MARS SCIENCE LABORATORY (MSL)

Mast Camera (Mastcam), Mars Hand Lens Imager (MAHLI), and Mars Descent Imager (MARDI)

Experiment Data Record (EDR)

and

Reduced Data Record (RDR)
Archive Volume
Software Interface Specification (SIS)

Version 1.6

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DOCUMENT CHANGE LOG

Date	Section Changed	Reason for Change	Revision
05/20/13	Initial Release, Version 1.0		
10/29/13	1.3, 5, Appendix A	1.3: updated date, version 5: added an ops member to list Appendix A: added sentence clarifying no RDR products for PRE_ATLO, ATLO, or Cruise; removed aforementioned directories under the RDR directory structure	1.1
10/30/15	1.3, 2.4.2, 2.6, 3.1.1, Appendix A	1.3: update date, version 2.4.2: Added the MAHLI_TECH_REPT_0001.PDF and its corresponding .LBL file 2.6: updated description of SRC directory 3.1.1: updated wording regarding PDF files being an open standard Appendix A: added files into MSLMHL_xxxx/DOCUMENT/ and updated the SOFTWARE directory listing for all three instruments	1.2
08/01/16	1.3, 2.3, Appendix A	1.3: added MAHLI Technical Report paper reference 2.3: added IMAGE_ID_LOOKUP_TABLES. {TAB, LBL} to and descriptions to the INDEX directory Appendix A: added IMAGE_ID_LOOKUP_TABLES. {TAB, LBL} to MSLMHL_xxxx/INDEX/ listing	1.3
12/5/16	Acronyms and Abbreviations, 2.8. Appendix A	Acronyms and Abbreviations: added NAIF, SPICE 2.8 new section added for the EXTRAS directory Appendix A: added the EXTRA directory structure to each instrument	1.4

12/5/17	1.2.2, 1.3, 2.4.1, 2.4.3, 2.7, 2.8, Appendix A	1.2.2: removed descriptors about radiometric calibration	1.5
		1.3: updated version and dates; added in 2 new Mastcam paper references	
		2.4.1: added 2 Mastcam reference papers to the DOCUMENTS directory	
		2.4.3: added 1 MARDI reference paper to the DOCUMENT directory	
		2.7: note added that flat fielding is no longer applied to MMM products	
		2.8: updated version for file MMM_CHRONOS_V02.TM	
		Appendix A: updated CHRONOS version number from 01 to 02 for all three volumes; added Mastcam and MARDI references papers to the DOCUMENTS directory	
1/20/2020	2.8, Appendix A	2.8: added file MMM_CHRONOS_V03.TM	1.6
		Appendix A: added MMM_CHRONOS_V03.TM to all three volumes	

ACRONYMS AND ABBREVIATIONS

ASCII	American Standard Code for Information Interchange
ATLO	Assembly, Test, and Launch Operations
CD-ROM	Compact Disk - Read-Only Memory
CD-WO	Write-Once Compact Disk
CODMAC	Committee on Data Management and Computation
DVD-ROM	Digital Versatile Disk – Read-Only Memory
EDR	Experiment Data Record
ELF	Executable and Linkable Format
FEI	File Exchange Interface
IEC	International Engineering Consortium
IMG	Image
ISO	International Standards Organization
JMS	Java Message Server
JPEG	Joint Photographic Experts Group
JPL	Jet Propulsion Laboratory
LSB	Linux Standard Base
Mach-O	Mach object file format
MAHLI	Mars Hand Lens Imager
MARDI	Mars Descent Imager
Mastcam	Mast Camera
MIPL	Multimission Instrument Processing Laboratory
MMM	Mastcam, MAHLI, MARDI
MPCS	Mission data Processing and Control Subsystem
MSL	Mars Science Laboratory
MSSS	Malin Space Science Systems
NAIF	Navigation and Ancillary Information Facility
NSSDC	National Space Science Data Center
ODL	Object Description Language
ODS	Operation Data Store
OPGS	Operational Product Generation Subsystem

PDF	Portable Document Format
PDS	Planetary Data System
PSG	Project Science Group
RDR	Reduced Data Record
SDVT	Science Data Validation Team
SIS	Software Interface Specification
SPICE	Spacecraft, Planet, Instrument C-Matrix Events
TBD	To Be Determined
TDS	Telemetry Delivery Subsystem

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, Archive Volume Set – 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. 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 – 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.

1. Introduction

This Software Interface Specification describes the format, content, and generation of the MMM Archive. Section 2, Archive Volume Contents, describes the procedure for transferring data products to archive media. Section 3, Archive Volume Format, describes the structure of the archive volumes and the contents of each file. Section 4, Archive Volume Generation, describes the data transfer and validation methods, backup and duplicates, labeling and identification, and data release dates. Section 5, Support Staff and Cognizant Persons, lists the individuals responsible for generating the archive volumes. Finally, Section 6, Appendix A, is an example of the archive delivery directory hierarchy.

1.1. Purpose and Scope

This Archive Volume Software Interface Specification (SIS) is intended to be used by those who wish to understand the format and content of the Experiment Data Record (EDR) and Reduced Data Record (RDR) archives of the following instruments aboard the Mars Science Laboratory (MSL) rover, Curiosity:

a. Mast Camera (Mastcam) consisting of two (34 mm and 100 mm) fixed focal length cameras

b. Mars Hand Lens Imager (MAHLI)

c. Mars Descent Imager (MARDI)

Typically, these individuals would be software engineers, data analysts, or planetary scientists. The specifications in this document apply to all Mastcam, MAHLI, and MARDI (MMM) standard product archive volumes that are generated by the MMM instrument team.

1.2. Content Overview

1.2.1. EDR

The MMM EDR is the camera data in their original compressed format. As a result, software is provided to decompress the data, and the process of extracting the original data from the downlink data format is described. There are 21 data types that can be wrapped into the original data format that is transferred from the cameras. Some of these are compressed without loss, some are transferred in lossy format, some are full-scale and others subscale (the only subscaling is by a factor of 8, used to produce thumbnail images). The EDR data file includes the original camera data as formatted by the camera and the camera mini-header generated by the camera, prepended to the raw data. The camera miniheader can easily be stripped off the data file, but information in this SIS also permits it to be decoded.

Software to decompress the data is included in the archive delivery as well as a description of the process of extracting the original data from the downlink data format. The primary header information is provided as a standalone ASCII label file in compliant PDS format.

1.2.2. RDR

The MMM RDR is validated, decompressed and calibrated image-formatted data. Four RDR products are generated from validated data in image format. These products are:

a. decompressed and radiometrically calibrated (16-bit)

b. decompressed, radiometrically calibrated, and color corrected (8-bit)

c. decompressed, radiometrically calibrated, and geometrically linearized (16-bit)

d. decompressed, radiometrically calibrated, color corrected, and geometrically linearized (8-bit)

Radiometric calibration can include processing, either in the frequency domain (for JPEG products) or in the spatial domain (for data either transmitted losslessly and all data after decompression) as follows:

a. 8-to-12-bit expansion

b. dark correction

c. shutter smear adjustment

d. color correction

Geometric linearization is the process of correcting for the optical distortion of the lens by spatial resampling. Linearization is the prerequisite for performing geometric processing for mosaicing or stereo processing, which are not delivered as archive products. The header information is provided as a standalone ASCII label file in compliant PDS format.

1.3. Applicable Documents and Constraints

This Archive Volume SIS is intended to be consistent with the following documents ("Applicable Documents"):

1. Mars Exploration Program Data Management Plan, R. E. Arvidson et al., Rev. 4.0, June 15, 2011.

2. Mars Science Laboratory Archive Generation, Validation, and Transfer Plan, J. Crisp and P. Theisinger, JPL D-35281, MSL-214-1333, May 28, 2010.

3. Mars Science Laboratory Software Interface Specification (SIS) Mast Camera (Mastcam), Mars Hand Lens Imager (MAHLI), and Mars Descent Imager (MARDI) Experiment Data Record (EDR) and Reduced Data Record (RDR) PDS Data Products, M. Malin et al., JPL D-75410, SIS-SCI035-MSL, Version 1.4, December 5, 2017.

4. Curiosity's Robotic Arm-Mounted Mars Hand Lens Imager (MAHLI): Characterization and Calibration Status, MSL MAHLI Technical Report 0001, K.S. Edgett et al., Version 2, October 5, 2015. doi:10.13140/RG.2.1.3798.5447

5. The Mars Science Laboratory *Curiosity* rover Mast Camera (Mastcam) instruments: Pre-flight and in-flight calibration, validation, and data archiving, J.F. Bell III et al., *Earth and Space Science,* July 20, 2017. doi: 10.1002/2016EA000219

6. The Mars Science Laboratory (MSL) Mast Cameras and Descent Imager: I. Investigation and Instrument Descriptions, M. Malin et al., *Earth and Space Science,* July 5, 2017. doi: 10.1002/2016EA000252

7. *Planetary Data System Archive Preparation Guide (APG)*, April 1, 2010, Version 1.4, JPL D-31224.

8. *Planetary Data System Standards Reference*, February 27, 2009, Version 3.8, JPL D-7669, Part 2.

1.4. Relationships with Other Interfaces

This Archive Volume SIS could be affected by changes to the design of the MMM PDS Data Product SIS [Applicable Document #3].

2. Archive Volume Contents

This section describes the contents of the MMM archive volumes, including directory names, file names, file contents, file types, and the institution responsible for providing the files (i.e. Data Provider: MMM instrument team, or MSL Project/PDS: JPL/NASA).

Mastcam, MAHLI, and MARDI are delivered as individual volumes based on instrument. Owing to the large number of products that each camera can generate, the data sets are separated out first on whether the product is an EDR or a RDR. Next, the data are divided on whether the product was acquired during PRE_ATLO (Assembly, Test, and Launch Operations) development, ATLO testing, cruise phase (CRUISE), or after landing on the surface (SURFACE). Finally, data are sorted by date for pre-ATLO, ATLO, and CRUISE or by sol acquired for SURFACE (Appendix A).

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. The following files are contained in the Root Directory.

File Name	File Contents	File Provided By
AAREADME.TXT	Volume content and format information	Data Provider
ERRATA.TXT	A cumulative listing of comments and updates concerning all archive volumes published to date	Data Provider
VOLDESC.CAT	A description of the contents of this volume in a PDS format readable by both humans and computers	Data Provider

2.2. Data Directory Contents and Naming

The contents and naming-scheme of the data sub-directories for specific instruments are described in Appendix A. Data-file naming format and nomenclature are described in the MMM PDS Data Product SIS [Applicable Document #3].

2.3. 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. The following files are contained in the Index Directory.

File Name	File Contents	File Provided By
INDXINFO.TXT	A description of the contents of this directory	Data Provider

EDRINDEX.TAB	A table listing all EDR data products on this volume	Data Provider
EDRINDEX.LBL	A PDS detached label that describes EDRINDEX.TAB	Data Provider
RDRINDEX.TAB	A table listing all RDR data products on this volume	Data Provider
RDRINDEX.LBL	A PDS detached label that describes RDRINDEX.TAB	Data Provider
EDR_CMDX.TAB	A cumulative listing of all EDR data products on this volume and on previous volumes in this set	Data Provider
EDR_CMDX.LBL	A PDS detached label that describes EDR_CMDX.TAB	Data Provider
RDR_CMDX.TAB	A cumulative listing of all RDR data products on this volume and on previous volumes in this set	Data Provider
RDR_CMDX.LBL	A PDS detached label that describes RDR_CMDX.TAB	Data Provider
EDR_IMAGE_ID_LOOKUP_TABLE.TAB	A lookup table correlating the file names of operationally produced EDRs with PDS archived EDRs for Releases 0001-0011	Data Provider
EDR_IMAGE_ID_LOOKUP_TABLE.LBL	A PDS detached label that describes EDR_IMAGE_ID_LOOKUP_TABLE.TAB	Data Provider
RDR_IMAGE_ID_LOOKUP_TABLE.TAB	A lookup table correlating the file names of operationally produced RDRs with PDS archived RDRs for Releases 0001-0011	Data Provider
RDR_IMAGE_ID_LOOKUP_TABLE.LBL	A PDS detached label that describes RDR_IMAGE_ID_LOOKUP_TABLE.TAB	Data Provider

2.4. Document Directory Contents

The Document Directory contains documentation to help the user understand and use the archive data. The following files are contained in the Document Directory.

2.4.1. Mastcam

File Name	File Contents	File Provided By
DOCINFO.TXT	A description of the contents of this directory	Data Provider
GEOMETRIC_CM.TXT	A description of the camera model parameters (CAVOR model) for MMM	Data Provider
MSL_MASTCAM_MAHLI_FOCUS_MERGE_PRODUCTS.PDF	A description of how Mastcam and MAHLI acquire focus stacks and merge products as a PDF file	Data Provider
MSL_MASTCAM_MAHLI_FOCUS_MERGE_PRODUCTS.LBL	A PDS detached label that describes the MSL_MASTCAM_MAHLI_FOCUS_MERGE_PRODUCTS.PDF	Data Provider
MSL_MASTCAM_MARDI_INSTRUMENT_DESCRIPTIONS.PDF	A technical paper describing both the Mastcam and MARDI instruments in detail	Data Provider
MSL_MASTCAM_MARDI_INSTRUMENT_DESCRIPTIONS.LBL	A PDS detached label that describes the MSL_MASTCAM_MARDI_INST_DESCRIPTIONS.PDF	Data Provider
MSL_MASTCAM_PRE_AND_INFLIGHT_CALIBRATION_REPORT.PDF	A Mastcam characterization report of both pre-flight and in-flight calibration, validation and data archiving	Data Provider
MSL_MASTCAM_PRE_AND_INFLIGHT_CALIBRATION_REPORT.LBL	A PDS detached label that describes the MSL_MASTCAM_PRE_AND_INFLIGHT_CALIBRATION_REPORT.PDF	Data Provider

File Name	File Contents	File Provided By
MSL_MMM_EDR_RDR_DPSIS.PDF	The MMM PDS Data Product SIS as a PDF file	Data Provider
MSL_MMM_EDR_RDR_DPSIS.LBL	A PDS detached label that describes the MMM_EDR_RDR_DPSIS.PDF	Data Provider
MSL_MMM_EDR_RDR_ARCHSIS.PDF	The MMM Archive Volume SIS (this document) as a PDF file	Data Provider
MSL_MMM_EDR_RDR_ARCHSIS.LBL	A PDS detached label that describes the MMM_EDR_RDR_ARCHSIS.PDF	Data Provider

2.4.2. MAHLI

File Name	File Contents	File Provided By
DOCINFO.TXT	A description of the contents of this directory	Data Provider
GEOMETRIC_CM.TXT	A description of the camera model parameters (CAVOR model) for MMM	Data Provider
MAHLI_TECH_REPT_0001.PDF	A MAHLI characterization and calibration report covering the pre-launch period from August 2008 through the early months of the extended surface mission through February 2015	Data Provider
MAHLI_TECH_REPT_0001.LBL	A PDS detached label that describes the MAHLI_TECH_REPT_0001.PDF	Data Provider
MSL_MASTCAM_MAHLI_FOCUS_MERGE_PRODUCTS.PDF	A description of how Mastcam and MAHLI acquire focus stacks and merge products as a PDF file	Data Provider
MSL_MASTCAM_MAHLI_FOCUS_MERGE_PRODUCTS.LBL	A PDS detached label that describes the MSL_MASTCAM_MAHLI_FOCUS_MERGE_PRODUCTS.PDF	Data Provider
MSL_MMM_EDR_RDR_DPSIS.PDF	The MMM PDS Data Product SIS as a PDF file	Data Provider
MSL_MMM_EDR_RDR_DPSIS.LBL	A PDS detached label that describes the MMM_EDR_RDR_DPSIS.PDF	Data Provider
MSL_MMM_EDR_RDR_ARCHSIS.PDF	The MMM Archive Volume SIS (this document) as a PDF file	Data Provider
MSL_MMM_EDR_RDR_ARCHSIS.LBL	A PDS detached label that describes the MMM_EDR_RDR_ARCHSIS.PDF	Data Provider

2.4.3. MARDI

File Name	File Contents	File Provided By
DOCINFO.TXT	A description of the contents of this directory	Data Provider
GEOMETRIC_CM.TXT	A description of the camera model parameters (CAVOR model) for MMM	Data Provider
MSL_MASTCAM_MARDI_INSTRUMENT_DESCRIPTIONS.PDF	A technical paper describing both the Mastcam and MARDI instruments in detail	Data Provider
MSL_MASTCAM_MARDI_INSTRMENT_DESCRIPTIONS.LBL	A PDS detached label that describes the MSL_MASTCAM_MARDI_INST_DESCRIPTIONS.PDF	Data Provider
MSL_MMM_EDR_RDR_DPSIS.PDF	The MMM PDS Data Product SIS as a PDF file	Data Provider
MSL_MMM_EDR_RDR_DPSIS.LBL	A PDS detached label that describes the MMM_EDR_RDR_DPSIS.PDF	Data Provider
MSL_MMM_EDR_RDR_ARCHSIS.PDF	The MMM Archive Volume SIS (this document) as	Data Provider

| | a PDF file | |
| MSL_MMM_EDR_RDR_ARCHSIS.LBL | A PDS detached label that describes the MMM_EDR_RDR_ARCHSIS.PDF | Data Provider |

2.5. 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 following files are found in the Catalog Directory.

2.5.1. Mastcam

File Name	File Contents	File Provided By
CATINFO.TXT	A description of the contents of this directory	Data Provider
MASTCAM_EDR_IMG_DS.CAT	Data set information for EDR image products for the PDS catalog	Data Provider
MASTCAM_EDR_VID_DS.CAT	Data set information for EDR video products for the PDS catalog	Data Provider
MASTCAM_EDR_Z_DS.CAT	Data set information for EDR z-stack products for the PDS catalog	Data Provider
MASTCAM_ RDR_IMG_DS.CAT	Data set information for RDR image products for the PDS catalog	Data Provider
MASTCAM_RDR_VID_DS.CAT	Data set information for RDR video products for the PDS catalog	Data Provider
MASTCAM_RDR_Z_DS.CAT	Data set information for RDR z-stack products for the PDS catalog	Data Provider
MASTCAM_INST.CAT	Instrument information for the PDS catalog	Data Provider
MASTCAM_PERSON.CAT	Personnel information for the PDS catalog (Team and PDS personnel responsible for generating the archive)	Data Provider
MASTCAM_REF.CAT	References mentioned in MASTCAM*.CAT files	Data Provider
MSL_INSTHOST.CAT	Instrument host (i.e., spacecraft) information for the PDS catalog	MSL Project
MSL_MISSION.CAT	Mission information for the PDS catalog	MSL Project
MSL_REF.CAT	References mentioned in MSL*.CAT files	MSL Project
SOFTWARE.CAT	A description of the software, dat2img	Data Provider

2.5.2. MAHLI

File Name	File Contents	File Provided By
CATINFO.TXT	A description of the contents of this directory	Data Provider
MAHLI_EDR_IMG_DS.CAT	Data set information for EDR image products for the PDS catalog	Data Provider

MAHLI_EDR_VID_DS.CAT	Data set information for EDR video products for the PDS catalog	Data Provider
MAHLI_ EDR_Z_DS.CAT	Data set information for EDR z-stack products for the PDS catalog	Data Provider
MAHLI_ RDR_IMG_DS.CAT	Data set information for RDR image products for the PDS catalog	Data Provider
MAHLI_ RDR_VID_DS.CAT	Data set information for RDR video products for the PDS catalog	Data Provider
MAHLI_ RDR_Z_DS.CAT	Data set information for RDR z-stack products for the PDS catalog	Data Provider
MAHLI_INST.CAT	Instrument information for the PDS catalog	Data Provider
MAHLI_PERSON.CAT	Personnel information for the PDS catalog (Team and PDS personnel responsible for generating the archive)	Data Provider
MAHLI_REF.CAT	References mentioned in other MAHLI*.CAT files	Data Provider
MSL_INSTHOST.CAT	Instrument host (i.e., spacecraft) information for the PDS catalog	MSL Project
MSL_MISSION.CAT	Mission information for the PDS catalog	MSL Project
MSL_REF.CAT	References mentioned in MSL*.CAT files	MSL Project
SOFTWARE.CAT	A description of the software, dat2img	Data Provider

2.5.3. MARDI

File Name	File Contents	File Provided By
CATINFO.TXT	A description of the contents of this directory	Data Provider
MARDI_EDR_IMG_DS.CAT	Data set information for EDR image products for the PDS catalog	Data Provider
MARDI_EDR_VID_DS.CAT	Data set information for EDR video products for the PDS catalog	Data Provider
MARDI_RDR_IMG_DS.CAT	Data set information for RDR image products for the PDS catalog	Data Provider
MARDI_RDR_VID_DS.CAT	Data set information for RDR video products for the PDS catalog	Data Provider
MARDI_INST.CAT	Instrument information for the PDS catalog	Data Provider
MARDI_PERSON.CAT	Personnel information for the PDS catalog (Team and PDS personnel responsible for generating the archive)	Data Provider
MARDI_REF.CAT	References mentioned in other MARDI*.CAT files	Data Provider
MSL_INSTHOST.CAT	Instrument host (i.e., spacecraft) information for the PDS catalog	MSL Project
MSL_MISSION.CAT	Mission information for the PDS catalog	MSL Project
MSL_REF.CAT	References mentioned in MSL*.CAT files	MSL Project
SOFTWARE.CAT	A description of the software, dat2img	Data Provider

2.6. Software Directory Contents

The Software Directory contains utilities or application programs to aid the user in viewing or extracting data from the data product files. The following files are contained in the Software Directory.

File Name	File Contents	File Provided By
SOFTINFO.TXT	A description of the contents of this directory	Data Provider
HUFFMAN_TABLE.TXT	Huffman code table for lossleslly compressed images	Data Provider
DOC	Directory containing MMM_DAT2IMG.TXT, a descriptive file of the software	Data Provider
SRC	Directory containing a standard UNIX zip file containing source code, MMM_DAT2IMG.ZIP and its corresponding label file, MMM_DAT2IMG.LBL in addition to example binaries built for MAC OS (OSXBIN) and Red Hat 5 Linux (RH5BIN)	Data Provider

Contents of MMM_DAT2IMG.ZIP:

File Name	File Contents	File Provided By
README	Quick build guide	Data Provider
build_all	Script to build dat2img.c	Data Provider
dat2img.c	C source code	Data Provider
pdecom_msl.c	C source code	Data Provider
jpeg-6b	Directory containing JPEG library source code listed below including C source code, header files, configuration files, and build scripts for the JPEG library	Data Provider

Makefile
README
ansi2knr.1
ansi2knr.c
cderror.h
cdjpeg.c
cdjpeg.h
change.log
cjpeg.1
cjpeg.c
ckconfig.c
coderules.doc
config.guess
config.sub
configure
djpeg.1
djpeg.c
example.c
filelist.doc
install-sh
install.doc
jcapimin.c
jcapistd.c
jccoefct.c
jccolor.c
jcdctmgr.c
jchuff.c
jchuff.h
jcinit.c
jcmainct.c
jcmarker.c
jcmaster.c
jcomapi.c

jconfig.bcc
jconfig.cfg
jconfig.dj
jconfig.doc
jconfig.h
jconfig.mac
jconfig.manx
jconfig.mc6
jconfig.sas
jconfig.st
jconfig.vc
jconfig.vms
jconfig.wat
jcparam.c
jcphuff.c
jcprepct.c
jcsample.c
jctrans.c
jdapimin.c
jdapistd.c
jdatadst.c
jdatasrc.c
jdcoefct.c
jdcolor.c
jdct.h
jddctmgr.c
jdhuff.c
jdhuff.h
jdinput.c
jdmainct.c
jdmarker.c
jdmaster.c
jdmerge.c
jdphuff.c
jdpostct.c
jdsample.c
jdtrans.c
jerror.c
jerror.h
jfdctflt.c
jfdctfst.c
jfdctint.c
jidctflt.c
jidctfst.c
jidctint.c
jidctred.c
jinclude.h
jmemansi.c
jmemdos.c
jmemdosa.asm
jmemmac.c
jmemmgr.c
jmemname.c
jmemnobs.c
jmemsys.h
jmorecfg.h
jpegint.h
jpeglib.h
jpegtran.1
jpegtran.c
jquant1.c
jquant2.c

jutils.c
jversion.h
libjpeg.doc
ltconfig
ltmain.sh
makcjpeg.st
makdjpeg.st
makeapps.ds
makefile.ansi
makefile.bcc
makefile.cfg
makefile.dj
makefile.manx
makefile.mc6
makefile.mms
makefile.sas
makefile.unix
makefile.vc
makefile.vms
makefile.wat
makelib.ds
makeproj.mac
makljpeg.st
maktjpeg.st
makvms.opt
rdbmp.c
rdcolmap.c
rdgif.c
rdjpgcom.1
rdjpgcom.c
rdppm.c
rdrle.c
rdswitch.c
rdtarga.c
structure.doc
transupp.c
transupp.h
usage.doc
wizard.doc
wrbmp.c
wrgif.c
wrjpgcom.1
wrjpgcom.c
wrppm.c
wrrle.c
wrtarga.c

The MMM agreement with PDS is that MMM provides the source code to produce an image file from an EDR product. However, it is PDS's responsibility to maintain and update it as needed. The source code provided creates a single command line tool called "dat2img". This tool reads, extracts, and decompresses image products within a MMM EDR. This tool creates image products from all 21 forms of image EDRs. The output format is a PDS compliant IMG file with an option to create a detached label (.LBL).

2.7. Calib Directory Contents

The Calib Directory contains calibration files used to process the data products or calibration data needed to use the data products. It should be noted that flat fielding is no longer applied to MMM products (starting with PDS Release 0015). However preliminary flats fields, based on ground calibration data, are still provided in this directory for all three insturments. In addition, note that filter 7 (solar filter) flat fields for the Mastcam are not provided in the archive volume delivery. The following files are contained in the Calib Directory.

2.7.1. Mastcam

File Name	File Contents	File Provided By
CALINFO.TXT	A description of the contents of this directory	Data Provider
FLAT_ML_filter0_0.IMG FLAT_ML_filter1_0.IMG FLAT_ML_filter2_0.IMG FLAT_ML_filter3_0.IMG FLAT_ML_filter4_0.IMG FLAT_ML_filter5_0.IMG FLAT_ML_filter6_0.IMG	First principle flat fields for the Mastcam 34mm instrument filters 0-6	Data Provider
FLAT_MR_filter0_0.IMG FLAT_MR_filter1_0.IMG FLAT_MR_filter2_0.IMG FLAT_MR_filter3_0.IMG FLAT_MR_filter4_0.IMG FLAT_MR_filter5_0.IMG FLAT_MR_filter6_0.IMG	First principle flat fields for the Mastcam 100mm instrument filters 0-6	Data Provider
DECOMPAND0.TXT DECOMPAND1.TXT DECOMPAND2.TXT DECOMPAND3.TXT DECOMPAND4.TXT DECOMPAND5.TXT DECOMPAND6.TXT DECOMPAND7.TXT DECOMPAND8.TXT DECOMPAND9.TXT DECOMPAND10.TXT DECOMPAND11.TXT DECOMPAND12.TXT DECOMPAND13.TXT DECOMPAND14.TXT DECOMPAND15.TXT DECOMPAND16.TXT DECOMPAND17.TXT DECOMPAND18.TXT DECOMPAND19.TXT DECOMPAND20.TXT DECOMPAND21.TXT DECOMPAND22.TXT DECOMPAND23.TXT DECOMPAND24.TXT DECOMPAND25.TXT DECOMPAND26.TXT DECOMPAND27.TXT DECOMPAND28.TXT DECOMPAND29.TXT	Files containing decompanding tables 0 through 32 applicable to all MMM instruments	Data Provider

DECOMPAND30.TXT
DECOMPAND31.TXT
DECOMPAND32.TXT

MSL_MMM_CAL.TXT	MMM camera calibration summary	Data Provider

2.7.2. MAHLI

File Name	File Contents	File Provided By
CALINFO.TXT	A description of the contents of this directory	Data Provider
FLAT_MH_0.IMG	First principle flat field for the MAHLI	Data Provider
DECOMPAND0.TXT DECOMPAND1.TXT DECOMPAND2.TXT DECOMPAND3.TXT DECOMPAND4.TXT DECOMPAND5.TXT DECOMPAND6.TXT DECOMPAND7.TXT DECOMPAND8.TXT DECOMPAND9.TXT DECOMPAND10.TXT DECOMPAND11.TXT DECOMPAND12.TXT DECOMPAND13.TXT DECOMPAND14.TXT DECOMPAND15.TXT DECOMPAND16.TXT DECOMPAND17.TXT DECOMPAND18.TXT DECOMPAND19.TXT DECOMPAND20.TXT DECOMPAND21.TXT DECOMPAND22.TXT DECOMPAND23.TXT DECOMPAND24.TXT DECOMPAND25.TXT DECOMPAND26.TXT DECOMPAND27.TXT DECOMPAND28.TXT DECOMPAND29.TXT DECOMPAND30.TXT DECOMPAND31.TXT DECOMPAND32.TXT	Files containing decompanding tables 0 through 32 applicable to all MMM instruments	Data Provider
MSL_MMM_CAL.TXT	MMM camera calibration summary	Data Provider

2.7.3. MARDI

File Name	File Contents	File Provided By
CALINFO.TXT	A description of the contents of this directory	Data Provider
FLAT_MD_0.IMG	First principle flat field for MARDI	Data Provider
DECOMPAND0.TXT DECOMPAND1.TXT DECOMPAND2.TXT DECOMPAND3.TXT DECOMPAND4.TXT DECOMPAND5.TXT	Files containing decompanding tables 0 through 32 applicable to all MMM instruments	Data Provider

```
DECOMPAND6.TXT
DECOMPAND7.TXT
DECOMPAND8.TXT
DECOMPAND9.TXT
DECOMPAND10.TXT
DECOMPAND11.TXT
DECOMPAND12.TXT
DECOMPAND13.TXT
DECOMPAND14.TXT
DECOMPAND15.TXT
DECOMPAND16.TXT
DECOMPAND17.TXT
DECOMPAND18.TXT
DECOMPAND19.TXT
DECOMPAND20.TXT
DECOMPAND21.TXT
DECOMPAND22.TXT
DECOMPAND23.TXT
DECOMPAND24.TXT
DECOMPAND25.TXT
DECOMPAND26.TXT
DECOMPAND27.TXT
DECOMPAND28.TXT
DECOMPAND29.TXT
DECOMPAND30.TXT
DECOMPAND31.TXT
DECOMPAND32.TXT
```

MSL_MMM_CAL.TXT	MMM camera calibration summary	Data Provider

2.8. Extras Directory Contents

The Extras Directory contains value added elements that are outside the scope of the PDS archive requirements. The files contained within this directory include a CHRONOS setup file as well as a meta-kernel file. Both files are to be used in conjunction with the MSL SPICE (Spacecraft, Planet, Instrument C-Matrix Events) kernels provided by NAIF (Navigation and Ancillary Information Facility). The following files are contained in the Extras Directory.

File Name	File Contents	File Provided By
EXTRINFO.TXT	A description of the contents of this directory	Data Provider
SPICE	Sub-directory of the EXTRAS directory that contains the MSL_CONSTANTS_V1.TXT file and the MK/ directory	Data Provider
MSL_CONSTANTS_ V1.TXT	CHRONOS setup file contained in the SPICE directory that includes a partial set of parameters needed for SPICE's CHRONOS utility program used by MSL to support time conversions	Data Provider
MK	Sub-directory of the SPICE directory that contains the meta-kernel file, MMM_CHRONOS_V02.TM	Data Provider
MMM_CHRONOS_V 02.TM	Meta-kernel file contained in the MK directory that lists the SPICE kernels used for product generation	Data Provider
MMM_CHRONOS_V 03.TM	Meta-kernel file contained in the MK directory that lists the SPICE kernels used for product generation	Data Provider

In addition, this directory includes low resolution size (thumbnail-size), middle resolution size (browse-size), and full resolution size (full-size) JPG versions of all the archived EDR and RDR products on the volume. These products are generated by the PDS Imaging Node.

3. Archive Volume Format

This section describes the format of MMM Archive Volumes. Data that comprise the Archive are formatted in accordance with Planetary Data System specifications [Applicable Documents #4 and #5].

3.1. File Formats

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

3.1.1. Document File Format

Document files with the .TXT suffix exist in the Root, Index, Software, Catalog, Document, and Calib directories. They are ASCII files, which may 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. In such a case, a PDF (Portable Document Format) is used which is an open standard of Adobe Systems Incorporated that is frequently used for distributing documents. Adobe offers a free program, Acrobat Reader, for viewing PDF files.

3.1.2. 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 (,) while character fields are enclosed in double quotation marks ("). (Character fields have been padded with spaces to maintain justification of 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 computers that do not support this file type.

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 EDRINDEX.TAB is accompanied by the detached label file EDRINDEX.LBL in the same directory.

3.1.3. PDS Label Format

All data files in the archive are associated with PDS labels, either attached at the beginning of the file or detached in a separate file. For examples of PDS labels for different types of data products, see the MMM PDS Data Product SIS [Applicable Document #3].

A PDS label, whether attached 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 (e.g., 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. Additionally,

    ^MINIHEADER_TABLE = ("F01.DAT",0 <BYTES>)

    ^DAT_TABLE = ("F01.DAT", 64 <BYTES>)

indicates that the file begins with the mini-header which precedes the original binary data packet produced by the instrument and that the binary packet is 64 bytes from the first byte of the file.

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.

3.1.4. Software File Format

The software tool "build_all" is a UNIX C-shell script. All other source code files are in the C programming language conforming to the standard ISO/IEC 9899:1999. The software tool "dat2img" is provided in the archive volume delivery in a pre-compiled executable for the Linux and Darwin operating systems. The supported Linux platform is Linux kernel 2.6.18 x86_64 (Red Hat Enterprise Linux release 5) and is compiled as an ELF 64-bit LSB executable. The supported Darwin platform is Darwin 11.4.0 i386 (Apple OS X 10.7) and is compiled as a Mach-O 64 bit executable.

Usage:
        dat2img [-d] input.DAT [output_dir]

Use -d option for detached label file (default is attached label)
Default output file is input_nn.IMG in the current directory

Example: ./dat2img -d 0000MD9999000032E1_XXXX.DAT out_dir

Output: out_dir/0000MD9999000032E1_XXXX_00.LBL
         out_dir/0000MD9999000032E1_XXXX_00.IMG

3.1.5. Catalog File Format

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

3.1.6. Science Data File Formats

For information about the format and content of the data products, see the MMM PDS Data Product SIS [Applicable Document #3].

4. Archive Volume Generation

4.1. Data Transfer and Validation Methods

Data provided to the MSL science teams meets the specifications detailed in the MMM PDS Data Product SIS [Applicable Document #3].

Prior to entering the MSSS pipeline, the MMM data processing begins with the reconstruction of packetized telemetry data resident on the Telemetry Data Subsystem (TDS), by the Mission data Processing and Control Subsystem (MPCS) into a binary ".dat" data product and associated ".emd" Earth meta-data file. The data product and meta-data are written by MPCS to the Operations Data Store (ODS) and messages are generated on a Java Message Server (JMS) bus. By MSL Project design, the "raw" MMM instrument data is then retrieved from the ODS by a process managed by Mulitmission Image Processing Laboratory (MIPL) under Operational Product Generation Subsytem (OPGS), and placed in the File Exchange Interface (FEI) directory system. While this process generates EDRs for other instruments on the rover, it does not do so for the MMM data. Upon FEI notification, the MMM data are transferred to MSSS by FEI subscription, where they are ingested by the MMM EDR/RDR data pipeline.

Validation of the MMM EDRs falls into two primary categories: automated and manual. Automated validation is performed on every EDR product produced for the mission while manual validation is only performed on a subset, as described below.

Automated validation is performed as a part of the archiving process simultaneously with the archive volume validation. Validation operations include:

a. validation of the PDS syntax of the label,

b. a check of the label values against the database and against the index tables included on the archive volume, and

c. checks for internal consistency of the label items.

The internal-consistency checks include such things as verifying that the product creation date is later than the Earth received time and comparing the geometry pointing information with the specified target. As problems are discovered and/or new possibilities identified for automated verification, they will be added to the validation procedure.

Manual validation of the images is performed by MMM team members both as spot-checking of data throughout the duration of the mission, and comprehensive validation of a sub-set of the data (for example, a few Sol's worth of data). Manual validation includes, but is not limited to:

a. inspection of the image or other data object for errors (e.g., missing lines, corrupted image blocks, etc.) not specified in the label parameters,

b. verification that the target shown and the apparent geometry match that specified in the labels,

c. verification that the product is viewable using the specified software tools (see Section 2.6), and

d. a general check for any problems that might not have been anticipated in the automated validation procedure.

A peer review, conducted prior to the first data delivery by the PDS Node, was performed on sample data, actual or simulated, to confirm that the archive is useable by members of the science community, both present and future, who are not familiar with the mission and/or instrument. Reviewers included members of the PDS, a distributed representation of the project science teams, and members of the science community not associated with the mission.

In addition, the PDS Node validates each individual volume delivery to verify that it adheres to PDS standards and to this Archive Volume SIS.

4.2. Backup and Duplicates

Copies of MSL archives are maintained at the curating PDS Node and at the National Space Science Data Center (NSSDC). In addition, the PDS releases are part of MSSS's normal storage backup.

4.3. Labeling and Identification

Each delivery consists of a single volume per instrument as defined below. For example, the first delivery for Mastcam is MSLMST_0001, the second delivery is MSLMST_0002, etc. Data products within the volumes are defined by the Data Set ID and Data Set Name listed in the table below. The Data Set ID, Data Set Name, and Volume ID were determined by the PDS Node to adhere to PDS standards.

Instrument	Data Set ID	Volume ID
Mastcam	MSL-M-MASTCAM-2-EDR-IMG-V1.0	MSLMST_0XXX
	MSL-M-MASTCAM-2-EDR-VID-V1.0	
	MSL-M-MASTCAM-2-EDR-Z-V1.0	
	MSL-M-MASTCAM-4-RDR-IMG-V1.0	
	MSL-M-MASTCAM-4-RDR-VID-V1.0	
	MSL-M-MASTCAM-4-RDR-Z-V1.0	
MAHLI	MSL-M-MAHLI-2-EDR-IMG-V1.0	MSLMHL_0XXX
	MSL-M-MAHLI-2-EDR-VID-V1.0	
	MSL-M-MAHLI-2-EDR-Z-V1.0	

MSL-M-MAHLI-4-RDR-IMG-V1.0

MSL-M-MAHLI-4-RDR-VID-V1.0

MSL-M-MAHLI-4-RDR-Z-V1.0

MARDI   MSL-M-MARDI-2-EDR-IMG-V1.0   MSLMRD_0XXX

MSL-M-MARDI-2-EDR-VID-V1.0

MSL-M-MARDI-4-RDR-IMG-V1.0

MSL-M-MARDI-4-RDR-VID-V1.0

Instrument	Data Set Name
Mastcam	MSL MARS MAST CAMERA 2 EDR IMAGE V1.0
	MSL MARS MAST CAMERA 2 EDR VIDEO V1.0
	MSL MARS MAST CAMERA 2 EDR ZSTACK V1.0
	MSL MARS MAST CAMERA 4 RDR IMAGE V1.0
	MSL MARS MAST CAMERA 4 RDR VIDEO V1.0
	MSL MARS MAST CAMERA 4 RDR ZSTACK V1.0
MAHLI	MSL MARS HAND LENS IMAGER 2 EDR IMAGE V1.0
	MSL MARS HAND LENS IMAGER 2 EDR VIDEO V1.0
	MSL MARS HAND LENS IMAGER 2 EDR ZSTACK V1.0
	MSL MARS HAND LENS IMAGER 4 RDR IMAGE V1.0
	MSL MARS HAND LENS IMAGER 4 RDR VIDEO V1.0
	MSL MARS HAND LENS IMAGER 4 RDR ZSTACK V1.0
MARDI	MSL MARS DESCENT IMAGER 2 EDR IMAGE V1.0
	MSL MARS DESCENT IMAGER 2 EDR VIDEO V1.0
	MSL MARS DESCENT IMAGER 4 RDR IMAGE V1.0
	MSL MARS DESCENT IMAGER 4 RDR VIDEO V1.0

4.4. Data Release Dates

In accordance with the MSL Archive Plan document (Applicable Document #2), the Project archives copies of all data acquired by the mission to the Planetary Data System within six months after its receipt on Earth. The MSL Project plans to make eight "batch" deliveries to the PDS, in 90 sol increments every 90 sols, starting with the first delivery 6 months after landing. In the event of an extended mission, subsequent data releases will continue at the same rate, with the final delivery occurring no later than six months after the last data have been received on

Earth. See Table 5 of the MSL Archive Plan document for archive data acquisition and release dates for the primary mission.

5. Support Staff and Cognizant Persons

Michael Malin, Kenneth Edgett, Elsa Jensen, Sean McNair, Leslie Lipkaman, Daniel Krysak, and Robert Zimdar

MMM Instruments

Malin Space Science Systems

Appendix A: MSLMST, MSLMHL, and MSLMRD Volume Structures

The following are the directory structures for Mastcam (MSLMST), MAHLI (MSLMHL), and MARDI (MSLMRD) volumes. The MSLMST and MSLMHL volumes have identical structures with the only difference being file names, i.e., MAHLI instead of MASTCAM.

The MSLMRD volume has a very similar structure to MSLMST and MSLMHL volumes. However, the MSLMRD volume is missing the "{EDR,RDR}_Z_DS.CAT" files as well as MSL_MASTCAM_MAHLI_FOCUS_MERGE_PRODUCTS.{PDF, .LBL} files. MARDI is not capable of producing a z-stack and thus it does not have these data sets and corresponding description file.

Data Directories

Every archive delivery always contains data acquired for a set period of time, e.g. sols 0-89, sols 90-179, etc. These data are archived in the SURFACE/*<sol acquired>/* directories. *<sol acquired>* has the format xxxx (e.g., 0025).

If data are being archived from PRE_ATLO, ATLO, or CRUISE, these directories are included in the volume; if there are no data being archived for PRE_ATLO, ATLO, or CRUISE, these directories are omitted from the volume. Data in these directories are archived in a subdirectory, <YYYY_MM_DD>, which has the format year_month_day.

Additionally, PRE_ATLO, ATLO, and CRUISE directories only contain EDR data products; no RDRs are produced for these phases.

MSLMST_xxxx

| -- AAREADME.TXT

| -- CALIB

       | -- CALINFO.TXT

       | -- DECOMPAND{0-32}.TXT

```
                | -- FLAT_ML_FILTER{0-6}_0.IMG
                | -- FLAT_MR_FILTER{0-6}_0.IMG
                | -- MSL_MMM_CAL.TXT
        | -- CATALOG
                | -- CATINFO.TXT
                | -- MASTCAM_EDR_IMG_DS.CAT
                | -- MASTCAM_EDR_VID_DS.CAT
                | -- MASTCAM_EDR_Z_DS.CAT
                | -- MASTCAM_INST.CAT
                | -- MASTCAM_PERSON.CAT
                | -- MASTCAM_RDR_IMG_DS.CAT
                | -- MASTCAM_RDR_VID_DS.CAT
                | -- MASTCAM_RDR_Z_DS.CAT
                | -- MASTCAM_REF.CAT
                | -- MSL_INSTHOST.CAT
                | -- MSL_MISSION.CAT
                | -- MSL_REF.CAT
                | -- SOFTWARE.CAT
        | -- DATA
                | -- EDR
                        | -- ATLO
                                | -- <YYYY_MM_DD>
                        | -- CRUISE
                                | -- <YYYY_MM_DD>
                        | -- PRE_ATLO
                                | -- <YYYY_MM_DD>
                        | -- SURFACE
                                | -- < sol acquired >
                | -- RDR
                        | -- SURFACE
                                | -- < sol acquired >
        | -- DOCUMENT
                | -- DOCINFO.TXT
                | -- GEOMETRIC_CM.TXT
                | -- MSL_MASTCAM_MAHLI_FOCUS_MERGE_PRODUCTS.PDF
                | -- MSL_MASTCAM_MAHLI_FOCUS_MERGE_PRODUCTS.LBL
                | -- MSL_MASTCAM_MARDI_INSTRUMENT_DESCRIPTIONS.PDF
```

```
                | -- MSL_MASTCAM_MARDI_INSTRUMENT_DESCRIPTIONS.LBL

                | -- MSL_MASTCAM_PRE_AND_INFLIGHT_CALIBRATION_REPORT.PDF

                | -- MSL_MASTCAM_PRE_AND_INFLIGHT_CALIBRATION_REPORT.LBL

                | -- MSL_MMM_EDR_RDR_ARCHSIS.PDF

                | -- MSL_MMM_EDR_RDR_ARCHSIS.LBL

                | -- MSL_MMM_EDR_RDR_DPSIS.PDF

                | -- MSL_MMM_EDR_RDR_DPSIS.LBL

    | -- ERRATA.TXT

    | -- EXTRAS

            | -- EXTRINFO.TXT

            | -- SPICE

                    | -- MK

                            | -- MMM_CHRONOS_V02.TM

                            | -- MMM_CHRONOS_V03.TM

                    | -- MSL_CONSTANTS_V1.TXT

    | -- INDEX

            | -- INDXINFO.TXT

            | -- EDRINDEX.TAB

            | -- EDRINDEX.LBL

            | -- EDR_CMDX.TAB

            | -- EDR_CMDX.LBL

            | -- EDR_IMAGE_ID_LOOKUP_TABLE.TAB

            | -- EDR_IMAGE_ID_LOOKUP_TABLE.LBL

            | -- RDRINDEX.TAB

            | -- RDRINDEX.LBL

            | -- RDR_CMDX.TAB

            | -- RDR_CMDX.LBL

            | -- RDR_IMAGE_ID_LOOKUP_TABLE.TAB

            | -- RDR_IMAGE_ID_LOOKUP_TABLE.LBL

    | -- SOFTWARE

            | -- SOFTINFO.TXT

            | -- HUFFMAN_TABLE.TXT

            | -- DOC

                    | -- MMM_DAT2IMG.TXT

            | -- SRC

                    | -- MMM_DAT2IMG.ZIP

                    | -- MMM_DAT2IMG.LBL
```

```
            | -- OSXBIN
                    | -- DAT2IMG
                    | -- DAT2IMG.LBL
            | -- RH5BIN
                    | -- DAT2IMG
                    | -- DAT2IMG.LBL
| -- VOLDESC.CAT
```

MSLMHL_xxxx

```
| -- AAREADME.TXT
| -- CALIB
        | -- CALINFO.TXT
        | -- DECOMPAND{0-32}.TXT
        | -- FLAT_MH_0.IMG
        | -- MSL_MMM_CAL.TXT
| -- CATALOG
        | -- CATINFO.TXT
        | -- MAHLI_EDR_IMG_DS.CAT
        | -- MAHLI_EDR_VID_DS.CAT
        | -- MAHLI_EDR_Z_DS.CAT
        | -- MAHLI_INST.CAT
        | -- MAHLI_PERSON.CAT
        | -- MAHLI_RDR_IMG_DS.CAT
        | -- MAHLI_RDR_VID_DS.CAT
        | -- MAHLI_RDR_Z_DS.CAT
        | -- MAHLI_REF.CAT
        | -- MSL_INSTHOST.CAT
        | -- MSL_MISSION.CAT
        | -- MSL_REF.CAT
        | -- SOFTWARE.CAT
| -- DATA
        | -- EDR
                | -- ATLO
                        | -- <YYYY_MM_DD>
                | -- CRUISE
                        | -- <YYYY_MM_DD>
```

```
            | -- PRE_ATLO
                    | -- <YYYY_MM_DD>
            | -- SURFACE
                    | -- < sol acquired >
        | -- RDR
            | -- SURFACE
                    | -- < sol acquired >
| -- DOCUMENT
        | -- DOCINFO.TXT
        | -- GEOMETRIC_CM.TXT
        | -- MAHLI_TECH_REPORT_0001.LBL
        | -- MAHLI_TECH_REPORT_0001.PDF
        | -- MSL_MASTCAM_MAHLI_FOCUS_MERGE_PRODUCTS.PDF
        | -- MSL_MASTCAM_MAHLI_FOCUS_MERGE_PRODUCTS.LBL
        | -- MSL_MMM_EDR_RDR_ARCHSIS.PDF
        | -- MSL_MMM_EDR_RDR_ARCHSIS.LBL
        | -- MSL_MMM_EDR_RDR_DPSIS.PDF
        | -- MSL_MMM_EDR_RDR_DPSIS.LBL
| -- ERRATA.TXT
| -- EXTRAS
        | -- EXTRINFO.TXT
        | -- SPICE
                | -- MK
                        | -- MMM_CHRONOS_V02.TM
                        | -- MMM_CHRONOS_V03.TM
                | -- MSL_CONSTANTS_V1.TXT
| -- INDEX
        | -- INDXINFO.TXT
        | -- EDRINDEX.TAB
        | -- EDRINDEX.LBL
        | -- EDR_CMDX.TAB
        | -- EDR_CMDX.LBL
        | -- EDR_IMAGE_ID_LOOKUP_TABLE.TAB
        | -- EDR_IMAGE_ID_LOOKUP_TABLE.LBL
        | -- RDRINDEX.TAB
        | -- RDRINDEX.LBL
        | -- RDR_CMDX.TAB
```

```
        | -- RDR_CMDX.LBL
        | -- RDR_IMAGE_ID_LOOKUP_TABLE.TAB
        | -- RDR_IMAGE_ID_LOOKUP_TABLE.LBL
| -- SOFTWARE
        | -- SOFTINFO.TXT
        | -- HUFFMAN_TABLE.TXT
        | -- DOC
                | -- MMM_DAT2IMG.TXT
        | -- SRC
                | -- MMM_DAT2IMG.ZIP
                | -- MMM_DAT2IMG.LBL
                | -- OSXBIN
                        | -- DAT2IMG
                        | -- DAT2IMG.LBL
                | -- RH5BIN
                        | -- DAT2IMG
                        | -- DAT2IMG.LBL
| -- VOLDESC.CAT
```

MSLMRD_xxxx

```
| -- AAREADME.TXT
| -- CALIB
        | -- CALINFO.TXT
        | -- DECOMPAND{0-32}.TXT
        | -- FLAT_MD_0.IMG
        | -- MSL_MMM_CAL.TXT
| -- CATALOG
        | -- CATINFO.TXT
        | -- MARDI_EDR_IMG_DS.CAT
        | -- MARDI_EDR_VID_DS.CAT
        | -- MARDI_INST.CAT
        | -- MARDI_PERSON.CAT
        | -- MARDI_RDR_IMG_DS.CAT
        | -- MARDI_RDR_VID_DS.CAT
        | -- MARDI_REF.CAT
        | -- MSL_INSTHOST.CAT
```

```
        | -- MSL_MISSION.CAT

        | -- MSL_REF.CAT

        | -- SOFTWARE.CAT

| -- DATA

        | -- EDR

                | -- ATLO

                        | -- <YYYY_MM_DD>

                | -- CRUISE

                        | -- <YYYY_MM_DD>

                | -- PRE_ATLO

                        | -- <YYYY_MM_DD>

                | -- SURFACE

                        | -- < sol acquired >

        | -- RDR

                | -- SURFACE

                        | -- < sol acquired >

| -- DOCUMENT

        | -- DOCINFO.TXT

        | -- GEOMETRIC_CM.TXT

        | -- MSL_MASTCAM_MARDI_INSTRUMENT_DESCRIPTIONS.PDF

        | -- MSL_MASTCAM_MARDI_INSTRUMENT_DESCRIPTIONS.LBL

        | -- MSL_MMM_EDR_RDR_ARCHSIS.PDF

        | -- MSL_MMM_EDR_RDR_ARCHSIS.LBL

        | -- MSL_MMM_EDR_RDR_DPSIS.PDF

        | -- MSL_MMM_EDR_RDR_DPSIS.LBL

| -- ERRATA.TXT

| -- EXTRAS

        | -- EXTRINFO.TXT

        | -- SPICE

                | -- MK

                        | -- MMM_CHRONOS_V02.TM

                        | -- MMM_CHRONOS_V03.TM

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