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UMLCAR :

RPI Level 1 Data formats and Browse Products

A Complete description of the Level 1 data sets and Browse products produced by the RPI instrument on the IMAGE satellite

Revision 2.5

December 1, 1998

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Table of Acronyms

ApID	**:**	Application ID (Telemetry Record Type)
BIT	**:**	Built In Test.
CDF	**:**	Common Data Format.
CIDP	**:**	Central Instrument Data Processor
CIT	**:**	Coherent Integration Time
DBD	**:**	Double Byte Data
HKD	**:**	House Keeping Data.
ICD	**:**	Interface Control Document.
IDFS	**:**	Instrument Data File Set
LTD	**:**	Linear Time-domain Data.
LSD	**:**	Linear Science Data
MET	**:**	Mission Elapsed Time
NSFM	**:**	Number of Software Fault Messages reported by RPI (see table 1.2).
PPS	**:**	Pulses Per Second
PRD	**:**	Precision Range Data.
RMS	**:**	Root Mean Square
RPI	**:**	Radio Plasma Imager
SBD	**:**	Single Byte Data.
S/C	**:**	Space Craft
SI	**:**	Science Instrument.
SMD	**:**	Spectral Maximum Data.
SPS	**:**	Staggered Pulse Sequence.
SSD	**:**	Standard Science Data.
SST	**:**	Schedule Start Time.
TN	**:**	Thermal Noise.
TPC	**:**	Transmitter Power Card.
TTD	**:**	Thermal Time-domain Data.

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RPI Level-1 (Browse Product) Data Formats

A subset of RPI data, Level-1 Data, is allocated for public release over the Internet in form of various Browse Products. Level-1 data is stored in Common Data Format (CDF) files at Space Physics Data Facility (SPDF) of NASA GSFC. Browse products are created from the CDF files each time a user request arrives at SPDF WWW server. The following sections introduce and describe the formats for RPI Level-1 data. There are two different types of Level-1 data files, "Plasmagram/Echomap" and "Dynamic Spectrogram". Both types are used to produce a number of different Browse Products.

1 Plasmagram/Echomap Level 1 Data

1.1 RPI Data Level 0, 0.5, 1 and 2

Level 0 telemetry packets are first collected by Front End Data Server (FEDS). A copy of Level 0 telemetry is maintained at Digital History Data Server (DHDS) and forwarded to the instrument teams on a DVD media. The main distribution of "raw" instrument data is however done at Level-0.5, where all data are converted into a commercial strength standard format for telemetry, *Universal Data Format* (UDF).

Level 0.5 (UDF) data requires another round of post-processing before they can be reduced to the Level 1 Browse Product data:

- Time domain SPS records are subject to specialized spectral analysis.
- Time domain chirp records are subject to high-resolution spectral analysis.
- Autogain settings are applied to amplitude readings
- Amplitudes in log scale are converted back to the linear scale quadrature format (for easier calculation of echo directions).
- If data content permits, echo directions (zenith, azimuth) are calculated.

The data product obtained after the post-processing finishes is called *"Level 2"* in this document. The Browse Product is obtained from the Level 2 by collapsing all data volume into three major browse products, plasmagram, dynamic spectrogram, and echomap.

Data formats for Level 0.5 (UDF) and Level 2 remain to be determined.

1.2 Reduction of Level-2 Spectral Data to Level-1

Figure 1.2-1 illustrates the data reduction required to create a Plasmagram/Echomap file from the Level-2 data. For each sounding frequency and range bin, Level-2 data comprises Doppler spectra obtained on each of antennas X, Y and Z, possibly in two sets corresponding to transmitter polarization *Tx*+ and *Tx*-. (The electric filed of a wave propagating in the +z direction can be represented as

$$\vec{E}_{\pm} = E_0\left(\hat{x} \pm i\hat{y}\right)e^{i(kz-\omega t)} \tag{1.2-1}$$

This is a right or left hand circularly polarized wave depending on whether the phase of the X transmitter antenna signal is advanced (+) by 90° or delayed (-) by 90°. Further in the text we refer to these waves as *Tx*+ and *Tx*- waves.)

For Level-1 presentations, the complete spectra are reduced to a single set of amplitude, Doppler shift, azimuth in XY plane, and polarization indicators per frequency-range bin.

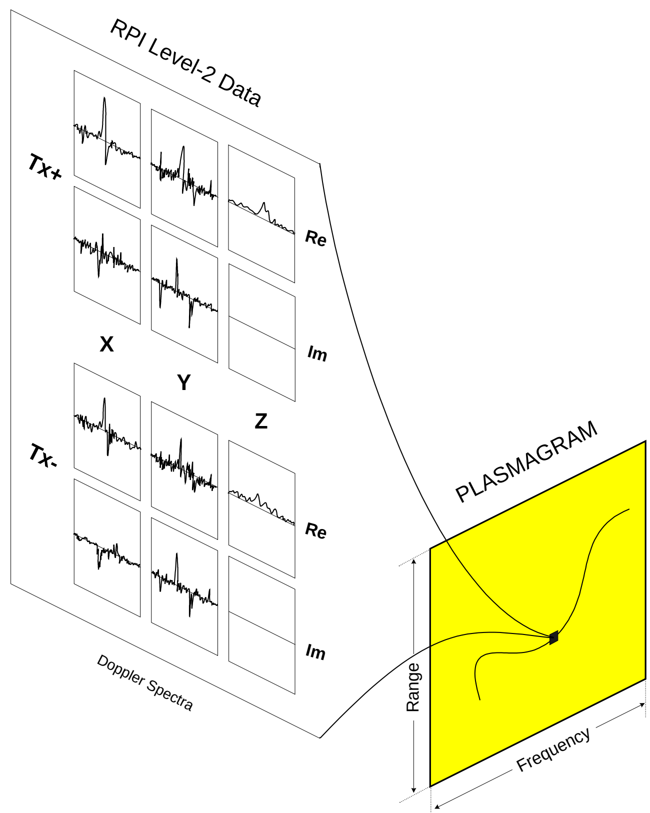

Figure 1.2-1 Data reduction to produce plasmagram/echomap data from Level-2 data

The reduction to Level-1 data include, for each frequency and range, the following three steps:

- Search of the maximum Doppler component, separately for *Tx*+ and *Tx*- data
- Identification of polarization signature

- Calculation of angle of arrival and its projection in XY plane.

Step 1 starts with calculation of spectral vector amplitudes S_d from the Level-2 quadrature components. For circularly polarized waves (see Figure 1.2-2) the amplitude S_d for each Doppler line d in the spectrum is simply

$$S_d = \sqrt{(\mathrm{Re}\,X_d)^2 + (\mathrm{Re}\,Y_d)^2 + (\mathrm{Re}\,Z_d)^2 + (\mathrm{Im}\,X_d)^2 + (\mathrm{Im}\,Y_d)^2 + (\mathrm{Im}\,Z_d)^2} \qquad (1.2\text{-}2)$$

NOTE
This expression can be improved to include elliptical polarization.

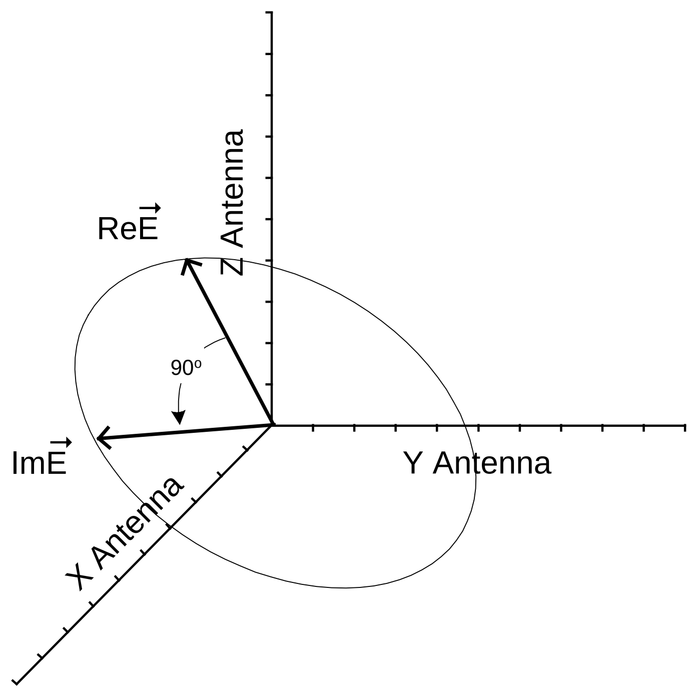

Figure 1.2-2 Circularly polarized wave projected on RPI antenna system.

The sense of rotation is obtained from the cross product of the two measured vectors $\mathrm{Re}\,\vec{E}$ = (ReX, ReY, ReZ) and $\mathrm{Im}\,\vec{E}$ = (ImX, ImY, ImZ):

$$\vec{N} = \mathrm{Re}\,\vec{E} \times \mathrm{Im}\,\vec{E} = (\mathrm{Re}\,X, \mathrm{Re}\,Y, \mathrm{Re}\,Z) \times (\mathrm{Im}\,X, \mathrm{Im}\,Y, \mathrm{Im}\,Z) \qquad (1.2\text{-}3)$$

The z-component of the product is

$$N_z = \mathrm{Re}\,X\ \mathrm{Im}\,Y - \mathrm{Re}\,Y\ \mathrm{Im}\,X \qquad (1.2\text{-}4)$$

If $N_z \geq 0$, the sense of rotation is the same as the *Tx*+ transmitted wave. After the *Tx*+ transmission, all echoes with $N_z<0$ are set to zero. The same process is applied to the signals received after the *Tx*- transmission. Then for each bin the amplitude S_d+ obtained from *Tx*+ transmission is compared to S_d- amplitude obtained from *Tx*- transmission to select the polarization for the bin.

For each range bin the maximum Doppler lines, *M+* and *M-*, are then selected:

$$M^+ = \max\left\{S_d^+\right\} \qquad (1.2\text{-}5)$$
$$M^- = \max\left\{S_d^-\right\}$$

In Step 2, *M+* is compared to *M-* to select the larger one and thus identify the polarization (i.e., the sense of the E-field rotation). At this point three indicators exist for the plasmagram bin: the amplitude (in logarithmic scale), the Doppler frequency and the polarization signature. In the following discussion the term "polarization" is referring to the sense of rotation: *P+* if *M+* was selected and *P*- is *M*- was selected.

Step 3 analyses three quadrature component pairs for the selected Doppler frequency and polarization to calculate the angle of arrival. The calculated angle has 180° ambiguity along the Z axis due to the fact that the quadrature components induced on the three antennas by two plane waves arriving along the same line from opposite hemispheres are identical. For the purpose of Level-1 presentations, Z+ hemisphere is assumed. Finally, the projection of the angle of arrival on the XY plane is obtained as the output value for the bin.

1.3 Plasmagram

Plasmagram is a raster image where frequency is x axis, range is y axis, and each pixel carries values of amplitude, polarization, Doppler shift and XY-plane azimuth (see Figure 1.3-1). Concise visualization of this information is impossible without further reduction.

1.3.1 Detailed plasmagram

For a *detailed* plasmagram format, each pixel can be represented by 16 different *optifont* characters (see Figure 1.3-1) and 16 possible *colors*. The optifont is designed to display amplitudes, with larger values appearing visually thicker on the screen or paper. Two different color assignment schemes are implemented corresponding to a *Beam Plasmagram* and a *Doppler Plasmagram.* For the Beam Plasmagram, the XY-plane azimuth values are sorted into 8 sectors, each 45° wide, and 8 colors are used to represent the sectors. For the Doppler Plasmagram, eight colors are assigned to the Doppler shift frequencies. A simulated browse plasmagram picture using groundbased Digisonde ionogram data is shown on Figure 1.3-2.

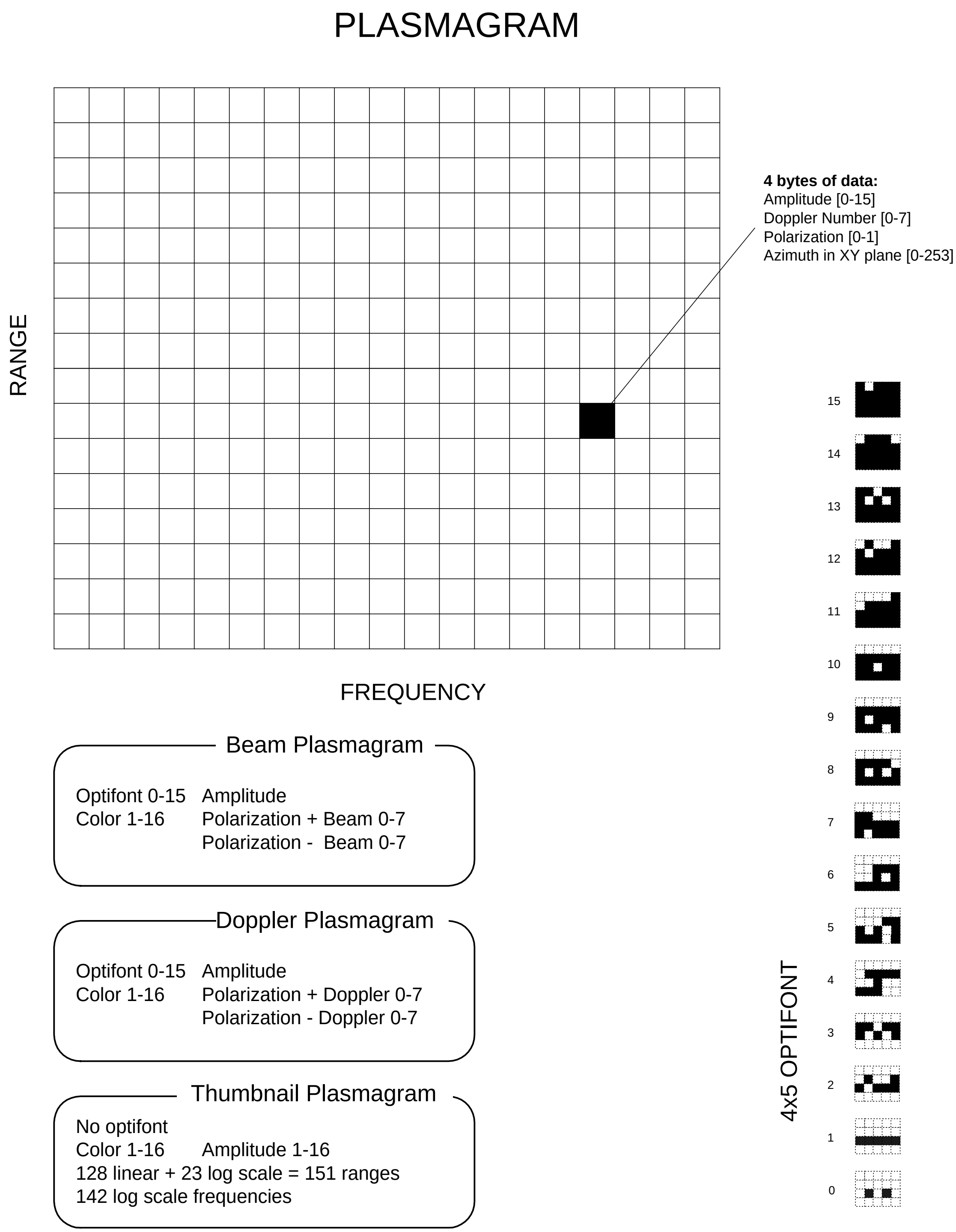

Figure 1.3-1 Plasmagram visualization options

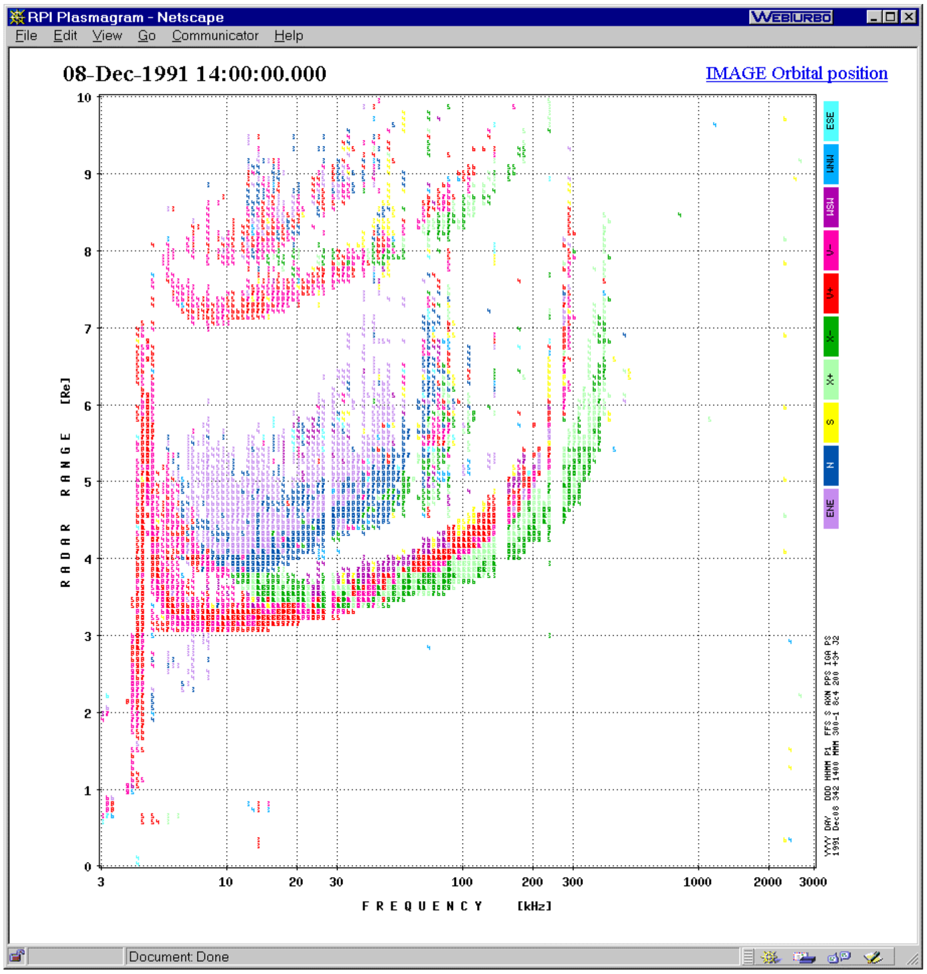

Figure 1.3-2 Simulated Detailed Beam Plasmagram Picture

The dimensions of the detailed plasmagram picture vary depending on the number of frequencies and ranges of the original RPI measurement program and usually reach 900x900 pixels.

1.3.2 Thumbnail plasmagram

For survey and movie formats it is necessary to reduce the size to the order of 100x100 and provide a fixed frame of frequency and range axes to ensure proper perception of event history. Thumbnail Plasmagram serves this purpose. The logarithmic frequency scale covers 3 kHz to 3000 kHz in 142 steps of 5% frequency increments and the range scale covers 0 to 10 Re range with 128 linear 480 km steps, and 10 Re to 30 Re with 23 logarithmic 5% steps, totaling 151 ranges. Figure 1.3-3 presents a simulated survey of 15 minute thumbnail plasmagrams fitting one standard printout page.

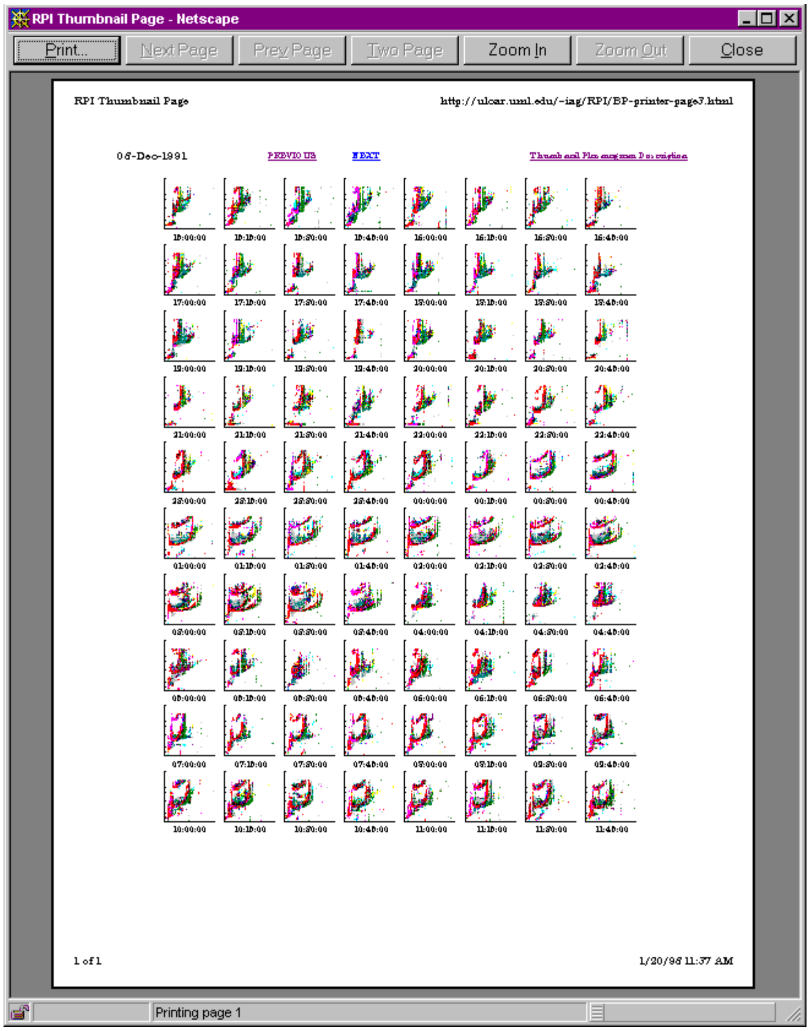

Figure 1.3-3 Thumbnail Plasmagram Printer page.

No optifont is used to indicate the amplitude in the thumbnail plasmagrams; the data is thresholded to remove data points below the average noise level. Two eight-level color tables are used to represent amplitudes, with shades of red for polarization *P+* and shades of green for polarization *P-*.

Due to considerable amount of calculations required to create thumbnail from the original Level-1 data (frequency and range axis transformations, evaluation of noise level for each frequency and thresholding), the thumbnail plasmagram data are calculated during reduction of Level-2 to Level-1 and stored in addition to the detailed plasmagram in the Level-1 files.

1.4 Echomap

An *Echomap* is produced to visualize the RPI complex three-dimensional reflection echo locations on a two-dimensional plot. The procedures require to produce an Echomap consist of;

- **Calculating the angle of arrival.** As previously mentioned the angle of arrival is calculated from the three quadrature component pairs for a selected Doppler frequency and polarization.

> **NOTE**
> The angle of arrival calculation has a 180^o ambiguity along the Z-axis since the quadrature components induced on the three antennas by two plane waves arriving along the same line from opposite hemispheres are identical.

- **Calculating echo location with respect to IMAGE position.** The range and angle of arrival measurements are used to determine the echo locations in the IMAGE centered coordinate system.

- **Mapping from 3-D to a 2-D surface.** The mapping of the echo location to a two dimensional surface retains information on the range and azimuth component of the angle of arrival. Figure 1.4-1 shows how the echo points are mapped to the X-Y plane. Considering a 3-D sphere around the IMAGE satellite, the mapping conserves the range and azimuth information by following the great circle arc projection to the X-Y plane (which is considered to be in the orbital plane). Inherent in this mapping as shown in Figure 1.4-1 is the effect of the 180^o ambiguity echo location that is also mapped to the X-Y plane. This ambiguity produces what is termed "Ghost" echoes that need to be resolved in the production of the final echomap.

- **Transformation to Orbital plane.** All echoes in the echomap are mapped in the IMAGE satellite orbital plane (Figure 1.4-2). The center of the echomap corresponds to the center of the orbit. This view is maintained since it allows more coverage of echo locations at apogee and least coverage at perigee.

- **Projection of Magnetospheric model and echo tagging.** A projection of the main observable features of the magnetosphere and plasmasphere is included in the echomap, and is used to tag echoes as ghosts, or real.

The complete detailed echomap is shown in Figure 1.4-2. The echomap picture consists of the echomap, the orbital-sun position diagram, and the colored frequency legend. These items are all contained in 900x900 pixel dimension. The echomap map displays a maximum of 16x16Re and is contained in 637x637 pixel dimension, allowing 212 range bins, with 3x3 pixel representation for each echo. All identified ghost echoes are colored grey, while the correctly identified echoes are color coded to the corresponding sounding frequency. The legend supplies the echo frequency and is a logarithmic frequency scale covering 3 kHz to 3000 kHz in 142 steps of 5% frequency increments.

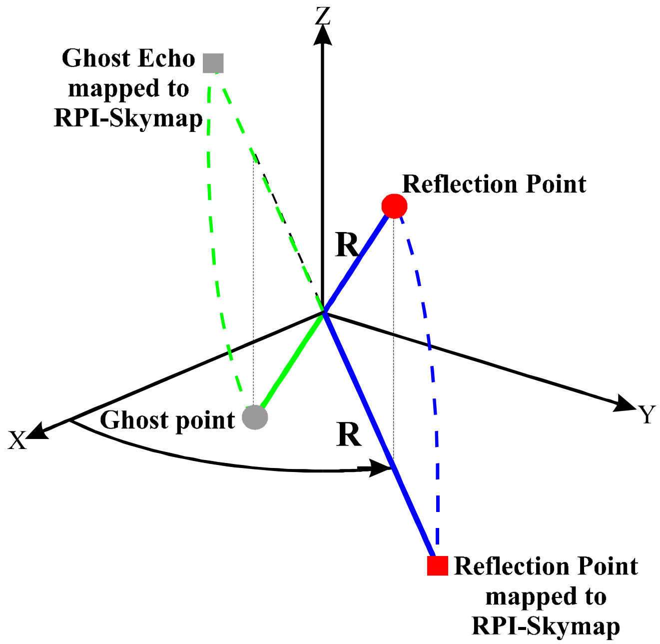

Figure 1.4-1 Mapping of reflection point to a 2D RPI-Echomap

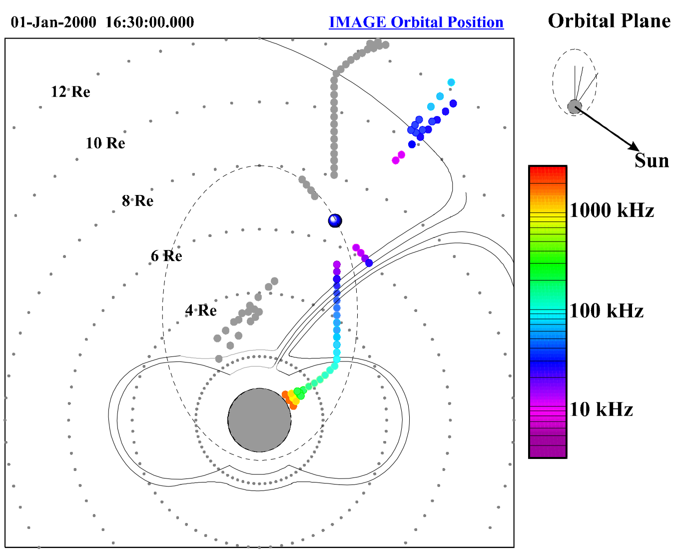

Figure 1.4-2 Echomap Survey

Since the earth is tilted approximately 23.5^{o} to the plane of its orbit around the sun, the angle of the sun and the orientation of the magnetosphere/plasmasphere change with respect to RPI orbital plane. The orbital-sun position diagram specifies the orientation of the echomap with respect to the sun. While the position and orientation of the plasmasphere, cusp, plasmapause etc.. will change in the echomap. Considering Figure 1.4-2 at time t_o the cusp and magnetopause are located on the right hand side of the echomap. At time t_o +3months the projection of the cusp in the orbital plane will consist of a thin line in the center of the echomap, while at t_o +6 months the cusp, magnetopause will be located on the left hand side of the echomap.

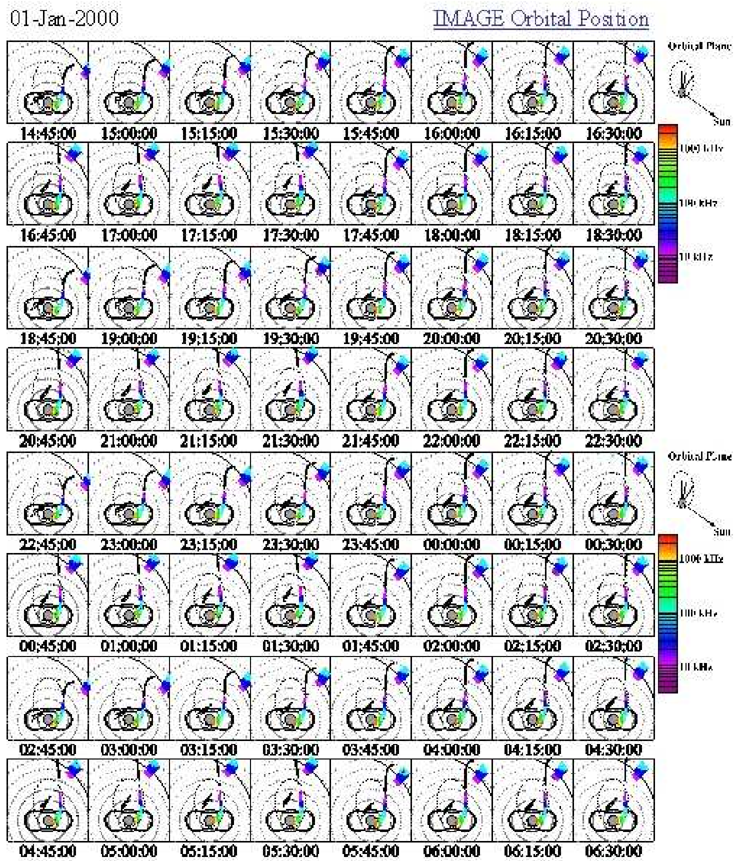

Figure 1.4-3 RPI Echomap Correct tagging of reflection regions and ghost traces

For the echomap survey formats it is necessary to reduce the size to the order of 100x100. The format of the echomaps remain unchanged. However due to dimensional limitations the echo is now represented by a single pixel, and two range bins are mapped to the same pixel, since for 16x16Re view the range resolution for each pixel is approximately 2. Color coded logarithmic frequency scale still covers 3 kHz to 3000 kHz in 142 steps of 5% frequency increments and ghost echos are still colored grey. Figure 1.4-3 presents a simulated survey of 15 minute thumbnail echomaps fitting one standard printout page. The color legend and orbital-sun position diagram are repeated after four rows of echomaps for the purpose of keeping one copy on the screen while scrolling down the page.

1.5 CDF Skeleton Table for Level-1 Plasmagram/Echomap Data

All instrument Level-1 data are stored in the Common Data Format (CDF). Converting of binary instrument data into CDF require specification of a CDF Skeleton Table which contains a comprehensive and detailed text description of all data items to be stored in the CDF. Then the CDF Skeleton Table is translated into a binary CDF file which contains all data structures ready to be "populated" with the instrument data.

This section contains a brief description of RPI CDF Skeleton Table. Full text of the Table is given in Appendix A for reference and additional information (e.g., detailed specifications of measurement units and default values).

CDF Skeleton Table consists of the following sections:

1. Global Scope Attributes
2. Time Reference
3. Spacecraft Position
4. RPI Program Settings
5. Other Ancillary Data
6. Detailed Plasmagram Dimensions
7. Detailed Plasmagram and Echomap Data
8. Thumbnail Plasmagram Dimensions
9. Thumbnail Plasmagram Data

1.5.1 Global Scope Attributes

The Global Scope Attributes section provides information on the data set as an entity. This is a standard part of all CDF Skeleton Tables helping automated management of the various CDF data file sets within the project. Refer to Appendix A for further details.

1.5.2 Time Reference

The Time Reference section contains times associated with the measurements, including:

1) **Epoch**: start time of the RPI measurement program run, in GMT;
2) **Duration_Msec***:* measurement program duration in msec.

1.5.3 Spacecraft Position

The Spacecraft position section includes standard information available from the s/c orbit file at SMOC:

1) **GSM_POSITION**: Spacecraft position vector in Geocentric Solar Magnetospheric (GSM) coordinate system, 3 components;
2) **GEO_POSITION**: Spacecraft position vector in geographic coordinates, 3 components;

3) **SM_POSITION**: Spacecraft position vector in Solar Magnetospheric (SM) coordinates, 3 components;
4) **Roll_Angle***:* Roll Angle to Magnetic North (the angle of rotation of the image field necessary to orient the North magnetic field at the top of the user's perspective).

1.5.4 RPI Program Settings

This section contains a list of all measurement program settings used to record the data presented in the CDF file. Refer to Table 4.3-1 and Section 1.5 for a more detailed description of RPI parameters.

1) **Mode**: Sounding mode;
2) **Waveform**: Signal waveform;
3) **Antennas**: Antenna System setting;
4) **Rep_Rate**: Pulse Repetition rate;
5) **Base_Gain**: Base gain;
6) **Freq_Search**: Frequency search;
7) **Peak_Power**: Peak power constraint.

1.5.5 Other Ancillary Data

This section includes:

1) **Quality_Flag**: Checksum error count provided by SMOC;
2) **Doppler Translation**: Doppler Translation Table containing Doppler shift frequencies in Hz corresponding to the Doppler Numbers stored in the plasmagram data.

1.5.6 Detailed Plasmagram Dimensions

The Detailed Plasmagram Dimensions section provides information necessary for plotting a Detailed Plasmagram and labeling its range and frequency axis.

1) **Start_Freq**: Start frequency in kHz;
2) **Num_Freqs**: Total number of operating frequencies;
3) **Freq_Step_Linear**: Frequency Step in Hz if a linear scale sweep is set, 0 otherwise;
4) **Freq_Step_Log**: Frequency Step in % if a logarithmic scale sweep is set, 0 otherwise;
5) **Frequency**: Array of frequency readings in kHz for each frequency bin of the plasmagram;
6) **Num_Ranges**: Total number of ranges;
7) **Range_Step**: Range step in km;
8) **Range_Start**: Start Range in km;
9) **Range**: Array of range readings in Re for each range bin of the plasmagram.

1.5.7 Detailed Plasmagram and Echomap Data

The Detailed Plasmagram and Echomap Data section contains 2D arrays of Amplitude, Polarization, Doppler number and Azimuth as functions of frequency and range. The size of arrays is allocated in anticipation of maximum possible size of detailed plasmagram, the display routine should refer to the Detailed Plasmagram Dimensions section for information on the actual number of ranges and frequencies containing data.

1) **Amplitude**: Amplitudes (0..15);
2) **Azimuth_XY**: Azimuth angle projections in XY plane (0..253) in 1.42 degree steps;
3) **Polarization**: Polarization signature [0..1];
4) **Doppler_Number**: Doppler shift frequency number (0..7), use Doppler Translation Table to convert to Hz.

1.5.8 Thumbnail Plasmagram Dimensions

The content of Thumbnail Plasmagram Dimensions section never changes and always corresponds to 142 log frequencies x 151 composite scale ranges described in Section 1.3.2.

1) **Num_Freqs_TN**: Total number of sounding frequencies;
2) **Frequency_TN**: Array of frequency readings in kHz for each frequency bin of the plasmagram;
3) **Num_Ranges_TN**: Total number of ranges;
4) **Range_TN**: Array of range readings in Re for each range bin of the plasmagram.

1.5.9 Thumbnail Plasmagram Data

The Thumbnail Plasmagram Data section contains 2D arrays of Amplitude and Polarization as functions of frequency and range. The size of arrays is fixed corresponding to the contents of the Thumbnail Plasmagram Dimensions section.

1) **Amplitude**: Amplitudes (0..15);
2) **Polarization**: Polarization signature [0..1];

2 Dynamic Spectrogram Level 1 Data (under construction)

Appendix A. RPI CDF Skeleton Table.

```
! Skeleton table for the "im_k0_rpi_00000000_v01" CDF.
! Generated: Wednesday, 7-Jan-1998 08:41:22
! CDF created/modified by CDF V2.6.6
! Skeleton table created by CDF V2.6.6

!
! HISTORY:
!              08-Jan-98   basics finished
!              14-Jan-98   skymap support added
!


#header

                       CDF NAME: im_k0_rpi_00000000_v01
                  DATA ENCODING: NETWORK
                       MAJORITY: COLUMN
                         FORMAT: SINGLE

! Variables  G.Attributes  V.Attributes  Records  Dims  Sizes
! ---------  ------------  ------------  -------  ----  -----
    0/13         11            16          0/z      0


#GLOBALattributes

! Attribute         Entry       Data
! Name              Number      Type       Value
! ---------         ------      ----       -----

  "PROJECT"             1:    CDF_UCHAR    { "IMAGE>Imager for " -
                                             "Magnetopause-to-Aurora " -
                                             "Global Exploration" } .

  "DISCIPLINE"          1:    CDF_UCHAR    { "Space " -
                                             "Physics>Magnetospheric " -
                                             "Science" } .

  "DESCRIPTOR"          1:    CDF_UCHAR    { "RPI>Radio Plasma " -
                                             "Imager" } .

  "PI_NAME"             1:    CDF_UCHAR    { "B.W. Reinisch" } .

  "PI_AFFILIATION"      1:    CDF_UCHAR    { "UMLCAR" } .

  "INSTRUMENT_TYPE"     1:    CDF_UCHAR    { "Imager" } .

  "DATA_TYPE"           1:    CDF_UCHAR    { "K0>Key Parameter" } .

  "DATA_VERSION"        1:    CDF_UCHAR    { "1" } .

  "TEXT"                1:    CDF_UCHAR    { "The logical_file_id stores" -
                                             " the name of the CDF file " -
                                             "using the ISTP naming " -
                                             "convention (source_name / " -
                                             "data_type / descriptor / " -
                                             "date / " -
                                             "data_version).im_k0_rpi_00" -
                                             "000000_v01" } .

  "LOGICAL_FILE_ID"     1:    CDF_UCHAR    { "im_k0_rpi_00000000_v01" } .
```

```
  "LOGICAL_SOURCE"      1:    CDF_UCHAR    { "im_k0_rpi" } .


#VARIABLEattributes

  "FIELDNAM"
  "VAR_TYPE"
  "DICT_KEY"
  "LABLAXIS"
  "FILLVAL"
  "FORMAT"
  "UNITS"
  "VALIDMIN"
  "VALIDMAX"
  "DELTA_PLUS_VAR"
  "DELTA_MINUS_VAR"
  "DEPEND_0"
  "DEPEND_1"
  "DEPEND_2"
  "LABL_PTR_1"
  "CATDESC"
  "VAR_NOTES"


#variables

! No rVariables.


#zVariables

!
!==================     T I M E S     ==================================
!

! Variable          Data      Number                 Record   Dimension
! Name              Type     Elements  Dims  Sizes  Variance  Variances
! --------          ----     --------  ----  -----  --------  ---------

  "Epoch"         CDF_EPOCH      1       0              T

  ! Attribute       Data
  ! Name            Type       Value
  ! --------        ----       -----

    "FIELDNAM"    CDF_UCHAR    { "Time Line" }
    "VAR_TYPE"    CDF_UCHAR    { "support_data" }
    "DICT_KEY"    CDF_UCHAR    { "time>epoch" }
    "LABLAXIS"    CDF_UCHAR    { "Epoch" }
    "FILLVAL"     CDF_DOUBLE   { -1.0e+31 }
    "FORMAT"      CDF_UCHAR    { "F16.1" }
    "UNITS"       CDF_UCHAR    { "ms" }
    "VALIDMIN"    CDF_FLOAT    { 01-Jan-1900 00:00:00.000 }
    "VALIDMAX"    CDF_FLOAT    { 01-Jan-2020 00:00:00.000 }
    "DELTA_PLUS_VAR"  CDF_CHAR { "Duration_Msec" }
    "CATDESC"     CDF_UCHAR    { "Plasmagram Time" }
    "VAR_NOTES"   CDF_UCHAR    { "The time in EPOCH refers to the beginning " -
                                 "of the plasmagram. Use Duration_Msec " -
                                 "to obtain stop time of the run." } .

  ! RV values were not requested.

! Variable          Data      Number                 Record   Dimension
! Name              Type     Elements  Dims  Sizes  Variance  Variances
! --------          ----     --------  ----  -----  --------  ---------

  "Duration_Msec"   CDF_REAL8   1       0              T

  ! Attribute       Data
  ! Name            Type       Value
```

```
  ! --------        ----       -----

    "FIELDNAM"    CDF_UCHAR    { "Measurement Duration" }
    "VAR_TYPE"    CDF_UCHAR    { "support_data" }
    "DICT_KEY"    CDF_UCHAR    { "time>range_absolute" }
    "LABLAXIS"    CDF_UCHAR    { "End" }
    "FILLVAL"     CDF_DOUBLE   { -1.0e+31 }
    "FORMAT"      CDF_UCHAR    { "F10.1" }
    "UNITS"       CDF_UCHAR    { "ms" }
    "VALIDMIN"    CDF_FLOAT    { 0.0 }
    "VALIDMAX"    CDF_FLOAT    { 1.8e+06 }
    "CATDESC"     CDF_UCHAR    { "Offset from Epoch time to " -
                                 "the end of the measurement run." }
    "DEPEND_0"    CDF_UCHAR    { "Epoch" }
    "VAR_NOTES"   CDF_UCHAR    { "Time in msec between start and " -
                                 "stop of the measurement run. " } .

  ! RV values were not requested.


!
!=========     S P A C E C R A F T     P O S I T I O N      ==============
!

! Variable          Data      Number                    Record   Dimension
! Name              Type     Elements  Dims  Sizes  Variance  Variances
! --------          ----     --------  ----  -----  --------  ---------

  "Roll_Angle"    CDF_REAL4      1       0              T

  ! Attribute       Data
  ! Name            Type       Value
  ! --------        ----       -----

    "FIELDNAM"    CDF_UCHAR    { "Roll Angle to Magnetic North" }
    "VAR_TYPE"    CDF_UCHAR    { "data" }
    "FILLVAL"     CDF_FLOAT    { -1.0e+31 }
    "FORMAT"      CDF_UCHAR    { "F8.4" }
    "UNITS"       CDF_UCHAR    { "Radians" }
    "VAR_NOTES"   CDF_UCHAR    { "Counter-clockwise defined to be the " -
                                 "positive direction.  Represents the " -
                                 "angle of rotation of the image field " -
                                 "necessary to orient the North magnetic" -
                                 " field at the top of the user's " -
                                 "perspective." } .

  ! RV values were not requested.


! Variable          Data      Number                    Record   Dimension
! Name              Type     Elements  Dims  Sizes  Variance  Variances
! --------          ----     --------  ----  -----  --------  ---------

  "GSM_POSITION"
                  CDF_REAL4      1       1     3        T         T

  ! Attribute       Data
  ! Name            Type       Value
  ! --------        ----       -----

    "FIELDNAM"    CDF_UCHAR    { "GSM Spacecraft Position Vector" }
    "VAR_TYPE"    CDF_UCHAR    { "data" }
    "DICT_KEY"    CDF_UCHAR    { "position>spacecraft_GSM" }
    "FILLVAL"     CDF_FLOAT    { -1.0e+31 }
    "FORMAT"      CDF_UCHAR    { "F8.1" }
    "UNITS"       CDF_UCHAR    { "km" }
    "VALIDMIN"    CDF_FLOAT    { -60000.0, -60000.0, -60000.0 }
    "VALIDMAX"    CDF_FLOAT    { 60000.0, 60000.0, 60000.0 }
    "DEPEND_0"    CDF_UCHAR    { "Epoch" }
    "DEPEND_1"    CDF_UCHAR    { "cartesian" }
```

```
    "LABL_PTR_1"
                  CDF_UCHAR    { "metavar0" }
    "CATDESC"     CDF_UCHAR    { "Spacecraft Position in GSM, 3 comp." }
    "VAR_NOTES"   CDF_UCHAR    { "GSM = gencentric solar magnetospheric " -
                                 "coordinates" } .

  ! RV values were not requested.


! Variable          Data      Number                    Record   Dimension
! Name              Type     Elements  Dims  Sizes  Variance  Variances
! --------          ----     --------  ----  -----  --------  ---------

  "GEO_POSITION"
                  CDF_REAL4      1       1     3        T         T

  ! Attribute       Data
  ! Name            Type       Value
  ! --------        ----       -----

    "FIELDNAM"    CDF_UCHAR    { "Geographic Spacecraft Position Vector" }
    "VAR_TYPE"    CDF_UCHAR    { "data" }
    "DICT_KEY"    CDF_UCHAR    { "position>spacecraft_Geo" }
    "FILLVAL"     CDF_FLOAT    { -1.0e+31 }
    "FORMAT"      CDF_UCHAR    { "F8.1" }
    "UNITS"       CDF_UCHAR    { "km" }
    "VALIDMIN"    CDF_FLOAT    { -60000.0, -60000.0, -60000.0 }
    "VALIDMAX"    CDF_FLOAT    { 60000.0, 60000.0, 60000.0 }
    "DEPEND_0"    CDF_UCHAR    { "Epoch" }
    "DEPEND_1"    CDF_UCHAR    { "cartesian" }
    "LABL_PTR_1"
                  CDF_UCHAR    { "metavar1" }
    "CATDESC"     CDF_UCHAR    { "Spacecraft Position in Geo, 3 comp." }
    "VAR_NOTES"   CDF_UCHAR    { "Geo = geographic coordinates" } .

  ! RV values were not requested.

! Variable          Data      Number                    Record   Dimension
! Name              Type     Elements  Dims  Sizes  Variance  Variances
! --------          ----     --------  ----  -----  --------  ---------

  "SM_POSITION"   CDF_REAL4      1       1     3        T         T

  ! Attribute       Data
  ! Name            Type       Value
  ! --------        ----       -----

    "FIELDNAM"    CDF_UCHAR    { "SM Spacecraft Position Vector" }
    "VAR_TYPE"    CDF_UCHAR    { "data" }
    "DICT_KEY"    CDF_UCHAR    { "position>spacecraft_SM" }
    "FILLVAL"     CDF_FLOAT    { -1.0e+31 }
    "FORMAT"      CDF_UCHAR    { "F8.1" }
    "UNITS"       CDF_UCHAR    { "km" }
    "VALIDMIN"    CDF_FLOAT    { -60000.0, -60000.0, -60000.0 }
    "VALIDMAX"    CDF_FLOAT    { 60000.0, 60000.0, 60000.0 }
    "DEPEND_0"    CDF_UCHAR    { "Epoch" }
    "DEPEND_1"    CDF_UCHAR    { "cartesian" }
    "LABL_PTR_1"
                  CDF_UCHAR    { "metavar2" }
    "CATDESC"     CDF_UCHAR    { "Spacecraft Position in SM, 3 comp." }
    "VAR_NOTES"   CDF_UCHAR    { "SM = solar magnetospheric coordinates" } .

  ! RV values were not requested.


! Variable          Data      Number                    Record   Dimension
! Name              Type     Elements  Dims  Sizes  Variance  Variances
! --------          ----     --------  ----  -----  --------  ---------

  "cartesian"     CDF_CHAR       1       1     3        F         T
```

```
  ! Attribute       Data
  ! Name            Type       Value
  ! --------        ----       -----

    "FIELDNAM"    CDF_UCHAR    { "Components in Cartesian Coord." }
    "VAR_TYPE"    CDF_UCHAR    { "metadata" }
    "DICT_KEY"    CDF_UCHAR    { "label>cartesian" }
    "CATDESC"     CDF_UCHAR    { "Components in Cartesian Coord." } .

  ! NRV values follow...

    [1] = { "x" }
    [2] = { "y" }
    [3] = { "z" }


! Variable          Data      Number                   Record   Dimension
! Name              Type     Elements  Dims  Sizes  Variance  Variances
! --------          ----     --------  ----  -----  --------  ---------

  "metavar0"      CDF_CHAR       7       1     3        F         T

  ! Attribute       Data
  ! Name            Type       Value
  ! --------        ----       -----

    "FIELDNAM"    CDF_UCHAR    { "metavar0" }
    "VAR_TYPE"    CDF_UCHAR    { "metadata" } .

  ! NRV values follow...

    [1] = { "X (GSM)" }
    [2] = { "Y (GSM)" }
    [3] = { "Z (GSM)" }


! Variable          Data      Number                   Record   Dimension
! Name              Type     Elements  Dims  Sizes  Variance  Variances
! --------          ----     --------  ----  -----  --------  ---------

  "metavar1"      CDF_CHAR       7       1     3        F         T

  ! Attribute       Data
  ! Name            Type       Value
  ! --------        ----       -----

    "FIELDNAM"    CDF_UCHAR    { "metavar1" }
    "VAR_TYPE"    CDF_UCHAR    { "metadata" } .

  ! NRV values follow...

    [1] = { "X (Geo)" }
    [2] = { "Y (Geo)" }
    [3] = { "Z (Geo)" }


! Variable          Data      Number                   Record   Dimension
! Name              Type     Elements  Dims  Sizes  Variance  Variances
! --------          ----     --------  ----  -----  --------  ---------

  "metavar2"      CDF_CHAR       6       1     3        F         T

  ! Attribute       Data
  ! Name            Type       Value
  ! --------        ----       -----

    "FIELDNAM"    CDF_UCHAR    { "metavar2" }
    "VAR_TYPE"    CDF_UCHAR    { "metadata" } .
```

```
  ! NRV values follow...

    [1] = { "X (SM)" }
    [2] = { "Y (SM)" }
    [3] = { "Z (SM)" }


!
!=========     R P I   P R O G R A M   S E T T I N G S     ==================
!

! Variable          Data      Number                    Record   Dimension
! Name              Type     Elements  Dims  Sizes  Variance  Variances
! --------          ----     --------  ----  -----  --------  ---------

  "Mode"          CDF_BYTE      1       0             T

  ! Attribute       Data
  ! Name            Type       Value
  ! --------        ----       -----

    "FIELDNAM"    CDF_UCHAR    { "Operating Mode" }
    "VAR_TYPE"    CDF_UCHAR    { "support_data" }
    "FILLVAL"     CDF_BYTE     { -128 }
    "FORMAT"      CDF_UCHAR    { "I2" }
    "UNITS"       CDF_UCHAR    { "n/a" }
    "VALIDMIN"    CDF_BYTE     { 1 }
    "VALIDMAX"    CDF_BYTE     { 5 }
    "DEPEND_0"    CDF_UCHAR    { "Epoch" }
    "VAR_NOTES"   CDF_UCHAR    { "1= Calibration, " -
                                 "2= Sounding, " -
                                 "3= Thermal Noise, " -
                                 "4= Relaxation, " -
                                 "5= Whistler." } .

  ! RV values were not requested.

! Variable          Data      Number                    Record   Dimension
! Name              Type     Elements  Dims  Sizes  Variance  Variances
! --------          ----     --------  ----  -----  --------  ---------

  "Waveform"       CDF_BYTE      1       0             T

  ! Attribute       Data
  ! Name            Type       Value
  ! --------        ----       -----

    "FIELDNAM"    CDF_UCHAR    { "Operating Mode" }
    "VAR_TYPE"    CDF_UCHAR    { "support_data" }
    "FILLVAL"     CDF_BYTE     { -128 }
    "FORMAT"      CDF_UCHAR    { "I2" }
    "UNITS"       CDF_UCHAR    { "n/a" }
    "VALIDMIN"    CDF_BYTE     { -5 }
    "VALIDMAX"    CDF_BYTE     { 5 }
    "DEPEND_0"    CDF_UCHAR    { "Epoch" }
    "VAR_NOTES"   CDF_UCHAR    { "1= Complimentary, " -
                                 "2= FM Chirp, " -
                                 "3= Staggered Pulse Sequence, " -
                                 "4= Long Pulse, " -
                                 "5= Short Pulse. " -
                                 "Negative number means no phase switching " -
                                 "is done between repetitions. " } .

  ! RV values were not requested.

! Variable          Data      Number                    Record   Dimension
! Name              Type     Elements  Dims  Sizes  Variance  Variances
! --------          ----     --------  ----  -----  --------  ---------

  "Antennas"      CDF_BYTE      1       0             T
```

```
  ! Attribute       Data
  ! Name            Type       Value
  ! --------        ----       -----

    "FIELDNAM"    CDF_UCHAR    { "Antenna System Setting" }
    "VAR_TYPE"    CDF_UCHAR    { "support_data" }
    "FILLVAL"     CDF_BYTE     { -128 }
    "FORMAT"      CDF_UCHAR    { "I2" }
    "UNITS"       CDF_UCHAR    { "n/a" }
    "VALIDMIN"    CDF_BYTE     { -7 }
    "VALIDMAX"    CDF_BYTE     { 7 }
    "DEPEND_0"    CDF_UCHAR    { "Epoch" }
    "VAR_NOTES"   CDF_UCHAR    { "1= Radio Silence (no Tx), " -
                                 "2= X antenna only, " -
                                 "3= Y antenna only, " -
                                 "4= X+Y Linear polarization, " -
                                 "5= X+Y Right Circular Polarization, " -
                                 "6= X+Y Left Circular Polarization, " -
                                 "7= X+Y Right/Left Alternated, "  -
                                 "negative means antenna coupler bypass." } .

  ! RV values were not requested.

! Variable          Data      Number                   Record   Dimension
! Name              Type     Elements  Dims  Sizes  Variance  Variances
! --------          ----     --------  ----  -----  --------  ---------

  "Rep_Rate"      CDF_BYTE      1       0              T

  ! Attribute       Data
  ! Name            Type       Value
  ! --------        ----       -----

    "FIELDNAM"    CDF_UCHAR    { "Pulse Repetition Rate" }
    "VAR_TYPE"    CDF_UCHAR    { "support_data" }
    "FILLVAL"     CDF_BYTE     { -128 }
    "FORMAT"      CDF_UCHAR    { "I2" }
    "UNITS"       CDF_UCHAR    { "n/a" }
    "VALIDMIN"    CDF_BYTE     { 0 }
    "VALIDMAX"    CDF_BYTE     { 4 }
    "DEPEND_0"    CDF_UCHAR    { "Epoch" }
    "VAR_NOTES"   CDF_UCHAR    { "0= 0.5 pps (1 pulse every 2 sec), " -
                                 "1= 1 pps, " -
                                 "2= 2 pps, " -
                                 "4= 4 pps. " } .

  ! RV values were not requested.

! Variable          Data      Number                   Record   Dimension
! Name              Type     Elements  Dims  Sizes  Variance  Variances
! --------          ----     --------  ----  -----  --------  ---------

  "Base_Gain"     CDF_BYTE      1       0              T

  ! Attribute       Data
  ! Name            Type       Value
  ! --------        ----       -----

    "FIELDNAM"    CDF_UCHAR    { "Base Gain" }
    "VAR_TYPE"    CDF_UCHAR    { "support_data" }
    "FILLVAL"     CDF_BYTE     { -128 }
    "FORMAT"      CDF_UCHAR    { "I2" }
    "UNITS"       CDF_UCHAR    { "n/a" }
    "VALIDMIN"    CDF_BYTE     { -7 }
    "VALIDMAX"    CDF_BYTE     { 7 }
    "DEPEND_0"    CDF_UCHAR    { "Epoch" }
    "VAR_NOTES"   CDF_UCHAR    { "0= fixed gain,  0 dB attenuation, " -
                                 "1= fixed gain,  9 dB attenuation, " -
                                 "2= fixed gain, 18 dB attenuation, " -
```

```
                                   "3= fixed gain, 27 dB attenuation, " -
                                   "4= fixed gain, 36 dB attenuation, " -
                                   "5= fixed gain, 45 dB attenuation, " -
                                   "6= fixed gain, 63 dB attenuation, " -
                                   "7= fixed gain, 70 dB attenuation, " -
                                   "-3= auto gain, 27 dB base attenuation, " -
                                   "-4= auto gain, 36 dB base attenuation, " -
                                   "-5= auto gain, 45 dB base attenuation, " -
                                   "-6= auto gain, 63 dB base attenuation, " -
                                   "-7= auto gain, 70 dB base attenuation . "} .

  ! RV values were not requested.

! Variable          Data      Number                   Record   Dimension
! Name              Type     Elements  Dims  Sizes  Variance  Variances
! --------          ----     --------  ----  -----  --------  ---------

  "Freq_Search"   CDF_BYTE      1       0              T

  ! Attribute       Data
  ! Name            Type       Value
  ! --------        ----       -----

    "FIELDNAM"    CDF_UCHAR    { "Frequency Search Enabled" }
    "VAR_TYPE"    CDF_UCHAR    { "support_data" }
    "FILLVAL"     CDF_BYTE     { -128 }
    "FORMAT"      CDF_UCHAR    { "I2" }
    "UNITS"       CDF_UCHAR    { "n/a" }
    "VALIDMIN"    CDF_BYTE     { 0 }
    "VALIDMAX"    CDF_BYTE     { 1 }
    "DEPEND_0"    CDF_UCHAR    { "Epoch" }
    "VAR_NOTES"   CDF_UCHAR    { "0= Search of quiet frequency disabled, " -
                                 "1= Search of quiet frequency enabled. " } .

  ! RV values were not requested.

! Variable          Data      Number                   Record   Dimension
! Name              Type     Elements  Dims  Sizes  Variance  Variances
! --------          ----     --------  ----  -----  --------  ---------

  "Peak_Power"    CDF_INT2      1       0              T

  ! Attribute       Data
  ! Name            Type       Value
  ! --------        ----       -----

    "FIELDNAM"    CDF_UCHAR    { "Peak Power Constraint" }
    "VAR_TYPE"    CDF_UCHAR    { "support_data" }
    "FILLVAL"     CDF_INT2     { -32768 }
    "FORMAT"      CDF_UCHAR    { "I3" }
    "UNITS"       CDF_UCHAR    { "Watts" }
    "VALIDMIN"    CDF_INT2     { 0 }
    "VALIDMAX"    CDF_INT2     { 250 }
    "DEPEND_0"    CDF_UCHAR    { "Epoch" }
    "VAR_NOTES"   CDF_UCHAR    { "Total RPI Peak Power Consumption Constraint. "
} .

  ! RV values were not requested.


!
!=============    O T H E R   A N C I L L A R Y   D A T A    ===============
!

! Variable          Data      Number                   Record   Dimension
! Name              Type     Elements  Dims  Sizes  Variance  Variances
! --------          ----     --------  ----  -----  --------  ---------

  "Quality_Flag"    CDF_INT4      1       0              T
```

```
  ! Attribute       Data
  ! Name            Type       Value
  ! --------        ----       -----

    "FIELDNAM"    CDF_UCHAR    { "Quality Flag" }
    "VAR_TYPE"    CDF_UCHAR    { "support_data" }
    "FILLVAL"     CDF_INT4     { -2147483648 }
    "FORMAT"      CDF_UCHAR    { "I10" }
    "UNITS"       CDF_UCHAR    { " " }
    "VALIDMIN"    CDF_INT4     { 0 }
    "VALIDMAX"    CDF_INT4     { 2147483648 }
    "DEPEND_0"    CDF_UCHAR    { "Epoch" }
    "VAR_NOTES"   CDF_UCHAR    { "TBD" } .

  ! RV values were not requested.


! Variable                Data      Number                 Record   Dimension
! Name                    Type     Elements  Dims  Sizes  Variance  Variances
! --------                ----     --------  ----  -----  --------  ---------

  "DopplerTranslation"  CDF_REAL4      1       1    8       T         T

  ! Attribute       Data
  ! Name            Type       Value
  ! --------        ----       -----

    "FIELDNAM"    CDF_UCHAR    { "Doppler Translation" }
    "UNITS"       CDF_UCHAR    { "Hz"}
    "FILLVAL"     CDF_REAL4    { -1.0e+31 }
    "FORMAT"      CDF_UCHAR    { "F8.1" }
    "VALIDMIN"    CDF_REAL4    { 0.0 }
    "VALIDMAX"    CDF_REAL4    { 200.0 }
    "DEPEND_0"    CDF_UCHAR    { "Epoch" }
    "DEPEND_1"    CDF_UCHAR    { "Doppler_Number"}
    "VAR_TYPE"    CDF_UCHAR    { "support_data" }
    "VAR_NOTES"   CDF_UCHAR    { "Translates Doppler_Number to an actual " -
                                 "Doppler Frequency. The entries are " -
                                 " calculated from program parameters. "} .

  ! NO NRV values follow...


!
!=====    D E T A I L E D   P L A S M A G R A M    D I M E N S I O N S   ===============
!

!
! Two types of plasmagrams are available: "detailed" and "thumbnail".
!
! Thumbnail plusmagram pictures are always 151x142 with a
! fixed range and frequency axis.
!
! Detailed plasmagram pictures have variable frequency and range axis.
! They may have linear or logarithmic frequency scale, various
! start and stop frequencies, and 128 or 256 ranges.
!
! CDF format requires a fixed array size (the largest
! possible). The rest (unused) area of the detailed plasmagram
! is filled with default values
!

! Variable          Data      Number                 Record   Dimension
! Name              Type     Elements  Dims  Sizes  Variance  Variances
! --------          ----     --------  ----  -----  --------  ---------

  "Start_Freq"     CDF_INT2      1      0              T

  ! Attribute       Data
  ! Name            Type       Value
```

```
  ! --------        ----       -----

    "FIELDNAM"    CDF_UCHAR    { "Start Frequency" }
    "VAR_TYPE"    CDF_UCHAR    { "support_data" }
    "FILLVAL"     CDF_DOUBLE   { -32768 }
    "FORMAT"      CDF_UCHAR    { "I6" }
    "UNITS"       CDF_UCHAR    { "kHz" }
    "VALIDMIN"    CDF_INT2     { 3 }
    "VALIDMAX"    CDF_INT2     { 3000 }
    "CATDESC"     CDF_UCHAR    { "Start Frequency" }
    "VAR_NOTES"   CDF_UCHAR    { " " } .

  ! RV values were not requested.

! Variable          Data      Number                  Record   Dimension
! Name              Type     Elements  Dims  Sizes  Variance  Variances
! --------          ----     --------  ----  -----  --------  ---------

  "Num_Freqs"      CDF_INT2     1       0              T

  ! Attribute       Data
  ! Name            Type       Value
  ! --------        ----       -----

    "FIELDNAM"    CDF_UCHAR    { "Number of Frequencies" }
    "VAR_TYPE"    CDF_UCHAR    { "support_data" }
    "FILLVAL"     CDF_DOUBLE   { -32768 }
    "FORMAT"      CDF_UCHAR    { "I4" }
    "UNITS"       CDF_UCHAR    { "n/a" }
    "VALIDMIN"    CDF_INT2     { 10 }
    "VALIDMAX"    CDF_INT2     { 142 }
    "CATDESC"     CDF_UCHAR    { "Number of Frequencies" }
    "VAR_NOTES"   CDF_UCHAR    { "Detailed plasmagram picture has the original number of
freqs " -
                                 "as specified by RPI measurement parameters. " -
                                 "Frequency axis varies from plasmagram to plasmagram. " -
                                 "Plasmagram *thumbnails* have a fixed frequency axis. " -
                                 "The original plasmagram data often requires transformation
" -
                                 "into thumbnail format by averaging. " } .

  ! RV values were not requested.


! Variable          Data      Number                  Record   Dimension
! Name              Type     Elements  Dims  Sizes  Variance  Variances
! --------          ----     --------  ----  -----  --------  ---------

  "Freq_Step_Linear"   CDF_INT2   1     0              T

  ! Attribute       Data
  ! Name            Type       Value
  ! --------        ----       -----

    "FIELDNAM"    CDF_UCHAR    { "Frequency Step, Linear scale" }
    "VAR_TYPE"    CDF_UCHAR    { "support_data" }
    "FILLVAL"     CDF_DOUBLE   { -32768 }
    "FORMAT"      CDF_UCHAR    { "I6" }
    "UNITS"       CDF_UCHAR    { "Hz" }
    "VALIDMIN"    CDF_INT2     { 100 }
    "VALIDMAX"    CDF_INT2     { 10000 }
    "CATDESC"     CDF_UCHAR    { "Frequency Step, Linear scale" }
    "VAR_NOTES"   CDF_UCHAR    { "There are two ways RPI sweeps frequencies: " -
                                 "Linear and Logarithmic scale. " -
                                 "This parameter valid if linear scale set " -
                                 "for the plasmagram. " } .

  ! RV values were not requested.
```

```
! Variable          Data      Number                    Record   Dimension
! Name              Type     Elements  Dims  Sizes  Variance  Variances
! --------          ----     --------  ----  -----  --------  ---------

  "Freq_Step_Log"  CDF_INT2     1       0              T

  ! Attribute       Data
  ! Name            Type       Value
  ! --------        ----       -----

    "FIELDNAM"    CDF_UCHAR    { "Plasmagram Frequency Step, Logarithmic" }
    "VAR_TYPE"    CDF_UCHAR    { "support_data" }
    "FILLVAL"     CDF_DOUBLE   { -32768 }
    "FORMAT"      CDF_UCHAR    { "I6" }
    "UNITS"       CDF_UCHAR    { "%" }
    "VALIDMIN"    CDF_INT2     { 1 }
    "VALIDMAX"    CDF_INT2     { 10 }
    "CATDESC"     CDF_UCHAR    { "Plasmagram Frequency Step, Logarithmic" }
    "VAR_NOTES"   CDF_UCHAR    { "There are two ways RPI sweeps frequencies: " -
                                 "Linear and Logarithmic scale. " -
                                 "This parameter valid if logarithmic scale is set " -
                                 "for the plasmagram. " } .

  ! RV values were not requested.


! Variable          Data      Number                    Record   Dimension
! Name              Type     Elements  Dims  Sizes  Variance  Variances
! --------          ----     --------  ----  -----  --------  ---------

  "Frequency"    CDF_REAL4       1       1    142       F         T

  ! Attribute       Data
  ! Name            Type       Value
  ! --------        ----       -----

    "FIELDNAM"    CDF_UCHAR    { "Frequency" }
    "LABLAXIS"    CDF_UCHAR    { "Frequency" }
    "UNITS"       CDF_UCHAR    { "kHz"}
    "FILLVAL"     CDF_REAL4    { -1.0e+31 }
    "FORMAT"      CDF_UCHAR    { "F7.2" }
    "VALIDMIN"    CDF_FLOAT    { 3.0 }
    "VALIDMAX"    CDF_FLOAT    { 3000.0 }
    "VAR_TYPE"    CDF_UCHAR    { "support_data" }
    "VAR_NOTES"   CDF_UCHAR    { "Frequency readings for full picture
plasmagram." -
                                 "Calculated for all Num_Freq frequencies." } .

  ! NRV values follow...

   [1] = 3.00
   [2] = 3.15
   [3] = 3.31
   [4] = 3.47
   [5] = 3.65
   [6] = 3.83
   [7] = 4.02
   [8] = 4.22
   [9] = 4.43
   [10] = 4.65
   [11] = 4.89
   [12] = 5.13
   [13] = 5.39
   [14] = 5.66
   [15] = 5.94
   [16] = 6.24
   [17] = 6.55
   [18] = 6.88
   [19] = 7.22
   [20] = 7.58
```

```
[21] = 7.96
[22] = 8.36
[23] = 8.78
[24] = 9.21
[25] = 9.68
[26] = 10.16
[27] = 10.67
[28] = 11.20
[29] = 11.76
[30] = 12.35
[31] = 12.97
[32] = 13.61
[33] = 14.29
[34] = 15.01
[35] = 15.76
[36] = 16.55
[37] = 17.38
[38] = 18.24
[39] = 19.16
[40] = 20.11
[41] = 21.12
[42] = 22.18
[43] = 23.28
[44] = 24.45
[45] = 25.67
[46] = 26.96
[47] = 28.30
[48] = 29.72
[49] = 31.20
[50] = 32.76
[51] = 34.40
[52] = 36.12
[53] = 37.93
[54] = 39.82
[55] = 41.82
[56] = 43.91
[57] = 46.10
[58] = 48.41
[59] = 50.83
[60] = 53.37
[61] = 56.04
[62] = 58.84
[63] = 61.78
[64] = 64.87
[65] = 68.11
[66] = 71.52
[67] = 75.10
[68] = 78.85
[69] = 82.79
[70] = 86.93
[71] = 91.28
[72] = 95.84
[73] = 100.64
[74] = 105.67
[75] = 110.95
[76] = 116.50
[77] = 122.32
[78] = 128.44
[79] = 134.86
[80] = 141.60
[81] = 148.68
[82] = 156.12
[83] = 163.92
[84] = 172.12
[85] = 180.73
[86] = 189.76
[87] = 199.25
[88] = 209.21
[89] = 219.67
[90] = 230.66
```

```
  [91] = 242.19
  [92] = 254.30
  [93] = 267.02
  [94] = 280.37
  [95] = 294.38
  [96] = 309.10
  [97] = 324.56
  [98] = 340.79
  [99] = 357.83
  [100] = 375.72
  [101] = 394.50
  [102] = 414.23
  [103] = 434.94
  [104] = 456.69
  [105] = 479.52
  [106] = 503.50
  [107] = 528.67
  [108] = 555.11
  [109] = 582.86
  [110] = 612.00
  [111] = 642.61
  [112] = 674.74
  [113] = 708.47
  [114] = 743.90
  [115] = 781.09
  [116] = 820.15
  [117] = 861.15
  [118] = 904.21
  [119] = 949.42
  [120] = 996.89
  [121] = 1046.74
  [122] = 1099.07
  [123] = 1154.03
  [124] = 1211.73
  [125] = 1272.31
  [126] = 1335.93
  [127] = 1402.73
  [128] = 1472.86
  [129] = 1546.51
  [130] = 1623.83
  [131] = 1705.02
  [132] = 1790.27
  [133] = 1879.79
  [134] = 1973.78
  [135] = 2072.47
  [136] = 2176.09
  [137] = 2284.89
  [138] = 2399.14
  [139] = 2519.09
  [140] = 2645.05
  [141] = 2777.30
  [142] = 2916.17

!
! Variable          Data      Number                     Record   Dimension
! Name              Type     Elements  Dims  Sizes  Variance  Variances
! --------          ----     --------  ----  -----  --------  ---------

  "Num_Ranges"     CDF_INT2     1       0              F

  ! Attribute       Data
  ! Name            Type       Value
  ! --------        ----       -----

    "FIELDNAM"    CDF_UCHAR    { "Number of Ranges" }
    "VAR_TYPE"    CDF_UCHAR    { "support_data" }
    "FILLVAL"     CDF_DOUBLE   { -32768 }
    "FORMAT"      CDF_UCHAR    { "I4" }
    "UNITS"       CDF_UCHAR    { "n/a" }
    "CATDESC"     CDF_UCHAR    { "Number of Ranges" }
```

```
    "VAR_NOTES"   CDF_UCHAR    { "Number of Ranges, depending on " -
                                 "program setting (128 or 256). " } .
  ! NRV value follow...

   1:[] = 151

! Variable          Data      Number                    Record   Dimension
! Name              Type     Elements  Dims  Sizes  Variance  Variances
! --------          ----     --------  ----  -----  --------  ---------

  "Range_Step"    CDF_INT2        1     0             F

  ! Attribute       Data
  ! Name            Type       Value
  ! --------        ----       -----

    "FIELDNAM"    CDF_UCHAR    { "Range Step" }
    "VAR_TYPE"    CDF_UCHAR    { "support_data" }
    "FILLVAL"     CDF_DOUBLE   { -32768 }
    "FORMAT"      CDF_UCHAR    { "I6" }
    "UNITS"       CDF_UCHAR    { "km" }
    "VALIDMIN"    CDF_INT2     { 240 }
    "VALIDMAX"    CDF_INT2     { 480 }
    "CATDESC"     CDF_UCHAR    { "Range Step" }
    "VAR_NOTES"   CDF_UCHAR    { "240 or 480 km, depending on program. " } .

  ! NRV values follow...

   1:[] = 480

! Variable          Data      Number                    Record   Dimension
! Name              Type     Elements  Dims  Sizes  Variance  Variances
! --------          ----     --------  ----  -----  --------  ---------

  "Range_Start"   CDF_INT2        1     0             F

  ! Attribute       Data
  ! Name            Type       Value
  ! --------        ----       -----

    "FIELDNAM"    CDF_UCHAR    { "Starting Range" }
    "VAR_TYPE"    CDF_UCHAR    { "support_data" }
    "FILLVAL"     CDF_DOUBLE   { -32768 }
    "FORMAT"      CDF_UCHAR    { "I6" }
    "UNITS"       CDF_UCHAR    { "1000 km" }
    "VALIDMIN"    CDF_INT2     { 0 }
    "VALIDMAX"    CDF_INT2     { 255 }
    "CATDESC"     CDF_UCHAR    { "Starting Range" }
    "VAR_NOTES"   CDF_UCHAR    { "Starting Range in Mm, depending on program. "
} .

  ! NRV values follow...

   1:[] = 0

! Variable          Data      Number                    Record   Dimension
! Name              Type     Elements  Dims  Sizes  Variance  Variances
! --------          ----     --------  ----  -----  --------  ---------

  "Range"        CDF_REAL4      1       1    151       F         T

  ! Attribute       Data
  ! Name            Type       Value
  ! --------        ----       -----

    "FIELDNAM"    CDF_UCHAR    { "Virtual Range" }
    "LABLAXIS"    CDF_UCHAR    { "Virtual Range" }
    "UNITS"       CDF_UCHAR    { "Re"}
    "FILLVAL"     CDF_REAL4    { -1.0e+31 }
    "FORMAT"      CDF_UCHAR    { "F6.2" }
```

```
  "VALIDMIN"    CDF_FLOAT    { 0.0 }
  "VALIDMAX"    CDF_FLOAT    { 50.0 }
  "VAR_TYPE"    CDF_UCHAR    { "support_data" }
  "VAR_NOTES"   CDF_UCHAR    { "Range readings for the detailed " -
                               "plasmagram, in Earth radii. " } .

! NRV values follow...

 [1] = 0.00
 [2] = 0.08
 [3] = 0.15
 [4] = 0.23
 [5] = 0.30
 [6] = 0.38
 [7] = 0.45
 [8] = 0.53
 [9] = 0.60
 [10] = 0.68
 [11] = 0.75
 [12] = 0.83
 [13] = 0.90
 [14] = 0.98
 [15] = 1.05
 [16] = 1.13
 [17] = 1.21
 [18] = 1.28
 [19] = 1.36
 [20] = 1.43
 [21] = 1.51
 [22] = 1.58
 [23] = 1.66
 [24] = 1.73
 [25] = 1.81
 [26] = 1.88
 [27] = 1.96
 [28] = 2.03
 [29] = 2.11
 [30] = 2.18
 [31] = 2.26
 [32] = 2.34
 [33] = 2.41
 [34] = 2.49
 [35] = 2.56
 [36] = 2.64
 [37] = 2.71
 [38] = 2.79
 [39] = 2.86
 [40] = 2.94
 [41] = 3.01
 [42] = 3.09
 [43] = 3.16
 [44] = 3.24
 [45] = 3.32
 [46] = 3.39
 [47] = 3.47
 [48] = 3.54
 [49] = 3.62
 [50] = 3.69
 [51] = 3.77
 [52] = 3.84
 [53] = 3.92
 [54] = 3.99
 [55] = 4.07
 [56] = 4.14
 [57] = 4.22
 [58] = 4.29
 [59] = 4.37
 [60] = 4.45
 [61] = 4.52
 [62] = 4.60
```

```
[63] = 4.67
[64] = 4.75
[65] = 4.82
[66] = 4.90
[67] = 4.97
[68] = 5.05
[69] = 5.12
[70] = 5.20
[71] = 5.27
[72] = 5.35
[73] = 5.42
[74] = 5.50
[75] = 5.58
[76] = 5.65
[77] = 5.73
[78] = 5.80
[79] = 5.88
[80] = 5.95
[81] = 6.03
[82] = 6.10
[83] = 6.18
[84] = 6.25
[85] = 6.33
[86] = 6.40
[87] = 6.48
[88] = 6.55
[89] = 6.63
[90] = 6.71
[91] = 6.78
[92] = 6.86
[93] = 6.93
[94] = 7.01
[95] = 7.08
[96] = 7.16
[97] = 7.23
[98] = 7.31
[99] = 7.38
[10] = 7.46
[101] = 7.53
[102] = 7.61
[103] = 7.68
[104] = 7.76
[105] = 7.84
[106] = 7.91
[107] = 7.99
[108] = 8.06
[109] = 8.14
[110] = 8.21
[111] = 8.29
[112] = 8.36
[113] = 8.44
[114] = 8.51
[115] = 8.59
[116] = 8.66
[117] = 8.74
[118] = 8.81
[119] = 8.89
[120] = 8.97
[121] = 9.04
[122] = 9.12
[123] = 9.19
[124] = 9.27
[125] = 9.34
[126] = 9.42
[127] = 9.49
[128] = 9.57
[129] = 10.00
[130] = 10.50
[131] = 11.03
[132] = 11.58
```

```
   [133] = 12.16
   [134] = 12.76
   [135] = 13.40
   [136] = 14.07
   [137] = 14.77
   [138] = 15.51
   [139] = 16.29
   [140] = 17.10
   [141] = 17.96
   [142] = 18.86
   [143] = 19.80
   [144] = 20.79
   [145] = 21.83
   [146] = 22.92
   [147] = 24.07
   [148] = 25.27
   [149] = 26.53
   [150] = 27.86
   [151] = 29.25


!
!=========   S K Y M A P   A N D   P L A S M A G R A M    D A T A   ==============
!

! Variable          Data      Number                    Record   Dimension
! Name              Type     Elements  Dims   Sizes   Variance  Variances
! --------          ----     --------  ----  -------  --------  ---------

  "Amplitude"    CDF_BYTE       1       2    151 142      T        T T

  ! Attribute       Data
  ! Name            Type       Value
  ! --------        ----       -----

    "FIELDNAM"    CDF_UCHAR    { "Echo Amplitude" }
    "VAR_TYPE"    CDF_UCHAR    { "data" }
    "FILLVAL"     CDF_BYTE     { -128 }
    "UNITS"       CDF_UCHAR    { "6db" }
    "VALIDMIN"    CDF_BYTE     { 0 }
    "VALIDMAX"    CDF_BYTE     { 15 }
    "DEPEND_0"    CDF_UCHAR    { "Epoch" }
    "DEPEND_1"    CDF_UCHAR    { "Range" }
    "DEPEND_2"    CDF_UCHAR    { "Frequency" }
    "CATDESC"     CDF_UCHAR    { "Echo Amplitude"}
    "VAR_NOTES"   CDF_UCHAR    { "TBD"} .

  ! RV values were not requested.

! Variable          Data      Number                    Record   Dimension
! Name              Type     Elements  Dims   Sizes   Variance  Variances
! --------          ----     --------  ----  -------  --------  ---------

  "Azimuth_XY"    CDF_UINT1      1       2   151 142      T        T T

  ! Attribute       Data
  ! Name            Type       Value
  ! --------        ----       -----

    "FIELDNAM"    CDF_UCHAR    { "Echo Azimuth in XY plane" }
    "VAR_TYPE"    CDF_UCHAR    { "data" }
    "FILLVAL"     CDF_UINT1    { 255 }
    "UNITS"       CDF_UCHAR    { "1.42 deg." }
    "VALIDMIN"    CDF_UINT1    { 0 }
    "VALIDMAX"    CDF_UINT1    { 253 }
    "DEPEND_0"    CDF_UCHAR    { "Epoch" }
    "DEPEND_1"    CDF_UCHAR    { "Range" }
    "DEPEND_2"    CDF_UCHAR    { "Frequency" }
    "CATDESC"     CDF_UCHAR    { "Echo Azimuth in XY plane"}
    "VAR_NOTES"   CDF_UCHAR    { "Values 0 to 253 cover 0 to 359 degrees" } .
```

```
  ! RV values were not requested.

! Variable          Data      Number                     Record   Dimension
! Name              Type     Elements  Dims   Sizes   Variance  Variances
! --------          ----     --------  ----  -------  --------  ---------

  "Polarization"   CDF_BYTE     1       2    151 142      T        T T

  ! Attribute       Data
  ! Name            Type       Value
  ! --------        ----       -----

    "FIELDNAM"    CDF_UCHAR    { "Echo Polarization" }
    "VAR_TYPE"    CDF_UCHAR    { "data" }
    "FILLVAL"     CDF_BYTE     { -128 }
    "UNITS"       CDF_UCHAR    { "n/a" }
    "VALIDMIN"    CDF_BYTE     { 0 }
    "VALIDMAX"    CDF_BYTE     { 1 }
    "DEPEND_0"    CDF_UCHAR    { "Epoch" }
    "DEPEND_1"    CDF_UCHAR    { "Range" }
    "DEPEND_2"    CDF_UCHAR    { "Frequency" }
    "CATDESC"     CDF_UCHAR    { "0=Ordinary,1=Extraordinary"} .

  ! RV values were not requested.

! Variable          Data      Number                     Record   Dimension
! Name              Type     Elements  Dims   Sizes   Variance  Variances
! --------          ----     --------  ----  -------  --------  ---------

  "Doppler_Number" CDF_BYTE     1       2   151 142      T        T T

  ! Attribute       Data
  ! Name            Type       Value
  ! --------        ----       -----

    "FIELDNAM"    CDF_UCHAR    { "Echo Doppler Number" }
    "VAR_TYPE"    CDF_UCHAR    { "data" }
    "FILLVAL"     CDF_BYTE     { -1.0e+31 }
    "UNITS"       CDF_UCHAR    { "steps" }
    "VALIDMIN"    CDF_BYTE     { 0 }
    "VALIDMAX"    CDF_BYTE     { 7 }
    "DEPEND_0"    CDF_UCHAR    { "Epoch" }
    "DEPEND_1"    CDF_UCHAR    { "Range" }
    "DEPEND_2"    CDF_UCHAR    { "Frequency" }
    "CATDESC"     CDF_UCHAR    { "Echo Doppler Number"}
    "VAR_NOTES"   CDF_UCHAR    { "TBD"} .

  ! RV values were not requested.

!
!========   T H U M B N A I L    P L A S M A G R A M   D I M E N S I O N S   ============
!
! Always fixed!
!

! Variable          Data      Number                   Record   Dimension
! Name              Type     Elements  Dims  Sizes  Variance  Variances
! --------          ----     --------  ----  -----  --------  ---------

  "Num_Freqs_TN"   CDF_INT2     1       0              F

  ! Attribute       Data
  ! Name            Type       Value
  ! --------        ----       -----

    "FIELDNAM"    CDF_UCHAR    { "Number of Plasmagram Thumbnail Frequencies" }
    "VAR_TYPE"    CDF_UCHAR    { "support_data" }
    "FILLVAL"     CDF_DOUBLE   { -32768 }
    "FORMAT"      CDF_UCHAR    { "I4" }
```

```
    "UNITS"       CDF_UCHAR    { "n/a" }
    "CATDESC"     CDF_UCHAR    { "Number of Plasmagram Thumbnail Frequencies" }
    "VAR_NOTES"   CDF_UCHAR    { "142 log scale frequencies " -
                                 "from 3 kHz to 3000 kHz. " -
                                 "Frequency axis is fixed for thumbnails." } .
  ! NRV value follow...

    1:[] = 142


! Variable          Data      Number                  Record   Dimension
! Name              Type     Elements  Dims  Sizes  Variance  Variances
! --------          ----     --------  ----  -----  --------  ---------

  "Frequency_TN"   CDF_REAL4    1       1    142       F         T

  ! Attribute       Data
  ! Name            Type       Value
  ! --------        ----       -----

    "FIELDNAM"    CDF_UCHAR    { "Frequency TN" }
    "LABLAXIS"    CDF_UCHAR    { "Frequency" }
    "UNITS"       CDF_UCHAR    { "kHz"}
    "FILLVAL"     CDF_REAL4    { -1.0e+31 }
    "FORMAT"      CDF_UCHAR    { "F7.2" }
    "VALIDMIN"    CDF_FLOAT    { 3.0 }
    "VALIDMAX"    CDF_FLOAT    { 3000.0 }
    "VAR_TYPE"    CDF_UCHAR    { "support_data" }
    "VAR_NOTES"   CDF_UCHAR    { "TBD"} .

  ! NRV values follow...

   [1] = 3.00
   [2] = 3.15
   [3] = 3.31
   [4] = 3.47
   [5] = 3.65
   [6] = 3.83
   [7] = 4.02
   [8] = 4.22
   [9] = 4.43
   [10] = 4.65
   [11] = 4.89
   [12] = 5.13
   [13] = 5.39
   [14] = 5.66
   [15] = 5.94
   [16] = 6.24
   [17] = 6.55
   [18] = 6.88
   [19] = 7.22
   [20] = 7.58
   [21] = 7.96
   [22] = 8.36
   [23] = 8.78
   [24] = 9.21
   [25] = 9.68
   [26] = 10.16
   [27] = 10.67
   [28] = 11.20
   [29] = 11.76
   [30] = 12.35
   [31] = 12.97
   [32] = 13.61
   [33] = 14.29
   [34] = 15.01
   [35] = 15.76
   [36] = 16.55
   [37] = 17.38
   [38] = 18.24
```

```
[39] = 19.16
[40] = 20.11
[41] = 21.12
[42] = 22.18
[43] = 23.28
[44] = 24.45
[45] = 25.67
[46] = 26.96
[47] = 28.30
[48] = 29.72
[49] = 31.20
[50] = 32.76
[51] = 34.40
[52] = 36.12
[53] = 37.93
[54] = 39.82
[55] = 41.82
[56] = 43.91
[57] = 46.10
[58] = 48.41
[59] = 50.83
[60] = 53.37
[61] = 56.04
[62] = 58.84
[63] = 61.78
[64] = 64.87
[65] = 68.11
[66] = 71.52
[67] = 75.10
[68] = 78.85
[69] = 82.79
[70] = 86.93
[71] = 91.28
[72] = 95.84
[73] = 100.64
[74] = 105.67
[75] = 110.95
[76] = 116.50
[77] = 122.32
[78] = 128.44
[79] = 134.86
[80] = 141.60
[81] = 148.68
[82] = 156.12
[83] = 163.92
[84] = 172.12
[85] = 180.73
[86] = 189.76
[87] = 199.25
[88] = 209.21
[89] = 219.67
[90] = 230.66
[91] = 242.19
[92] = 254.30
[93] = 267.02
[94] = 280.37
[95] = 294.38
[96] = 309.10
[97] = 324.56
[98] = 340.79
[99] = 357.83
[100] = 375.72
[101] = 394.50
[102] = 414.23
[103] = 434.94
[104] = 456.69
[105] = 479.52
[106] = 503.50
[107] = 528.67
[108] = 555.11
```

```
   [109] = 582.86
   [110] = 612.00
   [111] = 642.61
   [112] = 674.74
   [113] = 708.47
   [114] = 743.90
   [115] = 781.09
   [116] = 820.15
   [117] = 861.15
   [118] = 904.21
   [119] = 949.42
   [120] = 996.89
   [121] = 1046.74
   [122] = 1099.07
   [123] = 1154.03
   [124] = 1211.73
   [125] = 1272.31
   [126] = 1335.93
   [127] = 1402.73
   [128] = 1472.86
   [129] = 1546.51
   [130] = 1623.83
   [131] = 1705.02
   [132] = 1790.27
   [133] = 1879.79
   [134] = 1973.78
   [135] = 2072.47
   [136] = 2176.09
   [137] = 2284.89
   [138] = 2399.14
   [139] = 2519.09
   [140] = 2645.05
   [141] = 2777.30
   [142] = 2916.17

! Variable          Data      Number                   Record   Dimension
! Name              Type     Elements  Dims  Sizes  Variance  Variances
! --------          ----     --------  ----  -----  --------  ---------

  "Num_Ranges_TN"  CDF_INT2     1       0              F

  ! Attribute       Data
  ! Name            Type       Value
  ! --------        ----       -----

    "FIELDNAM"    CDF_UCHAR    { "Number of Plasmagram Thumbnail Ranges" }
    "VAR_TYPE"    CDF_UCHAR    { "support_data" }
    "FILLVAL"     CDF_DOUBLE   { -32768 }
    "FORMAT"      CDF_UCHAR    { "I4" }
    "UNITS"       CDF_UCHAR    { "n/a" }
    "CATDESC"     CDF_UCHAR    { "Number of Plasmagram Thumbnail Ranges" }
    "VAR_NOTES"   CDF_UCHAR    { "151 ranges with 128 linear scale ranges 0-10 Re. " -
                                 "and 23 log scale ranges from 10 to 30 Re. " -
                                 "Range axis is fixed for thumbnails." } .

  ! NRV value follow...

    1:[] = 151

! Variable          Data      Number                   Record   Dimension
! Name              Type     Elements  Dims  Sizes  Variance  Variances
! --------          ----     --------  ----  -----  --------  ---------

  "Range_TN"      CDF_REAL4      1       1    151       F         T

  ! Attribute       Data
  ! Name            Type       Value
  ! --------        ----       -----

    "FIELDNAM"    CDF_UCHAR    { "Range_TN" }
```

```
    "LABLAXIS"    CDF_UCHAR    { "Range" }
    "UNITS"       CDF_UCHAR    { "Re"}
    "FILLVAL"     CDF_REAL4    { -1.0e+31 }
    "FORMAT"      CDF_UCHAR    { "F6.2" }
    "VALIDMIN"    CDF_FLOAT    { 0.0 }
    "VALIDMAX"    CDF_FLOAT    { 30.0 }
    "VAR_TYPE"    CDF_UCHAR    { "support_data" }
    "VAR_NOTES"   CDF_UCHAR    { "Range readings for 151 range bins thumbnail " -
                                 " plasmagrams, in Earth radii. " -
                                 "The range axis of thumbnail plamsagrams is fixed. " -
                                 "It does not correspond to the way RPI makes measurements.
" -
                                 "RPI has linear range scale with 128 or 256 ranges and " -
                                 "various starting ranges. These data are transformed by " -
                                 "averaging into the Level 1 thumbnail plasmagram with " -
                                 "a bi-scaled axis: 128 linear scale ranges with 480 km
spacing " -
                                 "plus 23 log scale ranges from 10 to 30 Earth Radii. " -
                                 "This arrangement is done for thumbnail plasmagrams only."
} .

  ! NRV values follow...

   [1] = 0.00
   [2] = 0.08
   [3] = 0.15
   [4] = 0.23
   [5] = 0.30
   [6] = 0.38
   [7] = 0.45
   [8] = 0.53
   [9] = 0.60
   [10] = 0.68
   [11] = 0.75
   [12] = 0.83
   [13] = 0.90
   [14] = 0.98
   [15] = 1.05
   [16] = 1.13
   [17] = 1.21
   [18] = 1.28
   [19] = 1.36
   [20] = 1.43
   [21] = 1.51
   [22] = 1.58
   [23] = 1.66
   [24] = 1.73
   [25] = 1.81
   [26] = 1.88
   [27] = 1.96
   [28] = 2.03
   [29] = 2.11
   [30] = 2.18
   [31] = 2.26
   [32] = 2.34
   [33] = 2.41
   [34] = 2.49
   [35] = 2.56
   [36] = 2.64
   [37] = 2.71
   [38] = 2.79
   [39] = 2.86
   [40] = 2.94
   [41] = 3.01
   [42] = 3.09
   [43] = 3.16
   [44] = 3.24
   [45] = 3.32
   [46] = 3.39
   [47] = 3.47
```

```
[48] = 3.54
[49] = 3.62
[50] = 3.69
[51] = 3.77
[52] = 3.84
[53] = 3.92
[54] = 3.99
[55] = 4.07
[56] = 4.14
[57] = 4.22
[58] = 4.29
[59] = 4.37
[60] = 4.45
[61] = 4.52
[62] = 4.60
[63] = 4.67
[64] = 4.75
[65] = 4.82
[66] = 4.90
[67] = 4.97
[68] = 5.05
[69] = 5.12
[70] = 5.20
[71] = 5.27
[72] = 5.35
[73] = 5.42
[74] = 5.50
[75] = 5.58
[76] = 5.65
[77] = 5.73
[78] = 5.80
[79] = 5.88
[80] = 5.95
[81] = 6.03
[82] = 6.10
[83] = 6.18
[84] = 6.25
[85] = 6.33
[86] = 6.40
[87] = 6.48
[88] = 6.55
[89] = 6.63
[90] = 6.71
[91] = 6.78
[92] = 6.86
[93] = 6.93
[94] = 7.01
[95] = 7.08
[96] = 7.16
[97] = 7.23
[98] = 7.31
[99] = 7.38
[10] = 7.46
[101] = 7.53
[102] = 7.61
[103] = 7.68
[104] = 7.76
[105] = 7.84
[106] = 7.91
[107] = 7.99
[108] = 8.06
[109] = 8.14
[110] = 8.21
[111] = 8.29
[112] = 8.36
[113] = 8.44
[114] = 8.51
[115] = 8.59
[116] = 8.66
[117] = 8.74
```

```
   [118] = 8.81
   [119] = 8.89
   [120] = 8.97
   [121] = 9.04
   [122] = 9.12
   [123] = 9.19
   [124] = 9.27
   [125] = 9.34
   [126] = 9.42
   [127] = 9.49
   [128] = 9.57
   [129] = 10.00
   [130] = 10.50
   [131] = 11.03
   [132] = 11.58
   [133] = 12.16
   [134] = 12.76
   [135] = 13.40
   [136] = 14.07
   [137] = 14.77
   [138] = 15.51
   [139] = 16.29
   [140] = 17.10
   [141] = 17.96
   [142] = 18.86
   [143] = 19.80
   [144] = 20.79
   [145] = 21.83
   [146] = 22.92
   [147] = 24.07
   [148] = 25.27
   [149] = 26.53
   [150] = 27.86
   [151] = 29.25


!
!========  T h u m b n a i l   P l a m a g r a m   d a t a  ================
!

! Variable          Data      Number                    Record   Dimension
! Name              Type     Elements  Dims   Sizes   Variance  Variances
! --------          ----     --------  ----  -------  --------  ---------

  "Amplitude_TN"  CDF_BYTE      1       2   151 142      T        T T

  ! Attribute       Data
  ! Name            Type       Value
  ! --------        ----       -----

    "FIELDNAM"    CDF_UCHAR    { "Plasmagram Thumbnail Amplitude" }
    "VAR_TYPE"    CDF_UCHAR    { "data" }
    "FILLVAL"     CDF_BYTE     { -128 }
    "UNITS"       CDF_UCHAR    { "6db" }
    "VALIDMIN"    CDF_BYTE     { 0 }
    "VALIDMAX"    CDF_BYTE     { 15 }
    "DEPEND_0"    CDF_UCHAR    { "Epoch" }
    "DEPEND_1"    CDF_UCHAR    { "Range_TN" }
    "DEPEND_2"    CDF_UCHAR    { "Frequency_TN" }
    "CATDESC"     CDF_UCHAR    { "Plasmagram Thumbnail Amplitude"}
    "VAR_NOTES"   CDF_UCHAR    { "TBD"} .

  ! RV values were not requested.

! Variable          Data      Number                    Record   Dimension
! Name              Type     Elements  Dims   Sizes   Variance  Variances
! --------          ----     --------  ----  -------  --------  ---------

  "Polarization_TN"  CDF_BYTE   1       2   151 142      T        T T
```

```
  ! Attribute       Data
  ! Name            Type       Value
  ! --------        ----       -----

    "FIELDNAM"    CDF_UCHAR    { "Plasmagram Thumbnail Polarization" }
    "VAR_TYPE"    CDF_UCHAR    { "data" }
    "FILLVAL"     CDF_BYTE     { -128 }
    "UNITS"       CDF_UCHAR    { "n/a" }
    "VALIDMIN"    CDF_BYTE     { 0 }
    "VALIDMAX"    CDF_BYTE     { 1 }
    "DEPEND_0"    CDF_UCHAR    { "Epoch" }
    "DEPEND_1"    CDF_UCHAR    { "Range_TN" }
    "DEPEND_2"    CDF_UCHAR    { "Frequency_TN" }
    "CATDESC"     CDF_UCHAR    { "0=Ordinary,1=Extraordinary"} .

  ! RV values were not requested.

#end
```