Revision C

Multimission Image Processing Laboratory

# Mosaicked Image Data Record (MIDR)

## Software Interface Specification: IDPS-109

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Wednesday, October 2, 1991

National Aeronautics and
Space Administration

JPL

**Jet Propulsion Laboratory**
California Institute of Technology
Pasadena. California

# PROJECT MAGELLAN
# SOFTWARE INTERFACE SPECIFICATION
# SIGNATURE PAGE

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NUMBER: IDPS-109
REVISION: C
DATE: Wednesday, October 2, 1991

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**SIS NAME:**

Mosaicked Image Data Record (MIDR)

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**DOMAIN:**

| System | Subsystem | Program | Make/Use |
|---|---|---|---|
| GDS | IDPS | ARCHIVE | Make |
| GDS | IDPS | LOGMOS | Make |
| GDS | IDPS | SFASTMOS | Make |
| GDS | Science | –Various– | Use |

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**PURPOSE OF INTERFACE (SUMMARY):**

This interface describes the Mosaicked Image Data Record.

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**INTERFACE MEDIUM:**

9-Track Magnetic Tape, 6250 cpi

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**SIGNATURES**

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## Document Change Log

| Change Order | Date | Affected Portions |
|---|---|---|
| Original | April 23, 1986 | All |
| Rev. 1 | Feb. 17, 1988 | All |
| Rev. B | Jan. 16, 1990 | Incorporated changes per FRs 65059, 66448 and MCRs 065, 120, 423, 620, 621, 809, 908 and 952.<br>MCR 993: Clarified applicability of label keywords suggested by MCR 805, added Appendix C, reverted file names changed per MCR 621 to original names. |
| Rev. C | | Incorporated changes per FRs 65113, 67957, and 67958 and MCRs 997, 998, and 1164. Added Appendix D, "Summary of Changes in Cycle 2". Updated the applicable documents list. |

## Distribution List

| | | |
|---|---|---|
| | J. Clark | 168–427 |
| | P. Jepsen | 168–427 |
| | S. Lewicki | 168–427 |
| | M. Jentoft-Nilsen | 168–427 |
| (5) | T.W. Thompson | 230–225 |
| (4) | S. Wall | 230–225 |
| | R. Halverstadt | 230–201 |
| | J. Gunn | 230–201 |
| | S. Collins | 230–201 |
| | J. Miller | 230–216 |

## Table of Contents

# 1 General Description

## 1.1 Content Overview

This specification describes the content and format of all mosaicked image data records (MIDRs) to be produced by the Image Data Processing Subsystem (IDPS) at the Jet Propulsion Laboratory for the Magellan mission.

Except where specifically denoted below the acronym "MIDR" should be understood throughout this document to apply to the following image-based digital records of mosaicked synthetic aperture radar data which shall be produced by IDPS: the F-MIDR, C1-MIDR, C2-MIDR and C3-MIDR.

Each MIDR shall contain VICAR image files consisting of the mosaicked image data resulting from the processing of the orbital SAR image data.

## 1.2 Scope

This SIS is applicable to all MIDR tapes produced during the Magellan mission.

*Note: MIDR products will also be produced in a CD-ROM format. This format is described by another SIS: IDPS-145.*

## 1.3 Applicable Documents

• Magellan Mission: Image Data Processing Subsystem Functional Requirements. Allen Hodges. **MOS-4-272. Revision A, 10 December 1990.**

• *VICAR Run-Time Reference Manual.* Multimission Image Processing Laboratory, Dan Stanfill. **Revision 1, 24 November 1986** —VICAR *image file and label format definition.*

• *VICAR User's Guide.* Multimission Image Processing Laboratory. **JPL D—4186 Issue 1, 15 May 1987.** *—VICAR image file and label format definition.*

• *Recorded Magnetic Tape for Information Interchange (6250 cpi, Group Coded Recording).* **ANSI X3.54—1976.** *—ANSI recording format requirements for magnetic tape.*

• *Magnetic Tape Labels and File Structure for Information Interchange.* **ANSI X3.27—1978.** *—ANSI labeling requirements for magnetic tape.*

• *JPL SFDU Description and Usage.* **JJPL—0006—00—01, Issue 2.** November 1986.

• *JPL Standard Formatted Data Unit Description and Draft Standard.* **JPL D-3198, Issue** 4. July 1986.

• *VAX Architecture Handbook.* Digital Equipment Corporation. 1981. — *Floating point numeric representation: pp. 31-36.*

• *Map Projections Used by the U.S. Geological Survey.* Geological Survey Bulletin 1532, Second Edition. John Snyder. 1983. pp. 219-222—*The Sinusoidal Map Projection.*

• *Magellan Mission: Planetary Constants and Models Document.* PD 630—79, JPL D—2300.

## 1.4 Subsystem Siting

### 1.4.1 Interface Location, Medium

The interface shall be created during Magellan mission operations and be retained by the Data Management and Archive Team (DMAT) at the Jet Propulsion Laboratory as a set of computer compatible tapes.

### 1.4.2 Data Source, Destination, and Transfer Method

The MIDR tapes shall be generated by IDPS using programs specifically developed or adapted for Magellan and using as input the orbital SAR image digital records: the F-BIDR and C-BIDR.

The MIDR tapes shall be archived by DMAT and copies of the tapes shall be distributed to designated scientists for scientific investigation purposes.

### 1.4.3 Generation Method

Mosaics of the F-BIDR and C-BIDR shall be generated, as required in MOS—4-272, by dead-reckoning without geometric resampling of pixels. The resulting MIDR shall be in the sinusoidal map projection.

### 1.4.4 Pertinent Relationship With Other Interfaces

This SIS shall be affected only by changes to the requirements defining the MIDR products.

### 1.4.5 Labeling and Identification (Internal/External)

**External labels/Product ID** shall conform to the standards established by DMAT.

For the mosaicked image digital record products, the external tape label and product ID shall be as follows:

*x*-MIDR.*yydzzz*; V

where

*x* — is the one or two character product description resolution abbreviation, viz. *F, C1, C2 or C3;*
*yy* — is the absolute value of the latitude of the center of the MIDR frame rounded to the nearest integer, z.f.r.j.[1];
*d* — is the direction in which the latitude is measured from the equator *viz. N or S;*
*zzz* — is the longitude of the center of the MIDR frame rounded to the nearest integer, z.f.r.j.;
*V* — identifies the version number of this product. This will have one of three formats: 1. During Cycle 1, it begins with one and is simply incremented with each new version; 2. Beginning in Cycle 2, this will have the format *nvv*, where *n* is the cycle number and *vv* is the z.f.r.j. version number, e.g. 201 shall specify the version number one product of Cycle 2; and 3. All test products will have the

[1] zero-filled, right-justified

version number 999.

**ANSI volume labels** shall be of the form:

*x-nnn*

where *x* is the product description abbreviation (as defined above); and *nnn is* a sequence number, z.f.r.j., assigned in advance by DMAT for all compressed resolution MIDRs and assigned in chronological order of request for all full resolution MIDRs.

**File names** shall conform to ANSI standards as detailed below in Section 4.2.

**Internal labels** shall conform to the VICAR image file label format defined in the *VICAR Run-Time Reference Manual.*

# 2 Interface Characteristics

## 2.1 Hardware Characteristics and Limitations

### 2.1.1 Special Equipment and Device Interfaces

None.

### 2.1.2 Special Setup Requirements

None.

## 2.2 Volume and Size

During the primary mission, approximately 220 F-MIDR, 184 Cl-MIDR, 26 C2-MIDR and 6 C3-MIDR master magnetic tapes will be produced.

Each MIDR tape shall contain one mosaicked image, in both an unfiltered and a seam-corrected rendition.

Each rendition of a mosaicked image consists of approximately 56 MB[2] of image and ancillary data.

The F-MIDR and Cl-MIDR each contain a seam locations file containing approximately 43 kB of data.

All files on a MIDR tape shall be blocked into physical records of at most 16,384 bytes (16 kB).

## 2.3 Interface Medium Characteristics

MIDR tapes shall be recorded on half-inch wide magnetic tapes in 9-track format using the 6250 cpi Group Coding Recording method (known as the

[2] 1 MB = $1024^2$ bytes; 1 kB = 1024 bytes

GCR format), as specified by ANSI standard X3.54-1976.

The tapes shall be recorded on a 10 1/2 inch diameter reel containing 2400 feet of tape.

Labelling, block and file structure shall conform to ANSI standard X3.27-1978, Level 3.

## 2.4 File Backup Requirements

One MIDR tape shall be produced during processing. The MIDR data shall be backed up onto a Write Once Read Many (WORM) optical disk. The MIDR tape shall be bit checked against the MIDR data residing on the corresponding WORM optical disk to verify accuracy.

## 2.5 End-of-file (or Medium) Conventions

End-of-file and medium convention shall follow the ANSI standard X3.27-1978.

## 2.6 Data Order

Integers shall follow the DEC VAX/VMS representation with less significant bytes preceding more significant bytes.

The MIDR tapes do not contain any floating point numbers except in an ASCII string representation.

ASCII strings shall appear on tape with the $n$th character preceding the $(n+1)$th character for all characters in the string.

# 3 Access

## 3.1 Programs Using the Interface

The MIDR tapes shall be used by Magellan investigators at various institutions.

## 3.2 Synchronization Considerations

### 3.2.1 Timing and Sequencing Characteristics

The header file shall contain beginning and ending dates of acquisition of data contained in the MIDR tape. These dates are directly correlated to the orbit revolution number of the spacecraft.

### 3.2.2 Effective Duration

The effective duration of the data acquisition period for the data contained in the MIDR tapes is the difference between the beginning and ending dates in the header files.

# 4 Detailed Interface Specifications

## 4.1 Structure and Organization Overview

A MIDR tape shall contain one mosaicked image, in both an unfiltered and a seam-corrected rendition. Each rendition of the mosaicked image frame shall be recorded on the MIDR tape as a 56 file sequence of contiguous subframe files.

A frame shall be made up of a 7-row by 8-column assembly of subframes, recorded in row major order[3] beginning with the northwestern-most corner of the mosaicked image. Each subframe shall contain 1024 x 1024 one-byte pixels, preceded by a header as described in section 4.5.2, below.

The surface area covered by the MIDR image frame varies according to the resolution of the mosaicked image. The following table indicates the *approximate* area covered by a MIDR frame near the equator:

| | Resolution meters/pixel | Lat. x Long. kilometers | Lat. x Long. degrees |
|---|---|---|---|
| F-MIDR | 75 | 540 x 610 | 5 x 5 |
| Cl-MIDR | 225 | 1600 x 1800 | 15 x 15 |
| C2-MIDR | 675 | 4800 x 5500 | 45 x 45 |
| C3-MIDR | 2025 | 9500 x 13000 | 90 x 120 |

## 4.2 File Naming

Each file on the MIDRs shall have a unique file name, recorded in the ANSI header and trailer labels. The file name shall be extracted from the product ID (cf. § 1.4.5). The file name shall be of the form:

$$x\_yydzzz$$

where the fields are as described for the product ID.

The file sequence and type shall be as follows:

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[3] Row major order means that for {subframe(row, column) ≡ $S(r, c)$ }, $S(n, m)$ shall immediately precede $S(n, m + 1)$ and $S(n, 8)$ shall immediately precede $S(n + 1,1)$.

| File Number | File Type | Contents |
|---|---|---|
| 0 | .SFDUHDR | SFDU tape header |
| 1 | .MIDRLBL | data header |
| 2 | .R_001 | subframe #1, uncorrected |
| 3 | .R_002 | subframe #2, uncorrected |
| . | . | . |
| . | . | . |
| . | . | . |
| 56 | .R_055 | subframe #55, uncorrected |
| 57 | .R_056 | subframe #56, uncorrected |
| 58 | .C _001 | subframe #1, seam corrected |
| 59 | .C_002 | subframe #2, seam corrected |
| . | . | . |
| . | . | . |
| . | . | . |
| 112 | .C_055 | subframe #55, seam corrected |
| 113 | .C_056 | subframe #56, seam corrected |
| 114 | .SEAMLOC | seam locations[4] |
| 115 | .SFDUTRL | SFDU tape trailer |

## 4.3 Header and Trailer Files

### 4.3.1 File Overview

The header and trailer files shall each consist of a single record, formatted as an SFDU. Both files shall contain only printable ASCII characters.

### 4.3.2 Header File Definition

The header file shall consist of a single record containing the following sequence of fields (<CR><LF> represents the ASCII carriage return, line feed pair (0D0A HEX)):

**CCSDS Primary Label Type:** Indicates the start of a CCSDS standard data product.

[4] The C2-MIDRs and C3-MIDRs shall not have a seam locations file.

value = **'CCSD1Z00000l'**

**CCSDS Primary Label Length:** Length of tape header record in bytes starting from byte 20.

length = 8 bytes
value = *instance-dependent*

**Volume Start Marker Type:** Indicates the beginning of a logical collection.

value = **'NJPL1V00VL00'**

**Volume Start Marker Length:** Length of volume start value field.

value= **'00000000'**

**Volume Start Identifier Type:** Indicates a keyword-entry secondary header.

value = **'NJPL1K00HD00'**

**Volume Identifier Length:** Length in bytes of the volume identifier value (keyword entry) field.

length = 8 bytes
value = *instance-dependent*

**Data Product ID:** Indicates the product type (cf. § 1.4.5).

value = **'MAJOR_DATA_TYPE=SAR**<CR><LF>'

value = '**MINOR_DATA_TYPE=<Product ID>**<CR><LF>'

**Mission ID:** Magellan.

value = **'MISSION_CODE=MGN**<CR><LF>'

**Tape Write Time:** tape write date/time (wall-clock time).

value = **'TAPE_WRITE_TIME=**yyyy/*ddd—hh:mm:ss*<CR><LF>'

**Tape Creator ID:** written by IDPS.

value = **'CRTE_SYS_CODE=GDS**<CR><LF>'

value = **'CRTE_SBSYS_CODE=IDPS<CR><LF>'**

**Volume Start Value:** Indicates the type of data found in the logical collection.

value= **'NJPLlI00L007'**

**Volume Start Length:** Length of volume start value field.

value= **'00000000'**

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### 4.3.3 Trailer File Definition

The trailer file shall consist of the following sequence of fields:

**CCSDS Primary Label Type:** Indicates the start of a CCSDS standard data product.

value = **'CCSDlZ000001'**

**CCSDS Primary Label Length:** Length of tape trailer record in bytes starting from byte 20.

value = **'00000040'**

**Volume End Marker Type:** Indicates the end of a logical collection.

value = **'NJPLlA00VL01'**

**Volume End Marker Length:** Length of volume end value field.

value = **'00000020'**

**Volume End Value:** Indicates the type of data found in the logical collection.

value= **'NJPLlI00L007'**

**Volume End Length.** Length of volume end value field.

value = **'00000000'**

## 4.4 Tape Header File

### 4.4.1 File Definition

This file shall consist of a VICAR image file.[5] The VICAR label shall contain information which applies to the entire mosaicked image area.

### 4.4.2 Label Contents

The label shall conform to the VICAR image file standard.[5]

All label items detailed below shall be found in the VICAR label.

The label, which is located at the beginning of the field, shall contain a free field ASCII string consisting of "keyword=value" items.[6]

The following entries will be provided. The LBLSIZE keyword will always appear first, but the other entires may not be in the order shown, and may be accompanied by other non-essential entries:[7]

```
LBLSIZE=4096
PRODUCT='F-MIDR.00N017;1'
FILETYPE='MIDR TAPE HEADER'
FORMAT='BYTE'
NL=128
NS=1024
FILE=1
SUBF_TOT=56
MAP_PROJ='SINUSOIDAL'
PROJ_LON=17.4557
PROJSAMP=4096
SPECLINE=3520
DAT_TIM='MON FEB 12 11:33:24 1990'
ANALYST='DOE, JOHN'
REV_STRT=100
REV_END=250
LAT_UR=2.5
LAT_UL=2.5
LAT_LR=-2.5897
LAT_LL=-2.5897
```

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[5] See Appendix A for details of the VICAR image file format.
[6] Label keywords are limited to eight (8) characters.
[7] See Appendix B for the definition of keywords.

LON_UR=20.3614
LON_UL=14.55
LON_LR=20.3579
LON_LL=14.5502
PIXSIZ=75
IMAGE='TEST IMAGE'
DN_UNITS='NONE'
WHICHPIX='ALL_PIXELS'
SEAM _AGE=1
SWINDOW=30
MINFETHR=10
REF_ORB=0

### 4.4.3 Image Data

The VICAR image shall consist of two 64 x 1024 grey wedges. Each wedge shall be made up of 128 grey level chips, each being 8 pixels wide. The top wedge shall consist of grey level chips monotonically increasing by 1 DN from left to right beginning from a DN level of 0 and increasing to 127. The lower wedge shall consist of grey level chips monotonically decreasing by 1 DN from left to right beginning from a DN level of 255 and decreasing to 128.

Each pixel shall be an eight (8) bit, unsigned integer.

## 4.5 Subframe Image File

### 4.5.1 File Definition:

This file shall consist of a VICAR image file. The file shall contain the image data for one of the subframes within a given mosaicked image area.

### 4.5.2 Label Contents:

The label shall conform to the VICAR image file standard.[8]

All label items detailed below shall be found in the VICAR label as applicable.

[8] See Appendix A for detail of the VICAR image file format.

The label which is located at the beginning of the field, shall contain a free field ASCII string consisting of "keyword=value" items.

Some of the keywords in a subframe image label define subframe-local characteristics while others are global values. See Appendix B for the specific interpretation to be applied to each keyword.

The following entries, not necessarily in order except for the LBLSIZE entry first, will be provided (other nonessential entries may be present):

```
LBLSIZE=4096
PRODUCT='F-MIDR.00N017;1'
FILETYPE='MIDR SUBFRAME'
FORMAT='BYTE'
FILE=3
NL=1024
NS=1024
SUBF_COL=2
SUBF_ROW=1
SUBF_TOT=56
MAP_PROJ='SINUSOIDAL'
PROJ_LON=17.4557
PROJSAMP=3072
SPECLINE=3520
SEAM='UNCORRECTED'
DAT_TIM='MON FEB 12 11:33:24 1990'
ANALYST='DOE, JOHN'
REV_STRT=100
REV_END=250
LAT_UR=2.5
LAT_UL=2.5
LAT_LR=1.7735
LAT_LL=1.7735
LON_UR=16.0023
LON_UL=15.2765
LON_LR=16.0025
LON_LL=15.2765
PIXSIZ=75
IMAGE='RADAR CROSS SECTION'
DN_UNITS='DECIBELS'
LOW_DN=1
LOW_REP=-20.0
HI_DN=251
HI_REP=30.0
N_SPDN=1
SPDN_1=0
M_SPDN_1='MISSING DATA'
WHICHPIX='ALL_PIXELS'
SEAM _AGE=1
SWINDOW=30
```

MINFETHR=10
REF_ORB=0

### 4.5.3 Image Data

The VICAR image shall consist of a 1024 x 1024 pixel mosaicked image of the relative radar cross section ($\sigma_r$) in deciBels expressed in terms of data numbers (DN) as:

$$\sigma_r = \frac{DN - 101}{5} \qquad 1 \leq DN \leq 251$$

The DN value 0 designates missing data; DN values 252-255 are reserved for future use. Normalization and reduction to original $\sigma_r$ values is described in SDPS-101. Averaging of pixel values is described in IDPS-102.

The image shall be projected in the sinusoidal map projection centered on the longitude which bisects the total MIDR image area (specified by the 'PROJ_LON' value in the image label).

Near the poles of Venus, the subframes will be partially devoid of pixels as a consequence of the sinusoidal map projection; pixels of value zero (0) will be used for the regions outside of the map area.

The first image line shall be the northernmost in the image and the first pixel in each line shall be the westernmost in the line.

## 4.6 Seam Locations File

### 4.6.1 File Definition:

This file shall contain the seam location data for the entire mosaicked image area.

The seam location file shall be generated only for the F-MIDR and Cl-MIDR products.

A seam is defined to be the set of points midway between the edges of adjacent orbit swaths. (Two orbits may be considered adjacent and even overlap, yet not have consecutive orbit numbers, if there are missing orbits

between them.) At any given point, the two swaths may be either overlapping or non-overlapping. Thus both or neither orbit swath may contribute image data at the seam.

### 4.6.2 Label Contents:

The label shall conform to the VICAR image file standard.[9]

All label items detailed below shall be found in the VICAR label.

The label which is located at the beginning of the field, shall contain a free field ASCII string consisting of "keyword=value" items.

The following entries, not necessarily in order except for the LBLSIZE entry first, will be provided (other nonessential entries may be present):

```
LBLSIZE=1800
PRODUCT='F-MIDR.00N017;1'
FILE=114
FORMAT='HALF'
NL=12200
NS=3
FILETYPE='MIDR SEAM LOCATIONS'
DAT_TIM='MON FEB 12 11:33:24 1990'
ANALYST='DOE, JOHN'
REV_STRT=100
REV_END=250
M_SAMP_1='ORBITAL REV. NUMBER ON RIGHT OF SEAM'
M_SAMP_2='MIDR LINE OF SEAM'
M_SAMP_3='MIDR SAMPLE OF SEAM'
```

### 4.6.3 Image Data

The seam locations file shall consist of NL lines by three (3) samples of data.[10] Each sample shall consist of a sixteen (16) bit, unsigned binary integer value.

Seams shall be identified by scanning across every 100th MIDR line. When a

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[9] See Appendix A for details of the VICAR image file format.

[10] The number of lines in the seam locations file will vary depending upon the number of orbits mosaicked into the MIDR frame. The number of lines will be approximately equal to (REV_END - REV_STRT) x 71.68.

seam is found, the information described below is entered into the seam locations file.

The first sample in each line of the seam locations file shall designate the orbit number which returned the swath found to the right (east on the Venusian surface) of the seam.

The second and third samples in each line shall designate the line and sample in the MIDR frame which is the location of the seam in that line.

A given seam shall be identified approximately 80 times within a MIDR frame. Any seam may be traced by examining the orbit number field.

# A The VICAR Image File

## A.1 Physical Representation

The VICAR image file is stored as a series of fixed length logical records in a one to one correspondence to the raster lines of the digital image contained therein.

On tape, these logical records are blocked into physical records (using the standard ANSI protocol) to reduce the length of tape required to store the image file.

*For the mosaicked image products that are produced by IDPS for the Magellan project, sixteen (16) lines (logical records) will be blocked into each physical tape record. Thus the physical tape block size will be 16 kB.*

All information about the tape blocking is stored in the ANSI labels in accord with the ANSI standard X3.27-1978, Level 3.

Throughout the following description, the term *record* should be understood to mean a logical record as described above.

## A.2 Logical Content

### A.2.1 Image Label

The first $N$ (where $N \geq 0$) records of the VICAR file are reserved to contain the *image label.*

The label consists of free field ASCII entries, delimited by one or more spaces (20 HEX), of a *keyword=value* syntax.

Any excess bytes following the label but within the records reserved for label entries are filled with nulls (00 HEX).

The LBLSIZE entry in the label (see below) defines the length (in bytes) of the label domain and is always an integral multiple of the record length.

The FORMAT entry in the label will be 'BYTE' or 'HALF' for the image

products that MIPL produces for the Magellan project.

The logical record size in bytes is indicated by the NS label entry. Thus, *N* (above) is LBLSIZE/NS.

**Keywords:** Keywords consist of eight (8) or fewer characters drawn from the set of uppercase alphabetic characters, numerals, and the underscore (_). Keywords described in Appendix B must be unique within a single image label.

**Reserved Keywords:** Certain keywords are reserved by the VICAR system for its own use in maintaining the image files. These include the following: LBLSIZE, FORMAT, EOL, NL and NS.

**Other Keywords:** The definitions of keywords used in the MIPL-MGN mosaicked products are found in Appendix B.

**Values:** The value field may be occupied by an integer, a multiple valued integer, a real number or a string. The grammar for the construction of an integer is that of the FORTRAN 'I' format code. A multiple valued integer is a sequence of these. The grammar for the construction of a real number is that of the FORTRAN 'D' or 'G' format codes. A string value follows the FORTRAN representation of character constants (delimited by apostrophes).

### A.2.2 Image Data

For MIPL-MGN mosaicked products, the image data is stored as one byte pixels with NS pixels per line (record) and NL lines per image. The first pixel in the image file is the Northwesternmost pixel in the image.

# B Definition of Keywords

ANALYST Name of analyst. **EC**

ADD_ORBS The list of additional orbits, beyond the orbits within the range given by REV_STRT and REV_END, which make up the MIDR. Specifically, those orbits from one cycle used to fill gaps in a MIDR from another. The orbits are listed in the order in which they were mosaicked into the MIDR. There may be repeated orbit numbers from when orbits were rerun into the MIDR. If no additional orbits were used, this keyword will not be present. Multivalued **GI**

DAT_TIM Processing time and date. **EC**

DN_UNITS Units of physical parameter represented by pixels, *viz. DECIBELS.* **EC**

FILE File number on product tape. $1 \leq \text{FILE} \leq 114$. **LI**

FILETYPE File contents, *viz. MIDR TAPE HEADER, MIDR SUBFRAME,* or *MIDR SEAM LOCATIONS.* **LC**

FORMAT Data type format, *viz. BYTE, HALF.* **LC**

HI_DN Data number corresponding to the highest valid intensity. DNs greater than HI_DN have special interpretations. **GI**

HI_REP Maximum value representable in the image, in DN_UNITS; corresponds to the HI_DN value. **GR**

IMAGE Specific image represented in this file, *viz. NORMALIZED RADAR CROSS SECTION.* **LC**

LAT_LL The latitude of the lower leftmost pixel. **LR**

LAT_LR The latitude of the lower rightmost pixel. **LR**

LAT_UL The latitude of the upper leftmost pixel. **LR**

LAT_UR The latitude of the upper rightmost pixel. **LR**

LBLSIZE Length in bytes of the area reserved for the image label. **LI**

LON_LL The longitude of the lower leftmost pixel (cf. Appendix C). **LR**

LON_LR The longitude of the lower rightmost pixel (cf. Appendix C). **LR**

LON_UL The longitude of the upper leftmost pixel (cf. Appendix C). **LR**

LON_UR The longitude of the upper rightmost pixel (cf. Appendix C). **LR**

LOW_DN Data number corresponding to the lowest valid intensity. DNs less than LOW_DN have special interpretations. **GI**

LOW_REP Minimum value representable in the image, in DN_UNITS; corresponds to the LOW_DN value. **GR**

MAP_PROJ Type of map projection, *viz. SINUSOIDAL,* **GC**

MINFETHR The minimum feather size. this is the parameter $N_0$ in Appendix D of the IDPS FRD. **GI**

M_SAMP_*x* Meaning of sample *x*. This label item is only found in the seam locations file. **LC**

M_SPDN_*x* Interpretation of special data number *x* (see SPDN_*x* keyword below), *viz MISSING DATA.*

GC

NL Number of lines in the image. **LI**

NS Number of samples in the image. **LI**

N_SEAMS Number of seams locations calculated and stored for this image, if SEAMLOC equals YES. **GI**

N_SPDN Number of special data numbers designated by M_SPDN_*x* and SPDN_*x* keywords. **LI**

PIXSIZ Pixel spacing on the planet in meters. **GI**

PRODUCT Name of data product as defined in § 1.4.5. **GC**

PRODTYPE The type of image product, *viz. F-MIDR, C1-MIDR, C2-MIDR,* or *C3-MIDR*. **GC**

PROJ_LON Longitude of the meridian passing through the center of the MIDR image frame that is used as the reference special meridian for the sinusoidal projection. It is the same for all framelets.**GR**

PROJSAMP Sample number nearest the projection longitude counted from the first sample in the MIDR frame or framelets.(PROJ_LON). **GI**

REF_ORB The orbit number used as a reference when performing tiepoint adjustments based on an orbital solutions file. Present only if a solutions file is used and data has been mosaicked into the frame. **GI**

REV_END The highest orbital revolution number from which the image data for the image is derived. **GI**

REV_STRT The lowest orbital revolution number from which the image data for the image is derived. **GI**

SEAM Treatment applied to the orbit swath seams, *viz. CORRECTED,* or *UNCORRECTED*. **LC**

SEAM_AGE The number of previous lines over which the seam averages are again averaged. This is the the parameter Ω described in Appendix D of the

IDPS FRD. **GI**

SEAMLOC — Specifies whether seam locations were calculated and stored for this image, *viz. YES*, or *NO*. **GC**

SPDN_$x$ — DN value of the $x^{th}$ special data number, c.f. M_SPDN_$x$; and N_SPDN. **LI**

SPECLINE — The offset in lines from the first line of the full MIDR frame or framelet to where the global coordinate origin (the intersection of the reference meridian PROJ_LON with the equator) occurs. (Positive for frames above the equator, negative below the equator). **LI**

SPECSAMP — The number of samples from the prime meridian to the projection longitude of the frame, measured in the positive longitude direction. **GI**

SUBFRAME — The number of the subframe counting in the order they appear on the tape. **GI**

SUBF_COL — Column number from which a subframe was taken. $1 \leq$ SUBF_COL $\leq 8$. **LI**

SUBF_ROW — Row number from which a subframe was taken. $1 \leq$ SUBF_ROW $\leq 7$. **LI**

SUBF_TOT — Total number of subframes in an image frame. **GI**

SWINDOW — The minimum seam window size. This is the parameter $\omega_0$ in Appendix D of the IDPS FRD. **GI**

WHICHPIX — Specifies whether all pixels in the image line were used in the mosaic or only those delimited by the values P1 and P2 in the line header of the BIDR image lines, *viz.* "GOOD_PIXELS" or "ALL_PIXELS." (cf. SDPS-101) **GC**

NOTES:

1. Keyword type abbreviation: **I** ≡ integer; **C** ≡ character, (strings will be written out in all upper case characters); **R**≡ real.

2. Scope designations: **G** ≡ global scope, pertains to entire mosaicked area; **L** ≡ local scope, pertains to the file in which it is used (N.B. In the data header file, all label items pertain to the entire collection of subframes); **E** ≡ equivalent, the label item would have the same value whether its scope were either global or local.

# C Governing Formulae

The following appendix lists the formulae governing the conversion of latitude and longitude to line and sample, and the equations relating the various label items on the MIDR image frame. These equations are valid for both the full MIDR frame and the subframes.

## C.1 Latitude and Longitude

*LINE* = ROUND[ SPECLINE - *LATITUDE* * *SCALE* + 1]

*SAMPLE* = ROUND[ PROJSAMP + (*LONGITUDE* - PROJ_LON)
**SCALE* * cos(*LATITUDE*) + .5]

If *LONGITUDE* identically equals PROJ_LON, then *SAMPLE* is set to PROJSAMP.

Where *SCALE* equals the number of pixels per degree, which depends on the resolution of the product; e.g. for the F-MIDR the pixel width is 75 meters and using the nominal Venus radius of 6051000 meters gives

*SCALE* = (1 / PIXSIZ) * (2π * 6051000m / 360°)

PIXSIZ = 75 meters; *SCALE* = 1408.13045 pixels/degree

And ROUND[ ] means 4-5 integer rounding, ie.

+ .5 and truncate when positive
- .5 and truncate when negative

## C.2 Label Items

Let *FRAMELAT* and *FRAMELON* equal the coordinates of the center of the upper left-hand corner pixel, then:

PROJ_LON = *FRAMELON* + ((PROJSAMP -.5) / *SCALE* )/
cos(*FRAMELAT*)

SPECSAMP = PROJ_LON * *SCALE* + .5

SPECLINE = ROUND[*FRAMELAT* * *SCALE*]

LAT_UR, LAT_UL = *FRAMELAT*

LAT_LR, LAT_LL = *FRAMELAT* - (NL - 1) / *SCALE*

LON_UL = *FRAMELON*

LON_UR = *FRAMELON* + ((NS - 1) / *SCALE* )/ cos(*FRAMELAT*)

LON_LL = PROJ_LON - ((PROJSAMP - .5) / *SCALE* )/ cos(LAT_LL)

LON_LR = PROJ_LON + ((NS - 1) - ((PROJSAMP - .5))
/*SCALE* )/ cos(LAT_LR)

# D Summary of Changes in Cycle 2

The following appendix lists the changes to the MIDR tape product specific to the Cycle 2 era.

## D.1 Product ID

As described in Section 1.4.5, the external label/product ID shall have a different format beginning in Cycle 2. Changing the product ID like this makes it easier to distinguish Cycle 2 MIDR's from Cycle 1 MIDR's since the locations of the MIDR's are the same in all cycles.

## D.2 Keywords

Listed in Appendix B is the new keyword, ADD_ORBS. This keyword will appear only when inserting orbits from one cycle into a MIDR of another cycle.

## D.3 Special Products

During Cycle 2, a primary objective will be the filling in of gaps in the Cycle 1 MIDR products. Since all MIDR's in Cycle 2 will be by special request, there will be more opportunities to use all the parameters of the MIDR production software. For example, WHICHPIX may be set to "GOOD_PIXELS" if the overlap between orbits is sufficient for good seam correction using only the good pixels in a data line. The width of the seam window (through keywords MINFETHER and SWINDOW) may be modified and seam aging (keyword SEAM_AGE) may be used to improve the seam correction.