_CLOCK_START_COUNT = "1/1451608152.000"
SPACECRAFT_CLOCK_STOP_COUNT  = "1/1451626648.000"

INSTRUMENT_HOST_NAME = "CASSINI ORBITER"
INSTRUMENT_HOST_ID   = "CO"
TARGET_NAME          = {"SATURN"}
INSTRUMENT_NAME      = "CASSINI PLASMA SPECTROMETER"
INSTRUMENT_ID        = "CAPS"
DESCRIPTION = "This file contains the Level 3 data for CAPS TOFLEF."

MD5_CHECKSUM = "510609f57e47b65da25b43773fd11b2c"

NOTE = "See the PDS CAPS SIS Document for more details on the formats."

^TABLE = "TOFLEF_200400100_V01.DAT"
OBJECT = TABLE
  INTERCHANGE_FORMAT = "BINARY"
  ROWS        = 57
  COLUMNS     = 28
  ROW_BYTES   = 72372
  ^STRUCTURE  = "TOFLEF_V01.FMT"
  DESCRIPTION = "Describes the structure and content of the data file."
END_OBJECT = TABLE
END
```

TOFST_V1.FMT File

```
OBJECT             = COLUMN
  NAME             = UTC
  DATA_TYPE        = DATE  /* ASCII character string */
  START_BYTE       = 1
  BYTES            = 21
  VALID_MINIMUM    = 2011-217T00:00:00.001
  VALID_MAXIMUM    = 2018-001T00:00:00.000
  MISSING_CONSTANT = 0001-001T00:00:00.000
  DESCRIPTION      = "UTC timestamp, of format yyyy-dddTHH:MM:SS.sss
                     where yyyy = year, ddd = day of year,
                     HH = hour, MM = minute,
                     SS.sss = decimal seconds to millisecond resolution.
                     Value calculated via SPICE from spacecraft clock time."
/* RJW, UTC, c, 1, 21 */
END_OBJECT         = COLUMN
```

```
OBJECT              = COLUMN
  NAME              = DEAD_TIME_METHOD
  DATA_TYPE         = LSB_UNSIGNED_INTEGER
  START_BYTE        = 22
  BYTES             = 1
  VALID_MINIMUM     = 0
  VALID_MAXIMUM     = 2
  MISSING_CONSTANT  = 255
  DESCRIPTION       = "Dead Time Correction Method
                     0 = None: Data has not been Dead Time corrected.
                     1 = On ground (using quantized values).
                     2 = In flight, corrected prior to any bin summing and
                         prior to quantization for downlink (ELS only).
                   255 = Unknown."
/* RJW, DEAD_TIME_METHOD, B, 1, 1 */
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = TELEMETRY
  DATA_TYPE         = LSB_UNSIGNED_INTEGER
  START_BYTE        = 23
  BYTES             = 2
  VALID_MINIMUM     =   250
  VALID_MAXIMUM     = 16000
  MISSING_CONSTANT  = 65535
  UNIT              = "bps"
  DESCRIPTION       = "Telemetry Downlink Rate (bps).
                   (Independent of Solar Wind Modes)
                     Expected values are 250, 500,
                     1000, 2000, 4000, 8000, 16000"
/* RJW, TELEMETRY, H, 1, 1 */
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = DT
  DATA_TYPE         = PC_REAL /* i.e. a float in little endian format */
  START_BYTE        = 25
  BYTES             = 4
  VALID_MINIMUM     =  256.0
  VALID_MAXIMUM     = 1024.0
  MISSING_CONSTANT  = -1.0
  UNIT              = "SECONDS"
  DESCRIPTION       = "Duration of Record (seconds)"
/* RJW, DT, f, 1, 1 */
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = ACCUMULATION_TIME
  DATA_TYPE         = PC_REAL
  START_BYTE        = 29
  ITEMS             = 32
  ITEM_BYTES        = 4
  BYTES             = 128
  VALID_MINIMUM     = 3.50000000
  VALID_MAXIMUM     = 28.00000000
  MISSING_CONSTANT  = -1
  UNIT              = "SECONDS"
  DESCRIPTION       = "ACCUMULATION_TIME of each bin (seconds)"
```

```
/* RJW, ACCUMULATION_TIME, f, 1, 32 */
END_OBJECT          = COLUMN

OBJECT             = COLUMN
  NAME             = DATA
  DATA_TYPE        = PC_REAL
  START_BYTE       = 157
  ITEMS            = 16384
  ITEM_BYTES       = 4
  BYTES            = 65536
  VALID_MINIMUM    =       0.0
  VALID_MAXIMUM    = 1000000.0 /* 1e6 general upper limit*/
  MISSING_CONSTANT  = 4294967296 /* not 65535 */
  UNIT             = "COUNTS/SECOND"
  DESCRIPTION      = "TOFST data of each bin (Counts per second)
                   Counts per accumulation have been (in order):
                    -Moved to middle of quantization bin
                    -Converted to counts/second.
                    -Maybe Dead time corrected (See DEAD_TIME_METHOD)
                   For TOFST data, it is possible a very high count
                   rate could dead time correct to negative counts.
                   If so, all TOF channels at that energy are set
                   to fill."
/* Should be, DATA, f, 4, 32, 1, 1, 512 */
/* RJW, DATA, f, 1, 16384 */
END_OBJECT          = COLUMN

OBJECT             = COLUMN
  NAME             = DIM1_E
  DATA_TYPE        = PC_REAL
  START_BYTE       = 65693
  ITEMS            = 32
  ITEM_BYTES       = 4
  BYTES            = 128
  VALID_MINIMUM    =     0.0
  VALID_MAXIMUM    = 51000.0 /* rounded up to whole keV/q */
  MISSING_CONSTANT  = 65535.0
  UNIT             = "eV/q"
  DESCRIPTION      = "1st Dimension of DATA: Energy - center value (eV/q).
                    Upper and lower limits are given by the objects
                    DIM1_E_UPPER and DIM1_E_LOWER."
/* RJW, DIM1_E, f, 1, 32 */
END_OBJECT          = COLUMN

OBJECT             = COLUMN
  NAME             = DIM1_E_UPPER
  DATA_TYPE        = PC_REAL
  START_BYTE       = 65821
  ITEMS            = 32
  ITEM_BYTES       = 4
  BYTES            = 128
  VALID_MINIMUM    =     0.0
  VALID_MAXIMUM    = 51000.0 /* rounded up to whole keV/q */
  MISSING_CONSTANT  = 65535.0
  UNIT             = "eV/q"
  DESCRIPTION      = "1st Dimension of DATA: Energy - upper limit (eV/q).
                    See DIM1_E for description."
/* RJW, DIM1_E_UPPER, f, 1, 32 */
END_OBJECT          = COLUMN
```

```
OBJECT            = COLUMN
  NAME            = DIM1_E_LOWER
  DATA_TYPE       = PC_REAL
  START_BYTE      = 65949
  ITEMS           = 32
  ITEM_BYTES      = 4
  BYTES           = 128
  VALID_MINIMUM    =     0.0
  VALID_MAXIMUM    = 51000.0 /* rounded up to whole keV/q */
  MISSING_CONSTANT  = 65535.0
  UNIT            = "eV/q"
  DESCRIPTION     = "1st Dimension of DATA: Energy - lower limit (eV/q).
                   See DIM1_E for description."
/* RJW, DIM1_E_LOWER, f, 1, 32 */
END_OBJECT        = COLUMN


OBJECT            = COLUMN
  NAME            = DIM2_THETA
  DATA_TYPE       = PC_REAL
  START_BYTE      = 66077
  ITEMS           = 1
  ITEM_BYTES      = 4
  BYTES           = 4
  VALID_MINIMUM    =   -80.0
  VALID_MAXIMUM    =    80.0
  MISSING_CONSTANT  = 65535.0
  UNIT            = "Degrees"
  DESCRIPTION     = "2nd Dimension of DATA: Spacecraft Theta - center value.
                  Spacecraft Theta (degs) is analogous to latitude on
                  a sphere. In spacecraft xyz co-ords:
                   +z is equivalent to theta = +90 degs
                   -z is equivalent to theta = -90 degs
                     (The communication dish is directed along -z)
                   xy-plane at z=0 is equivalent to theta = 0
                  Just 1 anode for TOF data:
                    Anode 1 covers the range -80 to +80 degs
                  This 1 TOF anode covers the same field of
                  view as all 8 SNG anodes."
/* RJW, DIM2_THETA, f, 1, 1 */
END_OBJECT        = COLUMN

OBJECT            = COLUMN
  NAME            = DIM2_THETA_UPPER
  DATA_TYPE       = PC_REAL
  START_BYTE      = 66081
  ITEMS           = 1
  ITEM_BYTES      = 4
  BYTES           = 4
  VALID_MINIMUM    =   -80.0
  VALID_MAXIMUM    =    80.0
  MISSING_CONSTANT  = 65535.0
  UNIT            = "Degrees"
  DESCRIPTION     = "2nd Dimension of DATA: Spacecraft Theta - upper limit.
                   See DIM2_THETA for description."
/* RJW, DIM2_THETA_UPPER, f, 1, 1 */
END_OBJECT        = COLUMN
```

```
OBJECT             = COLUMN
  NAME             = DIM2_THETA_LOWER
  DATA_TYPE        = PC_REAL
  START_BYTE       = 66085
  ITEMS            = 1
  ITEM_BYTES       = 4
  BYTES            = 4
  VALID_MINIMUM    =   -80.0
  VALID_MAXIMUM    =    80.0
  MISSING_CONSTANT  = 65535.0
  UNIT             = "Degrees"
  DESCRIPTION      = "2nd Dimension of DATA: Spacecraft Theta - lower limit.
                    See DIM2_THETA for description."
/* RJW, DIM2_THETA_LOWER, f, 1, 1 */
END_OBJECT         = COLUMN


OBJECT             = COLUMN
  NAME             = DIM3_PHI
  DATA_TYPE        = PC_REAL
  START_BYTE       = 66089
  ITEMS            = 1
  ITEM_BYTES       = 4
  BYTES            = 4
  VALID_MINIMUM    =   155.0
  VALID_MAXIMUM    =   385.0
  MISSING_CONSTANT  = 65535.0
  UNIT             = "Degrees"
  DESCRIPTION      = "3rd Dimension of DATA: S/C Phi - representative value.
                   Spacecraft Phi (degs) is analogous to longitude on
                   a sphere. In spacecraft xyz co-ords:
                     +x is equivalent to phi =   0 degs
                     +y is equivalent to phi =  90 degs
                     -x is equivalent to phi = 180 degs
                     -y is equivalent to phi = 270 degs
                     +x is equivalent to phi = 360 degs
                     +y is equivalent to phi = 450 degs
                   The Phi angle varies because of actuator motion,
                     BUT this is NOT the same as actuator angle (ACT)
                     from the level 2 CAPS data: Phi = 270 - ACT
                   This is not a center value but a representative one.
                     Center values are the mid-points between the upper
                     and lower limits, in such cases the upper and lower
                     values are the first and last points of that range:
                       Center value  = (lower + upper)/2
                   In this case the actuator goes back and forth, slows
                     at the edges, such that a mid-point could be lower
                     than both the first and last points if the acuator
                     changed direction during that interval.
                   Phi angles are calculated every second from the start
                     to the end of the intervals duration and then:
                       Representative value  = mean(phi angles)
                       The lower limit value = min( phi angles)
                       The upper limit value = max( phi angles)"
/* RJW, DIM3_PHI, f, 1, 1 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = DIM3_PHI_UPPER
```

```
  DATA_TYPE        = PC_REAL
  START_BYTE       = 66093
  ITEMS            = 1
  ITEM_BYTES       = 4
  BYTES            = 4
  VALID_MINIMUM    =   155.0
  VALID_MAXIMUM    =   385.0
  MISSING_CONSTANT  = 65535.0
  UNIT             = "Degrees"
  DESCRIPTION      = "3rd Dimension of DATA: S/C Phi - upper limit.
                    See DIM3_PHI for description."
/* RJW, DIM3_PHI_UPPER, f, 1, 1 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = DIM3_PHI_LOWER
  DATA_TYPE        = PC_REAL
  START_BYTE       = 66097
  ITEMS            = 1
  ITEM_BYTES       = 4
  BYTES            = 4
  VALID_MINIMUM    =   155.0
  VALID_MAXIMUM    =   385.0
  MISSING_CONSTANT  = 65535.0
  UNIT             = "Degrees"
  DESCRIPTION      = "3rd Dimension of DATA: S/C Phi - lower limit.
                    See DIM3_PHI for description."
/* RJW, DIM3_PHI_LOWER, f, 1, 1 */
END_OBJECT         = COLUMN


OBJECT             = COLUMN
  NAME             = DIM4_TOF
  DATA_TYPE        = PC_REAL
  START_BYTE       = 66101
  ITEMS            = 512
  ITEM_BYTES       = 4
  BYTES            = 2048
  VALID_MINIMUM    = 0.0
  VALID_MAXIMUM    = 0.00000160078125 /* 2048 TOF ch. = 1.6e-06*/
  MISSING_CONSTANT  = 65535.0
  UNIT             = "SECONDS"
  DESCRIPTION      = "4th Dimension of DATA: Time Of Flight - center value.
                   "
/* RJW, DIM4_TOF, f, 1, 512 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = DIM4_TOF_UPPER
  DATA_TYPE        = PC_REAL
  START_BYTE       = 68149
  ITEMS            = 512
  ITEM_BYTES       = 4
  BYTES            = 2048
  VALID_MINIMUM    = 0.0
  VALID_MAXIMUM    = 0.00000160078125 /* 2048 TOF ch. = 1.6e-06*/
  MISSING_CONSTANT  = 65535.0
  UNIT             = "SECONDS"
  DESCRIPTION      = "4th Dimension of DATA: Time Of Flight - upper limit.
```

```
                    See DIM4_TOF for description."
/* RJW, DIM4_TOF_UPPER, f, 1, 512 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = DIM4_TOF_LOWER
  DATA_TYPE        = PC_REAL
  START_BYTE       = 70197
  ITEMS            = 512
  ITEM_BYTES       = 4
  BYTES            = 2048
  VALID_MINIMUM    = 0.0
  VALID_MAXIMUM    = 0.00000160078125 /* 2048 TOF ch. = 1.6e-06*/
  MISSING_CONSTANT = 65535.0
  UNIT             = "SECONDS"
  DESCRIPTION      = "4th Dimension of DATA: Time Of Flight - lower limit.
                    See DIM4_TOF for description."
/* RJW, DIM4_TOF_LOWER, f, 1, 512 */
END_OBJECT         = COLUMN


OBJECT             = COLUMN
  NAME             = SC_POS_R
  DATA_TYPE        = PC_REAL
  START_BYTE       = 72245
  BYTES            = 4
  VALID_MINIMUM    =     0.0
  VALID_MAXIMUM    =   200.0
  MISSING_CONSTANT = 65535.0
  UNIT             = "Saturn Radii"
  DESCRIPTION      = "Cassini radial distance from Saturn.
                  The non-cruise part of the mission is below 200 Rs.
                  (1 Rs = 60268.0 km)
                  [Values may be greater than VALID_MAX
                  during cruise to Saturn before primary mission.]"
/* RJW, SC_POS_R, f, 1, 1 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = SC_POS_LAT
  DATA_TYPE        = PC_REAL
  START_BYTE       = 72249
  BYTES            = 4
  VALID_MINIMUM    =   -90.0
  VALID_MAXIMUM    =    90.0
  MISSING_CONSTANT = 65535.0
  UNIT             = "Degrees"
  DESCRIPTION      = "Cassini Latitude above Saturn.
                  (0 = Equatorial)"
/* RJW, SC_POS_LAT, f, 1, 1 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = SC_POS_LOCAL_TIME
  DATA_TYPE        = PC_REAL
  START_BYTE       = 72253
  BYTES            = 4
  VALID_MINIMUM    =     0.0
  VALID_MAXIMUM    =    24.0
```

```
  MISSING_CONSTANT  = 65535.0
  UNIT              = "Hours"
  DESCRIPTION       = "Cassini Local Time from Saturn.
                    00 = Midnight
                    06 = Dawn
                    12 = Noon
                    18 = Dusk"
/* RJW, SC_POS_LOCAL_TIME, f, 1, 1 */
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = SC_POS_SATURN_J2000XYZ
  DATA_TYPE         = PC_REAL
  START_BYTE        = 72257
  ITEMS             = 3
  ITEM_BYTES        = 4
  BYTES             = 12
  VALID_MINIMUM     = -12000000.0 /* ~ -199 Rs */
  VALID_MAXIMUM     =  12000000.0 /* ~ +199 Rs */
  MISSING_CONSTANT  =     65535.0 /* ~ +1.1 Rs */
  UNIT              = "km"
  DESCRIPTION       = "Cassini position from Saturn in J2000 cartesian
                    co-ordinates [x,y,z] (units km).
                    [Values may be outside of VALID_MIN/MAX range (~199Rs)
                    during cruise to Saturn before primary mission.]"
/* RJW, SC_POS_SATURN_J2000XYZ, f, 1, 3 */
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = SC_VEL_SATURN_J2000XYZ
  DATA_TYPE         = PC_REAL
  START_BYTE        = 72269
  ITEMS             = 3
  ITEM_BYTES        = 4
  BYTES             = 12
  VALID_MINIMUM     =   -40.0 /* V_mag at SOI near 31 km/s */
  VALID_MAXIMUM     =    40.0
  MISSING_CONSTANT  = 65535.0
  UNIT              = "km/s"
  DESCRIPTION       = "Cassini Velocity with respect to Saturn in J2000
                    cartesian co-ordinates [Vx,Vy,Vz] (units km/s)."
/* RJW, SC_VEL_SATURN_J2000XYZ, f, 1, 3 */
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = SC_VEL_ANGULAR_J2000XYZ
  DATA_TYPE         = PC_REAL
  START_BYTE        = 72281
  ITEMS             = 3
  ITEM_BYTES        = 4
  BYTES             = 12
  VALID_MINIMUM     =    -1.0 /* General limit */
  VALID_MAXIMUM     =     1.0 /* General limit */
  MISSING_CONSTANT  = 65535.0
  UNIT              = "radians/s"
  DESCRIPTION       = "Cassini Angular Velocity in cartesian co-ordinates
                    [AVx,AVy,AVz] (units radians/s).
                     (This is calculated with the SPICE ckgpav command
                      where ref=J2000.  SPICE defines it as 'This is the
```

```
                   axisabout which the reference frame tied to the
                   instrument is rotating in the right-handed sense')"
/* RJW, SC_VEL_ANGULAR_J2000XYZ, f, 1, 3 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = SC_TO_J2000
  DATA_TYPE        = PC_REAL
  START_BYTE       = 72293
  ITEMS            = 9
  ITEM_BYTES       = 4
  BYTES            = 36
  VALID_MINIMUM    =   -1.0
  VALID_MAXIMUM    =    1.0
  MISSING_CONSTANT = 65535.0
  DESCRIPTION      = "Rotation matrix from spacecraft co-ordinates to J2000
                  This is a 3x3 matrix, expressed here as a 1x9 stream.
                  If the 1D stream is [a,b,c, d,e,f, g,h,i]
                  then the 2D matrix is [a,b,c
                                         d,e,f
                                         g,h,i]"
/* Should be, SC_TO_J2000, f, 2, 3, 3 */
/* RJW, SC_TO_J2000, f, 1, 9 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = J2000_TO_RTP
  DATA_TYPE        = PC_REAL
  START_BYTE       = 72329
  ITEMS            = 9
  ITEM_BYTES       = 4
  BYTES            = 36
  VALID_MINIMUM    =   -1.0
  VALID_MAXIMUM    =    1.0
  MISSING_CONSTANT = 65535.0
  DESCRIPTION      = "Rotation matrix from J2000 co-ordinates to RTP,
                  where RTP is Saturn centered right handed R-Theta-Phi.
                  This is a 3x3 matrix, expressed here as a 1x9 stream.
                  If the 1D stream is [a,b,c, d,e,f, g,h,i]
                  then the 2D matrix is [a,b,c
                                         d,e,f
                                         g,h,i]"
/* Should be, J2000_TO_RTP, f, 2, 3, 3 */
/* RJW, J2000_TO_RTP, f, 1, 9 */
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = AUX_HVU2_ST_DAC
  DATA_TYPE        = PC_REAL
  START_BYTE       = 72365
  BYTES            = 4
  VALID_MINIMUM    = -3600.0
  VALID_MAXIMUM    =    0.0
  MISSING_CONSTANT =    1.0
  UNIT             = "VOLTS"
  DESCRIPTION      = "High Voltage Unit 2 (HVU2) Straight Through
                  multichannel plate (mcp)."
/* RJW, AUX_HVU2_ST_DAC, f, 1, 1 */
END_OBJECT         = COLUMN
```

```
OBJECT             = COLUMN
  NAME             = AUX_HVU2_LEF_DAC
  DATA_TYPE        = PC_REAL
  START_BYTE       = 72369
  BYTES            = 4
  VALID_MINIMUM    = -2400.0
  VALID_MAXIMUM    =     0.0
  MISSING_CONSTANT =     1.0
  UNIT             = "VOLTS"
  DESCRIPTION      = "High Voltage Unit 2 (HVU2) Linear Electric
                   Field multichannel plate (mcp)."
/* RJW, AUX_HVU2_LEF_DAC, f, 1, 1 */
END_OBJECT         = COLUMN
```

Sample TOFST Label File: TOFST_YYYYDDDHH_V1.LBL

```
PDS_VERSION_ID = PDS3
DATA_SET_ID    = "CO-E/J/S/SW-CAPS-3-CALIBRATED-V1.0"

/* Input File: TOFST_2004001_V01.DAT */
/* File written: 2013-09-28T22:23:23 local time*/

STANDARD_DATA_PRODUCT_ID = "TOFST CALIBRATED L3"
PRODUCT_ID               = "TOFST_200400100_V01"
PRODUCT_TYPE             = "DATA"
PRODUCT_CREATION_TIME    = 2013-271T22:23:23 /* UTC 2013-09-28 */
PROCESSING_LEVEL_ID      = "3"

RECORD_TYPE  = FIXED_LENGTH
RECORD_BYTES = 72372
FILE_RECORDS = 57

START_TIME                  = 2004-001T00:06:39.360 /* 2004-01-01 */
STOP_TIME                   = 2004-001T05:14:55.241 /* 2004-01-01 */
SPACECRAFT_CLOCK_START_COUNT = "1/1451608152.000"
SPACECRAFT_CLOCK_STOP_COUNT  = "1/1451626648.000"

INSTRUMENT_HOST_NAME = "CASSINI ORBITER"
INSTRUMENT_HOST_ID   = "CO"
TARGET_NAME          = {"SATURN"}
INSTRUMENT_NAME      = "CASSINI PLASMA SPECTROMETER"
INSTRUMENT_ID        = "CAPS"
DESCRIPTION = "This file contains the Level 3 data for CAPS TOFST."

MD5_CHECKSUM = "510609f57e47b65da25b43773fd11b2c"

NOTE = "See the PDS CAPS SIS Document for more details on the formats."

^TABLE = "TOFST_200400100_V01.DAT"
OBJECT = TABLE
  INTERCHANGE_FORMAT = "BINARY"
  ROWS        = 57
  COLUMNS     = 28
  ROW_BYTES   = 72372
  ^STRUCTURE  = "TOFST_V01.FMT"
  DESCRIPTION = "Describes the structure and content of the data file."
END_OBJECT = TABLE
```

END

Appendix D. PDS Labels & Format Files for Standard HIGHERORDER Data Products

Sample ELS Moment (ELS_3DMOMT) Format & Label File:
ELS_3DMOMT_YYYYDDD_VV.LBL

```
PDS_VERSION_ID               = PDS3
DATA_SET_ID                  = "CO-S/SW-CAPS-5-DDR-ELE-MOMENTS-V1.0"

STANDARD_DATA_PRODUCT_ID     = "ELECTRON MOMENTS"
PRODUCT_ID                   = "ELS_3DMOMT_2005283_00"
PRODUCT_TYPE                 = "DATA"
PRODUCT_CREATION_TIME        = 2013-079T22:12
PRODUCT_VERSION_ID           = "1"

RECORD_TYPE                  = "FIXED_LENGTH"
RECORD_BYTES                 = 127
FILE_RECORDS                 = 2695
COLUMNS                      = 13

START_TIME                   = 2005-283T00:00:20
STOP_TIME                    = 2005-283T23:59:47
SPACECRAFT_CLOCK_START_COUNT = "1/1507595334.252"
SPACECRAFT_CLOCK_STOP_COUNT  = "1/1507681702.137"

INSTRUMENT_HOST_NAME         = "CASSINI ORBITER"
INSTRUMENT_HOST_ID           = "CO"
TARGET_NAME                  = {"SATURN"}
INSTRUMENT_NAME              = "CASSINI PLASMA SPECTROMETER"
INSTRUMENT_ID                = "CAPS"
DESCRIPTION                  = "
   This file contains Cassini CAPS electron moments data,
   acquired at SATURN between
   2005-283T00:00:20.000 and 2005-283T23:59:47.000 (orbit 016)."

MD5_CHECKSUM                 = "c0bbc8061d86617ec607f0dfebdf62cb"

^TABLE = "ELS_3DMOMT_2005283_00.TAB"

OBJECT                       = TABLE
 INTERCHANGE_FORMAT          = "ASCII"
 ROWS                        = 2695
 COLUMNS                     = 13
 ROW_BYTES                   = 127
 DESCRIPTION                 = "Electron Moments.  A description of how
                  moments are generated can be found in the
                  archive SIS."

 /* Description of the electron moment data */
 OBJECT             = COLUMN
  NAME              = "START_TIME"
  DATA_TYPE         = "TIME"
  START_BYTE        = 1
  BYTES             = 17
  VALID_MINIMUM     = 1997-288T10:43:00
  VALID_MAXIMUM     = 2025-001T00:00:00
  MISSING_CONSTANT  = 2030-001T00:00:00
```

```
  UNIT             = "N/A"
  DESCRIPTION      = "Start of the sampling period, spacecraft event time,
                     UTC, in ISOD format to second resolution.  ISOD
                     format is as follows:  YYYY-DOYTHH:MM:SS"
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = "END_TIME"
  DATA_TYPE        = "TIME"
  START_BYTE       = 19
  BYTES            = 17
  VALID_MINIMUM    = 1997-288T10:43:00
  VALID_MAXIMUM    = 2025-001T00:00:00
  MISSING_CONSTANT = 2030-001T00:00:00
  UNIT             = "N/A"
  DESCRIPTION      = "End of the sampling period, spacecraft event time,
                     UTC, in ISOD format to second resolution.  ISOD
                     format is as follows:  YYYY-DOYTHH:MM:SS"
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = "ANODE_USED"
  DATA_TYPE        = "ASCII_INTEGER"
  START_BYTE       = 37
  BYTES            = 1
  VALID_MINIMUM    = 1
  VALID_MAXIMUM    = 9
  MISSING_CONSTANT = 0
  DESCRIPTION      = "Anode used to calculate moments.  A value of 9
                     implies that multiple anodes were used."
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = "SIGNAL_TO_NOISE"
  DATA_TYPE        = "ASCII_REAL"
  START_BYTE       = 39
  BYTES            = 5
  VALID_MINIMUM    = 0.00
  VALID_MAXIMUM    = 10.00
  MISSING_CONSTANT = -9.99
  UNIT             = "N/A"
  DESCRIPTION      = "Signal to noise ratio threshold.  Only data values
                     above this threshold go into the moments
                     calculation."
END_OBJECT         = COLUMN

OBJECT             = COLUMN
  NAME             = "SC_POTENTIAL"
  DATA_TYPE        = "ASCII_REAL"
  START_BYTE       = 45
  BYTES            = 7
  VALID_MINIMUM    = -100.00
  VALID_MAXIMUM    = 100.00
  MISSING_CONSTANT = -999.99
  UNIT             = "V"
  DESCRIPTION      = "Spacecraft potential during the time period given"
END_OBJECT         = COLUMN

OBJECT             = COLUMN
```

```
  NAME              = "DENSITY"
  DATA_TYPE         = "ASCII_REAL"
  START_BYTE        = 53
  BYTES             = 13
  VALID_MINIMUM     = 1.000000E+03
  VALID_MAXIMUM     = 1.000000E+10
  MISSING_CONSTANT  = -9.000000E+00
  UNIT              = "ELECTRONS/M^3"
  DESCRIPTION       = "Density, summed over all energies."
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = "TEMPERATURE"
  DATA_TYPE         = "ASCII_REAL"
  START_BYTE        = 67
  BYTES             = 12
  VALID_MINIMUM     = 1.000000
  VALID_MAXIMUM     = 99999.999999
  MISSING_CONSTANT  = -9999.000000
  UNIT              = "eV"
  DESCRIPTION       = "Temperature, summed over all energies"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = "QUALITY_FACTOR"
  DATA_TYPE         = "ASCII_REAL"
  START_BYTE        = 80
  BYTES             = 7
  VALID_MINIMUM     =   0.000
  VALID_MAXIMUM     = 100.000
  MISSING_CONSTANT  = -99.000
  UNIT              = "N/A"
  DESCRIPTION       = "The number of standard deviations, assuming Poisson
                       counting statistics, that the peak of the Maxwellian
                       corresponding to the determined moments lies above
                       the ELS one-count level.  The larger the value, the
                       better."
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = "SC_CHARGE_STATE"
  DATA_TYPE         = "ASCII_INTEGER"
  START_BYTE        = 88
  BYTES             = 1
  VALID_MINIMUM     = 0
  VALID_MAXIMUM     = 1
  MISSING_CONSTANT  = 9
  UNIT              = "N/A"
  DESCRIPTION       = "Indicates whether the data is likely to be from a
                       region in which the spacecraft is negatively
                       charged.
                       0: likely positively charged
                       1: likely negatively charged"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = "PENETRATING_RADIATION"
  DATA_TYPE         = "ASCII_INTEGER"
  START_BYTE        = 90
```

```
   BYTES            = 1
   VALID_MINIMUM    = 0
   VALID_MAXIMUM    = 1
   MISSING_CONSTANT  = 9
   UNIT             = "N/A"
   DESCRIPTION      = "Indicates whether the data is probably from a
                region in which there is penetrating radiation
                present.
                0: not likely to be present
                1: likely to be present"
  END_OBJECT        = COLUMN

  OBJECT            = COLUMN
   NAME             = "DENSITY_WITH_PEN_RAD"
   DATA_TYPE        = "ASCII_REAL"
   START_BYTE       = 92
   BYTES            = 13
   VALID_MINIMUM    = 1.000000E+03
   VALID_MAXIMUM    = 1.000000E+10
   MISSING_CONSTANT  = -9.000000E+00
   UNIT             = "ELECTRONS/M^3"
   DESCRIPTION      = "Density, summed over all energies, but with
                penetrating radiation subtracted from the data
                before moments calculations were made."
  END_OBJECT        = COLUMN

  OBJECT            = COLUMN
   NAME             = "TEMPERATURE_WITH_PEN_RAD"
   DATA_TYPE        = "ASCII_REAL"
   START_BYTE       = 106
   BYTES            = 12
   VALID_MINIMUM    = 1.000000
   VALID_MAXIMUM    = 99999.999999
   MISSING_CONSTANT  = -9999.000000
   UNIT             = "eV"
   DESCRIPTION      = "Temperature, summed over all energies, but with
                penetrating radiation subtracted from the data
                before moments calculations were made."
  END_OBJECT        = COLUMN

  OBJECT            = COLUMN
   NAME             = "QUALITY_FACTOR_WITH_PEN_RAD"
   DATA_TYPE        = "ASCII_REAL"
   START_BYTE       = 119
   BYTES            = 7
   VALID_MINIMUM    =   0.000
   VALID_MAXIMUM    = 100.000
   MISSING_CONSTANT  = -99.000
   UNIT             = "N/A"
   DESCRIPTION      = "The number of standard deviations, assuming Poisson
                counting statistics, that the peak of the Maxwellian
                corresponding to the determined moments lies above
                the ELS one-count level, but with penetrating
                radiation subtracted from the data before moments
                calculations were made.  The larger the value, the
                better."
  END_OBJECT        = COLUMN
 END_OBJECT         = TABLE
 END
```

Sample ELS Spacecraft Potential (ELS_SCPOT) Format & Label File: ELS_SCPOT_YYYYDDD_VV.LBL

```
PDS_VERSION_ID              = PDS3
DATA_SET_ID                 = "CO-S/SW-CAPS-5-DDR-SC-POTENTIAL-V1.0"

STANDARD_DATA_PRODUCT_ID    = "SPACECRAFT POTENTIAL"
PRODUCT_ID                  = "ELS_SCPOT_2005283_00"
PRODUCT_TYPE                = "DATA"
PRODUCT_CREATION_TIME       = 2013-079T22:13
PRODUCT_VERSION_ID          = "1"

RECORD_TYPE                 = "FIXED_LENGTH"
RECORD_BYTES                = 50
FILE_RECORDS                = 12099
COLUMNS                     = 5

START_TIME                  = 2005-283T00:00:00
STOP_TIME                   = 2005-284T00:00:03
SPACECRAFT_CLOCK_START_COUNT = "1/1507595314.252"
SPACECRAFT_CLOCK_STOP_COUNT  = "1/1507681718.137"

INSTRUMENT_HOST_NAME        = "CASSINI ORBITER"
INSTRUMENT_HOST_ID          = "CO"
TARGET_NAME                 = {"SATURN"}
INSTRUMENT_NAME             = "CASSINI PLASMA SPECTROMETER"
INSTRUMENT_ID               = "CAPS"
DESCRIPTION                 = "
    This file contains Cassini CAPS spacecraft potential data,
    acquired at SATURN between
    2005-283T00:00:00.000 and 2005-284T00:00:03.000 (orbit 016)."

MD5_CHECKSUM                = "7c28c977775314f5a45167a7d62d016d"

^TABLE = "ELS_SCPOT_2005283_00.TAB"

OBJECT                      = TABLE
 INTERCHANGE_FORMAT         = "ASCII"
 ROWS                       = 12099
 COLUMNS                    = 5
 ROW_BYTES                  = 50
 DESCRIPTION                = "Spacecraft Potential.  A description of how
                    spacecraft potentials are generated by CAPS
                    can be found in our archived SIS."

 /* Description of the CAPS-ELS spacecraft potential data */
 OBJECT            = COLUMN
  NAME             = "START_TIME"
  DATA_TYPE        = "TIME"
  START_BYTE       = 1
  BYTES            = 17
  VALID_MINIMUM    = 1997-288T10:43:00
  VALID_MAXIMUM    = 2025-001T00:00:00
  MISSING_CONSTANT = 2030-001T00:00:00
  UNIT             = "N/A"
  DESCRIPTION      = "Start of the sampling period, spacecraft event time,
             UTC, in ISOD format to second resolution.  ISOD
```

```
                  format is as follows:  YYYY-DOYTHH:MM:SS"
  END_OBJECT         = COLUMN

  OBJECT             = COLUMN
    NAME             = "END_TIME"
    DATA_TYPE        = "TIME"
    START_BYTE       = 19
    BYTES            = 17
    VALID_MINIMUM    = 1997-288T10:43:00
    VALID_MAXIMUM    = 2025-001T00:00:00
    MISSING_CONSTANT  = 2030-001T00:00:00
    UNIT             = "N/A"
    DESCRIPTION      = "End of the sampling period, spacecraft event time,
                  UTC, in ISOD format to second resolution.  ISOD
                  format is as follows:  YYYY-DOYTHH:MM:SS"
  END_OBJECT         = COLUMN

  OBJECT             = COLUMN
    NAME             = "ANODE_USED"
    DATA_TYPE        = "ASCII_INTEGER"
    START_BYTE       = 37
    BYTES            = 1
    VALID_MINIMUM    = 1
    VALID_MAXIMUM    = 8
    MISSING_CONSTANT  = 0
    DESCRIPTION      = "Anode used to assign potential."
  END_OBJECT         = COLUMN

  OBJECT             = COLUMN
    NAME             = "SC_POTENTIAL"
    DATA_TYPE        = "ASCII_REAL"
    START_BYTE       = 39
    BYTES            = 7
    VALID_MINIMUM    = -100.00
    VALID_MAXIMUM    = 100.00
    MISSING_CONSTANT  = -999.99
    UNIT             = "V"
    DESCRIPTION      = "Spacecraft potential during the time period given"
  END_OBJECT         = COLUMN

  OBJECT             = COLUMN
    NAME             = "ACCURACY_FLAG"
    DATA_TYPE        = "ASCII_INTEGER"
    START_BYTE       = 47
    BYTES            = 2
    VALID_MINIMUM    = 0
    VALID_MAXIMUM    = 2
    MISSING_CONSTANT  = -1
    UNIT             = "N/A"
    DESCRIPTION      = "0 = Accurate value derived from ELS data.
                     Value will be accurate to +/- 8.5% as the dE/E
                     of ELS is 17%.
                  1 = Potential below ELS lowest energy, therefore
                     estimated, use with care.
                  2 = Accurate value derived from non-ELS data, ie.
                     RPWS at periapsis or PE at moon encounters."
  END_OBJECT         = COLUMN
END_OBJECT           = TABLE
END
```

Sample ION Moment (ION_MOMT) Format & Label File: ION_MOMT_YYYYDDD_VV.LBL

```
 PDS_VERSION_ID              = PDS3
DATA_SET_ID                 = "CO-S/SW-CAPS-5-DDR-ION-MOMENTS-V1.0"

STANDARD_DATA_PRODUCT_ID      = "ION MOMENTS"
PRODUCT_ID                  = "ION_MOMT_2005283_01"
PRODUCT_TYPE                = "DATA"
PRODUCT_CREATION_TIME        = 2013-079T22:00
PRODUCT_VERSION_ID           = "1"

RECORD_TYPE                 = "FIXED_LENGTH"
FILE_RECORDS                = 189
RECORD_BYTES                = 122
COLUMNS                     = 13
ROW_BYTES                   = 122

START_TIME                  = 2005-283T00:03:00
STOP_TIME                   = 2005-283T23:48:03
SPACECRAFT_CLOCK_START_COUNT  = "1/1507595494.252"
SPACECRAFT_CLOCK_STOP_COUNT   = "1/1507680998.136"

INSTRUMENT_HOST_NAME         = "CASSINI ORBITER"
INSTRUMENT_HOST_ID           = "CO"
TARGET_NAME                 = {"SATURN"}
INSTRUMENT_NAME              = "CASSINI PLASMA SPECTROMETER"
INSTRUMENT_ID               = "CAPS"
DESCRIPTION                 = "
    This file contains Cassini CAPS ion moments data,
    acquired at SATURN between
    2005-283T00:03:00.000 and 2005-283T23:48:03.000 (orbit 016)."

MD5_CHECKSUM                = "270041152131aff72b4326796c64461a"

^TABLE                      = "ION_MOMT_2005283_01.TAB"

OBJECT                      = TABLE
  INTERCHANGE_FORMAT         = "ASCII"
  ROWS                      = 189
  COLUMNS                   = 13
  ROW_BYTES                 = 122
  DESCRIPTION               = "
     Moments are generated from Cassini CAPS data and are partially
     described in the CAPS guide for users found at the PDS web site:
  http://ppi.pds.nasa.gov/search/view/?f=yes&id=pds://PPI/COCAPS_1SAT/DOCUMENT
     A brief description of the columns follows."

/* Description of the ion moment data */
OBJECT               = COLUMN
   NAME             = "TIME"
   DATA_TYPE        = "TIME"
   START_BYTE       = 1
   BYTES            = 17
   VALID_MINIMUM     = 1997-288T10:43:00
   VALID_MAXIMUM     = 2025-001T00:00:00
   MISSING_CONSTANT  = 2030-001T00:00:00
   UNIT             = "N/A"
   DESCRIPTION       = "Time, spacecraft event time, UTC, in ISOD format
```

```
                      to second resolution.  ISOD format is as follows:
                      YYYY-DOYTHH:MM:SS"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
   NAME               = "ION_METHOD_FLAG"
   DATA_TYPE          = "ASCII_INTEGER"
   START_BYTE         = 19
   BYTES              = 2
   VALID_MINIMUM      = 1
   VALID_MAXIMUM      = 4
   MISSING_CONSTANT   = -1
   DESCRIPTION        = "Ion Method Flag for calculation of numerical ion
                      moments. Value: meaning
                      1 : SNG data, TOF-based partition
                      2 : SNG data, E-based partition
                      3 : SNG data, hard-wired partition
                      4 : ION data"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
   NAME               = "H+_DENSITY"
   DATA_TYPE          = "ASCII_REAL"
   START_BYTE         = 22
   BYTES              = 8
   VALID_MINIMUM      = 0.000
   VALID_MAXIMUM      = 999.9999
   MISSING_CONSTANT   = -1
   UNIT               = "IONS/CM^3"
   DESCRIPTION        = "H+ density.  Please note the difference between a
                      value of 0.000 and -1.  The 0.000 corresponds to a
                      valid determination that is just extremely low (and
                      there is no confidence in the actual quantitative
                      value, other than that it is very low), whereas the
                      fill value corresponds to an invalid determination,
                      usually caused by problems in the integration
                      process."
END_OBJECT            = COLUMN

OBJECT                = COLUMN
   NAME               = "H+_TEMP"
   DATA_TYPE          = "ASCII_REAL"
   START_BYTE         = 31
   BYTES              = 9
   VALID_MINIMUM      = 0
   VALID_MAXIMUM      = 99999.999
   MISSING_CONSTANT   = -1
   UNIT               = "eV"
   DESCRIPTION        = "H+ temperature"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
   NAME               = "H2+_DENSITY"
   DATA_TYPE          = "ASCII_REAL"
   START_BYTE         = 41
   BYTES              = 8
   VALID_MINIMUM      = 0
   VALID_MAXIMUM      = 999.9999
   MISSING_CONSTANT   = -1
```

```
   UNIT            = "IONS/CM^3"
   DESCRIPTION     = "H2+ density.  Please note the difference between a
                     value of 0.000 and -1.  The 0.000 corresponds to a
                     valid determination that is just extremely low (and
                     there is no confidence in the actual quantitative
                     value, other than that is is very low), whereas the
                     fill value corresponds to an invalid determination,
                     usually caused by problems in the integration
                     process."
END_OBJECT         = COLUMN

OBJECT             = COLUMN
   NAME            = "H2+_TEMP"
   DATA_TYPE       = "ASCII_REAL"
   START_BYTE      = 50
   BYTES           = 9
   VALID_MINIMUM   = 0
   VALID_MAXIMUM   = 99999.999
   MISSING_CONSTANT = -1
   UNIT            = "eV"
   DESCRIPTION     = "H2+ temperature"
END_OBJECT         = COLUMN

OBJECT             = COLUMN
   NAME            = "W+_DENSITY"
   DATA_TYPE       = "ASCII_REAL"
   START_BYTE      = 60
   BYTES           = 8
   VALID_MINIMUM   = 0
   VALID_MAXIMUM   = 999.9999
   MISSING_CONSTANT = -1
   UNIT            = "IONS/CM^3"
   DESCRIPTION     = "W+ density.  Water-group ions, W+, includes O+, OH+,
                     H2O+, and H3O+ (where the 2 and 3 are subscripts).
                     Please note the difference between a value of 0.000
                     and -1.  The 0.000 corresponds to a valid
                     determination that is just extremely low (and there
                     is no confidence in the actual quantitative value,
                     other than that is is very low), whereas the fill
                     value corresponds to an invalid determination,
                     usually caused by problems in the integration
                     process."
END_OBJECT         = COLUMN

OBJECT             = COLUMN
   NAME            = "W+_TEMP"
   DATA_TYPE       = "ASCII_REAL"
   START_BYTE      = 69
   BYTES           = 9
   VALID_MINIMUM   = 0
   VALID_MAXIMUM   = 99999.999
   MISSING_CONSTANT = -1
   UNIT            = "eV"
   DESCRIPTION     = "W+ temperature, where W+ are water group ions.
                     W+ includes ions: O+, OH+, H2O+, and H3O+."
END_OBJECT         = COLUMN

OBJECT             = COLUMN
   NAME            = "AVE_V_R"
```

```
   DATA_TYPE        = "ASCII_REAL"
   START_BYTE       = 79
   BYTES            = 9
   VALID_MINIMUM    = -3000.000
   VALID_MAXIMUM    = 3000.000
   MISSING_CONSTANT  = -9999.999
   UNIT             = "KILOMETER/SECOND"
   DESCRIPTION      = "Weighted average flow velocity, r component, in
                  Saturn centered spherical coordinates."
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = "AVE_V_PHI"
   DATA_TYPE        = "ASCII_REAL"
   START_BYTE       = 89
   BYTES            = 9
   VALID_MINIMUM    = -3000.000
   VALID_MAXIMUM    = 3000.000
   MISSING_CONSTANT  = -9999.999
   UNIT             = "KILOMETER/SECOND"
   DESCRIPTION      = "Weighted average flow velocity, phi component, in
                  Saturn centered spherical coordinates."
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = "AVE_V_THETA"
   DATA_TYPE        = "ASCII_REAL"
   START_BYTE       = 99
   BYTES            = 9
   VALID_MINIMUM    = -3000.000
   VALID_MAXIMUM    = 3000.000
   MISSING_CONSTANT  = -9999.999
   UNIT             = "KILOMETER/SECOND"
   DESCRIPTION      = "Weighted average flow velocity, theta component, in
                  Saturn centered spherical coordinates."
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = "AVE_FLOW_SPEED"
   DATA_TYPE        = "ASCII_REAL"
   START_BYTE       = 109
   BYTES            = 9
   VALID_MINIMUM    = 0
   VALID_MAXIMUM    = 3000.000
   MISSING_CONSTANT  = -9999.999
   UNIT             = "KILOMETER/SECOND"
   DESCRIPTION      = "Weighted average flow speed."
END_OBJECT          = COLUMN

OBJECT              = COLUMN
   NAME             = "QUALITY_FLAG"
   DATA_TYPE        = "ASCII_INTEGER"
   START_BYTE       = 119
   BYTES            = 2
   VALID_MINIMUM    = 0
   VALID_MAXIMUM    = 2
   MISSING_CONSTANT  = -1
   DESCRIPTION      = "Value: meaning
                  0: Not-bad; corotation direction is in the Field of
```

```
                     View (FOV)
                   1: Not-bad; corotation direction not in FOV
                   2: Bad (the spacecraft is rolling and/or CAPS is not
                     actuating)"
END_OBJECT          = COLUMN
END_OBJECT          = TABLE
END
```