Thermal Emission Imaging System

2001 Mars Odyssey

STANDARD DATA PRODUCT
ARCHIVE VOLUME
SOFTWARE INTERFACE SPECIFICATION

(THEMIS Archive Volume SIS)

Version 1.0

July 1, 2003

Mars Space Flight Facility, Arizona State University

DOCUMENT CHANGE LOG

Change	Date	Affected Sections
Initial Draft	5/31/2002	All
First revision	10/01/2002	Most
Archive design revision; added BTR & ABR as standard products; defined virtual volume	01/01/03	Most
Browse image format change	07/01/03	Acronyms, Sections 2.2, 3.2.4, Appendices A & B

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ACRONYMS AND ABBREVIATIONS

ABR	Apparent Brightness Record
ASCII	American Standard Code for Information Interchange
ASU	Arizona State University
BTR	Brightness Temperature Record
DVD	Digital Versatile Disk
EDR	Experiment Data Record
IR	Infrared
ISO	International Standards Organization
JPEG	Joint Photographic Experts Group
JPL	Jet Propulsion Laboratory
Mbyte	Megabyte
NASA	National Aeronautics and Space Administration
NSSDC	National Space Science Data Center
ODY	2001 Mars Odyssey
PDS	Planetary Data System
PNG	Portable Network Graphics
SDVT	Science Data Validation Team
SIS	Software Interface Specification
RDR	Reduced Data Record
TLM	Telemetry
THM	THermal EMission Imaging System
VIS	Visible

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 CD-ROM or DVD-ROM. 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.

Virtual Archive Volume – When an archive is available online, it is not constrained by the size limitations of physical media and it is called a *virtual archive volume*. The virtual archive mimics the directory structure of a single archive volume, with an expanded data directory to contain all of the data available on the archive volume set.

Catalog Information – 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 spectrum table, or a time series table.

Data Set – An accumulation of data products. A data set together with supporting documentation and ancillary files is an archive.

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 nonstandard way are sometimes called *special data products.*

1. Introduction

1.1 Purpose and Scope

This Software Interface Specification is intended to be used by those who wish to understand the format and content of the THEMIS Archive. Typically, these individuals would be software engineers, data analysts, or planetary scientists.

The specifications in this document apply to all THEMIS standard product archive volumes that are generated by the Mars Odyssey Project.

1.2 Content Overview

This Software Interface Specification (SIS) describes the content, generation, and format of the THEMIS Archive. THEMIS is a combination visible (VIS) and infrared (IR) multi-spectral imager onboard the 2001 Mars Odyssey Orbiter. The standard data products in the archive are the raw (EDR) and calibrated (RDR) spectral image QUBEs at either visible or thermal infrared wavelengths: VISEDR or IREDR, and VISRDR or IRRDR. Additionally, a special data product derived from the RDR QUBE is available: visible apparent brightness images (ABR), and infrared brightness temperature images (BTR). In this text, the acronyms THM-EDR and THM-RDR may be used to collectively reference the raw and calibrated data products at both wavelengths. The THEMIS Team at the ASU Mars Space Flight Facility is responsible for generating these products and assembling the archive.

1.3 Applicable Documents and Constraints

This Archive Volume SIS is intended to be consistent with the following documents:

1. Mars Exploration Program Data Management Plan, R. E. Arvidson and S. Slavney, Rev. 2, Nov. 2, 2000.
2. 2001 Mars Odyssey Orbiter Archive Generation, Validation and Transfer Plan, R. E. Arvidson, R. S. Saunders, and S. Slavney, JPL D-20679, November 3, 2000.
3. Planetary Data System Data Preparation Workbook, February 1995, Version 3.1, JPL D-7669, Part 1.
4. Planetary Data System Standards Reference, October 30, 2002, Version 3.5, JPL D-7669, Part 2.
5. ISO 9660-1988, Information Processing - Volume and File Structure of CD-ROM for Information Exchange, April 15, 1988.

The user is referred to the following THEMIS documents for additional information:

6. The Thermal Emission Imaging System (THEMIS) for the Mars 2001 Odyssey Mission, P.R. Christensen, et. Al., Submitted to *Space Science Review*, 2001.
7. Calibration Report for the Thermal Emission Imaging System (THEMIS) for the 2001 Mars Odyssey Mission, P.R. Christensen.
8. THEMIS Standard Data Products Software Interface Specification, January 2003, JPL D-xxxx.
9. Mars Odyssey THEMIS: Data Processing User's Guide, P.R. Christensen.

10. Mars Odyssey THEMIS: Geometric Processing User's Guide

1.4 Relationships with Other Interfaces

This Archive Volume SIS could be affected by changes to the design of the THEMIS standard data products or the THEMIS processing software, described respectively in the THEMIS Software Interface Specification [8] and in the THEMIS Processing User's Guide [9].

2. Archive Volume Contents

This section describes the contents of the THEMIS archive volumes, including the file names, file contents, file types, and organization responsible for providing the files. Data from the six THEMIS datasets (IREDR, VISEDR, IRRDR, VISRDR, IRBTR, and VISABR) are stored in separate archive volumes; however, each volume has a similar directory structure, as described below and shown in Appendix A.

THEMIS archive volumes will be available on physical media only for permanent archive purposes, and available online for public consumption (details in section 4). The online archive is based on the format of the physical archive, with minor differences due to the size limitations of the latter. The format of the online archive is described in Appendix B.

2.1 Root Directory Contents

Files in the Root directory include an overview of the archive, a description of the volume for the PDS Catalog, and a list of errata or comments about the archive. All files in this directory are provided by the THEMIS team. The following files are contained in the Root directory.

File Name	File Contents
AAREADME.TXT	Volume content and format information
AAREADME.HTM	Hypertext version of AAREADME.TXT
AAREADME.LBL	A PDS detached label that describes both AAREADME.TXT and AAREADME.HTM
ERRATA.TXT	A cumulative listing of comments and updates concerning all archive volumes published to date
VOLDESC.CAT	A description of the contents of this volume in a PDS format readable by both humans and computers

2.2 Browse Directory Contents

The Browse directory is available with the calibrated and derived datasets (IRRDR, VISRDR, IRBTR, and VISABR). It contains reduced-size, easily viewed versions of data products to be used to help identify products of interest available on this archive volume. Browse image names are based on the PRODUCT_ID of the data product that they represent. The names follow the pattern of Aooooonnn.png, where

A is a 1 letter description of the type of image collected; [V = visible image; I = infrared image;]

ooooo	is a 5-digit mission orbit number when the image was collected; [01000 = mapping orbit number example]
nnn	is a 3-digit image sequence number indicating the order that images were collected each orbit; [001 = first image collected in the ooooo orbit]
.png	in a 3-letter extension describing this product as a PNG file.

Each browse image has the same dimensions (samples by lines) as a single band of the source data product. Infrared browse images are derived from the data collected in band 9 (centered at 12.57 μm) of the source IRRDR product. Visible browse images are derived from the data in band 3 (centered at 0.654 μm) of the source VISRDR product, then geographically projected. If the named band is not available in the source product the first available band, in numerical order, is used to create the browse image. Note that there are no browse images for infrared reset (R-RDR) images.

Thumbnail images are browse images reduced to 10% of the original file size. Thumbnail image names follow the pattern of Aooooonnn_small.jpg, with "A", "o", and "n" defined as above.

Individual browse and thumbnail images are contained in subdirectories following the same organizational conventions of the Data subdirectories which they represent (see Section 2.5). The file in this directory is provided by the THEMIS team. The following files are contained in the Browse directory.

File Name	File Contents
BROWSINFO.TXT	A description of the contents of this directory.

2.3 Calib Directory Contents

The Calib directory contains calibration documentation and files used to process the data products. All files in this directory are provided by the THEMIS team. One or more of the following files are contained in the Calib directory; files that are instrument specific (i.e. filenames end in _FILE) will only be available on the appropriate dataset volumes.

File Name	File Contents
BIAS_FILE	Used in VIS calibration; see THEMIS Processing User's Guide [9]
CALIBINFO.TXT	A description of the contents of this directory
CALIB.LBL	A PDS detached label that describes CALIB.PDF files
CALIB.PDF	The THEMIS Calibration Report as a PDF file
CALIB_APXB.PDF	The THEMIS Calibration Report, Appendix B as a PDF file
CALIB_FIGS.PDF	Figures for the THEMIS Calibration Report as a PDF file
DESMEAR_FILE	Used in VIS calibration; see THEMIS Processing User's Guide [9]
IRF_FILE	Used in IR calibration; see THEMIS Processing User's Guide [9]
PROCESS.HTM	The THEMIS Data Processing User Guide in HTML format
PROCESS.PDF	The THEMIS Data Processing User Guide as a PDF file
PROCESS.LBL	A PDS detached label that describes both PROCESS.TXT and PROCESS.PDF
TEMP2RAD_FILE	Used in IR calibration; see THEMIS Processing User's Guide [9]

STRAYLIGHT_FILE	Used in VIS calibration; see THEMIS Processing User's Guide [9]

2.4 Catalog Directory Contents

The files in the Catalog directory provide a top-level understanding of the mission, spacecraft, instruments, and data sets. The files in this directory are coordinated with the PDS data engineer, who is responsible for loading them into the PDS catalog. The THEMIS team has provided all of the files in this directory except the INSTHOST.CAT, MARTGT.CAT, and MISSION.CAT. One or more of the following files may be found in the Catalog directory; files that are dataset specific (i.e. filename starts with ODT) will only be available on the appropriate dataset volumes.

File Name	File Contents
CATINFO.TXT	A description of the contents of this directory
INSTHOST.CAT	Instrument host (Mars Odyssey spacecraft) information for the PDS catalog
INST.CAT	Instrument information for the PDS catalog
MARTGT.CAT	Physical information for the planetary target Mars
MISSION.CAT	Mission information for the PDS catalog
PERSON.CAT	THEMIS and PDS personnel information for the PDS catalog
ODTIBDS.CAT	IRBTR data set information for the PDS catalog
ODTIBREL.CAT	IRBTR release information for the PDS catalog
ODTIEDS.CAT	IREDR data set information for the PDS catalog
ODTIEREL.CAT	IREDR release information for the PDS catalog
ODTIRDS.CAT	IRRDR data set information for the PDS catalog
ODTIRREL.CAT	IRRDR release information for the PDS catalog
ODTVBDS.CAT	VISABR data set information for the PDS catalog
ODTVBREL.CAT	VISABR release information for the PDS catalog
ODTVEDS.CAT	VISEDR data set information for the PDS catalog
ODTVEREL.CAT	VISEDR release information for the PDS catalog
ODTVRDS.CAT	VISRDR data set information for the PDS catalog
ODTVRREL.CAT	VISRDR release information for the PDS catalog
PERSON.CAT	THEMIS and PDS personnel information for the PDS catalog
REF.CAT	References mentioned in other *.CAT files

2.5 Data Directory Contents and Naming

The Data directory contains data subdirectories and related overview files; the THEMIS standard data products (see THEMIS Standard Data Product SIS [8]) are stored in the data subdirectories. The number of subdirectories on an archive volume will maximize the storage space of the archive media, but will vary between individual volumes due to the inconsistent data volume over any given block of orbits.

The data subdirectories contain the image data products in groups of 10 orbits. The subdirectories are named for the data contents following the pattern of "AooooXPPP" where

A	is a 1 letter description of the type of image collected; [V = visible image; I = infrared image; R = infrared reset image; S = infrared shutter image]
oooo	is the first 4 numbers of the mission orbit number when the data was collected, zero padded
X	is a placeholder representing the remaining digit of the mission orbit number
PPP	is a 3 letter description of the processing level of the data products; [ABR = VIS apparent brightness image; BTR = IR brightness temperature image; EDR = raw data; RDR = radiometrically calibrated data]

A detailed description of the data products is available in the THEMIS Software Interface Specification [8].

All files and standard data products in this directory are provided by the THEMIS team. The following files are contained in the Data directory or the indicated subdirectory.

File Name	File Contents
DATAINFO.TXT	A description of the contents of this directory
TLM.FMT	The TLM.FMT file is included with raw, infrared data subdirectories (IooooXEDR, RooooXEDR, and SooooXEDR). The TLM format file contains the names of all fields stored in the TLM table header object in infrared raw data QUBEs.

2.6 Document Directory Contents

The Document directory contains documentation to help the user understand and use the archive data. All files in this directory are provided by the THEMIS team. The following files are contained in the Document directory.

File Name	File Contents
DOCINFO.TXT	A description of the contents of this directory
ARCHSIS.HTM	The Archive Volume SIS (this document) in HTML format
ARCHSIS.PDF	The Archive Volume SIS (this document) as a PDF file
ARCHSIS.LBL	A PDS detached label that describes both ARCHSIS.TXT and ARCHSIS.PDF
SDPSIS.HTM	The THEMIS Standard Data Product SIS in HTML format
SDPSIS.PDF	The THEMIS Standard Data Product SIS as a PDF file
SDPSIS.LBL	A PDS detached label that describes both SDPSIS.TXT and SDPSIS.PDF

2.7 Index Directory Contents

Files in the Index directory are provided to help the user locate products on this archive volume and on previously released volumes in the archive. All files in this directory are provided by the THEMIS team. The following files are contained in the Index directory.

File Name	File Contents
INDXINFO.TXT	A description of the contents of this directory
ODTIB_INDEX.TAB	A table listing all IRBTR data products on this volume
ODTIB_INDEX.LBL	A PDS detached label that describes ODTIB_INDEX.TAB
ODTIE_INDEX.TAB	A table listing all IREDR data products on this volume
ODTIE_INDEX.LBL	A PDS detached label that describes ODTIE_INDEX.TAB
ODTIR_INDEX.TAB	A table listing all IRRDR data products on this volume
ODTIR_INDEX.LBL	A PDS detached label that describes ODTIR_INDEX.TAB
ODTVB_INDEX.TAB	A table listing all VISABR data products on this volume
ODTVB_INDEX.LBL	A PDS detached label that describes ODTVB_INDEX.TAB
ODTVE_INDEX.TAB	A table listing all VISEDR data products on this volume
ODTVE_INDEX.LBL	A PDS detached label that describes ODTVE_INDEX.TAB
ODTVR_INDEX.TAB	A table listing all VISRDR data products on this volume
ODTVR_INDEX.LBL	A PDS detached label that describes ODTVR_INDEX.TAB
ODTVB_CMIDX.TAB	A cumulative listing of all IRBTR data products on this volume and on previous volumes in this set
ODTIB_CMIDX.LBL	A PDS detached label that describes the ODTIB_CMIDX.TAB
ODTIE_CMIDX.TAB	A cumulative listing of all IREDR data products on this volume and on previous volumes in this set
ODTIE_CMIDX.LBL	A PDS detached label that describes the ODTIE_CMIDX.TAB
ODTIR_CMIDX.TAB	A cumulative listing of all IRRDR data products on this volume and on previous volumes in this set
ODTIR_CMIDX.LBL	A PDS detached label that describes the ODTIR_CMIDX.TAB
ODTVB_CMIDX.TAB	A cumulative listing of all VISABR data products on this volume and on previous volumes in this set
ODTVB_CMIDX.LBL	A PDS detached label that describes the ODTVB_CMIDX.TAB
ODTVE_CMIDX.TAB	A cumulative listing of all VESEDR data products on this volume and on previous volumes in this set
ODTVE_CMIDX.LBL	A PDS detached label that describes the ODTVE_CMIDX.TAB
ODTVR_CMIDX.TAB	A cumulative listing of all VISRDR data products on this volume and on previous volumes in this set
ODTVR_CMIDX.LBL	A PDS detached label that describes the ODTVR_CMIDX.TAB

2.8 Software Directory Contents

The Software directory contains software documentation and source code that may be useful when manipulating the THEMIS data products. All files in this directory and software subdirectories are provided by the THEMIS team. These files are subject to change throughout the mission and only the most recent version will be available on the archive. The following files are contained in the Software directory or the indicated subdirectory.

File Name	File Contents
SOFTINFO.TXT	A description of the contents of this directory
SRCINFO.TXT	A description of the contents of SRC subdirectory; available in the SRC subdirectory
MD5_QUBE.PL	Pearl source code to calculate the MD5 value of a THM-EDR or THM-RDR; available in the SRC subdirectory

3. Archive Volume Format

This section describes the format of THEMIS Archive Volumes. Data that comprise the archive will be formatted in accordance with Planetary Data System specifications (PDS Data Preparation Workbook, [4] and PDS Standards Reference, [5]).

3.1 Disk Format

Archive Volumes have a digital versatile disk (DVD) format that is compatible with the computer operating systems MS-DOS, Macintosh, and SunOS. The volume format is in accordance with ISO 9660 level 2 Interchange Standard [6].

3.2 File Formats

This section describes file formats for the kinds of files contained on Archive Volumes.

3.2.1 PDS Label Format

All text and data files in the archive have PDS labels associated with them, either embedded at the beginning of the file or detached in a separate file; the label location is described in each of the following individual "file format" sections. For examples of PDS labels for each type of data product, see the THEMIS Standard Data Product SIS [8].

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 to which the label refers (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 an embedded label, the location is an integer representing the starting record number of the object (the first record in the file is record 1). In a detached 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 = ("F01.IMG",1)
^IMAGE = ("F01.IMG",1025 <BYTES>)

indicates that the IMAGE object begins at byte 1025 of the file F01.IMG, in the same directory as the detached label file. Below is a list of the possible formats for the ^object definition.

^object = n

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

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

ext is the 3 character upper-case file extension,

dirlist is a period-delimited path-list of parent directories, in upper case, that specifies the object file directory (used only when the object is not in the same directory as the label file). The list begins at the directory level below the root directory of the DVD. '[dirlist]' may be omitted when the object being described is located either in the same directory as the detached label, or in a subdirectory named LABEL that is located in a higher level of the directory tree, typically the DVD root itself.

Lines of text in detached labels end with a carriage return character (ASCII 13) and a line feed character (ASCII 10). This allows the files to be readable under various operating systems.

3.2.2 Document File Format

Document files with the .TXT suffix exist in the Root, Browse, Catalog, Data, Document, and Index directories. They are ASCII files which have embedded PDS labels. Lines in a .TXT file end with a carriage return character (ASCII 13) and a line feed character (ASCII 10). This allows the files to be readable under various operating systems.

Documents in the Document directory may contain formatting and figures that cannot be rendered as ASCII text. Therefore, each document is given in two formats, hypertext and PDF, and is accompanied by a detached PDS label. The hypertext file contains ASCII text plus hypertext markup language (HTML) commands that enable it to be viewed in a Web browser such as Netscape Navigator or Microsoft Internet Explorer. The hypertext file may be accompanied by ancillary files such as images and style sheets that are incorporated into the document by the Web browser. The second format, PDF (Portable Document Format) is a proprietary format of Adobe Systems Incorporated that is frequently used for distributing documents. Adobe offers free software, Acrobat Reader, for viewing PDF files.

3.2.3 Catalog File Format

Catalog files (suffix .CAT) exist in the Root and Catalog directories. They are ASCII text files with an embedded PDS label. The text contents are formatted in an object-oriented structure consisting of sets of 'keyword=value' declarations. Lines in a .CAT file end with a carriage return character (ASCII 13) and a line feed character (ASCII 10). This allows the files to be readable under various operating systems.

3.2.4 PNG and JPG File Format

THEMIS browse images are stored as PNG and JPEG files (.jpg suffix) in the Browse subdirectories. PNG and JPG images are 24-bit per pixel, color images in binary format. The THEMIS team uses the standardized image compression algorithms to create the browse files. For more information see http://www.libpng.org/pub/png and http://www.jpg.org.

3.2.5 IMAGE File Format

THEMIS brightness records are single band images stored as IMAGE files (.IMG suffix) in the Data subdirectories. All THEMIS IMAGEs adhere to the PDS standards for IMAGE objects as defined in the PDS Standards Reference [4]. Each IMAGE is composed of a header and a binary array of data derived from radiometric calibration of one observation. Each IMAGE header includes the embedded, ASCII PDS label, with information stored as ASCII text in a “keyword = value” format compliant with PDS standards.

For more information about the format and content of these data products, see the THEMIS Data Product SIS [8].

3.2.6 Tabular File Format

Tabular files (.TAB suffix) exist in the Index directory. Tabular files are ASCII files formatted for direct reading into many database management systems on various computers. All fields are separated by commas, 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 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.

All tabular files are described by PDS labels, either embedded at the beginning of the file or detached. If detached, the PDS label file has the same name as the data file it describes, with the extension .LBL; for example, the file INDEX.TAB is accompanied by the detached label file INDEX.LBL in the same directory.

3.2.7 QUBE File Format

THEMIS raw and calibrated data are multispectral images stored as QUBE files (.QUB suffix) in the Data subdirectories. All THEMIS QUBEs adhere to the PDS standards for SPECTRAL_QUBE objects as defined in the PDS Standards Reference [4]. Each QUBE is composed of a header and a binary array of data collected during one observation.

Each QUBE header includes the embedded, ASCII PDS label and a HISTORY data object; raw infrared (IREDR) data products also contain a telemetry (TLM) data table. The HISTORY object is a cumulative record of all the computer manipulations of the data file. The information is stored as ASCII text in a "keyword = value" format similar to, but not intended to be compliant with, PDS standards. The TLM table follows the PDS standards for a binary table of fixed-length records, and is accompanied by a detached PDS label (TLM.FMT) that defines the table structure.

For more information about the format and content of these data products, see the THEMIS Data Product SIS [8].

4. Archive Volume Generation

4.1 Interface Media Characteristics

All archive volumes in the THEMIS Standard Product Archive conform to the ISO 9660 standards (ISO 9660-1988, [6]).

4.2 Labeling and Identification

As per the PDS Standards Reference [4], each THEMIS archive volume will bear a VOLUME_ID based on the last two components of the VOLUME_SET_ID. The VOLUME_SET_ID is USA_NASA_PDS_ODTdsv_xxxx, where

OD	identifies this volume set with the Mars Odyssey spacecraft
T	identifies this volume set with the THEMIS instrument
dsv	identifies the THEMIS DATA_SET_ID and the version number of the data set
xxxx	is the volume number within the volume set.

VOLUME_SET_ID	VOLUME_ID	DATA_SET_ID
USA_NASA_PDS_ODTIEv_xxxx	ODTIEv_xxxx	ODY-M-THM-2-IREDR-v1.0
USA_NASA_PDS_ODTVEv_xxxx	ODTVEv_xxxx	ODY-M-THM-2-VISEDR-v1.0
USA_NASA_PDS_ODTIRv_xxxx	ODTIRv_xxxx	ODY-M-THM-3-IRRDR-v1.0
USA_NASA_PDS_ODTVRv_xxxx	ODTVRv_xxxx	ODY-M-THM-3-VISRDR-v1.0
USA_NASA_PDS_ODTIBv_xxxx	ODTIBv_xxxx	ODY-M-THM-3-IRBTR-v1.0
USA_NASA_PDS_ODTVBv_xxxx	ODTVBv_xxxx	ODY-M-THM-3-VISRDR-v1.0

For example, the first volumes in the original data release [v = 0] have the VOLUME_ID values of ODTIE0_0001, ODTVE0_0001, ODTIR0_0001, ODTVR0_0001, ODTIB0_0001, and ODTVB0_0001 for each data set respectively. The data available on each volume will maximize the space available, as described in Section 1.3; no attempt will be made to correlate the data in a given volume number (e.g. ODTIE0_9999) with the same volume number of another volume set (e.g. ODTIR0_9999).

4.3 Data Product Sizes and Delivery Rates

The size of individual raw data products (VISEDR & IREDR) depends on several factors: image type (VIS vs. IR), length of an image (# frames), and the number of bands in the image. Within these parameters, a raw VIS image (VISEDR) can vary in size from 0.38 to 3.7 Mbytes; a raw IR image (IREDR) can vary in size from 0.07 to 199 Mbytes. Calibration (VISRDR & IRRDR) increases the file size by a factor of two, as compared to the corresponding raw image.

The estimated total volume of data to be collected over the course of the mission is limited by the available downlink allocated to THEMIS. Many factors affect the actual downlink available on any given day, which can vary from 0 to 375 Mbytes per day. THEMIS mission planners will maximize data collection by balancing the day's available allocated downlink against the size-defining parameters of the daily planned observations (VIS/IR, image length, number of bands).

For example, the following shows the expected content range of the 10 orbit data subdirectories over the course of the mission, taking into account the primary variables affecting file size and data volume.

Subdirectory Name	No. of QUBEs	Subdirectory Size
IooooXEDR	10 - 180	125 - 2150 Mbytes
VooooXEDR	1 - 500	4 – 1750 Mbytes
IooooXRDR	10 - 180	250 – 4300 Mbytes
VooooXRDR	1 - 500	8 – 3500 Mbytes
IooooXBTR	10 - 180	10 – 180 Mbytes
VooooXABR	1 - 500	3 – 1500 Mbytes

In compliance with the Odyssey Archive Plan [2], THEMIS standard data products will become available through PDS six months after ground receipt of the last raw data within the three month acquisition period. An *approximate* THEMIS archive volume delivery schedule, based on the nominal science mission timeline and THEMIS primary data acquisition periods, is shown below.

Data Collection Period	Delivery Date
March 2002	Oct 2002*
Apr – Jun 2002	Jan 2003
Jul – Sept 2002	April 2003
Oct – Dec 2002	July 2003
Jan – Mar 2003	Oct 2003
Apr – Jun 2003	Jan 2004
Jul – Sept 2003	April 2004
Oct – Dec 2003	July 2004
Jan – Mar 2004	Oct 2004
Apr - Jun 2004	Jan 2005

*Delivery includes only ABR, BTR, and EDR standard data products.

4.4 Data Transfer and Validation Methods

In compliance with the Odyssey Archive Plan [2], the THEMIS Team will produce complete THM-EDR, THM-RDR, IR-BTR, and VIS-ABR Standard Product Archive Volumes at the ASU Mars Space Flight Facility. Archive volumes will be written as necessary to write-once DVDs (DVD-Rs) for distribution to co-investigators and the Science Data Validation Team (SDVT). The PDS Imaging Node will receive a DVD copy of each archive volume to verify that it conforms to the THM Standard Data Product SIS [3] and to PDS standards for archive volumes.

Upon approval of a volume by the SDVT, the THEMIS Team will make the volume available online for public consumption (see Appendix B). For archive purposes, the THEMIS Team will generate three DVD copies of each volume and deliver them to the permanent archive sites: PDS Imaging Node, PDS Central Node, and the National Space Science Data Center (NSSDC). THEMIS will make additional copies for the Mars Odyssey Project of a volume by special request only.

5. Support Staff and Cognizant Persons

5.1 THEMIS Archive Volume Staff

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Appendix A: Archive Volume Directory Structure

Below are the directory structures of the THEMIS archive volumes. There are six THEMIS archive volume sets corresponding to the six THEMIS datasets: IREDR, VISEDR, IRRDR, VISRDR, IRBTR, AND VISABR. Names without extensions are directory names (e.g. CATALOG), while names with extensions are file names (e.g. CATINFO.TXT). Lowercase letters in names are placeholders for numbers described in Sections 2.2 and 2.5 of the main text.

A.1 IREDR Volumes: ODTIEv_xxxx

```
ROOT
|------ AAREADME.HTM
|------ AAREADME.LBL
|------ AAREADME.TXT
|------ ERRATA.TXT
|------ VOLDESC.CAT
|------ CALIB
|       |----- CALIBINFO.TXT
|       |----- CALIB.LBL
|       |----- CALIB.PDF
|       |----- CALIB_APXB.PDF
|       |----- CALIB_FIGS.PDF
|       |----- IRF_FILE
|       |----- PROCESS.HTM
|       |----- PROCESS.LBL
|       |----- PROCESS.PDF
|       |----- TEMP2RAD_FILE
|------ CATALOG
|       |----- CATINFO.TXT
|       |----- INST.CAT
|       |----- INSTHOST.CAT
|       |----- MARTGT.CAT
|       |----- MISSION.CAT
|       |----- ODTIEDS.CAT
|       |----- ODTIEREL.CAT
|       |----- PERSON.CAT
|       |----- REF.CAT
|------ DATA
|       |----- DATAINFO.TXT
|       |----- IooooXEDR
|       |       |----- IooooonnnEDR.QUB
|       |       |----- TLM.FMT
|       |----- RooooXEDR
|       |       |----- RooooonnnEDR.QUB
|       |       |----- TLM.FMT
|       |----- SooooXEDR
|       |       |----- SooooonnnEDR.QUB
|       |       |----- TLM.FMT
```

```
|------ DOCUMENT
|       |----- ARCHSIS.HTM
|       |----- ARCHSIS.LBL
|       |----- ARCHSIS.PDF
|       |----- DOCINFO.TXT
|       |----- SDPSIS.HTM
|       |----- SDPSIS.LBL
|       |----- SDPSIS.PDF
|------ INDEX
|       |----- INDXINFO.TXT
|       |----- ODTIE_CINDX.LBL
|       |----- ODTIE_CINDX.TAB
|       |----- ODTIE_INDEX.LBL
|       |----- ODTIE_INDEX.TAB
|------ SOFTWARE
|       |----- SOFTINFO.TXT
|       |----- SRC
|       |       |----- SRCINFO.TXT
|       |       |----- MD5_QUBE.PL
```

A.2 VISEDR Volumes: ODTVEv_xxxx

```
ROOT
|------ AAREADME.HTM
|------ AAREADME.LBL
|------ AAREADME.TXT
|------ ERRATA.TXT
|------ VOLDESC.CAT
|------ CALIB
|       |----- BIAS_FILE
|       |----- CALIBINFO.TXT
|       |----- CALIB.LBL
|       |----- CALIB.PDF
|       |----- CALIB_APXB.PDF
|       |----- CALIB_FIGS.PDF
|       |----- DESMEAR_FILE
|       |----- PROCESS.ASC
|       |----- PROCESS.LBL
|       |----- PROCESS.PDF
|       |----- STRAYLIGHT_FILE
|------ CATALOG
|       |----- CATINFO.TXT
|       |----- INST.CAT
|       |----- INSTHOST.CAT
|       |----- MARTGT.CAT
|       |----- MISSION.CAT
|       |----- ODTVEDS.CAT
|       |----- ODTVEREL.CAT
```

```
|       |----- PERSON.CAT
|       |----- REF.CAT
|------ DATA
|       |----- DATAINFO.TXT
|       |----- VooooXEDR
|       |       |----- VooooonnnEDR.QUB
|------ DOCUMENT
|       |----- ARCHSIS.ASC
|       |----- ARCHSIS.LBL
|       |----- ARCHSIS.PDF
|       |----- DOCINFO.TXT
|       |----- THMSIS.ASC
|       |----- THMSIS.LBL
|       |----- THMSIS.PDF
|------ INDEX
|       |----- INDXINFO.TXT
|       |----- ODTVE_CMIDX.LBL
|       |----- ODTVE_CMIDX.TAB
|       |----- ODTVE_INDEX.LBL
|       |----- ODTVE_INDEX.TAB
|------ SOFTWARE
|       |----- SOFTINFO.TXT
|       |----- SRC
|       |       |----- SRCINFO.TXT
|       |       |----- MD5_QUBE.PL
```

A.3 IRRDR Volumes: ODTIRv_xxxx

```
ROOT
|------ AAREADME.HTM
|------ AAREADME.LBL
|------ AAREADME.TXT
|------ ERRATA.TXT
|------ VOLDESC.CAT
|------ BROWSE
|       |----- BROWINFO.TXT
|       |----- IooooX
|       |       |----- Iooooonnn.png
|       |       |----- Iooooonnn_small.jpg
|------ CALIB
|       |----- CALIBINFO.TXT
|       |----- CALIB.LBL
|       |----- CALIB.PDF
|       |----- CALIB_APXB.PDF
|       |----- CALIB_FIGS.PDF
|       |----- IRF_FILE
|       |----- PROCESS.ASC
|       |----- PROCESS.LBL
```

```
|       |----- PROCESS.PDF
|       |----- TEMP2RAD_FILE
|------ CATALOG
|       |----- CATINFO.TXT
|       |----- INST.CAT
|       |----- INSTHOST.CAT
|       |----- MARTGT.CAT
|       |----- MISSION.CAT
|       |----- ODTIRDS.CAT
|       |----- ODTIR.CAT
|       |----- PERSON.CAT
|       |----- REF.CAT
|------ DATA
|       |----- DATAINFO.TXT
|       |----- IooooXRDR
|       |         |----- IooooonnnRDR.QUB
|       |----- RooooXRDR
|       |         |----- RooooonnnRDR.QUB
|------ DOCUMENT
|       |----- ARCHSIS.ASC
|       |----- ARCHSIS.LBL
|       |----- ARCHSIS.PDF
|       |----- DOCINFO.TXT
|       |----- THMSIS.ASC
|       |----- THMSIS.LBL
|       |----- THMSIS.PDF
|------ INDEX
|       |----- INDXINFO.TXT
|       |----- ODTIR_CMIDX.LBL
|       |----- ODTIR_CMIDX.TAB
|       |----- ODTIR_INDEX.LBL
|       |----- ODTIR_INDEX.TAB
|------ SOFTWARE
|       |----- SOFTINFO.TXT
|       |----- SRC
|       |         |----- SRCINFO.TXT
|       |         |----- MD5_QUBE.PL
```

A.4 VISRDR Volumes: ODTVRv_xxxx

```
ROOT
|------ AAREADME.HTM
|------ AAREADME.LBL
|------ AAREADME.TXT
|------ ERRATA.TXT
|------ VOLDESC.CAT
|------ BROWSE
|       |----- BROWINFO.TXT
```

```
|       |----- VooooX
|       |       |----- Vooooonnn.png
|       |       |----- Vooooonnn_small.jpg
|------ CALIB
|       |----- BIAS_FILE
|       |----- CALIBINFO.TXT
|       |----- CALIB.LBL
|       |----- CALIB.PDF
|       |----- CALIB_APXB.PDF
|       |----- CALIB_FIGS.PDF
|       |----- DESMEAR_FILE
|       |----- PROCESS.ASC
|       |----- PROCESS.LBL
|       |----- PROCESS.PDF
|       |----- STRAYLIGHT_FILE
|------ CATALOG
|       |----- CATINFO.TXT
|       |----- INST.CAT
|       |----- INSTHOST.CAT
|       |----- MARTGT.CAT
|       |----- MISSION.CAT
|       |----- ODTVRDS.CAT
|       |----- ODTVRREL.CAT
|       |----- PERSON.CAT
|       |----- REF.CAT
|------ DATA
|       |----- DATAINFO.TXT
|       |----- VooooXRDR
|       |       |----- VooooonnnRDR.QUB
|------ DOCUMENT
|       |----- ARCHSIS.ASC
|       |----- ARCHSIS.LBL
|       |----- ARCHSIS.PDF
|       |----- DOCINFO.TXT
|       |----- THMSIS.ASC
|       |----- THMSIS.LBL
|       |----- THMSIS.PDF
|------ INDEX
|       |----- INDXINFO.TXT
|       |----- ODTVR_CMIDX.LBL
|       |----- ODTVR_CMIDX.TAB
|       |----- ODTVR_INDEX.LBL
|       |----- ODTVR_INDEX.TAB
|------ SOFTWARE
|       |----- SOFTINFO.TXT
|       |----- SRC
|       |       |----- SRCINFO.TXT
|       |       |----- MD5_QUBE.PL
```

A.5 IRBTR Volumes: ODTIBv_xxxx

```
ROOT
 |------ AAREADME.HTM
 |------ AAREADME.LBL
 |------ AAREADME.TXT
 |------ ERRATA.TXT
 |------ VOLDESC.CAT
 |------ BROWSE
 |         |----- BROWINFO.TXT
 |         |----- IooooX
 |         |          |----- Iooooonnn.png
 |         |          |----- Iooooonnn_small.jpg
 |------ CALIB
 |         |----- CALIBINFO.TXT
 |         |----- CALIB.LBL
 |         |----- CALIB.PDF
 |         |----- CALIB_APXB.PDF
 |         |----- CALIB_FIGS.PDF
 |         |----- IRF_FILE
 |         |----- PROCESS.ASC
 |         |----- PROCESS.LBL
 |         |----- PROCESS.PDF
 |         |----- TEMP2RAD_FILE
 |------ CATALOG
 |         |----- CATINFO.TXT
 |         |----- INST.CAT
 |         |----- INSTHOST.CAT
 |         |----- MARTGT.CAT
 |         |----- MISSION.CAT
 |         |----- ODTIRDS.CAT
 |         |----- ODTIR.CAT
 |         |----- PERSON.CAT
 |         |----- REF.CAT
 |------ DATA
 |         |----- DATAINFO.TXT
 |         |----- IooooXBTR
 |         |          |----- IooooonnnBTR.IMG
 |------ DOCUMENT
 |         |----- ARCHSIS.ASC
 |         |----- ARCHSIS.LBL
 |         |----- ARCHSIS.PDF
 |         |----- DOCINFO.TXT
 |         |----- THMSIS.ASC
 |         |----- THMSIS.LBL
 |         |----- THMSIS.PDF
 |------ INDEX
 |         |----- INDXINFO.TXT
```

```
|       |----- ODTIR_CMIDX.LBL
|       |----- ODTIR_CMIDX.TAB
|       |----- ODTIR_INDEX.LBL
|       |----- ODTIR_INDEX.TAB
|------ SOFTWARE
|       |----- SOFTINFO.TXT
|       |----- SRC
|       |       |----- SRCINFO.TXT
|       |       |----- MD5_QUBE.PL
```

A.6 VISABR Volumes: ODTVBv_xxxx

```
ROOT
|------ AAREADME.HTM
|------ AAREADME.LBL
|------ AAREADME.TXT
|------ ERRATA.TXT
|------ VOLDESC.CAT
|------ BROWSE
|       |----- BROWINFO.TXT
|       |----- VooooX
|       |       |----- Voooooonnn.png
|       |       |----- Voooooonnn_small.jpg
|------ CALIB
|       |----- BIAS_FILE
|       |----- CALIBINFO.TXT
|       |----- CALIB.LBL
|       |----- CALIB.PDF
|       |----- CALIB_APXB.PDF
|       |----- CALIB_FIGS.PDF
|       |----- DESMEAR_FILE
|       |----- PROCESS.ASC
|       |----- PROCESS.LBL
|       |----- PROCESS.PDF
|       |----- STRAYLIGHT_FILE
|------ CATALOG
|       |----- CATINFO.TXT
|       |----- INST.CAT
|       |----- INSTHOST.CAT
|       |----- MARTGT.CAT
|       |----- MISSION.CAT
|       |----- ODTVRDS.CAT
|       |----- ODTVRREL.CAT
|       |----- PERSON.CAT
|       |----- REF.CAT
|------ DATA
|       |----- DATAINFO.TXT
|       |----- VooooXABR
```

```
|       |       | ----- VooooonnnABR.IMG
| ------ DOCUMENT
|       | ----- ARCHSIS.ASC
|       | ----- ARCHSIS.LBL
|       | ----- ARCHSIS.PDF
|       | ----- DOCINFO.TXT
|       | ----- THMSIS.ASC
|       | ----- THMSIS.LBL
|       | ----- THMSIS.PDF
| ------ INDEX
|       | ----- INDXINFO.TXT
|       | ----- ODTVR_CMIDX.LBL
|       | ----- ODTVR_CMIDX.TAB
|       | ----- ODTVR_INDEX.LBL
|       | ----- ODTVR_INDEX.TAB
| ------ SOFTWARE
|       | ----- SOFTINFO.TXT
|       | ----- SRC
|       |       | ----- SRCINFO.TXT
|       |       | ----- MD5_QUBE.PL
```

Appendix B: THEMIS Virtual Archive Volume

B.1 Virtual Archive Volume Contents

In compliance with the Odyssey Archive Plan [2], and as discussed in Sections 4.3 and 4.4 above, THEMIS standard data products will be made available online from the PDS THEMIS Sub Node (http://themis-data.asu.edu). The THEMIS Virtual Archive is a very large PDS logical volume, containing all six of the THEMIS datasets. Although the overall structure of the Virtual Archive mimics the directory structure of the single archive volumes described in the body of this text, there are several significant differences to be noted.

1. The DATA directories are first divided into dataset directories, named according to the archive VOLUME_ID naming convention (see Section 4.2), with x's used as placeholders for the volume numbers. Within these dataset directories are image subdirectories which contain data products in groups of 100 orbits. As on the archive volumes, the image subdirectories are named following the pattern AoooXXPPP (see Section 2.5 for the pattern definition).
2. The BROWSE directory is divided into image subdirectories of 100 orbits, similar to the IRRDR and VISRDR DATA subdirectories from which the browse products were derived.
3. Both infrared and visible calibration files are available in the CALIB directory.
4. A logical volume VOLDESC.CAT will be available at the root level for all data in the virtual archive volume. Individual logical volume objects (ODTaaVOL.CAT) are available within the DATA-dataset directory; these are equivalent to the VOLDESC.CAT files on the individual archive volumes.
5. All six dataset files (ODTIBDS.CAT, ODTIEDS.CAT, ODTIRDS.CAT, ODTVBDS.CAT, ODTVEDS.CAT, and ODTVRDS.CAT) and all six release catalogs (ODTIBREL.CAT, ODTIEREL.CAT, ODTIRREL.CAT, ODTVBREL.CAT, ODTVEREL.CAT, and ODTVRREL.CAT) are available in the CATALOG directory.
6. Individual volume indexes (ODTaa_INDEX.TAB) are not available in the virtual archive volume; all index information for the dataset is included in the ODTaa_CMIDX.TAB files.

Below is the directory structure of the THEMIS virtual archive volume; lowercase o's are used as placeholders for the first 3-digits of the orbit number in image subdirectories names. All directory and file names listed below are case insensitive; o's and n's are used to represent orbit numbers and image numbers respectively.

B.2 Virtual Volume Directory Structure

root
|------ aareadme.htm
|------ aareadme.lbl
|------ aareadme.txt
|------ errata.txt
|------ voldesc.cat
|------ browse

```
|       |----- browinfo.txt
|       |----- ioooxx
|       |       |----- iooooonnn.png
|       |       |----- iooooonnn_small.jpg
|       |----- voooxx
|       |       |----- vooooonnn.png
|       |       |----- vooooonnn_small.jpg
|------ calib
|       |----- bias_file
|       |----- calibinfo.txt
|       |----- calib.lbl
|       |----- calib.pdf
|       |----- calib_apxb.pdf
|       |----- calib_figs.pdf
|       |----- desmear_file
|       |----- irf_file
|       |----- process.asc
|       |----- process.lbl
|       |----- process.pdf
|       |----- temp2rad_file
|       |----- straylight_file
|------ catalog
|       |----- catinfo.txt
|       |----- inst.cat
|       |----- insthost.cat
|       |----- martgt.cat
|       |----- mission.cat
|       |----- odtibds.cat
|       |----- odtibrel.cat
|       |----- odtieds.cat
|       |----- odtierel.cat
|       |----- odtirds.cat
|       |----- odtirrel.cat
|       |----- odtvbds.cat
|       |----- odtvbre..cat
|       |----- odtveds.cat
|       |----- odtverel.cat
|       |----- odtvrds.cat
|       |----- odtvrrel.cat
|       |----- person.cat
|       |----- ref.cat
|------ data
|       |----- datainfo.txt
|       |----- odtibv_xxxx
|       |       |----- ioooxxbtr
|       |       |       |----- iooooonnnbtr.img
|       |       |----- odtibvol.cat
|       |----- odtiev_xxxx
```

```
|       |       |----- iooooxxedr
|       |       |       |----- iooooonnnedr.qub
|       |       |       |----- tlm.fmt
|       |       |----- roooxxedr
|       |       |       |----- roooooonnnedr.qub
|       |       |       |----- tlm.fmt
|       |       |----- soooxxedr
|       |       |       |----- soooooonnnedr.qub
|       |       |       |----- tlm.fmt
|       |       |----- odtievol.cat
|       |----- odtirv_xxxx
|       |       |----- iooooxxrdr
|       |       |       |----- iooooonnnrdr.qub
|       |       |----- roooxxrdr
|       |       |       |----- roooooonnnrdr.qub
|       |       |----- odtirvol.cat
|       |----- odtvbv_xxxx
|       |       |----- voooxxabr
|       |       |       |----- voooooonnnabr.img
|       |       |----- odtvbvol.cat
|       |----- odtvev_xxxx
|       |       |----- voooxxedr
|       |       |       |----- voooooonnnedr.qub
|       |       |----- odtvevol.cat
|       |----- odtvrv_xxxx
|       |       |----- voooxxrdr
|       |       |       |----- voooooonnnrdr.qub
|       |       |----- odtvrvol.cat
|------ document
|       |----- archsis.htm
|       |----- archsis.lbl
|       |----- archsis.pdf
|       |----- docinfo.txt
|       |----- sdpsis.htm
|       |----- sdpsis.lbl
|       |----- sdpsis.pdf
|------ index
|       |----- odtib_cmidx.lbl
|       |----- odtib_cmidx.tab
|       |----- odtie_cmidx.lbl
|       |----- odtie_cmidx.tab
|       |----- odtir_cmidx.lbl
|       |----- odtir_cmidx.tab
|       |----- odtvb_cmidx.lbl
|       |----- odtvb_cmidx.tab
|       |----- odtve_cmidx.lbl
|       |----- odtve_cmidx.tab
|       |----- odtvr_cmidx.lbl
```

```
|       |----- odtvr_cmidx.tab
|       |----- indxinfo.txt
|------ software
|       |----- softinfo.txt
|       |----- src
|       |       |----- srcinfo.txt
|       |       |----- md5_qube.pl
```