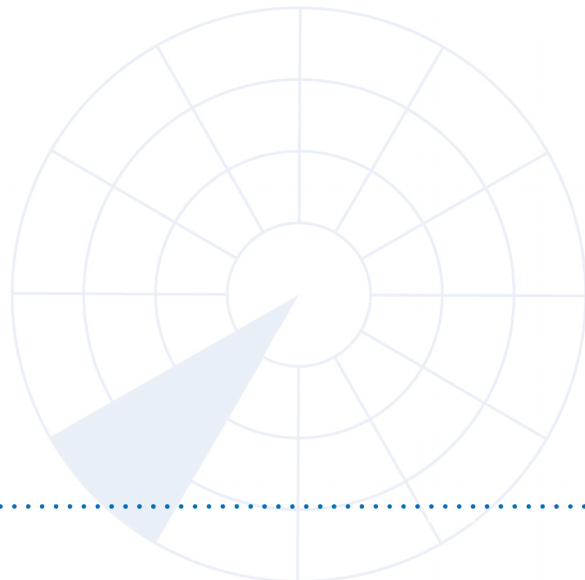
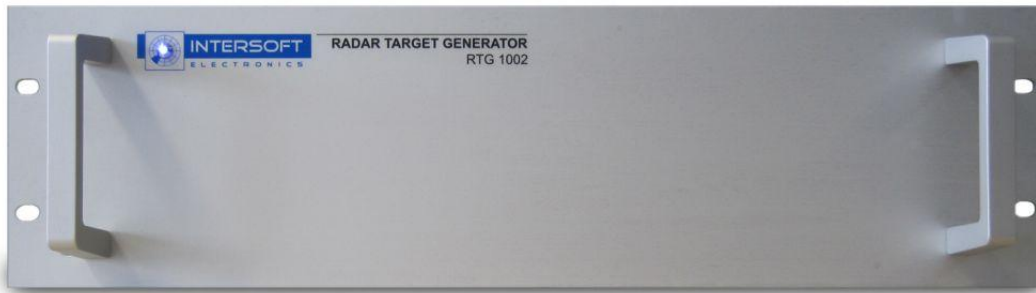




# User Manual RTG1002

## Radar Target Generator



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## CONVENTIONS USED



***Note: This icon to the left of bold italicized text denotes a note, which alerts you to important information.***



***Caution: This icon to the left of bold italicized text denotes a caution, which alerts you to the possibility of data loss or a system crash.***



***Warning: This icon to the left of bold italicized text denotes a warning, which alerts you to the possibility of damage to you or your equipment.***





## GLOSSARY OF TERMS

<b>ACP</b>	Azimuth Change Pulse
<b>ADS-B</b>	Automatic Dependent Surveillance, Broadcast
<b>Annex 10</b>	Aeronautical Telecommunication, <i>Annex 10 to the Convention on International Civil Aviation</i> , the principle international document defining SSR
<b>ARP</b>	Azimuth Reference Pulse
<b>ATC</b>	Air Traffic Control
<b>COTS</b>	Commercial Off The Shelf
<b>CPU</b>	Computer Processing Unit
<b>CW</b>	Continuous wave
<b>dB</b>	Decibel
<b>Downlink</b>	The signal path from aircraft to ground
<b>FL</b>	Flight Level, unit of altitude (expressed in 100's of feet)
<b>FRUIT</b>	False Replies Unsynchronized In Time, unwanted SSR replies received by an interrogator which have been triggered by other interrogators
<b>GPS</b>	Global Positioning System
<b>ICAO</b>	International Civil Aviation Organization
<b>ICD</b>	Interface Control Document
<b>IE</b>	Intersoft Electronics
<b>IF</b>	Intermediate Frequency
<b>I/O</b>	Input/Output
<b>IP</b>	Internet Protocol
<b>LAN</b>	Local Area Network
<b>LVA</b>	Large Vertical Aperture (antenna)
<b>Monopulse</b>	Radar-receiving processing technique used to provide a precise bearing measurement
<b>MSSR</b>	Monopulse Secondary Surveillance Radar
<b>MTD</b>	Moving Target Detection
<b>MTI</b>	Moving Target Indicator
<b>Multipath</b>	Interference and distortion effects due to the presence of more than one path between transmitter and receiver
<b>NM</b>	Nautical Mile, unit of distance
<b>OEM</b>	Original Equipment Manufacturer
<b>Plot extractor</b>	Signal-processing equipment which converts receiver video into digital target reports suitable for transmission by land lines
<b>PPI</b>	Plan Position Indicator
<b>PRF</b>	Pulse Repetition Frequency
<b>PSR</b>	Primary Surveillance Radar
<b>Radar</b>	Radio Detection And Ranging
<b>Radome</b>	Radio-transparent window used to protect an antenna principally against the effects of weather
<b>RASS-R</b>	Radar Analysis Support Systems – Real-time measurements
<b>RASS-S</b>	Radar Analysis Support Systems – Site measurements
<b>RCS</b>	Radar Cross Section
<b>RDP</b>	Radar Data Processing (system)
<b>RF</b>	Radio Frequency
<b>RTQC</b>	Real Time Quality Control
<b>RX</b>	Receiver
<b>SAC</b>	System Area Code
<b>SIC</b>	System Identification Code



<b>SLS</b>	Side Lobe Suppression, a technique to avoid eliciting transponder replies in response to interrogations transmitted via antenna sidelobes
<b>SLB</b>	Side Lobe Blanking
<b>SNR</b>	Signal-to-Noise ratio
<b>Squitter</b>	Random reply by a transponder not triggered by an interrogation
<b>SSR</b>	Secondary Surveillance Radar
<b>STC</b>	Sensitivity Time Control
<b>TACAN</b>	Tactical Air Navigation
<b>TCP</b>	Transmission Control Protocol
<b>TIS-B</b>	Traffic Information Services, Broadcast
<b>Transponder</b>	Airborne unit of the SSR system, detects an interrogator's transmission and responds with a coded reply stating either the aircraft's identity or its flight level
<b>TX</b>	Transmitter
<b>Uplink</b>	Ground-to-air signal path
<b>UTC</b>	Coordinated Universal Time



## 1. TECHNICAL MANUAL RTG1002

This document will describe the technical aspects of the Radar Target Generator RTG1002 and its usage in three different setups:

1. As a remote test target in a far field setup, using antennas.
2. As 'On site - target injection' connected directly to the radars' Rx.
3. In combination with a towertrack, simulation of ballistic trajectories, is possible in the far field.

### 1.1. Introduction

This document describes the use of the Intersoft Electronics' Radar Target Generator (RTG1002) for Primary Radar purposes. The RTG1002 is basically designed to generate primary radar returns and can be placed in the field (Remote Test Target) or connected to a radar (on site target injection), in this setup a target can be generated on two channels, the two beams of an ATC radar for example.

In all cases, the RTG1002 will detect and preserve the radar pulse, apply a fixed and highly precise delay and retransmit the pulse with the appropriate power, pulse-width, frequency and Doppler shift.

The RTG1002 or Radar Target Generator is the key element to provide a true and correct Primary Radar Environment Simulation. The design was kept versatile, covering with one design the L and S band.

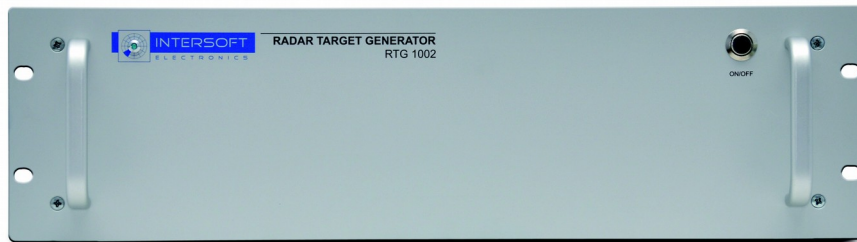


Figure 1: RTG 1002 front panel

For C-band frequencies there is RTGC1062

For X-band frequencies there is RTGX1063.

For UHF-band frequencies there is RTGU1085.

### 1.2. Key Features

The Radar Target Generator produces one or multiple programmable test target(s). The range, speed, Doppler speed, radar cross section and swerling model are programmable.

The target can be generated either remote from the field, passing through the radar antenna or injected via a coupler for what is called 'on site target generation'. On site injection allows to inject multiple targets in various directions on top of real clutter.



### 1.3. Hardware Description

#### 1.3.1. Block Diagram

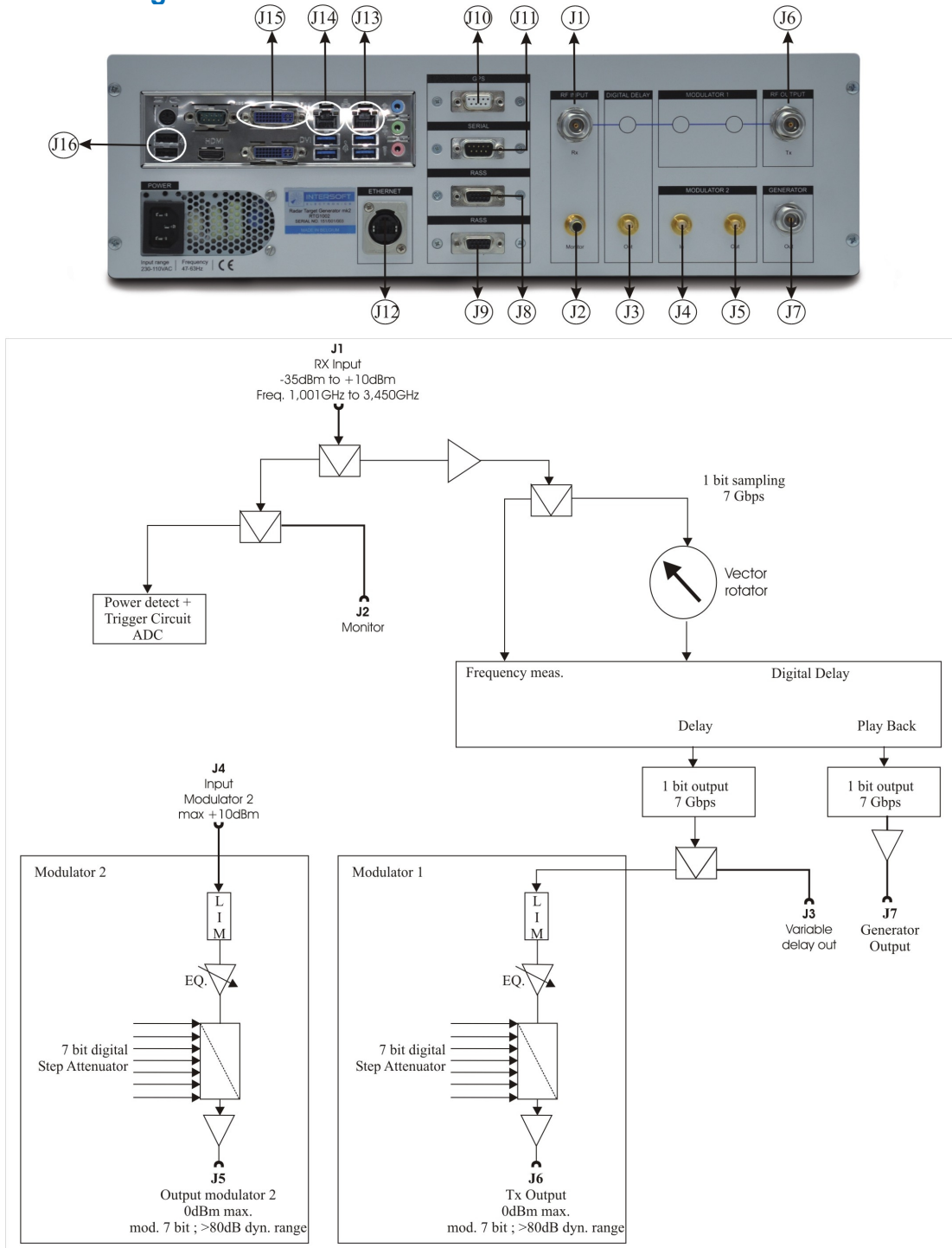


Figure 2: Block Diagram RTG1002



### 1.3.2. Connectors

- J1 – Rf Input Rx : +10dBm ..-30dBm , 1001MHz .. 3450MHz
- J2 – Rf Input Monitor : output for monitor purposes = Rx input - 8dB
- J3 – Digital Delay Out: delayed signal, unequalized
- J4 – Modulator 2 In : maximum input level +10dBm, +30dBm no damage
- J5 – Modulator 2 Out :equalized output vs freq. maximum output level 0dBm
- J6 – Rf Output Tx : equalized output vs freq. maximum output level 0dBm
- J7 – Generator Out : output of white noise generator, -10 dBm maximum integrated output power
- J8 – RASS : Rass – bus, interface for encoder signals, trigger out and Gate output.
- J9 – RASS : Rass – bus, the same bus interface for encoder signals, trigger out and Gate output
- J10 – GPS : DB9 connector for NMEA-protocol like Intersofts' compact weatherproof GPS, P619
- J11 – SERIAL : serial output ICARUS or towertrack, motor control.
- J12 – ETHERNET : connection to control the RTG1002 hardware.
- J13 – Network 1 : local embedded PC network connection equivalent to J14
- J14 – Network 2 : local embedded PC network connection equivalent to J13
- J15 – DVI: Digital Video Interface, display output
- J16 – USB2.0 : USB connection for keyboard and mouse.

## 2. REMOTE TEST TARGET

### 2.1. Theory


For Remote Test Target (RTT) usage the RTG1002 is deployed in the field, typically connected to two small horns or Log Periodic Antennas positioned on a pole or tripods with a limited height. This way, the radar antenna system becomes part of the test. The area where a target can be simulated is limited to the azimuth of choice and a range further than the chosen position. The simulated target can be moving radial or be fixed.

The fixed target can appear as point clutter (no Doppler) or can have a simulated Doppler frequency.

### 2.2. Software



**Warning:** Before you start making connections, estimate/calculate the distance of the set-up. Whenever you are close to the radar (<200m) add some attenuation to Tx and Rx plug before you make the setup. The maximum power level at the input should not exceed +10dBm and the power level at the output should not exceed +20dBm.

1. Load the **RTG1002 PSR Target Generation** software from the **Scenario Generation**  button in the PSR Generation section of the RASS-S toolbox.
2. Make sure the network cable is connected between J12 and J13 or J14. Click the little white arrow in the top left corner to run the vi.



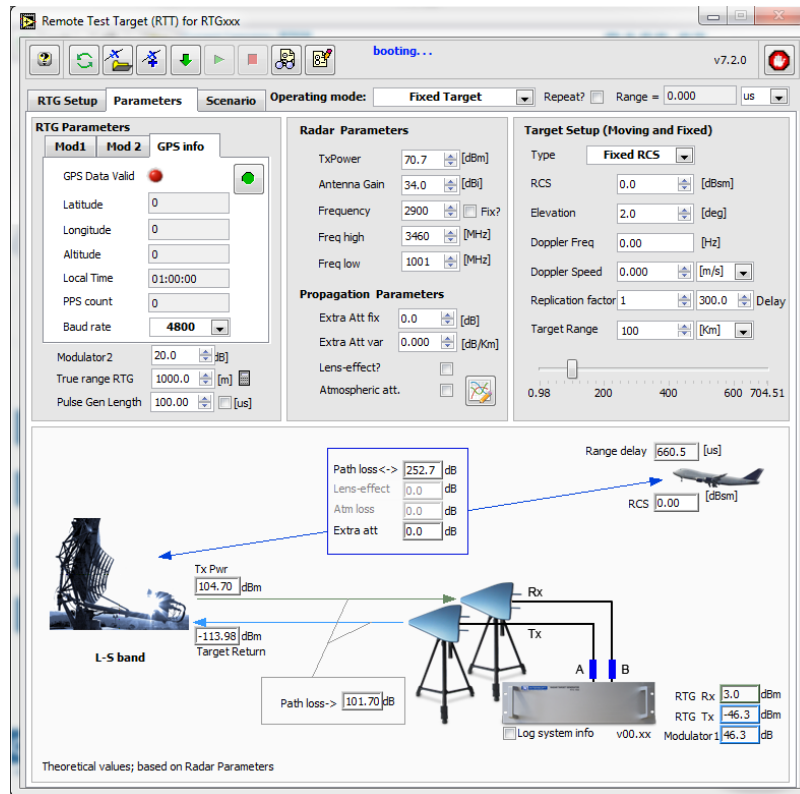
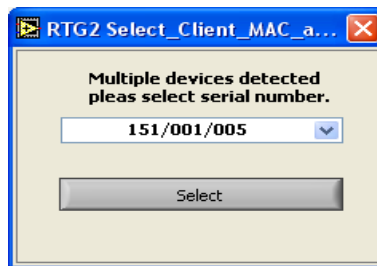


Figure 3: Booting, RTG parameters

- On every available network connection there will be checked if there is an RTG connected.



- If there is more than one target generator detected, connected to the same network segment (not via router but connected to a switch for example), a list will pop up and one can select which target generator to use. Then the calibration files and settings will be loaded into the FPGA to control the RTG1002. The HMI will indicate **Booting...**

If you want to control the RTG from another computer it's firewall must be turned off.

- It is possible to connect the RTG1002 to network switch instead of directly to the embedded PC. Then then RTG1002 can be controlled by multiple users but only one at a time. Warning: if a single RTG1002 is already controlled by another computer on a network, a second computer can also control the target generator. This situation must be avoided. When this situation occurs an indicator will warn about this. The other user may change parameters, like the trigger level in the hardware without any feedback in your application. The data stream of the received pulses will split up in two



data streams to the two users, so half of the received pulses could be missing. There could be gaps visible in the shape of the received beam.

### 2.2.1. Parameters tab

These parameters must be downloaded into the hardware before they can have an effect.

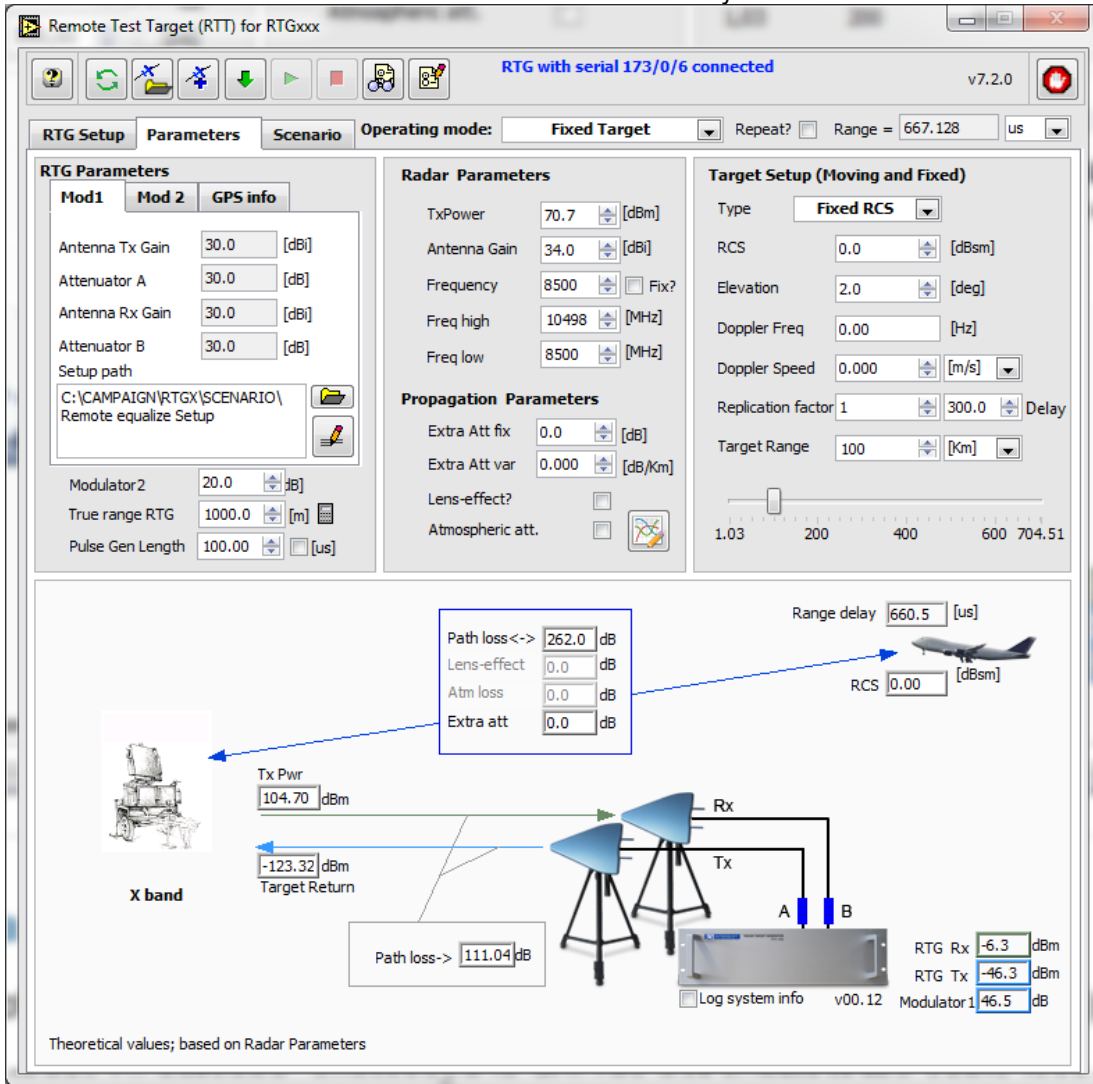


Figure 4: Parameters for the radar equation

#### 2.2.1.1. Radar parameters

**Tx power:** peak power of radar transmitter (subtract cable loss towards the radar antenna)

**Antenna gain :** Gain of radar Tx antenna, expressed in dBi (do not subtract the cable loss again)

**Frequency :** This frequency is used in the didactical panel to simulate the radar equation, for the test target. This frequency will be used to display the correct levels for the trigger in the RTG setup software tab. This frequency will be used for the power detector when the pulse data is displayed in scope mode (when the frequency is not yet measured).



**Freq High and Freq Low** : If Operating mode = Fixed target or Moving target, then these two parameters are used to clip the measured frequency to one of these limits when it is outside the interval [Freq low ..Freq high].

If Freq High is < 1401MHz then an L-band Low pass filter is used after the vector rotator before the sampling of the digital delay line. This will avoid harmonics of the Doppler rotation from being sampled. Therefore it is better to limit freq high to <1400MHz for L-band radars.

If Operating mode = white noise generation, then these two parameters will determine the bandwidth of the noise spectrum, reducing the bandwidth will increase the power/MHz for the noise signal. The maximum integrated power available at the generator output is around -10dBm.

**2.2.1.2. RTG parameters**

Antenna TX gain [dBi] , Attenuator A [dB] , Antenna Rx gain [dBi] , Attenuator B [dB]:

These parameters can be entered versus frequency. Cable loss can be compensated for every frequency, since RTG1002 will perform a frequency measurement on the received pulse. In order to verify the correct use of the tables for compensation of the cable loss it is possible to display the Rx power and the Rx antenna power

1. CALCULATE the maximum peak power received by the RTG antenna. Take the following parameters into account radar Tx power and frequency , radar (Tx) antenna gain, distance of the setup and the gain of RTG Rx antenna. You can use the didactical panel in the software to assist the calculations.
2. CALCULATE the attenuation needed for Attenuator B in the setup to reduce calculated peak power to +10dBm (trigger level possible +10dBm ... -35dBm RTG1002 or +5dBm ..-40dBm for RTGX). Enter the value and check the value for RTG Rx .... dBm.
3. Connect antenna, cables and attenuators to receive the pulses from the radar.
4. Create or load an equalize table for Attenuator B. This table will compensate variations in the cable loss vs frequency. You can add cables, attenuators, power splitters or amplifiers,... one by one.

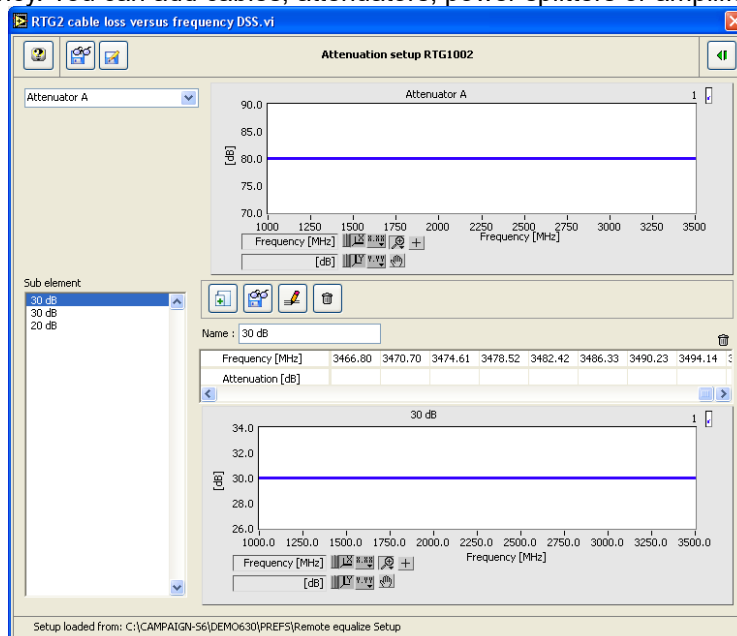


Figure 5: Attenuator A vs frequency for modulator 1





In the example of the previous figure attenuator A consists of 3 separate components: 2 attenuators of 30dB and 1 attenuator of 20dB, the total amount would be 80dB.

The loss of a cable depends on the frequency and the cable length. If for example an attenuation coefficient for the cable is 0.1dB/(m \*GHz), you should multiply it by the cable length in meter and the frequency in GigaHertz. If you have 10meter of cable the loss would be 1dB at 1GHz and 3dB at 3GHz.

You can enter a frequency table with multiple points, with a precision of 3.7MHz. The software will interpolate the values in between data points, but it will not extrapolate.

In the example of the cable, if it is described with only two points at 1 and 3GHz, the values inside the interval will be interpolated but the loss at 3.3GHz will be considered the same as at 3GHz. So it is necessary to describe the losses up to the minimum and maximum frequency of operation.

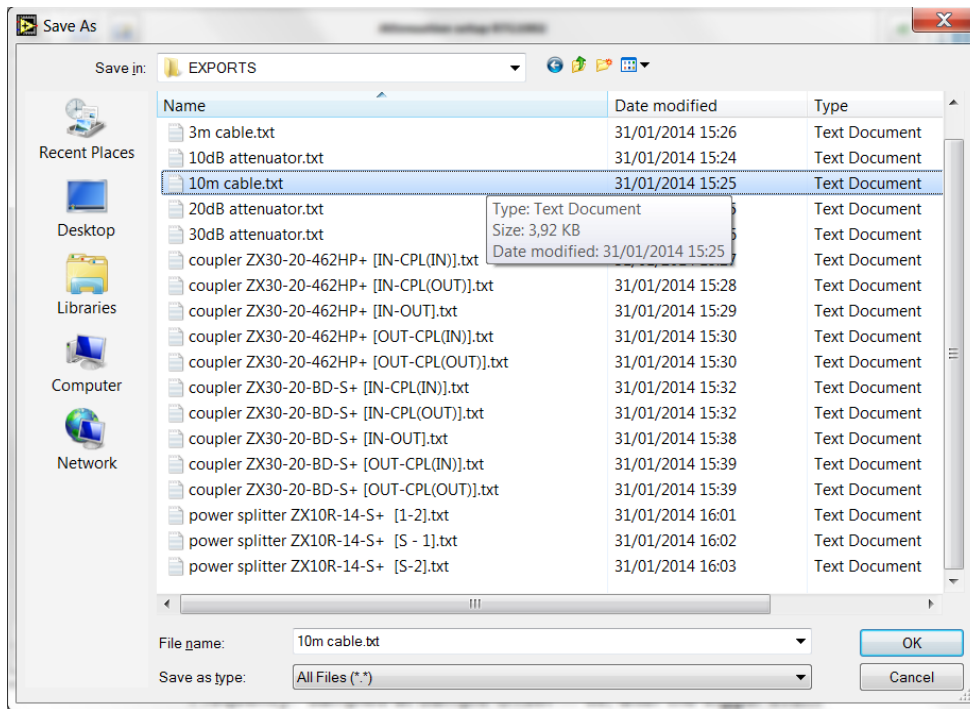


Figure 6: List of components supplied with RTG1002 loss vs frequency

1. The loss of the cable set and all microwave components for L- and S-band applications, supplied with RTG1002, have all been measured versus frequency. These files are available upon request or they could be found in the general campaign in the folder exports.
2. Look in scope view at the received pulses, adjust the parameters for the frequency measurement. If the radar uses different pulse lengths, the shortest pulse width will determine how to measure the frequency. The power level indicated in the scope view is only calibrated for the frequency entered as a parameter (the frequency is not yet measured in this view) and for the trigger level also.
3. Make sure the received peak power is the same as the predicted peak power. Especially when the adaptive beam modulation is used. Every dB of Rx power received less than the predicted peak power will be reduced from the calculated Tx power. If the powers do not match check the setup. Maybe there is a ground reflection that increases or decreases the power. If you can change the height of the antenna (possible on a tripod) a variation of 1 meter may already indicate this effect for S-band radar at a distance of a few hundreds of meter (depending on the radar height).
4. View the input data in **Pulse View** mode. The following views are available:

**RX power RTG input** : sampled at Sample Offset ... us, after the trigger event.



**Frequency:** counted, starting from Sample Offset ... us, after the trigger event during the 'frequency measurement period'

**Pulse width:** time between rising and falling edge of the trigger event. If the trigger level is at -3dB from the pulse level, then pulse width is measured the way it should be.

**Period:** elapsed time between the previous trigger event and current one.

**Rx antenna power:** = RX power RTG input + attenuator B f(measured frequency) [equalize table mod1]

**Tx power RTG output:** calculated power of the target, you can verify this power on a spectrum analyzer. Do not verify this power level on a broadband power detector, because of the spurious signals. You can see the real time effect of switching the adaptive beam modulation on or off in this view.

**Modulator 2:** = modulator 2 - attenuator A f(measured frequency) [equalize table mod2] - attenuator B f(measured frequency) [equalize table mod2]

This is the value of attenuation between the two SMA-connectors of modulator 2. If modulator 2 is used as an attenuator of -20dB for example but when it is connected with two cables of 2dB loss for the measured frequency, then the window will indicate the remaining decibels, in this example 16dB.

**Time stamp:** GPS time stamp of the trigger event, when GPS is connected. If no GPS then this is a relative time stamp. This may be useful to interpret the timing of the sidelobes of the antenna, when the trigger level is too low.

### 2.2.1.3. Target Setup Parameters

**Type:** The type control determines which swerling case type is being generated. You have the selection between Fixed RCS and Swerling case I through IV.

- A fixed RCS
- Swerling I modulates the pulse power from scan to scan with a Rayleigh distribution
- Swerling II modulates the pulse power from pulse to pulse with a Rayleigh distribution
- Swerling III modulates the pulse power from scan to scan with a modified distribution (in case of one main scattering element)
- Swerling IV modulates the pulse power from pulse to pulse with a Rayleigh distribution (in case of one main scattering element)

**RCS:** The simulated Radar Cross Section: This parameter determines the amount of power that is being reflected by a real target and as such also how much power the RTG1002 sends back to the radar. The power as it would be received by the radar in the simulated condition can be verified in the didactical drawing.

Following parameters are only relevant when the scenario mode is set to fixed target. For moving target, the scenario data is used:

- **Target Range:** this control sets the target range as it would appear on the radar's PPI or output data, for a fixed target. This control can be set by means of the slider or numerical control.
- **Elevation:** The elevation of the simulated target. This parameter is used to calculate the lens effect and the atmospheric attenuation for the target.
- **Doppler frequency:** This control allows the user to set the correct Doppler frequency for fixed (static) targets. For moving targets, the Doppler is automatically created using the target known



speed.

**Doppler speed:** The speed is linked to the Doppler frequency and visa-versa. If the user modifies the speed, the frequency is recalculated and when the user enters the frequency, the speed is recalculated.

### 2.2.2. Setup tab

The controls in this software tab have an immediate effect when they are changed, no need to download them first like the parameters.

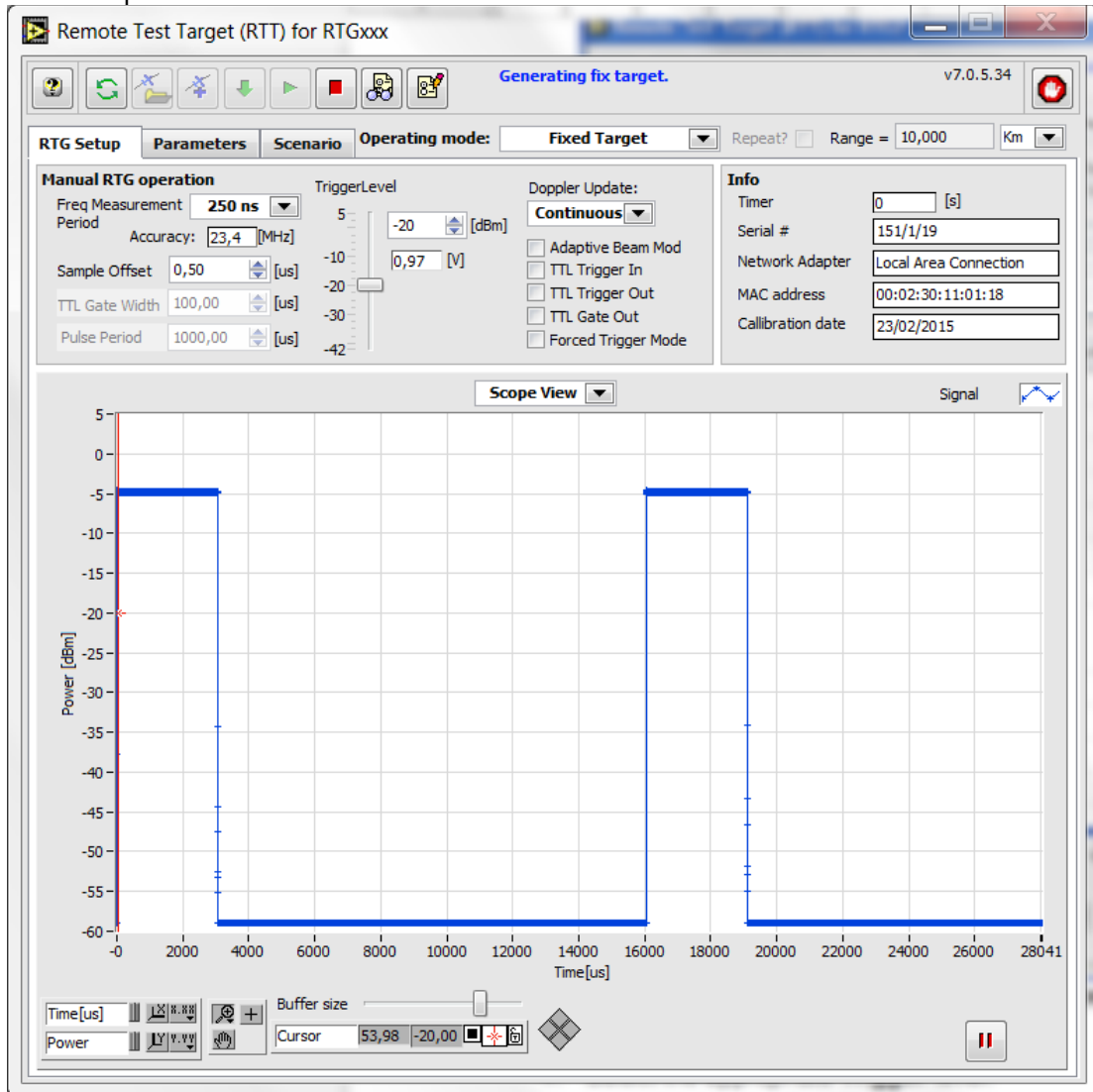


Figure 7: Setup tab, scope view of the received pulse

1. Select the appropriate **Trigger** level.
2. In scope view it is possible to increase the buffer size, to visualize very large pulse widths or very long pulse periods.



3. Pulse view in two windows, 8 different views are selectable from a drop down list, shown in the next figure.

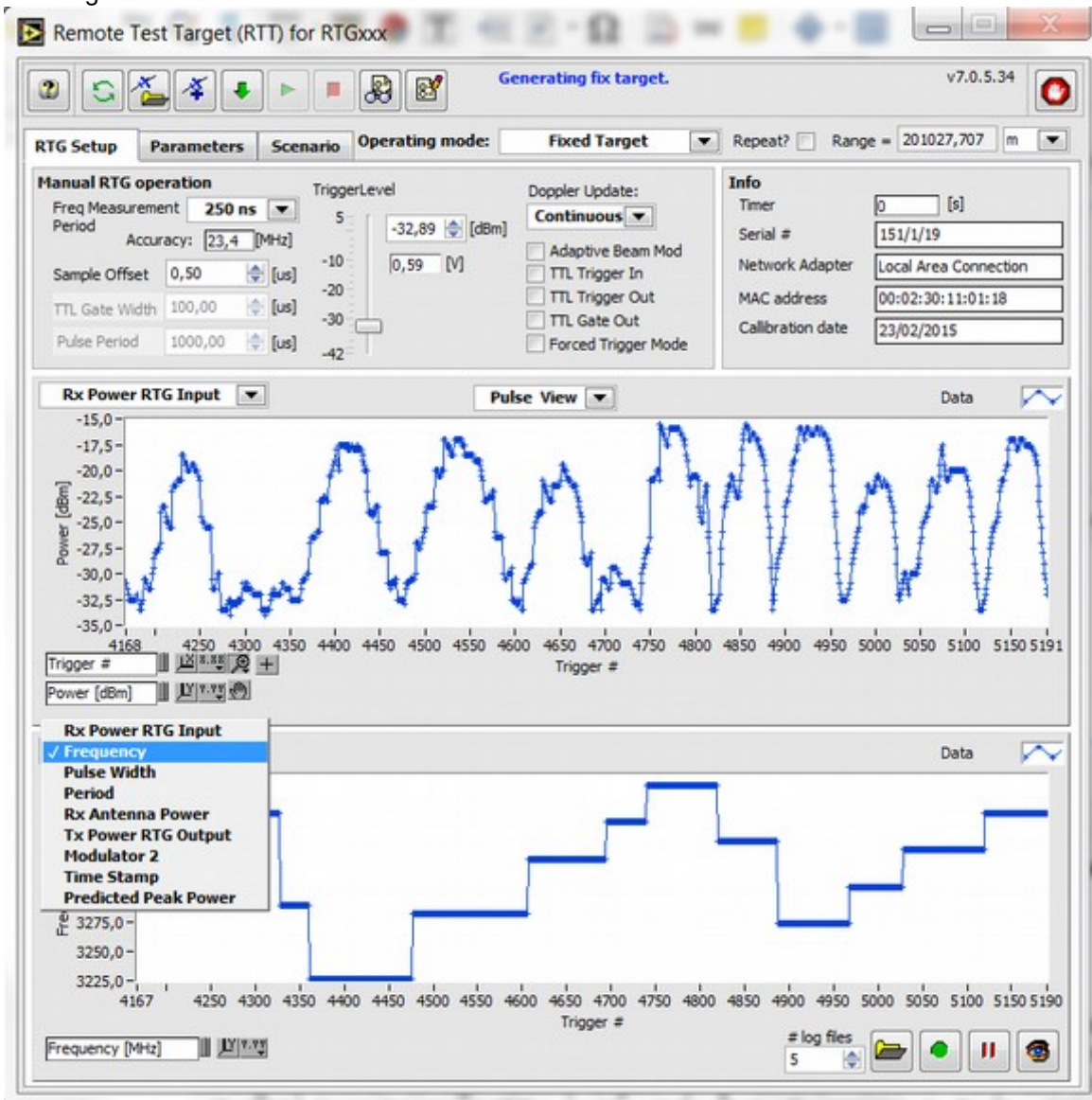


Figure 8: Pulse view with drop down list

4. **Doppler Update :**

**Continuous** will generate intrapulse doppler as well as interpulse doppler. It means that range updates (steps of 21.4 mm) can happen inside the returned pulse. As a result the pulse length can be slightly shorter for high velocity targets flying inbound. However the phase slope inside the pulse will still be linear because of the vector rotator that will compensate for the steps. A target with a speed of 214m/s will need a range update every 100us, If the radar pulse length is 50 us there is a 50% chance of an update in the pulse.

**Triggered** means the range will be updated from pulse to pulse, no range updates will happen inside the returned pulse. Therefore the pulse will have the same length as the received pulse. There will be no intrapulse Doppler shift, but only interpulse Doppler. The vector rotator will not rotating as long as the pulse is detected, but it will update its position with every new trigger event. This mode can be



used when analyzing the range Doppler compensation on high velocity targets.

- 5. **Forced Trigger mode:** Will allow the target generator to create trigger events every Xus (determined by the pulse period) It allows to delay continuous wave signals, could be useful on FMCW radar.

On pulse Doppler radar, this checkbox should be off, for normal operation.

- 6. **Adaptive beam modulation:** when OFF, RTG1002 will return the signal level calculated in the didactical panel, regardless of the power that was received. This behavior is similar to the operation of RTG698, predecessor of RTG1002. When ON, the return power of RTG1002 will be adjusted according to the received power, the calculated peak power will be used as a relative reference.

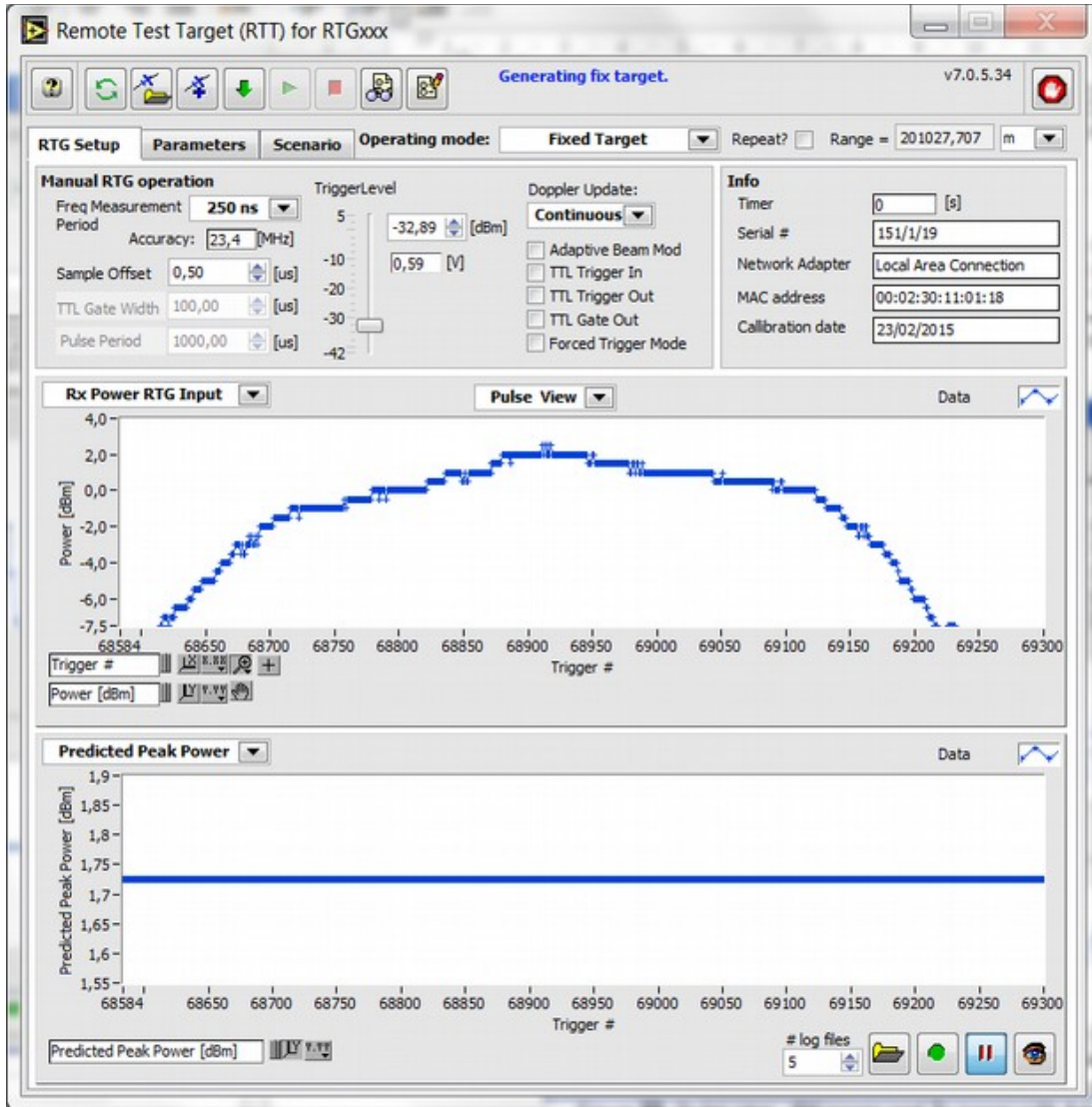


Figure 9: Predicted peak power should match the maximum received power level

- 7. The predicted peak power is displayed in the didactical panel, it can also be viewed in the pulse view window of RTG setup.



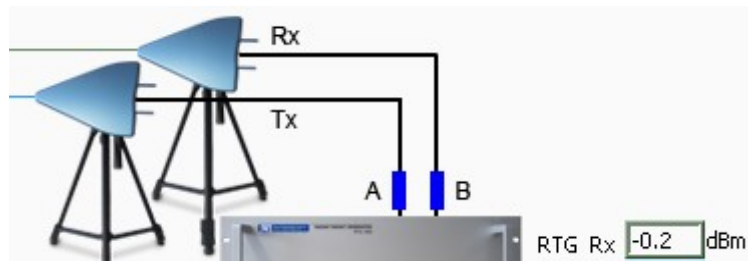


Figure 10: Predicted peak power in the didactical panel

- 8. The predicted peak power is -0.2dBm in this example and the peak power measured on the beam dwell is +0.5dBm. Then RTG1002 will return 0.7dB less than precalculated peak power level for the test target with a given RCS. This will generate a more realistic test target especially when the radar has the ability to point the transmit beam in different ways. On the other hand it will double the effect of 'not taking the cable loss into account' on the generated RCS, so it should be used with some precaution.

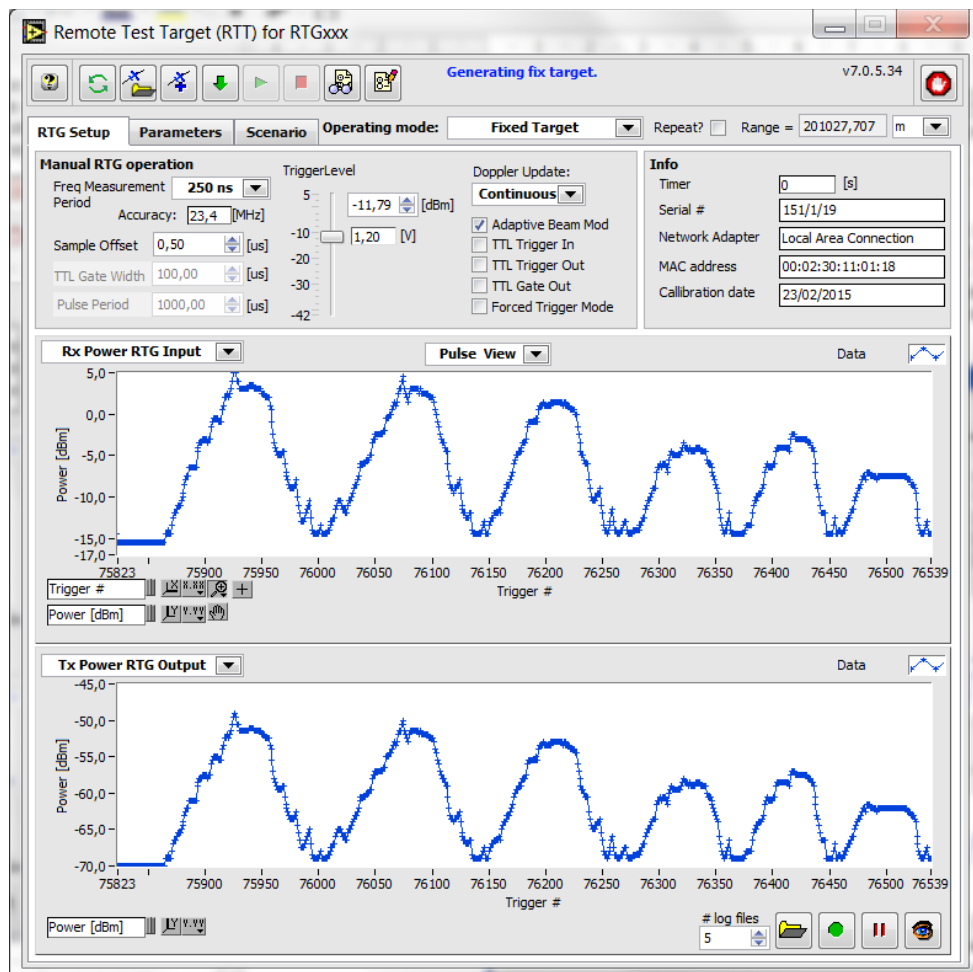
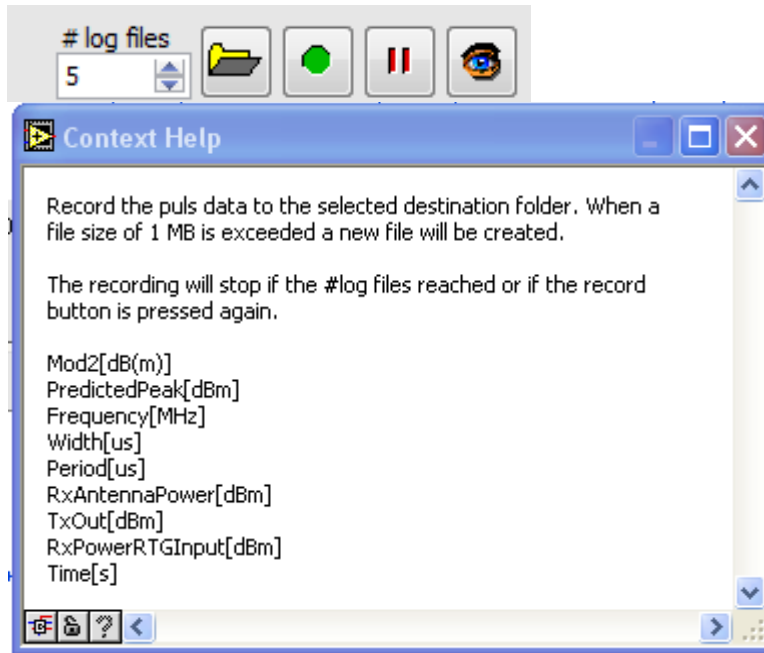


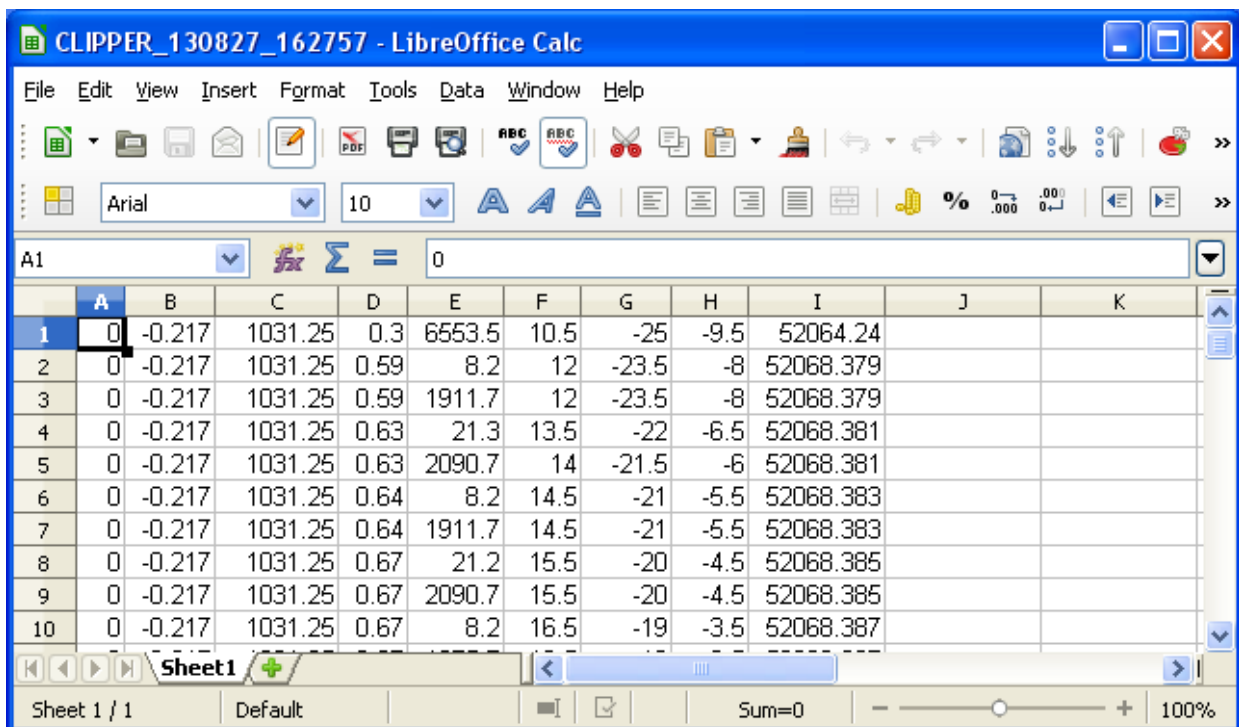
Figure 11: Pulse view , RX power and Tx power with Adaptive Beam Modulation ON, fixed target

- 9. The data, available in pulse view, can be recorded in a logfile.





This TAB separated file can be opened as a spreadsheet import.



10. The Log file can be converted into a .pls file



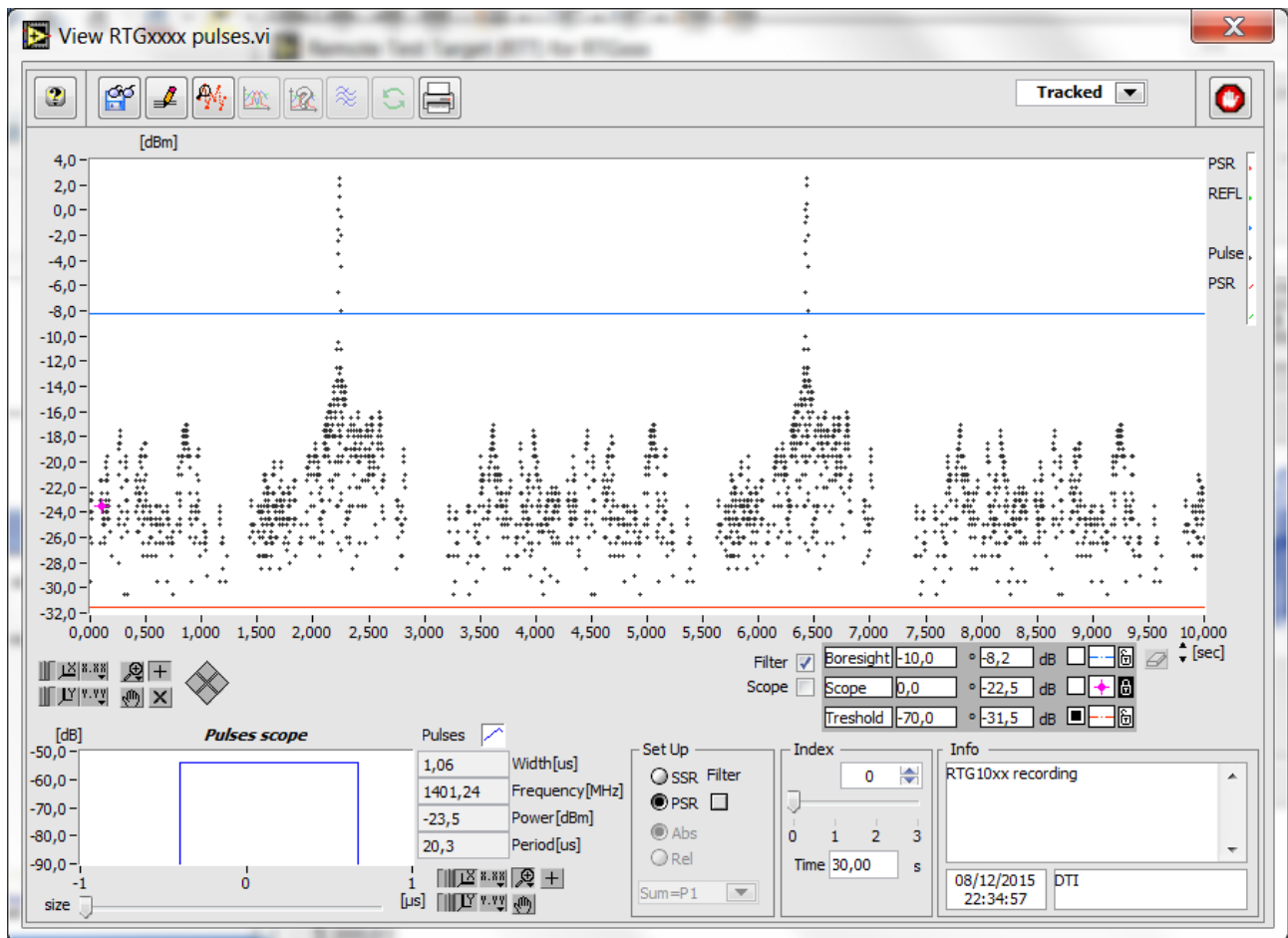


Figure 12: Pulse view of RTG recording





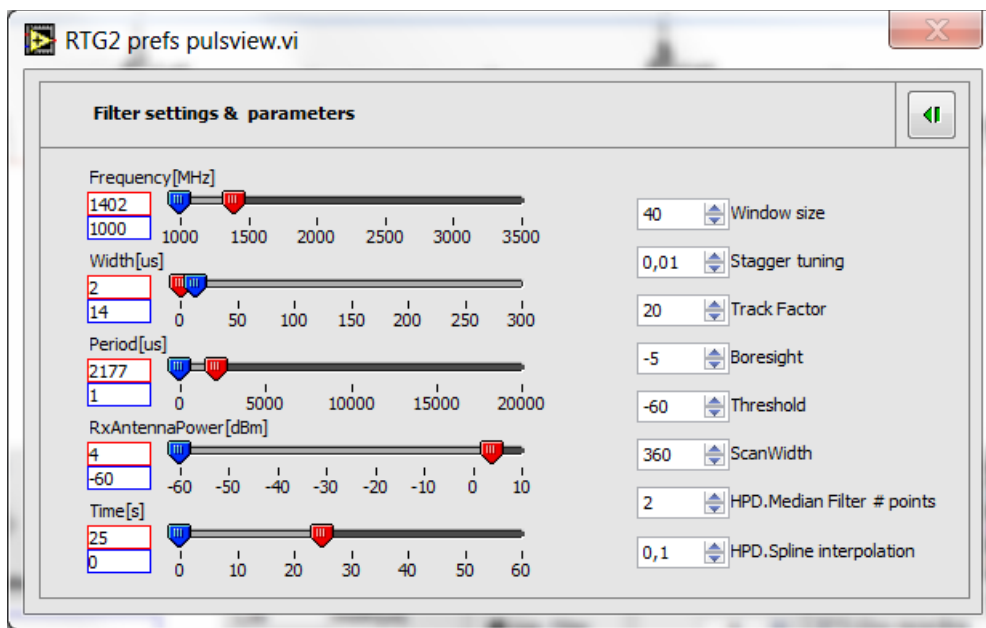


Figure 13: Filter setting and parameters of the RTG pulse viewer



### 2.2.2.1. Didactical Panel

The didactical panel contains a number of calculated power fields, each of which is calculated from the parameters entered above. The most important result from these calculations is the predicted RTG output power and thus the modulator settings. When adaptive beam modulation is ON, the input power is just as important, make sure it is within the linear range of (+10 .. -35dBm).

There is more than 90dB dB of dynamic range to modulate the output power on all RTG models. This corresponds to more than 7 range octaves (12dB) or a max range/min range ratio of 128. In other words, if you match all the attenuators of the setup perfectly and leave 18 dB of margin for the beam modulation it would be possible to fly one specific sized target from 1nm up to 64nm using the full 90dB modulator range.

This didactical panel will help the user to figure out what is possible and what not with the current attenuator values. This has to be done both in hardware and in software.

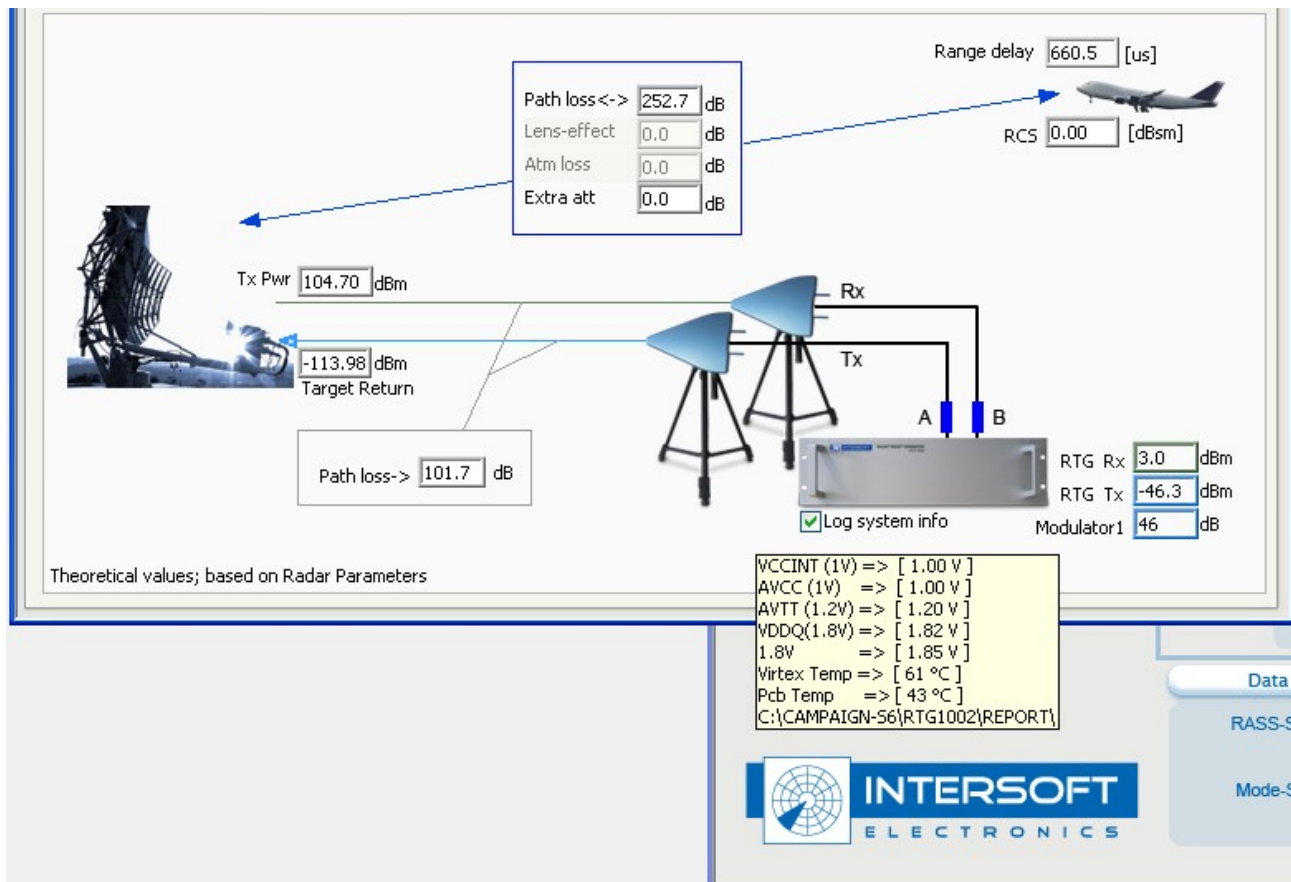


Figure 14: Didactical panel with system info being logged

When the checkbox under the picture of RTG1002 is selected, a log file with system info is created in the current campaign\report. During the design of this device it has been useful to have this information, some of the voltages have proven to be very critical. The temperature could be useful, the rest is intended to find a potential problem. The log file will not exceed 1MB filesize, so it is easy to send to Intersoft Electronics for analysis.

### 2.2.3. Scenario Tab

You can view the selected scenario in the scenario tab, when it is compiled, downloaded to the hardware. select the **Scenario** tab.

- The scenario graph shows you the scenario range or speed versus time.
- The Y scale menu allows selection between range in [Km], [Nm] or [us]. Also the speed can be seen in [m/s], [Nm/h] or the power can be checked.

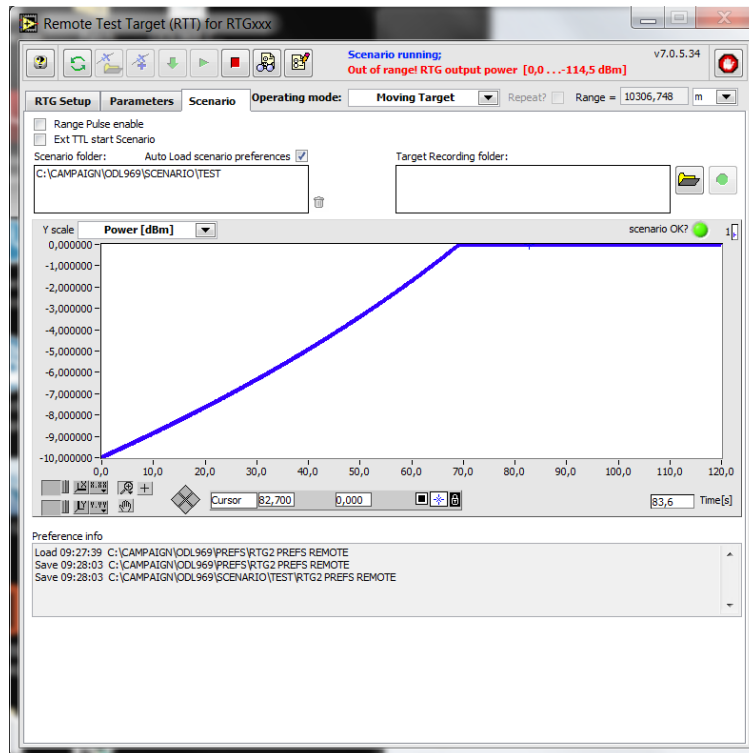


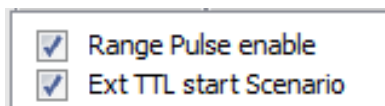
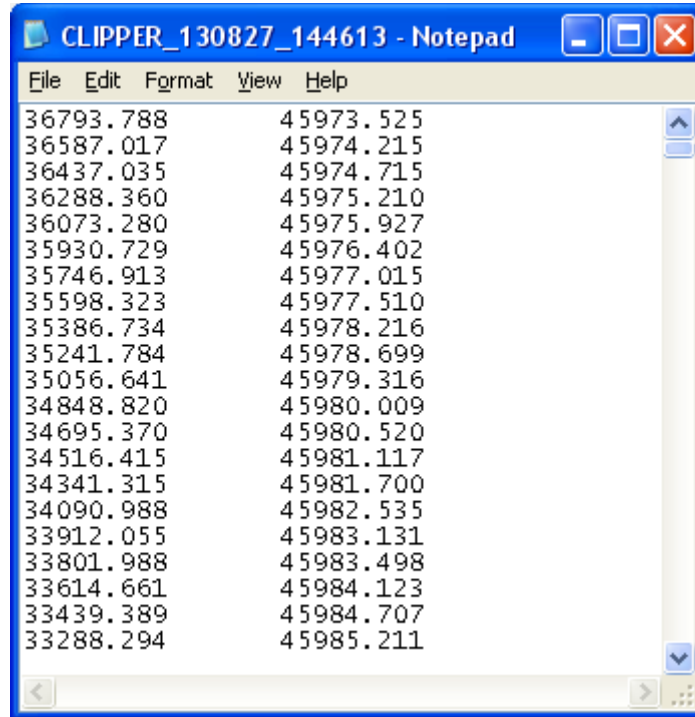
Figure 15: Power vs time of the scenario

- The output power will clip at 0dBm. There is no warning when you prepare the scenario if some levels are out of range. The warning **Out of range! RTG output power [0.0 ... -114,5dBm]** will be displayed when the clipped scenario is running and when this error happens, in case of the example after more then 1 minute. Therefore, one should check the power levels calculated for the scenario in advance. Decrease the value for attenuator A, both in hardware and software to avoid such a situation.
- The scenario can be recorded when it is running, A log file of range vs time (UTC time when GPS is connected) is created each time the scenario runs. This file can be used to determine the range accuracy or process delay of the radar. When the scenario is repeated a new file is created each time with the system time in the filename.

The text file contains two numbers  
 target range, expressed in meter: 36793.788m  
 Seconds past UTC midnight 45973.525 sec (when valid GPS data is connected)  
 the file in the example was created on 14h46m13sec in a time zone UTC +2

OR when there is no valid GPS data connected the time is just a relative time stamp of the seconds that have past after booting RTG1002.






For the towertrack application: the checkbox **Range Pulse Enable** will create a TTL pulse on the grey BNC every crossing of a 100m marker in the scenario relative to the radar.

The checkbox **Ext TTL start scenario** will make the target generator wait for a start event. This start for the scenario will be generated by the motor when it is IN POSITION, in case of the towertrack application.

### 2.2.4. Scenario Definition Window

In order to define a scenario, click the **Scenario definition**  button.

This window allows you to define the scenario of the flying target.



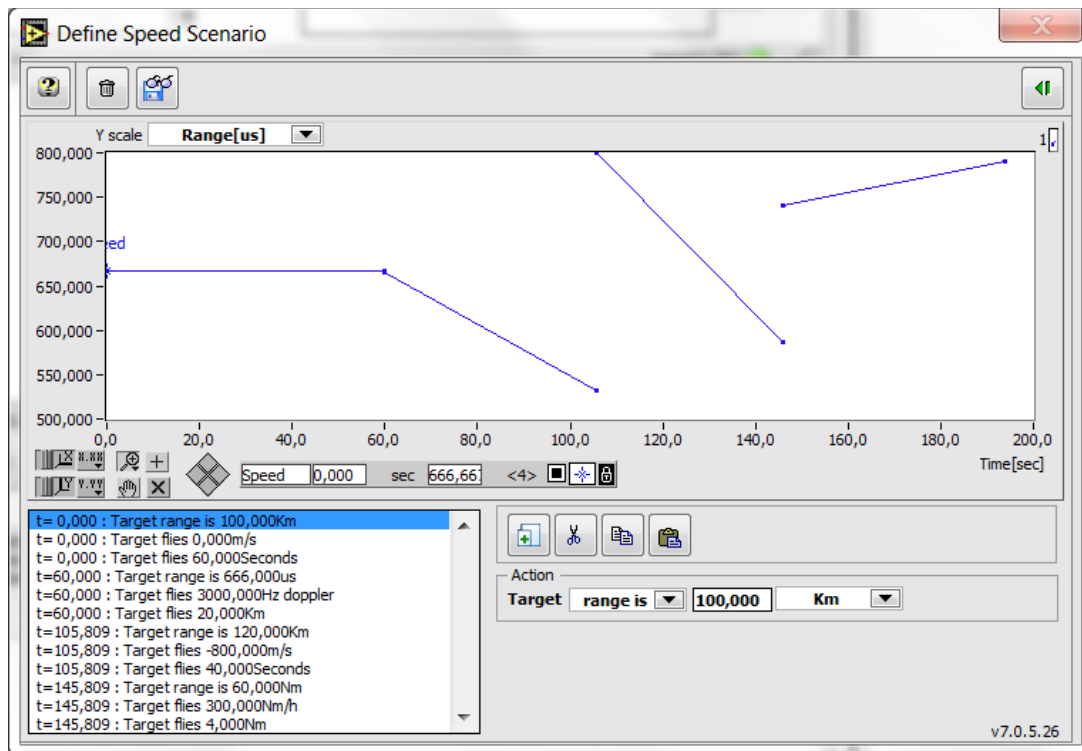


Figure 16: Define speed scenario

Creating a scenario goes in three steps, usually:

1. range (m, km, us or Nm)
2. speed (m/s, km/h, Nm/h or Hz Doppler (for frequency for the parameters tab))
3. duration (seconds, Nm or km)

A typical beginners mistake would be to define first range and duration and then speed, this would create a problem when the duration is expressed as a distance (the speed used would be 0m/s, it would take forever to cross the distance resulting in a lack of memory type of error).




### 3. ON SITE TARGET INJECTION

#### 3.1. Theory

For on site target injection RTG1002 is directly connected to the radar. In this way, multiple targets can be generated in various directions, on top of the existing radar environment, the current clutter situation. Targets can be programmed freely with any speed or RCS as long as there is only one target generated per beam dwell. If you want to test the resolution of the radar, resolving a 2 target overlap, you'll need two target generators.

The vertical antenna diagram can be loaded from a file for simulation. If the radar has two antennas on reception like most of the ATC radars, these two beams can be simulated simultaneous.

#### 3.2. Software

1. Load the **RTG1002 on site Target Generation** software from the **Scenario Generation**  button in the PSR Generation section of the RASS-S toolbox.

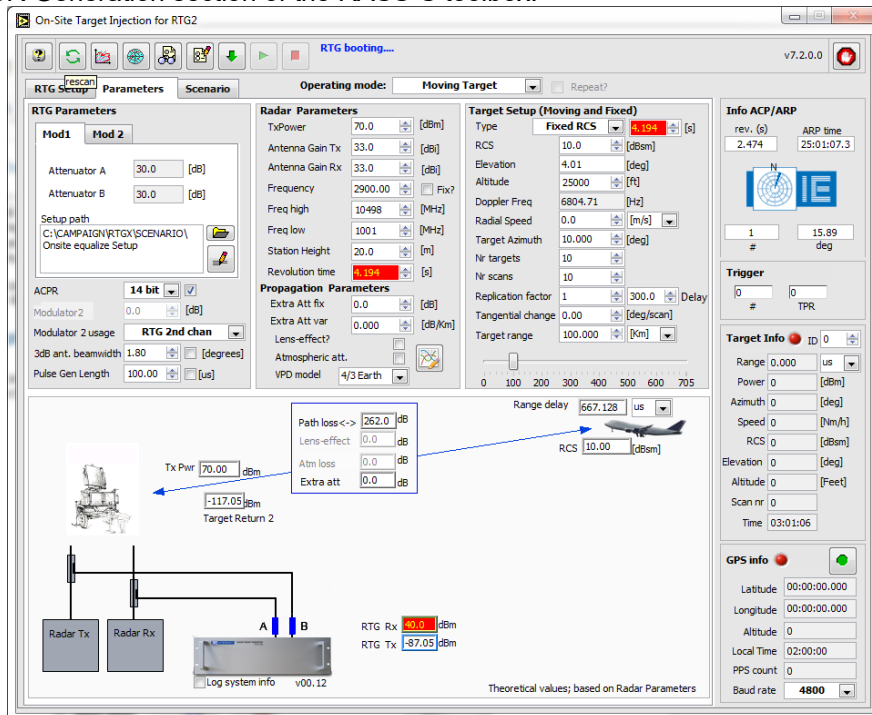


Figure 17: Booting , RTG parameters

2. On every available network connection there will be checked if there is a target generator connected.

If there is more than one target generator detected, connected to the same network segment (not via router but connected to a switch for example) a list will pop up and one can select which target generator to use. Then the calibration files and settings will be loaded into the FPGA to control the RTG1002. The HMI will indicate **Booting...**



### 3.3. Parameters Tab

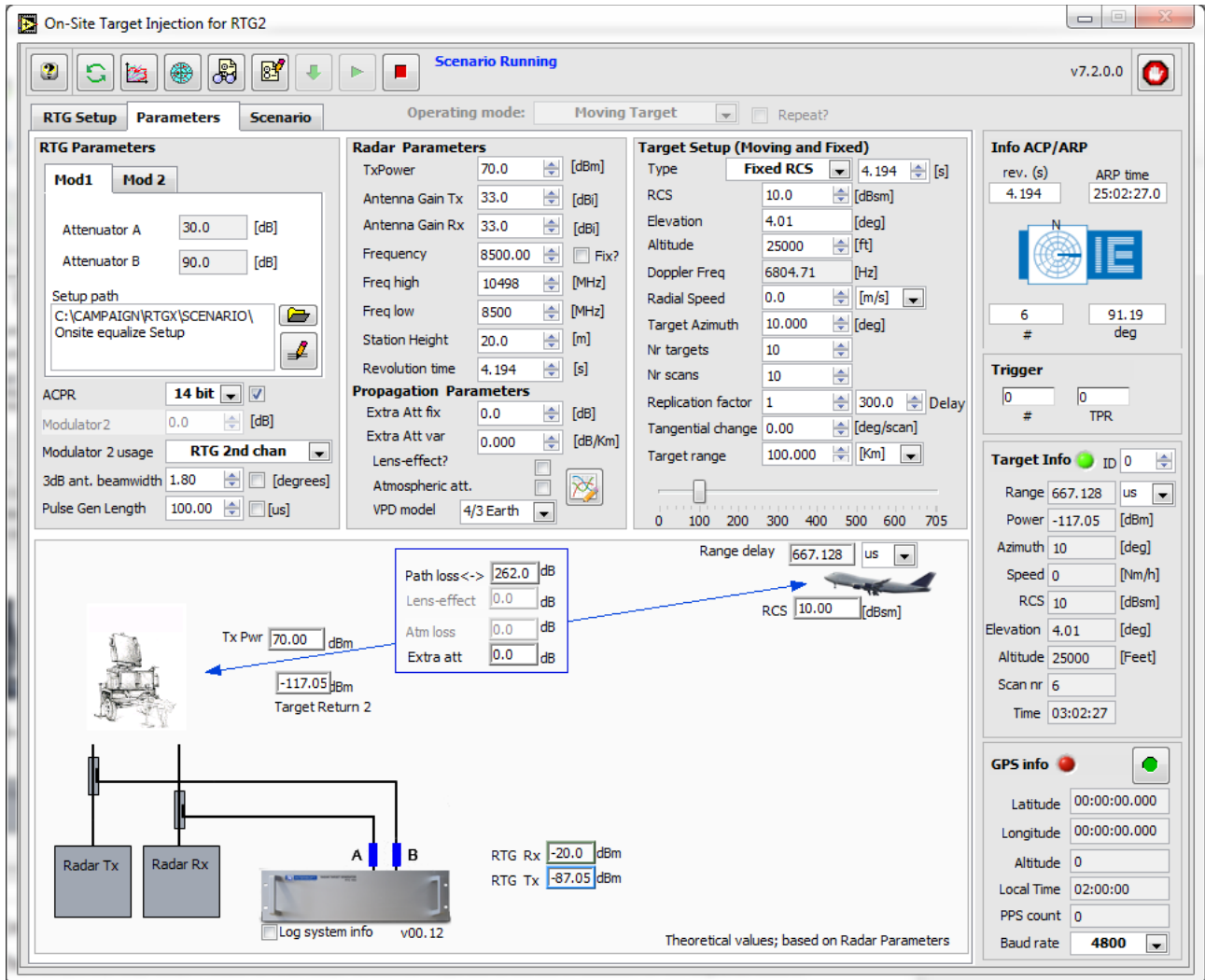


Figure 18: RTG on site parameters

3. Enter parameters of the radar, Tx power antenna gain of Tx antenna and Rx antenna.
4. The horizontal 3dB beam width of the radar antenna must be entered in section of RTG parameters. A typical value is 1.4degree for most ATC radar.
5. Next to the 3dB ant. beamwidth parameter is a checkbox 'flat beam enable'. When this checkbox is selected the horizontal beam modulation is disabled and the target will be generated over the 3dB beamwidth with the power level, calculated for the middle of the beam. You can use this function when you want to inject a ring with constant power level at a certain delay, when testing the receiver for example. In this case, increase the 3dB beamwidth to 360/number of targets.
6. Load a VPD file for the simulation, click on the third button in the toolbar.



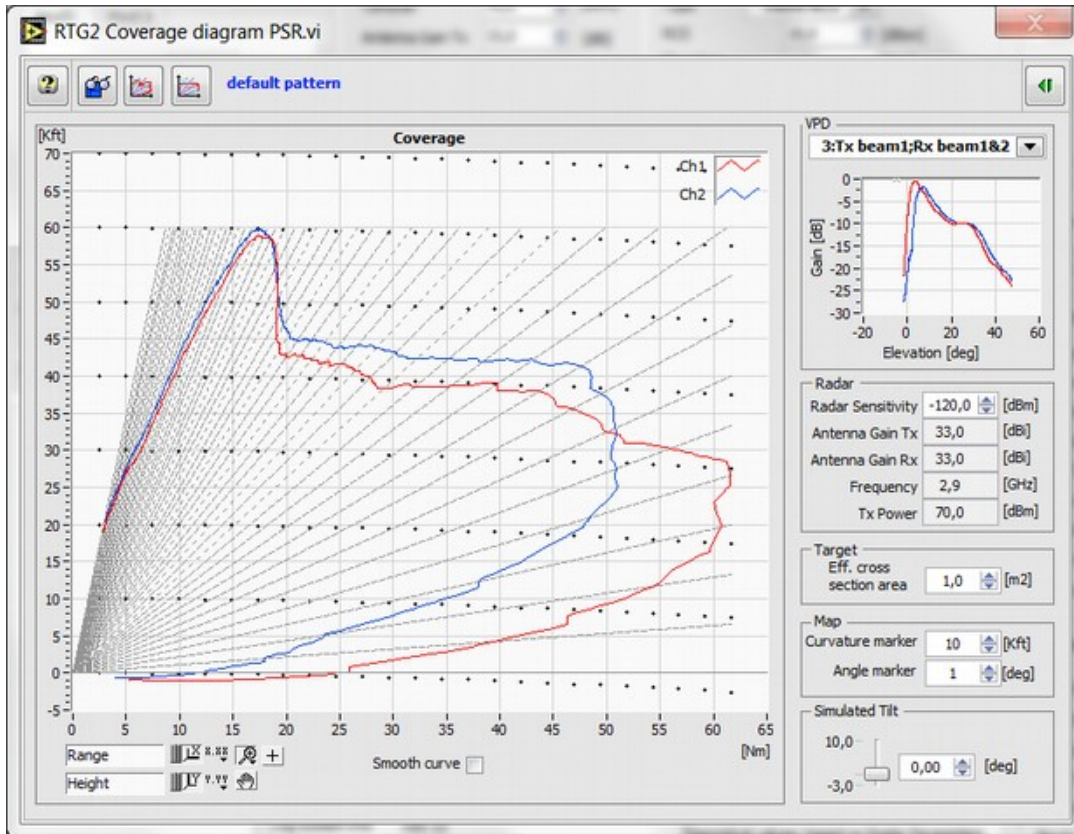



Figure 19: Default antenna diagram

7. The default antenna diagram, a typical ASR antenna with two antenna beams, is shown.
8. Use this  - button to select a vertical antenna diagram. A dialog will allow to select a tab separated file, a .slr or .vpd- file (file format from RASS-S for VPD, the result from a solar recording). If you click the cancel button, you can still use the default diagram. Just click the third button from the left.
- 9.

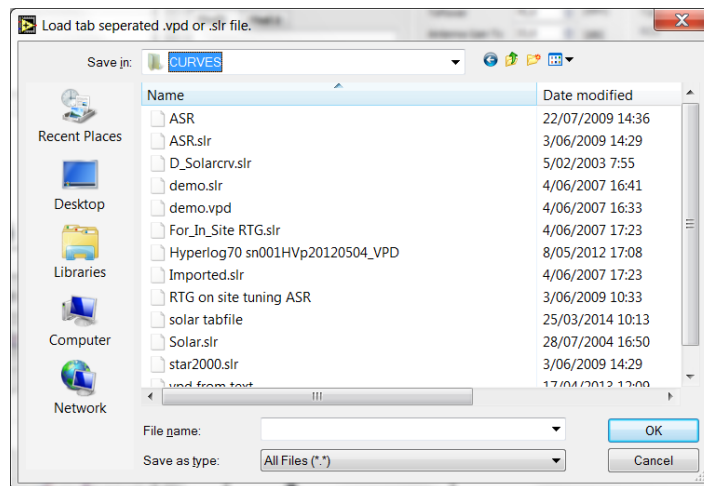


Figure 20: Select VPD curve





- 10. The radar coverage diagram will be displayed for the selected or the default VPD. Enter the correct Radar sensitivity, MDS level (after pulse compression and MTD).

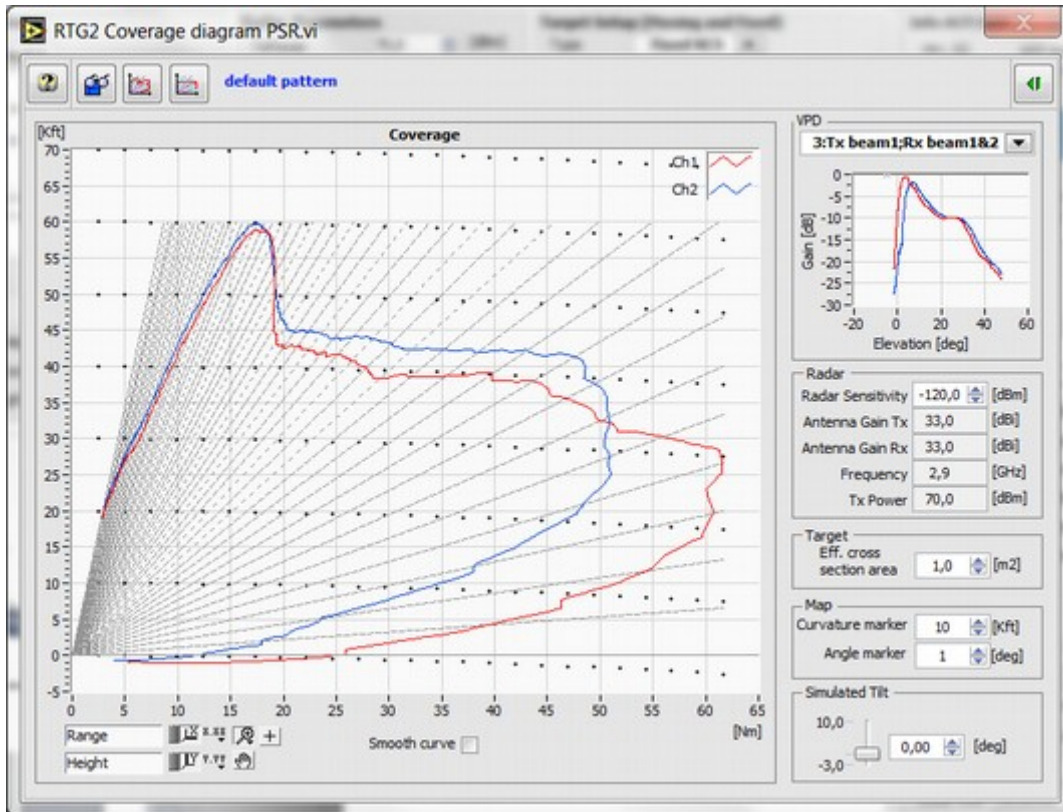


Figure 21: Radar coverage diagram, from a default antenna VPD

- 11. Sometimes you may need a constant power for a moving target, for this purpose there is a theoretical perfect cosecant square VPD available. The corresponding coverage diagram is therefore flat.



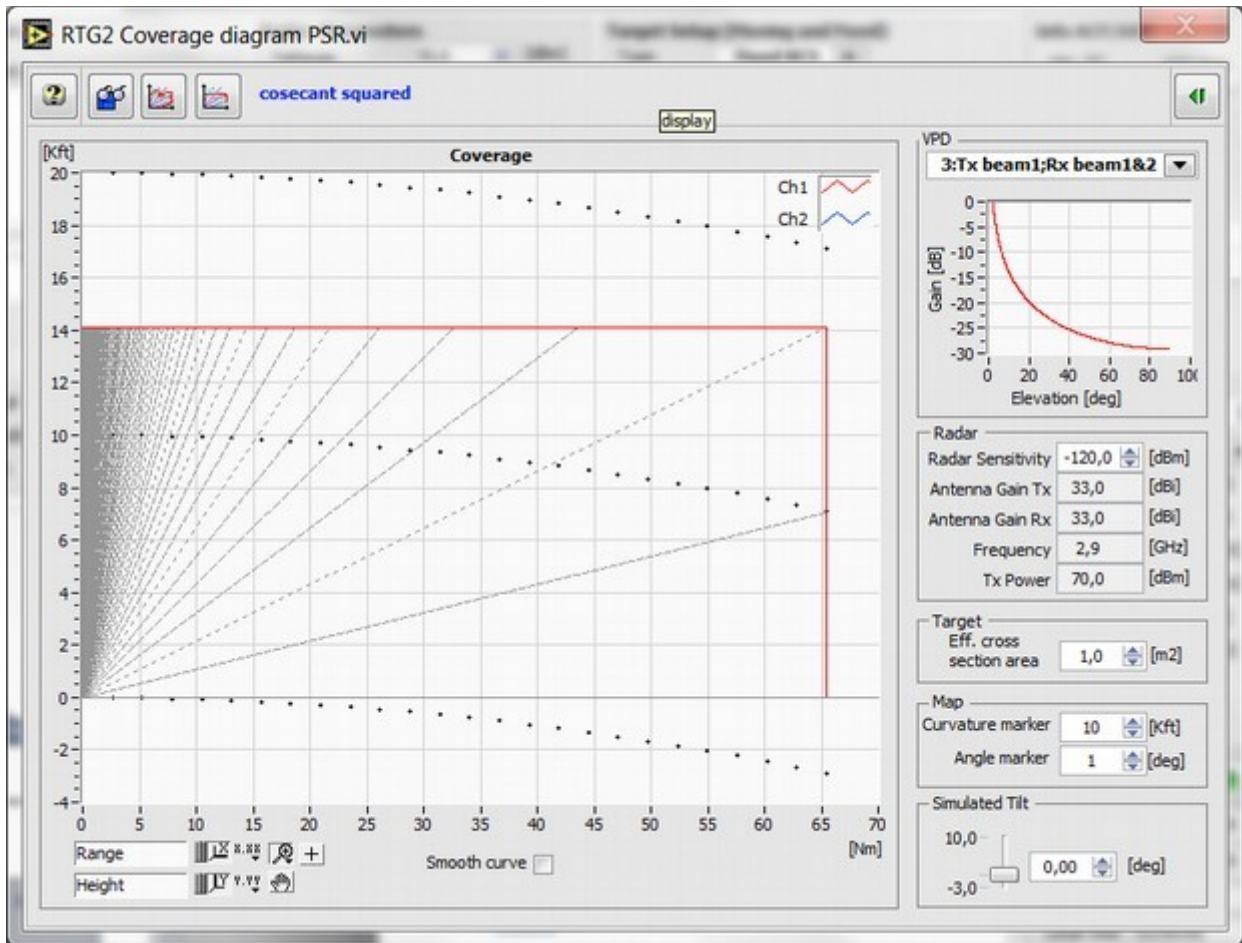



Figure 22: Coverage diagram for a theoretical cosecant square VPD

12. If you want to load a tab separated spreadsheet file, click  - button.
13. Enter **RTG Parameters** of the cables used in the setup. Create the connection between the radar transmitter and RTG1002 receiver, connector J1, preferably via a coupler or sufficient attenuation. The value of this coupler together with additional attenuators and cable losses is **attenuator B**, a software parameter. The input of RTG1002 is protected with a limiter (P1dB @ +11dBm), the input dynamic range is +5dBm ..-40dBm. Adjust the attenuator values to shift the peak power level within the dynamic range.
14. Create the connection between the RTG1002 output, connector J2, and the radar receiver preferably via a coupler so the antenna can still be used to receive some clutter. The value of this coupler together with additional attenuators and cable losses is **attenuator A**, a software parameter.
15. Attenuator A can be described vs frequency for modulator 1 and modulator 2. The description vs frequency for attenuator B is only available under modulator 1, since there is only one input.



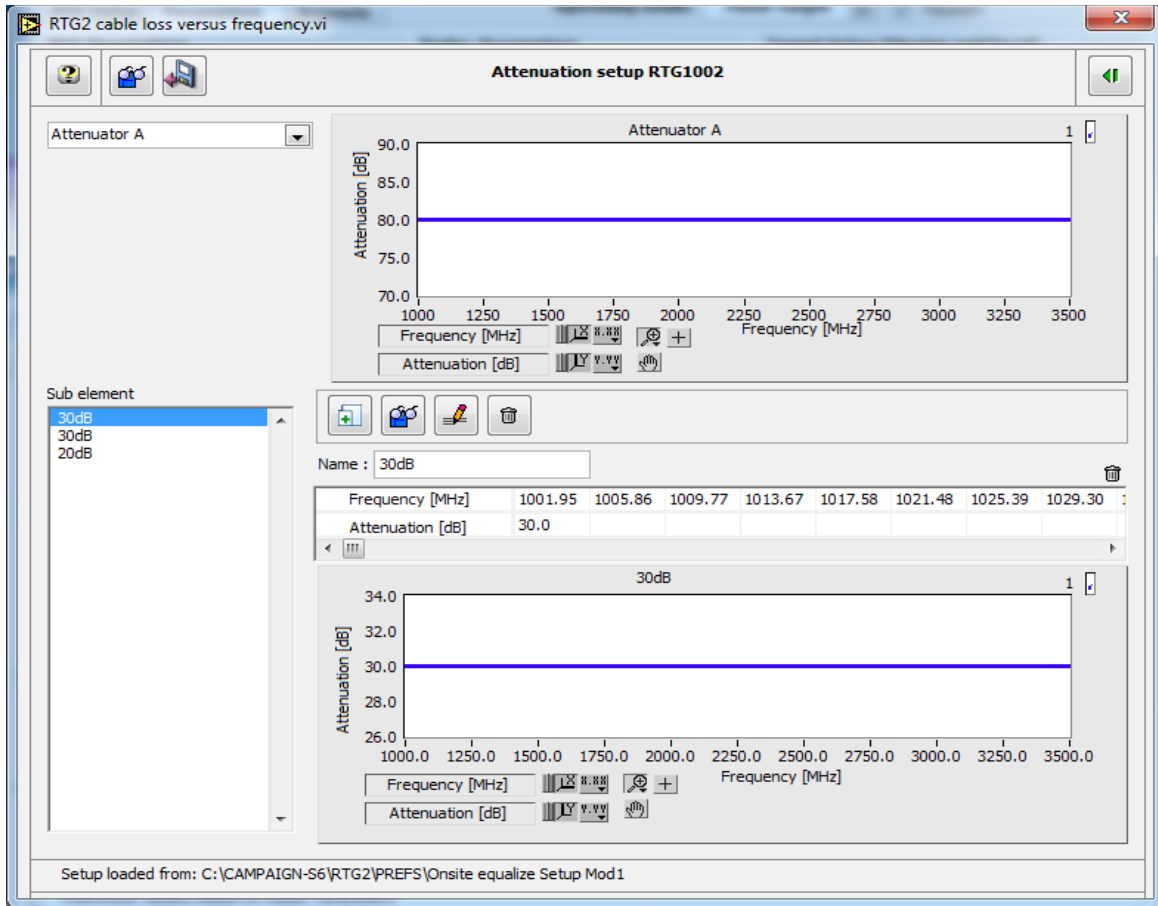


Figure 23: Attenuator A vs frequency for modulator 1

In the example of the previous figure attenuator A consists of 3 separate components. 2 attenuators of 30dB and 1 attenuator of 20dB, the total amount would be 80dB.

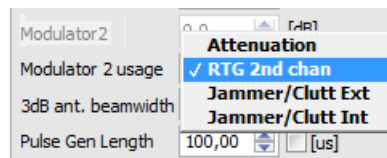
The loss of a cable depends on the frequency, for example 0.1dB/(m \*GHz). If you have 10meter of cable the loss would be 1dB at 1 GHz and 3dB at 3GHz.

You can enter a frequency table with multiple points, with a precision of 3.7MHz. The software will interpolate the values in between data points, but it will not extrapolate.

In the example of the cable if it is described with only two points at 1 and 3GHz, the values inside the interval will be interpolated but the loss at 3.3GHz will be considered the same as at 3GHz. So it is necessary to describe the losses up to the minimum and maximum frequency of operation.

Modulator 2 can be used as a software controlled, fixed(vs azimuth) step attenuator.

It can be used to simulate the high coverage beam, select a VPD and setting 'RTG2nd chan' for the usage of modulator 2.



It is possible to use Modulator 2 to modulate a signal from a noise generator or an external jammer vs azimuth.

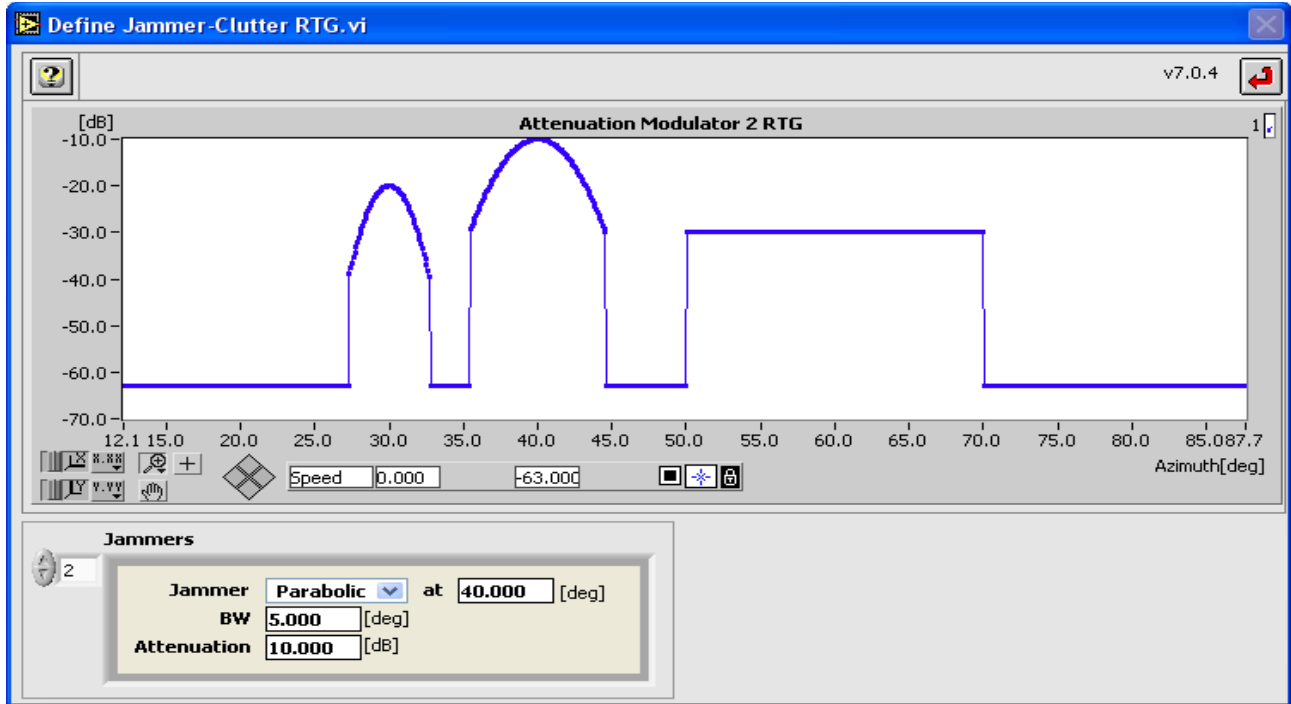


Figure 24: Define Jammer - Clutter settings for Modulator 2 vs azimuth



### 3.4. Fixed – or Moving Target Operating Mode

1. Create a simple scenario by entering these parameters

Figure 25: Parameters for fixed or moving target

2. This scenario will create 10 targets with RCS of 100m2. The first target at 10 degrees and rest with equidistant intervals (36 degrees).

All these targets will start at 70nm and fly inbound with a speed of 200 knots at a constant altitude of 23000feet.

3. The Replication Factor should be 1, for sensitivity tests. It is possible to replicate the test target every xx Nm/Km/microseconds (same as the unit selection of the target range). The minimum delay for replication is the pulse width + 1µs.

4. Select an antenna diagram from a VPD file for the simulation of the altitude of the test target. When the radar transmits on the low coverage beam and uses two beams on reception, then select the third option for VPD usage, as in the next figure. Place the sma-sma bridge adapter between the monitor output of the digital delay line and the input of modulator2.



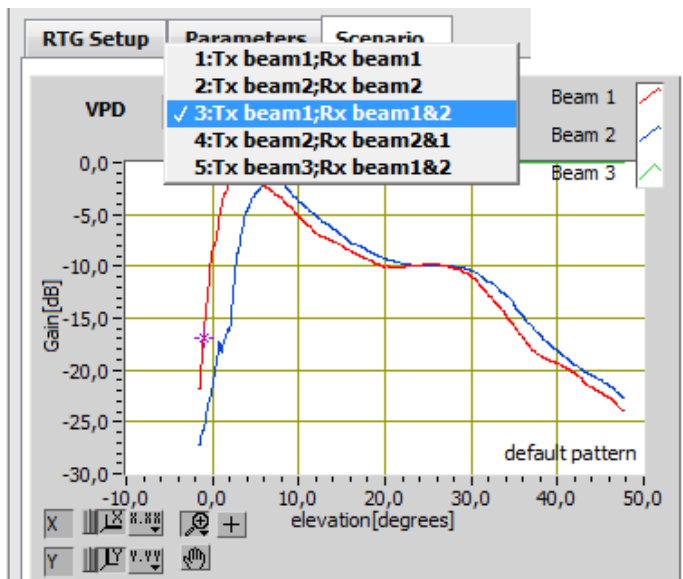
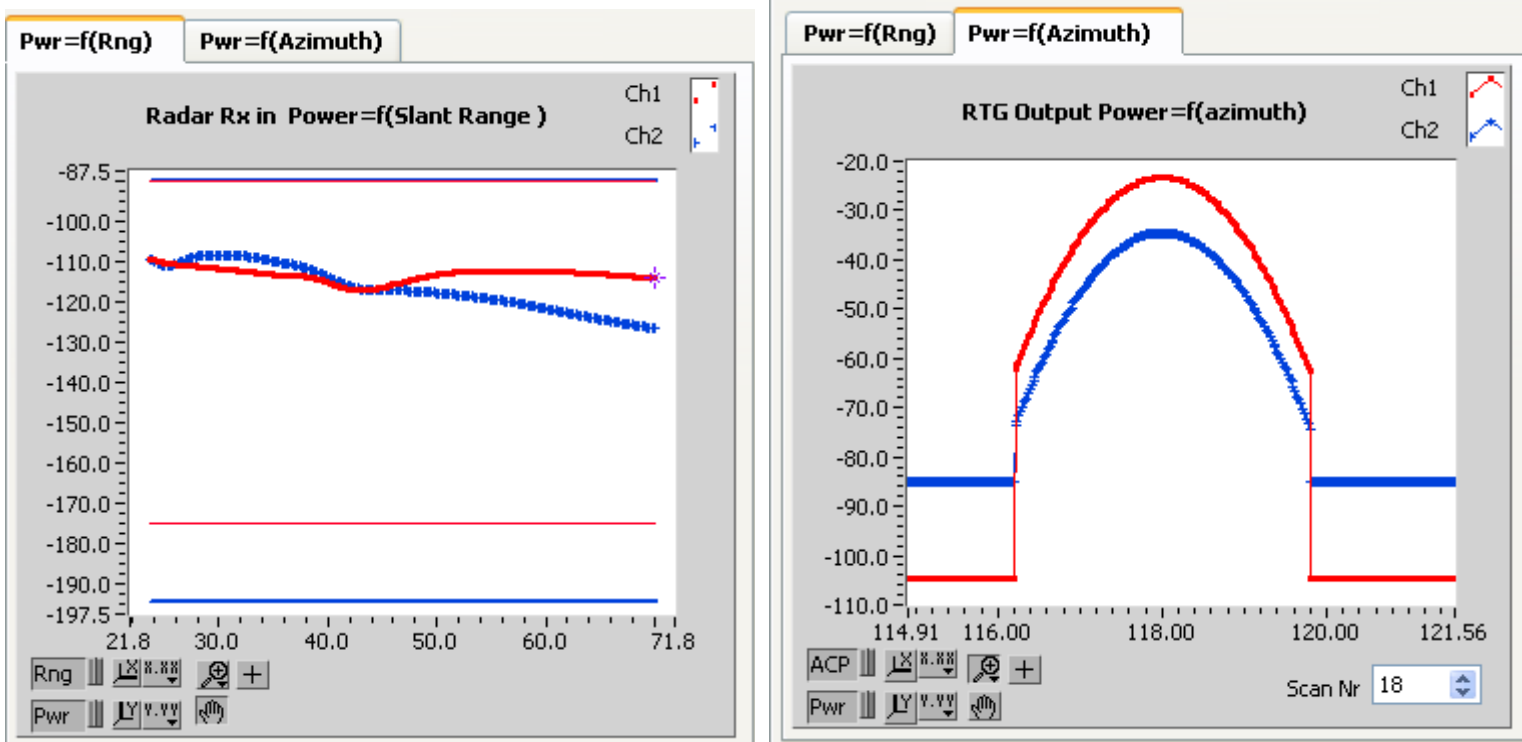


Figure 26: Typical Airfield Surveillance Radar VPD, Tx on beam 1 and two Rx beams

		RTG1002 Modulator 1	RTG 1002 Modulator 2
1	Tx beam 1 ; Rx beam 1	1 + 1 coverage	1 + 1 coverage
2	Tx beam 2 ; Rx beam 2	2 + 2 coverage	2 + 2 coverage
3	Tx beam 1 ; Rx beam 1 & 2	1 + 1 coverage	1 + 2 coverage (= 2 + 1 coverage)
4	Tx beam 2 ; Rx beam 1 & 2	2 + 2 coverage	1 + 2 coverage (= 2 + 1 coverage)
5	Tx beam 3 ; Rx beam 1 & 2	3 + 1 coverage	3 + 2 coverage

Table 1: Effect of VPD selector on the coverage and modulator settings





Verify the output powers injected in the radar vs range. Make sure the powers are within the available dynamic range indicated by the horizontal lines in red and blue color.

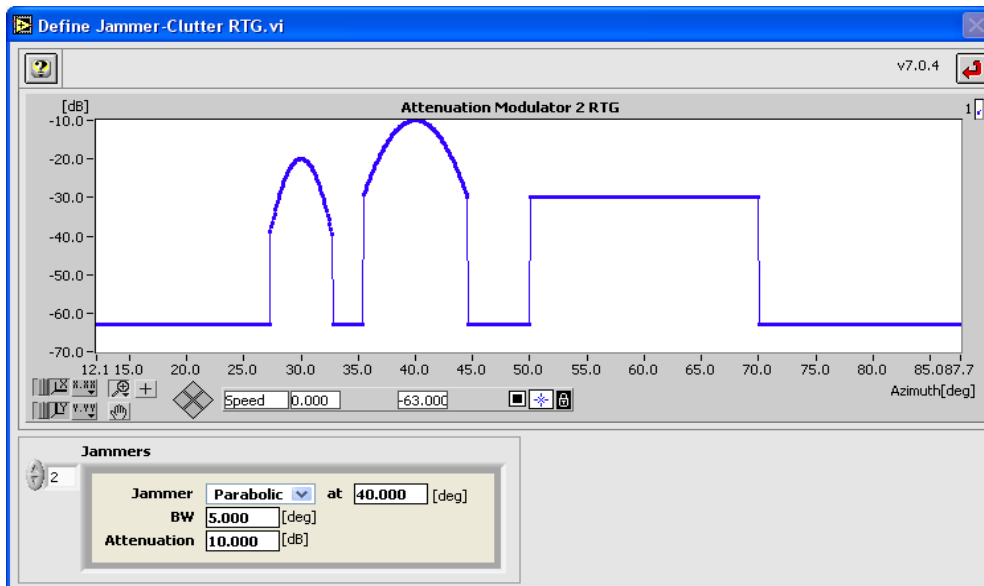


Figure 27: Modulator 2 used to modulate a signal vs azimuth to simulate a jammer or interfering signals.

Verify the RTG1002 output power vs azimuth. This view is selectable for every scan nr of the scenario. Modulator 2 setting will depend on the the use of modulator 2 as well.

Operating mode: RES scenario  Repeat?



## 4. REMOTE PROCEDURE CALL

### 4.1. Introduction

#### 4.1.1. General

Since version 7.0.4, we have implemented a Command line control of SOME vi's. Not all vi's can be controlled this way, we started with the RES, RTG2 and ADSB Tools. Later more vi's that can be controlled this way upon request.

Following instructions are supported since v 7.0.5.20:

-LOAD: This instruction loads a VI, when the RASS-S7 toolbox is running. You can either load or load plus run a tool.

-START: This instruction starts a vi, similar to clicking the START button on the main panel. This instruction also allows the preloading of the datafile (e.g. scenario) prior to running this.

-CLOSE: this instruction closes the panel of a vi.

-STOP: this instruction stops a vi, similar to clicking the STOP button on the main panel of the vi.

-RECORD: this instruction starts a recording, similar to hitting the record button on the main panel of the vi.

-STATUS: for batch file processing, this instruction allows you to retrieve the status of any VI

Following Tools are currently supported

- RES Main vi reference 60
- RES+RSE\_Main\_Control.vi reference 230
- RFAADSB control vi reference 223
- RES\_ADSB\_Control.vi: vi reference 191
- RTG2 Remote Target Generation.vi: vi reference 247
- RTG2 On-Site Target Injection.vi: vi reference 246

#### 4.1.2. Installation

To install this tool, you should either use the new installer of RASS-S v7.0.5.20 or later.

## 4.2. DETAILS

### 4.2.1. Prerequisites

In order to operate the Command line control, as a minimum the RASS-S7 toolbox must be running. The toolbox will start a RPC (remote procedure call) server.





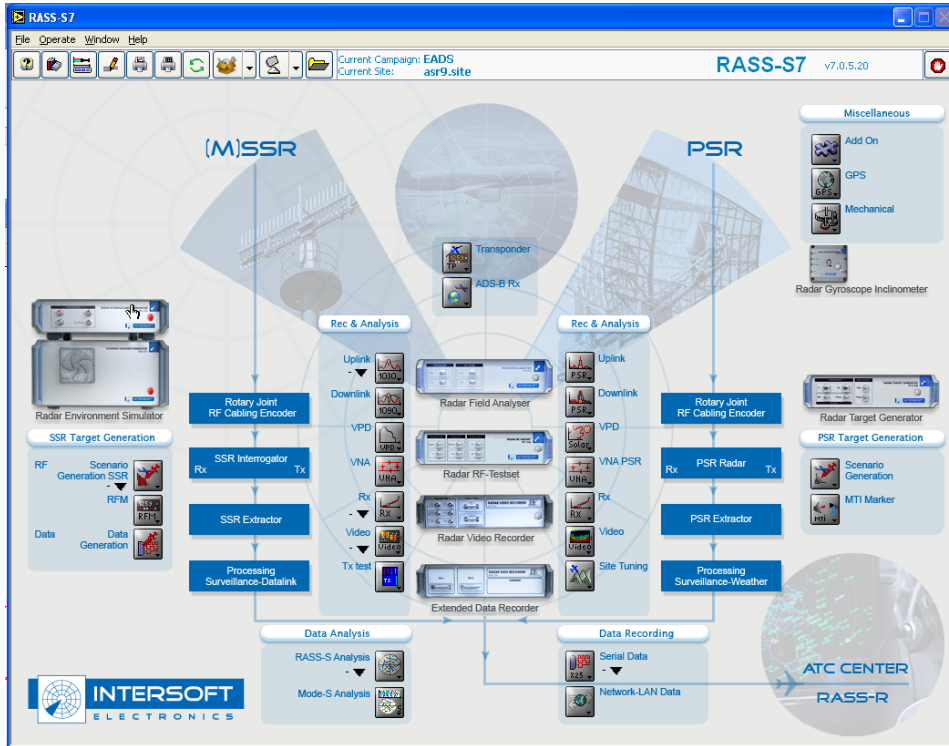


Figure 28: Toolbox must be running to allow RPC

#### 4.2.2. Syntax

The commands can be sent from the command line, using the “RASS” command. The corresponding RASS.exe can be found in the installed C: or D: disk, in the RASS-S7\LVXMLRPCServer folder.

The RASS.exe can be executed locally on RTG1002 or on a remote Windows PC. If the remote PC is chosen then you have to copy following folder to that PC:



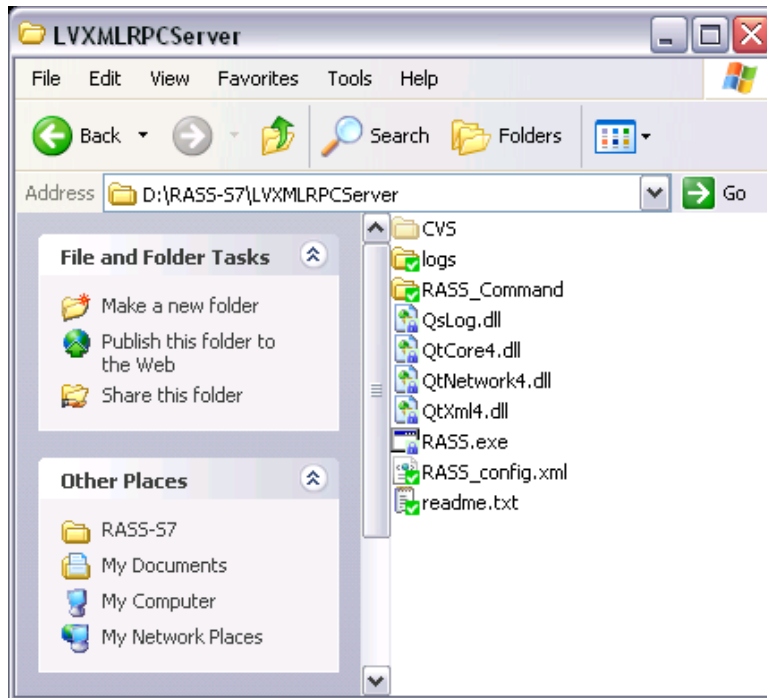


Figure 29: LVXMLRPCserver location

You should add a "path" pointing to this folder if you want to use the command from other locations or in batch (.bat) files.

The RASS command has the following syntax:

Beware! This is case sensitive!

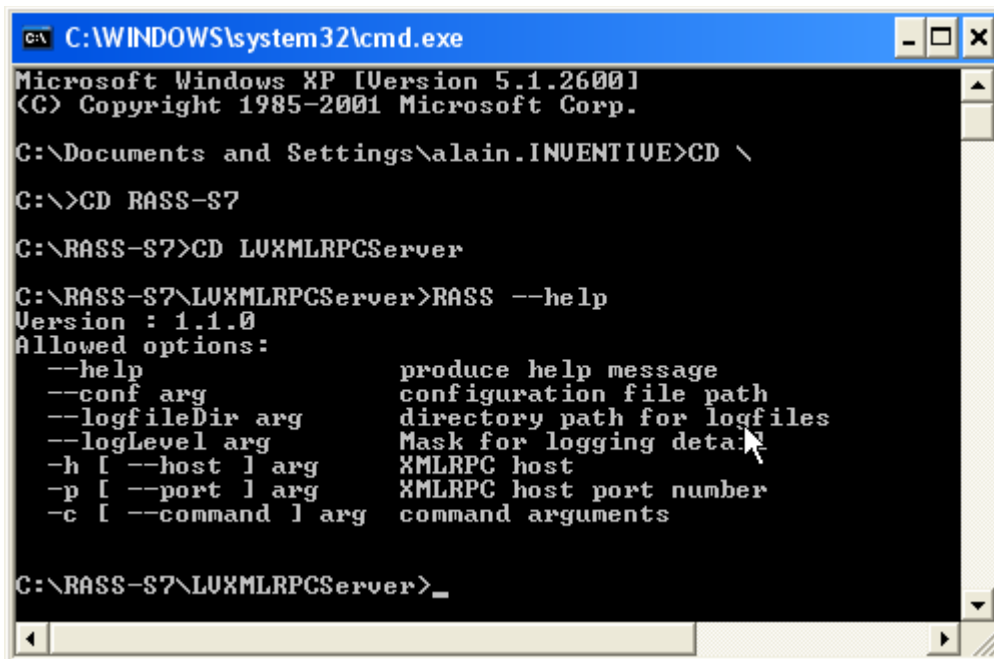


Figure 30: RASS --help



RASS -help creates a help message

RASS -conf *arg* sets the configuration file (see further) path. Default this is in the same directory as the RASS.exe file.

RASS -logfileDir *arg* sets the directory for the logfile with possible error messages

RASS -logLevel *arg* sets the mask for the level of logging data

RASS -h *arg* sets the host IP number (is be set to localhost in config file)

RASS --h *arg* sets the host port number (should be set to 9000 in config file)

RASS -c *arg* Sends the actual XMLRPC command to RASS-S

### 4.2.3. Config file

The RASS configuration file is typically placed in the same directory as the RASS.exe file, and contains the XML code that defines the port and host IP used by the XML RPC engine.

Figure 31: Configuration file for RPC

You can change the host parameter to a different IP address. The RASS RPC always uses port #9000.

### 4.2.4. Sending Commands

In practice, only the RASS -c *arg* syntax will be used.

*Arg* is the argument of the command, and should therefore be put between quotes.

As there are 6 possible commands, following arguments can be used:



#### 4.2.4.1. LOAD command

The load commands will load a RASS-S tool. The load command syntax is

```
RASS -c "LOAD vi_reference command" ( example RASS - c "LOAD 246 2" )
```

The *vi\_refence* is the index number of the tool in the internal RASS-S application database list. At this moment, these vi's support RPC: The Vi reference nr is added

```
-RES Main .vi : 60
```

```
-RES+RSE Main .vi : 230
```

```
-RFA ADSB control.vi : 223
```

```
-RTG2 Remote Target Generation.vi: vi reference 246
```

```
-RTG2 On-Site Target Injection.vi: vi reference 247
```

The *Command* can be 0 , 1 or 2. 0 does nothing, 1 loads the vi , and 2 loads and runs the vi.

#### 4.2.4.2. START command

The start commands will start a preloaded RASS-S tool and is similar as clicking the "Start" button on a tool.



The start command syntax is . Mind the Double quotes! The (optional) filename is a string that needs to be enclosed in quotes

```
RASS -c "START vi_reference [ Filename]"  
( example RASS - c "START 246 "PSR" " )
```

*Beware! The filename can not contain SPACE (\20) characters*

The *vi\_refence* is the index number of the tool in the internal RASS-S application database list.

The Filename is the name of the scenario folder (directory) in the current CAMPAIGN folder of RASS-S.

If you do not include a filename, it is assumed a scenario folder is preloaded in the tool, or the previously selected file will be played again.

Filename can be a single folder or a full patch ( e.g. D:\CAMPAIGN-S6\DEMO\SCENARIO\PSR)

Before the scenario is launched prefs stored in this campaign folder will be loaded. And the scenario will be downloaded automatically before executing the run command.



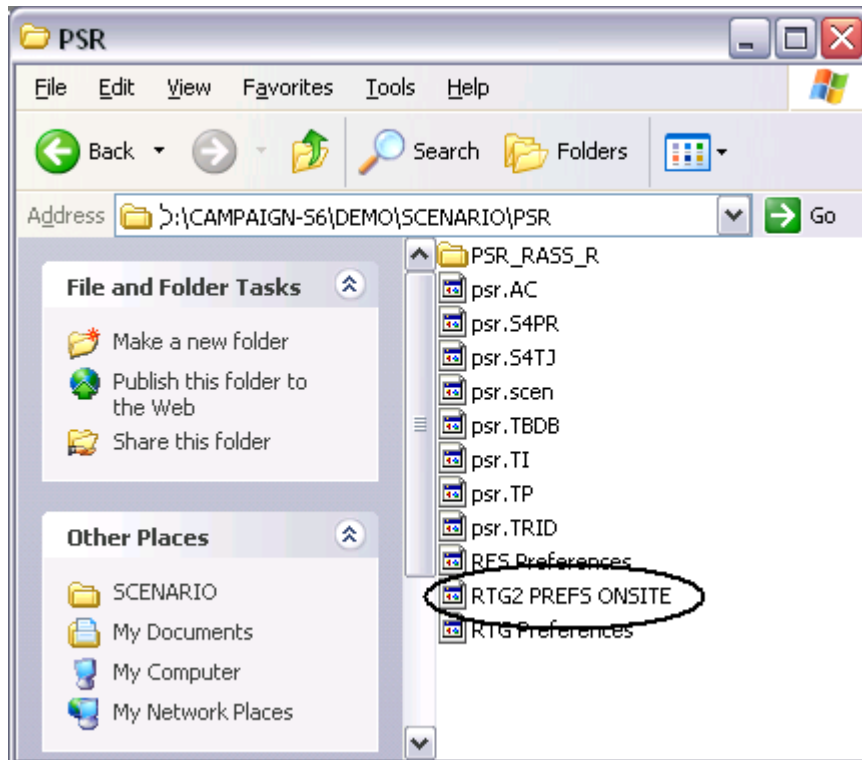


Figure 32: Preference file in case of this example

Beware! Put the pathname between quotes , so at the end of the command, there should be two quotes!

Preferences are stored automatically if a scenario is started into the scenario folder. So next time if the scenario is launched trough RPC the prefs will be loaded like earlier prepared. Next figure will show an example of a preference file. (This file could be edited manually).



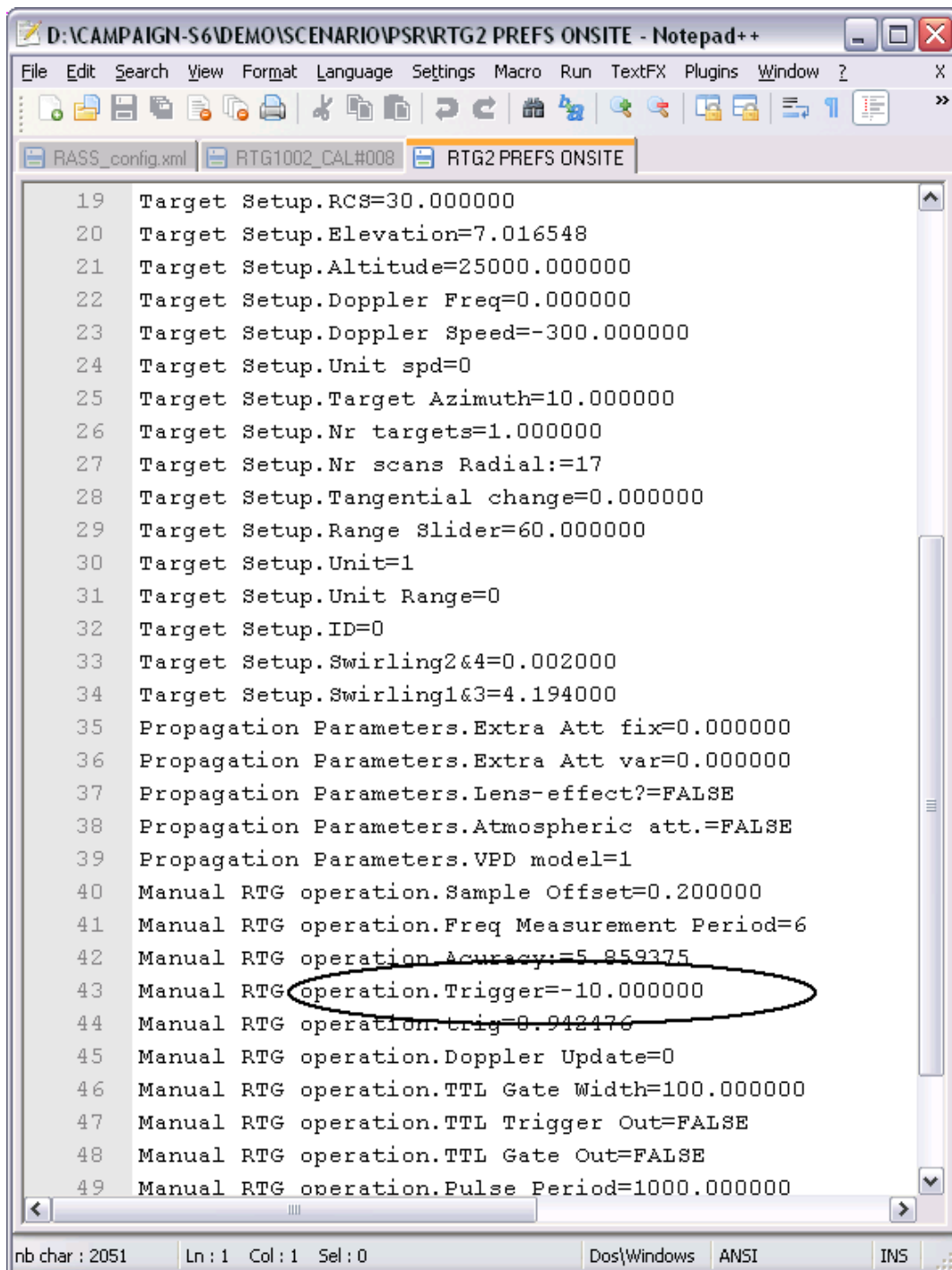


Figure 33: Preferences file for RTG on site target injection software

#### 4.2.4.3. RECORD command

The record command will start recording in a preloaded RASS-S tool , and is similar as clicking the “Record”



button on a tool. or in RTG1002, enables the recording of puls data in the provided file location.



The record command syntax is .

RASS -c "RECORD *vi\_reference* [*Filename*]"  
 ( example RASS - c "RECORD 246 "PulsRecOnsite" " )

Mind the Double quotes! The (optional) filename is a string that needs to be enclosed in quotes.

*Beware! The filename should not contain SPACE (\20) characters.*

The *vi\_refence* is the index number of the tool in the internal RASS-S application database list.

The Filename is the name of the recording folder (directory) in the current CAMPAIGN folder of RASS-S.

Filename can be a single folder or a full patch (e.g. D:\CAMPAIGN-S6\DEMO\RECORDING\PulsRecOnsite )

#### 4.2.4.4. STOP command

The stop commands will stop a running RASS-S tool , and is similar as clicking the "Stop" button on a tool.




(Not the DONE button! ) The stop command syntax is .

RASS -c "STOP *vi\_reference* " ( example RASS - c "STOP 246" )

The *vi\_refence* is the index number of the tool in the internal RASS-S application database list.

#### 4.2.4.5. CLOSE command

The Close command will abort and close a running RASS-S tool , and is similar as clicking the "Done"

button on a tool.  The close command syntax is .

RASS -c "CLOSE *vi\_reference* " ( example RASS - c "CLOSE 246" )

The *vi\_refence* is the index number of the tool in the internal RASS-S application database list.

#### 4.2.4.6. STATUS command

The status commands will return the current status of a running vi. It can be used to verify if a scenario for example has finished running.

The status command syntax is .

RASS -c "STATUS *vi\_reference* " ( example RASS - c "STATUS 246" )

The *vi\_refence* is the index number of the tool in the internal RASS-S application database list.

The command will return a number ;

0: RTG1002 not started

1: RTG1002 detected and booted

2: RTG1002 has started ( scenario running)

3: RTG1002 has stopped ( scenario ended or stopped manually)

4: RTG1002 error RTG not found



#### 4.2.5. EXAMPLE

The following snapshot shows some example implementation from the command line. The RASS-S toolbox is running.

These instructions will open the software and run the tool for On site target injection.

A scenario will be downloaded and executed.

Pulse information will be recorded.

The tool will be stopped.

```

C:\WINDOWS\system32\cmd.exe
D:\>cd RASS-S7
D:\RASS-S7>cd luxmlrpcServer
D:\RASS-S7\LUXMLRPCServer>RASS --help
Version : 1.2.0
Allowed options:
  --help                produce help message
  --conf arg            configuration file path
  --logfileDir arg     directory path for logfiles
  --logLevel arg       Mask for logging detail
  -h [ --host ] arg    XMLRPC host
  -p [ --port ] arg    XMLRPC host port number
  -c [ --command ] arg command arguments

D:\RASS-S7\LUXMLRPCServer>RASS -c "LOAD 246 2"
2
D:\RASS-S7\LUXMLRPCServer>RASS -c "STATUS 246"
1
D:\RASS-S7\LUXMLRPCServer>RASS -c "START 246 \"D:\CAMPAIGN-S6\DEMO\SCENARIO\PSR\""
1
D:\RASS-S7\LUXMLRPCServer>RASS -c "STATUS 246"
2
D:\RASS-S7\LUXMLRPCServer>RASS -c "STOP 246"
2
D:\RASS-S7\LUXMLRPCServer>RASS -c "STATUS 246"
3
D:\RASS-S7\LUXMLRPCServer>RASS -c "RECORD 246 \"PulsRecOnsite\""
1
D:\RASS-S7\LUXMLRPCServer>RASS -c "CLOSE 246"
3
D:\RASS-S7\LUXMLRPCServer>RASS -c "STATUS 246"
0
D:\RASS-S7\LUXMLRPCServer>

```

Figure 34: Example of RPC via the DOS command prompt

