Introduction:

The ORPA processed data consist of 4 file types: high resolution thermal electrons, high resolution superthermal electrons, high resolution ions, and a key parameters file at 12 second sampling. High resolution data are provided (for the entire orbit / only the portion of the orbit near periapsis) The sample rate of the high resolution data is variable and dependent on the telemetry rate and other operational considerations. All of these data are derived from the reformatted EDR data (RDR) which contains the raw I-V curve values. The moments of the distributions have been computed by a least squares fitting algorithm. The low resolution data are resampled from the high resolution files. All 5055 orbits of the mission, (Dec 5, 1978 - Oct 7, 1992) are included in the data set. The PV RPA is described in considerable detail by Knudsen et al. [1979-1980]. The principles of measurement are also described therein together with some of the factors affecting the accuracy of the derived quantities. Additional information on the theory of measurement by an RPA is presented by Knudsen [1966].

Sampling:

The ORPA instrument sweeps through the ion, electron, and photoelectron modes in an EIIIP sequence covering 5 spacecraft spin periods spending one spin period in each mode. A single retarding scan can be completed approximately 40 times in a spin period (0.3 sec). There are various algorithms by which the instrument can decide which scan to place in the telemetry frame. Please read the instrument description for more details.

Data Processing:

High resolution data were processing by using an automated least squares fitting procedure. Values derived from these fits are provided in the archive. Some of the quantities contained in this submittal of RPA data to the PDS are erroneous because of bad least-squares fits to the I-V curves. These bad fits were not detected by the data reduction algorithms and have not been removed by a trained observer viewing the I-V curves and making an educated judgment. A trained observer, looking at an I-V plot, can rather quickly recognize data that will produce erroneous fit results but it is difficult to write an algorithm that can recognize all the possible situations and make the necessary adjustments.

High Resolution Electrons:

In the electron mode, the ion current to the collector is negligible with the collector at 47 V, A potential difference of 20 V between G-4 and C was found sufficient to suppress most of the secondary electrons produced by ion or electron impact at the collector. The three front grids G-0, G-1 and G-2 are the energy analyzing grids. They are stepped together from +6.8 to -4.2 V in the coarse scan. The corresponding collector current is measured by an electrometer and then digitized. The straight line portion is the retarding region, and the logarithmic slope determines the electron temperature by the relation:

$$Te = \frac{e}{k} \; \frac{\mathrm{Delta}(V)}{\mathrm{Delta}(\ \log\ (-\ Ie)\ )}$$

where e is the electron charge; k, the Boltzmann constant; and Ie, the electron current. The left side with larger positive voltage is the attractive region. The voltage Vp at which these two portions of the curve join is the potential of plasma relative to spacecraft. Vp is expected to vary from a few volts negative in interplanetary space to 1 or 2 V positive in the Venusian ionosphere. For the simulation it was set to zero. The lower portion of the curve bends away from the straight-line portion because the velocity distribution is not a true Maxwellian distribution. An additional population of suprathermal electrons exists with higher energies than the thermal distribution.

High Resolution Ions:

The algorithm that scans the data in an ion I-V curve and computes the initial estimates of the ion quantities must also make a decision as to what ion mass is represented by a peak in DI [Knudsen et al., 1979; 1980]. The voltage at which the DI peak occurs for a given mass may be substantially smaller or larger than the nominal value because the Venus ionosphere is moving relative the planet with a velocity that can approach that of the spacecraft. Consequently, some peaks in DI have been assigned the wrong mass. The result is not only an erroneous concentration for that mass but also an erroneous ion velocity and total ion density. It is possible to recognize the incorrect assignments when comparing several I-V curves which are adjacent to each other in time, but the analysis algorithms are not this sophisticated. A few errors in ion quantities are present in the PDS files resulting from this difficulty. The uncertainties in the ion fitting process are included in an ancillary file.

High Resolution Suprathermal Electrons:

The analysis of a suprathermal electron I-V curve is similarly difficult. The interpretation of the electron distributions contributing to the I-V curve depends on the potential of the spacecraft relative to the ambient plasma which, in turn, depends on the location of the spacecraft and the properties of the ambient plasma. The spacecraft is negative in the dense ionospheric plasma. It is positive in the low density solar wind plasma provided the spacecraft is not in the umbra of the planet. An additional complication arises in that the sign of the current to the electrometer occasionally changes from negative to positive during a sweep. This can occur because the background current, with maximum retarding potential applied to the retarding grids, is compensated close to the noise level of the electrometer just before the sweep begins [Knudsen et al., 1979]. If the background current that has been compensated is significant relative to the saturation current and changes in the right direction during the ensuing sweep, the total current will go through zero and the sign change. The background current can change because the orientation of the rotating spacecraft relative to the sun changes, because a purely temporal change occurs or because the location of the spacecraft changes. Switching of the current from one sign to the other with the electrometer in its most sensitive mode produces a noise spike in -the electrometer that is digitized and becomes part of-the I-V curve. Writing an algorithm that recognizes the noise spike and the change in current sign is difficult because the sign of only the saturation current and background current of a sweep has been retained in the I-V data for reasons of minimizing the telemetry requirements of the RPA. A trained observer, looking at an I-V plot, can rather quickly recognize in most cases when this condition has occurred, but it is difficult to write an algorithm that can recognize all the possible situations and make the necessary adjustments.

Low Resolution Data:

The PV PDS LFD SEDR tapes have time tags at 12 second intervals from 30 minutes prior to periapsis to 30 minutes after periapsis. These time tags are the tags specified in the first four quantities of each of the EDR data records. All PV instruments are to report their data at these common time tags for the purpose of easy intercomparison of data. Principal Investigators (PIs) with instruments with a sampling period much less that 12 seconds are to report the average of measured quantities over a 12 second interval centered on the time tags. The RPA, because of a low telemetry word assignment, records at most one current-voltage (I-V) characteristic curve per spacecraft spin period. Except for one set of 14 orbits, the spin period of the PV spacecraft has been about 12 seconds. Thus, RPA physical quantities are derived at intervals of 12 seconds or more. Since the RPA operates in several modes, a particular quantity such as thermal electron temperature may be typically measured at much longer intervals. The thermal electron temperature is typically measured at either approximately 48 or 60 second intervals. In a few orbits, it was measured at 12 second intervals.

The quantities TOTI,- H+, O+, M29+, CO2+, TI, VX, VY, VZ, N1, TL, N2, and T2 are derived by least-squares fitting a strongly non-linear numerical algorithm to an I-V curve. It is necessary in performing such a fit to supply an initial estimate of the quantities that are to be derived. If the estimates are not sufficiently close to the true least-squares values, the algorithm may yield a grossly erroneous value by converging to a relative minimum of the variance and not to the absolute minimum. Also, it may not converge at all. Although some such erroneous values have been eliminated from our basic tables tapes by checking for the magnitude of the variance, some erroneous value are known to be present. Such values can be way outside the nominal uncertainty quoted in Table 1.

ASCII low resolution data are included as part of the high resolution data archive to facilitate browsing of the key parameters of the dataset.

Missing values:

RPA quantities may be unavailable for assigning to a specific time tag for several reasons as follows: The spacecraft data format in use at the time may not have contained any words for the RPA. The RPA may have been turned off for power conservation reasons. The spacecraft telemetry bit rate and/or data format may have been such that an RPA I-V curve was recorded only at long time intervals. RPA data for an interval of time, including the time tag, has not been reduced. (RPA data at the time of this submission have been reduced for only a small time interval about periapsis: plus and minus approximately 15 minutes for the first 800 orbits, plus and minus approximately 30 minutes for orbits 800-1300, plus and minus 60 minutes for orbits 1300-2890.)"

Data:

Each of the four data file types are described in this section. The 3 high resolution data files all contain 17 ephemeris data columns necessary for the interpretation of the data. Rather than repeat the description 3 times, we will described the ephemeris data columns once, and then place the phrase ephemeris(17) in the column name field of the file description.

Ephemeris(17)

name	type	description
EPH1	float_4	Roll spin angle <degrees> (NRSC - RAMROLL)**
EPH2	float_4	Spin period <seconds>
EPH3	float_4	Attitude of spin axis X (NRSC - ATTX)**
EPH4	float_4	Attitude of spin axis Y (NRSC - ATTY)**
EPH5	float_4	Attitude of spin axis Z (NRSC - ATTZ)**
EPH6	float_4	Distance from Venus to center of spacecraft, X component (ICC_ECLP - XP1SFF)*
EPH7	float_4	Distance from Venus to center of spacecraft, Y component (ICC_ECLP - YP1SFF)*
EPH8	float_4	Distance from Venus to center of spacecraft, Z component (ICC_ECLP - ZP1SFF)*
EPH9	float_4	Spacecraft velocity X component (ICC_ECLP - DXP1SF)*
EPH10	float_4	Spacecraft velocity Y component (ICC_ECLP - DYP1SF)*
EPH11	float_4	Spacecraft velocity Z component (ICC_ECLP - DZP1SF)*
EPH12	float_4	Distance from Sun to center of spacecraft, X component (ICC_ECLP - XPHSFF)*
EPH13	float_4	Distance from Sun to center of spacecraft, Y component (ICC_ECLP - YPHSFF)*
EPH14	float_4	Distance from Sun to center of spacecraft, Z component (ICC_ECLP - ZPHSFF)*
EPH15	float_4	Venus center velocity, X component (ICC_ECLP)*
EPH16	float_4	Venus center velocity, Y component (ICC_ECLP)*
EPH17	float_4	Venus center velocity, Z component (ICC_ECLP)*

*   Inertial Cartesian Coordinate System - Ecliptic
** Non-rotation spin coordinate system

Ions (binary table - IEEE UNIX byte order):

name	type	description
PDSTIME	char_24	Output from Time fitting
IORBT	integer_4	orbit number
TPER	integer_4	Periapsis time (UT)
KDAY	integer_4	Periapsis day of year
NDSI	integer_4	Unique sweep number
TIMI	float_4	Unique time of msrmnt for NDSI
ALTI	float_4	Altitude of NDSI.
SZAI	float_4	Solar Zenith Angle of NDSI
TOTI	float_4	Total ion density
H+	float_4	Hydrogen ion density
HE+	float_4	Helium ion density
O+	float_4	Oxygen ion density
M29+	float_4	Sum density of CO+, NO+, N2+ ions
O2+	float_4	O2+ ion density
CO2+	float_4	Carbon dioxide ion density
VELI	float_4	Ion bulk velocity component in direction of RPA out
TI	float_4	Ion temperature

PHII	float_4	Spacecraft ground potential
CSQ	float_4	Chi square, goodness of curve fit
FRSI	float_4	Saturation ion current
BCKI	float_4	Background ion current
ephemeris(17)		

Thermal Electrons(binary table - IEEE UNIX byte order):

name	type	description
PDSTIME	char_24	Output from Time fitting
IORBT	integer_4	orbit number
TPER	integer_4	Periapsis time (UT)
KDAY	integer_4	Periapsis day of year
NDSE	integer_4	Unique sweep number
TIME	float_4	Unique time of measurement for NDSE
ALTE	float_4	Altitude of NDSE
SZAE	float_4	Solar Zenith Angle of NDSE
TOTE	float_4	Electron density
TE	float_4	Electron temperature
PHIE	float_4	Spacecraft ground potential
FRSE	float_4	Saturation electron current
BCKE	float_4	Background electron current
ephemeris(17)		

Photoelectrons(binary table - IEEE UNIX byte order):

name	type	description
PDSTIME	char_24	Output from Time fitting
IORBT	integer_4	orbit number
TPER	integer_4	Periapsis time (UT)
KDAY	integer_4	Periapsis day of year
NSPH	integer_4	Unique sweep number
TIMPH	float_4	Unique time of measurement for NSPH
ALTPH	float_4	Altitude of NSPH.
SZAT	float_4	Solar Zenith Angle of NSPH
VPPH	float_4	Suprathermal electron spacecraft potential of NSPH
DENPH1	float_4	First suprathermal electron density of NSPH
TEMPH1	float_4	First suprathermal electron temp of NSPH
DENPH2	float_4	Second suprathermal electron density of NSPH
TEMPH2	float_4	Second suprathermal ele temp of NSPH
SDENPH1	float_4	Least-squares fit statistical uncertainty of DENPH1
STEMPH1	float_4	Least-squares fit statistical uncertainty of TEMPH1
SDENPH2	float_4	Least-squares fit statistical uncertainty of DENPH2
STEMPH2	float_4	Least-squares fit statistical uncertainty of TEMPH2
CSQPH	float_4	Chi square, goodness of curve fit
FRSPH	float_4	Saturation suprathermal electron current
BCKPH	float_4	Background suprathermal electron current
ephemeris(17)		

Key Parameters File (low resolution - ASCII table):

name	type	description
PDSTIME	char_24	UT of UADS record time which is defined for all PVO inst providing UADS data.

ORBIT	integer_4	Orbit number
TPER	integer_4	Time from periapsis
UT	integer_4	Universal time
TOTI	integer_4	Total ion density
H	float_4	Hydrogen ion density
O	float_4	Oxygen ion density
O2	float_4	O2 ion density
CO2	float_4	Carbon dioxide ion density
TI	float_4	Ion temperature
VX	float_4	Ion bulk velocity X component
VY	float_4	Ion bulk velocity Y component
VZ	float_4	Ion bulk velocity Z component
F1I	float_4	First ion current, no retarding potential
BKGI	float_4	Background current at start of ion sweep, +37V potential
VPI	float_4	S/C potential at start of ion sweep
TOTE	float_4	Total electron density
TE	float_4	Electron temperature
F1E	float_4	First thermal electron current, +6.8V from S/C ground
BKGE	float_4	Background current at start of thermal electron sweep, -4.6V potential
VPE	float_4	S/C potential at start of thermal electron sweep
N1	float_4	Cold electron density
T1	float_4	Cold electron temperature
N2	float_4	Hot electron density
T2	float_4	Hot electron temperature
F1P	float_4	First photoelectron current, no retarding potential
BKGP	float_4	Background current at start of photoelectron sweep, -58V potential
VPPE	float_4	S/C potential at start of photoelectron sweep

Ancillary Files:

The ion fitting process involves both mass and velocity discrimination In many cases, one or the other parameter can not be well determined. As an ancillary component of the high resolution ion data files, we have included an ion uncertainties file. Some of the reasons for the uncertainties in the fits are described in the following section on measured quantities. The ion uncertainty files have the following structure:

name	type	description
PDSTIME	char_24	Output from Time fitting
IORBT	integer_4	orbit number
TPER	integer_4	Periapsis time (UT)
KDAY	integer_4	Periapsis day of year
NDSI	integer_4	Unique sweep number
TIMI	float_4	Unique time of measurement for NDSI
ALTI	float_4	Altitude of NDSI.
SZAI	float_4	Solar Zenith Angle of NDSI
STOTI	float_4	Estimated uncertainty in total ion density
SH+	float_4	Least-squares fit statistical uncertainty of H+ ion density
SHE+	float_4	Least-squares fit statistical uncertainty of HE+ ion density
SO+	float_4	Least-squares fit statistical uncertainty of O+ ion density

SM29+	float_4	No significance
SO2+	float_4	Least-squares fit statistical uncertainty of O2+ ion density
SCO2+	float_4	Least-squares fit statistical uncertainty C02+ ion density
SVELI	float_4	Ion velocity
STI	float_4	Ion temperature
SPHII	float_4	Spacecraft ground potential
CSQ	float_4	Chi square, goodness of curve fit
ephemeris(17)		

RPA Measured Quantities

The PV RPA is described together with some of the principles of measurement in some detail by Knudsen et al. [1979,1980]. Many of the factors affecting accuracy are also described therein. We present in this section the quantities recorded on the PDS EDR data files following the four time tag quantities, their nominal uncertainty and measurement noise level, and additional limitations of the quantities.

Table 1 lists the symbol, quantity, measurement range with units in which the quantities are quoted, noise level of measurement, and uncertainty of the measurement for the quantities reported by the RPA. We have included in the list of quantities the vector components of the ion bulk velocity even though we do not supply values in this Oct 1988 submission to PDS.

TABLE 1

SYMBOL	QUANTITY	RANGE	NOISE LEVEL	UNCERTAINTY
UT	UNIVERSAL TIME OF MEASUREMENT	0 - 8.7x10**7ms	-	0.1s
TOTI	TOTAL ION DENSITY	10 - 1x10**7cm	10 cm-3	10%
H+	HYDROGEN ION DENSITY	300 - 10**7cm-3	300 cm-3	10%
O+	OXYGEN ION DENSITY	300 - 10**7cm-3	300 cm-3	10%
M29+	SUM DENSITY OF CO+,N2+,NO+,O2+	300 - 10**7cm-3	300 cm-3	10%
CO2+	CARBON DIOXIDE ION	300 - 10**7cm-3	300 cm-3	10%
TI	ION TEMPERATURE	150 - 10,000 K	-	10%
VX	ION BULK VELOCITY, X COMPONENT	0 - 7 km/s	0.4 km/s	0.4 km/s
VY	ION BULK VELOCITY, Y COMPONENT	0 - 7 km/s	0.4 km/s	0.4 km/s
VZ	ION BULK VELOCITY, Z COMPONENT	0 - 7 km/s	0.4 km/s	0.4 km/s
F1I	SATURATION ION CURRENT	0 - 1.3x10-4 A	1x10-12 A	1%
BKGI	ION BACKGROUND CURRENT	0 - 1.3x10-4 A	1x1O-12 A	1%
VPI	SPACECRAFT GROUND POTENTIAL	-5 - +3 V	-	0.1V
TOTE	ELECTRON DENSITY	102 - 107 cm 3	-	-
TE	ELECTRON TEMPERATURE	300 - 20,000 K	-	10%
F1E	SATURATION ELECTRON CURRENT	0 - 1.3x10-4 A	1x10-12 A	1%
BKGE	ELECTRON BACKGROUND CURRENT	0 - 1.3x10-4 A	1x10-12 A	1%
VPTE	SPACECRAFT GROUND POTENTIAL	-5 - +3V	-	0.1V
N1	FIRST SUPRATHERMAL ELECTRON DENSITY	0 - 107 cm-3	1 cm-3	20%
T1	FIRST SUPRATHERMAL ELECTRON TEMPERATURE	0 - 100 eV	0.2 eV	20%
N2	SECOND SUPRATHERMAL ELECTRON DENSITY	0 - 105 cm-3	1cm -3	20%
T2	SECOND SUPRATHERMAL ELECTRON TEMPERATURE	0 - 100 eV	0.2 eV	20%

F1P	SATURATION SUPRATHERMAL ELECTRON CURRENT	0 - 1.3x10-4A	1x10-12A	1%
BKGP	BACKGROUND SUPRATHERMAL ELECTRON CURRENT	0 - 1.3x10-4A	1x10-12A	1%
VPPE	SUPRATHERMAL ELECTRON SPACECRAFT POTENTIAL	0 - +20V	-	0.1 - 5V

UT: UT is the universal time in milliseconds assigned to the physical quantities recorded in this record. UT will typically, but not always, lie within plus or minus 6 seconds of the time of day assigned to the time tag of this record. UT should be accurate to within plus or minus 0.1 second.

TOTI: TOTI is the total ion density of the plasma in cm-3 and is derived from the FORTRAN expression

```
    TOTI=FlI/(VN*e*Area)
```

where F1I is the first ion current measured with zero retarding potential, VN is the component of ion bulk velocity parallel to the RPA axis derived from the lst-squares analysis when an analysis was possible, e is the electronic charge, and AREA is the effective area of the RPA collector (= 0.81 cm2). When a lst-squares analysis is not possible, VN is the component of the spacecraft velocity in ecliptic coordinates parallel to the RPA axis.

H+: H+ is the hydrogen ion density. When the RPA is operating in one of its peaks mode, H+ will be detected and recorded only when its density is greater than approximately 10% of the sum of more massive ion densities. H+ can be the second most abundant ion and still not be recorded when the RPA is operating in its two peaks mode. The uncertainty of the H+ density also depends on its density relative to that of more massive ions. For an H+ density comparable to that of more massive ions, the accuracy should be of the order of 10%. The detection noise level for H+ is estimated at 300 cm-3. Additional discussion of the RPA ion peak detection capability and limitation is given by Miller et al. [1984].

O+: O+ is the oxygen ion density. It will be detected in the presence of more massive ions only when its density is greater than approximately 10% of the sum of more massive ions. The RPA does not resolve C+, N+, or 0+. We have assumed in our least-squares fitting that (CC+] + CN+])/CO+] is constant at 0.07, a value derived from PV ion mass spectrometer results.

M29+: M29+ is the symbol assigned to the sum density of ions with mass near 32 atomic mass units, CO+, NO+, N2+, O2+. The RPA does not resolve these masses. In performing a least squares analysis, I have permitted the algorithm to adjust the density of a mass 32 ion and a fictitious mass 29 ion in fitting the measured DI peak corresponding to this mass range [Miller et al., 1984]. Measurements by the PV IMS have revealed that the density of NO+ can approach been that although the median density of each of the two masses varies with altitude in the expected way, on successive sweeps the least squares analysis can assign all the density to mass 29 for one sweep and to mass 32 in the next. For the PDS files, I have added the densities of the mass 29 and 32 ions and entered them under the symbol M29+. RPA results as well as IMS results show that the predominant ion mass in the group is 32 in most regions of the ionosphere. In future submissions, the sum density of this mass group will be submitted under the symbol m32+.

C02+: C02+ is the density of the carbon dioxide ion.

TI: TI is the ion temperature and is assumed to be the same for all ion masses. It is one of the adjustable variables in the least-squares analysis of ion sweeps.

VX: VX is the x component of ion bulk velocity. The vector ion bulk velocity is derived from three component velocities parallel to the RPA axis measured in three successive spin periods of the PV spacecraft [Knudsen et al., 1980]. In deriving the vector, it is necessary to assume that the ion bulk velocity is uniform over the region of space traversed by the spacecraft in two spin revolutions of the spacecraft, a distance of about 250 km. The coordinate system in which VX, VY, and VZ are given will be specified when data are submitted.

VY: VY is the y component of the bulk ion velocity.

VZ: VZ is the Z component of the ion bulk velocity.

F1I: F1I is the saturation (first) current measured in an ion I-V sweep. The retarding potential is programmed to be slightly negative of plasma potential during this measurement. F1I is measured relative to the ion current measured with the retarding potential equal to 37V positive [Knudsen et al. 1979].

BKGI: BKGI is the current to the RPA collector measured just before the beginning of an ion sweep with the retarding potential set at approximately +37V relative to plasma potential.

VPI: VPI is the value of the spacecraft potential relative to plasma potential that is assumed to exist at the time of the ion sweep. The value is derived by interpolating between values of the spacecraft potential measured in the thermal electron mode.

TOTE: TOTE is the total electron density derived from the thermal electron mode saturation current F1E. The formula used for this present PDS submission, in FORTRAN language, is:

```
    TOTE = 6.15E9*MAX(0, -3.5E-9 -F1E)~0.847
```

We consider this measure of the total electron density to be approximate and valid only while the PV spacecraft is within the ionosphere.

TE: TE is the thermal electron temperature derived using equation (1) in Knudsen et al. [1980]. When the spacecraft is positive relative to plasma potential r a condition existing with the spacecraft in the sun and in a low density plasma the value of TE is representative of the secondary electrons trapped in the positive spacecraft potential well.

F1E: F1E is the saturation electron current measured at the beginning of a thermal electron mode sweep. The front (retarding) grids are at a potential of +6.8 V relative to the spacecraft ground.

BKGE: BKGE is the current measured by the RPA electrometer at the beginning of the thermal electron mode. The front (retarding) grids of the RPA are held at a potential of -4.6 V during the measurement.

VPTE: VPTE is the spacecraft potential relative to the ambient plasma potential. It is derived from the thermal electron sweep data as described BY Knudsen et al. [1980]. When the spacecraft is in the solar wind and exposed to the sun, its potential is typically a few volts positive with respect to the solar wind plasma potential. VPTE loses its meaning in this situation.

N1: N1 is the density of the low temperature Maxwellian electron distribution used to fit the suprathermal electron I-V curve [Knudsen et al., 1985].

T1: T1 is the temperature of the low temperature Maxwellian electron distribution.

N2: N2 is the density of the high temperature Maxwellian electron distribution used to fit the suprathermal electron I-V curve [Knudsen et al., 1985]

T2: T2 is the temperature of the high temperature Maxwellian electron distribution.

F1P: F1P is the electron current measured by the RPA with zero retarding potential on the retarding grid.

BKGP: BKGP is the electron current to the RPA with the retarding potential on the retarding grid equal to -58V.

VPPE: VPPE is the spacecraft potential relative to the ambient plasma potential. When the spacecraft is in the solar wind and not in the Venus umbra, the spacecraft is positive, and the potential is inferred from the suprathermal electron I-V curve. When the spacecraft is within the ionosphere or in the Venus umbra, the potential is either estimated or taken from the potential measured in the thermal electron mode.

Coordinate systems:

Non-rotating spin coordinate system (NRSC):

The roll angle of the roll reference object will be calculated in this coordinate system as well as the roll angles of the Fs, RIP, RAM, and NADIR signals. The non-rotating coordinate system (Wx, Wy, Wz) is centered at the spacecraft center of mass. The Wz-axis is parallel to the spacecraft spin axis. The Wx-Wy plane is perpendicular to the spacecraft spin axis. The Wx-Wz plane includes the Vernal Equinox of reference. Thus the Wx-axis is at the intersection of the plane perpendicular to the spacecraft spin axis and the plane containing the spin axis and the Vernal Equinox. Roll angles in this coordinate system are measured in the Wx-Wy plane from the roll reference direction.

Inertial Cartesian Coordinate System - Ecliptic (ICC-ECLP)

The Ecliptic Inertial Cartesian Coordinate System is defined for the reference epoch of 1950.0 The X-direction lies in the Ecliptic Plane and is positive away from the reference body towards the Vernal Equinox which is determined by the line of intersection between the mean Earth equatorial plane and the ecliptic plane of reference. The Y direction is measured outward from the center of the reference body, perpendicular to and east of the the X-axis, and lying in the ecliptic plane of reference. The Z direction is positive toward the north ecliptic pole of reference, from the center of the reference body.

Some of the quantities contained in this submittal of RPA data to the PDS are erroneous because of bad least-squares fits to the I-V curves. These bad fits have not been detected by our current algorithms for reduction of the data and have not been removed by a trained observer viewing the I-V curves and making an educated judgment.