Cassini Orbiter
Dual Technique Magnetometer Experiment

MAG Standard Data Products and Archive Volume Software Interface Specification

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Version 1.18
rev. June 1, 2005

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Approved:

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1 Preface

This document describes the format and content of the Cassini MAG standard products archive.

1.1 Distribution list

Table 1: Distribution list

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1.2 Document change log

Table 2: Document change log

Change	Date	Affected portion
Initial draft	5/21/02	All
Modifications and additions by NA / SK	11/21/02	Preface, Introduction, Archive Volume Generation, Archive Volume Contents
Modifications and additions by NA / SK	01/17/03	Preface, Introduction, Archive Volume Generation, Archive Volume Contents
Modifications by SJ to reflect current PDS policies and documentation standards. Comments added to assist MAG team in future updates.	03/07/03	All
Modifications and additions by AH	03/24/03	Introduction, Archive Volume Generation, Archive Volume Contents, Appendix C
Modifications and additions by NA in response to SJ's comments, insertion of SJ's Appendix C (example PDS labels)	04/23/03	Sections 2.3, 4.7, Appendix C
Modifications by AH	6/26/03	Sections 1, 3.1, 3.3, 6, Appendix C
Modifications by AH	10/1/03	All
Incorporate old Appendix A into Section 4, add new Appendix B - AH	10/13/03	Appendix A, B, Section 4
Minor revisions ahead of submission of Earth-swingby archive volume - AH	12/1/03	All
Revisions following submission of Earth-swingby archive volume - AH	03/5/04	Section 4, Appendix C
Revisions following peer review of Earth-swingby archive volume - AH	04/28/04	Sections 2.2, 9.1

Add Browse directory and new appendix for calibration algorithms - AH	05/14/04	Sections 4.2, 5.2.6, Appendix D
Modify signature page, add Extras directory, modify Sections 4.7, 4.8, 4.10 - AH	05/28/04	Page ii, Sections 4.7, 4.8, 4.10
Update title page, signature page and support staff table. Modify all sections referring to SHM data to reflect change in archive volume contents from non-calibrated to calibrated SHM data - CND	05/06/05	Page i, ii, List of Tables, tables 6, 14, 16, 19, 20, 26, 33, and 35. Sections 4.5.2, 8.1, 9.4.3 and 10.2
Modify sections relating to Document Directory to reflect addition of gap files - CND	05/10/05	Table 16
Modified to reflect feedback from Joyce Wolf - CND	05/17/05	tables 19, 20 and section 10.2
Updated distribution list to include Joe Mafi – CND	05/24/05	Table 1
Updated SIS to reflect feedback from Diane Conner – CND	06/01/2005	Section 4.8 and 5.2.7 deleted. Table 1, Sections 3, 4.3, 4.7 and 9.3 modified

1.3 TBD items

Table 3 lists items that are not yet finalized.

Table 3: List of TBD items

Item	Section	Pages
Nil		

1.4 Abbreviations

Table 4: Abbreviations and their meaning

Abbreviation	Meaning
AACS	Attitude and Articulation Control Subsystem
ADC	Analog-Digital Converter
ALF	Assisted Load Format
ATC	Artificial Time Code
ASCII	American Standard Code for Information Interchange
BIU	Bus Interface Unit
CATS	Cassini Archive Tracking System
CD-R	Compact Disc – Recordable media
CD-ROM	Compact Disc – Read-Only Memory
CO	Cassini Orbiter
CRC	Cyclic Redundancy Check
DPU	Data Processing Unit
DTI	Dead Time Interrupt
DVD	Digital Versatile Disc
DVD-R	DVD - Recordable media
FGM	Fluxgate Magnetometer
FIFO	First In First Out
FTP	File Transfer Protocol
GB	Gigabyte(s)
HK	Housekeeping
IC	Imperial College, London
IFC	In-Flight Calibration
ISO	International Standards Organization
JPL	Jet Propulsion Laboratory
LU	Latch Up
MAG	Dual Technique Magnetometer
MB	Megabyte(s)

MCI	Measurement Cycle Interrupt
MDVT	MAG Data Validation Team
NASA	National Aeronautical and Space Administration
NAIF	Navigation and Ancillary Information Facility
NMI	Non-Maskable Interrupt
NSSDC	National Space Science Data Center
ODL	Object Description Language
PDS	Planetary Data System
PPI	Planetary Plasma Interactions Node
PROM	Programmable Read Only Memory
PSU	Power Supply Unit
REDR	Reformatted Experimental Data Record
RTI	Real-Time Interrupt
SCAS	Science Calibration and Alignment Subsystem
SCET	Spacecraft Event Time
SCLK	Spacecraft Clock
SD	Science Data
SDP	Standard Data Product
SH	Subcommutated Housekeeping
SIS	Software Interface Specification
SOI	Saturn Orbit Insertion
STM	Spacecraft Time Message
SUMM	Summary Data Record
TBC	To Be Confirmed
TBD	To Be Determined
TUB	Technical University of Braunschweig
UCLA	University of California, Los Angeles
UDF	Universal Directory Format
VCO	Voltage Controlled Oscillator
V/SHM	Vector/Scalar Helium Magnetometer

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 – A volume is a unit of media on which data products are stored; for example, one DVD-R. An *archive volume* is a volume containing all or part of an archive; that is, data products plus documentation and ancillary files.

Archive Volume Set – When an archive spans multiple volumes, they are called an *archive volume set*. Usually the documentation and some ancillary files are repeated on each volume of the set, so that a single volume can be used alone.

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 an accumulation of data products 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 SIS content overview

This software interface specification (SIS) describes the format, content, and generation of the MAG standard product archive volumes. Section 3, describes the procedure for transferring data products to archive media. Section 4, describes the structure of the archive volumes and the contents of each file. Section 5, describes the file formats used on the archive volumes. Finally, Section 6 lists the individuals responsible for generating the archive volumes.

2.2 MAG scientific overview

Magnetometers are direct-sensing instruments that detect and measure the strength and orientation of magnetic fields. The Cassini Dual Technique Magnetometer (MAG) measures magnetic fields in the vicinity of the Cassini obiter during its mission. The MAG instrument consists of two independent magnetometers, a common data processing unit, three power supplies, and associated operating software and electronics.

The first magnetometer, the vector/scalar helium magnetometer (V/SHM), is capable of two modes of operation. In vector mode, it measures three orthogonal components of the magnetic field, allowing determination of the field magnitude and direction. Using two dynamically selectable ranges of operation, vector fields up to ±256 nT may be measured. In scalar mode, in which only the field magnitude is measured, the magnetometer is capable of measuring fields in the range 256 to 16384 nT. The V/SHM and its electronics have been provided for the Cassini mission by the Jet Propulsion Laboratory (JPL).

The second magnetometer, the fluxgate magnetometer (FGM), uses three orthogonal ringcore fluxgate sensors to make vector field measurements. This magnetometer operates in one of four dynamically selectable ranges, allowing the measurement of fields up to ±44000 nT. The FGM and its electronics have been provided for the mission by Imperial College, London.

The instrument data processing unit (DPU) interfaces with the spacecraft Command and Data Subsystem through the JPL-designed bus interface unit (BIU). All commands, data, and processor program changes are received or transmitted through the BIU. Three power supplies and the 28 V spacecraft bus power the MAG components. Power supply 0 powers the BIU and the DPU core. Power supplies 1 and 2 are redundant and power the remainder of the instrument.

The magnetometers are sensitive to field distortions caused by electric currents and ferrous components onboard the spacecraft. To minimize these spurious effects the sensors are located on an 11 m boom which was deployed from the spacecraft before the first magnetic-field measurements were made. For the Cassini mission, the FGM sensor is located midway along the magnetometer boom and the V/SHM sensor is at the end of the boom.

2.2.1 Scientific objectives

The primary objectives of the MAG experiment are to determine the detailed structure of planetary magnetic fields and to study the physical processes in the planetary system that are associated with the magnetic field. In particular, the MAG experiment will endeavour to

- determine the internal magnetic field of Saturn,
- develop a three-dimensional model of Saturn's magnetosphere,
- determine the magnetic state of Titan and its atmosphere,
- derive an empirical model of the Titan electromagnetic environment,
- investigate the interactions of Titan with the magnetosphere, magnetosheath, and solar wind,
- survey the ring and dust interactions with the electromagnetic environment,
- study the interactions of the icy satellites with the magnetosphere of Saturn, and,
- investigate the structure of the magnetotail and the dynamic processes therein.

2.3 Product types

The product types generated by the MAG experiment are listed in Table 5.

Table 5: Product types

Product type	Description
REDR	Reformatted Experimenter Data Record (raw data)
Calibration files	Files containing instrument offsets and sensitivities used to calibrate raw data
Software	Software to calibrate the raw data and transform them to physically meaningful coordinate systems

Each MAG REDR product is a time-ordered table of magnetic-field and related measurements. The data in these files are extracted or computed from the raw telemetry data, assigned time tags, and formatted into simple binary tables of values in engineering units (data numbers). REDR products are generated for all mission phases during which magnetic-field data are acquired.

The calibration files and software required to calibrate REDR data and, if desired, transform them into alternative coordinate systems, are included in the MAG archive. As examples of the application of this software a selection of test files in raw and calibrated/transformed form accompany the software. These files enable archive users to check the calibrations that they perform on their own platforms.

2.3.1 Standard data products

The REDR dataset may consist of up to nine standard data products. The full set of standard products is shown in Table 6 and described in greater detail in Sections 4.5.4, 4.5.5 and 5.2.6.

Table 6: Standard data products

Standard data product ID	Description
MAG_FGM	Data files (and associated headers/labels) containing magnetic-field data from the MAG fluxgate magnetometer
MAG_VHM	Data files (and associated headers/labels) containing magnetic-field data from the MAG helium magnetometer operating in vector mode
MAG_SHM_C	Calibrated data files (and associated headers/labels) containing magnetic-field data from the MAG helium magnetometer operating in scalar mode
MAG_CON	Data files (and associated headers/labels) containing configuration image information maintained by the DPU computer
MAG_ANA	Data files (and associated headers/labels) containing analog housekeeping data
MAG_ERR	Data files (and associated headers/labels) containing error counter information
MAG_CMD	Data files (and associated headers/labels) containing command validation information
MAG_CHATT	Data files (and associated headers/labels) containing time-dependent attitude information for the Cassini spacecraft
MAG_CHUSR	Data files (and associated headers/labels) containing engineering data from a default set of channels
MAG_CAL	Calibration "history" files containing time-dependent information to be used for calibrating raw MAG data
MAG_SW	Software to calibrate and transform raw MAG data

2.4 Scope of this document

The specifications in this SIS apply to all MAG standard data products submitted for archive to the Planetary Data System (PDS), for all phases of the Cassini mission. Some sections of this document describe parts of the MAG archive and archiving process that are managed by the PDS archive team. These sections have been provided for completeness of information and are not maintained by the MAG team.

2.5 Applicable documents

ISO 9660-1988, Information Processing - Volume and File Structure of CD-ROM for Information Exchange, April 15, 1988.

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

Planetary Data System Data Preparation Workbook, February 17, 1995, Version 3.1, JPL D-7669, Part 1.

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

2.6 Audience

This document is intended to be useful to those who wish to understand the format and content of the MAG data submitted to the PDS archive. Such users might typically be software engineers, data analysts, or planetary scientists.

3 Archive volume generation

The MAG standard product archive collection is produced by the MAG instrument team in cooperation with the PDS Planetary Plasma Interactions (PPI) Node at the University of California, Los Angeles (UCLA). The archive volume creation process described in this section sets out the roles and responsibilities of both these groups. The assignment of tasks has been agreed by both parties during the process of creating this document.

Archived data received by the PPI Node from the MAG team will be made electronically available to PDS users as soon as practicable but no later than as laid out in Table 7. When sufficient data to fill a DVD-R volume have accumulated a new archive volume will be created.

3.1 Data transfer methods and delivery schedule

The MAG team will deliver data to the PPI Node in standard product packages containing three months of data, also adhering to the schedule set out in Table 7. Each package will comprise both data and ancillary data files, organized into directory structures consistent with the volume design described in Section 4, and combined into a deliverable file(s) using file archive and compression software. When these files are unpacked at the PPI Node in the appropriate location, the constituent files will be organized in a directory structure similar to the archive volume structure.

Table 7: Data delivery schedule

Date	Delivery
December 2003	Earth-swingby data, documentation, calibration files, and processing software (days 99-228 to 99-257)
July 2005	Interplanetary cruise (including Jupiter-flyby) data, documentation, calibration files, and software (days 99-258 to 04-182)
July 2005	First 3 months of Saturn data (04-183 to 04-274)
Every 3 months	Next 3 months of Saturn data

Table contents from Archive Plan for Science Data, 699-068, May 2004, Appendix B

Data files will be transferred using the File Transfer Protocol (FTP). The MAG team will sign into a user account on the PPI computer system, transfer the file(s) in binary mode, and then use the Cassini Archive Tracking System (CATS) to inform the PPI Node that an archive delivery has been made. The PPI Node will move the deliverable file to its appropriate location within the PPI file system, unpackage the data, and verify that both the file transfer and unpackaging were successful. Once PPI has verified that it has received a valid data delivery it will update CATS to mark the delivery as “received”.

Following receipt of a data delivery, PPI will organize the data into PDS archive volume structure within its online data system. PPI will generate all of the required files associated with a PDS archive volume (index file, readme files, etc.) as part of its routine processing of incoming MAG data. Newly delivered data will be made available publicly through the PPI online system once accompanying labels and other documentation have been validated. It is anticipated that this validation process will require at least fourteen working days from receipt of the data by PPI. The first two data deliveries are expected to require somewhat more time for the PPI Node to process before making the data publicly available.

The Cassini prime mission begins at Saturn Orbit Insertion (SOI) in July 2004 and lasts four years. Table 7 formalizes the data delivery schedule for all of the MAG cruise and prime mission data. Archiving of products from any extended mission period will be negotiated with the Cassini Project at a later date.

Acquisition of MAG data has been quasi-continuous since deployment of the magnetometer boom immediately prior to the Earth swingby (August 18, 1999). MAG data from the Earth swingby will be used to model the data delivery and validation procedure prior to SOI. These data will be delivered to the PPI Node during December 2003. Interplanetary cruise and Jupiter-flyby data will be archived after the Earth-swingby data has been validated and the automated archive volume creation software is completed and validated. These data will be delivered to the PDS by July 2005.

3.2 Data validation

The MAG data archive volume set will include all data acquired during the Cassini mission. The archive validation procedure described in this section applies to volumes generated during both the cruise and prime phases of the mission.

PDS standards recommend that all data included in the formal archive be validated through a peer-review process. This process is designed to ensure that both the data and documentation are of sufficient quality to be useful to future generations of scientists. The volume and nature of Cassini MAG data, however, necessitate some modification of the normal PDS review process since it is impractical to convene a review panel to examine every archive volume when data volumes are large and data sets are archived while still in a dynamic state.

The amended procedure adopted for MAG data validates, by a peer-review process, an archive volume created using data from the initial phase of acquisition. This review determines whether the archived data are appropriate to meet the stated science objectives of the instrument. The panel also reviews the archive product generation process for robustness and ability to detect discrepancies in the end products; documentation is reviewed for quality and completeness. One of the primary questions addressed during the peer-review process is: “Can an expert in the use of similar data meet the stated science objectives of the experiment using only the data and documentation included in this archive?” The peer-review panel may suggest changes to any of the areas under review if the answer to this question is not affirmative. More details of the data validation process are given in Appendix A.

As expertise with the instrument and data develops the MAG team may decide that changes to the structure or content of its standard data products are warranted. Should these changes be implemented the new data product and archive volume will be subjected to a full PDS peer review, and this document will be fully revised to reflect the modified archive. Table 2 lists the history of all modifications to the archive structure and contents.

Additionally, the MAG team may generate and archive special data products that cover specific observations or data-taking activities. This document does not specify how, when, or under what schedule, any such special archive products are generated.

3.3 Data product and archive volume size estimates

MAG data are organized into files that typically span a single day of data acquisition. Files vary in size depending on the telemetry rate and allocation. Table 8 summarizes the expected sizes of the MAG data products. The file size estimates are based on the largest files created during the Earth swingby. It is anticipated that actual file sizes, and the number of archive volumes required to store them, will be less than this estimate.

All MAG data are organized by the PDS team onto a single archive volume covering a time interval governed by the physical capacity of the archive volume media. The data on the volume are organized into one-day subdirectories, with an individual volume containing between 30 and 50 days of data. It is anticipated that data will be archived on DVD-R media, which have a capacity of 4.7 GB. These media will be produced in UDF bridge format with ISO partitions, in compliance with PDS standards.

Table 8: Data product size and archive volume production rate

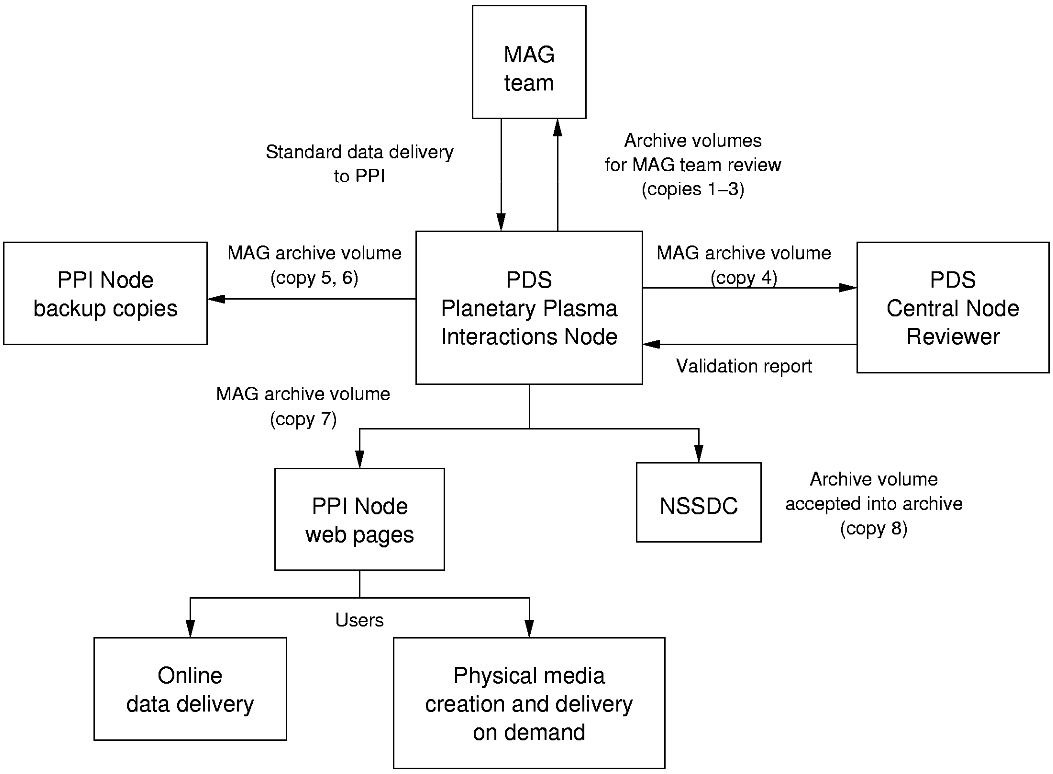
Product	Production rate (approximate)	Days per 4.7 GB volume	Volumes for 4-year primary mission
REDR	up to 120 MB per day	30-50	46

Following receipt of MAG data by the PPI Node it is expected that fourteen working days will be required before the data are made available on PPI web pages. Once sufficient data have accumulated a new archive volume will be created by PPI. It is anticipated that two weeks will be required to produce and validate this new archive volume once the data delivery that fills the volume has been made available online.

3.4 Backups and duplicates

The PPI Node keeps three copies of each archive volume. One copy is the primary archive volume, another is an onsite backup copy, and the final copy is a local, off-site backup copy. The volumes sent to the MAG team and the PDS Central Node are to be kept by those institutions. Once the archive volumes are fully validated and approved for inclusion in the archive, a copy of the data is sent to the National Space Science Data Center (NSSDC) for long-term archive in a NASA-approved deep-storage facility. The PPI Node may maintain additional copies of the archive volumes, either on or off-site as deemed necessary. Figure 1 describes the process of duplicating and disseminating MAG archive volumes.

Figure 1: Duplication and dissemination of MAG archive volumes



3.5 Labeling and identification

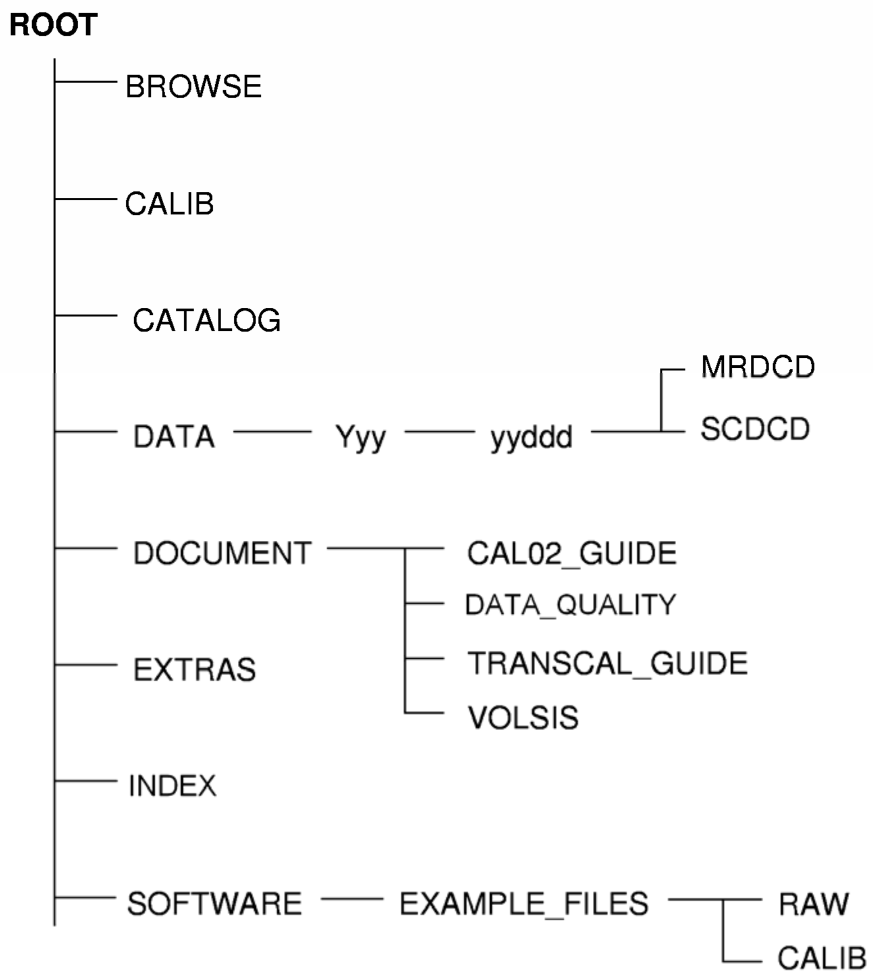
Each MAG data volume bears a unique volume ID using the last two components of the volume set ID [*PDS Standards Reference*, 2002]. For each physical medium, the volume set ID is USA_NASA_PDS_COMAG_nnnn, where nnnn is the sequence number of the individual volume. Hence the first MAG volume has the volume ID COMAG_0001.

The MAG REDR data set has the PDS DATA_SET_ID CO-E/SW/J/S-MAG-2-REDR-RAW-DATA-V1.0 except for the SHM_C data where MAG-2 is replaced by MAG-3.

4 Archive volume contents

This section describes the contents of the MAG standard product archive collection volumes, including the file names, file contents, file types, and the organizations responsible for providing the files. The complete directory structure is shown in Figure 2. All the ancillary files described herein appear on each MAG volume, except where noted.

Figure 2: Archive volume directory structure



4.1 Root directory

The following files are contained in the root directory, and are produced by the PPI Node. They are described here for information purposes only. With the exception of the hypertext file and its label, all of these files are required by the PDS volume organization standards.

Table 9: Root directory contents

File	Description	Responsibility
AAREADME.TXT	This file completely describes the volume organization and contents (PDS label attached)	PPI Node
AAREADME.HTM	HTML version of AAREADME.TXT	PPI Node
AAREADME.LBL	A PDS detached label that describes AAREADME.HTM	PPI Node
ERRATA.TXT	A text file containing a cumulative listing of comments and updates concerning all MAG standard data products on all MAG volumes in the volume set published to date	PPI Node
VOLDESC.CAT	A description of the contents of this volume in a PDS format readable by both humans and computers	PPI Node

4.2 BROWSE directory

The BROWSE directory contains daily browse plots of the MAG data. The contents of this directory are described in Table 10

Table 10: BROWSE directory contents

File	Description	Responsibility
BROINFO.TXT	A description of the contents of this directory	PPI Node
yyddd.PDF	A PDF file containing a plot of the magnetic-field data acquired on day ddd of year yy	MAG team, PPI Node
yyddd.LBL	The PDS label for the plot file	PPI Node

4.3 CALIB directory

The CALIB directory contains the files needed to calibrate raw MAG data. The contents of this directory are described in Table 11. These are the MAG_CAL standard data products.

Table 11: CALIB directory contents

File	Description	Responsibility
CALINFO.TXT	A description of the contents of this directory	MAG team, PPI Node
FGM_CAL.FFD	A flatfile data file containing FGM calibration information as a function of time. This file is required as input for the CAL02 application.	MAG team
FGM_CAL.FFH	The flatfile header for the FGM calibration data	MAG team
FGM_CAL.LBL	The PDS label for the FGM calibration data	MAG team
VHM_CAL.FFD	A flatfile data file containing VHM calibration information as a function of time. This file is required as input for the CAL02 application.	MAG team
VHM_CAL.FFH	The flatfile header for the VHM calibration data	MAG team
VHM_CAL.LBL	The PDS label for the VHM calibration data	MAG team

4.4 CATALOG directory

The files in the CATALOG directory provide a top-level understanding of the Cassini mission, spacecraft, instruments, and data sets in the form of completed PDS templates. The information necessary to create the files is provided by the MAG 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 Node and the PDS Central Node.

Table 12: CATALOG directory contents

File	Description	Responsibility
CATINFO.TXT	A description of the contents of this directory	PPI Node
INSTHOST.CAT	A description of the Cassini orbiter	Cassini Project
MAG_INST.CAT	PDS instrument catalog description of the MAG instrument	MAG team, PPI Node
MISSION.CAT	PDS mission catalog description of the Cassini mission	Atmospheres Node, Cassini Project
PERSON.CAT	PDS personnel catalog description of MAG team members and other persons involved with generation of MAG data products	MAG team, PPI Node
PROJREF.CAT	References mentioned in INSTHOST.CAT and MISSION.CAT	Cassini Project
REDR_DS.CAT	PDS data set catalog description of the MAG raw data	MAG team, PPI Node
REF.CAT	MAG-related references mentioned in other CAT files	MAG team, PPI Node

4.5 DATA directory

4.5.1 Contents

The DATA directory contains the actual data products and ancillary information files produced by the MAG team. The REDR dataset is primarily raw science data which has been reformatted into simple binary table structures, organized into correct time sequence, time tagged, and edited to remove obviously bad data.

When archived these data are of the highest quality possible. Any residual issues pertaining to the data are documented in AAREADME.TXT, ERRATA.TXT and REDR_DS.CAT. Users are referred to these files for a detailed description of any outstanding matters associated with the archived data.

Additional files located in the DATA directory include ancillary information files (engineering, housekeeping) and channelized data files (e.g. spacecraft attitude, status information for MAG instrumental subsystems), provided to facilitate data processing and analysis.

Time is represented in MAG REDR files in a number of formats. Appendix B describes the derivation of these different formats.

Table 13: DATA directory contents

File	Description	Responsibility
DATAINFO.TXT	A description of the contents of this directory	MAG team
MAGDATA.TXT	A file describing aspects of MAG data in greater detail	MAG team
Yyy	Subdirectories containing MAG data, where 'yy' represents the 2-digit year during which the data were acquired	MAG team

4.5.2 Subdirectory structure

All components of the MAG REDR dataset are organized into a file system called "flatfiles". In this system, data are stored in a binary file as a table composed of fixed-length records. All data files have an accompanying ASCII "header" file that describes the data file contents. The flatfile system was developed by UCLA, and a variety of software packages read and process data stored in this manner.

PDS archiving standards require that an additional ASCII "label" file describe each data file. This label contains similar information to, and may usually be derived from, the corresponding header file. Consequently, both a header file and a label file will describe each data file in the MAG archive, to accommodate both processing and archiving requirements.

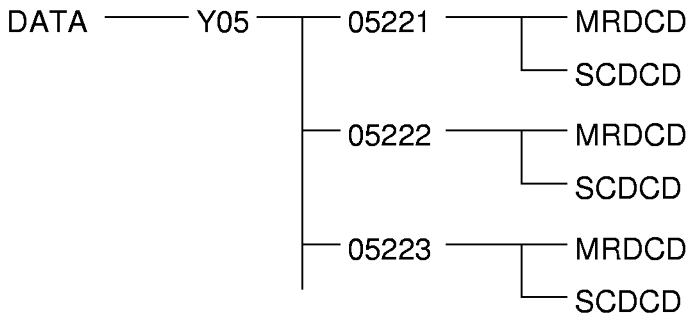
REDR standard data products, containing one day of data in total, consist of approximately 18 binary data files and approximately 14 additional files containing instrument housekeeping or channelized data. Each flatfile in the standard set contains all data of the specified file type for a single day. Depending on mission priorities, data may not necessarily be available for all file types on any given day.

In order to manage files in an archive volume more efficiently the DATA directory is divided into subdirectories. The first two levels of division are based on time; data are organized into yearly subdirectories which are further divided into a number of daily subdirectories. The naming convention for the yearly directories is Yyy, and for the daily directories is yyddd, where yy is the last two (least significant) digits of the year, and ddd is the three-digit day of year. For example, all data for the year 2005 are contained below the directory Y05, with data for January 1 2005 found in the subdirectory Y05/05001, and so on.

During the prime mission the magnetometers operate at higher data-acquisition rates and it is expected that data volumes for this period will have capacity for 30 to 50 days of data. During the cruise phase of the mission the instruments operate at reduced acquisition rates and, consequently, the number of days on each data volume may be greater than 50. However, in order to comply with PDS subdirectory specifications, the number of days per data volume will be specifically limited so that it does not exceed 256.

The daily directories are further divided into the MRDCD (MAG raw consolidated data for VHM and FGM as well as calibrated SHM data) and SCDCD (spacecraft consolidated data) subdirectories, according to the types of files they contain. Figure 3 shows a representative portion of the DATA directory tree.

Figure 3: Typical DATA directory tree



4.5.3 Required files

A PDS label describes each file in the DATA path of an archive volume. Text documentation files have attached (internal) PDS labels and data files have detached labels. Detached PDS label files have the same root name as the file they describe but have the extension LBL. The format of the data files for each standard data product is constant throughout the archive volume and is described in FMT files located in the DATA directory (see Section 4.5.1).

4.5.4 MRDCD subdirectory

This directory contains magnetic-field data files and their corresponding headers and labels. The data in these files correspond to a time interval of one day, the particular day being identified from both the file name and the name of the parent directory. Science data extracted from various sources (i.e. types of data packet) are included in

Table 14.

The procedures involved in extracting and processing science data taken in "snapshot" mode (data stored internally by MAG software and then downloaded at a later time) are not yet fully developed and tested. Snapshot data have therefore been omitted from the archive plan (and from

Table 14) at present.

Table 14: DATA/Yyy/yyddd/MRDCD directory contents

File	Description	Responsibility
yyddd_MRDCD_SDFGMC.FFD yyddd_MRDCD_HKFGMN.FFD yyddd_MRDCD_SHFGMC.FFD yyddd_MRDCD_SDFGMC.FFH yyddd_MRDCD_HKFGMN.FFH yyddd_MRDCD_SHFGMC.FFH yyddd_MRDCD_SDFGMC.LBL yyddd_MRDCD_HKFGMN.LBL yyddd_MRDCD_SHFGMC.LBL	MAG_FGM standard data products. Data files containing raw (uncalibrated) magnetic-field vector data from the fluxgate magnetometer (FGM). The original telemetric sources of this data are science data packets (SD), housekeeping packets (HK) and subcommutated housekeeping (SH). Generation of SH is configurable, thus SH data may not always be present. Labels and flatfile headers for the three data files are also included. The "yyddd" string identifies the year and day of year corresponding to the data e.g. 01037 denotes February 4th (Day 37) 2001. The final letter of the filename prefix indicates whether a configuration image was used ("C") when creating the file, or not ("N"). The sample interval used in pre processing is taken from the configuration image so if the configuration image is not available the default is used which is manually adjustable and is preset to the value which is nominally used. So while whether the image is used or not does not affect how the file is used not using the image puts the sample timing in doubt.	MAG team
yyddd_MRDCD_SDVHMC.FFD yyddd_MRDCD_HKVHMN.FFD yyddd_MRDCD_SHVHMC.FFD yyddd_MRDCD_SDVHMC.FFH yyddd_MRDCD_HKVHMN.FFH yyddd_MRDCD_SHVHMC.FFH yyddd_MRDCD_SDVHMC.LBL yyddd_MRDCD_HKVHMN.LBL yyddd_MRDCD_SHVHMC.LBL	As for previous entry in this table, except that the magnetic data are from the vector helium magnetometer (VHM) and are MAG_VHM standard data products.	MAG team
yyddd_MRDCD_SDSHMC_C.FFD yyddd_MRDCD_HKSHMN_C.FFD yyddd_MRDCD_SHSHMC_C.FFD yyddd_MRDCD_SDSHMC_C.FFH yyddd_MRDCD_HKSHMN_C.FFH yyddd_MRDCD_SHSHMC_C.FFH yyddd_MRDCD_SDSHMC_C.LBL yyddd_MRDCD_HKSHMN_C.LBL yyddd_MRDCD_SHSHMC_C.LBL	As for previous entry in this table, except that the magnetic data are now in scalar form (magnetic-field strength) from the scalar helium magnetometer (SHM) , the data are calibrated and are MAG_SHM_C standard data products. SHM data will not commonly be found in the relevant subdirectories of the archive because the SHM sensor is only used when the spacecraft is located within approximately 4 planetary radii of Saturn (where magnetic field strength exceeds 256 nT).	MAG team
yyddd_MRDCD_HKCONN.FFD yyddd_MRDCD_SHCONC.FFD yyddd_MRDCD_HKCONN.FFH yyddd_MRDCD_SHCONC.FFH yyddd_MRDCD_HKCONN.LBL yyddd_MRDCD_SHCONC.LBL	MAG_CON standard data products. Data files containing configuration (CON) image data related to the state of the instrument maintained by the MAG DPU computer. The original telemetric sources of this data are housekeeping packets (HK) and subcommutated housekeeping (SH). Labels and flatfile headers for the data files are also included.	MAG team
yyddd_MRDCD_HKANAN.FFD yyddd_MRDCD_SHANAC.FFD yyddd_MRDCD_SDANAC.FFD yyddd_MRDCD_HKANAN.FFH yyddd_MRDCD_SHANAC.FFH yyddd_MRDCD_SDANAC.FFH yyddd_MRDCD_HKANAN.LBL yyddd_MRDCD_SHANAC.LBL yyddd_MRDCD_SDANAC.LBL	MAG_ANA standard data products. Data files containing analog (ANA) housekeeping data. The original telemetric sources of this data are housekeeping packets (HK) and subcommutated housekeeping (SH), as well as some of the HK data from science packets. Labels and flatfile headers for the data files are also included.	MAG team
yyddd_MRDCD_HKERRN.FFD yyddd_MRDCD_SHERRC.FFD yyddd_MRDCD_HKERRN.FFH yyddd_MRDCD_SHERRC.FFH yyddd_MRDCD_HKERRN.LBL yyddd_MRDCD_SHERRC.LBL	MAG_ERR standard data products. Data files containing error counter (ERR) data. The original telemetric sources of this data are housekeeping packets (HK) and subcommutated housekeeping (SH). Labels and flatfile headers for the data files are also included.	MAG team

File	Description	Responsibility
yyddd_MRDCD_HKCMDN.FFD yyddd_MRDCD_HKCMDN.LBL	MAG_CMD standard data products. Data files containing command validation (CMD) information. The original telemetric sources of this data are housekeeping packets (HK). The labels and flatfile headers for the data files are also included.	MAG team

4.5.5 SCDCD subdirectory

This directory typically contains two data files and their corresponding headers and labels. The data in these files correspond to a time interval of one day, the particular day being identified by both the file name and the name of the parent directory. The data consist of spacecraft housekeeping or "channelized" data, such as attitude information.

Table 15: DATA/Yyy/yyddd/SCDCD directory contents

File	Description	Responsibility
yyddd_ECDCD_CHATT.FFD yyddd_ECDCD_CHATT.FFH yyddd_ECDCD_CHATT.LBL	MAG_CHATT standard data products. Channelized (CH) data file (with flatfile header and label) containing attitude (ATT) information for the Cassini spacecraft.	MAG team
yyddd_ECDCD_CHUSR.FFD yyddd_ECDCD_CHUSR.FFH yyddd_ECDCD_CHUSR.LBL	MAG_CHUSR standard data products. Channelized (CH) data file (with flatfile header and label) containing data from user-selected (USR) channels. The set of channels from which the data are extracted will be a "default set", determined by the MAG team.	MAG team

4.6 DOCUMENT directory

The DOCUMENT directory contains a range of documentation considered either necessary or useful for users to understand the archive data set. Documents may be included in multiple forms, for example, ASCII, PDF, MS Word, or HTML. PDS standards require that any documentation needed for use of the data be available in an ASCII format. HTML and PostScript are acceptable ASCII formats in addition to plain text. The following files are contained in the DOCUMENT directory, grouped into the subdirectories shown.

Table 16: DOCUMENT directory contents

File	Description	Responsibility
DOCINFO.TXT	A description of the contents of this directory	MAG team
Subdirectory: DATA_QUALITY		
GAP_FILE_SCI_HK.TXT	An accumulative listing of the missing House Keeping packets up to and including the days for the current volume	MAG team
GAP_FILE_SCI_HK.LBL	A PDS detached label for GAP_FILE_SCI_HK	MAG team PPI Node
GAP_FILE_SCI_SD.TXT	An accumulative listing of the missing Science packets for the days up to and including the days for the current volume	MAG team

File	**Description**	**Responsibility**
GAP_FILE_SCI_SD.LBL	A PDS detached label for GAP_FILE_SCI_SD	MAG team PPI Node
MODE_CHANGES.ASC	An accumulative listing of instrument mode changes for the days up to and including the days for the current volume	MAG team
MODE_CHANGES.LBL	A PDS detached label for MODE_CHANGES	MAG team PPI Node
RANGE_CHANGES.ASC	An accumulative listing of instrument mode changes for the days up to and including the days for the current volume	MAG team
RANGE_CHANGES.LBL	A PDS detached label for RANGE_CHANGES	MAG team PPI Node
SCAS_TIMES.ASC	An accumulative listing of Science CAlibration Subsystem (SCAS) activities for the days up to and including the days for the current volume	MAG team
SCAS_TIME.LBL	A PDS detached label for SCAS_TIME	MAG team PPI Node
Subdirectory: CAL02_GUIDE		
CAL02_GUIDE.DOC	A guide to using the software for calibrating vector magnetic-field data, in MS Word format	MAG team
CAL02_GUIDE.HTM	CAL02_GUIDE in HTML format	MAG team
CAL02_GUIDE.ASC	CAL02_GUIDE in plain ASCII text format	MAG team
CAL02_GUIDE.PDF	CAL02_GUIDE in PDF format	MAG team
CAL02_GUIDE.LBL	A PDS detached label for CAL02_GUIDE	MAG team
Subdirectory: TRANSCAL_GUIDE		
TRANSCAL_GUIDE.DOC	A guide to using the software for transforming vector magnetic-field data to alternative coordinate systems, in MS Word format	MAG team
TRANSCAL_GUIDE.HTM	TRANSCAL_GUIDE in HTML format	MAG team
TRANSCAL_GUIDE.ASC	TRANSCAL_GUIDE in plain ASCII text format	MAG team
TRANSCAL_GUIDE.PDF	TRANSCAL_GUIDE in PDF format	MAG team
TRANSCAL_GUIDE.LBL	A PDS detached label for TRANSCAL_GUIDE	MAG team
GFIG_001.PNG	Bit-map image of a figure in TRANSCAL_GUIDE, in PNG format	MAG team
Subdirectory: VOLSIS		
VOLSIS.DOC	The archive volume SIS (this document), in MS Word format	MAG team, PPI Node
VOLSIS.HTM	The SIS in HTML format	MAG team
VOLSIS.ASC	The SIS in plain ASCII text format	MAG team
VOLSIS.PDF	The SIS in PDF format	MAG team
VOLSIS.LBL	A PDS detached label for the SIS document	MAG team
SFIG_xxx.PNG	Bit-map images of figures in the SIS document, in PNG format	MAG team

4.7 EXTRAS directory

The EXTRAS directory contains files which facilitate the use of the archive volume but which are not considered part of the archive itself. Included in this directory are those SPICE kernels which were used to create the example data files. To process the MAG data.users are advised to check with the NAIF Node for updated kernels which may subsequently be made available.

4.8 INDEX directory

The following files are contained in the INDEX directory and are produced by the PPI Node. They are described here for information purposes only. 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) that lists all data products in the MAG archive volume set to date. The index and index information (INDXINFO.TXT) files are required by the PDS volume standards. The manifest tables are added by the PPI Node for completeness and are not required files. The cumulative index file is also a PDS requirement; however this file may not be reproduced on each data volume if it becomes clear in the early production that the file will grow to a substantial fraction of the archive media volume. An online and web-accessible cumulative index file will be available at the PPI Node while data volumes are being produced.

Table 177: INDEX directory contents

File	Description	Responsibility
INDXINFO.TXT	A description of the contents of this directory	PPI Node
CUMINDEX.TAB	A table listing all MAG data products published so far in this volume set, including the data on this volume	PPI Node
CUMINDEX.LBL	A PDS detached label that describes CUMINDEX.TAB	PPI Node
INDEX.TAB	A table listing all MAG data products on this volume	PPI Node
INDEX.LBL	A PDS detached label that describes INDEX.TAB	PPI Node

4.9 SOFTWARE directory

The SOFTWARE directory contains the software used to calibrate MAG data and transform them to alternative coordinate systems. This directory also includes the EXAMPLE_FILES subdirectory, which itself is further divided into the subdirectories RAW and CALIB. These subdirectories contain examples of raw data, and calibrated and transformed data, to enable users to confirm the output of the provided software. The SPICE kernels used by the software to process the example data files are contained in the EXTRAS directory (see Section 4.7). Information that describes the SPICE system, and the content and use of SPICE kernels is available from the PDS NAIF node.

Table 18 shows the contents of the SOFTWARE directory and Table 19 describes its subdirectories. These are the MAG_SW standard data products.

Table 18: SOFTWARE directory contents

File	Description	Responsibility
SOFTINFO.TXT	A description of the contents of this directory	MAG team, PPI Node
CAL02.EXE	The executable application required to calibrate raw vector data files to give correct magnetic-field values relative to the spacecraft coordinate system	MAG team
CAL02.CPP	The C++ source code and associated files required for compiling CAL02 on necessary for recompiling and rebuilding CAL02	MAG team
CAL02.LBL	PDS label file for the CAL02 suite of files	MAG team
CAL_MAG.H	C++ header file required by calibration software	MAG team
CAL_MAG.LBL	PDS label file for CAL_MAG.H	MAG team
CALFUNC02.H	C++ header file required by calibration software	MAG team
CALFUNC02.CPP	C++ source file required by calibration software	MAG team
CALFUNC02.LBL	PDS label file for CALFUNC02.*	MAG team
KERNEL_FILELIST.TXT KERNEL_FILELIST.LBL	Metafile (and associated label) containing a list of the SPICE kernels loaded by TransCal	MAG team
TRANSCAL.EXE	The application required to transform the calibrated magnetic-field components (produced by CAL02) from spacecraft coordinates to other coordinate systems	MAG team
TRANSCAL.CPP	The C++ source code and associated files required for compiling TransCal on necessary for recompiling and rebuilding TransCal.	MAG team
TRANSCAL.LBL	PDS label file for the TransCal suite of files	MAG team
FF_IGPP.C	C Source, UCLA Flatfile procedures	MAG team
FF_IGPP.H	C Header File, UCLA Flatfile declarations and type defs	MAG team
FF_IGPP.LBL	PDS Label file for the FF_IGPP suite of files	MAG team
TIME_IGPP.C	C Source, UCLA Flatfile Time Functions	MAG team
TIME_IGPP.H	C Header File, UCLA Flatfile Time declarations and definitions	MAG team
TIME_IGPP.LBL	PDS Label file for the TIME_IGPP suite of files	MAG team
TIME_IGPPP.H	C Header File, More UCLA Time definitions	MAG team
TIME_IGPPP.LBL	PDS Label file for the TIME_IGPPP file	MAG team
EXAMPLE_FILES	Subdirectory of the SOFTWARE directory	MAG team

Table 19: SOFTWARE/EXAMPLE_FILES directory contents

File	Description	Responsibility
Subdirectory: RAW		

File	Description	Responsibility
TEST_99238CHATT.FFD TEST_99238CHATT.FFH TEST_99238CHATT.LBL	Test files containing spacecraft attitude and engineering data corresponding to the same time period as the test science data files. These files are a required input for the TransCal application when the Q (quaternion) option is chosen. A flatfile header and PDS label are included.	MAG team
TEST_RAW_99238HKFGMN.FFD TEST_RAW_99238HKFGMN.FFH TEST_RAW_99238HKFGMN.LBL	Test files containing raw science data from the FGM instrument. A flatfile header and PDS label for these test data files are included.	MAG team
TEST_RAW_99238HKVHMN.FFD TEST_RAW_99238HKVHMN.FFH TEST_RAW_99238HKVHMN.LBL	Test files containing raw science data from the VHM instrument. A flatfile header and PDS label for these test data files are included.	MAG team
Subdirectory: CALIB		
TEST_CALIB_99238HKFGMN.FFD TEST_CALIB_99238HKFGMN.FFH TEST_CALIB_99238HKFGMN.LBL	The output files which result from correctly calibrating the raw FGM test files. Archive users can use these to check their own calibrations. A flatfile header and PDS label are included.	MAG team
TEST_CALIB_99238HKFGMN_RPT.TXT	Report file (with attached label) generated during the FGM calibration process.	MAG team
TEST_CALIB_99238HKVHMN.FFD TEST_CALIB_99238HKVHMN.FFH TEST_CALIB_99238HKVHMN.LBL	The output files which result from correctly calibrating the raw VHM test files.	MAG team
TEST_CALIB_99238HKVHMN_RPT.TXT	Report file (with attached label) generated during the VHM calibration process.	MAG team
TEST_TRANSGSE_99238HKFGMN.FFD TEST_TRANSGSE_99238HKFGMN.FFH TEST_TRANSGSE_99238HKFGMN.LBL	The output files which result from correctly transforming the FGM data in the calibrated test files to the GSE coordinate system. Archive users can use these files to check the accuracy of their own coordinate transforms.	MAG team
TEST_TRANSGSE_99238HKFGMN_RPT .TXT	Report file (with attached label) generated during the FGM transformation process.	MAG team
TEST_TRANSGSE_99238HKVHMN.FFD TEST_TRANSGSE_99238HKVHMN.FFH TEST_TRANSGSE_99238HKVHMN.LBL	The output files which result from correctly transforming the VHM data in the calibrated test files to the GSE coordinate system.	MAG team
TEST_TRANSGSE_99238HKVHMN_RPT .TXT	Report file (with attached label) generated during the VHM transformation process.	MAG team
TEST_TRANSRTN_99238HKFGMN.FFD TEST_TRANSRTN_99238HKFGMN.FFH TEST_TRANSRTN_99238HKFGMN.LBL	The output files which result from correctly transforming the FGM data in the calibrated test files to the RTN coordinate system.	MAG team
TEST_TRANSRTN_99238HKFGMN_RPT. TXT	Report file (with attached label) generated during the FGM transformation process.	MAG team
TEST_TRANSRTN_99238HKVHMN.FFD TEST_TRANSRTN_99238HKVHMN.FFH TEST_TRANSRTN_99238HKVHMN.LBL	The output files which result from correctly transforming the VHM data in the calibrated test files to the RTN coordinate system.	MAG team
TEST_TRANSRTN_99238HKVHMN_RPT. TXT	Report file (with attached label) generated during the VHM transformation process.	MAG team

5 Archive volume format

This section describes the format of MAG standard product archive volumes. The MAG instrument team maintains subsections 5.2.6 (Calibration files), and 5.2.7 (REDR data files). Data that comprise the MAG standard product archives will be formatted in accordance with PDS specifications [*Planetary Science Data Dictionary*, August 2002; *PDS Data Preparation Workbook*, 1995; *PDS Standards Reference*, October 2002].

5.1 Disk format

Although the MAG team does not control the disk format it is described in this SIS document for completeness. Archive volumes have a UDF-ISO bridge format file system with an ISO partition that is compatible with DVD readers and drivers for MS-DOS, MS-Windows (95 or higher) Macintosh, and Solaris. The MAG volumes will be created in accordance with the ISO 9660 level 2 Interchange Standard [*ISO 9660*, 1988] so that CD-R products can be created from the archive without modifying file names or other parameters.

5.2 File formats

The following section describes file formats for the kinds of files contained on archive volumes. For more information, see Appendix B of the *PDS Data Preparation Workbook* [1995].

5.2.1 Document files

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

In general, documents are provided in ASCII text format. However, some documents in the DOCUMENT directory contain formatting and figures that cannot be rendered as ASCII text. Hence these documents are also given in additional formats such as hypertext and Microsoft Word. Hypertext files contains ASCII text plus hypertext markup language (HTML) commands that enable them to be viewed in a web browser such as Netscape Navigator or Microsoft Internet Explorer. Hypertext documents may reference ancillary files, such as images, that are incorporated into the document by the web browser.

5.2.2 Tabular files

Tabular files (TAB extension) exist in the DATA, INDEX and CALIB directories. Tabular files are ASCII files formatted for direct reading into database management systems on various computers. Columns are fixed length, separated by commas or whitespace, and character fields are enclosed in double quotation marks ("). Character fields are padded with spaces to keep quotation marks in the same columns of successive records. Character fields are left justified, and numeric fields are right justified. The “start byte” and “bytes” values listed in the labels do not include the commas between fields or the quotation marks surrounding character fields. The records are of fixed length, and the last two bytes of each record contain the ASCII carriage return and line feed characters. This line format allows a table to be treated as a fixed length record file on computers that support this file type and as a text file with embedded line delimiters on those that don't support it.

Detached PDS label files will describe all tabular files. A detached label file has the same name as the data file it describes, but with the extension LBL. For example, the file INDEX.TAB is accompanied by the detached label file INDEX.LBL in the same directory.

5.2.3 PDS labels

All data files in the MAG Standard Product Archive Collection have associated detached PDS labels [see *Planetary Science Data Dictionary*, August 2002; *PDS Standards Reference*, October 2002]. These label files are named using the same prefix as the data file together with an LBL extension.

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. IMAGE, TABLE, 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 number 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-27-character, alphanumeric upper-case file name,
- ext is the up-to-3-character upper-case file extension, and,
- all detached labels contain 80-byte fixed-length 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.

Examples of PDS labels required for the MAG archive are given in Appendix C.

5.2.4 Catalog files

Catalog files (extension CAT) exist in the Root and CATALOG directories. They are plain text files formatted in an object-oriented structure consisting of sets of "keyword = value" declarations.

5.2.5 Index files

The PDS team provides PDS index files. The format of these files is described in this SIS document for completeness.

A PDS index table contains a listing of all data products on an archive volume. When a data product is described by a detached PDS label, the index file points to the label file which in turn points to the data file. When a data product is described by an attached PDS label, the index file points directly to the data product.

A PDS index is an ASCII table composed of required columns (file name, creation_time, data_set_id, product_id) and optional columns (user defined). When values are constant across an entire volume, it is permissible to promote the value out of the table and into the PDS label for the index table.

To facilitate users' searches of the MAG data submission, a few optional columns will be included in the index table. In particular, the file start and stop times will be included as well as the primary observation target of the data file (e.g. Saturn, Solar Wind, Jupiter). Table 20 contains a description of the MAG archive volume index files. Index files are by definition fixed length ASCII files containing comma delimited fields. Character strings are quoted using double quotes. The Start byte column gives the location of the first byte of the column within the file, skipping over delimiters and quotation marks.

Table 20: Format of index files

Column name	Data type	Start byte	Bytes	Description
Product_id	Char	2	27	PDS Product ID – A unique identifier for all products within a PDS data set.
File_specification_name	Char	33	80	The full specification of file name and the path to the PDS label file that describes the product, relative to the root of the archive volume.
Start_time	Time	117	22	The time of the first record in the data file.
Stop_time	Time	141	22	The time of the last record in the data file.
Target	Char	168	20	The name of the primary observation target identified in the PDS label file.
Product Type	Char	193	12	The "type" of data file.
Data_set_id	Char	210	40	The PDS ID of the data set of which this file is a member.
Product_creation_date	Time	244	8	The date when the product was delivered to the PDS.

PPI also maintains a cumulative index file that describes the location of every data product across every volume of a multi-volume archive. The cumulative index file has all of the same columns as the index file, plus one additional column: the PDS VOLUME_ID. The VOLUME_ID column is the first column in the table. It is an 11-byte character string beginning at byte 2 (begin quote at byte 1). All of the other columns in the index table are displaced by 15 bytes such that the Product_id column begins at byte 17 rather than byte 2, etc.

5.2.6 Calibration files

The calibration files contain offset vectors and matrix multipliers listed as a function of time. These elements are applied to raw magnetic-field data for the purpose of calibration (see Section 4.3). Calibration algorithms are described in Appendix D.

Table 21 and Table 22 describe the structure and contents of the calibration files associated with FGM and VHM data, respectively. The nomenclature of the column names in these tables indicates the sensor's dynamic range of operation associated with each offset or matrix element. For example,

- “Zrg0” denotes the offset associated with the MAG Z axis when the sensor (FGM or VHM) is operating in its “zeroth” dynamic range (see Table 36), and,
- “o32rg1” denotes the O/S matrix element in the third row and second column, which is valid when the sensor is operating in its “first” dynamic range (see Table 36).

In Table 21 to Table 31 the following data types are used:

- “T” represents an 8-byte real (time) value,
- “R” represents a 4-byte real value, and,
- “I” represents a 4-byte integer value.

Table 21: Format of FGM calibration files

Column	Name	Data type	Start byte	Description	Units
001	TIME_START	T	0	start time	SCLK counts
002	TIME_STOP	T	8	stop time	SCLK counts
003	Xrg0	R	16	instrument offset	nT
004	Yrg0	R	20	instrument offset	nT
005	Zrg0	R	24	instrument offset	nT
006	Xrg1	R	28	instrument offset	nT
007	Yrg1	R	32	instrument offset	nT
008	Zrg1	R	36	instrument offset	nT
009	Xrg2	R	40	instrument offset	nT
010	Yrg2	R	44	instrument offset	nT

011	Zrg2	R	48	instrument offset	nT
012	Xrg3	R	52	instrument offset	nT
013	Yrg3	R	56	instrument offset	nT
014	Zrg3	R	60	instrument offset	nT
015	o11rg0	R	64	O/S matrix element	
016	o12rg0	R	68	O/S matrix element	
017	o13rg0	R	72	O/S matrix element	
018	o21rg0	R	76	O/S matrix element	
019	o22rg0	R	80	O/S matrix element	
020	o23rg0	R	84	O/S matrix element	
021	o31rg0	R	88	O/S matrix element	
022	o32rg0	R	92	O/S matrix element	
023	o33rg0	R	96	O/S matrix element	
024	o11rg1	R	100	O/S matrix element	
025	o12rg1	R	104	O/S matrix element	
026	o13rg1	R	108	O/S matrix element	
027	o21rg1	R	112	O/S matrix element	
028	o22rg1	R	116	O/S matrix element	
029	o23rg1	R	120	O/S matrix element	
030	o31rg1	R	124	O/S matrix element	
031	o32rg1	R	128	O/S matrix element	
032	o33rg1	R	132	O/S matrix element	
033	o11rg2	R	136	O/S matrix element	
034	o12rg2	R	140	O/S matrix element	
035	o13rg2	R	144	O/S matrix element	
036	o21rg2	R	148	O/S matrix element	
037	o22rg2	R	152	O/S matrix element	
038	o23rg2	R	156	O/S matrix element	
039	o31rg2	R	160	O/S matrix element	
040	o32rg2	R	164	O/S matrix element	
041	o33rg2	R	168	O/S matrix element	
042	o11rg3	R	172	O/S matrix element	
043	o12rg3	R	176	O/S matrix element	
044	o13rg3	R	180	O/S matrix element	
045	o21rg3	R	184	O/S matrix element	
046	o22rg3	R	188	O/S matrix element	
047	o23rg3	R	192	O/S matrix element	
048	o31rg3	R	196	O/S matrix element	
049	o32rg3	R	200	O/S matrix element	
050	o33rg3	R	204	O/S matrix element	
051	Xs/c	R	208	S/C (spacecraft internal) field	nT

052	Ys/c	R	212	S/C field	nT
053	Zs/c	R	216	S/C field	nT
054	o11	R	220	S/C (sensor to spacecraft coordinate transformation) matrix element	
055	o12	R	224	S/C matrix element	
056	o13	R	228	S/C matrix element	
057	o21	R	232	S/C matrix element	
058	o22	R	236	S/C matrix element	
059	o23	R	240	S/C matrix element	
060	o31	R	244	S/C matrix element	
061	o32	R	248	S/C matrix element	
062	o33	R	252	S/C matrix element	

Table 22: Format of VHM calibration files

Column	Name	Data type	Start byte	Description	Units
001	TIME_ START	T	0	start time	SCLK counts
002	TIME_ STOP	T	8	stop time	SCLK counts
003	Xrg0	R	16	instrument offset	nT
004	Yrg0	R	20	instrument offset	nT
005	Zrg0	R	24	instrument offset	nT
006	Xrg1	R	28	instrument offset	nT
007	Yrg1	R	32	instrument offset	nT
008	Zrg1	R	36	instrument offset	nT
009	N/A	R	40	N/A	
010	N/A	R	44	N/A	
011	N/A	R	48	N/A	
012	N/A	R	52	N/A	
013	N/A	R	56	N/A	
014	N/A	R	60	N/A	
015	o11rg0	R	64	O/S matrix element	
016	o12rg0	R	68	O/S matrix element	
017	o13rg0	R	72	O/S matrix element	
018	o21rg0	R	76	O/S matrix element	
019	o22rg0	R	80	O/S matrix element	
020	o23rg0	R	84	O/S matrix element	
021	o31rg0	R	88	O/S matrix element	
022	o32rg0	R	92	O/S matrix element	
023	o33rg0	R	96	O/S matrix element	
024	o11rg1	R	100	O/S matrix element	

025	o12rg1	R	104	O/S matrix element	
026	o13rg1	R	108	O/S matrix element	
027	o21rg1	R	112	O/S matrix element	
028	o22rg1	R	116	O/S matrix element	
029	o23rg1	R	120	O/S matrix element	
030	o31rg1	R	124	O/S matrix element	
031	o32rg1	R	128	O/S matrix element	
032	o33rg1	R	132	O/S matrix element	
033	N/A	R	136	N/A	
034	N/A	R	140	N/A	
035	N/A	R	144	N/A	
036	N/A	R	148	N/A	
037	N/A	R	152	N/A	
038	N/A	R	156	N/A	
039	N/A	R	160	N/A	
040	N/A	R	164	N/A	
041	N/A	R	168	N/A	
042	N/A	R	172	N/A	
043	N/A	R	176	N/A	
044	N/A	R	180	N/A	
045	N/A	R	184	N/A	
046	N/A	R	188	N/A	
047	N/A	R	192	N/A	
048	N/A	R	196	N/A	
049	N/A	R	200	N/A	
050	N/A	R	204	N/A	
051	Xs/c	R	208	S/C field	nT
052	Ys/c	R	212	S/C field	nT
053	Zs/c	R	216	S/C field	nT
054	o11	R	220	S/C matrix element	
055	o12	R	224	S/C matrix element	
056	o13	R	228	S/C matrix element	
057	o21	R	232	S/C matrix element	
058	o22	R	236	S/C matrix element	
059	o23	R	240	S/C matrix element	
060	o31	R	244	S/C matrix element	
061	o32	R	248	S/C matrix element	
062	o33	R	252	S/C matrix element	

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5.2.7 REDR data files

As described in Section 2.3.1, the REDR data set may consist of up to nine different types of data file. Table 23 to Table 31 describe the structure and content of the REDR data files.

Table 23: Format of FGM data files

Column	Name	Data type	Start byte	Description
001	SCLK(1958)	T	0	SCLK count since the epoch Jan 1 1958 00:00:00
002	X_FGM	R	8	Magnetic-field component along sensor X-axis, in engineering units
003	Y_FGM	R	12	Magnetic-field component along sensor Y-axis, in engineering units
004	Z_FGM	R	16	Magnetic-field component along sensor Z-axis, in engineering units
005	MAGStatus	I	20	Array of bits containing status information related to active MAG magnetometer modes, packet type, etc
006	FGMStatus	I	24	Array of bits containing status information for the FGM instrument

Table 24: Format of VHM data files

Column	Name	Data type	Start byte	Description
001	SCLK(1958)	T	0	SCLK count since the epoch Jan 1 1958 00:00:00
002	X_VHM	R	8	Magnetic-field component along sensor X-axis, in engineering units
003	Y_VHM	R	12	Magnetic-field component along sensor Y-axis, in engineering units
004	Z_VHM	R	16	Magnetic-field component along sensor Z-axis, in engineering units
005	MAGStatus	I	20	Array of bits containing status information related to active MAG magnetometer modes, packet type, etc
006	VHMStatus	I	24	Array of bits containing status information for the VHM instrument

Table 25: Format of SHM_C data files

Column	Name	Data type	Start byte	Description
001	TIME_TAI	T	0	SCET in seconds since the epoch Jan 1 2000 12:00:00 TAI (= 11:59:28 UTC)
002	B_SHM	R	8	Corrected field magnitude, in nT
003	X_IAU_S	R	12	Cassini position (km) on the x axis relative to Saturn in IAU_SATURN coordinate system
004	Y_IAU_S	R	16	Cassini position (km) on the y axis relative to Saturn in IAU_SATURN coordinate system
005	Z_IAU_S	R	20	Cassini position (km) on the z axis relative to Saturn in IAU_SATURN coordinate system

Table 26: Format of CON data files

Column	Name	Data type	Start byte	Description
001	SCLK(1958)	T	0	SCLK count since the epoch Jan 1 1958 00:00:00
002	wNTChannel	R	8	Noise test channel data
003	wNTLenthExpo	R	12	Noise test exponent, 2^n
004	wTTChannel	R	16	Turbo test channel data
005	wADCSetTime	R	20	ADC (Analog Digital Converter) settlement time
006	wADCSetTimeGnd	R	24	ADC Ground settlement time
007	awSSStatJ0 (Job Status)	I	28	Snapshot Job 0 (J0) status
008	awSSStatJ1 (Job Status)	I	32	Snapshot Job 1 (J1) status
009	awSSStatJ2 (Job Status)	I	36	Snapshot Job 2 (J2) status
010	awSSStatJ3 (Job Status)	I	40	Snapshot Job 3 (J3) status
011	awSSSizeSRJ0	R	44	Snapshot size for J0 (number of subrings)
012	awSSSizeSRJ1	R	48	Snapshot size for J1 (number of subrings)
013	awSSSizeSRJ2	R	52	Snapshot size for J2 (number of subrings)
014	awSSSizeSRJ3	R	56	Snapshot size for J3 (number of subrings)
015	awSSFactorAEJ0	R	60	Snapshot trigger factor and averaging exponent for J0
016	awSSFactorAEJ1	R	64	Snapshot trigger factor and averaging exponent for J1
017	awSSFactorAEJ2	R	68	Snapshot trigger factor and averaging exponent for J2
018	awSSFactorAEJ3	R	72	Snapshot trigger factor and averaging exponent for J3
019	awSSRowDataRdJ0	R	76	Snapshot row data read pointer for J0
020	awSSRowDataRdJ1	R	80	Snapshot row data read pointer for J1
021	awSSRowDataRdJ2	R	84	Snapshot row data read pointer for J2
022	awSSRowDataRdJ3	R	88	Snapshot row data read pointer for J3
023	awSSPostTrigCntJ0	R	92	Snapshot post-trigger counter for J0
024	awSSPostTrigCntJ1	R	96	Snapshot post-trigger counter for J1
025	awSSPostTrigCntJ2	R	100	Snapshot post-trigger counter for J2
026	awSSPostTrigCntJ3	R	104	Snapshot post-trigger counter for J3
027	awSSTrigLevelJ0	R	108	Snapshot trigger level for J0
028	awSSTrigLevelJ1	R	112	Snapshot trigger level for J1
029	awSSTrigLevelJ2	R	116	Snapshot trigger level for J2
030	awSSTrigLevelJ3	R	120	Snapshot trigger level for J3
031	awSSAvValueJ0	R	124	Snapshot quality figure for J0
032	awSSAvValueJ1	R	128	Snapshot quality figure for J1

Column	Name	Data type	Start byte	Description
033	awSSAvValue J2	R	132	Snapshot quality figure for J2
034	awSSAvValue J3	R	136	Snapshot quality figure for J3
035	awSSsubring0 0	R	140	Snapshot subring status (subring 00)
036	awSSsubring0 1	R	144	Snapshot subring status (subring 01)
037	awSSsubring0 2	R	148	Snapshot subring status (subring 02)
038	awSSsubring0 3	R	152	Snapshot subring status (subring 03)
039	awSSsubring0 4	R	156	Snapshot subring status (subring 04)
040	awSSsubring0 5	R	160	Snapshot subring status (subring 05)
041	awSSsubring0 6	R	164	Snapshot subring status (subring 06)
042	awSSsubring0 7	R	168	Snapshot subring status (subring 07)
043	awSSsubring0 8	R	172	Snapshot subring status (subring 08)
044	awSSsubring0 9	R	176	Snapshot subring status (subring 09)
045	awSSsubring1 0	R	180	Snapshot subring status (subring 10)
046	awSSsubring1 1	R	184	Snapshot subring status (subring 11)
047	awSSsubring1 2	R	188	Snapshot subring status (subring 12)
048	awSSsubring1 3	R	192	Snapshot subring status (subring 13)
049	awSSsubring1 4	R	196	Snapshot subring status (subring 14)
050	awSSsubring1 5	R	200	Snapshot subring status (subring 15)
051	awSSsubring1 6	R	204	Snapshot subring status (subring 16)
052	awSSsubring1 7	R	208	Snapshot subring status (subring 17)
053	awSSsubring1 8	R	212	Snapshot subring status (subring 18)
054	awSSsubring1 9	R	216	Snapshot subring status (subring 19)
055	awSSsubring2 0	R	220	Snapshot subring status (subring 20)
056	awSSsubring2 1	R	224	Snapshot subring status (subring 21)
057	awSSsubring2 2	R	228	Snapshot subring status (subring 22)
058	awSSsubring2 3	R	232	Snapshot subring status (subring 23)
059	awSSsubring2 4	R	236	Snapshot subring status (subring 24)
060	awSSsubring2 5	R	240	Snapshot subring status (subring 25)
061	awSSsubring2 6	R	244	Snapshot subring status (subring 26)
062	awSSsubring2 7	R	248	Snapshot subring status (subring 27)
063	awSSsubring2 8	R	252	Snapshot subring status (subring 28)

Column	Name	Data type	Start byte	Description
064	awSSsubring29	R	256	Snapshot subring status (subring 29)
065	awSSsubring30	R	260	Snapshot subring status (subring 30)
066	awSSsubring31	R	264	Snapshot subring status (subring 31)
067	awSSsubring32	R	268	Snapshot subring status (subring 32)
068	wSSSubRintSCRd	R	272	Snapshot subring science read
069	wSSVecCntScRd	R	276	Snapshot vector counter science read
070	wSSSubRingHKRd	R	280	Snapshot subring housekeeping read
071	wSSVecCntHKRd	R	284	Snapshot vector counter housekeeping read
072	wSSXOffset	R	288	Commandable offset for ADC conversion of X field component
073	wSSYOffset	R	292	Commandable offset for ADC conversion of Y field component
074	wSSZOffset	R	296	Commandable offset for ADC conversion of Z field component
075	wJoiData	I	300	Field containing status / mode indicators for ADC clock frequency, range control, averaging mode, science packet generation in sleep mode, LU (Latch Up) testing, ATC (Artificial Time Code) generation, VHM sensor status, FGM calibration, etc.
076	byMemScrub	I	304	Memory scrubbing status
077	wPowerStat	R	308	Power (on/off) status
078	wVersion	R	312	Software version, Patch code status
079	dwRamChckUBa	R	316	RAM check end address (upper bound) A
080	dwRamChckUBb	R	320	RAM check end address (upper bound) B
081	dwRamChckLBa	R	324	RAM check start address (lower bound) A
082	dwRamChckLBb	R	328	RAM check start address (lower bound) B
083	wFCalTime	R	332	FGM calibration frequency 2^n
084	wFRSBound	R	336	FGM reverse range switching boundary
085	wFFSBound	R	340	FGM forward range switching boundary
086	wFRSBCntLimit	R	344	FGM counter limit, reverse range switch
087	wFFSBCntLimit	R	348	FGM counter limit, forward range switch
088	wHKDataStatus	R	352	Housekeeping data status
089	wLUCtrlStatus	I	356	Latch up detector control status
090	wHLUHLMask	I	360	Latch up detector high / low level mask
091	wRunAvExp	R	364	Running average exponent
092	wWDSwitchForNMI	R	368	Watchdog switch after 100 NMI (Non Maskable Interrupts)
093	bWDServeEnable	R	372	Watchdog service enabled / disabled
094	wNormalRTITime	R	376	Normal RTI (Real Time Interrupt) time for artificial RTI generation
095	wNormalDTITime	R	380	Normal DTI (Dead Time start Interrupt) time for artificial DTI generation
096	wArtRTITime	R	384	Artificial RTI time to detect missing RTI
097	wArtDTITime	R	388	Artificial DTI time to detect missing DTI
098	wArtRTICnt	R	392	Number of RTIs until switch to artificial RTI

Column	Name	Data type	Start byte	Description
099	wArtRTIFix	R	396	Artificial RTI status (free / fix)
100	bArtRTIEnd	R	400	Artificial RTI status (enabled / disabled)
101	wTime0	R	404	Measurement Cycle time
102	wTimeEna	I	408	Timer status (enabled / disabled)
103	wVRSBound	R	412	VHM reverse range switching boundary
104	wVFSBound	R	416	VHM forward range switching boundary
105	wVRSCntLimit	R	420	VHM counter limit, reverse range switch
106	wVFSCntLimit	R	424	VHM counter limit, forward range switch
107	wVAutoIFCTime	R	428	VHM automatic IFC (In Flight Calibration) time
108	wVAutoIFCCycle	R	432	VHM auto IFC cycle
109	wVFormatTime	R	436	VHM format pulse frequency

Table 27: Format of ANA data files

Column	Name	Data type	Start byte	Description	Units
001	SCLK(1958)	T	0	SCLK count since the epoch Jan 1 1958 00:00:00	
002	PreampOut	T	8	Subcommutated VHM data – pre-amplifier output	volt
003	IRDectBias	R	12	Subcommutated VHM data – infrared detector bias	volt
004	HeLmpRFAmp	R	16	Subcommutated VHM data – He lamp RF amplifier	volt
005	HeCllRFAmp	R	20	Subcommutated VHM data – He cell RF amplifier	volt
006	BIU VCCSPV	R	24	Subcommutated VHM data – BIU VCC, BIU supply voltage	volt
007	+/-3.75V	R	28	Subcommutated VHM data – +/-3.75V supply	volt
008	+/-12V	R	32	Subcommutated VHM data – +/-12V supply	volt
009	+/-6.2V	R	36	Subcommutated VHM data – +/-6.2V supply	volt
010	VCOMonitor	R	40	Subcommutated SHM data – VCO (Voltage Controlled Oscillator) monitor	volt
011	+/-7V	R	44	Subcommutated SHM data – +/-7V supply	volt
012	Detect2fg	R	48	Subcommutated SHM data – Detected $2f_o$	volt
013	VCOModltn	R	52	Subcommutated SHM data – VCO modulation	volt
014	+7.5V	R	56	Subcommutated FGM data – +7.5V supply	volt
015	-7.5V	R	60	Subcommutated FGM data – -7.5V supply	volt
016	X-Field	R	64	Subcommutated FGM data – X component of magnetic field	volt
017	Y-Field	R	68	Subcommutated FGM data – Y component of magnetic field	volt
018	Z-Field	R	72	Subcommutated FGM data – Z component of magnetic field	volt
019	PSU1	R	76	Subcommutated FGM data – PSU (Power Supply Unit) 1	volt
020	PSU2	R	80	Subcommutated FGM data – PSU 2	volt
021	Ground F	R	84	Subcommutated FGM data – FGM Ground	volt
022	Reference	R	88	Subcommutated DPU data – Reference voltage	volt
023	A_VCC	R	92	Subcommutated DPU data – Supply voltage processor system A	volt
024	P12V	R	96	Subcommutated DPU data – ADC (Analog Digital Converter) supply voltage of active processor system	volt
025	M12V	R	100	Subcommutated DPU data – ADC supply voltage of active processor system	volt

Column	Name	Data type	Start byte	Description	Units
026	B_VCC	R	104	Subcommutated DPU data – Supply voltage processor system B	volt
027	Ground D	R	108	Subcommutated DPU data – DPU Ground	volt
028	SOURCE	R	112	Subcommutation maintenance data derived from source sequence count of packets	

Table 28: Format of ERR data files

Column	Name	Data type	Start byte	Description
001	SCLK(1958)	T	0	SCLK count since the epoch Jan 1 1958 00:00:00
002	wBIUCheckErrCnt	R	8	BIU (Bus Interface Unit) Check Error Counter
003	wUnexptDTIErrCnt	R	12	Unexpected DTI (Dead Time Interrupt) Error Counter
004	wUnexptRTIErrCnt	R	16	Unexpected RTI (Real Time Interrupt) Error Counter
005	wALFCheckSumE	R	20	Calculated (even word) Checksum for last ALF (Assisted Load Format) command
006	wALFCheckSumO	R	24	Calculated (odd-word) Checksum for last ALF (Assisted Load Format) command
007	wCmd12CRC	R	28	CRC (Cyclic Redundancy Check) of last program load command
008	wCmd04CRC	R	32	CRC of last fixed length command
009	wCmd08CRC	R	36	CRC of last parameter load command
010	wTimeTagErrCnt	R	40	Time-tagged command error counter
011	dw16MTestErrCnta	R	44	Multi Snapshot Memory Test, Error Counter A
012	dw16MTestErrCntb	R	48	Multi Snapshot Memory Test, Error Counter B
013	wConfigErrCnt	R	52	Configuration error counter
014	wRegister	R	56	Register readout value
015	wResetCause	R	60	Cause of last reset (0 = Power on, 1 = Watchdog reset)
016	wSingleErrCnt	R	64	RAM single-bit error counter
017	wDoubleErrCnt	R	68	RAM double-bit error counter
018	wProm1TestErrCnt	R	72	PROM (Programmable Read-Only Memory) Bank 1 Test error counter
019	wProm2TestErrCnt	R	76	PROM Bank 2 Test error counter
020	w16M1SingleErrCnt	R	80	Multi Snapshot Memory Bank 1 single error counter
021	w16M1DoubleErrCnt	R	84	Multi Snapshot Memory Bank 1 double error counter
022	w16M2SingleErrCnt	R	88	Multi Snapshot Memory Bank 2 single error counter
023	w16M2DoubleErrCnt	R	92	Multi Snapshot Memory Bank 2 double error counter
024	awOGAnciSentErr	R	96	Outgoing ancillary data sent error, Packet sent count
025	MessErr_NotInit1	R	100	Message error counter / Not Initialized counter
026	PacketNotSentCnt1	R	104	Packet not sent yet counter
027	NotAllPckSentCnt1	R	108	Not all packets are sent yet counter
028	IllegalCallSeqCnt1	R	112	Illegal calling sequence counter

Column	Name	Data type	Start byte	Description
029	awSciPktSentErr	R	116	Science packet sent error, Packet sent counter
030	MessErr_NotInit2	R	120	Message error counter / Not Initialized counter
031	PacketNotSentCnt2	R	124	Packet not sent yet counter
032	NotAllPckSentCnt2	R	128	Not all packets are sent yet counter
033	IllegalCallSeqCnt2	R	132	Illegal calling sequence counter
034	awHKPktSentErr	R	136	HK (Housekeeping) packet sent error, Packet sent counter
035	MessErr_NotInit3	R	140	Message error counter / Not Initialized counter
036	PacketNotSentCnt3	R	144	Packet not sent yet counter
037	NotAllPckSentCnt3	R	148	Not all packets are sent yet counter
038	IllegalCallSeqCnt3	R	152	Illegal calling sequence counter
039	awJMTrigErrCnt	R	156	Job Manager Level Trigger error counter
040	MCITable	R	160	MCI (Measurement Cycle Interrupt) Table
041	RTIDTIFIFO	R	164	RTI/DTI Immediate FIFO
042	RTITable	R	168	RTI Table
043	_128MCITable	R	172	128 MCI Table
044	_032RTITable	R	176	32 RTI Table
045	_512RTITable	R	180	512 RTI Table
046	LongJobFIFO	R	184	Long job, immediate FIFO
047	wLUHandErrCnt	R	188	LU (Latch Up) handling error counter
048	wArtErrCnt	R	192	Artificial RTI error counter
049	awResetData, wLUMainCnt	I	196	Reset data (in BIU memory), LU main counter
050	wLUDRAMCnt	R	200	LU DRAM counter
051	wLUP12VCnt	R	204	LU (+12V supply) counter
052	wLUM12VCnt	R	208	LU (–12V supply) counter
053	wWatchDog	R	212	Watchdog reset status
054	wWDBounceCnt	R	216	Watchdog reset / bounce counter
055	wBIUReset	R	220	BIU reset flag
056	wBIUResetCnt	R	224	BIU reset counter
057	spare1	R	228	Unused
058	spare2	R	232	Unused
059	wMaxStackPos	R	236	Maximum stack position
060	awIntLogLstErr	R	240	BIU Interrupt log list error, Number of interrupts
061	NoMoreInterupts	R	244	No more interrupts
062	BIUNotInit	R	248	BIU not initialised
063	awRecAACSDataMsg	R	252	Received AACS (Attitude and Articulation Control Subsystem) data messages
064	MessageErr_NotIn1	R	256	Message error (not initialised)
065	NoMoreMess1	R	260	No more messages
066	MessageLost1	R	264	Some message lost

Column	Name	Data type	Start byte	Description
067	awRecCritCmdMsgEr	R	268	Received Critical command messages
068	MessageErr_NotIn2	R	272	Message error (not initialised)
069	NoMoreMess2	R	276	No more messages
070	MessageLost2	R	280	Some message lost
071	awRecFaultCmdMsgE	R	284	Received Fault Protection command messages
072	MessageErr_NotIn3	R	288	Message error (not initialised)
073	NoMoreMess3	R	292	No more messages
074	MessageLost3	R	296	Some message lost
075	awReclCAnciMsgErr	R	300	Received Incoming Ancillary Data messages
076	MessageErr_NotIn4	R	304	Message error (not initialised)
077	NoMoreMess4	R	308	No more messages
078	MessageLost4	R	312	Some message lost
079	awRecNomCmdMsgErr	R	316	Received Nominal command messages
080	MessageErr_NotIn5	R	320	Message error (not initialised)
081	NoMoreMess5	R	324	No more messages
082	MessageLost5	R	328	Some message lost
083	awRecTimModeErr	R	332	Received Telemetry Mode messages
084	MessageErr_NotIn6	R	336	Message error (not initialised)
085	NoMoreMess6	R	340	No more messages
086	MessageLost6	R	344	Some message lost
087	wSTMState	R	348	STM (Spacecraft Time Message) data, STM okay
088	NoSTMReceived	R	352	No STM received
089	UnexpectedSTM	R	356	Unexpected STM
090	wintErrCnt	R	360	Interrupt error counter
091	wSSAngErrCnt1	R	364	Snapshot angular error counter 1
092	wSSAngErrCnt2	R	368	Snapshot angular error counter 2
093	spare3	R	372	
094	Not used	R	376	
Columns 095 to 130 not used				
130	Not used	R	520	
131	Type	R	524	
132	Status	I	528	

Table 29: Format of CMD data files

Column	Name	Data type	Start byte	Description
001	SCLK(1958)	T	0	SCLK count since the epoch Jan 1 1958 00:00:00
002	VCCtr	R	8	Valid command counter
003	LVCC	R	12	Last valid command code
004	2LVCC	R	16	2^{nd} last valid command code

Column	Name	Data type	Start byte	Description
005	3LVCC	R	20	3rd last valid command code
006	ICC	R	24	Invalid command code
007	LICC	R	28	Last invalid command code
008	Error	R	32	Error code

Table 30: Format of CHATT data files

Column	Name	Data type	Start byte	Description	Units
001	SCLK(1958)	T	0	SCLK count since the epoch Jan 1 1958 00:00:00	
002	A1001	R	8	Attitude quaternion component 1	
003	A1002	R	12	Attitude quaternion component 2	
004	A1003	R	16	Attitude quaternion component 3	
005	A1004	R	20	Attitude quaternion component 4	
006	A1005	R	24	Rotation rate, X spacecraft axis	radians per second
007	A1006	R	28	Rotation rate, Y spacecraft axis	radians per second
008	A1007	R	32	Rotation rate, Z spacecraft axis	radians per second
009	STATUS	I	36	Status information for spacecraft attitude data	

Table 31: Format of CHUSR data files

Column	Name	Channel ID	Data type	Start byte	Description	Units
001	SCLK(1958)		T	0	SCLK count since the epoch Jan 1 1958 00:00:00	
002	U_MAG_FGM_T	/ S0200	R	8	FGM temperature	degrees C
003	U_MAG_VSHM_T	/ S0201	R	12	VHM/SHM temperature	degrees C
004	UBAY04_T	/ E2303	R	16	Temperature data	degrees C
005	UBAY07_T	/ E2306	R	20	Temperature data	degrees C
006	U_MAG_Elec_LC	/ E0621	R	24	Current	amp
007	S_MAG_ELECT_a	/ F0653	R	28	Power supply A on/off	
008	S_MAG_ELECT_b	/ F0654	R	32	Power supply B on/off	
009	S_MAG_ELECT_sw	/ F0655	R	36	Power supply operation normal/trip	
010	U_MAG_Elec_LC	/ E1121	R	40	Current	amp
011	S_MAG_ELECT_a	/ F1353	R	44	Power supply A on/off	
012	S_MAG_ELECT_b	/ F1354	R	48	Power supply B on/off	
013	S_MAG_ELECT_sw	/ F1355	R	52	Power supply operation normal/trip	
014	U_MAG_Htrs_LC	/ E0632	R	56	Current	amp
015	S_MAG_RHTR_a	/ F0722	R	60	Heater A on/off	
016	S_MAG_RHTR_b	/ F0723	R	64	Heater B on/off	
017	S_MAG_RHTR_sw	/ F0724	R	68	Heater operation normal/trip	
018	U_MAG_Htrs_LC	/ E1132	R	72	Current	amp
019	S_MAG_RHTR_a	/ F1422	R	76	Heater A on/off	
020	S_MAG_RHTR_b	/ F1423	R	80	Heater B on/off	
021	S_MAG_RHTR_sw	/ F1424	R	84	Heater operation normal/trip	
022	U_30VBus_HF_V	/ E0748	R	88	Bus power supply	volt
023	U_30VBus_HF_V	/ E0749	R	92	Bus power supply	volt
024	S_SCAS_COIL_b	/ F0744	R	96	SCAS coil B on/off	

Column	Name	Chan nel ID	Data type	Start byte	Description	Units
025	S_SCAS_COIL_a	/ F0743	R	100	SCAS coil A on/off	
026	S_SCAS_COIL_a	/ F1443	R	104	SCAS coil A on/off	
027	S_SCAS_COIL_b	/ F1444	R	108	SCAS coil B on/off	
028	STATUS	/ Status	I	112	Status information for MAG instrument	

6 Support staff and cognizant persons

Table 32: Archive collection support staff

Name	Address	Phone	Email
MAG team			
Dr Michele Dougherty Principal Investigator	The Blackett Laboratory Imperial College Prince Consort Road London, SW7 2AZ UK	+44 (0)20 75947757	m.dougherty@imperial.ac.uk
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7 Appendix A. Details of data validation

A peer-review panel determines if the data included in the archive are appropriate to meet the stated science objectives of the instrument. The documentation is reviewed for quality and completeness and the archive product generation process is reviewed for robustness and ability to detect problems in the end products.

The peer-review panel will consist of members of the instrument team, PPI and Central Node of the PDS, and at least two outside scientists actively working in the field of outer planet magnetic-field research. The PDS personnel will be responsible for validating that the archive volume(s) are fully compliant with PDS standards. The instrument team and outside science reviewers will be responsible for verifying the content of the data set, the completeness of the documentation, and the usability of the data in its archive format. After the initial volume completes the review process, and any liens against the product are appropriately resolved, the initial volume will be accepted into the archive and the process will move into the production development phase.

During production development, the MAG team and PPI will develop software to produce and validate the archive product in the form that was agreed to during the peer review. MAG will make any modification required to the software that produces data files and labels, and that packages these files into the deliverable data file. PPI will develop software to create the archive volume structure, unpack the deliverable data file into this structure, move any required files (AAREADME, ERRATA, VOLDESC, catalog files, documents, etc.) into the archive volume structure, update these files to reflect the current volume details (time coverage, volume id, etc.), and generate index, manifest, and cumulative index tables. A second review disk will be generated by the automated procedure and validated against the model disk that came out of the peer review process. The review of the automation process does not require the involvement of outside scientists. A subset of the review panel, the MAG Data Validation Team (MDVT), consisting of one member each from the MAG team, PPI, and the PDS Central Node will form this review panel. After the archive generation software is validated, automated archive volume production can begin at any time. All subsequent archive volumes within the Cassini MAG archive volume set will be validated by the MDVT.

Once routine archive volume production begins the MAG data provided to PPI will be the same data that has previously been supplied to MAG co-investigators for use in research. The analysis of these data in research projects conducted by a variety of independent researchers contributes to their validation in preparation for archiving.

In the event that a production volume is found to contain errors, the MDVT can recommend one of two courses of action: fix the disk, or publish it as is with a note in the ERRATA.TXT file. If the errors are minor, typically minor errors in the documentation, then the volume can be published if the appropriate notes are added to the volume's errata file and the error(s) are corrected on subsequent volumes. If the errors are major, typically involving errors in the data themselves, then the volume will be corrected, regenerated, and sent back to the MDVT for review. If the error is the result of a previously undetected problem in the archive production software, the software will be updated to correct the problem and then regression tested to ensure that new problems in the software were not introduced during the update.

A single archive volume set of MAG data is produced for the entire Cassini mission (see Figure 1). Eight (8) physical media copies of each volume are produced for validation prior to being formally included in the archive. Three copies are sent back to the MAG team (IC, JPL, TUB) and one copy is sent to the PDS Central Node for review. Included are a manifest that lists the contents of the volume in detail, and an error report log that describes any known deviations from the manifest or other anomalies. The remaining four copies stay at UCLA for online access, backup, and offsite backup. Upon approval of a volume from the MDVT, the volume is considered officially released to the PDS as defined by the Cassini data release policy. The PPI Node then sends one of the offsite backup copies of the volume to the PDS Central Node to be forwarded to the NSSDC.

8 Appendix B. Derivation of MAG times

The Cassini spacecraft clock (SCLK) is a counter that advances by one tick nominally every 1/256 seconds. SCLK counts have the format cccc:ttt, in which cccc specifies the number of full counts that have elapsed (one full count = 256 ticks), and ttt indicates by how many ticks the clock has advanced towards the next full count, since the epoch 00:00:00Z 1 January 1958.

SCLK counts may also include a partition number: p/cccc:ttt. This number is initially 1 but is incremented during the mission if the SCLK counter is reset or somehow interrupted or altered. The following discussion assumes a partition number of 1. For other partition numbers, the interpretation of SCLK counts requires knowledge of the time at which the current partition was initiated.

SCLK counts are also represented in MAG files in additional formats derived from the standard format described above. Firstly, SCLK counts are sometimes represented as decimal counts, obtained by dividing the ttt component of the count by 256. For example, a SCLK count of 1061078807:107 has an equivalent decimal count of 1061078807.418. Secondly, SCLK counts are also represented as an equivalent SCLK time by assuming a one-to-one correlation between SCLK counts and real seconds. Thus, the decimal SCLK count 1061078807.418 could also be represented as 99 229 AUG 17 00:06:47.418 (i.e. 00:06:47.418 on 17 August [day 229] 1999). It is important to note that such SCLK times have not been corrected for SCLK drift or for the leap seconds that are occasionally added to Universal Time Coordinated (UTC).

The other time system used in MAG files is Spacecraft Event Time (SCET), which, for Cassini, is UTC. The relationship between SCLK and SCET/UTC is dependent on the tick rate of the Cassini SCLK. Like most counter-based clocks, this rate is not constant but drifts with time and conversion of SCLK to SCET/UTC requires knowledge of this time-dependent drift. This information is recorded in the SCLK/SCET coefficients file maintained by the Cassini Spacecraft Operations (SCO) team at JPL. As the Cassini mission progresses the difference between SCLK and SCET times will typically be of order tens of minutes.

8.1 Data files

The times associated with magnetic-field vectors in MAG data files are decimal SCLK counts since epoch 1958. For the scalar SHM data, which are calibrated, the associated times are in seconds since the epoch Jan 1 2000 12:00:00 TAI (= 11:59:28 UTC).

8.2 Header and label files

Table 33 lists the time tags used in MAG header and label files, and indicates how they are derived.

Table 33: Time tags in header and label files

Time tag	Description
Header files	
FIRST TIME	SCLK time of first record in data file; derived from SCLK count in primary header of CHDO file
LAST TIME	SCLK time of last record in data file; derived from SCLK count in primary header of CHDO file
SCLK (in ABSTRACT)	SCLK count obtained from tertiary header of CHDO file; also converted into SCLK time format; may differ from FIRST TIME by some minutes
SCET (in ABSTRACT)	SCET time; determined from corrected SCLK count; also converted into an equivalent SCET count of seconds since 1958
Label files	
START_TIME	SCLK time of first record in data file; obtained from FIRST TIME in flatfile header
STOP_TIME	SCLK time of last record in data file; obtained from LAST TIME in flatfile header
SPACECRAFT_CLOCK_START_COUNT	SCLK count of first record in data file; determined from SPICE utility CHRONOS using START_TIME; format p/cccc.ttt
SPACECRAFT_CLOCK_STOP_COUNT	SCLK count of last record in data file; determined from SPICE utility CHRONOS using STOP_TIME; format p/cccc.ttt
SCLK (in NOTE)	SCLK time and SCLK count obtained from flatfile header ABSTRACT; may differ from START_TIME by some minutes
SCET (in NOTE)	SCET time and SCET count obtained from flatfile header ABSTRACT

9 Appendix C. PDS label files

As described in Section 4.5.2, MAG data are being archived using the IGPP flatfile system. This file system consists of formatted metadata in a header file (FFH) and data in a fixed length, IEEE (MSB) binary file (FFD). The material in this appendix describes the PDS labels for the IGPP Flatfiles (flatfiles) and the source of the information in these labels. The basic label for all MAG data products is:

```
PDS_VERSION_ID                 = PDS3
DATA_SET_ID                    = "CO-E/SW/J/S-MAG-2-REDR-RAW-DATA-V1.0"
STANDARD_DATA_PRODUCT_ID       = "$STD_PROD_ID"
PRODUCT_ID                     = "$NAME"
PRODUCT_TYPE                   = "$PROD_TYPE"
PRODUCT_CREATION_TIME          = $FF_CREATION_TIME

RECORD_TYPE                    = FIXED_LENGTH
RECORD_BYTES                   = $FF_RECL
FILE_RECORDS                   = $FF_RECS

START_TIME                     = $FF_START_TIME
STOP_TIME                      = $FF_STOP_TIME
SPACECRAFT_CLOCK_START_COUNT   = "$START_SCLK"
SPACECRAFT_CLOCK_STOP_COUNT    = "$STOP_SCLK"

INSTRUMENT_HOST_NAME           = "CASSINI ORBITER"
INSTRUMENT_HOST_ID             = "CO"
ORBIT_NUMBER                   = $ORBIT
TARGET_NAME                    = $TARGET_LIST
INSTRUMENT_NAME                = "DUAL TECHNIQUE MAGNETOMETER"
INSTRUMENT_ID                  = "MAG"
DESCRIPTION                    = "$STD_PROD_DESCR"

NOTE                           = "$FF_ABSTRACT"

^TABLE                         = "$FF_DATA_NAME"
OBJECT                         = TABLE
    INTERCHANGE_FORMAT         = "BINARY"
    ROWS                       = $FF_RECS
    COLUMNS                    = $FF_COLS
    ROW_BYTES                  = $FF_RECL
    ^STRUCTURE                 = "$STD_PROD_FMT"
    DESCRIPTION                = "$COL_DESCR"
END_OBJECT                     = TABLE

^HEADER                        = "$FF_HDR_NAME"
OBJECT                         = HEADER
    BYTES                      = $HDR_BYTES
    HEADER_TYPE                = "IGPP_VERSION_2.0"
    DESCRIPTION                = "$HDR_DESCR"
END_OBJECT                     = HEADER

END
```

Any value preceded by a $ is a derived value (parameter), all others are fixed values. Blank lines separate “sections” of the label to improve readability.

9.1 Resolving parameters in the generic MAG labels

The first section of the label is the “product” section. This section includes the PDS version, the data set identifier, which is fixed for all MAG data products, and information that is specific to the product. Table 34 is a tabulation of derived values for MAG data products where the base file name (no extension) matches the pattern in the $FF_NAME column.

The MAG team will baseline the archive description (labels, catalog files, etc.) at PDS version 3. Current PDS standards are at version 3.5. Minor updates to the current standards (i.e. PDS 3.6) will be considered for inclusion in the MAG archive procedures and may be reflected in the labels described here. Major structural revisions in the PDS standards (i.e. PDS 4.x) will not be adopted by the MAG team.

Table 34: Parameter settings for standard products

$FF_NAME[(a)]	$STD_PROD_ID	$PROD_TYPE	$FF_RECL	$STD_PROD_FMT[(b)]
"*FGM" [(c)]	"MAG_FGM"	"DATA"	28	"FGM_DATA.FMT"
"*VHM" [(c)]	"MAG_VHM"	"DATA"	28	"VHM_DATA.FMT"
"*SHM" [(c)]	"MAG_SHM_C"	"DATA"	24	"SHM_C_DATA.FMT"
"*CON" [(c)]	"MAG_CON"	"ANCILLARY"	440	"CON_DATA.FMT"
"*ANA" [(c)]	"MAG_ANA"	"ANCILLARY"	116	"ANA_DATA.FMT"
"*ERR" [(c)]	"MAG_ERR"	"ANCILLARY"	532	"ERR_DATA.FMT"
"*CMD" [(c)]	"MAG_CMD"	"ANCILLARY"	36	"CMD_DATA.FMT"
"*CHATT"	"MAG_CHATT"	"GEOMETRY"	40	"CHATT_DATA.FMT"
"*CHUSR"	"MAG_CHUSR"	"ANCILLARY"	116	"CHUSR_DATA.FMT"
"*CAL"	"MAG_CAL"	"ANCILLARY"	256	"FGM_CAL.FMT", "VHM_CAL.FMT"

(a) $FF_NAME refers to the base or root name of the file (no extension).
(b) Each flatfile type has a detached format file describing the file structure, columns, etc.
(c) Data for each of these file types can come from different sources (science data, housekeeping, or subcommutated housekeeping).

Derived values whose names begin with FF can be determined by scanning the flatfile header ($FF_RECL, $FF_RECS, $FF_COLS, $FF_CREATION_TIME, $FF_START_TIME, $FF_STOP_TIME, $FF_DATA_NAME, $FF_HDR_NAME, $FF_ABSTRACT). The remainder of the label values will be set in accordance with the following rules:

1. $START_SCLK and $STOP_SCLK will be determined by passing the values of the file start and stop times to the SPICE utility chronos, along with the remainder of the parameters chronos requires.
2. $ORBIT will be determined by using an orbit start/stop file and the file start/stop times. For most files, $ORBIT will be single valued (i.e. ORBIT_NUMBER = 7). However, it is likely that some files will span orbit boundaries. In these labels, $ORBIT will be multi-valued (i.e. ORBIT_NUMBER = {7, 8}). The orbits will be defined to run from apoapsis to apoapsis, with orbit 0 beginning upstream in the solar wind 1 month prior to the first Saturn orbit insertion burn and ending at apoapsis. Apoapsis times will be truncated to the nearest hour in the orbit file. This file will be regenerated frequently using the most current SPICE SPK reconstruction file for the Cassini mission. The orbit file will be maintained by PPI and available to MAG team (and others) using a web interface.
3. $TARGET_LIST will also be determined by using a target start/stop file and the file start/stop times. Each target in the data set (SATURN, JUPITER, EARTH, SOLAR_WIND, and Saturn satellites) will have a set of start stop times.
   a. The target SATURN will begin 1 month prior to the orbit insertion burn.

   b. The SATURN target will have a stop time set at the end of mission (EOM).
   c. The SOLAR_WIND target will start at launch and stop when the SATURN target begins.
   d. The target file will not track bow shock crossings to distinguish SOLAR_WIND from other targets.
   e. The EARTH target will have a start/stop time starting one day before the first bow shock crossing and ending one day after the last bow shock crossing.
   f. The JUPITER target will have a start/stop time starting one day before the first bow shock crossing and ending one day after the last bow shock crossing.
   g. Saturn satellite targets will have start/stop times set by the times when the Cassini spacecraft is within 20 R_{sat}.
   h. Target start/stop times will be overlapping.
   i. The target list will be formed by identifying all targets in the targets file that overlap with the file start/stop time. The list will give highest precedence to planets, next to satellites, and lastly to SOLAR_WIND (i.e. $TARGET_LIST could be any of "SATURN", {"JUPITER", "SOLAR_WIND"} or {"SATURN", "TITAN"} but would never be {"TITAN", "SATURN"} or {"SOLAR_WIND", "SATURN"}).
4. The target file will be regenerated frequently using the most current SPICE SPK reconstruction file. The target file will be maintained by PPI and available to the MAG team (and others) using a web interface.
5. $STD_PROD_DESCR will be formed by replacing the tokens in the phrase: "This file contains Cassini MAG ($STD_PROD_ID) data acquired $TARGET_PHRASE. The file covers the time period between $START_TIME and $STOP_TIME."
   a. $TARGET_PHRASE is determined from the $TARGET_LIST value such that it reads: "at SATURN", "at SATURN and SATELLITE", "at PLANET and possibly in the solar wind", or "in the solar wind".
6. $FF_ABSTRACT will be the abstract section of the flatfile header, beginning at OWNER and ending at END, with internal comment separator lines removed (see example label and FFH file).
7. $HDR_BYTES will be determined by examining the size of the FFH file.
8. $HDR_DESCR will be formed by replacing the tokens in the phrase: "$FF_HDR_NAME is the IGPP flatfile header for $FF_DATA_NAME. All information contained therein is reproduced in this label file. The header is provided for users of the IGPP flatfile utilities."

9.2 Example label file

```
PDS_VERSION_ID                 = PDS3
DATA_SET_ID                  = "CO-E/SW/J/S-MAG-2-REDR-RAW-DATA-V1.0"
STANDARD_DATA_PRODUCT_ID       = "MAG_FGM"
PRODUCT_ID                     = "99229_MRDCD_SDFGMC"
PRODUCT_TYPE                   = DATA
PRODUCT_VERSION_ID             = "1"
PRODUCT_CREATION_TIME          = 2003-06-25T13:24:58.000

START_TIME                     = 1999-08-17T00:06:47.418
STOP_TIME                      = 1999-08-18T00:06:48.401
SPACECRAFT_CLOCK_START_COUNT   = "1/1313536007.107"
SPACECRAFT_CLOCK_STOP_COUNT    = "1/1313622408.102"
```

```
NATIVE_START_TIME              = "1061075207.418"
NATIVE_STOP_TIME               = "1061161608.401"

INSTRUMENT_HOST_NAME           = "CASSINI ORBITER"
INSTRUMENT_HOST_ID             = "CO"
MISSION_PHASE_NAME             = "EARTH ENCOUNTER"
ORBIT_NUMBER                   = N/A
TARGET_NAME                    = {"EARTH", "SOLAR WIND"}
INSTRUMENT_NAME                = "DUAL TECHNIQUE MAGNETOMETER"
INSTRUMENT_ID                  = "MAG"
DESCRIPTION                    = "
      99229_MRDCD_SDFGMC.FFH contains Cassini fluxgate
      magnetometer data collected between 1999-08-17T12:06 and
      1999-08-18T12:06."

NOTE                           = "
      MISSING DATA FLAG  =   1.00000E+34
AVERAGE INTERVAL   =     00:00:00.004
#########
CASSINI ABSTRACT
#########
INPUT FILE: sourcedata/99229_mrdcd.fsd
FLAT FILE MAKER: caspre2ff v1.4 SUN
COMPILATION DATE : 05/31/02-15:12:03
wTime0 (from Configuration Data) determines time except for channel
data
Default MCI    : 62.480000
Time for channel data is extracted from the Tertiary data
SCET  99 229 AUG 17  00:00:00.399 1061078400.399
SCLK  99 229 AUG 17  00:06:47.418 1061078807.418
Configuration Image :
  /casdata2/tlm/prep/99229/mrdcd/99229_mrdcd_HKCONN
IFCFile
/casdata2/tlm/prep/99229/mrdcd/99229_mrdcd_fhk.ifc
Flat file times are SCLK and EPOC = Jan 1 1958"

^TABLE                         = "99229_MRDCD_SDFGMC.FFD"
OBJECT                         = FILE
  FILE_NAME                    = "99229_MRDCD_SDFGMC.FFD"
  RECORD_TYPE                  = FIXED_LENGTH
  RECORD_BYTES                 = 28
  FILE_RECORDS                 = 2444672
  OBJECT                       = TABLE
    INTERCHANGE_FORMAT         = BINARY
    ROWS                       = 2444672
    COLUMNS                    = 6
    ROW_BYTES                  = 28
    DESCRIPTION                = "
      99229_MRDCD_SDFGMC is an IGPP Flatfile which consists of
      two files: a data file (.FFD) and a header file (.FFH). The
      data file is a binary, fixed record length file and the header
      is an ASCII file.  All of the Cassini MAG flatfiles represent
      time as a spacecraft clock value, referenced to 1958,
      and with the minor frame converted from units of 1/256
      sec to units of milliseconds.  This label provides a mapping
      between the internal time representation (NATIVE_START_TIME),
      true spacecraft clock (SPACECRAFT_CLOCK_START_COUNT) and
      spacecraft event time in UTC (START_TIME).  See the MAG data
      set catalog file (*DS.CAT) and the MAG volume SIS (VOLSIS.PDF)
      for additional information on the MAG time tag.
```

```
      The FGM data file contains the following columns:

      Name        Units        Description
=================================================================
      SCLK(1958)  Counts      Time (SCLK not UTC) is represented as
                              a decimal SCLK count relative to epoch
                              Jan 1 1958 00:00:00.000.
      X_FGM,      ENG         Magnetic field component along the
      Y_FGM,                  fluxgate sensor X-axis, Y-axis, and
      Z_FGM                   Z-axis respectively. Data are in
                              engineering units.
      MAGStatus   N/A         Array of bits containing status
                              information related to active MAG
                              magnetometer modes, packet type, etc.
      FGMStatus   N/A         Array of bits containing status
                              information for the FGM instrument.
================================================================="

    ^STRUCTURE                = "FGM_DATA.FMT"
  END_OBJECT                  = TABLE
END_OBJECT                    = FILE

^HEADER                       = "99229_MRDCD_SDFGMC.FFH"
OBJECT                        = FILE
  FILE_NAME                   = "99229_MRDCD_SDFGMC.FFH"
  RECORD_TYPE                 = STREAM
  FILE_RECORDS                = 1
  OBJECT                      = HEADER
    INTERCHANGE_FORMAT        = ASCII
    HEADER_TYPE               = "IGPP VERSION 2.0"
    BYTES                     = 2448
    DESCRIPTION               = "
      99229_MRDCD_SDFGMC.FFH is an IGPP Flatfile header that
      describes the data file to software which recognizes this file
      system."
  END_OBJECT                  = HEADER
END_OBJECT                    = FILE

END
```

9.3 Example header file

In the UCLA flatfile system, header files describe the associated data file for software that recognises the flatfile system. The data description in MAG header files includes information on the source of the data. Table 35 describes the codes used in MAG header files to identify the source of data contained in the associated data file.

Table 35: Header file codes

Code	Description
Spacecraft ID	
CA	Cassini
Packet source	
SD	science data
HK	housekeeping data
Data file source	
RG	directly from packet
SH	subcommutated housekeeping
SS	snapshot data
Sensor or file type	

Code	Description
FGM	fluxgate magnetometer
VHM	vector helium magnetometer
SHM	scalar helium magnetometer
CON	configuration image data
ANA	analog data
ERR	error data
CMD	command data
CHATT	attitude data
CHUSR	user-selected data

The following header describes a data file containing FGM science data. It is an example of the format and content of headers that are used to describe the range of data collected as part of the MAG experiment. The fields in this header file are described in more detail immediately following the example.

```
DATA  = 99229_MRDCD_SDFGMC.FFD
CDATE = 2003 176 JUN 25 13:24:58
RECL  =    28
NCOLS =     6
NROWS =    2444672
OPSYS = SUN/UNIX
EPOCH = Y1958
  # NAME       UNITS     SOURCE                     TYPE   LOC
001 SCLK(1958) Counts    CA SD RG FGM               T        0
002 X_FGM      ENG       CA SD RG FGM               R        8
003 Y_FGM      ENG       CA SD RG FGM               R       12
004 Z_FGM      ENG       CA SD RG FGM               R       16
005 MAGStatus  b         CA SD RG FGM               I       20
006 FGMStatus  b         CA SD RG FGM               I       24
ABSTRACT
FIRST TIME         =  99 229 AUG 17  00:06:47.418
LAST TIME          =  99 230 AUG 18  00:06:48.401
OWNER              = IGPP/UCLA
MISSING DATA FLAG  =   1.00000E+34
AVERAGE INTERVAL   =     00:00:00.004
#########
CASSINI ABSTRACT
#########
INPUT FILE: sourcedata/99229_mrdcd.fsd
FLAT FILE MAKER: caspre2ff v1.4 SUN
COMPILATION DATE : 05/31/02-15:12:03
wTime0 (from Configuration Data) determines time except for channel
data
Default MCI    : 62.480000
Time for channel data is extracted from the Tertiary data
SCET  99 229 AUG 17  00:00:00.399 1061078400.399
SCLK  99 229 AUG 17  00:06:47.418 1061078807.418
Configuration Image :
/casdata2/tlm/prep/99229/mrdcd/99229_mrdcd_HKCONN
IFCFile
/casdata2/tlm/prep/99229/mrdcd/99229_mrdcd_fhk.ifc
Flat file times are SCLK and EPOC = Jan 1 1958
END
```

The fields in the FFH are as follows:

DATA: Name of the binary file (flatfil) containing magnetometer data, whose contents are described by the companion flatfile header (example shown above)

CDATA: Creation date of the flat file

RECL: Record length (bytes), where each record corresponds to on e magnetic field measurement.

NCOLS: Number of 'columns' in each record (see fields below)

NROWS: Number of 'rows' in the flat file, where each row (or record) corresponds to one magnetic field measurement

OPSYS: Operating system of the node on which the file was created.

EPOCH: The epoch used for indicateding time in the data field

NAME/UNITS/SOURCE/TYPE/LOC:
These fields describe the contents of the 'columns' in each record. Usually the information consists of a time, a corresponding B_field measurement, and instrument status information

ABSTRACT: This section contains the rimes corresponding to the first and last records ('FIRST TIME' and 'LAST TIME'). It also contains a numerical flag which indicates the presence of any invalid data or 'data gaps'

AVERAGE INTERVAL:
This field describes the time interval used for averaging the magnetic field data during processing.

CASSINI ABSTRACT:
This section contains information related to the creation of the flat file, such as the input file from which spacecraft telemetry was extracted, and the software used for the procedure. It also contains the name of the instrument configuration image used to assigne times to each data record (cross reference to CONFIG IMAGE section).

Format of flat files (.FFD suffix) is described in section 5.2.7. Note that there is a correspondence between the flat file name and the .FMT file (format description) which describes the format of its data records (the contents of this .FMT file are also found in the PDS label associated with the .FFD file). For example a file whose name contains the string 'SDFGM' is data recorded by the FGM instrument which is downlinked in the Science Data telemetry (SD) and which is formatted according to the description in FGM_DATA.FMT (see 4.5.3 for more detail)

9.4 Data file formats

The files comprising MAG standard data products have formats which are specified in the PDS label files. This section shows the format component of PDS labels for each of the data files listed in Table 34, Column 1 ($FF_NAME).

9.4.1 Fluxgate magnetometer data

```
OBJECT                      = COLUMN
  NAME                      = "SCLK(1958)"
  COLUMN_NUMBER             = 1
```

```
  UNIT                      = "Counts"
  DATA_TYPE                 = IEEE_REAL
  START_BYTE                = 1
  BYTES                     = 8
  DESCRIPTION               = "Time (SCLK NOT UTC) is represented as a
    decimal SCLK count relative to the epoch Jan 1 1958 00:00:00.000.
END_OBJECT

OBJECT                      = COLUMN
  NAME                      = "X_FGM"
  COLUMN_NUMBER             = 2
  UNIT                      = "ENG"
  DATA_TYPE                 = IEEE_REAL
  START_BYTE                = 9
  BYTES                     = 4
  MISSING_CONSTANT          = 1.0E34
  DESCRIPTION               = "
    Magnetic field component along the fluxgate sensor X-axis in
    engineering units.

   Magnetic-field units

   The units of the preprocessed FGM magnetic-field data are given in
   engineering units.  They represent the X, Y, and Z FGM sensor values at
   the given time.  These values were converted from data numbers (DN) using
   the following:
      ENG = (DN - 8192) / 8192 * factor.
   The value of the factor is determined from the range given with each
   vector using the following table:
             Range       Factor
                 0           40
                 1          400
                 2        10000
                 3        44000
   In order to convert the ENG unit data into nanoTesla, the sensor offsets
   must be subtracted out, gains must be applied, and the data from the
   3 sensors must be orthogonalized."
END_OBJECT

OBJECT                      = COLUMN
  NAME                      = "Y_FGM"
  COLUMN_NUMBER             = 3
  UNIT                      = "ENG"
  DATA_TYPE                 = IEEE_REAL
  START_BYTE                = 13
  BYTES                     = 4
  MISSING_CONSTANT          = 1.0E34
  DESCRIPTION               = "
    Magnetic field component along the fluxgate sensor Y-axis in
    engineering units."
END_OBJECT

OBJECT                      = COLUMN
  NAME                      = "Z_FGM"
  COLUMN_NUMBER             = 4
  UNIT                      = "ENG"
  DATA_TYPE                 = IEEE_REAL
  START_BYTE                = 17
  BYTES                     = 4
  MISSING_CONSTANT          = 1.0E34
  DESCRIPTION               = "
```

```
    Magnetic field component along the fluxgate sensor Z-axis in
    engineering units."
END_OBJECT

OBJECT                      = COLUMN
  NAME                      = "MAGSTATUS"
  COLUMN_NUMBER             = 5
  DATA_TYPE                 = MSB_INTEGER
  START_BYTE                = 21
  BYTES                     = 4
  DESCRIPTION               = "

   The MAGStatus data are an array of bits that describe the status of the
   MAG equipment, as set out in the following table.

    FIELD        SIZE  NAME                           BYTE   BIT
    PacketType      1  Housekeeping/Science-data flag    0     7  MSB
    SCAS            1  SCAS status                       0     6
    AverageType     1  Average Type (fixed/running)      0     5
    SHMFlag         1  SHM Flag                          0     4
    VHMFlag         1  VHM Flag                          0     3
    FGMFlag         1  FGM Flag                          0     2
    ADCFlag         1  ADC Flag                          0     1
    MCI             9  Measurement Cycle Interrupt     0-1 0,7-0  LSB,MSB
    Average         5  TimeCode Missing                  2     2
    sparebits       2  spare two bits                    2   1-0
   BIU Discretes                                        34    16
    PROM            1  PROM program                      3     7  MSB
    ConfigEnable    1  Config-Enable                     3     6
    PSU_2           1  PSU 2                             3     5
    PSU_1           1  PSU 1                             3     4
    Processor_B     1  Processor B                       3     3
    Processor_A     1  Processor A                       3     2
    SleepMode       1  Sleep Mode                        3     1
    Reset           1  Reset                             3     0  LSB"
END_OBJECT

OBJECT                      = COLUMN
  NAME                      = "FGMSTATUS"
  COLUMN_NUMBER             = 6
  DATA_TYPE                 = MSB_INTEGER
  START_BYTE                = 25
  BYTES                     = 4
  DESCRIPTION               = "
    The FGMStatus data are an array of bits that describe the status of the
    FGM, as set out in the following table.

     FIELD        SIZE  NAME                           BYTE   BIT
     rg              2  Range                             0   7-6  MSB
     IFCFlag         1  IFC Flag on/off                   0     5
     autorange       1  AutoRange on/off                  0     4
     TimeStatus      4  time quality status               0   3-0  LSB
     sparebyte       8  spare bits                        1   7-0
     CalibId         8  Calibration Id                    2   7-0
     CoordId         8  Field Angle data                  2   7-0"
END_OBJECT
```

9.4.2 Vector helium magnetometer data

```
OBJECT                      = COLUMN
```

```
  NAME                       = "SCLK(1958)"
  COLUMN_NUMBER              = 1
  UNIT                       = "Counts"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 1
  BYTES                      = 8
  DESCRIPTION                = "
    Time (SCLK NOT UTC) is represented as a decimal SCLK count
relative
    to the epoch Jan 1 1958 00:00:00.000."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "X_VHM"
  COLUMN_NUMBER              = 2
  UNIT                       = "ENG"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 9
  BYTES                      = 4
  MISSING_CONSTANT           = 1.0E34
  DESCRIPTION                = "
    Magnetic field component along the vector helium sensor X-axis
    in engineering units.

    Magnetic-field units (VHM)

    The units of the preprocessed VHM magnetic-field data are given
    in engineering units (ENG).  They represent the X, Y, and Z VHM
    sensor counts at the given time.  These counts were converted
    into ENG from data numbers (DN) by using the following:
      ENG = (DN - 8192) / 8192 * factor.
    The value of the factor is determined from the range given with
    each vector using the following table:
             Range       Factor
                 0           32
                 1          256"
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "Y_VHM"
  COLUMN_NUMBER              = 3
  UNIT                       = "ENG"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 13
  BYTES                      = 4
  MISSING_CONSTANT           = 1.0E34
  DESCRIPTION                = "
    Magnetic field component along the vector helium sensor Y-axis
    in engineering units."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "Z_VHM"
  COLUMN_NUMBER              = 4
  UNIT                       = "ENG"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 17
  BYTES                      = 4
  MISSING_CONSTANT           = 1.0E34
  DESCRIPTION                = "
    Magnetic field component along the vector helium sensor Z-axis
```

```
    in engineering units."
END_OBJECT

OBJECT                      = COLUMN
  NAME                      = "MAGSTATUS"
  COLUMN_NUMBER             = 5
  UNIT                      = "N/A"
  DATA_TYPE                 = MSB_INTEGER
  START_BYTE                = 21
  BYTES                     = 4
  DESCRIPTION               = "

   The MAGStatus data are an array of bits that describe the status
   of the MAG equipment, as set out in the following table.

    FIELD        SIZE  NAME                           BYTE   BIT
    PacketType      1  Housekeeping/Science-data flag    0     7  MSB
    SCAS            1  SCAS status                       0     6
    AverageType     1  Average Type (fixed/running)      0     5
    SHMFlag         1  SHM Flag                          0     4
    VHMFlag         1  VHM Flag                          0     3
    FGMFlag         1  FGM Flag                          0     2
    ADCFlag         1  ADC Flag                          0     1
    MCI             9  Measurement Cycle Interrupt     0-1 0,7-0 LSB,
                                                                 MSB
    Average         5  TimeCode Missing                  2     2
    sparebits       2  spare two bits                    2   1-0
   BIU Discretes                                        34    16
    PROM            1  PROM program                      3     7  MSB
    ConfigEnable    1  Config-Enable                     3     6
    PSU_2           1  PSU 2                             3     5
    PSU_1           1  PSU 1                             3     4
    Processor_B     1  Processor B                       3     3
    Processor_A     1  Processor A                       3     2
    SleepMode       1  Sleep Mode                        3     1
    Reset           1  Reset                             3     0 LSB"
END_OBJECT

OBJECT                      = COLUMN
  NAME                      = "VHMSTATUS"
  COLUMN_NUMBER             = 6
  UNIT                      = "N/A"
  DATA_TYPE                 = MSB_INTEGER
  START_BYTE                = 25
  BYTES                     = 4
  DESCRIPTION               = "

    The VHMStatus data are an array of bits that describe the status
    of the VHM, as set out in the following table.

    FIELD        SIZE  NAME                           BYTE   BIT
    rg              1  Range (debugging only)            0     7  MSB
    TimeStatus      4  time quality status               0   6-3
    sparebits       2  spare bits                        0   2-0  LSB
    Digital         8  Digital Status word               1   7-0
    CalibId         8  Calibration Id                    2   7-0
    CoordId         8  Field Angle data                  3   7-0"
END_OBJECT
```

9.4.3 Scalar helium magnetometer data

```
OBJECT                     = COLUMN
  NAME                     = "TIME_TAI"
  COLUMN_NUMBER            = 1
  UNIT                     = "SEC"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 1
  BYTES                    = 8
  DESCRIPTION              = "
    Time is represented as SCET in seconds since the epoch Jan 1 2000
12:00:00 TAI (= 11:59:28 UTC) ."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "B_SHM"
  COLUMN_NUMBER            = 2
  UNIT                     = "nT"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 9
  BYTES                    = 4
  MISSING_CONSTANT         = 1.0E34
  DESCRIPTION              = "
    Corrected field strength (scalar) in nT."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "X_IAU_S"
  COLUMN_NUMBER            = 3
  UNIT                     = "km"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 13
  BYTES                    = 4
  DESCRIPTION              = "

   Cassini position on the x axis relative to Saturn in IAU_SATURN
   coordinate system."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "Y_IAU_S"
  COLUMN_NUMBER            = 4
  UNIT                     = "km"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 17
  BYTES                    = 4
  DESCRIPTION              = "

   Cassini position on the y axis relative to Saturn in IAU_SATURN
   coordinate system"
END_OBJECT

OBJECT                     = COLUMN
   NAME                    = “Z_IAU_S”
   COLUMN_NUMBER           = 5
   UNIT                    = “km”
   DATA_TYPE               = IEEE REAL
   START_BYTE              = 21
   BYTES                   = 4
   DESCRIPTION             = “

   Cassini position on the x axis relative to Saturn in IAU_SATURN
   coordinate system “
END_OBJECT
```

9.4.4 Configuration data

```
OBJECT                          = COLUMN
  NAME                          = "SCLK(1958)"
  COLUMN_NUMBER                 = 1
  UNIT                          = "Counts"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 1
  BYTES                         = 8
  DESCRIPTION                   ="
        Time (SCLK NOT UTC) is represented as a decimal SCLK count
        relative to the epoch Jan 1 1958 00:00:00.000."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "wNTChannel"
  COLUMN_NUMBER                 = 2
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 9
  BYTES                         = 4
  DESCRIPTION                   = "
    Noise Test channel data."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "wNTLengthExpo"
  COLUMN_NUMBER                 = 3
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 13
  BYTES                         = 4
  DESCRIPTION                   = "
    Noise Test exponent, 2^n."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "wTTChannel"
  COLUMN_NUMBER                 = 4
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 17
  BYTES                         = 4
  DESCRIPTION                   = "
    Turbo Test channel data."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "wADCSetTime"
  COLUMN_NUMBER                 = 5
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 21
  BYTES                         = 4
  DESCRIPTION                   = "
    ADC (Analog Digital Converter) settlement time."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "wADCSetTimeGnd"
  COLUMN_NUMBER                 = 6
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 25
  BYTES                         = 4
  DESCRIPTION                   = "
    ADC (Analog Digital Converter) Ground settlement time."
END_OBJECT
```

```
OBJECT                          = COLUMN
  NAME                          = "awSSStatJ0"
  COLUMN_NUMBER                 = 7
  DATA_TYPE                     = MSB_INTEGER
  START_BYTE                    = 29
  BYTES                         = 4
  DESCRIPTION                   = "
    Snapshot Job 0 (J0) status."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "awSSStatJ1"
  COLUMN_NUMBER                 = 8
  DATA_TYPE                     = MSB_INTEGER
  START_BYTE                    = 33
  BYTES                         = 4
  DESCRIPTION                   = "
    Snapshot Job 1 (J1) status."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "awSSStatJ2"
  COLUMN_NUMBER                 = 9
  DATA_TYPE                     = MSB_INTEGER
  START_BYTE                    = 37
  BYTES                         = 4
  DESCRIPTION                   = "
    Snapshot Job 2 (J2) status."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "awSSStatJ3"
  COLUMN_NUMBER                 = 10
  DATA_TYPE                     = MSB_INTEGER
  START_BYTE                    = 41
  BYTES                         = 4
  DESCRIPTION                   = "
    Snapshot Job 3 (J3) status."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "awSSSizeSRJ0"
  COLUMN_NUMBER                 = 11
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 45
  BYTES                         = 4
  DESCRIPTION                   = "
    Snapshot size for J0 (number of subrings)."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "awSSSizeSRJ1"
  COLUMN_NUMBER                 = 12
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 49
  BYTES                         = 4
  DESCRIPTION                   = "
    Snapshot size for J1 (number of subrings)."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "awSSSizeSRJ2"
  COLUMN_NUMBER                 = 13
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 53
```

```
  BYTES                    = 4
  DESCRIPTION              = "
    Snapshot size for J2 (number of subrings)."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "awSSSizeSRJ3"
  COLUMN_NUMBER            = 14
  UNIT                     = "N/A"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 57
  BYTES                    = 4
  DESCRIPTION              = "
    Snapshot size for J3 (number of subrings)."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "awSSFactorAEJ0"
  COLUMN_NUMBER            = 15
  UNIT                     = "N/A"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 61
  BYTES                    = 4
  DESCRIPTION              = "
    Snapshot trigger factor and averaging exponent for J0."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "awSSFactorAEJ1"
  COLUMN_NUMBER            = 16
  UNIT                     = "N/A"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 65
  BYTES                    = 4
  DESCRIPTION              = "
    Snapshot trigger factor and averaging exponent for J1."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "awSSFactorAEJ2"
  COLUMN_NUMBER            = 17
  UNIT                     = "N/A"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 69
  BYTES                    = 4
  DESCRIPTION              = "
    Snapshot trigger factor and averaging exponent for J2."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "awSSFactorAEJ3"
  COLUMN_NUMBER            = 18
  UNIT                     = "N/A"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 73
  BYTES                    = 4
  DESCRIPTION              = "
    Snapshot trigger factor and averaging exponent for J3."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "awSSRowDataRdJ0"
  COLUMN_NUMBER            = 19
  UNIT                     = "N/A"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 77
  BYTES                    = 4
  DESCRIPTION              = "
    Snapshot row data read pointer for J0."
```

```
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "awSSRowDataRdJ1"
  COLUMN_NUMBER                 = 20
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 81
  BYTES                         = 4
  DESCRIPTION                   = "
    Snapshot row data read pointer for J1."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "awSSRowDataRdJ2"
  COLUMN_NUMBER                 = 21
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 85
  BYTES                         = 4
  DESCRIPTION                   = "
    Snapshot row data read pointer for J2."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "awSSRowDataRdJ3"
  COLUMN_NUMBER                 = 22
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 89
  BYTES                         = 4
  DESCRIPTION                   = "
    Snapshot row data read pointer for J3."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "awSSPostTrigCntJ0"
  COLUMN_NUMBER                 = 23
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 93
  BYTES                         = 4
  DESCRIPTION                   = "
    Snapshot post-trigger counter for J0."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "awSSPostTrigCntJ1"
  COLUMN_NUMBER                 = 24
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 97
  BYTES                         = 4
  DESCRIPTION                   = "
    Snapshot post-trigger counter for J1."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "awSSPostTrigCntJ2"
  COLUMN_NUMBER                 = 25
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 101
  BYTES                         = 4
  DESCRIPTION                   = "
    Snapshot post-trigger counter for J2."
END_OBJECT

OBJECT                          = COLUMN
```

```
  NAME                         = "awSSPostTrigCntJ3"
  COLUMN_NUMBER                = 26
  UNIT                         = "N/A"
  DATA_TYPE                    = IEEE_REAL
  START_BYTE                   = 105
  BYTES                        = 4
  DESCRIPTION                  = "
    Snapshot post-trigger counter for J3."
END_OBJECT

OBJECT                         = COLUMN
  NAME                         = "awSSTrigLevelJ0"
  COLUMN_NUMBER                = 27
  UNIT                         = "N/A"
  DATA_TYPE                    = IEEE_REAL
  START_BYTE                   = 109
  BYTES                        = 4
  DESCRIPTION                  = "
    Snapshot trigger level for J0."
END_OBJECT

OBJECT                         = COLUMN
  NAME                         = "awSSTrigLevelJ1"
  COLUMN_NUMBER                = 28
  UNIT                         = "N/A"
  DATA_TYPE                    = IEEE_REAL
  START_BYTE                   = 113
  BYTES                        = 4
  DESCRIPTION                  = "
    Snapshot trigger level for J1."
END_OBJECT

OBJECT                         = COLUMN
  NAME                         = "awSSTrigLevelJ2"
  COLUMN_NUMBER                = 29
  UNIT                         = "N/A"
  DATA_TYPE                    = IEEE_REAL
  START_BYTE                   = 117
  BYTES                        = 4
  DESCRIPTION                  = "
    Snapshot trigger level for J2."
END_OBJECT

OBJECT                         = COLUMN
  NAME                         = "awSSTrigLevelJ3"
  COLUMN_NUMBER                = 30
  UNIT                         = "N/A"
  DATA_TYPE                    = IEEE_REAL
  START_BYTE                   = 121
  BYTES                        = 4
  DESCRIPTION                  = "
    Snapshot trigger level for J3."
END_OBJECT

OBJECT                         = COLUMN
  NAME                         = "awSSAvValueJ0"
  COLUMN_NUMBER                = 31
  UNIT                         = "N/A"
  DATA_TYPE                    = IEEE_REAL
  START_BYTE                   = 125
  BYTES                        = 4
  DESCRIPTION                  = "
    Snapshot quality figure for J0."
END_OBJECT

OBJECT                         = COLUMN
  NAME                         = "awSSAvValueJ1"
  COLUMN_NUMBER                = 32
  UNIT                         = "N/A"
```

```
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 129
  BYTES                       = 4
  DESCRIPTION                 = "
    Snapshot quality figure for J1."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "awSSAvValueJ2"
  COLUMN_NUMBER               = 33
  UNIT                        = "N/A"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 133
  BYTES                       = 4
  DESCRIPTION                 = "
    Snapshot quality figure for J2."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "awSSAvValueJ3"
  COLUMN_NUMBER               = 34
  UNIT                        = "N/A"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 137
  BYTES                       = 4
  DESCRIPTION                 = "
    Snapshot quality figure for J3."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "awSSsubring00"
  COLUMN_NUMBER               = 35
  UNIT                        = "N/A"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 141
  BYTES                       = 4
  DESCRIPTION                 = "
    Snapshot subring status (subring 00)."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "awSSsubring01"
  COLUMN_NUMBER               = 36
  UNIT                        = "N/A"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 145
  BYTES                       = 4
  DESCRIPTION                 = "
    Snapshot subring status (subring 01)."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "awSSsubring02"
  COLUMN_NUMBER               = 37
  UNIT                        = "N/A"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 149
  BYTES                       = 4
  DESCRIPTION                 = "
    Snapshot subring status (subring 02)."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "awSSsubring03"
  COLUMN_NUMBER               = 38
  UNIT                        = "N/A"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 153
  BYTES                       = 4
```

```
  DESCRIPTION                = "
    Snapshot subring status (subring 03)."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "awSSsubring04"
  COLUMN_NUMBER              = 39
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 157
  BYTES                      = 4
  DESCRIPTION                = "
    Snapshot subring status (subring 04)."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "awSSsubring05"
  COLUMN_NUMBER              = 40
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 161
  BYTES                      = 4
  DESCRIPTION                = "
    Snapshot subring status (subring 05)."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "awSSsubring06"
  COLUMN_NUMBER              = 41
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 165
  BYTES                      = 4
  DESCRIPTION                = "
    Snapshot subring status (subring 06)."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "awSSsubring07"
  COLUMN_NUMBER              = 42
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 169
  BYTES                      = 4
  DESCRIPTION                = "
    Snapshot subring status (subring 07)."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "awSSsubring08"
  COLUMN_NUMBER              = 43
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 173
  BYTES                      = 4
  DESCRIPTION                = "
    Snapshot subring status (subring 08)."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "awSSsubring09"
  COLUMN_NUMBER              = 44
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 177
  BYTES                      = 4
  DESCRIPTION                = "
    Snapshot subring status (subring 09)."
END_OBJECT
```

```
OBJECT                        = COLUMN
  NAME                        = "awSSsubring10"
  COLUMN_NUMBER               = 45
  UNIT                        = "N/A"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 181
  BYTES                       = 4
  DESCRIPTION                 = "
    Snapshot subring status (subring 10)."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "awSSsubring11"
  COLUMN_NUMBER               = 46
  UNIT                        = "N/A"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 185
  BYTES                       = 4
  DESCRIPTION                 = "
    Snapshot subring status (subring 11)."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "awSSsubring12"
  COLUMN_NUMBER               = 47
  UNIT                        = "N/A"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 189
  BYTES                       = 4
  DESCRIPTION                 = "
    Snapshot subring status (subring 12)."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "awSSsubring13"
  COLUMN_NUMBER               = 48
  UNIT                        = "N/A"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 193
  BYTES                       = 4
  DESCRIPTION                 = "
    Snapshot subring status (subring 13)."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "awSSsubring14"
  COLUMN_NUMBER               = 49
  UNIT                        = "N/A"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 197
  BYTES                       = 4
  DESCRIPTION                 = "
    Snapshot subring status (subring 14)."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "awSSsubring15"
  COLUMN_NUMBER               = 50
  UNIT                        = "N/A"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 201
  BYTES                       = 4
  DESCRIPTION                 = "
    Snapshot subring status (subring 15)."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "awSSsubring16"
```

```
  COLUMN_NUMBER              = 51
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 205
  BYTES                      = 4
  DESCRIPTION                = "
    Snapshot subring status (subring 16)."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "awSSsubring17"
  COLUMN_NUMBER              = 52
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 209
  BYTES                      = 4
  DESCRIPTION                = "
    Snapshot subring status (subring 17)."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "awSSsubring18"
  COLUMN_NUMBER              = 53
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 213
  BYTES                      = 4
  DESCRIPTION                = "
    Snapshot subring status (subring 18)."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "awSSsubring19"
  COLUMN_NUMBER              = 54
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 217
  BYTES                      = 4
  DESCRIPTION                = "
    Snapshot subring status (subring 19)."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "awSSsubring20"
  COLUMN_NUMBER              = 55
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 221
  BYTES                      = 4
  DESCRIPTION                = "
    Snapshot subring status (subring 20)."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "awSSsubring21"
  COLUMN_NUMBER              = 56
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 225
  BYTES                      = 4
  DESCRIPTION                = "
    Snapshot subring status (subring 21)."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "awSSsubring22"
  COLUMN_NUMBER              = 57
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
```

```
  START_BYTE                  = 229
  BYTES                       = 4
  DESCRIPTION                 = "
    Snapshot subring status (subring 22)."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "awSSsubring23"
  COLUMN_NUMBER               = 58
  UNIT                        = "N/A"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 233
  BYTES                       = 4
  DESCRIPTION                 = "
    Snapshot subring status (subring 23)."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "awSSsubring24"
  COLUMN_NUMBER               = 59
  UNIT                        = "N/A"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 237
  BYTES                       = 4
  DESCRIPTION                 = "
    Snapshot subring status (subring 24)."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "awSSsubring25"
  COLUMN_NUMBER               = 60
  UNIT                        = "N/A"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 241
  BYTES                       = 4
  DESCRIPTION                 = "
    Snapshot subring status (subring 25)."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "awSSsubring26"
  COLUMN_NUMBER               = 61
  UNIT                        = "N/A"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 245
  BYTES                       = 4
  DESCRIPTION                 = "
    Snapshot subring status (subring 26)."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "awSSsubring27"
  COLUMN_NUMBER               = 62
  UNIT                        = "N/A"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 249
  BYTES                       = 4
  DESCRIPTION                 = "
    Snapshot subring status (subring 27)."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "awSSsubring28"
  COLUMN_NUMBER               = 63
  UNIT                        = "N/A"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 253
  BYTES                       = 4
  DESCRIPTION                 = "
```

```
    Snapshot subring status (subring 28)."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "awSSsubring29"
  COLUMN_NUMBER            = 64
  UNIT                     = "N/A"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 257
  BYTES                    = 4
  DESCRIPTION              = "
    Snapshot subring status (subring 29)."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "awSSsubring30"
  COLUMN_NUMBER            = 65
  UNIT                     = "N/A"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 261
  BYTES                    = 4
  DESCRIPTION              = "
    Snapshot subring status (subring 30)."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "awSSsubring31"
  COLUMN_NUMBER            = 66
  UNIT                     = "N/A"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 265
  BYTES                    = 4
  DESCRIPTION              = "
    Snapshot subring status (subring 31)."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "awSSsubring32"
  COLUMN_NUMBER            = 67
  UNIT                     = "N/A"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 269
  BYTES                    = 4
  DESCRIPTION              = "
    Snapshot subring status (subring 32)."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "wSSSubRintSCRd"
  COLUMN_NUMBER            = 68
  UNIT                     = "N/A"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 273
  BYTES                    = 4
  DESCRIPTION              = "
    Snapshot subring science read."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "wSSVecCntScRd"
  COLUMN_NUMBER            = 69
  UNIT                     = "N/A"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 277
  BYTES                    = 4
  DESCRIPTION              = "
    Snapshot vector counter science read."
END_OBJECT
```

```
OBJECT                     = COLUMN
  NAME                     = "wSSSubRingHKRd"
  COLUMN_NUMBER            = 70
  UNIT                     = "N/A"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 281
  BYTES                    = 4
  DESCRIPTION              = "
    Snapshot subring housekeeping read."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "wSSVecCntHKRd"
  COLUMN_NUMBER            = 71
  UNIT                     = "N/A"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 285
  BYTES                    = 4
  DESCRIPTION              = "
    Snapshot vector counter housekeeping read."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "wSSXOffset"
  COLUMN_NUMBER            = 72
  UNIT                     = "N/A"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 289
  BYTES                    = 4
  DESCRIPTION              = "
    Commandable offset for ADC conversion of X field component."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "wSSYOffset"
  COLUMN_NUMBER            = 73
  UNIT                     = "N/A"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 293
  BYTES                    = 4
  DESCRIPTION              = "
    Commandable offset for ADC conversion of Y field component."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "wSSZOffset"
  COLUMN_NUMBER            = 74
  UNIT                     = "N/A"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 297
  BYTES                    = 4
  DESCRIPTION              = "
    Commandable offset for ADC conversion of Z field component."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "wJoiData"
  COLUMN_NUMBER            = 75
  UNIT                     = "N/A"
  DATA_TYPE                = MSB_INTEGER
  START_BYTE               = 301
  BYTES                    = 4
  DESCRIPTION              = "
    Field containing status / mode indicators for ADC clock
    frequency, range control, averaging mode, science packet
    generation in sleep mode, LU (Latch Up) testing, ATC (Artificial
    Time Code) generation, VHM sensor status, FGM calibration, etc."
END_OBJECT
```

```
OBJECT                          = COLUMN
  NAME                          = "byMemScrub"
  COLUMN_NUMBER                 = 76
  UNIT                          = "N/A"
  DATA_TYPE                     = MSB_INTEGER
  START_BYTE                    = 305
  BYTES                         = 4
  DESCRIPTION                   = "
    Memory scrubbing status."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "wPowerStat"
  COLUMN_NUMBER                 = 77
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 309
  BYTES                         = 4
  DESCRIPTION                   = "
    Power (on/off) status."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "wVersion"
  COLUMN_NUMBER                 = 78
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 313
  BYTES                         = 4
  DESCRIPTION                   = "
    Software version, Patch code status."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "dwRamChckUBa"
  COLUMN_NUMBER                 = 79
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 317
  BYTES                         = 4
  DESCRIPTION                   = "
    RAM check end address (upper bound) a."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "dwRamChckUBb"
  COLUMN_NUMBER                 = 80
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 321
  BYTES                         = 4
  DESCRIPTION                   = "
    RAM check end address (upper bound) b."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "dwRamChckLBa"
  COLUMN_NUMBER                 = 81
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 325
  BYTES                         = 4
  DESCRIPTION                   = "
    RAM check start address (lower bound) a."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "dwRamChckLBb"
  COLUMN_NUMBER                 = 82
```

```
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 329
  BYTES                      = 4
  DESCRIPTION                = "
    RAM check start address (lower bound) b."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "wFCalTime"
  COLUMN_NUMBER              = 83
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 333
  BYTES                      = 4
  DESCRIPTION                = "
    FGM calibration frequency."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "wFRSBound"
  COLUMN_NUMBER              = 84
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 337
  BYTES                      = 4
  DESCRIPTION                = "
    FGM reverse range switching boundary."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "wFFSBound"
  COLUMN_NUMBER              = 85
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 341
  BYTES                      = 4
  DESCRIPTION                = "
    FGM forward range switching boundary."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "wFRSBCntLimit"
  COLUMN_NUMBER              = 86
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 345
  BYTES                      = 4
  DESCRIPTION                = "
    FGM counter limit, reverse range switch."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "wFFSBCntLimit"
  COLUMN_NUMBER              = 87
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 349
  BYTES                      = 4
  DESCRIPTION                = "
    FGM counter limit, forward range switch."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "wHKDataStatus"
  COLUMN_NUMBER              = 88
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 353
```

```
  BYTES                      = 4
  DESCRIPTION                = "
    Housekeeping data status."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "wLUCtrlStatus"
  COLUMN_NUMBER              = 89
  UNIT                       = "N/A"
  DATA_TYPE                  = MSB_INTEGER
  START_BYTE                 = 357
  BYTES                      = 4
  DESCRIPTION                = "
    Latch up detector control status."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "wHLUHLMask"
  COLUMN_NUMBER              = 90
  UNIT                       = "N/A"
  DATA_TYPE                  = MSB_INTEGER
  START_BYTE                 = 361
  BYTES                      = 4
  DESCRIPTION                = "
    Latch up detector high / low level mask."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "wRunAvExp"
  COLUMN_NUMBER              = 91
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 365
  BYTES                      = 4
  DESCRIPTION                = "
    Running average exponent."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "wWDSwitchForNMI"
  COLUMN_NUMBER              = 92
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 369
  BYTES                      = 4
  DESCRIPTION                = "
    Watchdog switch after 100 NMI (Non Maskable Interrupts)."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "bWDServeEnable"
  COLUMN_NUMBER              = 93
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 373
  BYTES                      = 4
  DESCRIPTION                = "
    Watchdog service enabled / disabled."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "wNormalRTITime"
  COLUMN_NUMBER              = 94
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 377
  BYTES                      = 4
  DESCRIPTION                = "
    Normal RTI (Real Time Interrupt) time for artificial RTI
```

```
    generation."
END_OBJECT

OBJECT                      = COLUMN
  NAME                      = "wNormalDTITime"
  COLUMN_NUMBER             = 95
  UNIT                      = "N/A"
  DATA_TYPE                 = IEEE_REAL
  START_BYTE                = 381
  BYTES                     = 4
  DESCRIPTION               = "
    Normal DTI (Dead Time start Interrupt) time for artificial DTI
    generation."
END_OBJECT

OBJECT                      = COLUMN
  NAME                      = "wArtRTITime"
  COLUMN_NUMBER             = 96
  UNIT                      = "N/A"
  DATA_TYPE                 = IEEE_REAL
  START_BYTE                = 385
  BYTES                     = 4
  DESCRIPTION               = "
    Artificial RTI time to detect missing RTI."
END_OBJECT

OBJECT                      = COLUMN
  NAME                      = "wArtDTITime"
  COLUMN_NUMBER             = 97
  UNIT                      = "N/A"
  DATA_TYPE                 = IEEE_REAL
  START_BYTE                = 389
  BYTES                     = 4
  DESCRIPTION               = "
    Artificial DTI time to detect missing DTI."
END_OBJECT

OBJECT                      = COLUMN
  NAME                      = "wArtRTICnt"
  COLUMN_NUMBER             = 98
  UNIT                      = "N/A"
  DATA_TYPE                 = IEEE_REAL
  START_BYTE                = 393
  BYTES                     = 4
  DESCRIPTION               = "
    Number of RTIs until switch to artificial RTI."
END_OBJECT

OBJECT                      = COLUMN
  NAME                      = "wArtRTIFix"
  COLUMN_NUMBER             = 99
  UNIT                      = "N/A"
  DATA_TYPE                 = IEEE_REAL
  START_BYTE                = 397
  BYTES                     = 4
  DESCRIPTION               = "
    Artificial RTI status (free / fix)."
END_OBJECT

OBJECT                      = COLUMN
  NAME                      = "bArtRTIEnd"
  COLUMN_NUMBER             = 100
  UNIT                      = "N/A"
  DATA_TYPE                 = IEEE_REAL
  START_BYTE                = 401
  BYTES                     = 4
  DESCRIPTION               = "
    Artificial RTI status (enabled / disabled)."
END_OBJECT
```

```
OBJECT                          = COLUMN
  NAME                          = "wTime0"
  COLUMN_NUMBER                 = 101
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 405
  BYTES                         = 4
  DESCRIPTION                   = "
    Measurement Cycle time."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "wTimeEna"
  COLUMN_NUMBER                 = 102
  UNIT                          = "N/A"
  DATA_TYPE                     = MSB_INTEGER
  START_BYTE                    = 409
  BYTES                         = 4
  DESCRIPTION                   = "
    Timer status (enabled / disabled)."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "wVRSBound"
  COLUMN_NUMBER                 = 103
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 413
  BYTES                         = 4
  DESCRIPTION                   = "
    VHM reverse range switching boundary."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "wVFSBound"
  COLUMN_NUMBER                 = 104
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 417
  BYTES                         = 4
  DESCRIPTION                   = "
    VHM forward range switching boundary."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "wVRSCntLimit"
  COLUMN_NUMBER                 = 105
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 421
  BYTES                         = 4
  DESCRIPTION                   = "
    VHM counter limit, reverse range switch."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "wVFSCntLimit"
  COLUMN_NUMBER                 = 106
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 425
  BYTES                         = 4
  DESCRIPTION                   = "
    VHM counter limit, forward range switch."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "wVAutoIFCTime"
```

```
  COLUMN_NUMBER              = 107
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 429
  BYTES                      = 4
  DESCRIPTION                = "
    VHM automatic IFC (In Flight Calibration) time."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "wVAutoIFCCycle"
  COLUMN_NUMBER              = 108
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 433
  BYTES                      = 4
  DESCRIPTION                = "
    VHM auto IFC cycle."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "wVFormatTime"
  COLUMN_NUMBER              = 109
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 437
  BYTES                      = 4
  DESCRIPTION                = "
    VHM format pulse frequency."
END_OBJECT
```

9.4.5 Analog data

```
OBJECT                       = COLUMN
  NAME                       = "SCLK(1958)"
  COLUMN_NUMBER              = 1
  UNIT                       = "Counts"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 1
  BYTES                      = 8
  DESCRIPTION                ="
    Time  (SCLK  NOT  UTC)  is  represented  as  a  decimal  SCLK  count
relative
    to the epoch Jan 1 1958 00:00:00.000."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "PreampOut"
  COLUMN_NUMBER              = 2
  UNIT                       = "VOLTS"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 9
  BYTES                      = 4
  DESCRIPTION                = "
    Subcommutated VHM data - pre-amplifier output."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "IRDectBias"
  COLUMN_NUMBER              = 3
  UNIT                       = "VOLTS"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 13
  BYTES                      = 4
  DESCRIPTION                = "
    Subcommutated VHM data - infrared detector bias."
END_OBJECT
```

```
OBJECT                     = COLUMN
  NAME                     = "HeLmpRFAmp"
  COLUMN_NUMBER            = 4
  UNIT                     = "VOLTS"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 17
  BYTES                    = 4
  DESCRIPTION              = "
    Subcommutated VHM data - He lamp RF amplifier."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "HeCllRFAmp"
  COLUMN_NUMBER            = 5
  UNIT                     = "VOLTS"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 21
  BYTES                    = 4
  DESCRIPTION              = "
    Subcommutated VHM data - He cell RF amplifier."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "BIU VCCSPV"
  COLUMN_NUMBER            = 6
  UNIT                     = "VOLTS"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 25
  BYTES                    = 4
  DESCRIPTION              = "
    Subcommutated VHM data - BIU VCC, BIU supply voltage."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "+/-3.75V"
  COLUMN_NUMBER            = 7
  UNIT                     = "VOLTS"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 29
  BYTES                    = 4
  DESCRIPTION              = "
    Subcommutated VHM data -  +/-3.75 V supply."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "+/-12V"
  COLUMN_NUMBER            = 8
  UNIT                     = "VOLTS"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 33
  BYTES                    = 4
  DESCRIPTION              = "
    Subcommutated VHM data -  +/-12 V supply."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "+/-6.2V"
  COLUMN_NUMBER            = 9
  UNIT                     = "VOLTS"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 37
  BYTES                    = 4
  DESCRIPTION              = "
    Subcommutated VHM data -  +/-6.2 V supply."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "VCOMonitor"
```

```
  COLUMN_NUMBER               = 10
  UNIT                        = "VOLTS"
  DATA_TYPE                   = MSB_INTEGER
  START_BYTE                  = 41
  BYTES                       = 4
  DESCRIPTION                 = "
    Subcommutated SHM data - VCO (Voltage Controlled Oscillator)
    monitor."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "+/-7V"
  COLUMN_NUMBER               = 11
  UNIT                        = "VOLTS"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 45
  BYTES                       = 4
  DESCRIPTION                 = "
    Subcommutated SHM data -  +/-7V supply."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "Detect2fg"
  COLUMN_NUMBER               = 12
  UNIT                        = "VOLTS"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 49
  BYTES                       = 4
  DESCRIPTION                 = "
    Subcommutated SHM data - Detected 2fo."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "VCOModltn"
  COLUMN_NUMBER               = 13
  UNIT                        = "VOLTS"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 53
  BYTES                       = 4
  DESCRIPTION                 = "
    Subcommutated SHM data - VCO modulation."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "+7.5V"
  COLUMN_NUMBER               = 14
  UNIT                        = "VOLTS"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 57
  BYTES                       = 4
  DESCRIPTION                 = "
    Subcommutated FGM data -  +7.5V supply."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "-7.5V"
  COLUMN_NUMBER               = 15
  UNIT                        = "VOLTS"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 61
  BYTES                       = 4
  DESCRIPTION                 = "
    Subcommutated FGM data -  -7.5V supply."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "X-Field"
  COLUMN_NUMBER               = 16
  UNIT                        = "VOLTS"
```

```
  DATA_TYPE                 = IEEE_REAL
  START_BYTE                = 65
  BYTES                     = 4
  DESCRIPTION               = "
    Subcommutated FGM data - X component of magnetic field."
END_OBJECT

OBJECT                      = COLUMN
  NAME                      = "Y-Field"
  COLUMN_NUMBER             = 17
  UNIT                      = "VOLTS"
  DATA_TYPE                 = IEEE_REAL
  START_BYTE                = 69
  BYTES                     = 4
  DESCRIPTION               = "
    Subcommutated FGM data - Y component of magnetic field."
END_OBJECT

OBJECT                      = COLUMN
  NAME                      = "Z-Field"
  COLUMN_NUMBER             = 18
  UNIT                      = "VOLTS"
  DATA_TYPE                 = IEEE_REAL
  START_BYTE                = 73
  BYTES                     = 4
  DESCRIPTION               = "
    Subcommutated FGM data - Z component of magnetic field."
END_OBJECT

OBJECT                      = COLUMN
  NAME                      = "PSU1"
  COLUMN_NUMBER             = 19
  UNIT                      = "VOLTS"
  DATA_TYPE                 = IEEE_REAL
  START_BYTE                = 77
  BYTES                     = 4
  DESCRIPTION               = "
    Subcommutated FGM data - PSU (Power Supply Unit) 1."
END_OBJECT

OBJECT                      = COLUMN
  NAME                      = "PSU2"
  COLUMN_NUMBER             = 20
  UNIT                      = "VOLTS"
  DATA_TYPE                 = IEEE_REAL
  START_BYTE                = 81
  BYTES                     = 4
  DESCRIPTION               = "
    Subcommutated FGM data - PSU 2."
END_OBJECT

OBJECT                      = COLUMN
  NAME                      = "Ground F"
  COLUMN_NUMBER             = 21
  UNIT                      = "VOLTS"
  DATA_TYPE                 = IEEE_REAL
  START_BYTE                = 81
  BYTES                     = 4
  DESCRIPTION               = "
    Subcommutated FGM data -  FGM Ground."
END_OBJECT

OBJECT                      = COLUMN
  NAME                      = "Reference"
  COLUMN_NUMBER             = 22
  UNIT                      = "VOLTS"
  DATA_TYPE                 = IEEE_REAL
  START_BYTE                = 85
  BYTES                     = 4
```

```
  DESCRIPTION                = "
    Subcommutated DPU data - Reference voltage."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "A_VCC"
  COLUMN_NUMBER              = 23
  UNIT                       = "VOLTS"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 93
  BYTES                      = 4
  DESCRIPTION                = "
    Subcommutated DPU data - Supply voltage processor system A."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "P12V"
  COLUMN_NUMBER              = 24
  UNIT                       = "VOLTS"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 97
  BYTES                      = 4
  DESCRIPTION                = "
    Subcommutated  DPU  data  -  ADC  (Analog  Digital  Converter)  supply
    voltage of active processor system."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "M12V"
  COLUMN_NUMBER              = 25
  UNIT                       = "VOLTS"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 101
  BYTES                      = 4
  DESCRIPTION                = "
    Subcommutated DPU data - ADC supply voltage of active processor
system."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "B_VCC"
  COLUMN_NUMBER              = 26
  UNIT                       = "VOLTS"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 105
  BYTES                      = 4
  DESCRIPTION                = "
    Subcommutated DPU data - Supply voltage processor system B."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "Ground D"
  COLUMN_NUMBER              = 27
  UNIT                       = "VOLTS"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 109
  BYTES                      = 4
  DESCRIPTION                = "
    Subcommutated DPU data - DPU Ground."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "SOURCE"
  COLUMN_NUMBER              = 28
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 113
  BYTES                      = 4
  DESCRIPTION                = "
```

```
    Subcommutation maintenance data derived from source sequence
    count of packets."
END_OBJECT
```

9.4.6 Error counter data

```
OBJECT                          = COLUMN
  NAME                          = "SCLK(1958)"
  COLUMN_NUMBER                 = 1
  UNIT                          = "Counts"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 1
  BYTES                         = 8
  DESCRIPTION                   ="
    Time  (SCLK  NOT  UTC)  is  represented  as  a  decimal  SCLK  count
relative
    to the epoch Jan 1 1958 00:00:00.000."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "wBIUCheckErrCnt"
  COLUMN_NUMBER                 = 2
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 9
  BYTES                         = 4
  DESCRIPTION                   = "
    BIU (Bus Interface Unit) Check Error Counter."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "wUnexptDTIErrCnt"
  COLUMN_NUMBER                 = 3
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 13
  BYTES                         = 4
  DESCRIPTION                   = "
    Unexpected DTI (Dead Time Interrupt) Error Counter."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "wUnexptRTIErrCnt"
  COLUMN_NUMBER                 = 4
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 17
  BYTES                         = 4
  DESCRIPTION                   = "
    Unexpected RTI (Real Time Interrupt) Error Counter."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "wALFCheckSumE"
  COLUMN_NUMBER                 = 5
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 21
  BYTES                         = 4
  DESCRIPTION                   = "
    Calculated (even word) Checksum for last ALF (Assisted Load
    Format) command."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "wALFCheckSumO"
  COLUMN_NUMBER                 = 6
```

```
  UNIT                        = "N/A"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 25
  BYTES                       = 4
  DESCRIPTION                 = "
    Calculated (odd-word) Checksum for last ALF (Assisted Load
    Format) command."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "wCmd12CRC"
  COLUMN_NUMBER               = 7
  UNIT                        = "N/A"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 29
  BYTES                       = 4
  DESCRIPTION                 = "
    CRC (Cyclic Redundancy Check) of last program load command."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "wCmd04CRC"
  COLUMN_NUMBER               = 8
  UNIT                        = "N/A"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 33
  BYTES                       = 4
  DESCRIPTION                 = "
    CRC of last fixed length command."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "wCmd08CRC"
  COLUMN_NUMBER               = 9
  UNIT                        = "N/A"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 37
  BYTES                       = 4
  DESCRIPTION                 = "
    CRC of last parameter load command."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "wTimeTagErrCnt"
  COLUMN_NUMBER               = 10
  UNIT                        = "N/A"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 41
  BYTES                       = 4
  DESCRIPTION                 = "
    Time-tagged command error counter."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "dw16MTestErrCnta"
  COLUMN_NUMBER               = 11
  UNIT                        = "N/A"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 45
  BYTES                       = 4
  DESCRIPTION                 = "
    Multi Snapshot Memory Test, Error Counter A."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "dw16MTestErrCntb"
  COLUMN_NUMBER               = 12
  UNIT                        = "N/A"
  DATA_TYPE                   = IEEE_REAL
```

```
  START_BYTE                 = 49
  BYTES                      = 4
  DESCRIPTION                = "
    Multi Snapshot Memory Test, Error Counter B."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "wConfigErrCnt"
  COLUMN_NUMBER              = 13
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 53
  BYTES                      = 4
  DESCRIPTION                = "
    Configuration error counter."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "wRegister"
  COLUMN_NUMBER              = 14
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 57
  BYTES                      = 4
  DESCRIPTION                = "
    Register readout value."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "wResetCause"
  COLUMN_NUMBER              = 15
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 61
  BYTES                      = 4
  DESCRIPTION                = "
    Cause of last reset (0 = Power on, 1 = Watchdog reset)."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "wSingleErrCnt"
  COLUMN_NUMBER              = 16
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 65
  BYTES                      = 4
  DESCRIPTION                = "
    RAM single-bit error counter."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "wDoubleErrCnt"
  COLUMN_NUMBER              = 17
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 69
  BYTES                      = 4
  DESCRIPTION                = "
    RAM double-bit error counter."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "wProm1TestErrCnt"
  COLUMN_NUMBER              = 18
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 73
  BYTES                      = 4
  DESCRIPTION                = "
```

```
    PROM (Programmable Read-Only Memory) Bank 1 Test error counter."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "wProm2TestErrCnt"
  COLUMN_NUMBER            = 19
  UNIT                     = "N/A"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 77
  BYTES                    = 4
  DESCRIPTION              = "
    PROM Bank 2 Test error counter."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "w16M1SingleErrCnt"
  COLUMN_NUMBER            = 20
  UNIT                     = "N/A"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 81
  BYTES                    = 4
  DESCRIPTION              = "
    Multi Snapshot Memory Bank 1 single error counter."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "w16M1DoubleErrCnt"
  COLUMN_NUMBER            = 21
  UNIT                     = "N/A"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 85
  BYTES                    = 4
  DESCRIPTION              = "
    Multi Snapshot Memory Bank 1 double error counter."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "w16M2SingleErrCnt"
  COLUMN_NUMBER            = 22
  UNIT                     = "N/A"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 89
  BYTES                    = 4
  DESCRIPTION              = "
    Multi Snapshot Memory Bank 2 single error counter."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "w16M2DoubleErrCnt"
  COLUMN_NUMBER            = 23
  UNIT                     = "N/A"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 93
  BYTES                    = 4
  DESCRIPTION              = "
    Multi Snapshot Memory Bank 2 double error counter."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "awOGAnciSentErr"
  COLUMN_NUMBER            = 24
  UNIT                     = "N/A"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 97
  BYTES                    = 4
  DESCRIPTION              = "
    Outgoing ancillary data sent error, Packet sent count."
END_OBJECT
```

```
OBJECT                     = COLUMN
  NAME                     = "MessErr_NotInit1"
  COLUMN_NUMBER            = 25
  UNIT                     = "N/A"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 101
  BYTES                    = 4
  DESCRIPTION              = "
    Message error counter / Not Initialized counter."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "PacketNotSentCnt1"
  COLUMN_NUMBER            = 26
  UNIT                     = "N/A"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 105
  BYTES                    = 4
  DESCRIPTION              = "
    Packet not sent yet counter."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "NotAllPckSentCnt1"
  COLUMN_NUMBER            = 27
  UNIT                     = "N/A"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 109
  BYTES                    = 4
  DESCRIPTION              = "
    Not all packets are sent yet counter."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "IllegalCallSeqCnt1"
  COLUMN_NUMBER            = 28
  UNIT                     = "N/A"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 113
  BYTES                    = 4
  DESCRIPTION              = "
    Illegal calling sequence counter."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "awSciPktSentErr"
  COLUMN_NUMBER            = 29
  UNIT                     = "N/A"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 117
  BYTES                    = 4
  DESCRIPTION              = "
    Science packet sent error, Packet sent counter."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "MessErr_NotInit2"
  COLUMN_NUMBER            = 30
  UNIT                     = "N/A"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 121
  BYTES                    = 4
  DESCRIPTION              = "
    Message error counter / Not Initialized counter."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "PacketNotSentCnt2"
  COLUMN_NUMBER            = 31
```

```
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 125
  BYTES                      = 4
  DESCRIPTION                = "
    Packet not sent yet counter."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "NotAllPckSentCnt2"
  COLUMN_NUMBER              = 32
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 129
  BYTES                      = 4
  DESCRIPTION                = "
    Not all packets are sent yet counter."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "IllegalCallSeqCnt2"
  COLUMN_NUMBER              = 33
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 133
  BYTES                      = 4
  DESCRIPTION                = "
    Illegal calling sequence counter."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "awHKPktSentErr"
  COLUMN_NUMBER              = 34
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 137
  BYTES                      = 4
  DESCRIPTION                = "
    HK (Housekeeping) packet sent error, Packet sent counter."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "MessErr_NotInit3"
  COLUMN_NUMBER              = 35
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 141
  BYTES                      = 4
  DESCRIPTION                = "
    Message error counter / Not Initialized counter."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "PacketNotSentCnt3"
  COLUMN_NUMBER              = 36
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 145
  BYTES                      = 4
  DESCRIPTION                = "
    Packet not sent yet counter."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "NotAllPckSentCnt3"
  COLUMN_NUMBER              = 37
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 149
```

```
  BYTES                     = 4
  DESCRIPTION               = "
    Not all packets are sent yet counter."
END_OBJECT

OBJECT                      = COLUMN
  NAME                      = "IllegalCallSeqCnt3"
  COLUMN_NUMBER             = 38
  UNIT                      = "N/A"
  DATA_TYPE                 = IEEE_REAL
  START_BYTE                = 153
  BYTES                     = 4
  DESCRIPTION               = "
    Illegal calling sequence counter."
END_OBJECT

OBJECT                      = COLUMN
  NAME                      = "awJMTrigErrCnt"
  COLUMN_NUMBER             = 39
  UNIT                      = "N/A"
  DATA_TYPE                 = IEEE_REAL
  START_BYTE                = 157
  BYTES                     = 4
  DESCRIPTION               = "
    Job Manager Level Trigger error counter."
END_OBJECT

OBJECT                      = COLUMN
  NAME                      = "MCITable"
  COLUMN_NUMBER             = 40
  UNIT                      = "N/A"
  DATA_TYPE                 = IEEE_REAL
  START_BYTE                = 161
  BYTES                     = 4
  DESCRIPTION               = "
    MCI (Measurement Cycle Interrupt) Table."
END_OBJECT

OBJECT                      = COLUMN
  NAME                      = "RTIDTIFIFO"
  COLUMN_NUMBER             = 41
  UNIT                      = "N/A"
  DATA_TYPE                 = IEEE_REAL
  START_BYTE                = 165
  BYTES                     = 4
  DESCRIPTION               = "
    RTI/DTI Immediate FIFO."
END_OBJECT

OBJECT                      = COLUMN
  NAME                      = "RTITable"
  COLUMN_NUMBER             = 42
  UNIT                      = "N/A"
  DATA_TYPE                 = IEEE_REAL
  START_BYTE                = 169
  BYTES                     = 4
  DESCRIPTION               = "
    RTI Table."
END_OBJECT

OBJECT                      = COLUMN
  NAME                      = "_128MCITable"
  COLUMN_NUMBER             = 43
  UNIT                      = "N/A"
  DATA_TYPE                 = IEEE_REAL
  START_BYTE                = 173
  BYTES                     = 4
  DESCRIPTION               = "
    128 MCI Table."
```

```
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "_032RTITable"
  COLUMN_NUMBER                 = 44
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 177
  BYTES                         = 4
  DESCRIPTION                   = "
    32 RTI Table."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "_512RTITable"
  COLUMN_NUMBER                 = 45
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 181
  BYTES                         = 4
  DESCRIPTION                   = "
    512 RTI Table."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "LongJobFIFO"
  COLUMN_NUMBER                 = 46
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 185
  BYTES                         = 4
  DESCRIPTION                   = "
    Long job, immediate FIFO."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "wLUHandErrCnt"
  COLUMN_NUMBER                 = 47
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 189
  BYTES                         = 4
  DESCRIPTION                   = "
    LU (Latch Up) handling error counter."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "wArtErrCnt"
  COLUMN_NUMBER                 = 48
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 193
  BYTES                         = 4
  DESCRIPTION                   = "
    Artificial RTI error counter."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "awResetData,wLUMainCnt"
  COLUMN_NUMBER                 = 49
  UNIT                          = "N/A"
  DATA_TYPE                     = MSB_INTEGER
  START_BYTE                    = 197
  BYTES                         = 4
  DESCRIPTION                   = "
    Reset data (in BIU memory), LU main counter."
END_OBJECT

OBJECT                          = COLUMN
```

```
  NAME                          = "wLUDRAMCnt"
  COLUMN_NUMBER                 = 50
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 201
  BYTES                         = 4
  DESCRIPTION                   = "
    LU DRAM counter."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "wLUP12VCnt"
  COLUMN_NUMBER                 = 51
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 205
  BYTES                         = 4
  DESCRIPTION                   = "
    LU (+12V supply) counter."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "wLUM12VCnt"
  COLUMN_NUMBER                 = 52
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 209
  BYTES                         = 4
  DESCRIPTION                   = "
    LU (-12V supply) counter."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "wWatchDog"
  COLUMN_NUMBER                 = 53
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 213
  BYTES                         = 4
  DESCRIPTION                   = "
    Watchdog reset status."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "wWDBounceCnt"
  COLUMN_NUMBER                 = 54
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 217
  BYTES                         = 4
  DESCRIPTION                   = "
    Watchdog reset / bounce counter."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "wBIUReset"
  COLUMN_NUMBER                 = 55
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 221
  BYTES                         = 4
  DESCRIPTION                   = "
    BIU reset flag."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "wBIUResetCnt"
  COLUMN_NUMBER                 = 56
  UNIT                          = "N/A"
```

```
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 225
  BYTES                      = 4
  DESCRIPTION                = "
    BIU reset counter."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "spare1"
  COLUMN_NUMBER              = 57
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 229
  BYTES                      = 4
  DESCRIPTION                = "
    Unused."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "spare2"
  COLUMN_NUMBER              = 58
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 233
  BYTES                      = 4
  DESCRIPTION                = "
    Unused."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "wMaxStackPos"
  COLUMN_NUMBER              = 59
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 237
  BYTES                      = 4
  DESCRIPTION                = "
    Maximum stack position."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "awIntLogLstErr"
  COLUMN_NUMBER              = 60
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 241
  BYTES                      = 4
  DESCRIPTION                = "
    BIU Interrupt log list error, Number of interrupts."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "NoMoreInterupts"
  COLUMN_NUMBER              = 61
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 245
  BYTES                      = 4
  DESCRIPTION                = "
    No more interrupts."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "BIUNotInit"
  COLUMN_NUMBER              = 62
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 249
  BYTES                      = 4
```

```
  DESCRIPTION                 = "
    BIU not initialised."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "awRecAACSDataMsg"
  COLUMN_NUMBER               = 63
  UNIT                        = "N/A"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 253
  BYTES                       = 4
  DESCRIPTION                 = "
    Received AACS (Attitude and Articulation Control Subsystem) data
    messages."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "MessageErr_NotIn1"
  COLUMN_NUMBER               = 64
  UNIT                        = "N/A"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 257
  BYTES                       = 4
  DESCRIPTION                 = "
    Message error (not initialised)."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "NoMoreMess1"
  COLUMN_NUMBER               = 65
  UNIT                        = "N/A"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 261
  BYTES                       = 4
  DESCRIPTION                 = "
    No more messages."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "MessageLost1"
  COLUMN_NUMBER               = 66
  UNIT                        = "N/A"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 265
  BYTES                       = 4
  DESCRIPTION                 = "
    Some message lost."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "awRecCritCmdMsgErr"
  COLUMN_NUMBER               = 67
  UNIT                        = "N/A"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 269
  BYTES                       = 4
  DESCRIPTION                 = "
    Received Critical command messages."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "MessageErr_NotIn2"
  COLUMN_NUMBER               = 68
  UNIT                        = "N/A"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 273
  BYTES                       = 4
  DESCRIPTION                 = "
    Message error (not initialised)."
```

```
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "NoMoreMess2"
  COLUMN_NUMBER                 = 69
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 277
  BYTES                         = 4
  DESCRIPTION                   = "
    No more messages."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "MessageLost2"
  COLUMN_NUMBER                 = 70
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 281
  BYTES                         = 4
  DESCRIPTION                   = "
    Some message lost."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "awRecFaultCmdMsgE"
  COLUMN_NUMBER                 = 71
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 285
  BYTES                         = 4
  DESCRIPTION                   = "
    Received Fault Protection command messages."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "MessageErr_NotIn3"
  COLUMN_NUMBER                 = 72
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 289
  BYTES                         = 4
  DESCRIPTION                   = "
    Message error (not initialised)."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "NoMoreMess3"
  COLUMN_NUMBER                 = 73
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 293
  BYTES                         = 4
  DESCRIPTION                   = "
    No more messages."
END_OBJECT

OBJECT                          = COLUMN
  NAME                          = "MessageLost3"
  COLUMN_NUMBER                 = 74
  UNIT                          = "N/A"
  DATA_TYPE                     = IEEE_REAL
  START_BYTE                    = 297
  BYTES                         = 4
  DESCRIPTION                   = "
    Some message lost."
END_OBJECT

OBJECT                          = COLUMN
```

```
  NAME                         = "awReclCAnciMsgErr"
  COLUMN_NUMBER                = 75
  UNIT                         = "N/A"
  DATA_TYPE                    = MSB_INTEGER
  START_BYTE                   = 301
  BYTES                        = 4
  DESCRIPTION                  = "
    Received Incoming Ancillary Data messages."
END_OBJECT

OBJECT                         = COLUMN
  NAME                         = "MessageErr_NotIn4"
  COLUMN_NUMBER                = 76
  UNIT                         = "N/A"
  DATA_TYPE                    = IEEE_REAL
  START_BYTE                   = 305
  BYTES                        = 4
  DESCRIPTION                  = "
    Message error (not initialised)."
END_OBJECT

OBJECT                         = COLUMN
  NAME                         = "NoMoreMess4"
  COLUMN_NUMBER                = 77
  UNIT                         = "N/A"
  DATA_TYPE                    = IEEE_REAL
  START_BYTE                   = 309
  BYTES                        = 4
  DESCRIPTION                  = "
    No more messages."
END_OBJECT

OBJECT                         = COLUMN
  NAME                         = "MessageLost4"
  COLUMN_NUMBER                = 78
  UNIT                         = "N/A"
  DATA_TYPE                    = IEEE_REAL
  START_BYTE                   = 313
  BYTES                        = 4
  DESCRIPTION                  = "
    Some message lost."
END_OBJECT

OBJECT                         = COLUMN
  NAME                         = "awRecNomCmdMsgErr"
  COLUMN_NUMBER                = 79
  UNIT                         = "N/A"
  DATA_TYPE                    = IEEE_REAL
  START_BYTE                   = 317
  BYTES                        = 4
  DESCRIPTION                  = "
    Received Nominal command messages."
END_OBJECT

OBJECT                         = COLUMN
  NAME                         = "MessageErr_NotIn5"
  COLUMN_NUMBER                = 80
  UNIT                         = "N/A"
  DATA_TYPE                    = IEEE_REAL
  START_BYTE                   = 321
  BYTES                        = 4
  DESCRIPTION                  = "
    Message error (not initialised)."
END_OBJECT

OBJECT                         = COLUMN
  NAME                         = "NoMoreMess5"
  COLUMN_NUMBER                = 81
  UNIT                         = "N/A"
```

```
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 325
  BYTES                      = 4
  DESCRIPTION                = "
    No more messages."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "MessageLost5"
  COLUMN_NUMBER              = 82
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 329
  BYTES                      = 4
  DESCRIPTION                = "
    Some message lost."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "awRecTimModeErr"
  COLUMN_NUMBER              = 83
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 333
  BYTES                      = 4
  DESCRIPTION                = "
    Received Telemetry Mode messages."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "MessageErr_NotIn6"
  COLUMN_NUMBER              = 84
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 337
  BYTES                      = 4
  DESCRIPTION                = "
    Message error (not initialised)."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "NoMoreMess6"
  COLUMN_NUMBER              = 85
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 341
  BYTES                      = 4
  DESCRIPTION                = "
    No more messages."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "MessageLost6"
  COLUMN_NUMBER              = 86
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 345
  BYTES                      = 4
  DESCRIPTION                = "
    Some message lost."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "wSTMState"
  COLUMN_NUMBER              = 87
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 349
  BYTES                      = 4
```

```
  DESCRIPTION                 = "
    STM (Spacecraft Time Message) data, STM okay."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "NoSTMReceived"
  COLUMN_NUMBER               = 88
  UNIT                        = "N/A"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 353
  BYTES                       = 4
  DESCRIPTION                 = "
    No STM received."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "UnexpectedSTM"
  COLUMN_NUMBER               = 89
  UNIT                        = "N/A"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 357
  BYTES                       = 4
  DESCRIPTION                 = "
    Unexpected STM."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "wintErrCnt"
  COLUMN_NUMBER               = 90
  UNIT                        = "N/A"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 361
  BYTES                       = 4
  DESCRIPTION                 = "
    Interrupt error counter."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "wSSAngErrCnt1"
  COLUMN_NUMBER               = 91
  UNIT                        = "N/A"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 365
  BYTES                       = 4
  DESCRIPTION                 = "
    Snapshot angular error counter 1."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "wSSAngErrCnt2"
  COLUMN_NUMBER               = 92
  UNIT                        = "N/A"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 369
  BYTES                       = 4
  DESCRIPTION                 = "
    Snapshot angular error counter 2."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "spare3"
  COLUMN_NUMBER               = 93
  UNIT                        = "N/A"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 373
  BYTES                       = 4
  DESCRIPTION                 = "
    Not Used."
END_OBJECT
```

```
OBJECT                     = COLUMN
  NAME                     = "Not used"
  COLUMN_NUMBER            = 94
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 377
  BYTES                    = 152
  ITEMS                    = 38
  ITEM_BYTES               = 4
  DESCRIPTION              = "
    38 unused floats."
END_OBJECT
```

9.4.7 Command data

```
OBJECT                     = COLUMN
  NAME                     = "SCLK(1958)"
  COLUMN_NUMBER            = 1
  UNIT                     = "Counts"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 1
  BYTES                    = 8
  DESCRIPTION              ="
    Time  (SCLK  NOT  UTC)  is  represented  as  a  decimal  SCLK  count
relative
    to the epoch Jan 1 1958 00:00:00.000."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "VCCtr"
  COLUMN_NUMBER            = 2
  UNIT                     = "N/A"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 9
  BYTES                    = 4
  DESCRIPTION              = "
    Valid command counter."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "LVCC"
  COLUMN_NUMBER            = 3
  UNIT                     = "N/A"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 13
  BYTES                    = 4
  DESCRIPTION              = "
    Last valid command code."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "2LVCC"
  COLUMN_NUMBER            = 4
  UNIT                     = "N/A"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 17
  BYTES                    = 4
  DESCRIPTION              = "
    2nd last valid command code."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "3LVCC"
  COLUMN_NUMBER            = 5
  UNIT                     = "N/A"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 21
```

```
  BYTES                     = 4
  DESCRIPTION               = "
    3rd last valid command code."
END_OBJECT

OBJECT                      = COLUMN
  NAME                      = "ICC"
  COLUMN_NUMBER             = 6
  UNIT                      = "N/A"
  DATA_TYPE                 = IEEE_REAL
  START_BYTE                = 25
  BYTES                     = 4
  DESCRIPTION               = "
    Invalid command code."
END_OBJECT

OBJECT                      = COLUMN
  NAME                      = "LICC"
  COLUMN_NUMBER             = 7
  UNIT                      = "N/A"
  DATA_TYPE                 = IEEE_REAL
  START_BYTE                = 29
  BYTES                     = 4
  DESCRIPTION               = "
    Last invalid command code."
END_OBJECT

OBJECT                      = COLUMN
  NAME                      = "Error"
  COLUMN_NUMBER             = 8
  UNIT                      = "N/A"
  DATA_TYPE                 = IEEE_REAL
  START_BYTE                = 33
  BYTES                     = 4
  DESCRIPTION               = "
    Error code."
END_OBJECT
```

9.4.8 Channelized attitude data

```
OBJECT                      = COLUMN
  NAME                      = "SCLK(1958)"
  COLUMN_NUMBER             = 1
  UNIT                      = "Counts"
  DATA_TYPE                 = IEEE_REAL
  START_BYTE                = 1
  BYTES                     = 8
  DESCRIPTION               ="
    Time  (SCLK  NOT  UTC)  is  represented  as  a  decimal  SCLK  count
relative
    to the epoch Jan 1 1958 00:00:00.000."
END_OBJECT

OBJECT                      = COLUMN
  NAME                      = "A1001"
  COLUMN_NUMBER             = 2
  UNIT                      = "N/A"
  DATA_TYPE                 = IEEE_REAL
  START_BYTE                = 9
  BYTES                     = 4
  DESCRIPTION               = "
    Attitude quaternion component 1."
END_OBJECT

OBJECT                      = COLUMN
  NAME                      = "A1002"
  COLUMN_NUMBER             = 3
```

```
  UNIT                        = "N/A"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 13
  BYTES                       = 4
  DESCRIPTION                 = "
    Attitude quaternion component 2."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "A1003"
  COLUMN_NUMBER               = 4
  UNIT                        = "N/A"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 17
  BYTES                       = 4
  DESCRIPTION                 = "
    Attitude quaternion component 3."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "A1004"
  COLUMN_NUMBER               = 5
  UNIT                        = "N/A"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 21
  BYTES                       = 4
  DESCRIPTION                 = "
    Attitude quaternion component 4."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "A1005"
  COLUMN_NUMBER               = 6
  UNIT                        = "Radians/second"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 25
  BYTES                       = 4
  DESCRIPTION                 = "
    Rotation rate, X spacecraft axis."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "A1006"
  COLUMN_NUMBER               = 7
  UNIT                        = "Radians/second"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 29
  BYTES                       = 4
  DESCRIPTION                 = "
    Rotation rate, Y spacecraft axis."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "A1007"
  COLUMN_NUMBER               = 8
  UNIT                        = "Radians/second"
  DATA_TYPE                   = IEEE_REAL
  START_BYTE                  = 33
  BYTES                       = 4
  DESCRIPTION                 = "
    Rotation rate, Z spacecraft axis."
END_OBJECT

OBJECT                        = COLUMN
  NAME                        = "STATUS"
  COLUMN_NUMBER               = 9
  UNIT                        = "N/A"
  DATA_TYPE                   = MSB_INTEGER
  START_BYTE                  = 37
```

```
  BYTES                      = 4
  DESCRIPTION                = "
    Status information for spacecraft attitude data."
END_OBJECT
```

9.4.9 Channelized user data

```
OBJECT                       = COLUMN
  NAME                       = "SCLK(1958)"
  COLUMN_NUMBER              = 1
  UNIT                       = "Counts"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 1
  BYTES                      = 8
  DESCRIPTION                ="
    Time  (SCLK  NOT  UTC)  is  represented  as  a  decimal  SCLK  count
relative
    to the epoch Jan 1 1958 00:00:00.000."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "U_MAG_FGM_T"
  COLUMN_NUMBER              = 2
  UNIT                       = "CELSIUS"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 9
  BYTES                      = 4
  DESCRIPTION                = "
    FGM temperature."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "U_MAG_VSHM_T"
  COLUMN_NUMBER              = 3
  UNIT                       = "CELSIUS"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 13
  BYTES                      = 4
  DESCRIPTION                = "
    VHM/SHM temperature."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "UBAY04_T"
  COLUMN_NUMBER              = 4
  UNIT                       = "CELSIUS"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 17
  BYTES                      = 4
  DESCRIPTION                = "
    Temperature data."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "UBAY07_T"
  COLUMN_NUMBER              = 5
  UNIT                       = "CELSIUS"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 21
  BYTES                      = 4
  DESCRIPTION                = "
    Temperature data."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "U_MAG_Elec_LC"
  COLUMN_NUMBER              = 6
```

```
  UNIT                       = "Amps"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 25
  BYTES                      = 4
  DESCRIPTION                = "
    Current."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "S_MAG_ELECT_a"
  COLUMN_NUMBER              = 7
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 29
  BYTES                      = 4
  DESCRIPTION                = "
    Power supply a on/off."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "S_MAG_ELECT_b"
  COLUMN_NUMBER              = 8
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 33
  BYTES                      = 4
  DESCRIPTION                = "
    Power supply b on/off."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "S_MAG_ELECT_sw"
  COLUMN_NUMBER              = 9
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 37
  BYTES                      = 4
  DESCRIPTION                = "
    Power supply operation normal/trip."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "U_MAG_Elec_LC"
  COLUMN_NUMBER              = 10
  UNIT                       = "Amps"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 41
  BYTES                      = 4
  DESCRIPTION                = "
    Current."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "S_MAG_ELECT_a"
  COLUMN_NUMBER              = 11
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 45
  BYTES                      = 4
  DESCRIPTION                = "
    Power supply a on/off."
END_OBJECT

OBJECT                       = COLUMN
  NAME                       = "S_MAG_ELECT_b"
  COLUMN_NUMBER              = 12
  UNIT                       = "N/A"
  DATA_TYPE                  = IEEE_REAL
  START_BYTE                 = 49
```

```
  BYTES                    = 4
  DESCRIPTION              = "
    Power supply b on/off."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "S_MAG_ELECT_sw"
  COLUMN_NUMBER            = 13
  UNIT                     = "N/A"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 53
  BYTES                    = 4
  DESCRIPTION              = "
    Power supply operation normal/trip."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "U_MAG_Htrs_LC"
  COLUMN_NUMBER            = 14
  UNIT                     = "Amps"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 57
  BYTES                    = 4
  DESCRIPTION              = "
    Current."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "S_MAG_RHTR_a"
  COLUMN_NUMBER            = 15
  UNIT                     = "N/A"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 61
  BYTES                    = 4
  DESCRIPTION              = "
    Heater a on/off."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "S_MAG_RHTR_b"
  COLUMN_NUMBER            = 16
  UNIT                     = "N/A"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 65
  BYTES                    = 4
  DESCRIPTION              = "
    Heater b on/off."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "S_MAG_RHTR_sw"
  COLUMN_NUMBER            = 17
  UNIT                     = "N/A"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 69
  BYTES                    = 4
  DESCRIPTION              = "
    Heater operation normal/trip."
END_OBJECT

OBJECT                     = COLUMN
  NAME                     = "U_MAG_Htrs_LC"
  COLUMN_NUMBER            = 18
  UNIT                     = "Amps"
  DATA_TYPE                = IEEE_REAL
  START_BYTE               = 73
  BYTES                    = 4
  DESCRIPTION              = "
    Current."
```

```
END_OBJECT

OBJECT                         = COLUMN
  NAME                         = "S_MAG_RHTR_a"
  COLUMN_NUMBER                = 19
  UNIT                         = "N/A"
  DATA_TYPE                    = IEEE_REAL
  START_BYTE                   = 77
  BYTES                        = 4
  DESCRIPTION                  = "
    Heater a on/off."
END_OBJECT

OBJECT                         = COLUMN
  NAME                         = "S_MAG_RHTR_b"
  COLUMN_NUMBER                = 20
  UNIT                         = "N/A"
  DATA_TYPE                    = IEEE_REAL
  START_BYTE                   = 81
  BYTES                        = 4
  DESCRIPTION                  = "
    Heater b on/off."
END_OBJECT

OBJECT                         = COLUMN
  NAME                         = "S_MAG_RHTR_sw"
  COLUMN_NUMBER                = 21
  UNIT                         = "N/A"
  DATA_TYPE                    = IEEE_REAL
  START_BYTE                   = 85
  BYTES                        = 4
  DESCRIPTION                  = "
    Bus power supply."
END_OBJECT

OBJECT                         = COLUMN
  NAME                         = "U_30VBus_HF_V"
  COLUMN_NUMBER                = 22
  UNIT                         = "Volts"
  DATA_TYPE                    = IEEE_REAL
  START_BYTE                   = 89
  BYTES                        = 4
  DESCRIPTION                  = "
    Bus power supply."
END_OBJECT

OBJECT                         = COLUMN
  NAME                         = "U_30VBus_HF_V"
  COLUMN_NUMBER                = 23
  UNIT                         = "Volts"
  DATA_TYPE                    = IEEE_REAL
  START_BYTE                   = 93
  BYTES                        = 4
  DESCRIPTION                  = "
    Bus power supply."
END_OBJECT

OBJECT                         = COLUMN
  NAME                         = "S_SCAS_COIL_b"
  COLUMN_NUMBER                = 24
  UNIT                         = "N/A"
  DATA_TYPE                    = IEEE_REAL
  START_BYTE                   = 97
  BYTES                        = 4
  DESCRIPTION                  = "
    SCAS (Science Calibration and Alignment Subsystem) coil b
on/off."
END_OBJECT
```

```
OBJECT                      = COLUMN
  NAME                      = "S_SCAS_COIL_a"
  COLUMN_NUMBER             = 25
  UNIT                      = "N/A"
  DATA_TYPE                 = IEEE_REAL
  START_BYTE                = 101
  BYTES                     = 4
  DESCRIPTION               = "
    SCAS coil a on/off."
END_OBJECT

OBJECT                      = COLUMN
  NAME                      = "S_SCAS_COIL_a"
  COLUMN_NUMBER             = 26
  UNIT                      = "N/A"
  DATA_TYPE                 = IEEE_REAL
  START_BYTE                = 105
  BYTES                     = 4
  DESCRIPTION               = "
    SCAS coil a on/off."
END_OBJECT

OBJECT                      = COLUMN
  NAME                      = "S_SCAS_COIL_b"
  COLUMN_NUMBER             = 27
  UNIT                      = "N/A"
  DATA_TYPE                 = IEEE_REAL
  START_BYTE                = 109
  BYTES                     = 4
  DESCRIPTION               = "
    SCAS coil b on/off."
END_OBJECT

OBJECT                      = COLUMN
  NAME                      = "STATUS"
  COLUMN_NUMBER             = 28
  UNIT                      = "N/A"
  DATA_TYPE                 = MSB_INTEGER
  START_BYTE                = 113
  BYTES                     = 4
  DESCRIPTION               = "
    Status information for MAG instrument."
END_OBJECT
```

10 Appendix D. MAG data-calibration algorithms

This appendix contains the algorithms that describe the calibration of FGM and V/SHM data. The calibration algorithm is identical for the vector data from both instruments, whereas a separate algorithm is applicable to the SHM scalar data.

10.1 Vector data (FGM and VHM)

In general, the vector calibration algorithm consists of the following steps:

1. Subtract offset vector from raw data (i.e. uncalibrated field vector). The precise value of the offsets is partly determined by the dynamic range of measurement associated with the magnetometer mode of operation. For the FGM, there are four such ranges, and for the VHM, there are two. Their limits and associated resolutions are given in Table 36. A common method for computing offsets is to use magnetic-field data taken over long periods in the solar wind ("cruise" mission phase), exploiting special statistical properties of the solar wind field. Full details will be given in the MAG archive documentation. The uncalibrated field vectors (which will form a large part of the MAG archive) are recorded in engineering units that have had a basic scaling factor applied.
2. Multiply offset-corrected field vectors (as column vectors) by the orthogonality / sensitivity (O/S) matrix. The elements of this matrix are computed using the measurements of onboard sources of magnetic field with a known strength and orientation. Multiplication by the O/S matrix converts a measured field vector from scaled engineering units to true nT units.
3. Multiply the calibrated field vector by the orthogonal spacecraft ("O") matrix. This operation transforms the field vector components from sensor / instrument coordinates to spacecraft coordinates. The orientation of the MAG coordinate axes with respect to the Cassini orbiter is described in the instrument mounting kernel (IK) is distributed by NAIF.
4. Remove spacecraft internal field from the corrected field vector produced in step 3 above. The internal field of the spacecraft is usually determined by measurements taken during periods when the spacecraft orientation is changing (spacecraft rolls, especially, are useful in this regard). In the sensor frame of reference during such period, the spacecraft field component will remain static, while any external field component of interest will appear to rotate.

Table 36: Dynamic operation ranges of MAG sensors

Range	Limits	Resolution
FGM		
0	+/- 40 nT	4.9 pT
1	+/- 400 nT	48.8 pT
2	+/- 10000 nT	1.2 nT
3	+/- 44000 nT	5.4 nT
VHM		
0	+/- 32 nT	3.9 pT
1	+/- 256 nT	31.2 pT

10.2 Scalar data (SHM)

Several corrections need to be applied to the raw SHM data. There is a fixed timing correction for the downlink sensor time. There are also corrections that are a function of the field direction, these correction coefficients are found using the calibrated FGM data. The following describes the calibration algorithm for the SHM scalar data.

Let Fm = Measured Frequency,
Tc = Counting Interval
= 1 / 0.9971259 Hz
(this value is from Cassini FM V/SHM Fredericksburg March 1996 Calibration Report),
N = Scalar Value returned in telemetry.
Bm = Measured Field Magnitude in nT.

Then Fm = N / Tc,
Bm = Fm / G

where G = Gyromagnetic Ratio
= 28.023561.

Calibrating the SHM values consists of subtracting a correction term which is in general quite small; i.e. for the Earth swingby its range was 2 to 4 nT.

Let Bc = Corrected Field Magnitude,
Then Bc = Bm – E.

The error term E consists of constants and terms that depend upon the orientation and magnitude of the magnetic field vector B.

E = LR + (LV + Boz)*cos(alpha)
+ Box*sin(alpha)*cos(beta) + Boy*sin(alpha)*sin(beta)
+ ΔBS(alpha, beta, B),

where LR = Real Light Shift,
LV = Virtual Light Shift,
Box, Boy, Boz = Vector Offset,
alpha = Polar angle of ambient field in V/SHM coordinate system,
beta = Azimuthal angle of ambient field in V/SHM coordinate system,
ΔBS = Bloch-Siegert Shift = inverse power series in B whose coefficients depend upon the field angles alpha and beta. Here we take B = Bm.

The values in the column named "B_SHM" in calibrated data files of type SHM_C represent Bc (corrected field magnitude) and are in nT units.

The following values were determined as a result of calibrations carried out at the Fredericksburg Observatory and at JPL:
LR = 0.65 nT
LV + Boz = 1.25 nT
Box = -0.64 nT
Boy = -0.05 nT

$$\Delta BS = (-12+20*K) / (B/100) + (-41+56*K) / (B/100)**2 + (64-115*K) / (B/100)**3$$

where K = (cos(alpha))**2 – (sin(alpha)*sin(beta))**2.

The coefficients for the inverse powers of B were obtained from linear fits to Fredericksburg calibration data residuals as functions of K.
The corrected field is within 1 nT of the true field at the sensor.