**Software Interface Specification**

**Voyager Jupiter**

**Radio Science**

**Raw Data Archive (REDR)**

(restoration from Voyager Radio Science Team archives)

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#

# Change Log

|  |  |  |  |
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| **Date** | **Sections Changed** | **Reason for Change** | **Revision** |
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# Contents

[Change Log 2](#_Toc149903540)

[Contents 3](#_Toc149903541)

[Acronyms and Abbreviations 5](#_Toc149903542)

[1 Introduction 7](#_Toc149903543)

[1.1 Document Overview 7](#_Toc149903544)

[1.2 Data Overview 7](#_Toc149903545)

[1.3 Experiment Overview 7](#_Toc149903546)

[1.4 Example Data 9](#_Toc149903547)

[1.5 Applicable Documents 10](#_Toc149903548)

[1.6 System Siting 11](#_Toc149903549)

[1.6.1 Interface Location and Medium 11](#_Toc149903550)

[1.6.2 Data Sources, Destinations, and Transfer Methods 11](#_Toc149903551)

[1.6.3 Generation Method and Frequency 11](#_Toc149903552)

[1.7 Assumptions and Constraints 12](#_Toc149903553)

[1.7.1 Usage Constraints 12](#_Toc149903554)

[1.7.2 Documentation Conventions 12](#_Toc149903555)

[2 Interface Characteristics 13](#_Toc149903556)

[2.1 Hardware Characteristics and Limitations 13](#_Toc149903557)

[2.1.1 Special Equipment and Device Interfaces 13](#_Toc149903558)

[2.1.2 Special Set-Up Requirements 13](#_Toc149903559)

[2.2 Volume and Size 13](#_Toc149903560)

[2.3 Labeling and Identification 13](#_Toc149903561)

[2.3.1 External Labels 13](#_Toc149903562)

[2.3.2 Internal Labels 13](#_Toc149903563)

[2.4 Interface Medium Characteristics 13](#_Toc149903564)

[2.5 Backup and Duplicates 13](#_Toc149903565)

[3 Structure and Organization Overview 14](#_Toc149903566)

[3.1 Logical Organization 14](#_Toc149903567)

[3.1.1 Bundles and Collections 14](#_Toc149903568)

[3.1.2 Products 15](#_Toc149903569)

[3.1.2.1 ODR and Browse Products 15](#_Toc149903570)

[3.1.2.2 Frequency Calibration Products 16](#_Toc149903571)

[3.1.2.3 Geometry Products 16](#_Toc149903572)

[3.1.2.4 Document Products 17](#_Toc149903573)

[3.1.3 Versioning 17](#_Toc149903574)

[3.1.4 Labels 17](#_Toc149903575)

[3.2 Physical Organization 18](#_Toc149903576)

[3.2.1 File Naming and Conversions 18](#_Toc149903577)

[3.2.1.1. ODR and Browse Product File Names 18](#_Toc149903578)

[3.2.1.2 Frequency Calibration Product File Names 19](#_Toc149903579)

[3.2.1.3 Geometry Product File Names 19](#_Toc149903580)

[3.2.1.4 Document Product File Names 19](#_Toc149903581)

[3.2.2 File Conversions 19](#_Toc149903582)

[3.2.2.1 ODR Conversions 19](#_Toc149903583)

[3.2.2.1 HGA Pointing Reconstruction Conversions 20](#_Toc149903584)

[3.2.3 Directories 20](#_Toc149903585)

[4 Support Staff and Cognizant Personnel 21](#_Toc149903586)

[4.1 Planetary Data System 21](#_Toc149903587)

[5 Errata and User Notes 21](#_Toc149903588)

[5.1 Bad or Missing Data 21](#_Toc149903589)

[5.1.1 Unreadable Records 21](#_Toc149903590)

[5.1.2 Tape/File Naming Variations 22](#_Toc149903591)

[5.1.3 Duplicate and Missing Files 22](#_Toc149903592)

[5.2 Buffer delays 22](#_Toc149903593)

[5.3 Truncations for Creating Browse Products 23](#_Toc149903594)

[5.4 User Notes 23](#_Toc149903595)

[5.4.1 Receiver Operation 23](#_Toc149903596)

[Appendix A Tape/File Index – Voyager 1 at Jupiter 24](#_Toc149903597)

[Appendix B Tape/File Index – Voyager 2 at Jupiter 27](#_Toc149903598)

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# Acronyms and Abbreviations

 ASCII American Standard Code for Information Interchange

 CCT computer-compatible tape

 CD-ROM compact disc, read-only memory

 DSN NASA Deep Space Network

 DSS Deep Space Station (antenna and associated facilities)

 GB gigabyte

 GHz gigaHertz

 HGA high-gain antenna

 JPL Jet Propulsion Laboratory

 LID logical identifier

 LIDVID versioned logical identifier

 MB megabyte

 NASA National Aeronautics and Space Administration

 NAIF Navigation Ancillary Information Facility

 OCC occultation

 ODA Occultation Data Assembly

 ODR Original Data Record[[1]](#footnote-1)

 PDF (Adobe Systems) Portable Data Format

 PDS Planetary Data System

 PDS3 PDS Standards, version 3

 PDS4 PDS Standards, version 4

 POCA Programmable Oscillator Control Assembly

 RCP right-circular polarization

 RDA Raw Data Archive

 REDR Reconstructed Data Record

 RMS Ring Moon Systems (PDS discipline node)

 RS radio science

 RSS Radio Science Subsystem

 RSST Radio Science Support Team

 RST Radio Science Team

 S S-band (a frequency near 2.3 GHz)

 s/c spacecraft

 SCAT scatter (as in ring scattering observations)

 SETI Search for Extra-Terrestrial Intelligence

 SIS Software Interface Specification

 SPICE information system produced by the NAIF Team

 USO ultra-stable oscillator

 VG, VGR Voyager

 VG1 Voyager 1

 VG1J Voyager 1 Jupiter

 VG2 Voyager 2

 VG2J Voyager 2 Jupiter

 VID version identifier

 X X-band (a frequency near 8.4 GHz)

 XML eXtensible Markup Language

#

# 1 Introduction

## 1.1 Document Overview

This Software Interface Specification (SIS) describes the format and content of two bundles within the Voyager (VGR) Jupiter Radio Science (RS) Raw Data Archive (RDA) after restoration from original holdings of the Voyager Radio Science Team. The data are from radio science observations with the Voyager 1 spacecraft and NASA Deep Space Network (DSN) facilities near Madrid, Spain, (DSS-63) during the Jupiter encounter in March 1979 (VG1J) and with Voyager 2 and DSN facilities near Barstow, California, (DSS-14) during the Jupiter encounter in July 1979 (VG2J). The bundles conform to Planetary Data System standards version 4 (PDS4) [1]. The restorations to PDS4 were carried out in 2021-3 with support from the PDS Ring Moon Systems (RMS) node.

## 1.2 Data Overview

The two bundles are distinguished by spacecraft (Voyager 1 or 2). Bundle contents are summarized in Table 1.2-1. Within each bundle are several collections, summarized in Table 1.2-2. This document applies to both bundles. Investigations were occultations (OCC) targeting the neutral atmosphere and ionosphere [6, 7]. Searches for a ring signature and for an ‘evolute flash’ were conducted; neither was detected [8, 9]. The observing geometry is illustrated in Figure 1.2-1.

|  |
| --- |
| **Table 1.2-1: Bundles within the Voyager Jupiter Radio Science Raw Data Archive** |
| **bundle\_id** | **Investigations** | **Dates** |
| *voyager1\_rss\_jupiter\_raw* | OCC | 1979-064 |
| *Voyager2\_rss\_jupiter\_raw* | OCC | 1979-191 |

## 1.3 Experiment Overview

In each experiment the spacecraft transmitted an unmodulated carrier referenced to the output frequency of an on-board ultra-stable oscillator (USO). As the signal passed through Jupiter’s atmosphere, it was refracted, absorbed, and/or scattered (Figure 1.2-1). Refraction may be interpreted in terms of the temperature and pressure in a neutral atmosphere or the electron density in an ionosphere. Changes in signal intensity may be attributed to refraction, diffraction, and/or presence of absorbing materials in the atmosphere. In the deep atmosphere, the spacecraft antenna pointing was offset to compensate for predicted refraction.

The raw data were outputs from receivers connected to the DSN antenna, which were digitally sampled and recorded (Figure 1.2-1). Two receivers were operated in parallel — at S-band (13 cm wavelength) and X-band (3.6 cm wavelength), both capturing the signal in right-circular polarization (RCP). The sample streams were combined with housekeeping data so that a single computer-compatible tape (CCT) held 200 seconds of Voyager 1 data or 400 seconds of Voyager 2 data.

|  |
| --- |
| **Table 1.2-2: Collections within Voyager Jupiter RS RDA Bundles** |
| **collection\_id** | **Product Contents** | **Number of Products** |
| **VG1J** | **VG2J** |
| *data* | 8-bit samples of radio receiver output (binary and ASCII) | 54 | 41 |
| *browse* | Quick-look plots illustrating content of each ODR (in PDF/A format); tables of received signal strength and frequency | 56 | 43 |
| *calib\_freq* | Estimates of USO frequency | 1 | 1 |
| *context* | References to context products, which are maintained elsewhere | 02 | 02 |
| *geometry* | Geometry files in non-SPICE formats, including spacecraft trajectory and antenna pointing reconstructions | 4 | 4 |
| *document* | Documents relevant to use of data files | 3[[2]](#footnote-2) | 22 |



Figure 1.2-1. Observational geometry for data collection at Jupiter. As the spacecraft passed behind the planet, its S- and X-band signals were refracted by the atmosphere, causing an apparent Doppler shift at the receiving station. During occultation by Jupiter’s rings, signal intensity might have been reduced and frequency might have been spread when scattered by ring particles; but neither was observed.

## 1.4 Example Data

Figure 1.4-1 is an example of partially processed S-RCP data from the Voyager 1 ingress occultation. For each raw data file in the *data* collection, there are two such four-panel plots in the *browse* collection (one plot for S-RCP and a second plot for X-RCP).



Figure 1.4-1: Example data from the beginning of the Voyager 1 S-RCP Jupiter ingress occultation. Upper left: histogram of raw data sample values. Lower left: Power versus time in sample values —one second averages of squared sample values after removal of the mean. Upper right: Power spectra (0-5 kHz); each trace is an average over 10 seconds. Time increases from bottom to top.

Raw data files have real 8-bit samples; sampling rate was 10000 samples per second at S-band and 30000 samples per second at X-band. The samples were interleaved and combined with housekeeping information in a single digital file of 10000 1692-byte records for Voyager 1 and 20000 1692-byte records for Voyager 2. Table 1.2-2 shows the total number of ODR products for each encounter.

## 1.5 Applicable Documents

This document references the following:

[1] PDS4 Information Model Specification, version 1.16.0.0, April 23, 2021 (<https://pds.nasa.gov/datastandards/documents/im/current/index_1G00.html>).

See also Planetary Data System Standards Reference, JPL D-7669, Part 2, version 1.16.0, April 21, 2021 (<https://pds.nasa.gov/datastandards/documents/sr/current/StdRef_1.16.0.pdf>)

[2] REDR Formats for Voyager Radio Occultation Data from Jupiter (<https://pds-geosciences.wustl.edu/radiosciencedocs/urn-nasa-pds-radiosci_documentation/dsn_redr/dsn_redr.2021-07-31.xml>)

[3] Interpretation and Use of Binary REDR Data (<https://pds-geosciences.wustl.edu/radiosciencedocs/urn-nasa-pds-radiosci_documentation/dsn_redr/redr_unpack.xml>)

[4] Berman, A. L., and G. L. Tyler, Reconstruction of Downlink Frequency from Open-Loop Data, JPL IOM ALB-78-133, 22 November 1978. (<https://pds-geosciences.wustl.edu/radiosciencedocs/urn-nasa-pds-radiosci_documentation/document/berman.1978.xml>)

[5] Eshleman, V. R., G. L. Tyler, J. D. Anderson, G. Fjeldbo, G. S. Levy, G. E. Wood, and T. A. Croft, Radio Science Investigations with Voyager, *Space Science Reviews*, volume 21, Issue 2, pp. 207-232 (1977). doi: 10.1007/BF00200851.

[6] Eshleman, V. R., G. L. Tyler, G. E. Wood, G. F. Lindal, J. D. Anderson, G. S. Levy, and T. A. Croft, Radio Science with Voyager 1 at Jupiter: Preliminary Profiles of the Atmosphere and Ionosphere, *Science*, 204, pp. 976-978, 1979.

[7] Eshleman, V. R., G. L. Tyler, G. E. Wood, G. F. Lindal, J. D. Anderson, G. S. Levy, and T. A. Croft, Radio Science with Voyager at Jupiter: Initial Voyager 2 Results and a Voyager 1 Measure of the Io Torus, *Science*, 206, pp. 959-962, 1979.

[8] Tyler, G. L., E. A. Marouf, and G. E. Wood, Radio occultation of Jupiter's ring: bounds on optical depth and particle size and a comparison with infrared and optical results, *J. Geophys. Res*., 86, 8699-8703 (1981). doi [10.1029/JA086iA10p08699](https://ui.adsabs.harvard.edu/link_gateway/1981JGR....86.8699T/doi%3A10.1029/JA086iA10p08699).

[9] Martin, J. M., G. L. Tyler, V. R. Eshleman, G. E. Wood, and G. F. Lindal, A Search for the Radio Occultation Flash at Jupiter*, J. Geophys. Res*., 86, pp. 8729-8732, 1981.

## 1.6 System Siting

### 1.6.1 Interface Location and Medium

The storage medium, including at least two backups, is determined by the PDS RMS Node. The user interface is through the PDS RMS web site (<https://pds-rings.seti.org>).

### 1.6.2 Data Sources, Destinations, and Transfer Methods

Bundles in the Voyager Jupiter RS RDA are aggregations of products generated by various elements of the DSN, the Voyager Project, the Voyager Radio Science Team (RST), the Voyager Radio Science Support Team (RSST), and others. The original data were delivered on CCTs to the Voyager RST at Stanford University, where they were maintained by Richard Simpson, an Associate Member of the RST. In 2020 he relocated to the SETI Institute, where he assembled the files into the PDS4 Voyager Jupiter RS RDA. All transfers during the final steps were electronic.

### 1.6.3 Generation Method and Frequency

The Voyager Jupiter RS RDA bundles have one primary observational data type — the Original Data Record (ODR), stored in the *data*  collection (Table 1.2-2). In some documentation, the data acquisition system is called the Occultation Data Assembly (ODA) and the data are described as ODA records. Elsewhere, the Voyager Jupiter format is described as the REDR (Reconstructed Data Record) format.

The ODR format evolved over time; ODRs during the Voyager Jupiter era were quite different from ODRs during the Voyager Neptune era, when CCTs were being supplanted by electronic transfers. However, all ODRs were binary files. In the late 1970s and early 1980s they were often recorded on high-speed magnetic tape during data acquisition, then replayed at slower speed and copied to CCTs for delivery to science investigators.

Quick-look plots showing contents of the ODRs were originally generated by the Voyager Radio Science Team at Stanford. Those existed only as paper plots in the Jupiter era; new plots (such as Figure 1.4-1) have been generated as PDF/A-1b files for the PDS4 archive and are stored in the *browse* collection.

Estimates of the USO frequency at specific times during the mission for both Voyager 1 and Voyager 2 are included in the *calib\_freq* collection as a memo in ASCII format. Receiver tuning at the DSN station was controlled by the Programmable Oscillator Control Assembly (POCA); the relationships among POCA values (included in the ODR records), the sky frequency, and the frequency observed in the sample output are described by a second memo [4].

Non-SPICE geometry files are in the *geometry* collection, which includes (1) one ASCII file with position and velocity data for selected targets with respect to the spacecraft and (2) a pair of files (one binary, one ASCII) with reconstructed high-gain antenna (HGA) pointing vectors, which are required to interpret radio occultation data in the deep atmosphere. SPICE geometry files may be found at <https://naif.jpl.nasa.gov/naif/data_outer.html>

The *document* collection includes files which describe the Voyager mission, the radio science operations plan, and the archive (this document). DSN document collections which describe radio science data formats that are mission independent — for example, [2]-[4] — are included as secondary members of the Voyager RS RDA collections.

## 1.7 Assumptions and Constraints

### 1.7.1 Usage Constraints

Access to Voyager RS RDA bundles is determined by PDS.

### 1.7.2 Documentation Conventions

1.7.2.1 Data Format Descriptions

Since formats vary widely among data/file types, users should consult product labels for details. Files containing receiver samples and housekeeping data are described by [2]; example conversions of binary to ASCII formats are given in [3].

1.7.2.3 Limits of This Document

This document applies only to PDS4 bundles containing Voyager radio science raw data collected during the Jupiter encounters.

#

# 2 Interface Characteristics

## 2.1 Hardware Characteristics and Limitations

### 2.1.1 Special Equipment and Device Interfaces

The PDS4 version of the Voyager Jupiter RS RDA is posted on the PDS/RMS web site. Users of the data must have access to systems which can connect with the web site.

### 2.1.2 Special Set-Up Requirements

None.

### 2.2 Volume and Size

Typical ODR data files are 16.92 MB for Voyager 1 and 33.84 MB for Voyager 2. ASCII files with S-band samples are slightly smaller than the parent ODR files (15.7 MB and 31.4 MB for Voyager 1 and Voyager 2, respectively). ASCII files with X-band samples are slightly smaller than three times the ODR sizes (47.1 MB and 94.2 MB, respectively). Other files are small by comparison. There are 54 ODRs in the Voyager 1 bundle, making the bundle volume approximately 4.4 GB. There are 41 ODRs in the Voyager 2 bundle, making that bundle approximately 6.8 GB.

## 2.3 Labeling and Identification

### 2.3.1 External Labels

There is no external labeling of the Voyager Jupiter RS RDA bundles; these archives are stored electronically on systems managed by the PDS RMS Node.

### 2.3.2 Internal Labels

Voyager Jupiter RS RDA bundles, collections, and products are identified by logical and version identifiers (LIDs and VIDs, respectively) constructed in accordance with PDS4 standards [1]. These identifiers are described further in Section 3 of this document.

## 2.4 Interface Medium Characteristics

The Voyager Jupiter RS RDA bundles are posted on the PDS RMS Node web site; the storage media and methods are determined by PDS/RMS.

## 2.5 Backup and Duplicates

The entire content of each Voyager Jupiter RS RDA bundle is backed up following procedures developed by PDS/RMS in accordance with PDS policies.

#

# 3 Structure and Organization Overview

## 3.1 Logical Organization

The Voyager Jupiter RS RDA is organized into two bundles as specified in Table 1.2-1. Each bundle has six collections (Table 1.2-2). The members of collections are data products, each including its own label written in the eXtensible Markup Language (XML). The members of each collection are listed in a collection Inventory, which is accompanied by an XML label. The bundle has a label which lists the member collections, but there is no separate inventory file. Figure 3.1-1 illustrates the logical structure for the Voyager 1 Jupiter bundle. The logical structures for the Voyager 2 Jupiter bundle is identical except that the value for <bundle\_id> in the upper left is voyager2\_rss\_jupiter\_raw.



Figure 3-1.1. Logical structure of the Voyager 1 Jupiter bundle, which has one data collection, one browse collection, two calibration collections (frequency and geometry), one document collection, and one context collection (with only secondary members), which is not shown explicitly.

### 3.1.1 Bundles and Collections

The Logical Identifier (LID) for a bundle is constructed by appending the appropriate <bundle\_id> from Table 1.2-1 to the PDS-specific root (urn:nasa:pds). Fields within the LID are delimited by ASCII colon characters. So long as the <bundle\_id> value is unique within PDS, each bundle will be uniquely identified by its LID to all users of PDS and its archiving partners.

urn:nasa:pds:<bundle\_id>

For example, the LID for the Voyager 1 bundle in Figure 3.1-1 is

urn:nasa:pds:voyager1\_rss\_jupiter\_raw

Collection LIDs are constructed by appending <collection\_id> (Table 1.2-2) to the bundle LID. Because the bundle LID is unique, it follows that the collection LIDs are also unique.

urn:nasa:pds:<bundle\_id>:<collection\_id>

For example, the collection LIDs for the data (ODR) and document collections in Figure 3.1-1 are:

urn:nasa:pds:voyager1\_rss\_jupiter\_raw:data

urn:nasa:pds:voyager1\_rss\_jupiter\_raw:document

### 3.1.2 Products

A product is one or more PDS4 data objects (*e.g*., digital files) and an associated, detached PDS4 label, which is written in XML and describes the data object(s). Product LIDs are constructed by appending <product\_id> to the collection LID. Because the collection LID is unique, it follows that the product LIDs are also unique.

urn:nasa:pds:<bundle\_id>:<collection\_id>:<product\_id>

### 3.1.2.1 ODR and Browse Products

In the *data* collection, each product includes six files: the original binary ODR file, a file containing ASCII translations of each record header and trailer, a text file with terse titles for fields in the header/trailer file[[3]](#footnote-3), a file containing ASCII translations of each record’s S-band data samples, a file containing ASCII translations of each record’s X-band data samples, and an XML label.

In the *browse* collection, each product includes a summary plot of the S-band data from the associated ODR product (in PDF/A-1b format), a summary plot of the X-band data (PDF/A-1b), and a PDS4 label.

Identifiers for data (ODR) and browse products have the form

vgnx\_aabp\_yyyydddthhmmss

 where

 n = spacecraft number (“1” for Voyager 1, “2” for Voyager 2)

 x = target (“j” for Jupiter)

 aa = antenna number (“14” for DSS-14, “63” for DSS-63)

 b = band (“s” for S-band, “x” for X-band, “m” for both)

 p = polarization (“r” for RCP)

 yyyy = year

 ddd = day of year

 hh = hour

 mm = minute

 ss = second

Examples of Voyager 1 Jupiter ODR and browse product LIDs derived from the same ODR are, respectively:

urn:nasa:pds:voyager1\_rss\_jupiter\_raw:data:vg1j\_63mr\_1979064t161300

urn:nasa:pds:voyager1\_rss\_jupiter\_raw:browse:vg1j\_63mr\_1979064t161300

Although the <product\_id> is the same for both products, they have different LIDs because the <collection\_id> values are distinct. The value for b (band) in both cases is “m” because each product contains both S-band and X-band data objects.

In addition to the plot products, each *browse* collection also includes a pair of tables containing estimates of received signal strength and frequency. There is one table for ingress and a second table for egress. The Voyager 1 LIDs for the tables are, respectively:

urn:nasa:pds:voyager1\_rss\_jupiter\_raw:browse:vg1\_radio\_ing

urn:nasa:pds:voyager1\_rss\_jupiter\_raw:browse:vg1\_radio\_egr

### 3.1.2.2 Frequency Calibration Products

There is one product in the *calib\_freq* collection; its Voyager 1 LID is:

urn:nasa:pds:voyager1\_rss\_jupiter\_raw:calib\_freq:vgr\_uso

The Voyager 2 product has the same LID except for the bundle\_id:

urn:nasa:pds:voyager2\_rss\_jupiter\_raw:calib\_freq:vgr\_uso

### 3.1.2.3 Geometry Products

Logical identifiers for products in the Voyager 1 *geometry* collection are as follows:

urn:nasa:pds:voyager1\_rss\_jupiter\_raw:geometry:vg1\_traj\_ing

urn:nasa:pds:voyager1\_rss\_jupiter\_raw:geometry:vg1\_traj\_egr

urn:nasa:pds:voyager1\_rss\_jupiter\_raw:geometry:vh008a

urn:nasa:pds:voyager1\_rss\_jupiter\_raw:geometry:vh008b

The first two products are non-SPICE trajectory reconstructions for ingress and egress, respectively. The second two are high-gain antenna pointing reconstructions in ASCII and binary formats, respectively.

For Voyager 2 the corresponding LIDs are

urn:nasa:pds:voyager2\_rss\_jupiter\_raw:geometry:vg2\_traj\_ing

urn:nasa:pds:voyager2\_rss\_jupiter\_raw:geometry:vg2\_traj\_egr

urn:nasa:pds:voyager2\_rss\_jupiter\_raw:geometry:vu001a

urn:nasa:pds:voyager2\_rss\_jupiter\_raw:geometry:vu001b

### 3.1.2.4 Document Products

Logical identifiers for primary members of the Voyager 1 *document* collection are as follows:

urn:nasa:pds:voyager1\_rss\_jupiter\_raw:document:mission (mission overview)

urn:nasa:pds:voyager1\_rss\_jupiter\_raw:document:vg1j\_hga (HGA pointing)

urn:nasa:pds:voyager1\_rss\_jupiter\_raw:document:sis\_vgr\_rs (this document)

The Voyager 2 *document* collection includes the mission overview and the archive volume SIS; but there is no document describing the high-gain antenna pointing reconstruction. The LIDs are:

urn:nasa:pds:voyager2\_rss\_jupiter\_raw:document:mission (mission overview)

urn:nasa:pds:voyager2\_rss\_jupiter\_raw:document:sis\_vgr\_rs (this document)

The *document* collection also includes several products which are physically not included in the Voyager Jupiter RS RDA. They are listed in the collection\_document.csv file as secondary members and can be found at

<https://pds-geosciences.wustl.edu/radiosciencedocs/urn-nasa-pds-radiosci_documentation/>

### 3.1.3 Versioning

A version identifier(VID) may be appended to a logical identifier to specify one of several versions of the same bundle, collection, or product [1]. The combination is called a versioned identifier(LIDVID). LIDVIDs are used to locate specific products within PDS; every version of every product within PDS has a unique LIDVID. VIDs are separated from LIDs by a double colon (“::”) and have the form M.n where M and n are integers. All versions are 1.0 in the initial release of Voyager Jupiter RS RDA bundles. Example LIDVIDs are shown below:

urn:nasa:pds:voyager1\_rss\_jupiter\_raw:calib\_freq:vgr\_uso::1.0

urn:nasa:pds:voyager1\_rss\_jupiter\_raw:document:sis\_vgr\_rs::1.0

urn:nasa:pds:voyager1\_rss\_jupiter\_raw:data::1.0 (collection LIDVID)

urn:nasa:pds:voyager2\_rss\_jupiter\_raw::1.0 (bundle LIDVID)

### 3.1.4 Labels

Each digital data object is accompanied by a PDS4 label, which describes the data object and is written in XML. In many cases in the Voyager Jupiter RS RDA a single label will describe multiple data objects. In a few cases (*e.g*., the Bundle product), the label may exist by itself since the data object is either 'physical' or 'conceptual'. A typical label includes sections which identify the associated data file(s) (by file name, version identifier, modification history, time and/or spatial coverage, etc.), provide references to other relevant information (journal articles, observing system, target description, etc.), and describe the format of the file(s) at the bit level, if necessary. PDS4 labels are digital files in their own right; their file names are the <product\_id> as described above with the extension ".xml" appended.

## 3.2 Physical Organization

### 3.2.1 File Naming and Conversions

Both within this document and within the archive itself bundle, collection, and product file names (including both digital data objects and their labels) are lower case.

File names are of the form "filename.ext" where the base "filename" contains up to 27 characters and "ext" contains 3-4 characters. The allowable characters for PDS file names are "a-z", "0-9", and the underscore "\_". Extensions are "dat" for binary files, "tab" for tables with fixed-length records, "txt" for text files, and "pdf" for PDF/A document and browse files. Other extensions (*e.g.,* “docx”) are available for document files.

In addition to the various data files and their labels identified in the sections below, each collection has a collection Inventory file (collection\*.csv) and label (collection\*.xml).

### 3.2.1.1. ODR and Browse Product File Names

Base file names are constructed according to the procedure outlined in Section 3.1.2.1; the base file name is followed by an ASCII period “.” and a file name extension. The value for b (band) in the base file name is “s” if the file contains only S-band data, “x” if the file contains only X-band data, or “m” if the file contains data for both bands. File name extensions in these two collections are listed below. Header files (including the file with field names) and label files use “m” for band.

dat original binary ODR file

hdr file containing ASCII translations of ODR header and trailer records

pdf PDF/A-1b file with 4-panel browse plots

tab file containing ASCII translations of receiver sample values from an ODR, or

 an ASCII table of receiver signal strength and frequency values in a

browse collection

txt text file with terse field names to accompany the hdr file

xml PDS4 label file

For example, the following six files constitute one PDS4 product:

vc134a.odr original ODR file (binary)

vg1j\_63mr\_1979064t123001.hdr header/trailer data (ASCII)

vg1j\_63sr\_1979064t123001.tab S-band receiver samples (ASCII)

vg1j\_63xr\_1979064t123001.tab X-band receiver samples (ASCII)

vg1j\_63mr\_1979064t123001.xml PDS4 XML label (ASCII)

vg1j\_63mr\_1979064t123001.txt field headers for hdr file (ASCII)

### 3.2.1.2 Frequency Calibration Product File Names

Each product in the *calib\_freq* collection is a digital data object paired with a PDS4 label. The file name pair for the product in the *calib\_freq* collection is:

vgr\_uso.txt vgr\_uso.xml

### 3.2.1.3 Geometry Product File Names

Each product in the *geometry* collection is a digital data object paired with a PDS4 label. File name pairs for the trajectory and HGA products in the Voyager 1 *geometry* collection are:

vg1\_traj\_ing.tab vg1\_traj\_ing.xml

vg1\_traj\_egr.tab vg1\_traj\_egr.xml

vh008a.tab vh008a.xml

vh008b.tab. vh008b.xml

### 3.2.1.4 Document Product File Names

Each product in the *document* directory is a PDS4 label plus one or more digital data objects. For example, the mission description document includes a label plus the document in two formats. The three file names are:

mission.pdf mission.txt mission.xml

### 3.2.2 File Conversions

Binary files can be difficult to read; this is particularly true when the binary format is no longer supported on contemporary platforms. Voyager Jupiter ODRs used ‘packed’ formats to minimize storage requirements; reconstructions of Voyager high-gain antenna pointing were delivered using Univac 36-bit binary integers.

### 3.2.2.1 ODR Conversions

A typical ODR file has 10000 (VG1J) or 20000 (VG2J) binary records. Each record includes a 12-byte header, followed by 200 8-bit samples of receiver output from each of four analog-to-digital converters (800 total samples), followed by an 80-byte trailer. The receiver samples are stored in groups of four — the first from the S-band receiver, the next three from the X-band receiver. As part of the PDS4 archiving task, the headers and trailers from each ODR were extracted and written to an ASCII file. The binary data samples were converted to ASCII and were written to a pair of separate files (one for S-band, one for X-band), each with 20 samples per line. The original binary format of the ODR is described in [2]. Conversion to ASCII is described in [3]; the conversion document is accompanied by an example.

Browse products were derived from the S-band and X-band ASCII files of receiver samples. There is one four-panel summary plot (*e.g.,* Figure 1.4-1) from the S-band samples and a separate plot from the X-band samples. A single PDS4 label file describes the pair of plots.

### 3.2.2.1 HGA Pointing Reconstruction Conversions

High-gain antenna (HGA) pointing reconstructions were delivered to the Voyager Radio Science Team in Univac binary format (18 36-bit integers per record); the final reconstruction was converted to ASCII for this archive.

### 3.2.3 Directories

PDS4 products are stored in directory structures determined by the PDS/RMS node. The PDS4 Registry can locate bundles, collections, and products as needed by users. No further information can be provided here.

#

# 4 Support Staff and Cognizant Personnel

## 4.1 Planetary Data System

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 PDS Radio Science Adviser

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# 5 Errata and User Notes

The following errors/anomalies apply to the PDS4 archive. Notes of possible use, prompted by the peer review of the PDS4 bundles, have been added in section 5.4.

## 5.1 Bad or Missing Data

### 5.1.1 Unreadable Records

While Voyager Jupiter data were held at Stanford, the binary data were transferred from magnetic tape to CD-ROM for better long-term storage. When a record could not be read from tape, the CD-ROM file was terminated, and a new file was started with the first readable record after the error. For example, records 69 and 70 could not be read from tape VC139; the file VC139A was created with 68 records, and the file VC139B became the continuation and had 9930 records. During creation of the PDS4 archive, two replacement records were fabricated, then inserted between VC139A and VC139B. The restored VC139X appears in this archive with 10000 records, two of which are dummy records. Values in header and trailer fields of the replacement records were adjusted for continuous transitions; the value in field 6 of the binary file (field 3 of the ASCII header/trailer file) was set to ‘2’ in replacement records. Sample values from the receivers were set to zero. Table 5.1.1-1 lists Voyager 1 products with replacement records. There were no replacement records in the Voyager 2 files.

|  |
| --- |
| **Table 5.1.1-1: Listing of Files with Replacement Records (in time order)** |
| **Tape ID** | **Fabricated Record(s)** | **PDS4 LID** |
| VC139 | 69, 70 | vg1j\_63mr\_1979064t161940 |
| VC146 | 276, 470 | vg1j\_63mr\_1979064t164300 |
| VC169 | 9875, 9876 | vg1j\_63mr\_1979064t175940 |
| VC170 | 5672, 5673 | vg1j\_63mr\_1979064t180300 |

### 5.1.2 Tape/File Naming Variations

Tapes delivered to the Voyager Radio Science Team were labeled VCnnn (Voyager 1) and VPnnn (Voyager 2), as described above and as used in Appendices A and B. Suffixes were added to identify variations on the original files. These modified names may appear within the archive (especially in panels of browse plots). Users may use the root (VCnnn or VPnnn) to determine origins. Within the PDS4 archive, products and files are identified as described in Section 3 of this document.

### 5.1.3 Duplicate and Missing Files

The CD-ROM files in Table 5.1.3-1 contain identical data; the reason(s) for duplication are not known. Only one copy of these data (from VC149) has been included in the PDS4 archive.

|  |
| --- |
| **Table 5.1.3-1: Listing of Tapes/Files with Duplicate Records** |
| **Tape ID** | **Duplicate Record(s)** | **PDS4 LID** |
| VC149 | All | vg1j\_63mr\_1979064t165300 |
| VC150 | All | vg1j\_63mr\_1979064t165300 |
| VC151 | All | vg1j\_63mr\_1979064t165300 |
| VC152 | All | vg1j\_63mr\_1979064t165300 |
| VC153 | All | vg1j\_63mr\_1979064t165300 |

The following time period is not covered by any Voyager 1 tape or CD-ROM file. The reason for the gap is not known. There are no known gaps in the Voyager 2 data.

|  |
| --- |
| **Table 5.1.3-2: Data Gaps** |
| **Data Gap** | **Notes** |
| 179-064T16:53:29 to 1979-064T17:09:40 | There may have been a tape copying error in the time between 1979-064T16:53:00 and 1979-064T17:09:40. Five tapes covered the first 29 seconds (Table 5.1.2-1) and none covered the remaining 971 seconds. This gap is more than 20 minutes after the ground station lost the Voyager 1 signal in the deep atmosphere. |

## 5.2 Buffer delays

Because of buffering in the recording process, samples may be delayed by 1-2 sample positions (a few microseconds) compared with the record time tag in ODR files.

Similarly, POCA readings are delayed 1-2 seconds compared to time tags.

No corrections for buffer delays have been applied during the archiving process.

## 5.3 Truncations for Creating Browse Products

In four cases, the file was temporarily truncated to an even number of seconds to allow generation of the browse product (VC145, VC149, VP095, and VP096). The original file (with all records) is retained in the *data* collection.

## 5.4 User Notes

The following notes have been added following peer review of the PDS4 bundles. They are suggestions, based on limited knowledge of the people involved in the restoration. They should not be considered definitive since the correct answers have been lost in the passage of time.

### 5.4.1 Receiver Operation

Open loop receiver operation is described in [4]. For example, the DSS 63 VG1J data start at 12:30:01 UTC. If the S-band transmitted frequency was

ftx = (3/11)\* 8414995272.53 = 2.29499871069e9

(from calib\_freq:vgr\_uso.txt in this archive), then the expected baseband frequency in the samples should be [4]

fb = ftx – 48\*fpo – 3e8 = 730.37 Hz

where

fpo = 4.15624579232e+07 Hz

is ‘commanded\_frequency’ in the first row of data/vg1j\_63mr\_1979064r123001.tab in this archive. The value of ftx used here is the best estimate for Voyager 1 at Titan. Refining the estimate to correct for drift since the Jupiter encounter and then incorporating Doppler effects, timing/frequency errors, and other calibrations is well beyond the scope of this restoration effort. Nonetheless, fb = 730.37 Hz is only ~1300 Hz different from the signal position in browse/vg1j\_63sr\_1979064r123001.jpg.

Note that ‘commanded frequency’ is related to ‘synthesizer count’ at t+n seconds (Ot+n ) and ‘sweep rate’ (SR) by [2]

fpo = 4e+07 + [(Ot+n – Ot - 0.5\*SR\*n2)/n]

##

## Appendix A Tape/File Index – Voyager 1 at Jupiter

The table below lists Voyager 1 Jupiter radio science raw data files in chronological order. Except as noted, each file contained 10000 records, covering 200 seconds.

The columns give (left to right):

YYYY Earth receive time at start time of the file (UTC year)

DDD Earth receive time at start time of the file (UTC day of year)

HH Earth receive time at start time of the file (UTC hour)

MM Earth receive time at start time of the file (UTC minute)

SS Earth receive time at start time of the file (UTC second)

SECS Earth receive time at start time of the file (UTC cumulative seconds since 0h UTC)

TAPE Identifier of the computer-compatible tape delivered to the Voyager Radio Science Team.

DD DSN ground station recording the radio science data

B Frequency band of the data in the file (“S” for 13 cm, “X” for 3.5 cm, “M” for both)

P Polarization of the data in the file (“R” for right circular, RCP; “L” for left circular, LCP)

S/C Spacecraft (“VG1” for Voyager 1, “VG2” for Voyager 2)

T Target (“J” for Jupiter)

LID Logical identifier for the PDS4 archive, constructed in the form

 vgnx\_aabp\_yyyydddthhmmss

 where

 n = spacecraft number (“1” for Voyager 1, “2” for Voyager 2)

 x = target (“j” for Jupiter)

 aa = antenna number (“14” for DSS-14, “63” for DSS-63)

 b = band (“s” for S-band, “x” for X-band, “m” for both)

 p = polarization (“r” for RCP. “l” for LCP)

yyyy = year (“1979”)

ddd = day of year

hh = hour

mm = minute

ss = second

Appendix A (continued; page 2 of 3)

|------------------------------------------------------------------------------------------|

|YYYY|DDD|HH|MM|SS| SECS| TAPE|DD|B|P|S/C|T| LID | NOTES |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|12|30|01|45001|VC193|63|M|R|VG1|J|vg1j\_63mr\_1979064t123001|Pre-encounter test |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|12|33|21|45201|VC194|63|M|R|VG1|J|vg1j\_63mr\_1979064t123321|Pre-encounter test |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|12|36|41|45401|VC195|63|M|R|VG1|J|vg1j\_63mr\_1979064t123641|Pre-encounter test; |

| | | | | | | | | | | | | |9930 records |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|16|03|00|57780|VC134|63|M|R|VG1|J|vg1j\_63mr\_1979064t160300| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|16|06|20|57980|VC135|63|M|R|VG1|J|vg1j\_63mr\_1979064t160620| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|16|09|40|58180|VC136|63|M|R|VG1|J|vg1j\_63mr\_1979064t160940| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|16|13|00|58380|VC137|63|M|R|VG1|J|vg1j\_63mr\_1979064t161300| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|16|16|20|58580|VC138|63|M|R|VG1|J|vg1j\_63mr\_1979064t161620| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|16|19|40|58780|VC139|63|M|R|VG1|J|vg1j\_63mr\_1979064t161940|Replacement records at|

| | | | | | | | | | | | | |69, 70 |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|16|23|00|58980|VC140|63|M|R|VG1|J|vg1j\_63mr\_1979064t162300| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|16|26|20|59180|VC141|63|M|R|VG1|J|vg1j\_63mr\_1979064t162620| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|16|29|40|59380|VC142|63|M|R|VG1|J|vg1j\_63mr\_1979064t162940| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|16|33|00|59580|VC143|63|M|R|VG1|J|vg1j\_63mr\_1979064t163300| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|16|36|20|59780|VC144|63|M|R|VG1|J|vg1j\_63mr\_1979064t163620| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|16|39|40|59980|VC145|63|M|R|VG1|J|vg1j\_63mr\_1979064t163940| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|16|43|00|60180|VC146|63|M|R|VG1|J|vg1j\_63mr\_1979064t164300|Replacement records at|

| | | | | | | | | | | | | |276, 470 |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|16|46|20|60380|VC147|63|M|R|VG1|J|vg1j\_63mr\_1979064t164620| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|16|49|40|60580|VC148|63|M|R|VG1|J|vg1j\_63mr\_1979064t164940| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|16|53|00|60780|VC149|63|M|R|VG1|J|vg1j\_63mr\_1979064t165300|1448 records |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

| GAP IN COVERAGE |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|17|09|40|61780|VC154|63|M|R|VG1|J|vg1j\_63mr\_1979064t170940| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|17|13|00|61980|VC155|63|M|R|VG1|J|vg1j\_63mr\_1979064t171300| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|17|16|20|62180|VC156|63|M|R|VG1|J|vg1j\_63mr\_1979064t171620| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|17|19|40|62380|VC157|63|M|R|VG1|J|vg1j\_63mr\_1979064t171940| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|17|23|00|62580|VC158|63|M|R|VG1|J|vg1j\_63mr\_1979064t172300| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|17|26|20|62780|VC159|63|M|R|VG1|J|vg1j\_63mr\_1979064t172620| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|17|29|40|62980|VC160|63|M|R|VG1|J|vg1j\_63mr\_1979064t172940| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|17|33|00|63180|VC161|63|M|R|VG1|J|vg1j\_63mr\_1979064t173300| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|17|36|20|63380|VC162|63|M|R|VG1|J|vg1j\_63mr\_1979064t173620| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|17|39|40|63580|VC163|63|M|R|VG1|J|vg1j\_63mr\_1979064t173940| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|17|43|00|63780|VC164|63|M|R|VG1|J|vg1j\_63mr\_1979064t174300| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

Appendix A (continued; page 3 of 3)

|------------------------------------------------------------------------------------------|

|1979|064|17|46|20|63980|VC165|63|M|R|VG1|J|vg1j\_63mr\_1979064t174620| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|17|49|40|64180|VC166|63|M|R|VG1|J|vg1j\_63mr\_1979064t174940| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|17|53|00|64380|VC167|63|M|R|VG1|J|vg1j\_63mr\_1979064t175300| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|17|56|20|64580|VC168|63|M|R|VG1|J|vg1j\_63mr\_1979064t175620| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|17|59|40|64780|VC169|63|M|R|VG1|J|vg1j\_63mr\_1979064t175940|Replacement records at|

| | | | | | | | | | | | | |9875, 9876 |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|18|03|00|64980|VC170|63|M|R|VG1|J|vg1j\_63mr\_1979064t180300|Replacement records at|

| | | | | | | | | | | | | |5672, 5673 |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|18|06|20|65180|VC171|63|M|R|VG1|J|vg1j\_63mr\_1979064t180620| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|18|09|40|65380|VC172|63|M|R|VG1|J|vg1j\_63mr\_1979064t180940| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|18|13|00|65580|VC173|63|M|R|VG1|J|vg1j\_63mr\_1979064t181300| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|18|16|20|65780|VC174|63|M|R|VG1|J|vg1j\_63mr\_1979064t181620| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|18|19|40|65980|VC175|63|M|R|VG1|J|vg1j\_63mr\_1979064t181940| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|18|23|00|66180|VC198|63|M|R|VG1|J|vg1j\_63mr\_1979064t182300| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|18|26|20|66380|VC199|63|M|R|VG1|J|vg1j\_63mr\_1979064t182620| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|18|29|40|66580|VC178|63|M|R|VG1|J|vg1j\_63mr\_1979064t182940| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|18|33|00|66780|VC179|63|M|R|VG1|J|vg1j\_63mr\_1979064t183300| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|18|36|20|66980|VC180|63|M|R|VG1|J|vg1j\_63mr\_1979064t183620| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|18|39|40|67180|VC181|63|M|R|VG1|J|vg1j\_63mr\_1979064t183940| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|18|43|00|67380|VC182|63|M|R|VG1|J|vg1j\_63mr\_1979064t184300| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|18|46|20|67580|VC183|63|M|R|VG1|J|vg1j\_63mr\_1979064t184620| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|18|49|40|67780|VC184|63|M|R|VG1|J|vg1j\_63mr\_1979064t184940| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|18|53|00|67980|VC185|63|M|R|VG1|J|vg1j\_63mr\_1979064t185300| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|18|56|20|68180|VC186|63|M|R|VG1|J|vg1j\_63mr\_1979064t185620| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|18|59|40|68380|VC187|63|M|R|VG1|J|vg1j\_63mr\_1979064t185940| |

|----+---|--|--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|064|19|03|00|68580|VC188|63|M|R|VG1|J|vg1j\_63mr\_1979064t190300| |

|------------------------------------------------------------------------------------------|

## Appendix B Tape/File Index – Voyager 2 at Jupiter

The table below lists Voyager 2 Jupiter radio science raw data files in chronological order. Except as noted, each file contained 20000 records, covering 400 seconds. See Appendix A for column definitions.

|------------------------------------------------------------------------------------------|

|YYYY|DDD|HH|MM|SS| SECS| TAPE|DD|B|P|S/C|T| LID | NOTES |

|----+---|--+--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|191|13|17|27|47847|VP095|14|M|R|VG2|J|vg2j\_14mr\_1979191t131727|Pre-encounter tests |

|----+---|--+--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|191|13|24|07|48247|VP096|14|M|R|VG2|J|vg2j\_14mr\_1979191t132407|Pre-encounter tests; |

| | | | | | | | | | | | | |4970 records |

|----+---|--+--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|191|19|50|57|71457|VP097|14|M|R|VG2|J|vg2j\_14mr\_1979191t195057| |

|----+---|--+--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|191|19|57|37|71857|VP098|14|M|R|VG2|J|vg2j\_14mr\_1979191t195737| |

|----+---|--+--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|191|20|04|17|72257|VP099|14|M|R|VG2|J|vg2j\_14mr\_1979191t200417| |

|----+---|--+--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|191|20|10|57|72657|VP100|14|M|R|VG2|J|vg2j\_14mr\_1979191t201057| |

|----+---|--+--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|191|20|17|37|73057|VP101|14|M|R|VG2|J|vg2j\_14mr\_1979191t201737| |

|----+---|--+--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|191|20|24|17|73457|VP102|14|M|R|VG2|J|vg2j\_14mr\_1979191t202417| |

|----+---|--+--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|191|20|30|57|73857|VP103|14|M|R|VG2|J|vg2j\_14mr\_1979191t203057| |

|----+---|--+--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|191|20|37|37|74257|VP104|14|M|R|VG2|J|vg2j\_14mr\_1979191t203737| |

|----+---|--+--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|191|20|44|17|74657|VP105|14|M|R|VG2|J|vg2j\_14mr\_1979191t204417| |

|----+---|--+--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|191|20|50|57|75057|VP106|14|M|R|VG2|J|vg2j\_14mr\_1979191t205057| |

|----+---|--+--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|191|20|57|37|75457|VP107|14|M|R|VG2|J|vg2j\_14mr\_1979191t205737| |

|----+---|--+--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|191|21|04|17|75857|VP108|14|M|R|VG2|J|vg2j\_14mr\_1979191t210417| |

|----+---|--+--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|191|21|10|57|76257|VP109|14|M|R|VG2|J|vg2j\_14mr\_1979191t211057| |

|----+---|--+--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|191|21|17|37|76657|VP158|14|M|R|VG2|J|vg2j\_14mr\_1979191t211737| |

|----+---|--+--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|191|21|24|17|77057|VP159|14|M|R|VG2|J|vg2j\_14mr\_1979191t212417| |

|----+---|--+--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|191|21|30|57|77457|VP093|14|M|R|VG2|J|vg2j\_14mr\_1979191t213057| |

|----+---|--+--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|191|21|37|37|77857|VP111|14|M|R|VG2|J|vg2j\_14mr\_1979191t213737| |

|----+---|--+--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|191|21|44|17|78257|VP112|14|M|R|VG2|J|vg2j\_14mr\_1979191t214417| |

|----+---|--+--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|191|21|50|57|78657|VP160|14|M|R|VG2|J|vg2j\_14mr\_1979191t215057| |

|----+---|--+--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|191|21|57|37|79057|VP114|14|M|R|VG2|J|vg2j\_14mr\_1979191t215737| |

|----+---|--+--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|191|22|04|17|79457|VP115|14|M|R|VG2|J|vg2j\_14mr\_1979191t220417| |

|----+---|--+--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|191|22|10|57|79857|VP116|14|M|R|VG2|J|vg2j\_14mr\_1979191t221057| |

|----+---|--+--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|191|22|17|37|80257|VP117|14|M|R|VG2|J|vg2j\_14mr\_1979191t221737| |

|----+---|--+--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|191|22|24|17|80657|VP118|14|M|R|VG2|J|vg2j\_14mr\_1979191t222417| |

|----+---|--+--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|191|22|30|57|81057|VP119|14|M|R|VG2|J|vg2j\_14mr\_1979191t223057| |

|----+---|--+--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|191|22|37|37|81457|VP120|14|M|R|VG2|J|vg2j\_14mr\_1979191t223737| |

|----+---|--+--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

Appendix B (continued; page 2 of 2)

|------------------------------------------------------------------------------------------|

|1979|191|22|44|17|81857|VP121|14|M|R|VG2|J|vg2j\_14mr\_1979191t224417| |

|----+---|--+--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|191|22|50|57|82257|VP122|14|M|R|VG2|J|vg2j\_14mr\_1979191t225057| |

|----+---|--+--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|191|22|57|37|82657|VP123|14|M|R|VG2|J|vg2j\_14mr\_1979191t225737| |

|----+---|--+--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|191|23|04|17|83057|VP124|14|M|R|VG2|J|vg2j\_14mr\_1979191t230417| |

|----+---|--+--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|191|23|10|57|83457|VP125|14|M|R|VG2|J|vg2j\_14mr\_1979191t231057| |

|----+---|--+--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|191|23|17|37|83857|VP126|14|M|R|VG2|J|vg2j\_14mr\_1979191t231737| |

|----+---|--+--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|191|23|24|17|84257|VP127|14|M|R|VG2|J|vg2j\_14mr\_1979191t232417| |

|----+---|--+--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|191|23|30|57|84657|VP128|14|M|R|VG2|J|vg2j\_14mr\_1979191t233057| |

|----+---|--+--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|191|23|37|37|85057|VP129|14|M|R|VG2|J|vg2j\_14mr\_1979191t233737| |

|----+---|--+--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|191|23|44|17|85457|VP130|14|M|R|VG2|J|vg2j\_14mr\_1979191t234417| |

|----+---|--+--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|191|23|50|57|85857|VP131|14|M|R|VG2|J|vg2j\_14mr\_1979191t235057| |

|----+---|--+--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|191|23|57|37|86257|VP132|14|M|R|VG2|J|vg2j\_14mr\_1979191t235737| |

|----+---|--+--+--+-----+-----+--+-+-+---+-+------------------------+----------------------|

|1979|192|00|04|17|00257|VP133|14|M|R|VG2|J|vg2j\_14mr\_1979192t000417| |

|-------------------------------------------------------------------+----------------------|

1. The Original Data Record (ODR) is the output from DSN receivers used to acquire open-loop radio science data during Voyager encounters with Jupiter. It should not be confused with a ‘processing level’, also called ODR, and sometimes used by PDS. [↑](#footnote-ref-1)
2. Number includes only primary member products of the collection; additional, secondary, members are included by reference to products already archived elsewhere in PDS. [↑](#footnote-ref-2)
3. The text file includes one record with field names and a second record with field formats. [↑](#footnote-ref-3)