Application Note

How to extract a VPD from a sectorial recording

Scope

This application note describes how to extract a Vertical antenna Pattern Diagram (VPD) from a sectorial recording.

The first section is a summary of how to use the RASS-S Toolbox in order to make a sectorial recording with the Radar Interface Module (RIM782) and extract a pulse file from it.

The second section provides an in depth description of the actual extraction of the VPD starting from the pulse file.

Finally, a flow chart gives an overview of the RSAA-S tools used and files created during the VPD extraction process.

1. Sectorial Video Recording and Extraction

The RIM782 is used for making a sectorial video recording. How to make a recording, view it and perform a sectorial extraction is in depth described in chapters 3 and 4 of the user manual of the RIM782. Therefore we refer to that manual for the detailed explanation and mention in this chapter only the topics which are of importance with reference to the extraction of the VPD.

Note: Pay attention to these notes because making a recording and extracting a pulse file that contains enough data to extract a VPD takes a lot of time (depending an air traffic density)!

When clicking the **Video** button 

in the **RASS-S Toolbox** a drop down menu opens [Figure 1.1].

Figure 1.1: Video drop down menu

This menu allows for

- (1) making a sectorial recording (.uvr files) and (2) viewing it
- (3) extracting a pulse (.pls) file and (4) analysing it

These four tools should be used sequentially. They are explained in the following paragraphs.

1.1. Making a recording

Open the Sector Video Recording Tool from the Video drop down menu [Figure 1.1].

Before making a sectorial recording it is important to set the **Window** in the Sector Settings to 360 degrees [Figure 1.2]. A 360 degree window will result in a continuous 32MB/sec data stream to disk.

Note: Only 360 degree recordings can be used for VPD extraction!

Check the available free disk space before starting the recording. The **Recording Size** can be controlled in the Record Settings of the Sectorial Video Recorder [Figure 1.2].

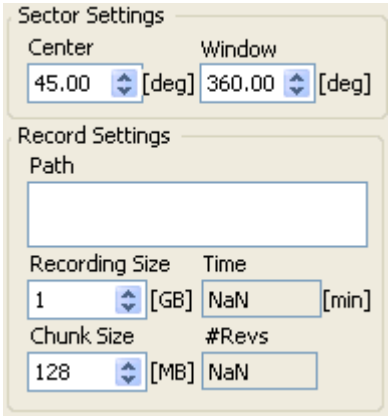

Figure 1.2: Sector and Recording Settings of the Sectorial Video Recorder

When the recording is finished, a set of .uvr files is saved to the destination folder set in the **Path** field.

Refer to the RIM782 User Manual section 3.2 for more information on the Sectorial Video Recording.

1.2. Viewing a Recording

Open the View Sector Recording Tool from the Video drop down menu [Figure 1.1].

With the Sectorial Video Viewer the video recordings can be displayed. After the recording is loaded click the **Create Index File** button . This will create an index file used to select data. Indexing takes about 10% of the recording time and can be stopped with the **Stop** button.

Note: Only the indexed recordings can be viewed and used for VPD extraction!

Refer to the RIM782 User Manual section 3.3 for more information on the Sectorial Video Viewer.

1.3. Sectorial Extraction

Open the Sectorial Extractor Tool from the Video drop down menu [Figure 1.1].

The Sectorial Extractor is used to convert a sectorial video recording to the RASS-S Video Pulse format. In order to get a useful .pls file it is important to set the threshold level just above the noise [Figure 1.3].

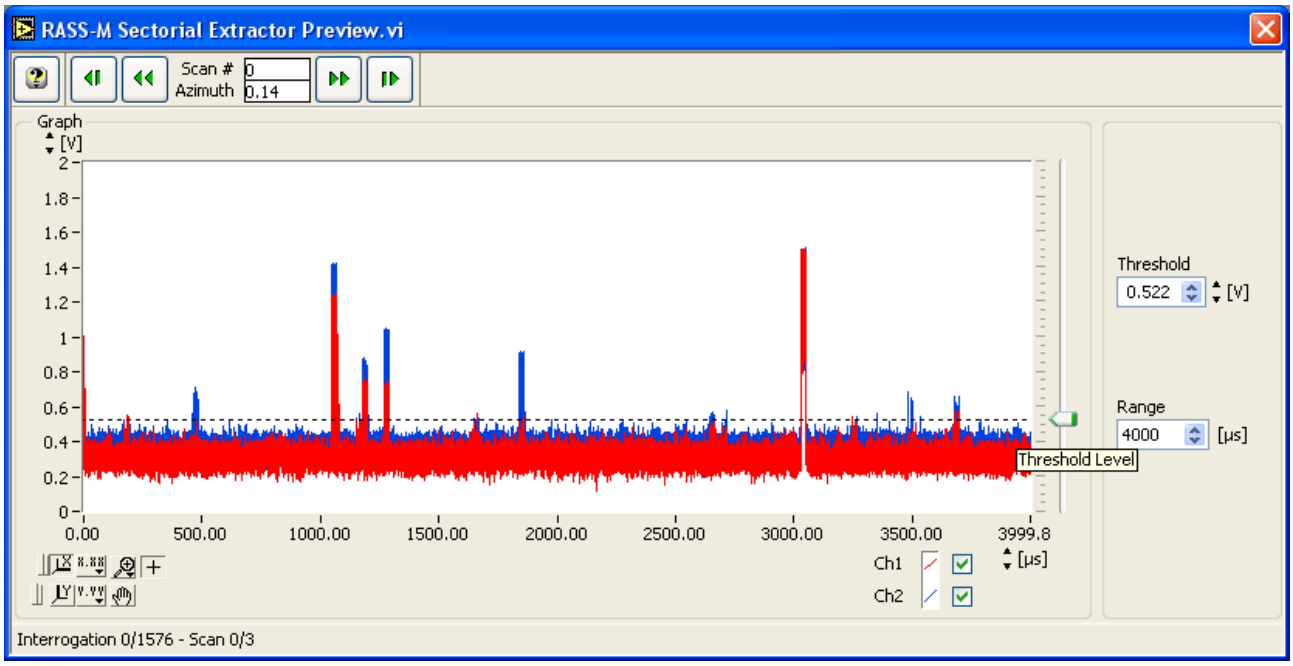

Figure 1.3: Setting the threshold level in the Sectorial Extractor Preview

Note: Sectorial Extraction can take up to 300% of the recording time. Make sure you have good recordings!

Refer to the RIM782 User Manual chapter 4 for more information on the Sectorial Extractor.

2. Extracting the VPD

This section provides an in depth description of the actual extraction of the VPD starting from the pulse file.

When clicking the **VPD** button 

in the **RASS-S Toolbox** a drop down menu opens [Figure 2.1].

Figure 2.1: VPD drop down menu

This menu allows for

- (1) analysing a pulse recording (.S4RE file)
- (2) build a plot (.Plot) file
- (3) build VPD & Coverage (.vpd) and (4) viewing it

These four tools should be used sequentially. They are explained in the following paragraphs.

2.1. Analyse Pulse Recording

Open the Analyse Pulse Recording Tool [Figure 2.2] from the VPD drop down menu [Figure 2.1].

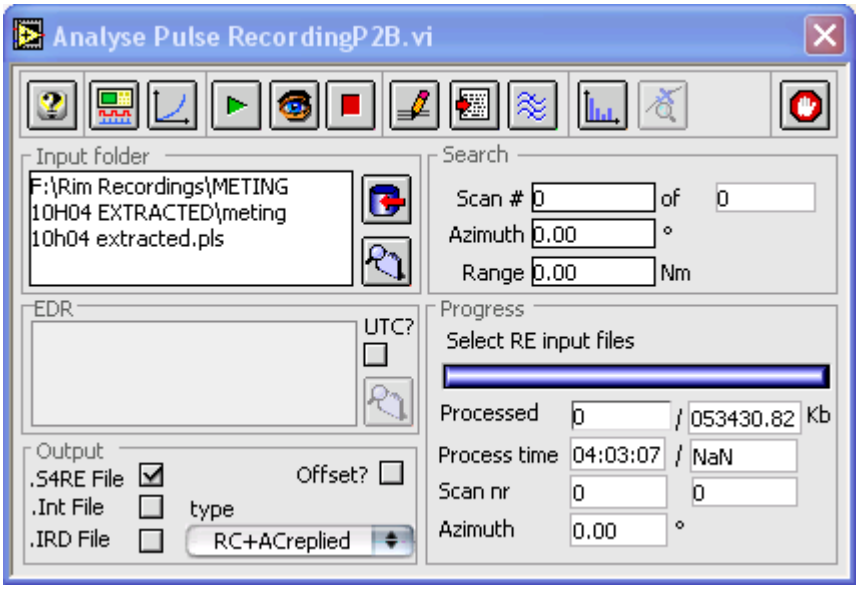

Figure 2.2: Analyse Pulse Recording Tool

Select the input folder containing the .pls file by clicking the **Select File** button  . A warning pops up. Select 'Use preferences from recording' and click OK.

Figure 2.3: Select 'Use preferences from recording'

By clicking the **Index** button  the index file (.arp) is generated and the View ACPR/IPR window [Figure

2.4] appears. In this window the number of A/C codes per revolution (ACPR) and the number of interrogations per revolution (IPR) can be verified.

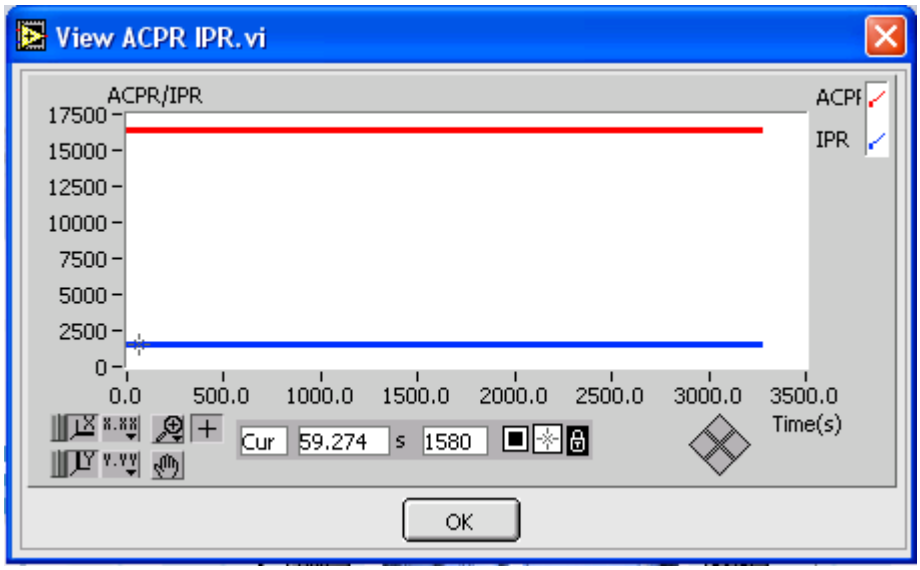

Figure 2.4: View ACPR/IPR window

Click the **Calibration** button  to open the Select Calibration File window. A default calibration file is loaded when no specific file is selected.

Click the **Preferences** button  to open the Extraction Preferences window [Figure 2.5]. Under the Extraction tab the following extraction parameters can be set:

- ACP smooth: Factor for smoothing out ACP jitter
- Min Range and Max Range: Minimum and maximum range between which pulses are recognized
- Trigger level: Only pulses above this level are used for analysis
- Extraction Mode: Mode of operation of the extractor
- Azimuth window: Width of the window in which replies are used for plot extraction
- Range Margin: Replies within this margin are supposed to be from the same target
- S-D Crossover: Outside this region the OBA curve is too flat to result in good data points
- Bin size: The number of replies in an azimuth section (bin size) is counted in a histogram function. At azimuths where a minimum number of replies is found, plot extraction is started.
- Threshold histogram: The number of replies required in the histogram to start plot extraction
- Azimuth extension: The maximum azimuth that might contain replies of the same plot

- Max azimuth: The maximum allowed standard deviation on each of the replies contained in a plot to extract the plot
- Min # A/C codes: The minimum number of valid A/C codes to extract a plot

Enable the Context help by clicking the **Context Help** button  in the RASS-S Toolbox if more information on these parameters is required. Context help also provides the common settings of the extraction parameters.

Note: In order to extract a .Plot file that will be useful for VPD extraction make sure that the Sliding Extraction Mode is selected and the bin size is set to 2,50 degrees!

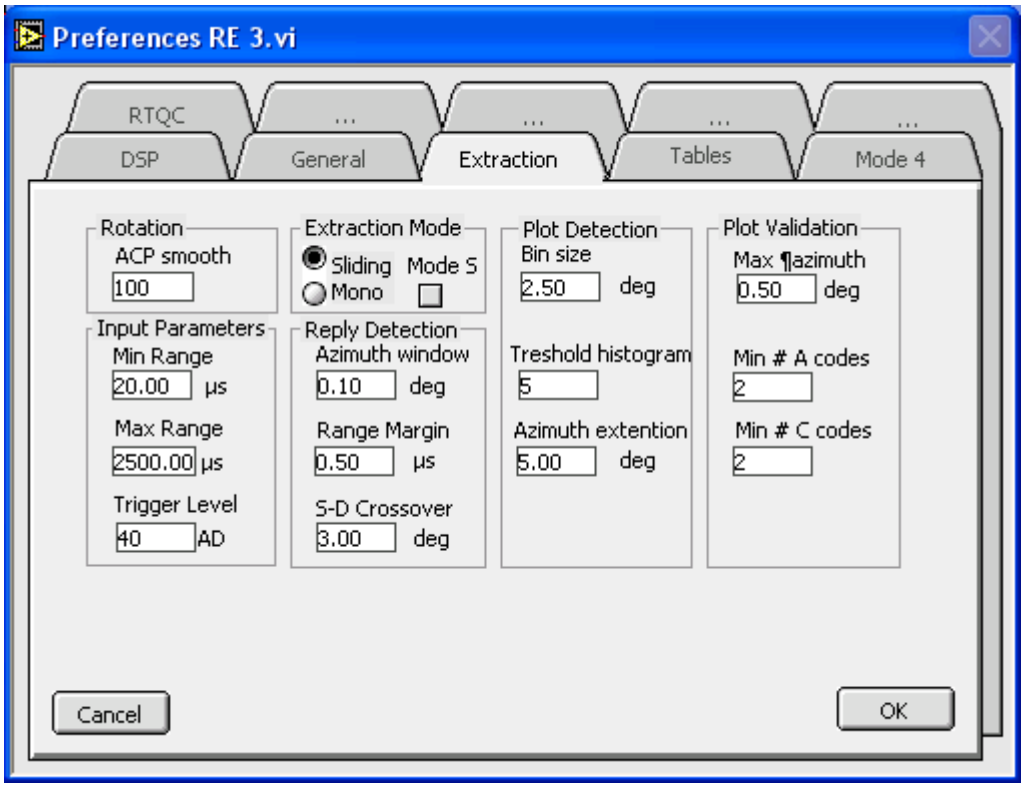

Figure 2.5: Extraction Preferences

Click the **Play** button  to start the extraction process. The progress is monitored in the Progress field [Figure 2.6].

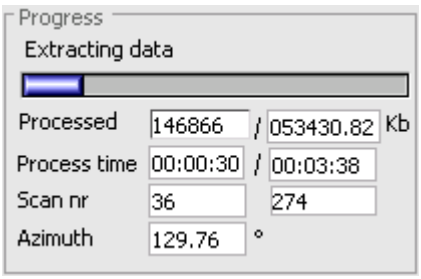

Figure 2.6: Progress of extraction process

When the extraction process has finished, a .S4RE file is built. This file contains plots in the RASS S4 format.

Click the **Search** button  to open the Pulses to Plots window [Figure 2.7]. The Radar Video Data graph shows video pulses (green), A/C replies (blue) and plots (black). This window will be used in section 2.3. Build VPD & Coverage.

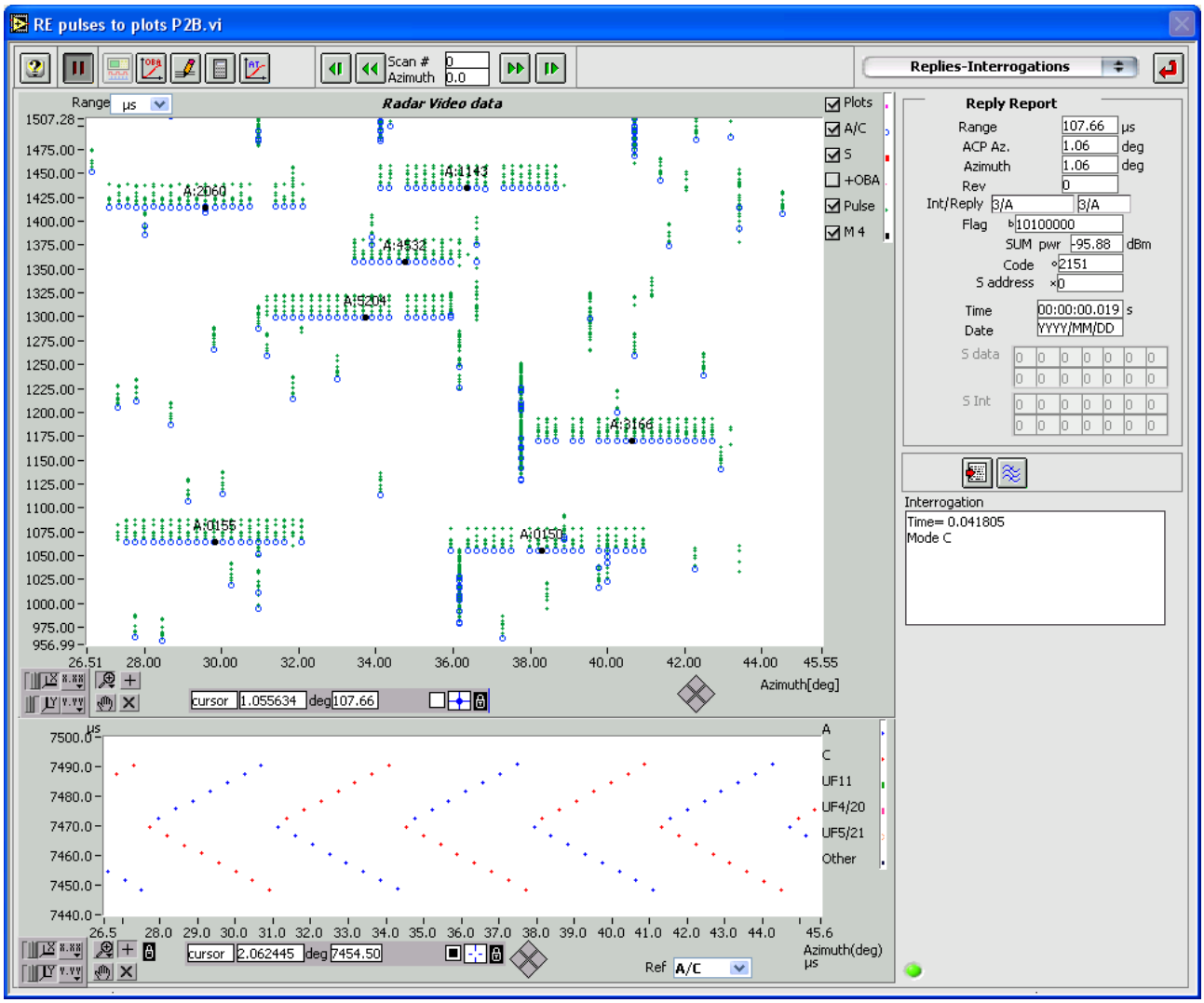

Figure 2.7: Pulses to Plots window with video pulses (green), A/C replies (blue) and plots (black)

2.2. Build Plot File

Open the Build Plot File Tool [Figure 2.8] from the VPD drop down menu [Figure 2.1].

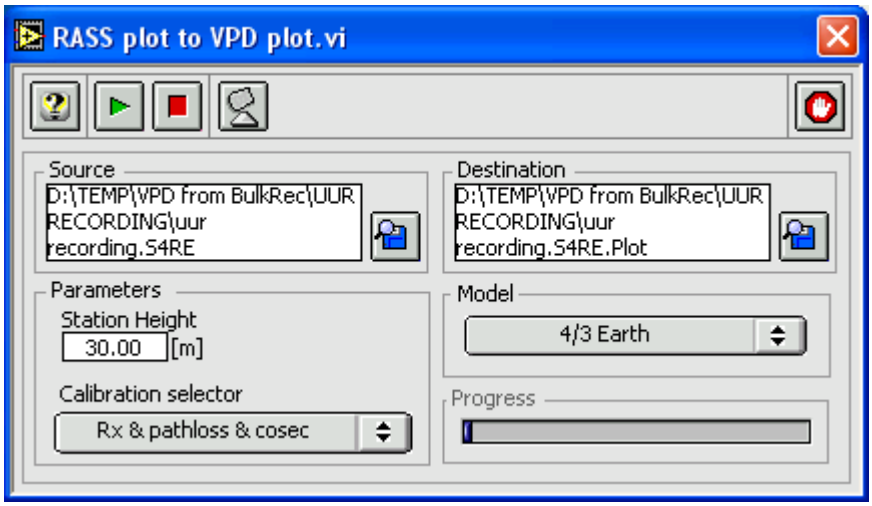

Figure 2.8: Build Plot File Tool

Select the source folder containing the .S4RE file and select a destination folder, both by clicking the appropriate **Select** button  .

Click the **Play** button  to build a .Plot file.

2.3. Build VPD & Coverage

Open the Build VPD & Coverage Tool [Figure 2.9] from the VPD drop down menu [Figure 2.1].

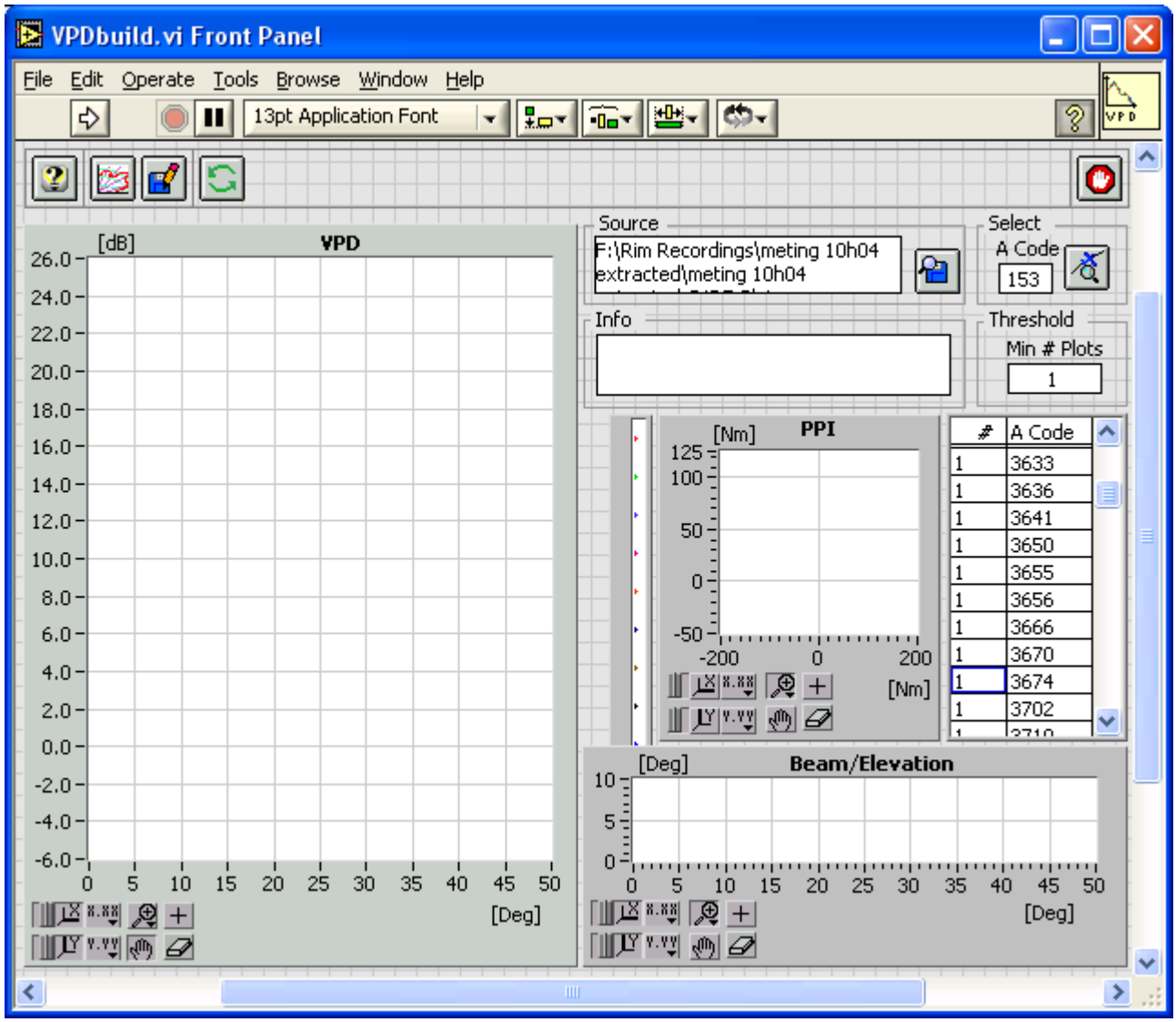

Figure 2.9: Build VPD & Coverage Tool

When running this tool you are prompted to select a source folder containing the .Plot file. You can change the source folder afterwards by clicking the **Select** button  .

If it isn't still open, open the Pulses to Plots window [Figure 2.7] using the **Search** button  in the Analyse Pulse Recording window [Figure 2.2].

Open also the Inventory tool from the **Analysis** drop down menu  in the RASS-S Toolbox.

In the Inventory Tool load the .S4RE file by clicking the **Load** button  .

Select R=f(elevation) in the Graph Type drop down menu.

Use the zoom function to display some nice tracks [Figure 2.10].

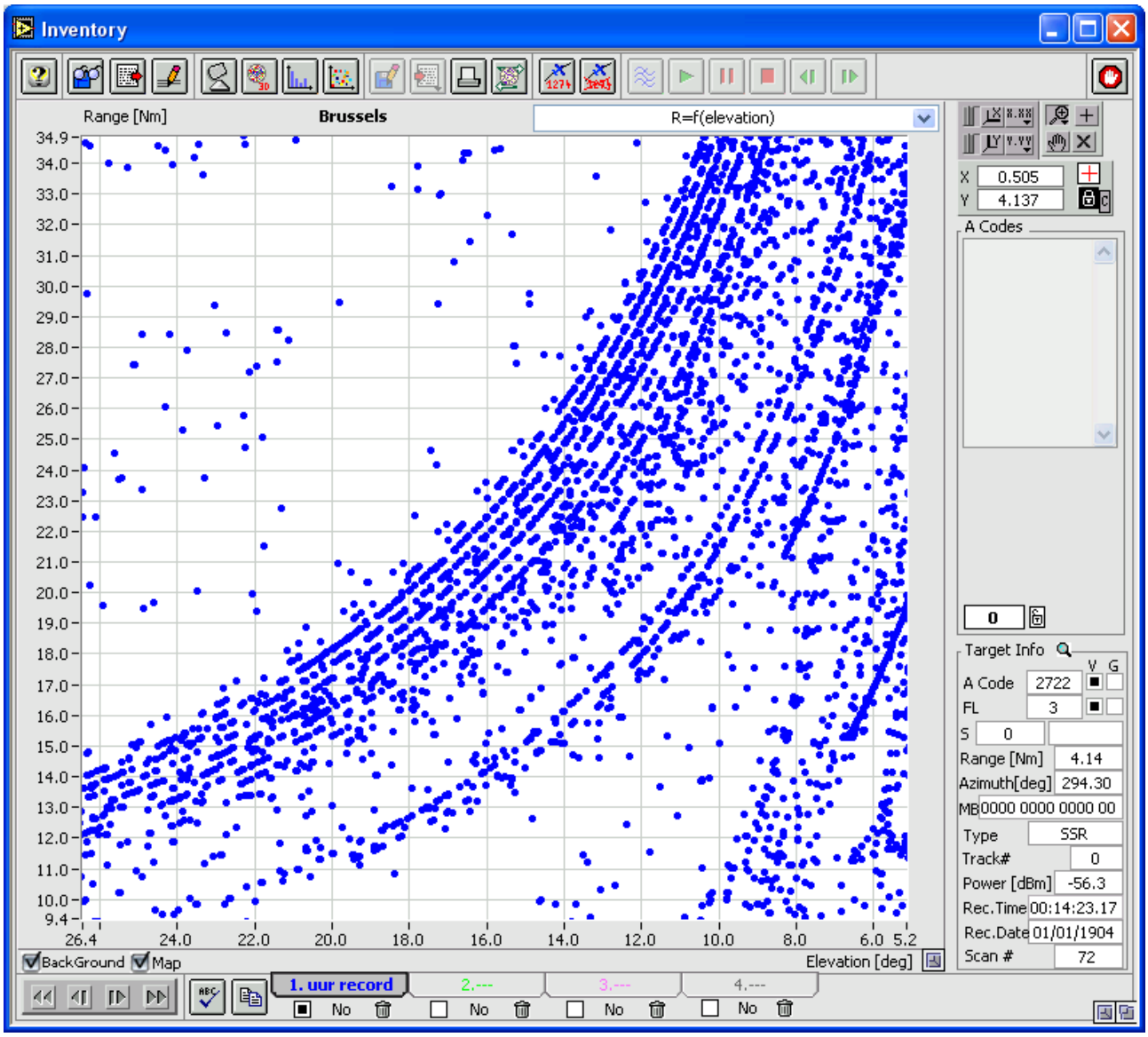

Figure 2.10: Zoom on some nice tracks in the Inventory Tool

Activate the cursor using the  buttons and select a plot on a trace.

When click the **Multi Level Linking** button  , the cursor in the Pulses to Plots window moves to the same plot and the Extract Code from VPD Log window [Figure 2.11] appears. This window shows the VPD, the track of the target used for the VPD in X-Y coordinates and the beam width in function of elevation.

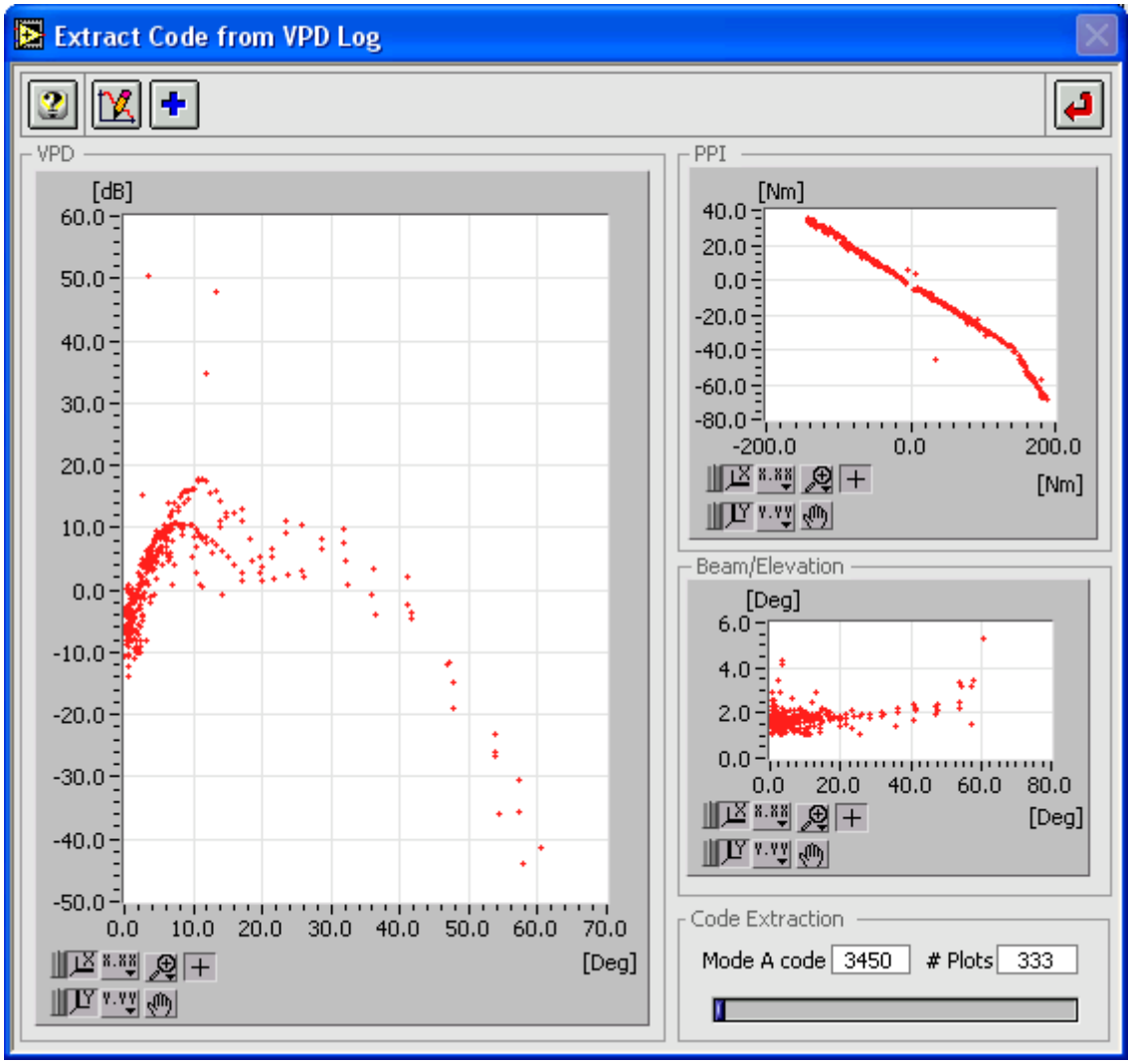

Figure 2.11: Extract code from VPD Log window

Outbound points, as can be seen on the VPD diagram on Figure 2.11 are not useful to build the VPD curve. These points should be removed.

Click the **Edit** button  to open the Edit VPD Graph window [Figure 2.12].

Set the cursor on an outbound point and use the **Cut** button  to remove it.

Figure 2.12: Edit VPD Graph window

When the VPD looks good, use the **Add** button  to add the VPD to the VPD Build tool.

Repeat this procedure on several nice tracks.

Click the **Smooth and Coverage** button  in the Build VPD and Coverage window [Figure 2.9].

The Smooth VPD window [Figure 2.13] appears. This window shows a Smooth VPD fir curve on top of the original points. In the Filter field the **Order** of the fit can be set. Typically an eighth order filter renders a good fit. Increasing the order doesn't significantly improve the fit but does entail a higher processing load.

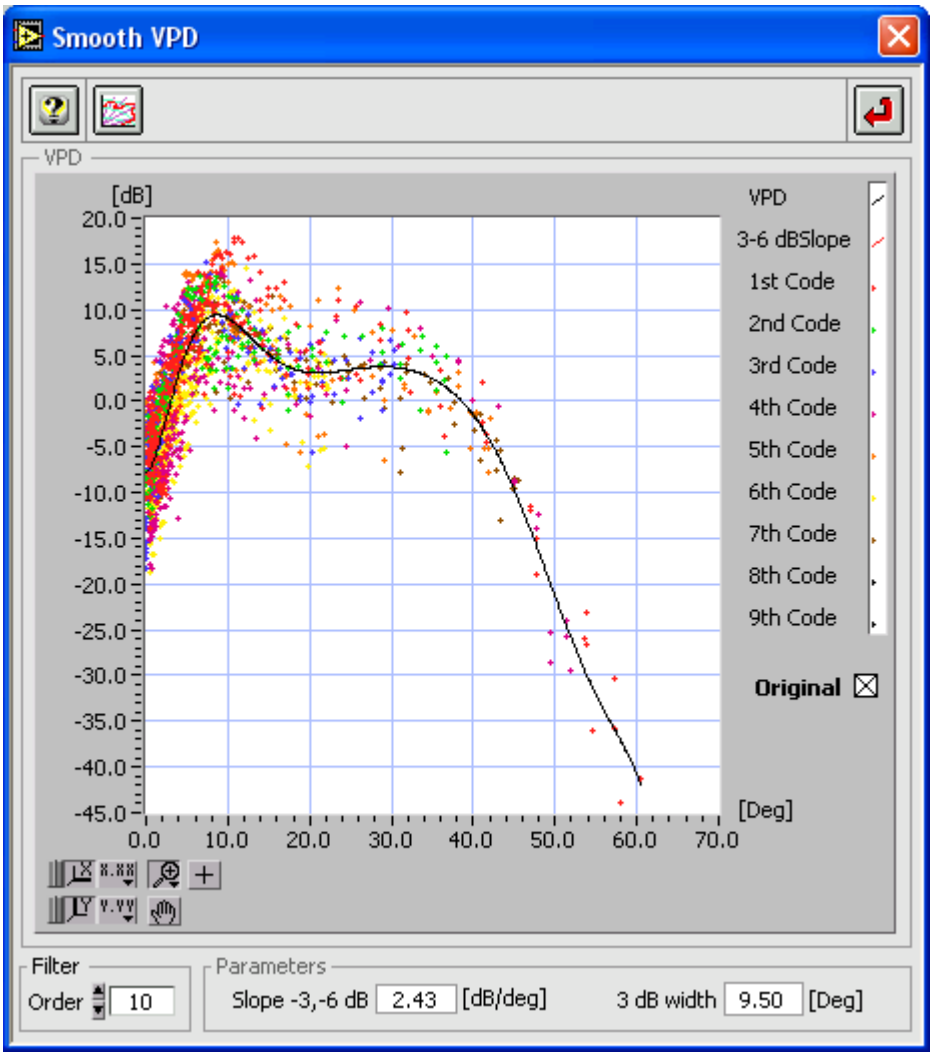

Figure 2.13: Smooth VPD window

Click the **Smooth and Coverage** button  in the Smooth VPD window [Figure 2.13] to evoke the Coverage Diagram window [Figure 2.14].

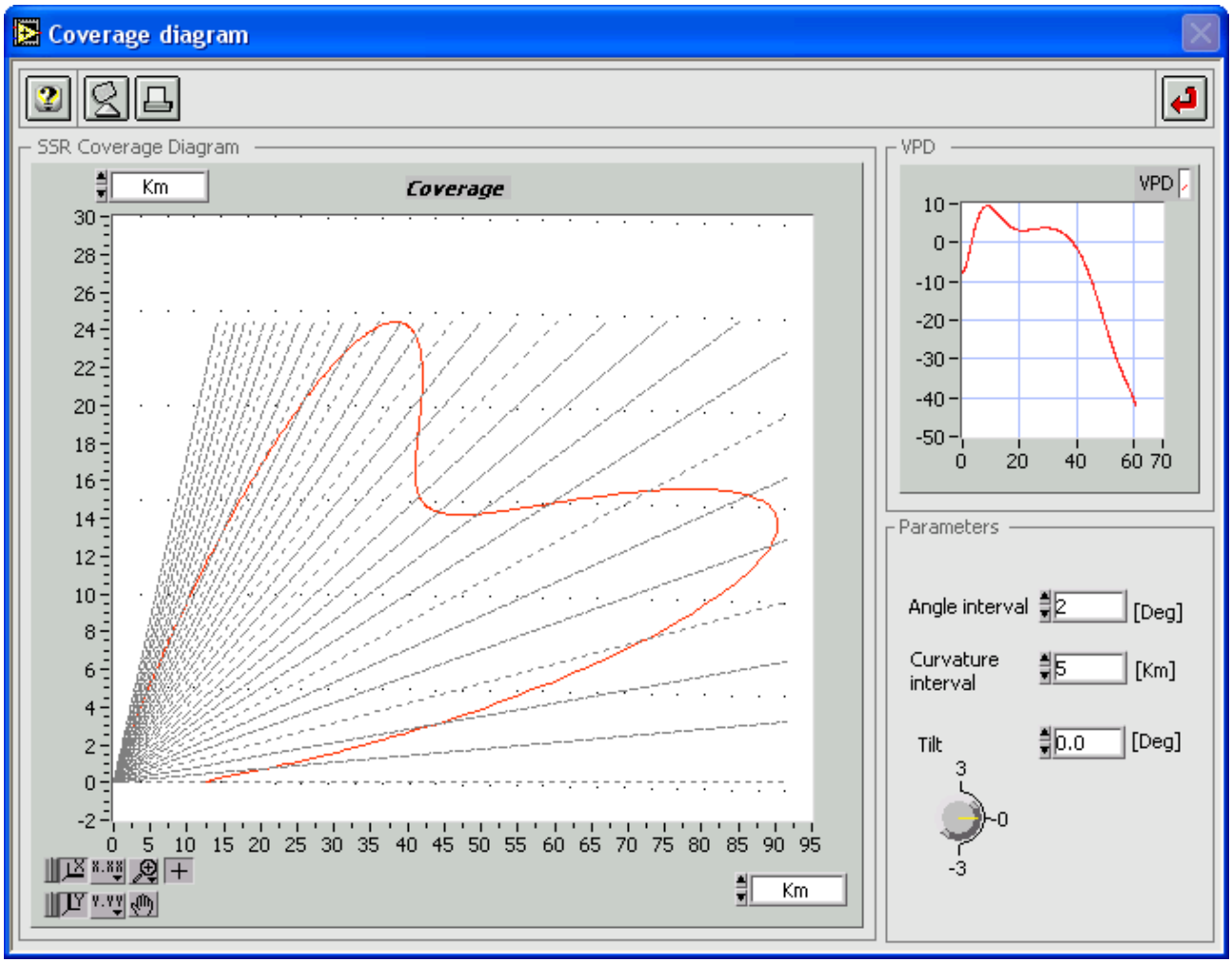

Figure 2.14: Coverage Diagram window

Click the **Save** button  in the Build VPD & Coverage window [Figure 2.9] to save the .vpd file for future use.

2.4. View VPD Curves

Open the View VPD Curves Tool [Figure 2.15] from the VPD drop down menu [Figure 2.1].

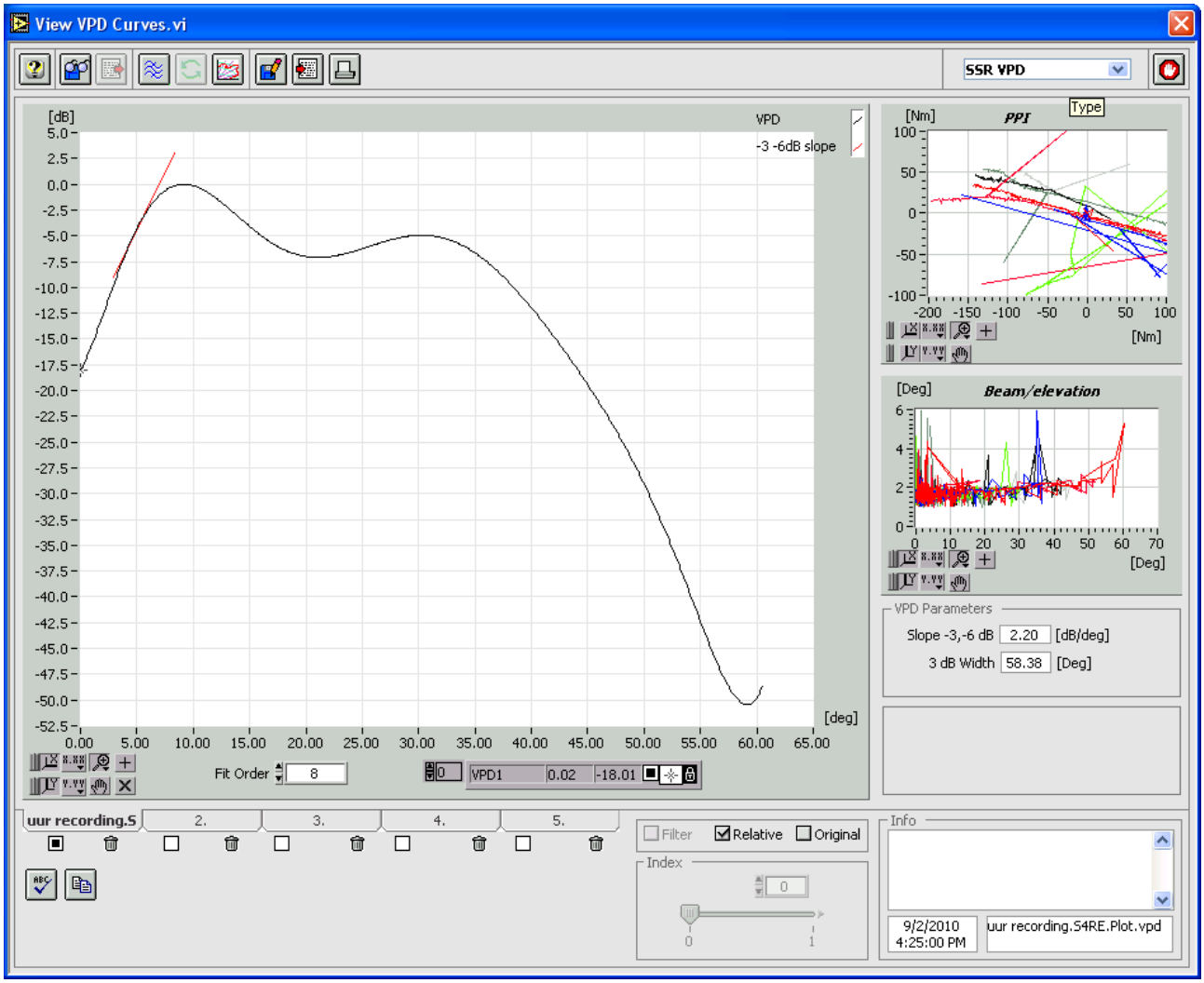

Figure 2.15: View VPD Curves window

This window shows the VPD, the tracks of the targets used for the VPD build in X-Y coordinates and the beam width in function of elevation. The VPD curve is shown in black. Again the order of the fit should be set in the **Fit Order** field.

3. Flow chart and Files Created