DRFA912 Uplink Manual

Use of DRFA912 for Uplink Measurement

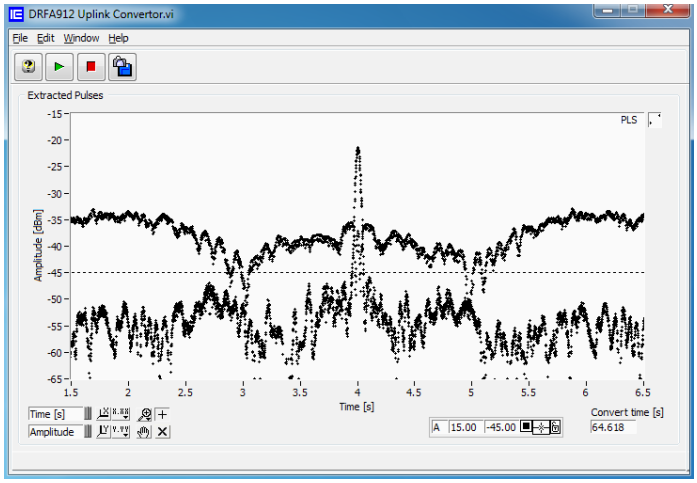

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Table of Contents

Table of Figures

1. Introduction

This manual explains how to perform an uplink recording with a DRFA912 device and how to convert this recording into a pulse file which can be used to extract an HPD diagram using the RASS-S HPD Uplink software.

2. Performing the uplink recording

2.1. Measurement Principle

The Uplink measurement will provide you with horizontal polar diagrams of any (M)SSR/PSR antenna in its operational environment by recording the Tx pulses of the radar. For this purpose the DRFA912 is set-up in the field with no connection to the radar. An antenna will pick up the radar signal from the air (P1-P2-P3 1030MHz or PSR transmissions) and the DRFA Scope software will perform the recording and save the pulses to the harddisk of your computer.

The detailed pulse shape is recorded and after the recording the DRFA912 Uplink Convertor plug-in can be used to read the recorded file and convert it into a pulse file that can be analysed using the RASS-S HPD Uplink software.

When selecting a measurement position for the uplink equipment, take into account the following guidelines:

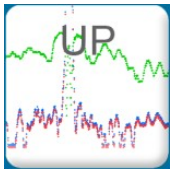
- Make sure to have direct line of sight to the radar under test and select a location at a distance of min. 0.5km and max. 40km.
- Place the antenna at least 1.5m above ground level, preferably even higher. If the radar station remains visible, even when standing behind the antenna, a good measurement result may be expected.
- Choose the correct antenna polarization. All SSRs are vertically polarized. Primary radars can be vertical (most common), horizontal or circular.
- It is advisable to record the antenna signals in both polarization modes. That way, whatever the mode used, or expected, the data is never lost. At the same time the cross polarization is measured, including the effect of the environment. Usually the effect of a high cross polarization is caused by reflections. Therefore it can be used to determine bad positioning of the measuring antenna for reference measurements.
- Beware of nearby buildings or other structures reflecting large portions of the signal. These reflections may influence your measurement.
- The most frequent error is a measurement from a too low elevation angle. The HPD diagram is still correct but doesn't represent the view of the targets and antenna. If in doubt, use an inclinometer to find the elevation angle from the measurement position towards the radar under test.
- Depending on the distance of the uplink setup to the radar system, extra attenuation must be inserted at the Rx input. As a general rule it is best to start with 20dB (SSR) or 40dB attenuation (PSR) or even more.
- If an uplink measurement shows any abnormality/anomaly of the beam pattern, it is recommended that additional uplink measurements are taken from 2 different location, ideally separated 120 degrees apart around the radar. The abnormality/anomaly may be due to an antenna fault or the environment. If the abnormality/anomaly is at the same location within the beam pattern from all

locations, the problem is caused by the antenna. If the abnormality/anomaly moves within the beam pattern between the 3 locations, the abnormality/anomaly is caused by the environment e.g. lightning pole.

Check-out the Uplink connection diagram leaflet delivered with the DRFA912 for the correct connections and set-up. This connection diagram can also be loaded through the Help menu of the DRFA912 software. A Tutorial explaining how to use the DRFA912 together with a DTI529 (Didactical Test Interrogator) to practice the uplink measurement can also be found in the Help menu.

2.2. Using the DRFA912 Software

The DRFA912 Scope software can be started from the RASS-M Toolbox or the Windows Start menu.



DRFA912 Scope button

The DRF912 Scope software will load, showing:

- the menu bar
- the toolbar
- the scope display and related settings,
- the DRFA controls and settings,
- a comment field
- the status bar

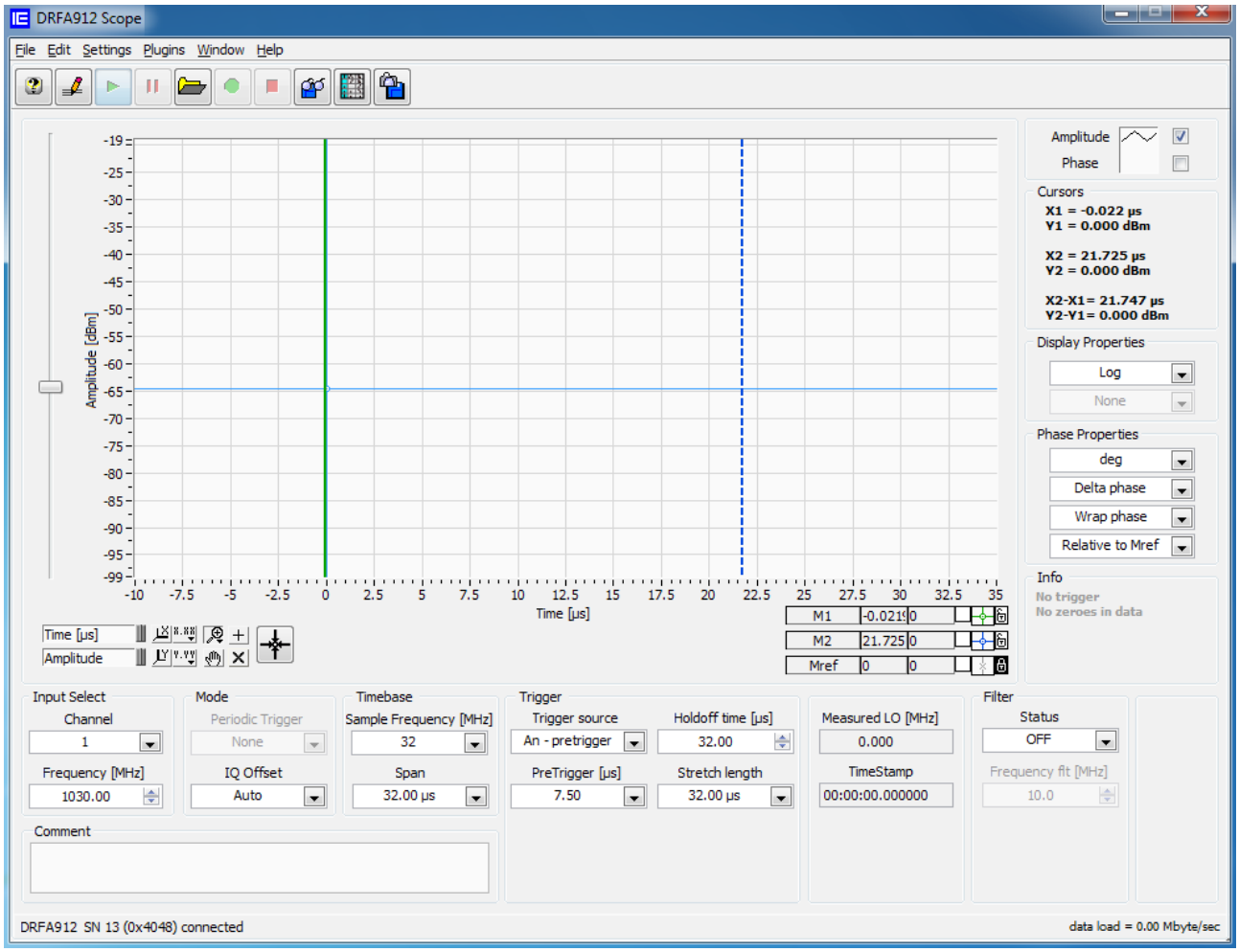


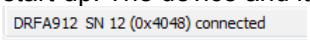
Figure 1: DRFA912 Scope GUI

The DRFA912 scope can operate in two different modes:

- ***Live mode***: In this mode the software is used to control the DRFA912 and the scope display gives a live view of the signal available at the selected input of the DRFA912 according to the settings used.
- ***File mode***: This mode is automatically entered when loading a recording. The controls section will change into a file control section. ***In this mode the uplink conversion plug-in can be used to extract the pulses for the antenna diagram.***

The DRFA Scope software always starts in Live mode and checks if a DRFA912 can be detected. If the DRFA912 is not connected yet or is not powered on, the status bar will indicate 'no device'.

Once the DRFA912 is detected, it will be initialized with the default settings as loaded by the software at start-up. The device and its serial number are indicated in the status bar.



In ***Live*** mode the following toolbar buttons are important:

 ***Live Capture***: starts displaying video and data. This button also switches from file mode (viewing recordings) to live mode.
At start the Live Capture button is automatically selected and disabled indicating that the DRFA912 is running.

 ***Pause display / Force trigger***: the display stops updating after clicking this button. Clicking it again forces a trigger. Click the ***Live Capture*** button to switch back to live mode.
Please note that the Pause button only stops the display update. When a recording is in progress, the recording will continue.

2.2.1. Performing an Uplink recording

Step 1: Set display mode

For the purpose of recording an antenna diagram it is best to set the display to ***Log*** mode. In that case the log amplitude of the received signal is displayed vs time.
To do this, click the ***Display Mode*** selector in the ***Display Properties*** section at the right of the display and set it to ***Log***.

Step 2: Verify settings

Before starting a recording it is necessary to adjust the settings according to the signal connected.

Input select

- ***Channel***: Select the channel that the measurement antenna is connected to (Rf CH1 or CH2).
- ***Frequency [MHz]***: For SSR the Rx frequency should be 1030MHz, for PSR this should be the PSR frequency of the radar.

Mode

- ***IQ Offset***: It is recommended to set this to ***Auto***. In that case the zero level offset of the I and Q channel are automatically calculated.

Timebase

- ***Sample Frequency[MHz]***: More samples means more data (64MHz or 32MHz is OK).
- ***Span***: Should be enough to hold all pulses in the window.

Trigger

- ***Trigger Source***: For Uplink measurements always use ***An-pretrigger***. This selects triggering to occur on the selected input channel.
- ***PreTrigger [µs]***: User choice (make sure all pulses are visible). It depends on the sample rate. For SSR it is best to have a pretrigger larger than 2 µs. In that case when triggering on a P2 pulse, also P1 is captured in the same span.
- ***Holdoff Time [µs]***: Defines the time before a new trigger can occur. For antenna measurement purposes it can be kept at 0.
- ***Stretch Length***: Defines how much data should be captured after a trigger.

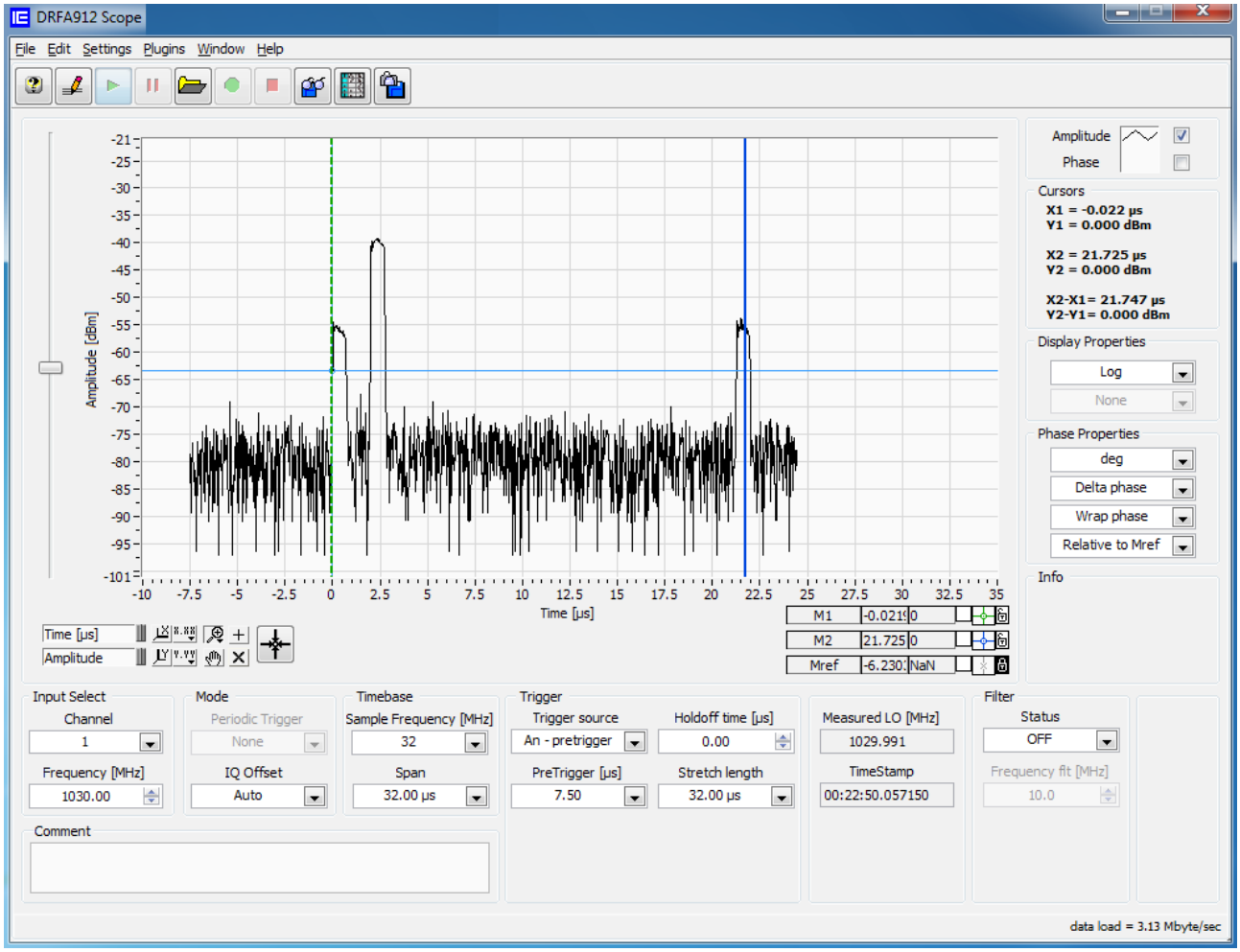
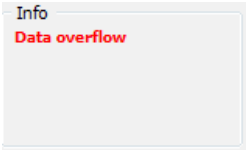


Figure 2: User interface settings in live mode (example)

Depending on the selected sample frequency and the selected trigger level, the data load is calculated.

Since the DRFA912 is connected to the computer using USB 2.0, it is required to keep the data load below 40MB/s. Data load is indicated in the status bar at the right side. When data overflow occurs, it is indicated in the Info window. ***Data overflow mostly happens when the trigger level is set too low.***



Step 3: Set trigger level

At the left of the display a slider is available that can be used to set the trigger level. Its scale is always the same as the Y-scale of the signal display. Position the trigger level such that all pulses are detected properly, but no false triggers occur due to the noise. If the trigger level is too low; only noise will be sampled.

Step 4: Select folder

If the settings give results that are satisfying, please click the  ***Select folder*** button to select a specific folder to store the recording. A window will pop-up asking to select a folder. If required first create a new recording folder then select the wanted destination folder. The DRFA scope status bar will show the selected folder name.
Caution: When the selected folder is not empty, previous recordings will be overwritten. A message will inform the user when the selected folder is not empty!

Step 5: Record data

You can use the ***Comment*** field to include information about the recording in the recording directory (information like measurement place, attenuation used, polarisation of measurement antenna,...).

After selecting a folder, use the  ***Record*** button to begin writing to disk. A progress bar will indicate recording progress.

Step 6: Stop recording

The DRFA software stops recording when you click the  ***Stop*** button or when the maximum recording size is reached. For uplink recordings it is strongly advised to record minimal 3 scans due to the reason that the HPD extraction algorithm (within RFA RASS-S tools) requires minimal 3 full scans to successfully extract a HPD diagram from the recorded pulses. The recording is automatically saved to the selected folder when the ***Stop*** button is hit or when the maximum recording size is reached.

The user also has the option to export the data to a tab separated file format. Set the vertical M1 (green) and M2 (blue) marker to select the data which you wish to export. The data between markers M1 and M2 of that scan will be exported to a tab separated file when you click the  ***Save to Spreadsheet*** button. The exported file will include 4 columns: absolute timestamp, relative timestamp and the data from the 2 recording channels.

Use the ***Snapshot***  button to save a snapshot (.jpeg) of the DRFA912 Scope window.

2.2.2. Viewing the recorded data

Step 7: Load file to view recording

Viewing recorded data can be done using the DRFA Scope software in file mode. When you click the  ***Load file*** button a dialog will be presented to select the folder containing the recording of interest. Click the folder of interest and use the ***Select*** button to start loading the file.

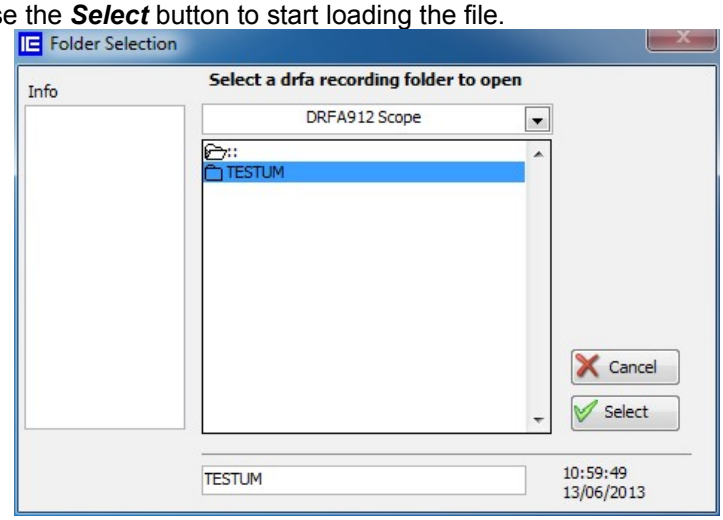


Figure 3: Folder selection dialog

Loading the file can take a few moments. A pop-up window is shown indicating the progress:

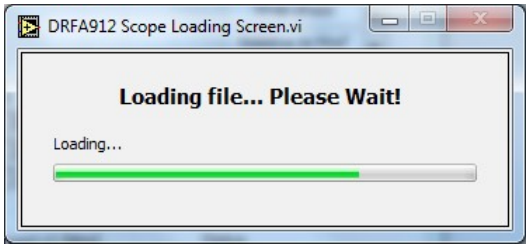


Figure 4: Loading file progress bar

Once loaded, the DRFA Scope will switch to file mode. This can be recognized by the file controls becoming visible. The status bar indicates the name of the recording currently being viewed and its size. You can step through the different spans by clicking the  ***Forward*** button or the  ***Backward*** button or you can step through the successive frames by using the ***File Control*** slider.

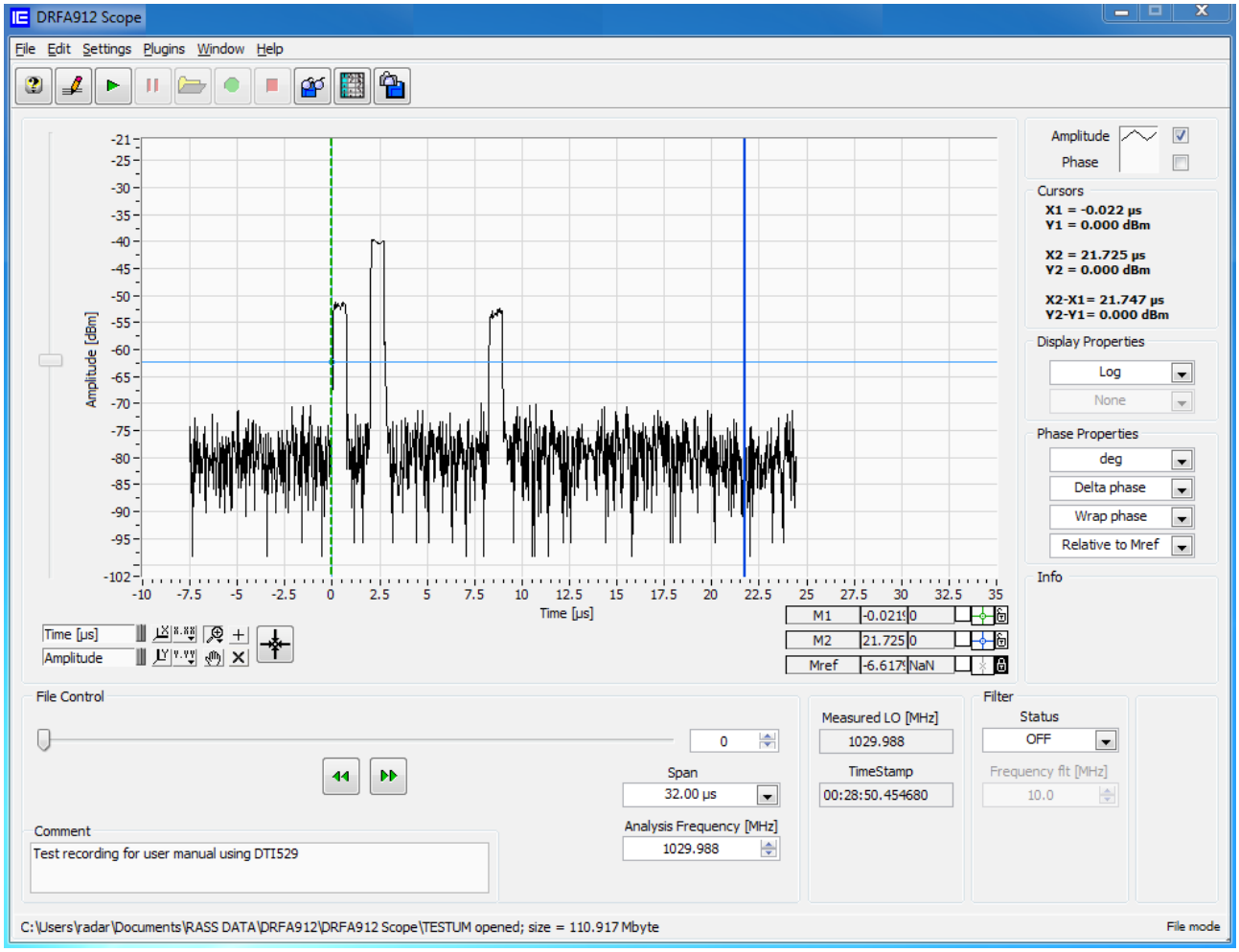


Figure 5: DRFA912 Scope file mode

If these steps are performed in the right order you have now succeeded in recording and saving the uplink data, the conversion is the next step.

3. CONVERTING UPLINK RECORDING

Step 8: Load uplink converter

After creating the recording, a plug-in is used in order to convert the DRFA912 recording to a pulse file with a .pls extension. This plug-in (called DRFA912 Uplink Convertor) is launched from the ***Plugins*** menu at the top of the DRFA912 scope interface:

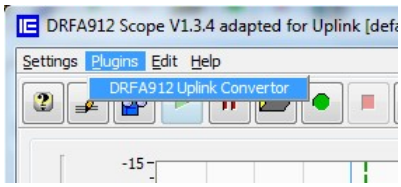


Figure 6: Location of conversion software

After launching, the Uplink Convertor tool is displayed:

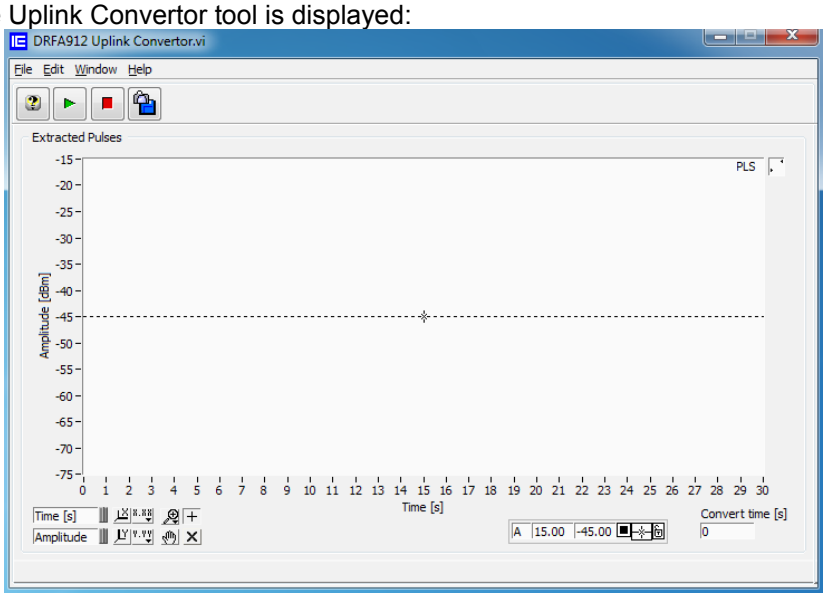


Figure 7: Software to convert DRFA912 recordings to pulse files

Step 9: Start converting recorded data

The only thing the user is required to do is to click the  ***Start*** button to convert the recorded data to pulses. The software itself will run through the complete file and will calculate and log the amplitude of the pulses to a new file with a .pls extension. A progress bar at the bottom of the interface informs the user how far the conversion is accomplished. The more scans are recorded, the longer it takes to convert. There is also a software filter included to filter out pulses with a pulse width smaller than 0,25µs and greater than 10µs.

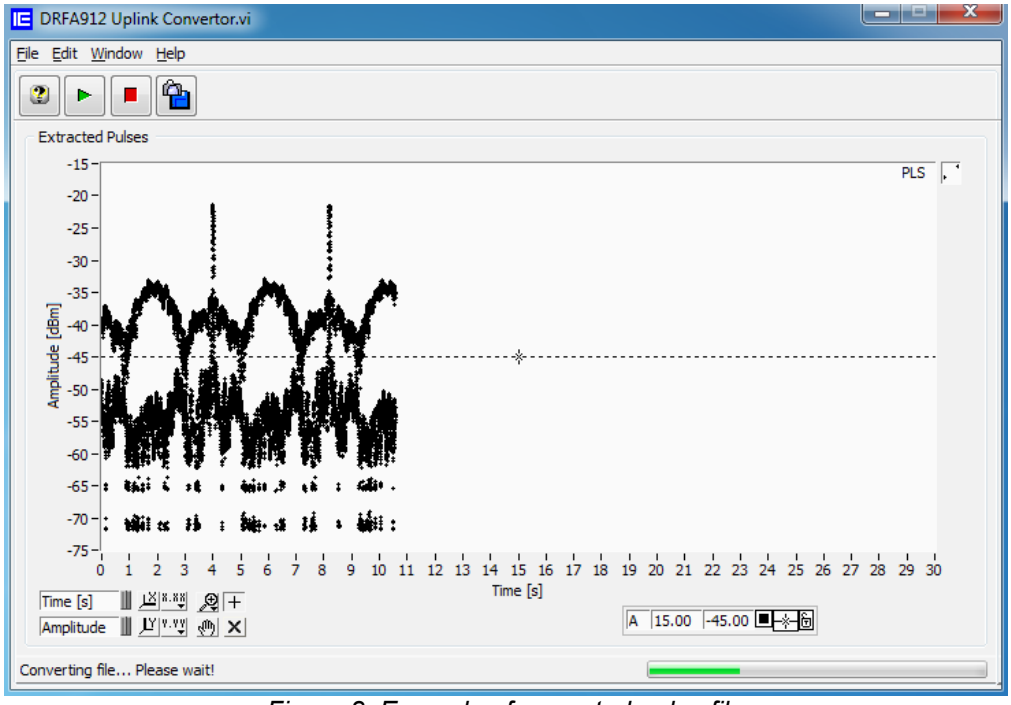


Figure 8: Example of a created pulse file

Figure 8 shows an example of a conversion in progress. The graph displays the calculated amplitudes of each of the pulses detected above threshold setting. A warning is displayed after the conversion is finished indicating the file that is saved to disk.

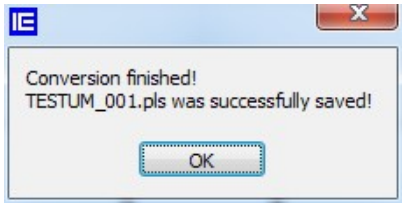


Figure 9: Conversion finished dialog

Step 10: Verify antenna diagram

You can now zoom in and analyse the recorded antenna diagram by comparing it for example to a previously recorded antenna diagram of the same radar site.

Use the ***Snapshot***  button to save a snapshot of the DRFA912 Uplink Convertor window.

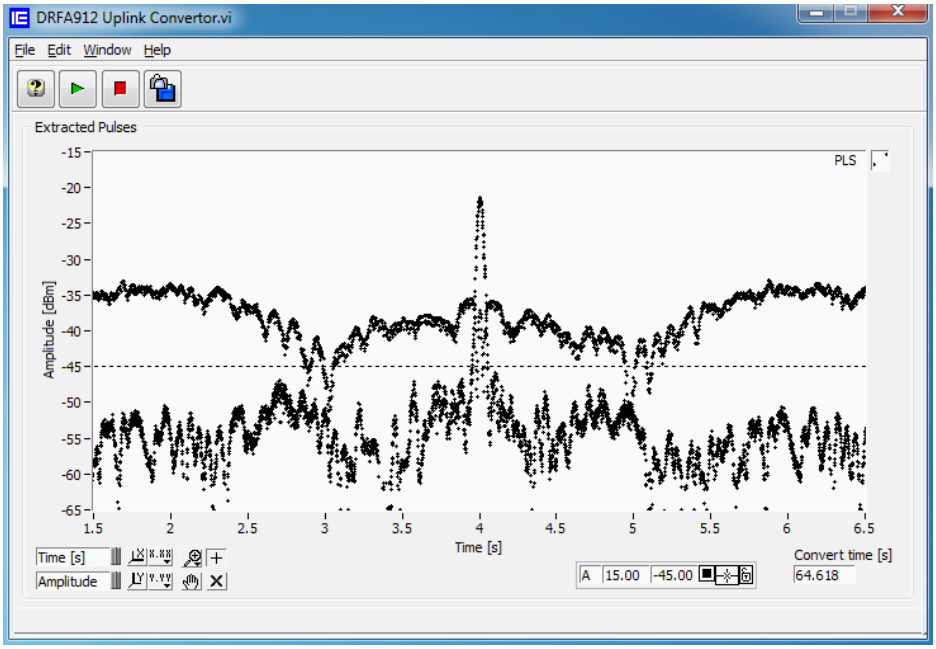


Figure 10: Zoomed view of the antenna diagram

4. EXTRACTING HPD DIAGRAM

The final step is to extract the HPD diagram using the ***Extract HPD*** tool in the Analysis section of the toolbox. The program is capable of reading, recognizing and displaying Uplink and Downlink HPD logfiles of both (M)SSR and PSR measurements.

More information on how this is performed can be consulted in the ***Extract HPD*** User Manual.