

**Date: January 09., 2024** 



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#### 1. Introduction

The Planetary Data System (PDS) Radio Science Data Viewer (PRSDV) is an interactive application developed using MATLAB App Designer to provide quick-look functions to browse PDS4 TRK-2-34 formatted data. TRK-2-34 data, also known as Tracking and Navigation Files (TNFs), are the primary radiometric data type recorded at NASA's Deep Space Network for many interplanetary missions. The PDS4 standard in use at NASA's PDS utilizes Extensible Markup Language (XML) to label the files' metadata and is essential for use of the PRSDV (i.e., the PDS4 labels adjoining the TNFs are required for execution of the PRSDV). The app supports Linux, Mac OS, or Windows operating systems for non-MATLAB environments (i.e., PRSDV users do not require MATLAB software to run the app); however, the users need to install a compatible version of Runtime software on their local machines to run the app (details in section 1.2). The source code is also provided so that users can compile the APP to fit their operational environments. The current version (V1.0) provides functions to read PDS TRK-234 files, filter data with different configuration selections, plot the filtered data, and output the plotted data points into an ASCII file for further analysis. Future upgraded versions will be released at the NASA PDS GitHub.

#### 1.1 PDS Transform Installation

The PRSDV app utilizes some functions of the PDS Transform Tool (https://nasa-pds.github.io/transform/index.html). Windows Users need to install the PDS Transform Tool and set up the configuration following the PDS tool instruction (https://nasa-pds.github.io/transform/install/index.html); section 1.2.1 also summarizes details of Windows environment settings for using the PRSDV tool. For Linux and Mac OS environments, the PDS Transform Tool is packed into the PRSDV app; users can run the app via Runtime.

## 1.2 PDS Transform Environment Setting

PDS Radio Science Data Viewer users should install or update their JAVA program (<a href="https://www.java.com/en/download/manual.jsp">https://www.java.com/en/download/manual.jsp</a>) to run the PDS transform functions in the PRSDV app.

#### 1.2.1 Windows Users

Once the Windows users complete the JAVA installation or update, they need to create JAVA\_HOME and PATH in the Windows Environment Variables via Control Panel > System > Advanced System Settings > Environment Variables (Figure 1-1 to Figure 1-3).

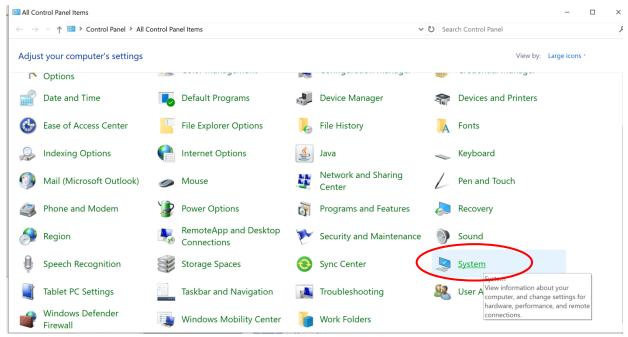
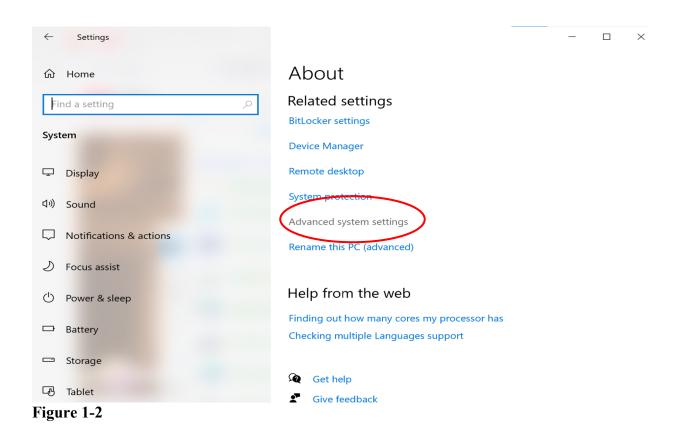


Figure 1-1



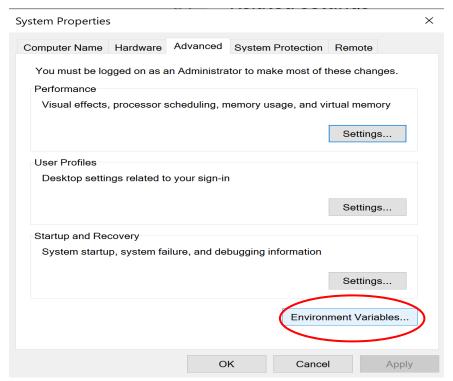


Figure 1-3

In the **Environment Variables**, users need to click New in the User Variable Panel and create/edit Variable name: JAVA\_HOME and Variable value: C:\Program Files\Java\jre- 1.8 (or use the Browse Directory to select the JAVA program directory that users installed) as shown in **Figure 1-4 and Figure 1-5**.

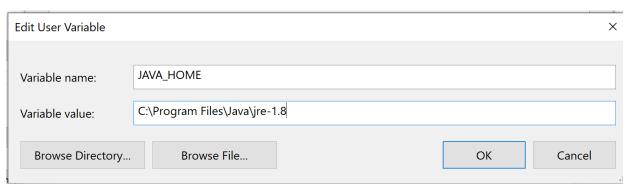


Figure 1-4 JAVA HOME directory setting.

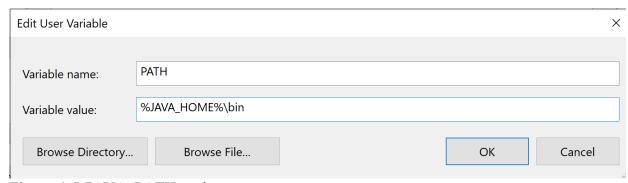


Figure 1-5 JAVA\_PATH setting.

#### 1.2.2 Linux and Mac OS Users

For Linux and Mac OS users, the standalone PRSDV app packs the required PDS transform functions in the sub-directory (/bin) of the software package. PDS Radio Science Data Viewer users might need to update their JAVA program; please check the website for details (https://www.java.com/en/download/manual.jsp).

#### 1.3 Runtime Installation

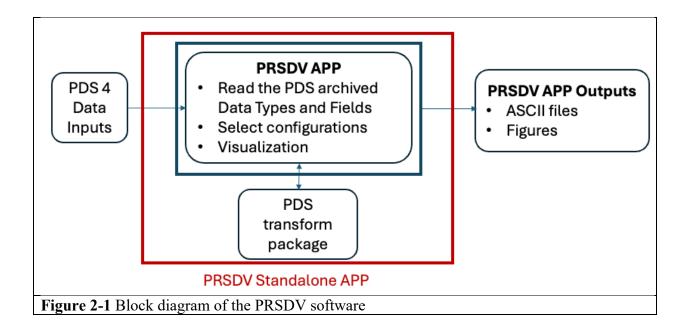
To run the standalone PRSDV MATLAB app in an environment without MATLAB, users must install MATLAB Runtime. The MATLAB Runtime version (shown in the following **Figure 1-6**) needs to be compatible with the MATLAB version that is used to compile and pack the standalone application. MATLAB Runtime may be downloaded and installed from the website: <a href="https://www.mathworks.com/products/compiler/matlab-runtime.html">https://www.mathworks.com/products/compiler/matlab-runtime.html</a>. The current PRSDV app is compatible with the R2023a (9.14) version of MATLAB.

Release (MATLAB Runtime Version#)	Windows	Linux	Мас
R2024b (24.2)	64-bit	64-bit	Intel 64-bit / arm64
R2024a (24.1)	64-bit	64-bit	Intel 64-bit / arm64
R2023b (23.2)	64-bit	64-bit	Intel 64-bit / arm64
R2023a (9.14)	64-bit	64-bit	Intel 64-bit
R2022b (9.13)	64-bit	64-bit	Intel 64-bit
R2022a (9.12)	64-bit	64-bit	Intel 64-bit
R2021b (9.11)	64-bit	64-bit	Intel 64-bit
R2021a (9.10)	64-bit	64-bit	Intel 64-bit
R2020b (9.9)	64-bit	64-bit	Intel 64-bit
R2020a (9.8)	64-bit	64-bit	Intel 64-bit
R2019b (9.7)	64-bit	64-bit	Intel 64-bit
R2019a (9.6)	64-bit	64-bit	Intel 64-bit
R2018b (9.5)	64-bit	64-bit	Intel 64-bit
R2018a (9.4)	64-bit	64-bit	Intel 64-bit
R2017b (9.3)	64-bit	64-bit	Intel 64-bit

Figure 1-6 The Runtime Versions for Linux, Mac, and Windows.

# 2. PDS Radio Science Data Viewer (PRSDV) App

The standalone PRSDV app visualizes data types and fields archived as PDS4 format files. **Figure 2-1** shows the function block diagram of the PRSDV software; PRSDV app users can input a PDS4 header file (\*.xml) to read and select the data types and fields for visualization. The standalone PRSDV app is compatible with Linux, Mac OS, and Windows operating systems without MATLAB software.



### 2.1 PDS4 data inputs

The PRSDV app is only compatible with the PDS4 format label (\*.xml) and data files ). Table 1 contains a list of PDS4-format Tracking and Navigation Files available at the time of this edition. More PDS4 datasets are expected to become available as they are migrated from the PDS3 format.

Table 1. Available PDS4 TNF datasets

Mission	Website	
Dawn	https://sbnarchive.psi.edu/pds4/dawn/gravity/dawn-rss-raw-ceres/data-	
	tnf/2018/	
InSight	https://pds-geosciences.wustl.edu/insight/urn-nasa-pds-	
	insight_rise_raw/data_tnf/	
Juno	https://atmos.nmsu.edu/PDS/data/jnogrv_1001/DATA/TNF/	
Lucy	https://pdssbn.astro.umd.edu/holdings/pds4-lucy.rss-	
	v1.0/data_dinkinesh_trk234/	
MAVEN	https://pds-	
	ppi.igpp.ucla.edu/collection/urn:nasa:pds:maven.rose.raw:data.tnf	
Messenger	https://pds-ppi.igpp.ucla.edu/data/mess-rs-raw/data-tnf/	
OSIRIS-REx	https://sbnarchive.psi.edu/pds4/orex/orex.radioscience/trk234 trknav/	

# 2.2 Configuration Selection

Once users load a PDS file (.xml) via the Browse icon, the app will list all the data types in the dropdown box Available Data Types. Users can click to select the data type for visualization. Once users select the data type, the app will fill the Description and Records fields as well as the Available Fields dropdown menu in the Select Data Fields panel. Once the data field is selected, the app will populate the corresponding Configuration Selection in the GUI automatically

(shown in **Figure 2-2**). The current version supports the visualization of TRK-2-34 Data Type 1 – Downlink Carrier Phase, Data Type 9 – Ramp, and Data Type 16 – Carrier Observables. See Tables 2, 3, and 4, respectively, for listings of the available data fields and filtering options for each of these data types. **Figures 2-3, 2-4,** and **2-5** illustrate examples of the three selected data types for the Juno Gravity Science PDS data archive.

Table 2. Data fields and available filters for Data Type 1, Downlink Carrier Phase

Downlink Carrier Phase   Downlink Carrier Phase   Filter Description		Data Type1			
Abbreviation pen0 Pe/N0 Carrier Power to Noise Spectral Density Ratio.  System_noise_temp System_noise_temp Ablance  Ablance System_noise_temp Ablance Alas a value of 300.0 if no signal or carrier is suppressed.  System_noise_temp System_noise_temp Ablance Ablance Ablance Alas a value of 300.0 if no signal or carrier is suppressed.  System_noise_temp Ablance Ablance Ablance Alas a value of 300.0 if no signal or carrier is suppressed.  Early Ablance Ablance Ablance Alas a value of 300.0 if no signal or carrier is suppressed.  Early Ablance Ablan		_			
Pc/N0   Carrier Power to Noise Carrier Power to Noise Spectral Density Ratio.   Has a value of Spectral Density Ratio.   System Noise Temperature   System Noise Temperature   System Noise Temperature   Frequency   Predicts mode.   Uplink station used for predicts.   Uplink band assumed by downlink.   Uplink band assumed by	Data Field	Item Name and	Unit: Precision	Unit : Precision   Filter   Filter Descriptions	
Carrier Power to Noise Spectral Density Ratio.   Hz   Has a value of Spectral Density Ratio.   Density Ratio.   Density Ratio.   System noise temp   System Noise Temperature   System Noise Temperature   Temperature   Frequency   Fre	Abbreviation	Description		Abbreviations	
to Noise Spectral Density Ratio.  Bensity Ratio. Density Ratio. Density Ratio.  System_noise_temp System_noise_temp System_noise_temp  Buttle Residual  Downlink Frequency  Downlink Frequency  Downlink Frequency  Hz:1 mHz Adp_noise  Adp_noise  Doppler Residual  Doppler Residual  Doppler Noise (Averaged over 10 points in record)  Doppler Noise (Averaged over 10 points in record)  Doppler Noise Adp_noise  Doppler Noise Adp_noise  Doppler Noise (Averaged over 10 points in record)  Doppler Noise Adp_noise  Doppler Noise Adveraged over 10 points in record)  Doppler Noise Adp_noise  Add Sas id Add Sas	pcn0	Pc/N0	dB-Hz: 0.1 dB-	dl_dss_id	Downlink Antenna Number
Spectral Density Ratio.   Signal or carrier is suppressed.   Signal or carrier is suppressed.   System_noise_temp   System_Noise Temperature   Temperature   System_noise_temp   Temperature   System_noise_temp   Temperature   System_noise_temp   Temperature   System_noise_temp   System_noise_temp   System_noise_temp   System_noise_temp   Temperature   System_noise_temp   System_noise_temp   System_noise_temp   System_noise_temp   System_noise_temp   System_noise_temp   System_noise_temp   System_noise_temperature   System_noise		Carrier Power	Hz	dl_band	Downlink frequency band
Density Ratio.    Signal or carrier is suppressed.		to Noise	Has a value of -	dl_chan_num)	Downlink Channel Number
system_noise_temp  System Noise_Temperature  System_noise_temp  All freq  Downlink  Frequency  All freq  All fireq  All fireq  Downlink  All frequency band  All band  Downlink Antenna Number  All band  Downlink Channel Number  Predicts mode.  Uplink band assumed by downlink.  Carri lock statt  All band  Downlink Antenna Number  All band  Downlink Channel Number  Predicts mode.  Uplink band assumed by downlink.  Carri lock statt  All band  Downlink Antenna Number  All das id  Downlink Antenna Number  All carri elock status  All carri elock status  All carri elock status  All carri elock status  All das id  Downlink Antenna Number  All carri elock status  All das id  Downlink Antenna Number				prdx mode	Predicts mode.
system_noise_temp System_Noise_Temperature  System_noise_temp Apperature  System_noise_temp System_noise_temp Temperature  Apperature  System_noise_temp Temperature  Id dss id I dsan d Downlink Antenna Number Id band Downlink Frequency band Id chan num Downlink Channel Number Id band Downlink Antenna Number Id band Downlink Ant		Density Ratio.	signal or carrier	ul prdx stn	Uplink station used for predicts.
System_noise_temp   Compared the part of the propertion of the propertion of the propertion of the propertion of the properties of the propertion of the properties of the p			is suppressed.		
System_noise_temp   Camperature   Femperature   Femperat				carr lock stat	Carrier lock status
Temperature   Kelvin): 0.1 K   dl band   Downlink frequency band   dl chan num   Downlink Channel Number   Carrier lock status   SNT measurement flag   SNT measurement flag   dl band   Downlink Antenna Number   dl band   Downlink Frequency band   dl chan num   Downlink Channel Number   prdx mode   Predicts mode.   ul prdx stn   Uplink station used for predicts.   ul band_dl   Uplink band assumed by downlink.   Carrier lock status	system noise temp	System Noise	K (degrees	dl dss id	Downlink Antenna Number
Downlink Channel Number   Carri lock statis   SNT measurement flag   SNT measurement measureme				dl band	
dl_freq Downlink Frequency  Apple		1	,	dl chan num	
dl_freq Downlink Frequency Abril 1 mHz Brequency Abril 1 mHz Abril 2 mHz Abril 1 mHz Abril 2 mHz Abril 1 mHz Abril 2 mHz Abril 2 mHz Abril 1 mHz Abril 2 mHz Abril 2 mHz Abril 1 mHz Abril 2 mHz Abril 1 mHz Abril 2 mHz Abril 3 measurement flag Abril 1 mHz Abril 1 mHz Abril 2 mHz Abril 3 measurement flag Abril 1 mHz Abril 2 mHz Abril 3 mode Abril 3 measurement flag Abril 3 mode Abril 3 mode Abril 3 measurement flag Abril 4 min min mement ld band Abownlink Antenna Number Abril 3 measurement Ald band Abownlink Antenna Number Abril 4 min					
Downlink Frequency					
Frequency    Frequency	dl freq	Downlink	Hz:1 mHz		
dl chan num   Downlink Channel Number   prdx mode   Predicts mode.   ul prdx stn   Uplink station used for predicts.   ul band_dl   Uplink band assumed by downlink.   Carrier lock status   Carrier lock status     dop_resid   Doppler   Residual   Hz:1 mHz   dl dss id   Downlink Antenna Number   dl band   Downlink Channel Number   prdx mode   Predicts mode.   ul prdx stn   Uplink station used for predicts.   ul band_dl   Uplink band assumed by downlink.   carr lock status   Carrier lock status   Carrier lock status   Uplink band assumed by downlink.   carr lock status   Carrier lock status   Carrier lock status   Uplink band assumed by downlink.   Carrier lock status   Uplink band assumed by downlink   Downlink Channel Number   prdx mode   Predicts mode.   Uplink station used for predicts.   Uplink band assumed by downlink.   Carrier lock status   Carrier lock status   Carrier lock status   Downlink Antenna Number   Downlink Antenna	_ 1	Frequency		dl band	
Predicts mode.   Predicts mode.   Ul prdx stn   Uplink station used for predicts.   Ul band_dl   Uplink band assumed by downlink.   Carri lock status				dl chan num	
Doppler   Hz : 1 mHz   Hz : 1 mHz   Hz : 1 mHz     dop_noise   Doppler Noise (Averaged over 10 points in record)   Predicts in record)   Predicts in record)   Predicts   Hz : 1 mHz   Hz : 1 mHz     dop_noise   Predicts   Predicts   Predicts   Predicts   Hz : 1 mHz   Hz : 1 mHz   Hz : 1 mHz     dop_noise   Predicts mode   Hz : 1 mHz   Hz : 1 mHz   Hz : 1 mHz   Hz : 1 mHz     dop_noise   Predicts mode   Hz : 1 mHz   H					
dop_resid					
dop_resid  Doppler Residual  Hz:1 mHz  dl dss id  Downlink Antenna Number  dl band  Downlink Channel Number  Predicts mode.  ul prdx stn  Uplink station used for predicts.  ul_band_dl  Uplink band assumed by downlink.  carr_lock_stat  Carrier lock status  Carrier lock status  Uplink band assumed by downlink.  carr_lock_stat  Carrier lock status  Carrier lock status  Downlink Antenna Number  dl_dss id  Downlink Antenna Number  dl_band  Downlink Grequency band  dl_chan_num  Downlink Grequency band  dl_chan_num  Downlink Channel Number  prdx_mode  Predicts mode.  ul_prdx_stn  Uplink station used for predicts.  ul_band_dl  Uplink band assumed by downlink.  carr lock_stat  Carrier lock status  Downlink Channel Number  prdx_mode  Predicts mode.  ul_prdx_stn  Uplink band assumed by downlink.  carr lock_stat  Carrier lock status  Downlink Antenna Number  dl_dss id  Downlink Antenna Number  dl_dss id  Downlink Antenna Number  Downlink Antenna Number  dl_dss id  Downlink Antenna Number  Downlink Antenna Number  Downlink Antenna Number					Uplink band assumed by
Doppler   Residual				carr lock stat	
Residual    A	dop resid	Doppler	Hz: 1 mHz		
dl chan num Downlink Channel Number prdx mode Predicts mode.  ul prdx stn Uplink station used for predicts.  ul band dl Uplink band assumed by downlink.  carr lock stat Carrier lock status  dop_noise  Doppler Noise (Averaged over 10 points in record)  record)  Hz: 1 mHz  dl dss_id Downlink Antenna Number dl_band Downlink Channel Number prdx_mode Predicts mode.  ul_prdx_stn Uplink station used for predicts.  ul_band_dl Uplink band assumed by downlink.  carr lock stat Carrier lock status  prdx_freq_offset  Predicts  Predicts  Hz: 1 mHz  dl dss_id Downlink Antenna Number  dl band Downlink Antenna Number  dl dss_id Downlink Antenna Number  dl band Downlink Antenna Number	1 -				
prdx mode   predicts mode.   ul prdx stn   Uplink station used for predicts.   ul_band_dl   Uplink band assumed by downlink.   carr_lock_stat   Carrier lock status				dl chan num	
Light of the latest content of the latest					
Ul_band_dl   Uplink band assumed by downlink.   Carr_lock_stat   Carrier lock status					
dop_noise    Doppler Noise (Averaged over 10 points in record)   Doppler Noise (Averaged over 10 points in pownlink frequency band   Doppler Noise (Averaged over 10 pownlink frequency band   Doppler Noise (Averaged over					Uplink band assumed by
dop_noise    Doppler Noise (Averaged over 10 points in record)   Doppler Noise (Averaged over 10 points in pownlink frequency band   Doppler Noise (Averaged over 10 pownlink frequency band   Doppler Noise (Averaged over				carr lock stat	Carrier lock status
(Averaged over 10 points in record)    Averaged over 10 points in record)   Averaged over 10 points in record)   Averaged over 10 points in record   Downlink frequency band	dop noise	Doppler Noise	Hz: 1 mHz		
10 points in record)    dl chan num	1 =			dl band	Downlink frequency band
record)  prdx_mode Predicts mode.  ul_prdx_stn Uplink station used for predicts.  ul_band_dl Uplink band assumed by downlink.  carr_lock_stat Carrier lock status  prdx_freq_offset Predicts Hz:1 mHz dl_dss_id Downlink Antenna Number  frequency dl_band Downlink frequency band					
ul_prdx_stn     Uplink station used for predicts.       ul_band_dl     Uplink band assumed by downlink.       carr lock stat     Carrier lock status       prdx_freq_offset     Predicts     Hz:1 mHz     dl dss id     Downlink Antenna Number       Frequency     dl band     Downlink frequency band					
prdx_freq_offset     Predicts     Hz:1 mHz     dl dss id     Downlink Antenna Number       frequency     dl band     Downlink frequency band				<del></del>	
prdx_freq_offset Predicts Frequency Predicts Hz : 1 mHz dl dss id Downlink Antenna Number dl band Downlink frequency band					
prdx_freq_offset					
prdx_freq_offsetPredicts FrequencyHz:1 mHzdl dss id dl bandDownlink Antenna NumberDownlink frequency band				carr lock stat	
Frequency dl band Downlink frequency band	prdx freq offset	Predicts	Hz: 1 mHz		
CILCHAIL HUIL LIMWIIIIK (ARAIRIKA MIIIIK)		Offset (Hz		dl chan num	Downlink Channel Number

added to	prdx_mode	Predicts mode.
predicted	ul_prdx_stn	Uplink station used for predicts.
value)	ul band dl	Uplink band assumed by
		downlink.
	carr lock stat	Carrier lock status

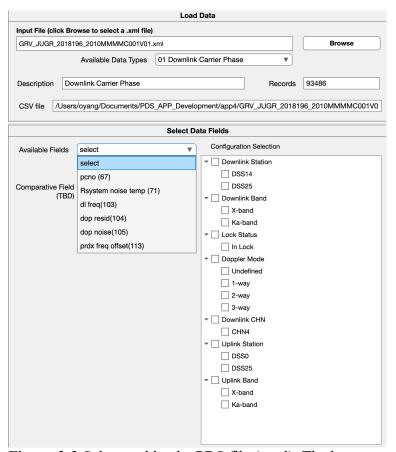
Table 3. Data fields and available filters for Data Type 9, Ramps

Data Type 9				
		Ramps		
Data Field Abbreviation	Item Name and Description	Unit : Precision	Filter Abbreviations	Filter Description
Ramp_freq	Ramp Frequency	Hz. Precision varies with band. A value of 0.0 indicates an invalid or unknown value.	ul_band ul_dss_id	Uplink frequency band  Uplink antenna number
Ramp_rate	Ramp Rate	Hz/sec : μHz/sec	ul_band	Uplink frequency band
			ul_dss_id	Uplink antenna number.

Table 4. Data fields and available filters for Data Type 16, Carrier Frequency Observable

Data Type 16				
Carrier Frequency Observable				
Data Field	Item Name and	Unit: Precision	Filter	Filter Description
Abbreviation	Description		Abbreviations	
Dop_noise	Doppler Noise.	Hz:1 mHz	dl dss id	Downlink Antenna Number
		Invalid indicated	vld_dl_band	Validated downlink frequency
		by value of -1.0		band
			dl chan num	Downlink Channel Number
			prdx_mode	Predicts mode.
			ul prdx stn	Uplink station used for predicts.
			ul_band_dl	Uplink band assumed by downlink.
			carr_lock_stat	Carrier lock status
Rcv_sig_lvl	Received	dBm: 0.1 dBm	dl_dss_id	Downlink Antenna Number
	Signal Level.	300 indicates	vld_dl_band	Validated downlink frequency
	Carrier power	invalid		band
	or data power		dl chan num	Downlink Channel Number
	(if suppressed		prdx_mode	Predicts mode.
	carrier		ul prdx stn	Uplink station used for predicts.
	tracking).		ul_band_dl	Uplink band assumed by downlink.
			carr lock stat	Carrier lock status
Rcv_carr_obs	Received	Hz: 1 mHz	dl dss id	Downlink Antenna Number
	Carrier		vld_dl_band	Validated downlink frequency
	Observable			band
	(aka sky		dl_chan_num	Downlink Channel Number
	frequency)		prdx_mode	Predicts mode.
			ul_prdx_stn	Uplink station used for predicts.

			ul_band_dl carr lock stat	Uplink band assumed by downlink.  Carrier lock status
Carr prefit resid	Received	Hz:1 mHz	dl dss id	Downlink Antenna Number
	carrier pre-fit		vld_dl_band	Validated downlink frequency
	residual (aka			band
	pseudo-		dl_chan_num	Downlink Channel Number
	residual).		prdx_mode	Predicts mode.
	Observed		ul_prdx_stn	Uplink station used for predicts.
	minus		ul_band_dl	Uplink band assumed by
	predicted			downlink.
			carr_lock_stat	Carrier lock status



**Figure 2-2** Select and load a PDS file (.xml). The bottom panel shows the Data Type 1 available fields for the Juno Gravity Science PDS TRK-2-34 data archive.

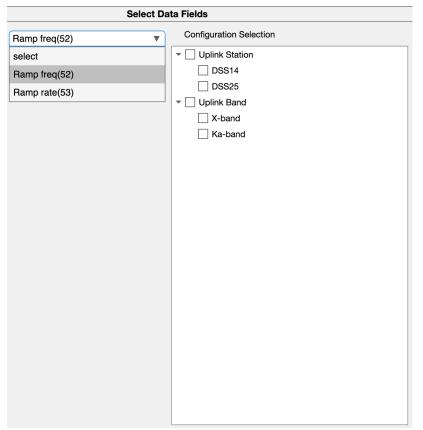
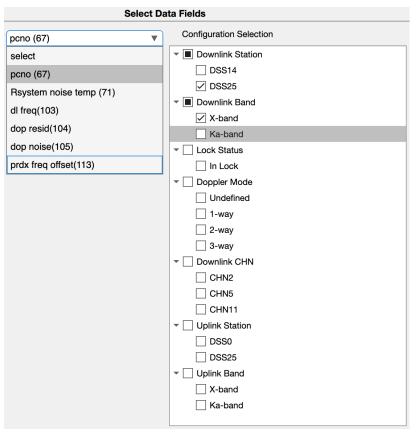


Figure 2-3 Data Type 9 (Ramps) for the Juno Gravity Science PDS TRK-2-34 data archive.



**Figure 2-4** Data Type 16 (Carrier Observables) for the Juno Gravity Science PDS TRK-2-34 data archive.

## 2.3 Data Field Filtering

Users can check options in the configuration list to visualize the selected data points. The selected configuration data points (S) are defined as:

$$S = \bigcup_{i=1}^{n} A_i,$$

where  $A_i = \bigcap_{k=1}^m B_k$  and  $B_k$  (k = 1, ..., m) are the selected subsets of each configuration option ( $A_i$  (i = 1, ..., n)) such as downlink station, downlink band, and uplink station shown in **Figure 2-4**. For example, users can filter out data points for the downlink station DSS-25 and downlink band X by checking the corresponding boxes in the configuration list (**Figure 2-4**). Once users check the configuration options for data visualization, they can click the Select icon to execute the filtering function (the indicator light will turn from red to the green). All subset data points will be selected if users don't check any subset boxes. For example: if users only check the downlink station DSS-14, the filtering function will pick up all the downlink station DSS-14 data points with configuration options for all uplink stations, all Doppler modes, and all uplink/downlink bands. See Table 5 for a listing of the available values for the data filtering fields in data types 1, 9, and 16.

Table 5. Data Filtering Key

Filter Abbreviation	Filter Description	Values
carr_lock_stat	Carrier lock status	0 => Off 1 => Open (only using predicts) 2 => Acquiring, FFT Search 3 => Acquiring, Waiting for Lock Decision 4 => In Lock 5 => Out of Lock
dl_band	Downlink frequency band	Downlink frequency band.  0 => Unknown  1 => S-band  2 => X-band  3 => Ka-band (Deep Space)  4 => K-band (Near Earth)  5 => L-band
dl_chan_num	Downlink Channel Number	1 to 24
dl_dss_id	Downlink Antenna Number	0 to 255
prdx_mode	Predicts mode. Predicts subset used by downlink channel.	0 => No Predicts 1 => One-way 2 => Two-way 3 => Three-way
snt_flag	SNT measurement flag	0 => SNT value is the predicted value 1 => SNT value is the measured value
ul_band	Uplink frequency band	0 => Unknown 1 => S-band 2 => X-band 3 => Ka-band (Deep Space) 4 => K-band (Near Earth) 5 => L-band
ul_band_dl	Uplink band assumed by downlink.	0 => Unknown or not applicable 1 => S-band 2 => X-band 3 => Ka-band (Deep Space) 4 => K-band (Near Earth) 5 => L-band
ul_dss_id	Uplink antenna number	0 to 255
ul_prdx_stn	Uplink station used for predicts. Valid only if prdx_mode is 2 or 3.	0 to 255 A value of 0 means that the number is unknown or not valid (e.g., no uplink).
vld_dl_band	Validated downlink frequency band	0 => Unknown 1 => S-band 2 => X-band 3 => Ka-band (Deep Space) 4 => K-band (Near Earth) 5 => L-band 6 => S or X band (26m stations)

#### 2.4 Visualization Functions

Once users the select the configuration, they can click the Plot button to visualize the data points. The app will automatically generate the plot title, data units, and axis legend corresponding to the selected data field and configurations. The entries for the title, axes, and units are pulled directly from those in the \*.xml label. Users can also manually update the plot title and legends via typing the title and legends in the Manual Legend Update and clicking the Update Legend button (Figure 2-5).

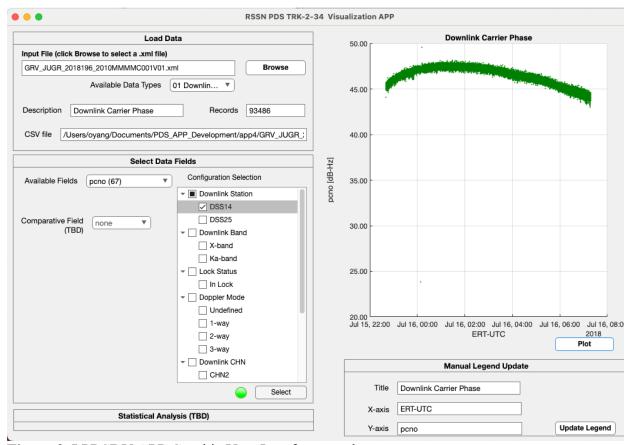


Figure 2-5 PRSDV APP Graphic User Interface panel.