

Cassini Composite Infrared Spectrometer (CIRS)

Planetary Data System (PDS) Time Sequential Data Record (TSDR) Data Product Software Interface Specification (SIS)

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1 Introduction

This document describes the format and content of the Cassini Composite Infrared Spectrometer (CIRS) Time Sequential Data Record (TSDR) products, as archived to the Planetary Data System (PDS). The aim of this document is to provide a user guide for persons accessing and using the archived data.

Acknowledgment

The heritage of the CIRS ground data system draws heavily on the experience and tools developed by the Mars Global Surveyor Thermal Emission Spectrometer (MGS TES) team. Their database utility 'Vanilla' is used as a core access tool by the CIRS team. In addition, the authors have drawn on the TES-TSDR Standard Data Product SIS as a template and starting point for this document.

2 Data Overview

2.1 CIRS Instrument

CIRS is a Fourier Transform Spectrometer, and a dual interferometer by design (see Kunde et al 1996, Flasar et al 2004). In the mid-infrared, a conventional Michelson mirror arrangement is terminated by dual 10-element detector arrays. The 10 photoconductive (PC) detectors of focal plane 3 (FP3) have a bandpass of 600–1100 cm^{-1} approximately, and the 10 photovoltaic detectors of focal plane 4 (FP4) are sensitive from 1000–1500 cm^{-1} . Each of the 20 MIR detectors has a square field of view (FOV) which is 0.273 milliradian across.

In the far-infrared, a Martin-Puplett type (Martin and Puplett 1969) polarizing interferometer conveys the radiation onto two redundant thermopile detectors, one sensitive to the transmitted and one to the reflected beam at the final polarizer-analyzer. Each detector has a circular FOV of full width to half maximum (FWHM) 2.4 milliradians. Each covers the spectral range 10–600 cm^{-1} , and are known as FP1.¹

CIRS records interferograms (IFMs) at varying resolution: from 0.5 cm^{-1} to 15.5 cm^{-1} . The resolution is determined by the scan distance (time), normally commanded in units of 1/8 second (=1 RTI, or 'Real Time Interrupt'). The valid range of RTIs is 36 to 416. The resolution is approximately inversely proportional to the scan time, although in fact the relationship is non-linear, especially at short scan times (see Figure 1). This is due to (i) mirror flyback time, which is included in the commanded scan time, and (ii) mirror acceleration and deceleration to constant-velocity scanning.

¹In the original design for CIRS, a second FIR detector (FP2) was planned; but this was later removed during a de-scope exercise.

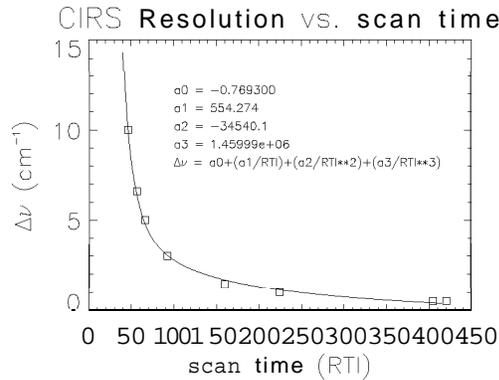


Figure 1: CIRS resolution vs scan time.

2.2 CIRS MIR Observing Modes

In the mid-IR, CIRS has only five solid-state 'channels'⁷ for post-detection signal processing, for each of FP3 and FP4. These arrays each have 10 detectors, so the solution is that exactly five detectors can be activated at a time from each array.

There are four pre-programmed observing modes (see figure 2):

ODD Detectors 1, 3, 5, 7, 9 active on each array.

EVEN Detectors 2, 4, 6, 8, 10 active on each array.

CENTER Detectors 4-8 (FP3) and 3-7 (FP4) active on each array.

PAIRS The signal from the detectors is combined pairwise before signal processing; so 1&2 are paired etc, through 9&10.

The result is that CIRS normally writes 11 IFMs at a time to the Bus Interface Unit (BIU): 1 from FP1, 5 from each of FP3 and FP4. However, there are reduced data modes where only 6 (FP1 plus either FP3 or FP4) or 1 (FP1) channels are written. Note that, in addition, CIRS may be commanded to co-add IFMs pairwise in time, with the result that data are only written on alternate scans. This achieves a 50% reduction in data volume if and when required, at the cost of possible 'smear' of spatial field if the spacecraft is scanning.

2.3 Standards Used in Generating Data Products

2.3.1 Time Standards

The primary key field, used to cross-link CIRS data in different files together, is **spacecraft** event time (SCET) stored **as** an integer number of seconds since 1/1/1970 00:00:00 UT,

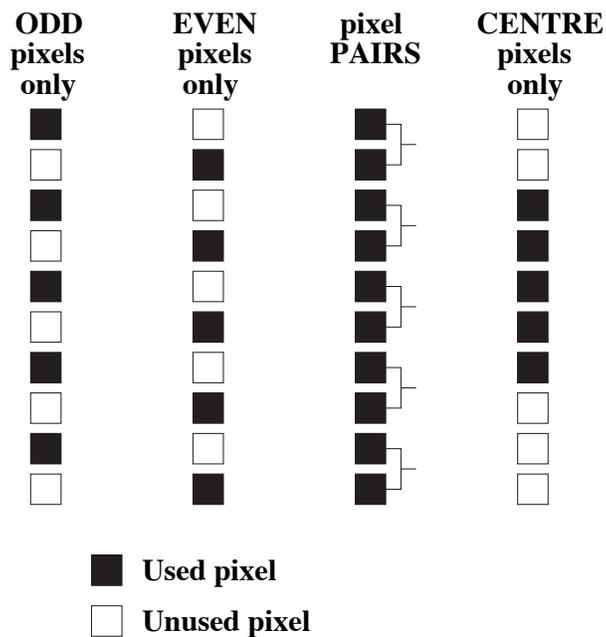


Figure 2: CIRS pixel switching modes.

ignoring leap seconds. Also stored as retrievable field, but not a key field, is *spacecraft clock* (SCLK), and the SCLK partition number. These are stored as two integers.

SCLK is essentially an integer number related to oscillations of the on-board quartz crystal clock. Partition number is advanced by one when the SCLK count is reset, expected to be a rare event, if ever. SCLK ticks are not even linearly related to universal time, and the conversion between the two requires a polynomial to account for drifts in the SCLK oscillation frequency. SCET on the other hand *is* linearly related to universal time.

SCET is used as the primary time key field rather than SCLK for two reasons: firstly, SCLK may reset, and not be monotonically increasing, in which case the partition number also changes; and secondly, SCET may easily and conveniently be converted to text time using standard computer library functions, whereas interpreting SCLK requires the NAIF toolkit and Cassini time kernel (SCLKSCET) files.

At the time of writing, standard computer library routines are available which facilitate the conversion to and from text time to SCET number, such as the C call to `gmtime`.

2.3.2 Co-ordinate Systems

In general, our conventions will follow the Cassini Archive Plan for Science Data: refer to that document for further details.

Jupiter: System III west longitude and planetographic latitude.

Titan: Titan longitude is the standard Longitude of Central Meridian (West Longitude) with the origin in the Saturn-facing direction of synchronous rotation. Latitude is relative to a spherical body at the time of writing: hence the planetographic/planetocentric dichotomy does not occur.

Saturn: System III west longitude and planetographic latitude.

Rings: see appendices.

Icy Satellites: standard Cassini definitions will be applied (see the APSD document).

2.3.3 Orbit Numbers (revs)

We use Cassini orbit numbers, as determined by the Cassini project.

2.3.4 Data Storage Conventions

CIRS data is produced on PC-type machines using, at the time of writing, 32 bit Intel CPU's of either the Pentium or Xeon class. These chips use the LSB (least significant byte) storage convention. More details can be found in Appendix C of the PDS Standards Reference document.

2.4 Interferences and Noises

CIRS interferogram data suffers from a number of external interferences, especially:

- A 8 Hz spike pattern due to the spacecraft clock ticks.
- A 1/2 Hz spike pattern due to the Bus Interface Unit, transfer of data.
- A sine wave of variable frequency which appears correlated with the electronics board temperature.
- Scan speed fluctuations which have been traced to two mechanical vibrations on the spacecraft: (a) the MIMI LEMMS actuator (b) the reaction wheels used to turn the spacecraft.

These various effects are described in more detail in the [cirs_interferences.pdf](#) document found in the DOC directory.

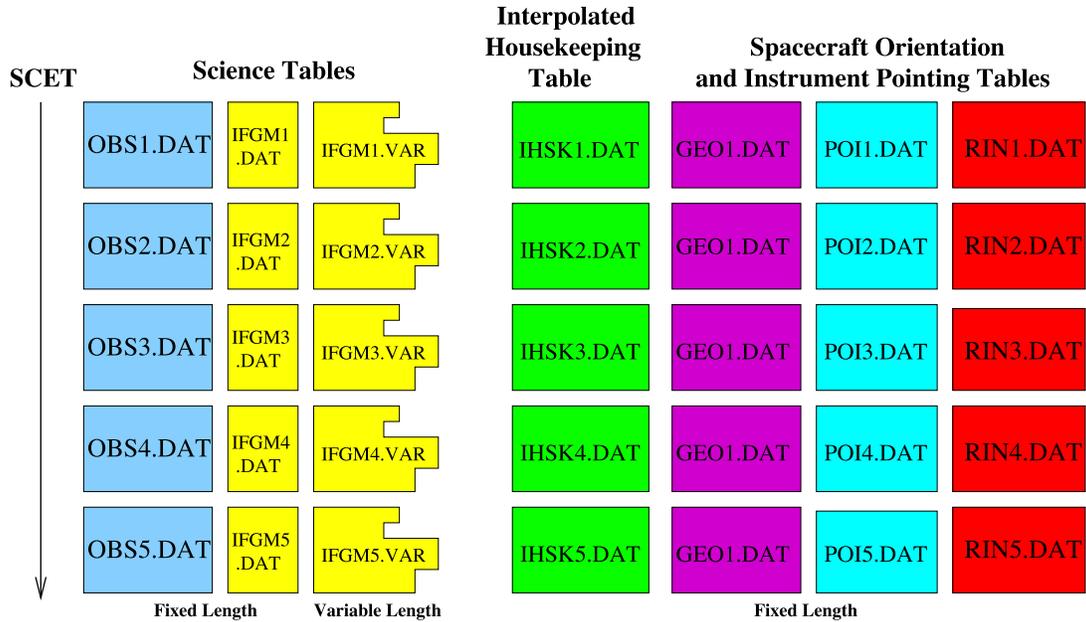


Figure 3: CIRS data file fragments.

3 Data Detailed Description

3.1 Logical Table and Physical Organisation

The dataset is conceptually one huge table, with records ('rows') time-ordered, and containing many fields ('columns'). In practice, this large 'virtual' (or 'logical') table is stored in multiple files, known as fragments. This 'physical' table is fragmented both in the 'row' and 'column' sense.

Table fragments have name stems of the form NNNYYMMDDHH, where 'NNN' is a fragment type descriptor, such as 'OBS' indicating observation parameters, and 'IFGM' indicating interferogram data. The remainder of the stem is a time period: year (YY), month (MM), day (DD) and hour (HH) corresponding to the start of the data period covered. CIRS data typically is divided into 4-hour blocks at the uncalibrated level and 24-hour blocks at the calibrated level, although there may be exceptions. Normally this division is transparent to the user in any case, because Vanilla treats all separate files as forming part of a single, huge logical search table.

Each fragment stem has a file extension '.DAT' if it contains only fixed-length fields. If it contains both fixed length and variable length fields, then fragments with both '.DAT' and '.VAR' will be written for that stem name. The '.DAT' portion of a variable length fragment specifies the location of the variable length data in the '.VAR' file.

See figure 3 for schematic.

Fixed length files are designed to contain data fields of unvarying length. These items include fixed byte-size scalar values such as detector number, scet time, number of points in the IFM etc, and also fixed-size vectors such as the distance to the target surface for each of the nine Q-points in each detector.

The variable length files contain vectors types which may vary in length. The archetypal examples of variable-length vector fields are the interferograms and spectra. The number of points in an FTS spectrum depends is proportional to the spectral resolution (approximately): the higher the spectral resolution, the longer the interferogram (i.e. greater path difference sampled), and the more spectral points in the final spectrum. I.e. the fixed bandpass is being covered by more and more points closer and closer together.

CIRS has a variable spectral resolution from 0.5 cm⁻¹ to 15.5 cm⁻¹ (apodized), depending on commanded scan length, and hence the need for variable-length vector fields. If these were stored as fixed-length vectors padded with zeroes, it would be extremely inefficient storage.

3.2 Fields and Key Fields

As mentioned above, each fragment type stores different fields of the table. For example, while the 'OBS' (observation parameters) fragment may store the MIR shutter open/closed status, the 'HSK' (housekeeping) fragment may store the temperature of the primary mirror. All fragments generally store unique information, not contained in other fragments. The exceptions to this are the so-called 'key fields', which provide the row indexing.

The primary key field is scet - the spacecraft event time, stored as a number of seconds since the start of 1970. However, as CIRS simultaneously records 11 IFMs, the time alone is not enough to uniquely label an IFM. Hence, a unique detector id is used, as listed in table 1. Note that the same physical detector is treated separately depending on whether it is being used in ODD/EVEN or CENTER mode. This is due to the fact that the signal will be processed by a different receiver channel in the electronics in the two cases, and so they must be calibrated separately.

As well as spectral information, the table stores pointing information for the detectors at the time of observation. This information is generated on the ground from the reconstructed c-kernels provided by JPL, in association with the instrument frames kernel.

However, a further degeneracy may be introduced into the data, if multiple targets appear in a single FOV. We must find a way to specify multiple pointings for say, a moon, which appears superimposed on the parent planet. Hence, the third key field is the target id.²

Thus a maximum of 3 key fields uniquely determine a row in the table. A given data fragment will store the key fields sufficient to uniquely identify the data within. E.g, the OBS fragment stores SCET only, the IFGM fragment stores SCET and DET, while the POI stores SCET, DET and TARGETJD.

²The target id field is called 'body id' when it occurs in the GEO tables, to distinguish objects which may or may not be in the FOV ('bodies') from objects which are definitely in the FOV ('targets').

Focal Plane	Observing Mode	Detector Number	Database ID Code
1	ALL	1	0
3	PAIR	1 & 2	1
3	PAIR	3 & 4	2
3	PAIR	5 & 6	3
3	PAIR	7 & 8	4
3	PAIR	9 & 10	5
3	CENTER	4	6
3	CENTER	5	7
3	CENTER	6	8
3	CENTER	7	9
3	CENTER	8	10
3	ODD	1	11
3	EVEN	2	12
3	ODD	3	13
3	EVEN	4	14
3	ODD	5	15
3	EVEN	6	16
3	ODD	7	17
3	EVEN	8	18
3	ODD	9	19
3	EVEN	10	20
4	ODD	1	21
4	EVEN	2	22
4	ODD	3	23
4	EVEN	4	24
4	ODD	5	25
4	EVEN	6	26
3	ODD	7	27
4	EVEN	8	28
4	ODD	9	29
4	EVEN	10	30
4	CENTER	3	31
4	CENTER	4	32
4	CENTER	5	33
4	CENTER	6	34
4	CENTER	7	35
4	PAIR	1 & 2	36
4	PAIR	3 & 4	37
4	PAIR	5 & 6	38
4	PAIR	7 & 8	39
4	PAIR	9 & 10	40

Table 1: Detector ID specifications in the database.

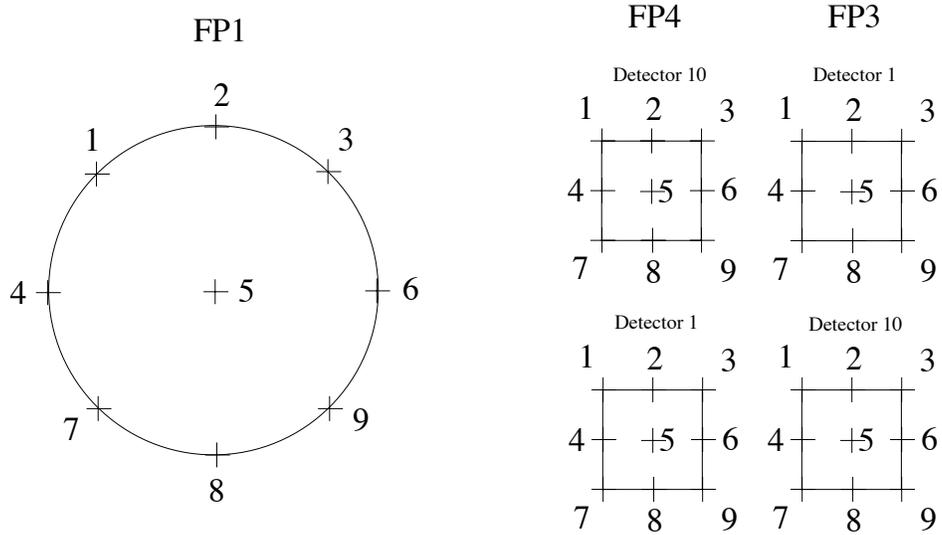
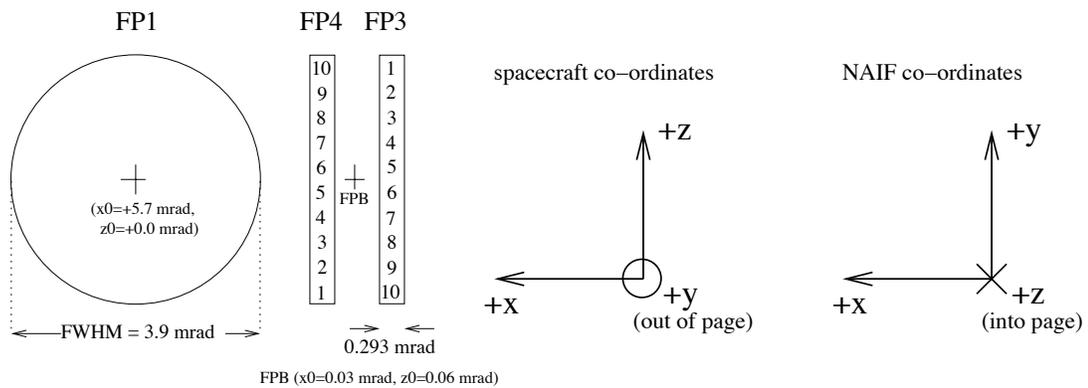


Figure 4: Q-points for CIRS detectors.

Table Type	Key fields			
	SCET	DET	TARGETJD	BODYJD
AIFM	X	X		
GEO	X			X
IFGM/FIFM	X	X		
IHSK/HSK	X			
OBS	X			
POI	X	X	X	
RIN	X	X		
SPM/ISPM	X	X		
TAR	X	X		

Table 2: Key fields for different file types.

The field BODYJD, as used in the GEO tables, is similar to the TARGETJD used in the POI tables. The main difference is that GEO table contains positional information for a subset of large bodies (primary planet, larger moons) with respect to the spacecraft, *whether* or not they are in the instrument FOV. The POI tables on the other hand store pointing information for all bodies which enter one or more of the FOVs. Hence, the list of bodies is different in the two cases, and a different keyword must be used to separate between the two.

3.3 Fixed-Length Data File Format

When we say 'fixed-length' file format in this document, we refer to the record, not the file. I.e., we mean that the record may consist of say 10, 4-byte numbers, for a total fixed width of 40 bytes. No field varies in width. However, the length of the file (number of records) can and will vary between instances of the file type. One may have 100 fixed-length records, another 300.

Fixed-length data record files (.DAT type) store much of the CIRS pointing, geometry, housekeeping and some science data fields. The other main type of data files are the variable-length data files (.VAR type), which act as extensions to the fixed-length data files and are described below. Both file types are binary, written in PC encoding (LSB).

Each record in a fixed-length record file consists of a number of fields. The field widths are fixed, and every field is written for every record. The field layout of each type of fixed-format data files is give in a format file (.FMT), which are re-produced in Appendix B. Format files also form an integral part of the Vanilla database, and hence there is always a copy of the requisite format files in each data subdirectory.

Important Note: fields are written to the file with the exact byte-lengths described in the format files. Depending on which system, language and compiler is used to read/write the binary data, this will usually mean that each field must be read/written by a single command statement, rather than read/writing the entire record at a time, using a data 'structure'. Structures are often padded, so that a 1-byte number may be read/written

as 4-bytes for example, if it occurs next to 4-byte integers in a structure. The code used to write CIRS data is all written in the (ANSI) C-language, and the subroutines are all included in the SOFTWARE/SRC directory of each volume.

3.4 PDS Label Files

Each fixed-format binary data file (.DAT type) is accompanied by an ASCII label file (.LBL type) containing key fields written in PDS3 Object Description Language (ODL) format. An example is:

```

PDS_VERSION_ID          = PDS3
INSTRUMENTHOSTNAME     = "CASSINI ORBITER"
INSTRUMENTNAME         = "COMPOSITE INFRARED SPECTROMETER"
MISSIONPHASENAME       = "JUPITER CRUISE"
DATASETID              = "C0-J-CIRS-2/3/4-TSDR-V1.0"
PRODUCTID              = "CIRS-ISPM01013000"
STANDARD-DATA-PRODUCT-ID = "CIRS-ISPM"
NOIE                   = 'Created by Conor A Nixon.
      MD5 checksum of table = 0fe68fbba98e8869724a7f58e60232f2
      NAIF toolkit version = N0054"
PRODUCT-CREATION-TIME  = 2003-10-29T22:21:58
SPACECRAFTCLOCKSTARTCOUNT = "1/1359504733.204"
SPACECRAFT-CLOCK-STOP-COUNT = "1/1359590206.099"
STARTTIME              = 2001-01-30T00:00:18
STOP_TIME              = 2001-01-30T23:44:50
SPICEPRODUCTID        = { "cas_cirs_v05.ti", "cas_v28_mod.tf",
      'naif0007.tls', "pck00007.tpc",
      "010420R_SCPSE_EP1_JP83.bsp", "SCLK.ker",
      "010129_010201rb.bc" }
TARGET-NAME            = { JUPITER }
OBJECT                 = FILE
      *TABLE            = "ISPM01013000.DAT"
      FILE-NAME         = "ISPM01013000.DAT"
      RECORD-TYPE       = FIXED-LENGTH
      RECORDBYTES       = 45
      FILERECORDS       = 3478
      OBJECT            = TABLE
      NAME              = ISPM
      INTERCHANGEFORMAT = BINARY
      *STRUCTURE        = "ISPM.FMT"
      START-PRIMARY-KEY = (980812818)
      STOP-PRIMARY-KEY  = (980898290)
      PRIMARY-KEY       = ( "SCET", "DET" )
      ROWS              = 3478
      ENDOBJECT        = TABLE
END_OBJECT             = FILE

```

```

OBJECT                = FILE
  FILENAME            = "ISPM01013000.VAR"
  RECORDTYPE          = UNDEFINED
  DESCRIPTION          = "This file contains variable length spectra
                        which can be read using the Vanilla software
                        package. See the Vanilla software
                        documentation for details."
END-OBJECT            = FILE
END

```

These fields are interpreted as follows:

PDS_VERSION_ID, RECORD-TYPE	standard items.
INSTRUMENTHOSTNAME,	
INSTRUMENTNAME	spacecraft and instrument name.
MISSION_PHASE_NAME	mission phase.
DATA-SETJD, PRODUCTJD,	data set id; product id.
STANDARD-DATA-PRODUCTJ D	standard data product id.
NOTE	data creating person; MD5 checksum; NAIF version
PRODUCT-CREATIONTIME	data creation time.
SPACECRAFT-CLOCK-START-COUNT,	
SPACECRAFT-CLOCK-STOP-COUNT	values of the spacecraft clock for the first and last records in this file.
START-TIME, STOP-TIME	as previous, but in UTC time rather than seconds since epoch.
SPICE_PRODUCT_ID	IDs of SPICE kernels used in pointing.
TARGETNAME	target name.
Lines 21-36	description of table object (.DAT file contents).
TABLE	pointer to start record of table object.
FILE-NAME	name of this file, in the format: [type]YYMMDDHH where WMMDD is the year-month-day of the science data, and HH is the hour of the data start.
RECORD-TYPE	file is fixed-length records.
RECORD_BYTES	number of bytes per record.
FILE-RECORDS	number of data records in file.
STRUCTURE	file name of table format description.
PRIMARY_KEY	names of key fields, primary key first.
Lines 37-44	description of variablelength record file.

3.5 Variable-length Data File Format

When a particular table fragment type contains variable-length data, then only a pointer is stored in the '.DAT' file. The actual variable-length data is contained in a file having the

same name, except that the extension is `‘.VAR’`. E.g. a table fragment `‘IFGM0001.DAT’` would be accompanied by `‘IFGM0001.VAR’`.

In the variable-length data file, each record starts at the byte position indicated for that record in the `‘.DAT’` file. Preceding, and following the actual data is a 2-byte integer giving the length in bytes. E.g. if the first record in the file was a spectrum of 32 4-byte floats, the first two bytes in the file would be the short integer `‘32’`, followed by the 32 4-byte floats, followed by the 2-byte number `‘32’` again.

In the fixed-length file, the first pointer would be 1, the second pointer would be $133 = (32 * 4) + 2 + 2 + 1$, pointing to the next spectrum, and so on. Note that although the fixed-format `‘.DAT’` files can exist without a `‘.VAR’` accompanying, the reverse is not true: a `‘.VAR’` file must always have a `‘.DAT’` counterpart, to store the byte offset positions of the variable-length record data.

3.6 Table Types

The following sections describe the different types of CIRS data tables. Field names given are the exact field names which are used when interrogating the database using Vanilla. Field names followed by `‘[]’` are variable width fields, i.e. an array, whose number of elements may vary from record to record. Normally, the number of elements in the array for each record is given in the preceding field. Some fields are fixed-width arrays, e.g. `‘LATITUDE_ZPD[9]’`, an array of nine elements. Please see the Vanilla Users Guide document for more information on querying arrays.

3.6.1 OBS tables

These tables store information relating to the instrument data-taking settings for each scan, and also the values of warning or indicator flags. Fields:

SCET

Spacecraft Event Time, in UT seconds from epoch (01/01/1970). This field is the primary key for all table fragments, and is a required field in all table types. Note that there is a utility `cirs_time` for converting text time to SCET.

SCLK

Spacecraft clock ticks, approximately from launch. Not guaranteed to exact one-second intervals. SCLK is not used a primary key field because unlike SCET, it cannot be simply converted to UT without the NAIF library routines, and the SCLKSCET kernels.

RTI The length of the scan, in real time interrupts (1/8 second).

FP3_MODE Detectors enabled on FP3. Four possible values: (O)dd, (E)ven, (C)enter or (P)airs.

FP4_MODE Detectors enabled on FP4. Values as for **FP3_MODE**.

HR-OVERFLOW Overflow detected on FIR accumulation.

FP1_OVERFLOW Overflow on FP1 average buffer.

FP3_OVERFLOW Overflow on FP3 average buffer.

FP4_OVERFLOW Overflow on FP4 average buffer.

FP1_COMP_OVERFLOW Overflow on compression buffer 1.

FP3_COMP_OVERFLOW Overflow on compression buffer 3.

FP4_COMP_OVERFLOW Overflow on compression buffer 4.

FP3_ZERO Detected **000H** on FP3 raw data.

FP3_0FFF Detected **0FFFH** on FP3 raw data.

FP1_ZERO Detected **000H** on FP1 raw data.

FP1_0FFF Detected **0FFFH** on FP1 raw data.

FP4_ZERO Detected **000H** on FP4 raw data.

FP4_0FFF Detected **0FFFH** on FP4 raw data.

COADD Coadding enabled.

SCIENCEOVERWRITTEN Science data overwritten condition detected.

FLYBACK-EXCEEDED Flyback exceeded.

SCANEXCEEDED Scan exceeded.

MECHANSMENABLED Mechanism enabled.

MECH_OUT_OF_PHASE Mechanism out of phase some time.

LASER_A_ENABLED Laser A enabled.

LASER_B_ENABLED Laser B enabled.

MECH_CMDED Enable mechanism cmded.

WHITE-OVERRIDE White light override.

OPTICAL-SENSENODE Optical sensor (0), decs (1) mode.

SHUTTER Shutter open (0), closed (1).

RIELASCMDLSB RIE: LASCMDJLSB Lamp current select.

RIELASCMDNSB RIE: LASCMDJMBSB Lamp current select.

RIE_LASCMD_A RIE: LASCMDA Lamp A select.

RIE_LASCMD_B RIE: LASCMD_B Lamp B select.

RAW_NO_SET Count of raw samples without set control bits.

RAW_FP1_COUNT Number of FP1 samples read in this scan.

RAW_FP3_COUNT Number of FP3 samples read in this scan.

RAW_FP4_COUNT Number of FP4 samples read in this scan.

FIRST_SAMPLE_RTI RTI value when 1st sample in scan collected.

3.6.2 FRV tables

These tables store the voltages of the central fringe of the CIRS white-light interferometer, sampled at 1 second intervals after mirror flyback. See Kunde et. al. (1996) for details of this device.

SCEI

The Spacecraft Event Time of start of scan (seconds from epoch).

NRV

The number of data points in the fringe voltage record.

RV

A pointer to the location of the data in the variable length record file.

3.6.3 IFGM tables

These tables store the actual IFM records. Note that there will be eleven IFM records (one per signal channel) for each OBS record.

Each record consists of a fixed-length part and a variable-length part corresponding to the actual IFM, which is stored in a separate file. The header stores the detector number and a pointer to the position of the variable-length data record in the VAR file.

Fields:

SCEI

The Spacecraft Event Time of start of scan (seconds from epoch 1/1/1970 neglecting leap seconds).

DET

The number of the detector which recorded the IFM (see table 1).

NPTS

The number of data points in the interferogram.

IFGM

A pointer to the location of the IFM in the variable length record file.

3.6.4 HSK tables

These tables store the data from the housekeeping packets, including temperature information which is required for the calibration of IFMs. Note that the housekeeping packets are created every 64 seconds, and records do not have a direct one-to-one or one-to-many correspondence to science scans, as all other table records do. A full description of these data is in the CIRS flight software documentation.

Fields:

SCET Spacecraft event time of this record.

SMERIESTAT SME/RIE status echo word.

FP3LASTCMD FP3 last command.

FP4LASTCMD FP4 last command.

TCMLASTCMD TCM last command.

FP1MAX FP1 maximum raw sample.

FP3MAX FP3 maximum raw sample.

FP4MAX FP4 maximum raw sample.

FRINGEMAX Fringe maximum voltage.

FRINGEMIN Fringe minimum voltage.

PENDINGTTAG Number of pending time tagged commands.

CODECHK Code checksum.

REJECTOP Last command rejected opcode.

PCAATEM PCA 'A' board temperature.

PCA_BTEM PCA 'B' board temperature.

PCA_CTEM PCA 'C' board temperature.

SMEATEM SME 'A' board temperature.

SME_BTEM SME 'B' board temperature.

RIATEM RIE 'A' board temperature.
FEE_ATEM FEE 'A' board temperature.
FEE_BTEM FEE 'B' board temperature.
FEE_CTEM FEE 'C' board temperature.
FEE_DTEM FEE 'D' board temperature.
TCM_ATEM TCM 'A' board temperature.
TCM_BTEM TCM 'B' board temperature.
BASEPLATETEM Base plate temperature.
PROCESSORTEM Processor board temperature.
BIUTEM Bus Interface Unit (BIU) board temperature.
ADCTEM Analog to digital converter (ADC) board temperature.
MOTORCURRENT Scan motor current.
DECSPOSN DECS position.
VELERR Velocity percentage error.
PHASEERR Phase error.
FRINGEV Fringe voltage.
RIESMEPOS12V RIE/SME positive 12V.
RIESMENEG12V RIE/SME negative 12V.
RIESMEPOS5V RIE/SME positive 5V.
LASERCURRENT Laser current.
LEDCURRENT LED current.
IDSPOS15V IDS positive 15 volts.
IDSNEG15V IDS negative 15 volts
IDSPOS5V IDS positive 5 volts.
PHOTDIODE Photodiode monitor.
HTR80KCURR 80K heater current.
HTR0P_ACURR Optics assembly heater current.
HTRP_MRCURR Primary mirror heater current.
HTRS_MRCURR Secondary mirror heater current.

HSECOOLTEM Housing temperature at cooler interface near Ge lens.
FIWOLRIZTEM Far-IR (FIR) inout polarizer temperature.
HSEABVMECHTEM Housing temperature on radiator above scan mechanism.
FPIDETTEM FP1 detector temperature.
MECHHSETEM Scan mechanism housing temperature.
SECMIRRTEM Secondary mirror back side temperature.
PRIMIRRTEM Primary mirror back side edge temperature.
SECMIRBAFFTEM Secondary mirror baffle back side temperature.
PMSUNSHDMLITEM Primary mirror MLI side sun-shade temperature.
PMSUNSHDRADTEM Primary mirror radiator side sun-shade temperature.
CONERIMTEM Cone rim temperature.
FPATEM Focal Plane Assembly (FPA) temperature.
THERMISTORDRV Thermistor drive.
IDSCALIB IDS Calibration.
IDSNEG5V IDE negative 5 volts.

3.6.5 IHSK tables

These tables store interpolated housekeeping data. Selected quantities from the HSK house-keeping tables are interpolated to the times of the actual scans, for use in calibration. Fields:

SCET Spacecraft Event Time (UT) seconds from 1/1/70.
HSECOOLTEM Scan mechanism housing cooler temperature.
FIWOLRIZTEM Temperature of the FIR polarizer.
ZINSTRADTEM Z-axis instrument radiator temperature.
FPIDETTEM Temperature of the FP1 detector.
MECHHSETEM Scan mechanism housing temperature.
SECMIRRTEM Temperature of the secondary mirror.
PRIMIRRTEM Temperature of the primary mirror.
SECMIRBAFFTEM Temperature of the secondary mirror baffle.
PMSUNSHDMLITEM Temperature of the primary mirror sunshade MLI.
PMSUNSHDRADTEM Temperature of the primary mirror sunshade radiator.
FPATEM Temperature of the MIR focal plane assembly.

3.6.6 DIAG tables

These tables contain diagnostic information determined regarding the raw interferograms, including the presence or absence of noise interferences.

SCET

The Spacecraft Event Time of start of scan (seconds from epoch 1/1/1970 neglecting leap seconds).

DET

The number of the detector which recorded the IFM (see table 1).

BIURTI

RTI offset of BIU interference.

noise

Noise status identification. Bits are set as follows:

2^0	Normal
2^1	DC Level
2^2	Drift
2^3	(Big) Spikes
2^4	Std Dev
2^5	Long
2^6	Short
2^7	Insuf.Samples
2^8	Avg Ifm
2^9	Invalid Time Stamp
2^{10}	Shutter
2^{11}	ZPD Position

DSCAL

Set to 1 for DSCAL and 0 for no DSCAL. This identifies whether a given IFM occurs inside a DSCAL request, or not. DSCAL requests are dedicated observations of deep space for calibration purposes. Note however that space IFMs may occur in other request types.

LASER

Arbitrary laser mode number:

1	[4.95 - 5.25V]
2	[5.55 - 5.85V]
3	[5.95 - 6.25V]
0	the rest RIE[2]

3.6.7 GEO tables

These tables store the 'geometry', the relative positions and orientations of the spacecraft, primary body, and object bodies (which may include the primary, e.g. Saturn), usually at the time of the zero path difference (ZPD) of the interferogram (when most of the signal is collected). One entry is generated for every body in the target list.

Fields:

SCET

The SCET of the beginning of a scan is stored as an integer containing "Unix time", the whole number of seconds past January 1, 1970 UT, *neglecting leap seconds*. This means that for every leap second added (subtracted) the "zero of time" actually shifts forward (backward) with respect to UT. This is ordinarily not a problem, but has to be taken into account when converting SCET to ephemeris time.

SCET_FRACTIONAL_SECONDS

The fractional part of the SCET.

SCLK

The SCLK.

PARTITION

The partition number of the SCLK. See the NAIF toolkit documentation for a description of SCLK partitions.

TIME_ZPD

The time of the ZPD, which is a few seconds after `scet`. This is also a "Unix time".

BODY_ID

The NAIF id of the body, for example, 699 (Saturn).

EPHEMERISTIME

The ephemeris time used to obtain the following entries from the SP kernels. This ephemeris time is computed from `TIME_ZPD`.

BODY_SPACECRAFT_RANGE

The distance from the center of the body to the spacecraft, in km.

BODY_POSITION

The Cartesian coordinates of the body as seen from the spacecraft, in km, in the J2000 coordinate system. This is computed at the `EPHEMERIS-TIME`.

BODY_SUB_SPACECRAFT_LONGITUDE

The planetographic sub-spacecraft longitude at SCET, in degrees west, in the IAU coordinate system defined for the body. The body can be Saturn or Jupiter or one of their satellites. The NAIF ellipsoid for the surface of the body is used to determine

the sub-spacecraft point. For Saturn and Jupiter, this is the ellipsoid defining the 1-bar level, for the satellites, including Titan, their surfaces. The longitude is that of the point nearest to the spacecraft on the NAIF ellipsoid.

BODY_SUB_SPACECRAFT_LATITUDE

The planetographic sub-spacecraft latitude, in degrees north. The latitude is that of the point nearest to the spacecraft on the NAIF ellipsoid.

BODY_SUN_RANGE

The distance from the Sun to the body, in km. This is computed at the EPHEMERIS-TIME minus one light travel time from the spacecraft to the body.

BODY_SUN_RIGHTASCENSION

The right ascension of the Sun as seen from the body, in degrees, in the J2000 coordinate system.

BODYSUNDECLINATION

The declination of the Sun as seen from the body, in degrees, in the J2000 coordinate system.

BODYSUB-SOLARLONGITUDE

The longitude, in degrees west, of the sub-solar point on the body.

BODYSUB-SOLARLATITUDE

The planetographic latitude, in degrees north, of the sub-solar point on the body.

BODY_PHASE_ANGLE

The angle in degrees between the radial vector of the spacecraft and the radial vector of the Sun, from the center of the body.

BODYANGULAR-SEMIDIAMETER

The equatorial angular radius of the body as seen by the spacecraft, in milliradians.

BODY-ORBITALLONGITUDE

The longitude of the body, in degrees, as measured from the anti-solar point on the primary. If the body and primary are the same body, this is set to -200.

BODY_SYS3_LONGITUDE

The longitude of the body in the primary's body fixed IAU coordinate system. If the body is the primary, this is set to -200.

PRIMARY-ID

The NAIF id of the primary. This will be the same as BODY-ID if the primary is the body.

PRIMARY_SPACECRAFT_RANGE

The distance from the primary to the spacecraft, in km.

PRIMARY_SUB_SPACECRAFT_LONGITUDE

The planetographic sub-spacecraft longitude, in degrees west, in the IAU coordinate system defined for the primary. The NAIF ellipsoid for the primary of the body is used to determine the sub-spacecraft point. For Saturn or Jupiter, this is the ellipsoid defining the 1-bar level.

PRIMARY_SUB_SPACECRAFT_LATITUDE

The planetographic primary sub-spacecraft latitude, in degrees north.

PRIMARY-SUN-RANGE

The distance from the Sun to the primary, in km.

PRIMARY-SUB-SOLARLONGITUDE

The longitude, in degrees west, of the sub-solar point on the primary.

PRIMARY-SUB-SOLARLATITUDE

The planetographic latitude, in degrees north, of the sub-solar point on the primary.

PRIMARY_PHASEANGLE

The angle in degrees between the radial vector of the spacecraft and the radial vector of the Sun, from the center of the primary.

PRIMARY_ANGULAR_SEMIDIAMETER

The equatorial angular radius of the primary **as** seen by the spacecraft, in milliradians.

SCET-STRING

The SCET in a human readable string form in ISO format. For example, an SCET of 1091318406 corresponds to an **SCET.STRING** of "2004-214T00:00:06".

3.6.8 POI tables

These tables store the pointing for each active detector at the ZPD of the IFM. One POI entry is generated for each detector and each non-rings non-primary target in the field of view. An entry is always generated for the primary **as** the target, whether or not it is in the field of view. Rings are described in a separate **RIN** table rather than as entries in the POI tables.

Some of the values are stored as **array**[9]. For these quantities, not only are the values at field of view center stored, but at other locations of the projected field of view as well, known as **Q points**. For FP1, the Q points are each of the eight cardinal compass points around the edge of the circular FOV are used. For the square mid-IR detectors, the corners of the FOV and midpoints on the lines connecting the corners are used (see Figure 4). Q point 5 is always the boresight of the detector. The NAIF routine **getfov_c** is used to get the vectors corresponding to the Q points. All values, unless otherwise noted, are computed at **TIME_ZPD**.

Fields:

TARGET-ID

The NAIF id of the target. See table 3.

PRIMARY-ID

The NAIF id of the primary. This may be the same as **TARGET-ID**.

SCET

The SCET of the beginning of the scan.

TIMEZPD

The time of ZPD.

TIME_END

The time of the end of the scan.

DET

The detector id. See Table 1.

ALL_Q_ON

A boolean argument, 1 if all 9 Q points for a given detector hit the target. If one or more miss, it's 0.

LATITUDEZPD

This array of nine values, in degrees north, gives the planetographic latitude of the "ray periapsis" for each of the individual Q points of a particular detector at **TIME-ZPD**. If the Q point is on the target, then this is the latitude of the intersection of the ray with the "surface". Otherwise, it is the latitude of the point on the ray closest to the surface.

LONGITUDE_ZPD

The array containing the longitudes, in degrees west, of the ray periapses for the Q points.

ALTITUDE-ZPD

The array containing the altitudes of the ray periapses for the Q points at **TIME-ZPD**. If a Q point is on target, this is zero. Otherwise, it's the altitude of the ray periapsis in km.

RIGHTASCENSION

An array containing the right ascension towards which each of the Q points is pointing, in degrees, in the J2000 coordinate system at **TIME-ZPD**.

DECLINATION

An array containing the declination towards which each of the Q points pointing, in degrees, in the J2000 coordinate system at **TIME-ZPD**.

SPACECRAFT-TO-IMAGEPOINTZPD

The distance along the Q points to either the "surface" of the target or the ray periapsis, in km.

LATITUDEEND

The planetographic latitude, at **TIMEEND**, of the boresight (Q point 5) ray periapsis or intersection point on the target, in degrees north.

LONGITUDEEND

The longitude, at **TIMEEND**, of the boresight (Q point 5) ray periapsis or intersection point on the target, in degrees west.

ALTITUDEEND

The altitude, at **TIMEEND**, of the boresight (Q point 5). If the boresight is on target, this is zero. Otherwise, it's the altitude of the ray periapsis in km.

SMEAR

The **SMEAR** is defined in the following manner. The position of the boresight on the target at **TIMEZPD** is computed and saved. Then, at **TIMEEND**, the angle between that point and the position of the boresight at **TIMEEND** is computed. **SMEAR** is the ratio of this angle with the angular width of the field of view of the detector, or in other words, is the fraction of the field of view that the original intersection point of the boresight has moved between **TIMEZPD** and **TIMEEND**. If the boresight at either **TIMEZPD** or **TIMEEND** is off the target, then this is set to -200.

EMISSIONANGLE

This array contains the angle in degrees between the normal at the point on the surface at which the Q point intersects and the spacecraft direction vector, in degrees. If the Q point doesn't intersect the surface, this is set to 90 degrees.

EMISSIONANGLE-FOVAVERAGE

This is an average of the values of the emission angle over the field of view. It is currently computed using a Monte Carlo integration with 1000 points randomly distributed in the field of view. If a given point is off the target, it is rejected and a new one is tried. If the target isn't in the field of view, or more than 80% of the points attempted are off the target this is set to -200.

FILLINGFACTOR

This contains the fraction of the FOV filled by the target (between 0.0 and 1.0), computed during the same Monte Carlo integration as **EMISSIONANGLE-FOVAVERAGE**. For FP3 and FP4 this is the geometric filling factor, since their response functions are uniform. For FP1, the response function is approximately a gaussian (the full width at half maximum used is 2.42 mrad), and this is used in the computation of **EMISSION_ANGLE_FOV_AVERAGE** to select points preferentially towards the center of the detector where it is more sensitive. This means that **FILLINGFACTOR** is not geometric, but instead the center of the detector is given more weight than the edges.

EMISSIONAZIMUTHANGLE

This is the projection of the spacecraft position vector on the surface of the target and north, in degrees, for the boresight only. This projection is done for the ray periapsis if the boresight doesn't hit the surface, and so **ALTITUDE.ZPD[4]** should be checked to see if this contains a useful value.

SOLAR_ZENITH

The angle, for each Q point, between the direction vector of the Sun and the normal to the surface at point at which the Q point intersects the surface, in degrees.

SOLAR_AZIMUTH

The angle, for the boresight only, between the projection of the direction vector of the Sun and north on the surface of the target, in degrees.

SOLAR_PHASE

The angle, for the boresight only, between the Sun and the boresight at the point at which the boresight intersects the target, in degrees. If the boresight is off the target, this will be inaccurate.

LOCAL_TIME

The local solar time for each Q point is encoded as

$$\text{LOCAL_TIME} = 100 \times \text{hour} + \text{min} + \text{sec}/100 \quad (1)$$

If the Q point doesn't intersect the surface, this is the local time of the ray periapsis, and so is probably of limited usefulness.

NAIF ID	BODY	NAIF ID	BODY
599	Jupiter	699	Saturn
501	10	601	Mimas
502	Europa	602	Enceladus
503	Ganymede	603	Tethys
504	Callisto	604	Dione
505	Amalthea	605	Rhea
506	Himalia	606	Titan
507	Elara	607	Hyperion
508	Pasiphae	608	Iapetus
509	Sinope	609	Phoebe
510	Lysithea	610	Janus
511	Carme	611	Epimetheus
512	Ananke	612	Helene
513	Leda	613	Telesto
514	Thebe	614	Calypso
515	Adrastea	615	Atlas
516	Metis	616	Prometheus
		617	Pandora
		618	Pan

Table 3: Selected NAIF IDS of relevance to Cassini CIRS.

3.6.9 BIN tables

One entry is generated for each detector at all times. For the purpose of this table, the rings are assumed to fill the equatorial plane of the primary ($z = 0$ in the coordinate system of

the primary with z along the rotation axis) out to a selected cutoff radius. If a line of sight intersects the primary body before intersecting the rings, or if the line of sight falls outside the cutoff radius, the values for most fields for that line of sight are set to **-200**.

As for the POI table, many entries in the RIN tables are `array[9]`. These contain individual entries for the Q points, as discussed above.

PRIMARY-ID

The NAIF id of the primary.

SCET

The SCET of the beginning of the scan.

TIME_ZPD

The time of ZPD, a few seconds after `scet`.

TIME_END

The time of the end of the scan.

DET

The detector ID.

RINGRADIUSZPD

An array containing the radius, in km, at which each Q point intercepts the equatorial plane of the primary. Set to **-200** if the ray falls outside the rings or the primary is in front of the rings.

RING_SPACECRAFT_RANGE_ZPD

An array containing the distance, in km, from the spacecraft; to the intercepts of the Q points on the equatorial plane. Set to **-200** if the ray falls outside the rings or the primary is in front of the rings.

RING_EMISSION_AZIMUTH_ANGLE

This array contains the angles, in degrees, between the Q point vectors projected into the ring plane and the outward radial away from the primary's center. The Q point vectors are vectors along the Q point directions from the focal point of the instrument (center of the focal plane) to the ring plane. Set to **-200** if the ray falls outside the rings or the primary is in front of the rings.

RING_SOLAR_PHASE

The angle, in degrees, between the Sun's position vector and the Q point's line of sight vectors. Set to **-200** if the ray falls outside the rings or the primary is in front of the rings.

RING_EMISSION_ANGLE

An array containing the angles in degrees between lines of sight of the Q points and the rotation axis of the primary, which is assumed to be normal to the ring plane. Set to **-200** if the ray falls outside the rings or the primary is in front of the rings.

RING_LONGITUDE_ZPD

This entry, for the boresight only, conforms to the PDS standard definition of a longitude on a ring. Longitudes are measured eastwards in an inertial frame from the "ascending node of the intersection of the ring plane with J2000". Entries here are in degrees. Set to **-200** if the ray falls outside the rings or the primary is in front of the rings.

RING_SOLAR_AZIMUTH

This is the angle, in degrees, between the Sun's position vector projected into the ring plane and the outward radial from the center of the primary. This is computed for the boresight (Q point 5) only. Set to **-200** if the ray falls outside the rings or the primary is in front of the rings. The angle increases counterclockwise when viewed from above the ring plane.

RING_SOLAR_ZENITH

The angle, in degrees, between the Sun's position vector and the rotation axis of the primary at the intercept point of the boresight. Set to **-200** if the ray falls outside the rings or the primary is in front of the rings.

RING_LONGITUDE_END

The longitude, in degrees, for the boresight only, at **TIME-END**. This is also measured eastwards in an inertial frame from the "ascending node of the intersection of the ring plane with J2000". Set to **-200** if the ray falls outside the rings or the primary is in front of the rings.

RING_RADIUS_END

The radius, in km, for the boresight of its intercept with the ring plane at **TIME_END**. Set to **-200** if the ray falls outside the rings or the primary is in front of the rings.

RING_SPACECRAFT_RANGE_END

The distance, in km, from the spacecraft to the ring plane intercept point of the boresight at **TIME_END**. Set to **-200** if the ray falls outside the rings or the primary is in front of the rings.

RINGSMEAR

This is computed much like **smear** in the pointing tables. The position of the boresight on the ring plane at **TIME_ZPD** is computed and saved. Then, at **TIME_END**, the angle between that point and the position of the boresight at **TIME-END** is computed. **RING-SMEAR** is the ratio of this angle with the angular width of the field of view of the detector, or in other words, is the fraction of the field of view that the original intersection point of the boresight has moved between **TIME_ZPD** and **TIME_END**. If the boresight at either **TIME-ZPD** or **TIME-END** is edge on to the rings (in the equatorial plane), then this is set to **-200**. These computations are done in the J2000 inertial frame, so the rotation of the primary does not contribute to the smear. This also means that the Keplerian motion of the ring particles does not contribute to the smear. Set to **-200** if the ray falls outside the rings or the primary is in front of the rings.

RINGLOCAL-TIME

This contains the ring local hour angle in the primary's coordinate system for the intercept of the Q points in the ring plane. It is encoded by

$$\text{RINGLOCAL-TIME} = 100 \times \text{hour} + \text{min} + \text{sec}/100 \quad (2)$$

Set to -200 if the ray falls outside the rings or the primary is in front of the rings.

3.6.10 TAR tables

These tables describe which, if any, of the various targets are in the field of view of a given detector. Individual fields (e.g. TITAN) are set to 1 or 0 according to whether the body appears in the FOV or not. Any, all or none of these fields may be specified individually to select data with a particular subset of bodies in the FOV. Additionally, the field FOV-TARGETS contains the same information as the individual byte fields, except stored as bits in a single 4-byte integer. This may provide a useful shorthand for selecting an exact target body combination. Fields:

SCET

The SCET of the beginning of the scan.

DET

The detector ID. See Table 1.

FOV-TARGETS

A bitfield with a single bit for each of the targets that Cassini might observe. If the bit is 0, the object isn't in the field of view. If it's 1, it may or may not be, subject to the following conditions. For the planets and their satellites, a fixed angular width "penumbra" is attached outside their "surfaces" (for satellites, their actual hard surfaces, for Jupiter and Saturn, the 1 bar level in their atmospheres). The angular width of the penumbra is detector and body dependent. If any of the lines of sight of the 9 Q points intersects either the object or the penumbra, this bit is 1. If the center of the object is entirely inside the field of view of the detector, this bit is 1 (this condition is to account for objects small enough to fit entirely inside the detector and miss all of the Q points). A crude ring model is used. If the lines of sight of the Q points hit the equatorial plane of the primary within a fixed radius (129400 km for Jupiter, 140270 km for Saturn), and the primary isn't hit first, then the ring bit is 1. Otherwise, the ring bit is zero.

Bit assignments are as follows:

00000000000000000000000000000000	space (no recognized target)
00000000000000000000000000000001	Jupiter rings
00000000000000000000000000000010	Jupiter
00000000000000000000000000000100	10

TETHYS Set to 1 if Tethys is in the FOV, 0 otherwise.
DIONE Set to 1 if Dione is in the FOV, 0 otherwise.
RHEA Set to 1 if Rhea is in the FOV, 0 otherwise.
TITAN Set to 1 if Titan is in the FOV, 0 otherwise.
HYPERION Set to 1 if Hyperion is in the FOV, 0 otherwise.
IAPETUS Set to 1 if Iapetus is in the FOV, 0 otherwise.
PHOEBE Set to 1 if Phoebe is in the FOV, 0 otherwise.
JANUS Set to 1 if Janus is in the FOV, 0 otherwise.
EPHMETHEUS Set to 1 if Epimetheus is in the FOV, 0 otherwise.
HELENE Set to 1 if Helene is in the FOV, 0 otherwise.
TELESTO Set to 1 if Telesto is in the FOV, 0 otherwise.
CALYPSO Set to 1 if Calypso is in the FOV, 0 otherwise.
ATLAS Set to 1 if Atlas is in the FOV, 0 otherwise.
PROMETHEUS Set to 1 if Prometheus is in the FOV, 0 otherwise.
PANDORA Set to 1 if Pandora is in the FOV, 0 otherwise.
PAN Set to 1 if Pan is in the FOV, 0 otherwise.
SRING Set to 1 if Saturn's rings are in the FOV, 0 otherwise.
DEEPSPACE Set to 1 if **FOV_TARGETS** is zero, 0 otherwise.
STELLAR Set to 1 if a stellar target is in the FOV, 0 otherwise.

3.6.11 ISPM tables

These tables contain the 'interpolated' (resampled) calibrated spectra. The ISPM **fragment** type is now commonly created, instead of the SPM type (non-resampled), and is the type to be archived. The SPM type created formerly used a 'natural' wavelength index resulting from the instrument, which meant that the final spectrum fell on 'irrational' wavenumber values such 577.3256, 577.7792, instead of 577.250, 577,500, 577.750 etc. The ISPM type contains the same spectra, but interpolated and re-sampled onto a more user-friendly grid. There is no loss of resolution or data in this process.

Fields:

SCET

The spacecraft event time of the beginning of scan (seconds from epoch). The **circs_time** utility may be useful for converting text time to SCET.

DET

Detector number (see table 1).

ISPTS

The number of points in the output spectrum.

DSIAVE

Number of spectra used in the deep-space calibration average IFM, during the calibration process. This may pose an intrinsic limit to how many calibrated spectra may be co-added. See **SHIAVE**.

SHIAVE

Number of spectra used in the shutter calibration average IFM, during the calibration process. This may pose an intrinsic limit to how many calibrated spectra may be co-added. For example, assume that the shutter is 170 K and the planet spectrum is similar, and **SHNAVE**=100. Now, consider that we have 500 planet spectra which were calibrated using the same 100-spectrum shutter average. Then, co-adding more than 100 planet spectra will no longer reduce the random noise level any further, because the NESR level of the 100 shutter will become the limiting (biggest) noise source.

TINSTR

The instrument temperature (kelvin). For **FP1** (detector 0), the **firpolrize**tem from the **IHSK** tables is used. For the mid-IR (detectors 1–30) the **hsecool**tem from the **IHSK** is used.

IWN_START

The wavenumber of the first point in the spectrum (cm⁻¹). Together with **IWN_STEP** defines the spectrum wavenumber axis.

IWN_STEP

The wavenumber increment size between successive points in the spectrum (cm⁻¹). Together with **IWN_START** defines the spectrum wavenumber axis.

APODTYPE

The number of the apodization type applied to the final spectrum (if any). See table 4. Apodization is the process of suppressing side-lobes ('ripples') of the **ILS** by tapering the **IFM** in the spatial dimension, before **FFT**ing.

FWHM

The **Full-Width at Half-Maximum** of the idealised monochromatic instrumental line shape (**ILS**) in cm⁻¹. If the spectrum is apodized, then it is the apodized **FWHM**.

RAYLEIGH

The 'Rayleigh' resolution of the spectrum (cm⁻¹). Actually, the distance from the peak of an isolated line to the first 'null' (zero-crossing, not minimum) in the **ILS**. (Rayleigh resolution is actually defined on the basis of a line doublet being resolved, not individual spectral lines).

No.	Apodisation Function Name
0	Boxcax (no apodisation)
1	Norton & Beer type 1 function
2	Norton & Beer type 2 function
3	Norton & Beer type 3 function
4	Forman type
5	Triangular type
6	Hanning type
7	Hamming type

Table 4: Apodisation functions available for post-processing CIRS spectra.

NYQUIST

The Nyquist bin size (cm^{-1}), or intrinsic resolution limit. This is equivalent to the width of the bandpass divided by the number of interferogram samples. This number gives a measure of how far the actual resolution achieved, perhaps after apodization, differs from the 'natural' resolution of the instrument.

POWER

The integrated radiance under the power spectrum ($\text{W cm}^{-2} \text{sr}^{-1}$).

DS_SCET

The mean scet time of the deep space scan block used to create the deep space average IFM used in the calibration of the current target IFM.

DS_SH_SCET

The mean scet time of the shutter scan block used to create the shutter average IFM used in the calibration of the current target IFM.

ISPM

A pointer to the spectrum in the associated variable-length record (.VAR) file. The spectral data points are radiance in units of ($\text{W cm}^{-2} \text{sr}^{-1} (\text{cm}^{-1})^{-1}$).

4 Software

4.1 Calibration Software

4.2 Utility Software

4.3 Vanilla software

The MGS TES project has produced a software tool that not only reads the PDS table and the variable length records, but is also capable of joining the related records among multiple tables. This piece of software is called 'vanilla' and was offered for use by the CIRS team. Vanilla is included on every volume, along with the *Vanilla Users Guide* (written for MGS-TES, but nevertheless useful). See also the examples in the document **Vanilla Examples with the CIRS database**.

The Vanilla program was developed for use on both LSB and MSB machines.

4.4 PDS software

The CIRS team does not use any PDS software to process or view the data. However the tables are stored using the PDS TABLE standard structure and any tool that understands that structure should be able to read all of the data except the variable length spectra.

A Acronyms and Abbreviations

BIU Bus Interface Unit; interface to spacecraft bus.

CIRS Composite Infrared Spectrometer.

FIR Far Infra-Red.

FOV Field Of View.

FWHM Full-width to half maximum. A measure of spectral line width or FOV width.

IFM Interferogram.

ILS Instrumental Line Shape

LSB Least Significant Bit, data storage convention.

MIR Mid Infra-Red.

MGS Mars Global Surveyor spacecraft.

MSB Most Significant Bit, data storage convention.

NAIF Navigation and Ancilliary Information Facility

NESR Noise Equivalent Spectral Radiance

ODL Object Description Lanaguage.

PDS Planetary Data System.

RTI Real Time Interrupt (= 1/8 sec).

TES Thermal Emission Spectrometer (on MGS).

TSDR Time Sequential Data Records.

ZPD Zero-Path Difference; IFM peak.

B Data format files

B.1 OBS.FMT

```
COLUMNS                = 39
ROW-BYTES                = 51

OBJECT                   = COLUMN
  NAME                   = SCET
  DATA-TYPE              = LSB-UNSIGNED-INTEGERS
  STARTBYTE              = 1
  BYTES                   = 4
  DESCRIPTION             = "packet time"
ENDOBJECT                = COLUMN

OBJECT                   = COLUMN
  NAME                   = SCLK
  DATA_TYPE              = LSB-UNSIGNED-INTEGERS
  STARTBYTE              = 5
  BYTES                   = 4
  DESCRIPTION             = "spacecraft clock time "
END-OBJECT                = COLUMN

OBJECT                   = COLUMN
  NAME                   = RTI
  DATA_TYPE              = LSB-UNSIGNED-INTEGERS
  STARTBYTE              = 9
  BYTES                   = 2
  DESCRIPTION             = "Length of scan in Real Time Interrupts
                          (1/8 sec) "
ENDOBJECT                = COLUMN

OBJECT                   = COLUMN
  NAME                   = FP3_MODE
  DATA_TYPE              = CHARACTER
  STARTBYTE              = 11
  BYTES                   = 1
  DESCRIPTION             = "FP3 array pixel mode: 0(dd), E(ven),
                          C(enter), P(airs) "
ENDOBJECT                = COLUMN

OBJECT                   = COLUMN
  NAME                   = FP4_MODE
  DATA-TYPE              = CHARACTER
  START-BYTE              = 12
  BYTES                   = 1
```

```

        DESCRIPTION      = "FP4 array pixel mode: 0(dd), E(ven),
                           (enter) , R(airs)  "
    ENDOBJECT           = COLUMN

OBJECT                 = COLUMN
    NAME                = FIR_OVERFLOW
    DATA_TYPE          = LSB-UNSIGNED-INTEG
    START-BYTE          = 13
    BYTES                = 1
    DESCRIPTION          = "Overflow detected on FIR accumulation"
    ENDOBJECT

OBJECT                 = COLUMN
    NAME                = FP1_OVERFLOW
    DATA_TYPE          = LSB-UNSIGNED-INTEG
    STARTBYTE           = 14
    BYTES                = 1
    DESCRIPTION          = "Overflow on FP1 average buffer"
    ENDOBJECT

OBJECT                 = COLUMN
    NAME                = FP3_OVERFLOW
    DATA_TYPE          = LSB-UNSIGNED-INTEG
    START-BYTE          = 15
    BYTES                = 1
    DESCRIPTION          = "Overflow on FP3 average buffer"
    ENDOBJECT

OBJECT                 = COLUMN
    NAME                = FP4_OVERFLOW
    DATA_TYPE          = LSB-UNSIGNED-INTEG
    STARTBYTE           = 16
    BYTES                = 1
    DESCRIPTION          = "Overflow on FP4 average buffer"
    ENDOBJECT

OBJECT                 = COLUMN
    NAME                = FP1_COMP_OVERFLOW
    DATA_TYPE          = LSB-UNSIGNED-INTEG
    STARTBYTE           = 17
    BYTES                = 1
    DESCRIPTION          = "Overflow on compression buffer 1"
    END-OBJECT

OBJECT                 = COLUMN
    NAME                = FP3_COMP_OVERFLOW
    DATA_TYPE          = LSB-UNSIGNED-INTEG
    STARTBYTE           = 18

```

```

        BYTES = 1
        DESCRIPTION = "Overflow on compression buffer 3"
    ENDOBJECT

OBJECT = COLUMN
    NAME = FP4_COMP_OVERFLOW
    DATA_TYPE = LSB-UNSIGNED-INTEGERS
    START-BYTE = 19
    BYTES = 1
    DESCRIPTION = "Overflow on compression buffer 4"
    ENDOBJECT

OBJECT = COLUMN
    NAME = FP3_ZERO
    DATA_TYPE = LSB-UNSIGNED-INTEGERS
    STARTBYTE = 20
    BYTES = 1
    DESCRIPTION = "Detected 0000H on FP3 raw data"
    ENDOBJECT

OBJECT = COLUMN
    NAME = FP3_OFFF
    DATA_TYPE = LSB-UNSIGNED-INTEGERS
    START-BYTE = 21
    BYTES = 1
    DESCRIPTION = "Detected OFFFH on FP3 raw data"
    ENDOBJECT

OBJECT = COLUMN
    NAME = FP1_ZERO
    DATA-TYPE = LSB-UNSIGNED-INTEGERS
    STARTBYTE = 22
    BYTES = 1
    DESCRIPTION = "Detected 0000H on FP1 raw data"
    ENDOBJECT

OBJECT = COLUMN
    NAME = FP1_OFFF
    DATA_TYPE = LSB-UNSIGNED-INTEGERS
    STARTBYTE = 23
    BYTES = 1
    DESCRIPTION = "Detected OFFFH on FP1 raw data"
    END-OBJECT

OBJECT = COLUMN
    NAME = FP4_ZERO
    DATA-TYPE = LSB-UNSIGNED-INTEGERS
    STARTBYTE = 24

```

```

        BYTES = 1
        DESCRIPTION = "Detected 0000H on FP4 raw data"
    ENDOBJECT

OBJECT = COLUMN
    NAME = FP4_OFFF
    DATA_TYPE = LSB-UNSIGNED-INTEGERS
    START-BYTE = 25
    BYTES = 1
    DESCRIPTION = "Detected OFFFH on FP4 raw data"
    ENDOBJECT

OBJECT = COLUMN
    NAME = COADD
    DATA_TYPE = LSB-UNSIGNED-INTEGERS
    STARTBYTE = 26
    BYTES = 1
    DESCRIPTION = "Coadding enabled"
    ENDOBJECT

OBJECT = COLUMN
    NAME = SCIENCEOVERWRITTEN
    DATA_TYPE = LSB-UNSIGNED-INTEGERS
    START-BYTE = 27
    BYTES = 1
    DESCRIPTION = "Science data overwritten condition detected"
    ENDOBJECT

OBJECT = COLUMN
    NAME = FLYBACK-EXCEEDED
    DATA-TYPE = LSB-UNSIGNED-INTEGERS
    STARTBYTE = 28
    BYTES = 1
    DESCRIPTION = "Flyback exceeded"
    ENDOBJECT

OBJECT = COLUMN
    NAME = SCANEXCEEDED
    DATA_TYPE = LSB-UNSIGNED-INTEGERS
    STARTBYTE = 29
    BYTES = 1
    DESCRIPTION = "Scan exceeded"
    END-OBJECT

OBJECT = COLUMN
    NAME = MECHANISM-ENABLED
    DATA-TYPE = LSB-UNSIGNED-INTEGERS
    STARTBYTE = 30

```

```

        BYTES = 1
        DESCRIPTION = "Mechanism enabled"
    ENDOBJECT

OBJECT = COLUMN
    NAME = MECHOUTOFPHASE
    DATA_TYPE = LSB-UNSIGNED-INTEGER
    START-BYTE = 31
    BYTES = 1
    DESCRIPTION = "Mechanism out of phase some time"
    ENDOBJECT

OBJECT = COLUMN
    NAME = LASERAENABLED
    DATA_TYPE = LSB-UNSIGNED-INTEGER
    STARTBYTE = 32
    BYTES = 1
    DESCRIPTION = "Laser A enabled"
    ENDOBJECT

OBJECT = COLUMN
    NAME = LASERBENABLED
    DATA_TYPE = LSB-UNSIGNED-INTEGER
    START-BYTE = 33
    BYTES = 1
    DESCRIPTION = "Laser B enabled"
    ENDOBJECT

OBJECT = COLUMN
    NAME = MECH_CMDED
    DATA_TYPE = LSB-UNSIGNED-INTEGER
    STARTBYTE = 34
    BYTES = 1
    DESCRIPTION = "Enable mechanism cmded"
    ENDOBJECT

OBJECT = COLUMN
    NAME = WHITEOVERRIDE
    DATA_TYPE = LSB-UNSIGNED-INTEGER
    STARTBYTE = 35
    BYTES = 1
    DESCRIPTION = "White light override"
    END-OBJECT

OBJECT = COLUMN
    NAME = OPTICAL-SENSE-MODE
    DATA_TYPE = LSB-UNSIGNED-INTEGER
    STARTBYTE = 36

```

```

        BYTES = 1
        DESCRIPTION = 'Optical sensor (0), decs (1) mode'
    ENDOBJECT

OBJECT = COLUMN
    NAME = SHUTTER
    DATA_TYPE = LSB-UNSIGNED-INTEGERS
    START-BYTE = 37
    BYTES = 1
    DESCRIPTION = 'Shutter open (0), closed (1)'
    ENDOBJECT

OBJECT = COLUMN
    NAME = RIE_LASCMD_LSB
    DATA_TYPE = LSB-UNSIGNED-INTEGERS
    STARTBYTE = 38
    BYTES = 1
    DESCRIPTION = "RIE: LASCMD_LSB Lamp current select"
    ENDOBJECT

OBJECT = COLUMN
    NAME = RIE_LASCMD_MSB
    DATA_TYPE = LSB-UNSIGNED-INTEGERS
    START-BYTE = 39
    BYTES = 1
    DESCRIPTION = "RIE: LASCMD_MSB Lamp current select"
    ENDOBJECT

OBJECT = COLUMN
    NAME = RIE_LASCMD_A
    DATA-TYPE = LSB-UNSIGNED-INTEGERS
    STARTBYTE = 40
    BYTES = 1
    DESCRIPTION = "RIE: LASCMD_A Lamp A select"
    ENDOBJECT

OBJECT = COLUMN
    NAME = RIELASCMD_B
    DATA_TYPE = LSB-UNSIGNED-INTEGERS
    STARTBYTE = 41
    BYTES = 1
    DESCRIPTION = "RIE: LASCMD_B Lamp B select"
    END-OBJECT

OBJECT = COLUMN
    NAME = RAW-NO-SET
    DATA-TYPE = LSB-UNSIGNED-INTEGERS
    STARTBYTE = 42

```

BYTES = 2
 DESCRIPTION = "Count of raw samples without set control bits"
 ENDOBJECT

OBJECT = COLUMN
 NAME = **RAW_FP1_COUNT**
 DATA_TYPE = LSB-UNSIGNED-INTEGER
 START-BYTE = 44
 BYTES = 2
 DESCRIPTION = "Number of FP1 samples read in this scan"
 ENDOBJECT

OBJECT = COLUMN
 NAME = **RAW_FP3_COUNT**
 DATA_TYPE = LSB-UNSIGNED-INTEGER
 STARTBYTE = 46
 BYTES = 2
 DESCRIPTION = "Number of FP3 samples read in this scan"
 ENDOBJECT

OBJECT = COLUMN
 NAME = **RAW_FP4_COUNT**
 DATA_TYPE = LSB-UNSIGNED-INTEGER
 START-BYTE = 48
 BYTES = 2
 DESCRIPTION = "Number of FP4 samples read in this scan"
 ENDOBJECT

OBJECT = COLUMN
 NAME = **FIRST-SAMPLE-RTI**
 DATA-TYPE = LSB-UNSIGNED-INTEGER
 STARTBYTE = 50
 BYTES = 2
 DESCRIPTION = "RTI value when 1st sample in scan collected"
 ENDOBJECT

B.2 FRV.FMT

COLUMNS = 3
 ROW-BYTES = 10

OBJECT = COLUMN
 NAME = SCET
 DATA_TYPE = LSB-UNSIGNED-INTEGER
 STARTBYTE = 1
 BYTES = 4

```

        DESCRIPTION      = 'scan time '
END-OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = NFRV
    DATA_TYPE          = LSBINTEGER
    STARTBYTE           = 5
    BYTES                = 2
    DESCRIPTION         = "number of fringe voltage samples "
ENDOBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = FRV
    DATA_TYPE          = LSBINTEGER
    STARTBYTE           = 7
    BYTES                = 4
    VARDATATYPE         = PCREAL
    VAR_ITEM_BYTES      = 8
    VARRECORDTYPE       = VAXVARIABLELENGTH
    DESCRIPTION         = "pointer to fringe voltage data "
END-OBJECT              = COLUMN

```

B.3 IFGM.FMT

```

COLUMNS                = 4
ROW-BYTES               = 11

OBJECT                  = COLUMN
    NAME                = SCET
    DATA_TYPE          = LSB_UNSIGNED_INTEGER
    STARTBYTE           = 1
    BYTES                = 4
    DESCRIPTION         = "SCAN TIME "
ENDOBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = DET
    DATA_TYPE          = LSB-INTEGER
    STARTBYTE           = 5
    BYTES                = 1
    DESCRIPTION         = "DETECTOR NUMBER "
ENDOBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = NPTS

```

DATA_TYPE	= LSBINTEGER
START-BYTE	= 6
BYTES	= 2
DESCRIPTION	= "NUMBER OF POINTS IN INTERFEROGRAM "
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= IFGM
DATA-TYPE	= LSB-INTEGER
STARTBYTE	= 8
BYTES	= 4
VARDATATYPE	= LSBINTEGER
VARITEMBYTES	= 2
VARRECORDTYPE	= VAXVARIABLELENGTH
DESCRIPTION	= "POINTER TO INTERFEROGRAM DATA "
ENDOBJECT	= COLUMN

B.4 HSK.FMT

COLUMNS	= 62
ROW-BYTES	= 402
OBJECT	= COLUMN
NAME	= SCET
DATA-TYPE	= LSB-UNSIGNED-INTEGER
START-BYTE	= 1
BYTES	= 4
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= SMERIESTAT
DATA_TYPE	= LSB-UNSIGNED-INTEGER
STARTBYTE	= 5
BYTES	= 2
END-OBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= FP3LASTCMD
DATA_TYPE	= LSB-UNSIGNED-INTEGER
STARTBYTE	= 7
BYTES	= 2
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= FP4LASTCMD

DATA_TYPE	= LSB-UNSIGNED-INTEGER
START-BYTE	= 9
BYTES	= 2
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= TCMLASTCMD
DATA-TYPE	= LSB-UNSIGNED-INTEGER
START-BYTE	= 11
BYTES	= 2
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= FP1MAX
DATA_TYPE	= LSB-UNSIGNED-INTEGER
STARTBYTE	= 13
BYTES	= 2
END-OBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= FP3MAX
DATA_TYPE	= LSB-UNSIGNED-INTEGER
STARTBYTE	= 15
BYTES	= 2
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= FP4MAX
DATA_TYPE	= LSB-UNSIGNED-INTEGER
START-BYTE	= 17
BYTES	= 2
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= FRINGEMAX
DATA_TYPE	= PCREAL
STARTBYTE	= 19
BYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= FRINGEMIN
DATA-TYPE	= PC-REAL
STARTBYTE	= 27
BYTES	= 8
END-OBJECT	= COLUMN
OBJECT	= COLUMN

NAME	= PENDINGTTAG
DATA-TYPE	= LSB-UNSIGNED-INTEGER
STARTBYTE	= 35
BYTES	= 2
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= CODECHK
DATA-TYPE	= LSB-UNSIGNED-INTEGER
STARTBYTE	= 37
BYTES	= 2
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= REJECTOP
DATA_TYPE	= LSB-UNSIGNED-INTEGER
STARTBYTE	= 39
BYTES	= 2
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= PCAATEM
DATA_TYPE	= PCREAL
START-BYTE	= 41
BYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= PCABTEM
DATA-TYPE	= PC-REAL
START-BYTE	= 49
BYTES	= 8
END-OBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= PRACTEM
DATA_TYPE	= PCREAL
STARTBYTE	= 57
BYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= SME_ATEM
DATA_TYPE	= PCREAL
STARTBYTE	= 65
BYTES	= 8
END-OBJECT	= COLUMN

OBJECT = COLUMN
NAME = SME_BTEM
DATA_TYPE = PCREAL
STARTBYTE = 73
BYTES = 8
ENDOBJECT = COLUMN

OBJECT = COLUMN
NAME = RIE_ATEM
DATA_TYPE = PCREAL
STARTBYTE = 81
BYTES = 8
ENDOBJECT = COLUMN

OBJECT = COLUMN
NAME = FEE_ATEM
DATA_TYPE = PCREAL
START-BYTE = 89
BYTES = 8
END-OBJECT = COLUMN

OBJECT = COLUMN
NAME = FEE-BTEM
DATA-TYPE = PC-REAL
STARTBYTE = 97
BYTES = 8
ENDOBJECT = COLUMN

OBJECT = COLUMN
NAME = FEE-CTEM
DATA-TYPE = PC-REAL
STARTBYTE = 105
BYTES = 8
ENDOBJECT = COLUMN

OBJECT = COLUMN
NAME = FEE-DTEM
DATA_TYPE = PCREAL
STARTBYTE = 113
BYTES = 8
ENDOBJECT = COLUMN

OBJECT = COLUMN
NAME = TCMATEM
DATA_TYPE = PCREAL
START-BYTE = 121
BYTES = 8
ENDOBJECT = COLUMN

OBJECT	= COLUMN
NAME	= TCMBTEM
DATA_TYPE	= PCREAL
STARTBYTE	= 129
BYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= BASEPLATETEM
DATA_TYPE	= PCREAL
STARTBYTE	= 137
BYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= PROCESSORTEM
DATA-TYPE	= PC-REAL
STARTBYTE	= 145
BYTES	= 8
END-OBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= BIUTEM
DATA_TYPE	= PCREAL
STARTBYTE	= 153
BYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= ADCTEM
DATA_TYPE	= PCREAL
START-BYTE	= 161
BYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= MOTORCURRENT
DATA_TYPE	= PCREAL
STARTBYTE	= 169
BYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= DECSPOSN
DATA-TYPE	= LSB_UNSIGNED_INTEGER
START-BYTE	= 177
BYTES	= 2

ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= VELERR
DATA_TYPE	= PCREAL
STARTBYTE	= 179
BYTES	= 8
END-OBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= PHASEERR
DATA_TYPE	= LSB_UNSIGNED_INTEGER
STARTBYTE	= 187
BYTES	= 2
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= FRINGEV
DATA_TYPE	= PCREAL
START-BYTE	= 189
BYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= RIESMEPOS12V
DATA_TYPE	= PCREAL
STARTBYTE	= 197
BYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= RIESMENEG12V
DATA-TYPE	= PC-REAL
STARTBYTE	= 205
BYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= RIESMEPOS5V
DATA_TYPE	= PCREAL
STARTBYTE	= 213
BYTES	= 8
END-OBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= LASERCURRENT
DATA-TYPE	= PC-REAL
STARTBYTE	= 221

BYTES	= 8
END-OBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= LEDCURRENT
DATA_TYPE	= PCREAL
STARTBYTE	= 229
BYTES	= 8
END-OBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= IDSP0S15V
DATA_TYPE	= PCREAL
STARTBYTE	= 237
BYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= IDSNEG15V
DATA-TYPE	= PC-REAL
START-BYTE	= 245
BYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= IDSP0S5V
DATA_TYPE	= PCREAL
STARTBYTE	= 253
BYTES	= 8
END-OBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= PHOTODIODE
DATA_TYPE	= LSB_UNSIGNED_INTEGER
STARTBYTE	= 261
BYTES	= 2
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= HTR80KCURR
DATA_TYPE	= PCREAL
STARTBYTE	= 263
BYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= HTROP_ACURR
DATA_TYPE	= PCREAL

STARTBYTE	= 271
BYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= HTRP_MRCURR
DATA_TYPE	= PCREAL
START-BYTE	= 279
BYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= HTRS_MRCURR
DATA_TYPE	= PCREAL
STARTBYTE	= 287
BYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= HSECOOLTEM
DATA-TYPE	= PC-REAL
STARTBYTE	= 295
BYTES	= 8
END-OBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= FIRPOLRIZTEM
DATA_TYPE	= PCREAL
STARTBYTE	= 303
BYTES	= 8
END-OBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= HSEABVMECHTEM
DATA_TYPE	= PCREAL
STARTBYTE	= 311
BYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= FP1DETTEM
DATA_TYPE	= PCREAL
START-BYTE	= 319
BYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= MECHHSETEM

DATA_TYPE	= PCREAL
START-BYTE	= 327
BYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= SECMIRRTEM
DATA-TYPE	= PC-REAL
START-BYTE	= 335
BYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= PRIMIRRTEM
DATA_TYPE	= PCREAL
STARTBYTE	= 343
BYTES	= 8
END-OBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= SECMIRBAFFTEM
DATA_TYPE	= PCREAL
STARTBYTE	= 351
BYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= PMSUNSHDMLITEM
DATA_TYPE	= PCREAL
START-BYTE	= 359
BYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= PMSUNSHDRADTEM
DATA_TYPE	= PCREAL
STARTBYTE	= 367
BYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= CONERIMTEM
DATA-TYPE	= PC-REAL
STARTBYTE	= 375
BYTES	= 8
END-OBJECT	= COLUMN
OBJECT	= COLUMN

NAME	= FPATEM
DATA-TYPE	= PC-REAL
STARTBYTE	= 383
BYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= THERMISTORDRV
DATA-TYPE	= LSB-UNSIGNED-INTEGERS
STARTBYTE	= 391
BYTES	= 2
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= IDSCALIB
DATA_TYPE	= LSB-UNSIGNED-INTEGERS
STARTBYTE	= 393
BYTES	= 2
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= IDSNEG5V
DATA_TYPE	= PCREAL
START-BYTE	= 395
BYTES	= 8
ENDOBJECT	= COLUMN

B.5 IHSK.FMT

COLUMNS	= 12
ROW-BYTES	= 92
OBJECT	= COLUMN
NAME	= SCET
DATA_TYPE	= LSB-UNSIGNED-INTEGERS
START-BYTE	= 1
BYTES	= 4
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= HSECOOLTEM
DATA_TYPE	= PCREAL
STARTBYTE	= 5
BYTES	= 8
ENDOBJECT	= COLUMN

OBJECT	= COLUMN
NAME	= FIRPOLRIZTEM
DATA_TYPE	= PCREAL
STARTBYTE	= 13
BYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= ZINSTRADTEM
DATA_TYPE	= PCREAL
STARTBYTE	= 21
BYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= FP1DETTEM
DATA_TYPE	= PCREAL
START-BYTE	= 29
BYTES	= 8
END-OBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= MECHHSETEM
DATA-TYPE	= PC-REAL
STARTBYTE	= 37
BYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= SECMIRRTEM
DATA-TYPE	= PC-REAL
STARTBYTE	= 45
BYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= PRIMIRRTEM
DATA_TYPE	= PCREAL
STARTBYTE	= 53
BYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= SECMIRBAFFTEM
DATA_TYPE	= PCREAL
START-BYTE	= 61
BYTES	= 8
ENDOBJECT	= COLUMN

OBJECT = COLUMN
 NAME = PMSUNSHDMLITEM
 DATA_TYPE = PCREAL
 STARTBYTE = 69
 BYTES = 8
 ENDOBJECT = COLUMN

OBJECT = COLUMN
 NAME = PMSUNSHDRADTEM
 DATA_TYPE = PCREAL
 STARTBYTE = 77
 BYTES = 8
 ENDOBJECT = COLUMN

OBJECT = COLUMN
 NAME = FPATEM
 DATA-TYPE = PC-REAL
 STARTBYTE = 85
 BYTES = 8
 END-OBJECT = COLUMN

B.6 DIAG.FMT

COLUMNS = 6
 ROW-BYTES = 11

OBJECT = COLUMN
 NAME = SCET
 DATA_TYPE = LSB_UNSIGNED_INTEGER
 STARTBYTE = 1
 BYTES = 4
 DESCRIPTION = **'spacecraft clock time "**
 ENDOBJECT = COLUMN

OBJECT = COLUMN
 NAME = DET
 DATA_TYPE = LSBINTEGER
 START-BYTE = 5
 BYTES = 1
 DESCRIPTION = **'detector number "**
 ENDOBJECT = COLUMN

OBJECT = COLUMN
 NAME = BIURTI
 DATA_TYPE = LSBINTEGER

```

START-BYTE      = 6
BYTES          = 2
DESCRIPTION    = "RTI offset of BIU interference"
END-OBJECT    = COLUMN

OBJECT        = COLUMN
NAME         = NOISE
DATA-TYPE    = LSB-INTEGER
START-BYTE   = 8
BYTES       = 2
DESCRIPTION  = "Description of interferogram:
                2^0 - Normal
                2^1 - DC Level
                2^2 - Drift
                2^3 - (Big) Spikes
                2^4 - Std Dev
                2^5 - Long
                2^6 - Short
                2^7 - Insuf.Samples
                2^8 - Avg Ifm
                2^9 - Invalid Time Stamp
                2-10- Shutter
                2^11- ZPD Position
                "
END-OBJECT    = COLUMN

OBJECT        = COLUMN
NAME         = DSCAL
DATA_TYPE    = LSB-INTEGER
START-BYTE   = 10
BYTES       = 1
DESCRIPTION  = "1-DSCAL, 0-rest sequenses"
END-OBJECT    = COLUMN

OBJECT        = COLUMN
NAME         = LASER
DATA_TYPE    = LSB-INTEGER
START-BYTE   = 11
BYTES       = 1
DESCRIPTION  = "1 - [4.95 - 5.25V]
                2 - [5.55 - 5.85V]
                3 - [5.95 - 6.25V]
                0 - the rest RIE[2]
                "
END-OBJECT    = COLUMN

```

B.7 GEO.FMT

COLUMNS	= 30
ROW-BYTES	= 244
OBJECT	= COLUMN
NAME	= SCET
DATA_TYPE	= LSBINTEGER
START-BYTE	= 1
BYTES	= 4
DESCRIPTION	= "SPACECRAFT EVENT TIME, ENCODED AS AN INT "
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= SCET_FRACTIONAL_SECONDS
DATA_TYPE	= LSBINTEGER
STARTBYTE	= 5
BYTES	= 4
DESCRIPTION	= "FRACTIONAL PART OF SCET, IN 1/100 SECONDS "
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= SCLK
DATA_TYPE	= LSBINTEGER
START-BYTE	= 9
BYTES	= 4
DESCRIPTION	= "SPACECRAFT CLOCK, IN SCLK FORMAT "
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= PARTITION
DATA_TYPE	= LSBINTEGER
STARTBYTE	= 13
BYTES	= 4
DESCRIPTION	= " SCLK PARTITION "
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= TIME-ZPD
DATA_TYPE	= LSBINTEGER
START-BYTE	= 17
BYTES	= 4
DESCRIPTION	= "TIME OF ZPD "
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= BODY-ID

DATA_TYPE	=	LSBINTEGER
START-BYTE	=	21
BYTES	=	4
DESCRIPTION	=	"NAIF BODY ID "
ENDOBJECT	=	COLUMN
OBJECT	=	COLUMN
NAME	=	EPHEMERIS-TIME
DATA-TYPE	=	PC-REAL
STARTBYTE	=	25
BYTES	=	8
DESCRIPTION	=	"EPHEMERIS TIME CORRESPONDING TO THIS SCET "
ENDOBJECT	=	COLUMN
OBJECT	=	COLUMN
NAME	=	BODY-SPACECRAFT-RANGE
DATA_TYPE	=	PCREAL
START-BYTE	=	33
BYTES	=	8
DESCRIPTION	=	"KM "
END-OBJECT	=	COLUMN
OBJECT	=	COLUMN
NAME	=	BODY-POSITION
DATA_TYPE	=	PCREAL
STARTBYTE	=	41
BYTES	=	24
ITEMS	=	3
ITEMBYTES	=	8
DESCRIPTION	=	"KM "
END-OBJECT	=	COLUMN
OBJECT	=	COLUMN
NAME	=	BODYSUBSPACECRAFTLONGITUDE
DATA_TYPE	=	PCREAL
STARTBYTE	=	65
BYTES	=	8
DESCRIPTION	=	"PLANETOGRAPHIC SUB SPACECRAFT LONGITUDE "
ENDOBJECT	=	COLUMN
OBJECT	=	COLUMN
NAME	=	BODYSUBSPACECRAFTLATITUDE
DATA-TYPE	=	PC-REAL
STARTBYTE	=	73
BYTES	=	8
DESCRIPTION	=	"PLANETOGRAPHIC SUB SPACECRAFT LATITUDE "
END-OBJECT	=	COLUMN

OBJECT	= COLUMN
NAME	= BODY-SUN-RANGE
DATA_TYPE	= PCREAL
STARTBYTE	= 81
BYTES	= 8
DESCRIPTION	= "KM "
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= BODY-SUN-RIGHT-ASCENSION
DATA_TYPE	= PCREAL
STARTBYTE	= 89
BYTES	= 8
DESCRIPTION	= "DEGREES "
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= BODY-SUN-DECLINATION
DATA_TYPE	= PCREAL
START-BYTE	= 97
BYTES	= 8
DESCRIPTION	= "DEGREES "
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= BODYSUBSOLARLONGITUDE
DATA_TYPE	= PCREAL
STARTBYTE	= 105
BYTES	= 8
DESCRIPTION	= "PLANETOGRAPHIC SUB SOLAR LONGITUDE "
END-OBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= BODYSUBSOLARLATITUDE
DATA_TYPE	= PCREAL
STARTBYTE	= 113
BYTES	= 8
DESCRIPTION	= "PLANETOGRAPHIC SUB SOLAR LATITUDE "
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= BODYPHASEANGLE
DATA-TYPE	= PC-REAL
STARTBYTE	= 121
BYTES	= 8
DESCRIPTION	= "PLANETARY PHASE ANGLE "
END-OBJECT	= COLUMN

OBJECT	= COLUMN
NAME	= BODY-ANGULAR-SEMIDIAMETER
DATA_TYPE	= PCREAL
STARTBYTE	= 129
BYTES	= 8
DESCRIPTION	= "MILLIRADIANS "
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= BODY-ORBITAL-LONGITUDE
DATA_TYPE	= PCREAL
STARTBYTE	= 137
BYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= BODY_SYS3_LONGITUDE
DATA-TYPE	= PC-REAL
STARTBYTE	= 145
BYTES	= 8
END-OBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= PRIMARY-ID
DATA_TYPE	= LSBINTEGER
STARTBYTE	= 153
BYTES	= 4
DESCRIPTION	= "NAIF PRIMARY ID "
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= PRIMARYSPACECRAFTRANGE
DATA-TYPE	= PC-REAL
STARTBYTE	= 157
BYTES	= 8
DESCRIPTION	= "KM "
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= PRIMARYSUBSPACECRAFTLONGITUDE
DATA_TYPE	= PCREAL
STARTBYTE	= 165
BYTES	= 8
DESCRIPTION	= "PLANETOGRAPHIC SUB SPACECRAFT LONGITUDE "
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= PRIMARY_SUB_SPACECRAFT_LATITUDE

```

    DATA_TYPE           = PCREAL
    START-BYTE           = 173
    BYTES                 = 8
    DESCRIPTION           = "PLANETOGRAPHIC SUB SPACECRAFT LATITUDE "
    ENDOBJECT            = COLUMN

OBJECT                  = COLUMN
    NAME                  = PRIMARY-SUN-RANGE
    DATA-TYPE            = PC-REAL
    STARTBYTE             = 181
    BYTES                 = 8
    DESCRIPTION           = "KM "
    ENDOBJECT            = COLUMN

OBJECT                  = COLUMN
    NAME                  = PRIMARYSUBSOLARLONGITUDE
    DATA_TYPE           = PCREAL
    START-BYTE           = 189
    BYTES                 = 8
    DESCRIPTION           = "PLANETOGRAPHIC SUB SOLAR LONGITUDE "
    END-OBJECT           = COLUMN

OBJECT                  = COLUMN
    NAME                  = PRIMARY_SUB_SOLAR_LATITUDE
    DATA_TYPE           = PCREAL
    STARTBYTE             = 197
    BYTES                 = 8
    DESCRIPTION           = "PLANETOGRAPHIC SUB SOLAR LATITUDE "
    ENDOBJECT            = COLUMN

OBJECT                  = COLUMN
    NAME                  = PRIMARY-PHASE-ANGLE
    DATA-TYPE            = PC-REAL
    STARTBYTE             = 205
    BYTES                 = 8
    DESCRIPTION           = "PLANETARY PHASE ANGLE "
    ENDOBJECT            = COLUMN

OBJECT                  = COLUMN
    NAME                  = PRIMARYANGULARSEMIDIAMETER
    DATA_TYPE           = PCREAL
    STARTBYTE             = 213
    BYTES                 = 8
    DESCRIPTION           = "MILLIRADIANS "
    ENDOBJECT            = COLUMN

OBJECT                  = COLUMN
    NAME                  = SCETSTRING

```

DATA_TYPE	= CHARACTER
START-BYTE	= 221
BYTES	= 24
ITEMS	= 24
ITEMBYTES	= 1
ENDOBJECT	= COLUMN

B.8 POL.FMT

COLUMNS	= 25
ROW-BYTES	= 752

OBJECT	= COLUMN
NAME	= TARGET-ID
DATA_TYPE	= LSBINTEGER
STARTBYTE	= 1
BYTES	= 4
DESCRIPTION	= "NAIF TARGET ID "
ENDOBJECT	= COLUMN

OBJECT	= COLUMN
NAME	= PRIMARYID
DATA_TYPE	= LSBINTEGER
STARTBYTE	= 5
BYTES	= 4
DESCRIPTION	= "NAIF ID OF THE PRIMARY "
END-OBJECT	= COLUMN

OBJECT	= COLUMN
NAME	= SCET
DATA_TYPE	= LSBINTEGER
STARTBYTE	= 9
BYTES	= 4
DESCRIPTION	= "SPACECRAFT EVENT TIME ENCODED AS AN INTEGER "
ENDOBJECT	= COLUMN

OBJECT	= COLUMN
NAME	= TIME-ZPD
DATA-TYPE	= LSB-INTEGER
STARTBYTE	= 13
BYTES	= 4
ENDOBJECT	= COLUMN

OBJECT	= COLUMN
NAME	= TIME-END
DATA_TYPE	= PCREAL

STARTBYTE	= 17
BYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= DET
DATA_TYPE	= LSBINTEGER
START-BYTE	= 25
BYTES	= 4
DESCRIPTION	= "DETECTOR ID "
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= ALL_Q_ON
DATA_TYPE	= LSBINTEGER
STARTBYTE	= 29
BYTES	= 4
DESCRIPTION	= "BOOLEAN, 1 IF ALL 9 Q POINTS ARE ON THE TARGET, 0 IF 1 OR MORE IS OFF "
END-OBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= LATITUDEZPD
DATA-TYPE	= PC-REAL
STARTBYTE	= 33
BYTES	= 72
ITEMS	= 9
ITEMBYTES	= 8
DESCRIPTION	= "PLANETOGRAPHIC LATITUDE AT ZPG, 1 BAR LEVEL "
END-OBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= LONGITUDE-ZPD
DATA_TYPE	= PCREAL
STARTBYTE	= 105
BYTES	= 72
ITEMS	= 9
ITEMBYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= ALTITUDEZPD
DATA-TYPE	= PC-REAL
STARTBYTE	= 177
BYTES	= 72
ITEMS	= 9
ITEM-BYTES	= 8
ENDOBJECT	= COLUMN

OBJECT	= COLUMN
NAME	= RIGHTASCENSION
DATA_TYPE	= PCREAL
STARTBYTE	= 249
BYTES	= 72
ITEMS	= 9
ITEM-BYTES	= 8
END-OBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= DECLINATION
DATA_TYPE	= PCREAL
STARTBYTE	= 321
BYTES	= 72
ITEMS	= 9
ITEMBYTES	= 8
END-OBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= SPACECRAFT_TO_IMAGE_POINT_ZPD
DATA_TYPE	= PCREAL
STARTBYTE	= 393
BYTES	= 72
ITEMS	= 9
ITEMBYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= LATITUDE-END
DATA-TYPE	= PC-REAL
STARTBYTE	= 465
BYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= LONGITUDEEND
DATA_TYPE	= PCREAL
STARTBYTE	= 473
BYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= ALTITUDEEND
DATA_TYPE	= PCREAL
START-BYTE	= 481
BYTES	= 8
ENDOBJECT	= COLUMN

OBJECT	= COLUMN
NAME	= SMEAR
DATA_TYPE	= PCREAL
STARTBYTE	= 489
BYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= EMISSIONANGLE
DATA_TYPE	= PCREAL
STARTBYTE	= 497
BYTES	= 72
ITEMS	= 9
ITEMBYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= EMISSION-ANGLE-FOV-AVERAGE
DATA-TYPE	= PC-REAL
START-BYTE	= 569
BYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= FILLINGFACTOR
DATA_TYPE	= PCREAL
STARTBYTE	= 577
BYTES	= 8
END-OBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= EMISSION_AZIMUTH_ANGLE
DATA_TYPE	= PCREAL
STARTBYTE	= 585
BYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= SOLARZENITH
DATA_TYPE	= PCREAL
STARTBYTE	= 593
BYTES	= 72
ITEMS	= 9
ITEMBYTES	= 8
END-OBJECT	= COLUMN
OBJECT	= COLUMN

NAME	= SOLARAZIMUTH
DATA-TYPE	= PC-REAL
STARTBYTE	= 665
BYTES	= 8
ENDOBJECT	= COLUMN

OBJECT	= COLUMN
NAME	= SOLAR-PHASE
DATA-TYPE	= PC-REAL
STARTBYTE	= 673
BYTES	= 8
ENDOBJECT	= COLUMN

OBJECT	= COLUMN
NAME	= LOCALTIME
DATA_TYPE	= PCREAL
STARTBYTE	= 681
BYTES	= 72
ITEMS	= 9
ITEM-BYTES	= 8
END-OBJECT	= COLUMN

B.9 RIN.FMT

COLUMNS	= 18
ROW-BYTES	= 512

OBJECT	= COLUMN
NAME	= PRIMARYID
DATA_TYPE	= LSBINTEGER
STARTBYTE	= 1
BYTES	= 4
DESCRIPTION	= "NAIF ID OF THE PRIMARY "
ENDOBJECT	= COLUMN

OBJECT	= COLUMN
NAME	= SCET
DATA_TYPE	= LSBINTEGER
START-BYTE	= 5
BYTES	= 4
DESCRIPTION	= "SPACECRAFT EVENT TIME ENCODED AS AN INTEGER "
ENDOBJECT	= COLUMN

OBJECT	= COLUMN
NAME	= TIME-ZPD
DATA_TYPE	= LSBINTEGER

STARTBYTE	= 9
BYTES	= 4
DESCRIPTION	= "TIME ZPD "
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= TIME-END
DATA-TYPE	= PC-REAL
START-BYTE	= 13
BYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= DET
DATA_TYPE	= LSBINTEGER
STARTBYTE	= 21
BYTES	= 4
DESCRIPTION	= "DETECTOR ID "
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= RINGRADIUSZPD
DATA_TYPE	= PCREAL
START-BYTE	= 25
BYTES	= 72
ITEMS	= 9
ITEMBYTES	= 8
DESCRIPTION	= "RADIUS OF INTERCEPT "
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= RING-SPACECRAFT-RANGE-ZPD
DATA-TYPE	= PC-REAL
STARTBYTE	= 97
BYTES	= 72
ITEMS	= 9
ITEMBYTES	= 8
DESCRIPTION	= "DISTANCE OF SPACECRAFT FROM RING INTERCEPT "
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= RING_EMISSION_AZIMUTH_ANGLE
DATA-TYPE	= PC-REAL
STARTBYTE	= 169
BYTES	= 72
ITEMS	= 9
ITEM-BYTES	= 8
ENDOBJECT	= COLUMN

OBJECT	= COLUMN
NAME	= RING-SOLAR-PHASE
DATA_TYPE	= PCREAL
STARTBYTE	= 241
BYTES	= 72
ITEMS	= 9
ITEM-BYTES	= 8
END-OBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= RING-EMISSION-ANGLE
DATA_TYPE	= PCREAL
STARTBYTE	= 313
BYTES	= 72
ITEMS	= 9
ITEMBYTES	= 8
END-OBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= RING-LONGITUDE-ZPD
DATA_TYPE	= PCREAL
STARTBYTE	= 385
BYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= RING-SOLAR-AZIMUTH
DATA_TYPE	= PCREAL
START-BYTE	= 393
BYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= RINGSOLARZENITH
DATA_TYPE	= PCREAL
STARTBYTE	= 401
BYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= RINGLONGITUDEEND
DATA-TYPE	= PC-REAL
STARTBYTE	= 409
BYTES	= 8
END-OBJECT	= COLUMN
OBJECT	= COLUMN

NAME	= RINGRADIUSEND
DATA-TYPE	= PC-REAL
STARTBYTE	= 417
BYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= RING-SPACECRAFT-RANGE-END
DATA-TYPE	= PC-REAL
STARTBYTE	= 425
BYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= RINGSMEAR
DATA_TYPE	= PCREAL
STARTBYTE	= 433
BYTES	= 8
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= RINGLOCALTIME
DATA_TYPE	= PCREAL
START-BYTE	= 441
BYTES	= 72
ITEMS	= 9
ITEMBYTES	= 8
ENDOBJECT	= COLUMN

B.10 TAR.FMT

COLUMNS	= 31
ROW-BYTES	= 40
OBJECT	= COLUMN
NAME	= SCET
DATA_TYPE	= LSBINTEGER
STARTBYTE	= 1
BYTES	= 4
DESCRIPTION	= 'spacecraft event time encoded as an integer "
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= DET
DATA_TYPE	= LSBINTEGER
STARTBYTE	= 5

```

        BYTES = 4
        DESCRIPTION = "detector ID "
    ENDOBJECT = COLUMN

OBJECT = COLUMN
    NAME = FOVTARGETS
    DATA_TYPE = LSB_UNSIGNED_INTEGER
    START-BYTE = 9
    BYTES = 4
    DESCRIPTION = "A bitfield, with the following assignments:

```

```

        2^0 Jupiter ring
        2^1 Jupiter
        2-2 10
        2^3 Europa
        2^4 Ganymede
        2^5 Callisto
        2^6 Saturn
        2^7 Mimas
        2^8 Enceladus
        2^9 Tethys
        2-10 Dione
        2^11 Rhea
        2^12 Titan
        2-13 Hyperion
        2-14 Iapetus
        2^15 Phoebe
        2-16 Janus
        2^17 Epimetheus
        2^18 Helene
        2^19 Telesto
        2-20 Calypso
        2^21 Atlas
        2-22 Prometheus
        2^23 Pandora
        2-24 Pan
        2-25 Saturn ring
        2-31 A stellar target from the "stars" file

```

If the corresponding bit is on, the object is in the field of view, otherwise it isn't. "

```

    ENDOBJECT = COLUMN

OBJECT = COLUMN
    NAME = JRING
    DATA_TYPE = LSB_UNSIGNED_INTEGER
    START-BYTE = 13
    BYTES = 1
    ENDOBJECT = COLUMN

```

OBJECT	= COLUMN
NAME	= JUPITER
DATA_TYPE	= LSB-UNSIGNED-INTEGER
STARTBYTE	= 14
BYTES	= 1
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= 10
DATA_TYPE	= LSB-UNSIGNED-INTEGER
STARTBYTE	= 15
BYTES	= 1
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= EUROPA
DATA-TYPE	= LSB-UNSIGNED-INTEGER
STARTBYTE	= 16
BYTES	= 1
END-OBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= GANYMEDE
DATA_TYPE	= LSB-UNSIGNED-INTEGER
STARTBYTE	= 17
BYTES	= 1
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= CALLISTO
DATA_TYPE	= LSB-UNSIGNED-INTEGER
START-BYTE	= 18
BYTES	= 1
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= SATURN
DATA_TYPE	= LSB-UNSIGNED-INTEGER
STARTBYTE	= 19
BYTES	= 1
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= MIMAS
DATA-TYPE	= LSB-UNSIGNED-INTEGER
START-BYTE	= 20
BYTES	= 1

ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= ENCELADUS
DATA_TYPE	= LSB-UNSIGNED-INTEGER
STARTBYTE	= 21
BYTES	= 1
END-OBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= TETHYS
DATA_TYPE	= LSB-UNSIGNED-INTEGER
STARTBYTE	= 22
BYTES	= 1
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= DIONE
DATA_TYPE	= LSB-UNSIGNED-INTEGER
START-BYTE	= 23
BYTES	= 1
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= RHEA
DATA_TYPE	= LSB-UNSIGNED-INTEGER
STARTBYTE	= 24
BYTES	= 1
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= TITAN
DATA-TYPE	= LSB-UNSIGNED-INTEGER
STARTBYTE	= 25
BYTES	= 1
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= HYPERION
DATA_TYPE	= LSB-UNSIGNED-INTEGER
STARTBYTE	= 26
BYTES	= 1
END-OBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= IAPETUS
DATA-TYPE	= LSB-UNSIGNED-INTEGER
STARTBYTE	= 27

BYTES	= 1
END-OBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= PHOEBE
DATA_TYPE	= LSB-UNSIGNED-INTEGER
STARTBYTE	= 28
BYTES	= 1
END-OBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= JANUS
DATA_TYPE	= LSB-UNSIGNED-INTEGER
STARTBYTE	= 29
BYTES	= 1
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= EPHMETHEUS
DATA-TYPE	= LSB-UNSIGNED-INTEGER
START-BYTE	= 30
BYTES	= 1
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= HELENE
DATA_TYPE	= LSB-UNSIGNED-INTEGER
STARTBYTE	= 31
BYTES	= 1
END-OBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= TELESTO
DATA_TYPE	= LSB-UNSIGNED-INTEGER
STARTBYTE	= 32
BYTES	= 1
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= CALYPSO
DATA_TYPE	= LSB-UNSIGNED-INTEGER
STARTBYTE	= 33
BYTES	= 1
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= ATLAS
DATA_TYPE	= LSB-UNSIGNED-INTEGER

STARTBYTE	= 34
BYTES	= 1
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= PROMETHEUS
DATA_TYPE	= LSB-UNSIGNED-INTEGER
START-BYTE	= 35
BYTES	= 1
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= PANDORA
DATA_TYPE	= LSB-UNSIGNED-INTEGER
STARTBYTE	= 36
BYTES	= 1
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= PAN
DATA-TYPE	= LSB-UNSIGNED-INTEGER
STARTBYTE	= 37
BYTES	= 1
END-OBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= SRING
DATA_TYPE	= LSB-UNSIGNED-INTEGER
STARTBYTE	= 38
BYTES	= 1
END-OBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= DEEPSPACE
DATA_TYPE	= LSB-UNSIGNED-INTEGER
STARTBYTE	= 39
BYTES	= 1
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= STELLAR
DATA_TYPE	= LSBUNSIGNEDINTEGER
START-BYTE	= 40
BYTES	= 1
ENDOBJECT	= COLUMN

B.11 ISPM.FMT

COLUMNS	= 16
ROW-BYTES	= 53
OBJECT	= COLUMN
NAME	= SCET
DATA_TYPE	= LSB_UNSIGNED_INTEGER
START-BYTE	= 1
BYTES	= 4
DESCRIPTION	= "spacecraft clock time "
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= DET
DATA_TYPE	= LSBINTEGER
STARTBYTE	= 5
BYTES	= 1
DESCRIPTION	= "detector number "
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= ISPTS
DATA_TYPE	= LSBINTEGER
START-BYTE	= 6
BYTES	= 2
DESCRIPTION	= "number of points in regridded spectrum"
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= DS_NAVE
DATA_TYPE	= LSBINTEGER
STARTBYTE	= 8
BYTES	= 2
DESCRIPTION	= "number of spectra in deep space average"
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= SH_NAVE
DATA_TYPE	= LSBINTEGER
START-BYTE	= 10
BYTES	= 2
DESCRIPTION	= "number of spectra in shutter average"
ENDOBJECT	= COLUMN
OBJECT	= COLUMN
NAME	= TINSTR

```

        DATA_TYPE           = PCREAL
        START-BYTE           = 12
        BYTES                 = 4
        DESCRIPTION          = 'instrument temperature in calibration (K)'
    ENDOBJECT               = COLUMN

    OBJECT                   = COLUMN
        NAME                  = IWN_START
        DATA-TYPE            = PC-REAL
        STARTBYTE             = 16
        BYTES                 = 4
        DESCRIPTION          = "wavenumber of first regridded spectral
point (cm-1)"
    ENDOBJECT               = COLUMN

    OBJECT                   = COLUMN
        NAME                  = IWNSTEP
        DATA-TYPE            = PC-REAL
        STARTBYTE             = 20
        BYTES                 = 4
        DESCRIPTION          = "wavenumber step size of regridded data (cm-1)"
    ENDOBJECT               = COLUMN

    OBJECT                   = COLUMN
        NAME                  = APODTYPE
        DATA_TYPE            = LSBINTEGGER
        STARTBYTE             = 24
        BYTES                 = 2
        DESCRIPTION          = "numeric type of apodisation function"
    END-OBJECT              = COLUMN

    OBJECT                   = COLUMN
        NAME                  = FWHM
        DATA_TYPE            = PCREAL
        STARTBYTE             = 26
        BYTES                 = 4
        DESCRIPTION          = "FWHM of instrument line shape (cm-1)"
    ENDOBJECT               = COLUMN

    OBJECT                   = COLUMN
        NAME                  = RAYLEIGH
        DATA_TYPE            = PCREAL
        START-BYTE           = 30
        BYTES                 = 4
        DESCRIPTION          = "Rayleigh resol.
(= dist to first null of ILS) in cm-1"
    END-OBJECT              = COLUMN

```

```

OBJECT          = COLUMN
  NAME          = NYQUIST
  DATA_TYPE    = PCREAL
  STARTBYTE     = 34
  BYTES         = 4
  DESCRIPTION   = "Nyquist bin size (intrinsic resol. limit)
in cm-1"
END-OBJECT     = COLUMN

OBJECT          = COLUMN
  NAME          = POWER
  DATA_TYPE    = PCREAL
  STARTBYTE     = 38
  BYTES         = 4
  DESCRIPTION   = 'integrated radiance under the spectrum
in W cm-2 sr-1"
ENDOBJECT      = COLUMN

OBJECT          = COLUMN
  NAME          = DS_SCET
  DATA_TYPE    = LSB_UNSIGNED_INTEGER
  STARTBYTE     = 42
  BYTES         = 4
  DESCRIPTION   = "Deep Space SCET "
ENDOBJECT      = COLUMN

OBJECT          = COLUMN
  NAME          = DS_SH_SCET
  DATA_TYPE    = LSB_UNSIGNED_INTEGER
  START-BYTE    = 46
  BYTES         = 4
  DESCRIPTION   = "Deep Space Shutter Closed SCET "
END-OBJECT     = COLUMN

OBJECT          = COLUMN
  NAME          = ISPM
  DATA_TYPE    = LSBINTEGER
  STARTBYTE     = 50
  BYTES         = 4
  VARDATATYPE  = PCREAL
  VARITEMBYTES = 4
  VARRECORDTYPE = VAXVARIABLELENGTH
  DESCRIPTION   = "pointer to regridded spectra data. Spectra data
has units W cm-2 sr-1 (cm-1)-1"
ENDOBJECT      = COLUMN

```