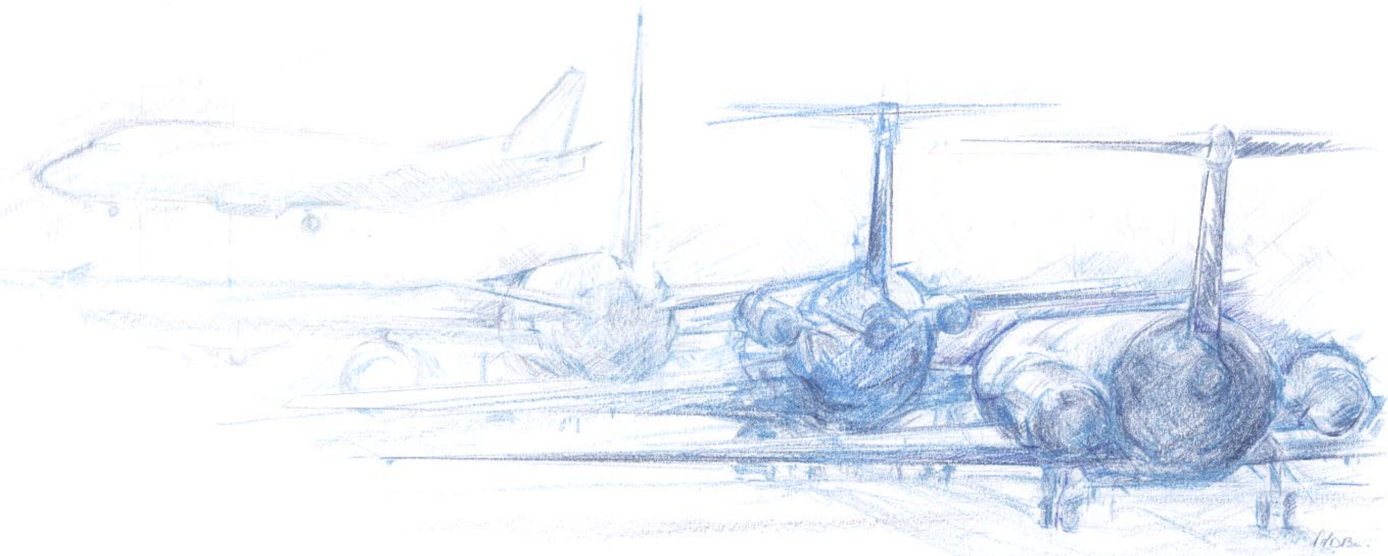
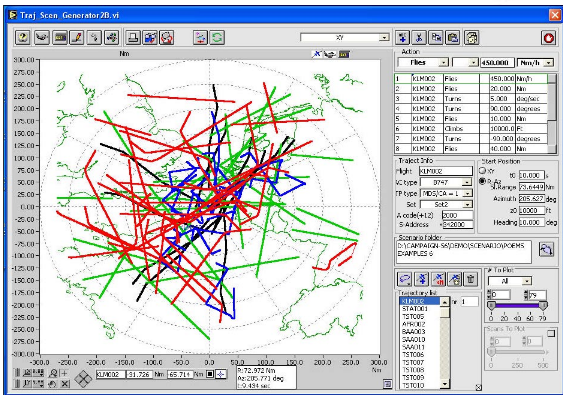
RASS-S v6.1.3

Covers SASS-S ; PTE P1-P2-P5 ; RASS-M





Radar Analysis Support System for Site Measurements

User Manual

Volume 5 : Radar Environment Simulator: Target Injection

intersoft electronics

Conform RASS-S v6.1.3 Product
Conforms RASS-M v6.1.3 Product
Conform PTE P1-P2-P5 v4.4 Product
Conforms SASS-Se v4.4. Product
Released - June 2004

Table of Contents Volume 5

Organisation of This Volume

The RASS-S User manual is a complete user manual describing how to use the hardware and software of the RASS-S Radar Analysis Support System.

The RASS-S User manual is divided into seven volumes:

Volume 1	Introduction / Technical Specifications
Volume 2	Antenna Diagram Measurements
Volume 3	Reply Recording & Analysis
Volume 4	Data Recording & Analysis
Volume 5	Radar Environment Simulation & Target Injection (PTE)
Volume 6	RF Test Set & Special Tools
Volume 7	Transmitter Test Tool (PTE)

This volume you are now in is:

Volume 5 Radar Environment Simulation & Target Injection

- **Chapter I** Gives a short introduction on the Radar Environment Simulation in general.
- **Chapter II** Was moved to Volume 6, Chapter VI.
- **Chapter III** Describes the RES hardware and concepts.
- **Chapter IV** Describes the RES software.
- **Chapter V** Describes the FRUIT Generation.
- **Chapter VI** Describes the Ground Data Link Processor.
- **Chapter VII** Describes the ACP / ARP Fan Out Unit.
- **Chapter VIII** Describes the Interrogation Analysis.
- **Chapter IX** Describes the REDR Replay of Asterix Data or scenarios

-Chapter X Describes the IRS (Interrogation data) export features

-Chapter XI Describes the Multi radar Scenario Generator Software and LAN replay

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If you are having problems, it is recommended to carefully read the manual. In case you would not find the appropriate answers to your questions, or if you would still be in need of assistance, do not hesitate to contact us on the following address :

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MODIFICATIONS CHANGE

Revision	Date	Description	Responsible

Chapter I : Introduction

RASS-S

The Radar Analysis Support System for Site evaluation (RASS-S) is a radar manufacturer independent system for evaluating a radar under operational conditions. The tool supports the need of the radar engineer responsible for the daily maintenance of the radar. The RASS-S radar evaluation equipment and software has evolved over the years to a powerful radar maintenance tool.
In Europe, RASS-S is recommended to comply with the "Sensor Performance Analysis Standard" (SPAS) of Eurocontrol for the evaluation of civil radar stations. The tool is being validated and is regularly used by the civil administrations of several European countries.

Simulating the Radar Environment

The next logical step is the development of a tool capable of simulating the full operational environment of the radar for factory or site acceptance testing.
The Radar Environment Simulator (RES) is a dedicated instrument that mimics the behaviour of multiple free flying aircraft (Up to 1000 targets) at antenna level and fully simulates the environment in which a Mode S / Monopulse Secondary Surveillance Radar (MSSR) station operates. The system can be used both for factory acceptance testing and for site evaluation testing of Mode S / (M)SSR systems. It consists of a limited number of lightweight, portable units driven by a laptop computer. The RES is built around two core elements: a multi level software package to program a simulated radar environment, and dedicated hardware to interface with the radar under test and to generate the simulated environment.

Creating trajectories

The multi level software package is easy to use, with a full colour, graphical interface to provide the user with a feasible method of creating a realistic radar test environment. In the first level trajectories are built using the Trajectory Scenario Generator tool. This tool uses libraries with aircraft, transponder and trajectory data thereby reducing the time required to enter or edit scenarios. Up to 1000 free flying targets with the possibility of four target overlap situations can be programmed. Features like trajectory duplication and randomize functions are available. Individual trajectories can be specified using speed, distance, heading, turn rate, climb rate, and acceleration. Each trajectory is identified with a fully programmable transponder in accordance with ICAO Annex 10. Individual programmable transponder features are: Type (up to Mode S level 5), Tx frequency, Tx power, reply probability and mode delay. The Trajectory Scenario Generator tool has built in functions to verify sectorial loads. There are powerful zoom and filter tools available for detailed trajectory investigation.

Programming Errors

Using a second level, special events can be attached to the created trajectories with the Event Scenario Generator tool. The purpose is to create a repeatable environment, including programmable errors, for evaluating the radar under test. This tool has the same look and feel as the Trajectory Scenario Generator tool. The Event Scenario Generator allows insertion of special events on individual trajectories in position and time. These special events can be: Tx frequency change, Mode A/C code change, Mode S level change, BDS register change, reply delay change, alerts (SPI, Mil), misses, etc. Mode S data link events like AICB, broadcast commB and downlink ELM are also programmable. Features like event duplication and randomize functions are available. Event scenarios can be stored in libraries for reuse.

Introducing Interference

The final level to be programmed is the radar's operational environment. Parameters like antenna patterns, rotational speed, reflectors and obstructions can be programmed to construct a realistic radar operation environment. Additional to the simulated targets, interference signals better known as FRUIT (False Replies Unsynchronised In Time) can be generated by the Interference Generator tool. The FRUIT can be specified in rate (up to 20000 FRUIT per second), type (A/C or Mode S), content, power, frequency and sector. Through the reuse of existing RASS-S equipment the tool allows the generation of Out Of Beam FRUIT (SLS) and In Beam FRUIT (SUM/DELTA). This way the sensitivity of the radar for disturbances like surrounding radars and buildings can be verified in a realistic way.

Injecting targets

The outcome of the multi level software package are files to be compiled and used by the RES hardware. Once the compiling is done, the process of running the scenario, injecting the targets and monitoring the different data streams can be started by a single command within one minute. The RES Main Control tool can handle the complete target injection without interference of the user. Built in functions allow the user to monitor the result streams in order to verify the target injection process. The compiled scenarios can be replayed several times without any preparation delay.

Analysis

Several specialised tools allow the user to analyse the results of the simulation for both directions (uplink and downlink) in detail. Uplink analysis can be done by means of the Interrogation Viewer tool. This tool makes it possible to decode and display the contents of all interrogations send during the simulation. Statistics on timing and contents can be calculated and displayed. The downlink analysis can be done with the Multi Level Analysis tool. This allows an in depth investigation starting from the individual pulses, combined to replies, finally ending in a plot report. Each of the different levels can be queried to analyze the data and problems encountered. Reply plot extraction can be repeated with different parameters on the same data set and avoids trial and error on the real radar. The analysis can be done for the complete coverage of the radar.

Hardware

The hardware is built using state of the art digital and analog components to achieve an extremely high accuracy of the generated targets: the azimuthal accuracy is 0.022 degrees while the range accuracy is better than 10 meters. The signals are generated on IF level using Direct Digital Synthesis (DDS) technology in combination with 12 bit multiplying Digital to Analog Convertors (DAC). Multiple DSP processors take care of timing, communication, pulse amplitude and phase shaping. The system uses the same basic principles for monopulse generation as applied inside an LVA antenna. The pulses generated on IF level are upconverted to RF level and injected in the RF receiver part of the radar as if they are received through the LVA antenna. All signals necessary for the simulation of the radar environment like timing and antenna rotation can also be generated by the RES hardware. Therefore the RES is well suited for Factory Acceptance Testing of Mode S/ (M)SSR radar systems.

Since the RES is lightweight and easy transportable, it is also an indispensable tool for site evaluation testing of Mode S/(M)SSR radar systems.

Benefits

The RES will become part of the Radar Analysis Support System for Site evaluation (RASS-S) tools. The radar environment generation part and the radar measurement part of the tools are physically and logically separated.

With the development of the RES the circle is closed: the radar under test is given perfectly known input signals in well controlled circumstances that can be measured and evaluated by the RASS-S tools. Non- conform actions from the radar under test can be pinpointed, investigated in detail and solved before the radar becomes operational.

Chapter II : BSG Target Injection

The BSG Target Injection part was moved to volume 6 of the RASS-S4 user manual. Please consult this volume for details.

For reasons of consitency and chapter numbering, chapter II was not removed from volume 5.

Chapter III : Radar Environment Simulator (RES)

1.0. Introduction

In the first phase (P1) of the PTE (POEMS Test Environment) development the emphasis was put on the simulation of the environment, the recording and analysis of signals at different levels in the radar chain. Additionally, in the second stage (P2) detailed information on the data originating from the MODE-S processing and scheduling will also be investigated. The major section of the P1 phase of PTE consists of the RES, (Radar Environment Simulator).

1.1. Purpose

The purpose of the RES is to create a test environment by mimicking the behaviour of multiple aircraft at antenna level to simulate the future environment in which a POEMS station is to be used.

By recording the interrogations and output of the station for such a repeatable "virtual" environment, the performance of the radar can be analysed.

As a starting base the proven RASS-S is used but additional equipment needs to be designed to fulfil all requirements.

Three important parts can be distinguished :

1. The generation of test signals to simulate a specific environment
2. The recording of all important signals
3. A software package to analyse the results

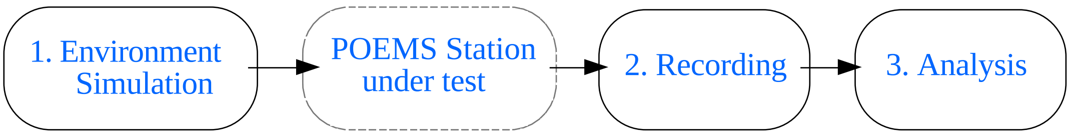


Fig. 1 : Logical Units

In order to reduce the complexity, the design and discussion are split up according to the above stated three logical units.

1.2. Scope

The Radar Environment Simulator (RES) is a dedicated instrument that mimics the behaviour of multiple aircraft at antenna level and fully simulates the environment in which a Secondary Surveillance Radar (SSR) station is operating. The system can be used both for factory acceptance testing and site evaluation testing. It consists of a limited number of lightweight, portable units driven by a laptop computer.

Therefore the system consists of a limited number of lightweight, portable units driven by user - friendly portable computers.

The field proven RASS-S units already provide a large part of the required functionality. Therefore these units form the basis for the design.

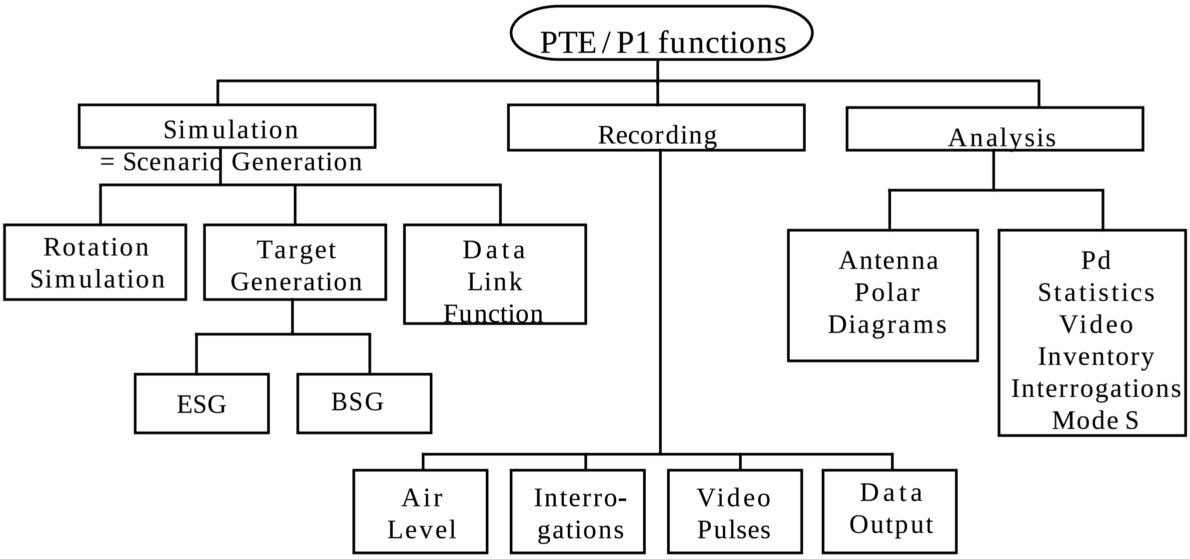


Fig. 2 : PTE Functional overview

1.3. Radar Environment Simulator

The RES is build around two core elements:
-A set of software tools (scenario generator and driver tool) to program a simulated radar environment.
-A hardware part (ESG + RIU) to generate the simulated environment and interface with the radar under test. On top of that the RFA can be used as an Interference Generator to simultaneously inject out of beam interference signals (FRUIT) into the radar.

The software consists of three main tools:
-The Trajectory Scenario Generator.
-The Event Scenario Generator
-The RES Main Control
and a number of “special” tools which allow additional editing or analysis of special information for the RES:
-The Antenna Diagram editor
-The RES Calibration Tool
-The Interrogation Viewer & Analyser Tools

Further more, a set of additional tools was developed to allow analysis of radar performance after scenario injection:
-Asterix (EDR) convertor
-Asterix protocol viewer
-Inventory tool
-Pd and Accuracy tool
-Data Link Analyser
-Data Display
-DataLInk Status Display

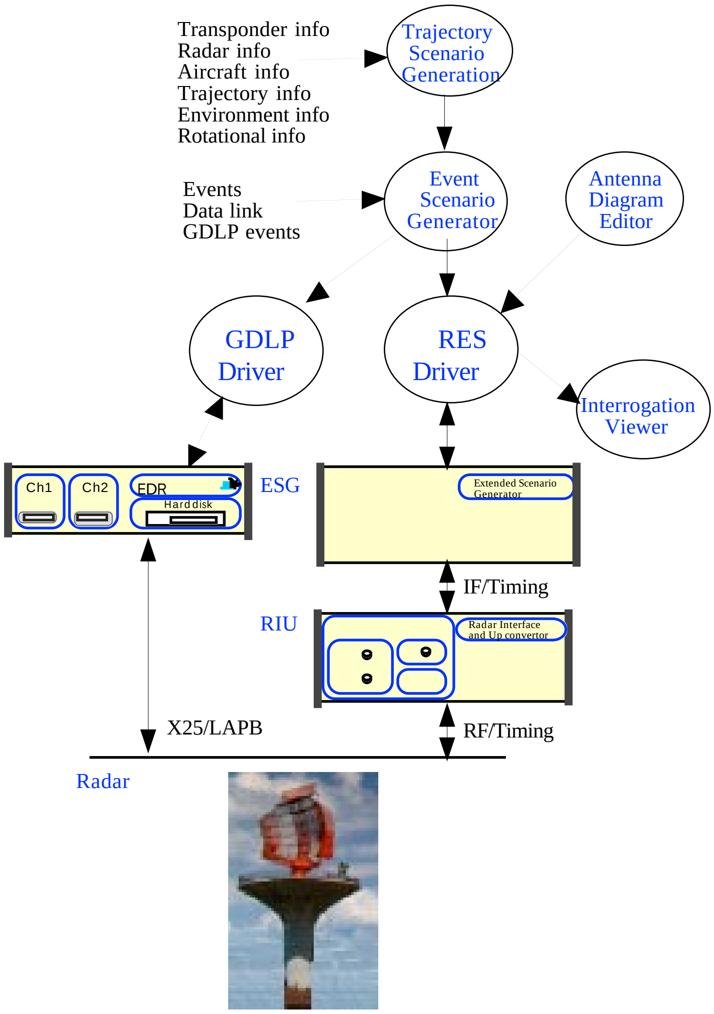


Fig. 3 : RES data stream model

The Trajectory Scenario Generator tool is an easy to use software packet with a fully graphical interface to provide the user a with feasible method of creating a realistic radar test environment. The tool uses libraries with aircraft, transponder and trajectory data thereby reducing the time required to enter or edit scenarios. Up to 2000 free flying targets with the possibility of four target overlap situations can be programmed. Features like trajectory duplication and randomise functions are available. Trajectories can be piece wise specified using speed, heading, turn rate, climb rate, and acceleration. Each trajectory is identified with a fully programmable transponder in accordance with ICAO Annex 10. The radar's environment is simulated using specific antenna patterns, rotational speed, reflectors and obstructions. The outcome of the scenario generator is a file to be compiled and used by the hardware part of the RES.

The Event Scenario Generator is a tool using the same graphical user interface as the Trajectory Scenario Generator, but used to create all different sorts of "events". These events can be a number of transponder parameter changes (like A code), datalink events (Comm B, Comm D, Broadcasts, etc..) or misses in the scenario. The tool uses the files created by the trajectory scenario generator to start with, and on top of the generated target plots, the user can define the events. The outcome of the scenario generator is a file to be compiled and used by the hardware part of the RES.

The RES Main control uses the compiled data from the scenario generators and feeds the RES hardware with the necessary data. In the meanwhile, the tool saves the results of the generated scenario (uplink data messages etc..) for later analysis.
The Antenna diagram editor provides the RES with the required antenna information, which can be extracted from prerecorded RASS-S antenna diagram measurements.

The RES Calibration tool provides the User with a self calibration tool for the RES, providing vital monopulse checking of the RES output.

The hardware part is build using state of the art digital and analog components to achieve an extremely high accuracy of the generated targets: the azimuthal accuracy is 0.02 degrees while the range accuracy is better than 4 meters. The signals are generated on IF level using Direct Digital Synthesis (DDS) technology in combination with 12 bit multiplying Digital to Analog Convertors (DAC). Multiple (7 in total) DSP processors take care of timing, communication, pulse amplitude and phase shaping. The system uses the same basic principles for monopulse generation as applied inside an LVA antenna. The pulses generated on IF level (ESG) are up converted to RF level (RIU) and injected in the RF receiver part of the radar as if they are received through the LVA antenna. All signals necessary for the simulation of the radar environment like timing and antenna rotation are also generated by the RES hardware. Therefore the RES is well suited for Factory Acceptance Testing of MSSR radar systems. Since the RES is lightweight and easy transportable it is also an indispensable tool for site evaluation testing of MSSR radar systems.

2.0.Theoretical Explanation of Mode of Operation

2.1. General Concepts

The RES is used to simulate Secondary Surveillance Radar Targets, both in simple SSR (1, 2, 3/A or C) mode of operation or in the more complex Mode S mode of operation. These SSR Targets must mimic in all senses real airborne targets. This implies that the targets properties, the transponder properties and the complete environment in which these targets operate must be mimicked.

The RES interfaces to the radar at RF level,between the antenna and the interrogator entry of the sensor.
Additional rotational information can be input by the RES (in a SAT environment) or can be output by the RES (in a FAT situation).
We can summarise all items to be simulated as follows, starting from the viewpoint of the radar:

-The Target itself, with positional information such as range, azimuth and altitude.
-The Antenna rotation (ARP/ACP signals, rotational scenario in time)
-The Sensor feeder propagation
-The Radar 3D antenna properties (Gain as function of azimuth, elevation)
-The atmospheric propagation of the signals towards and from the transponder
-The transponder antenna
-The transponder cabling
-The transponder with its SSR and Mode S section

2.2. RES Modules

When we designed the RES, it was clear that the process of injecting up to 1080 operational Mode S targets would require a split-up of the project into some mayor sub modules.

Each module handles a single step in the process of generating the targets. Each module, either software or hardware is required in order to complete the injection of the targets.
In order of use, we can distinguish between the following modules :

-RES Self Test and Calibration : Tool, used to verify the operation of the RES and generation of certain internal calibration tables. The Use of this tool is optional.
-Antenna Diagram editor : Tool to create a number of internal tables, containing the vital data for exact antenna simulation.
-Trajectory Scenario Generation : Tool used to generate a number of files containing the scan based positional information of all the simulated targets.
-Event Scenario Generator: Tool used to generate a number of files containing transponder property changes (events) and Downlink datalink scenarios.
-RES Main Control : Tool used to read all the above files and load the files into the RES at startup and stream the other vital data to the RES in real time.

-RIU: Radar Interface and Up convertor: Tool used to convert the RES IF signals into Rf signals ready to be injected into the radar, plus decoding the radars interrogations and sending these to the RES module. Finally, the RIU also handles the rotational generation (ACP and ARP).
- Analysis Tools: A number of independent tools take care of the viewing and analysis of recorded data by the RES. These tools allow the viewing of the interrogations and of the

Result log (containing the recorded Uplink datalink messages).

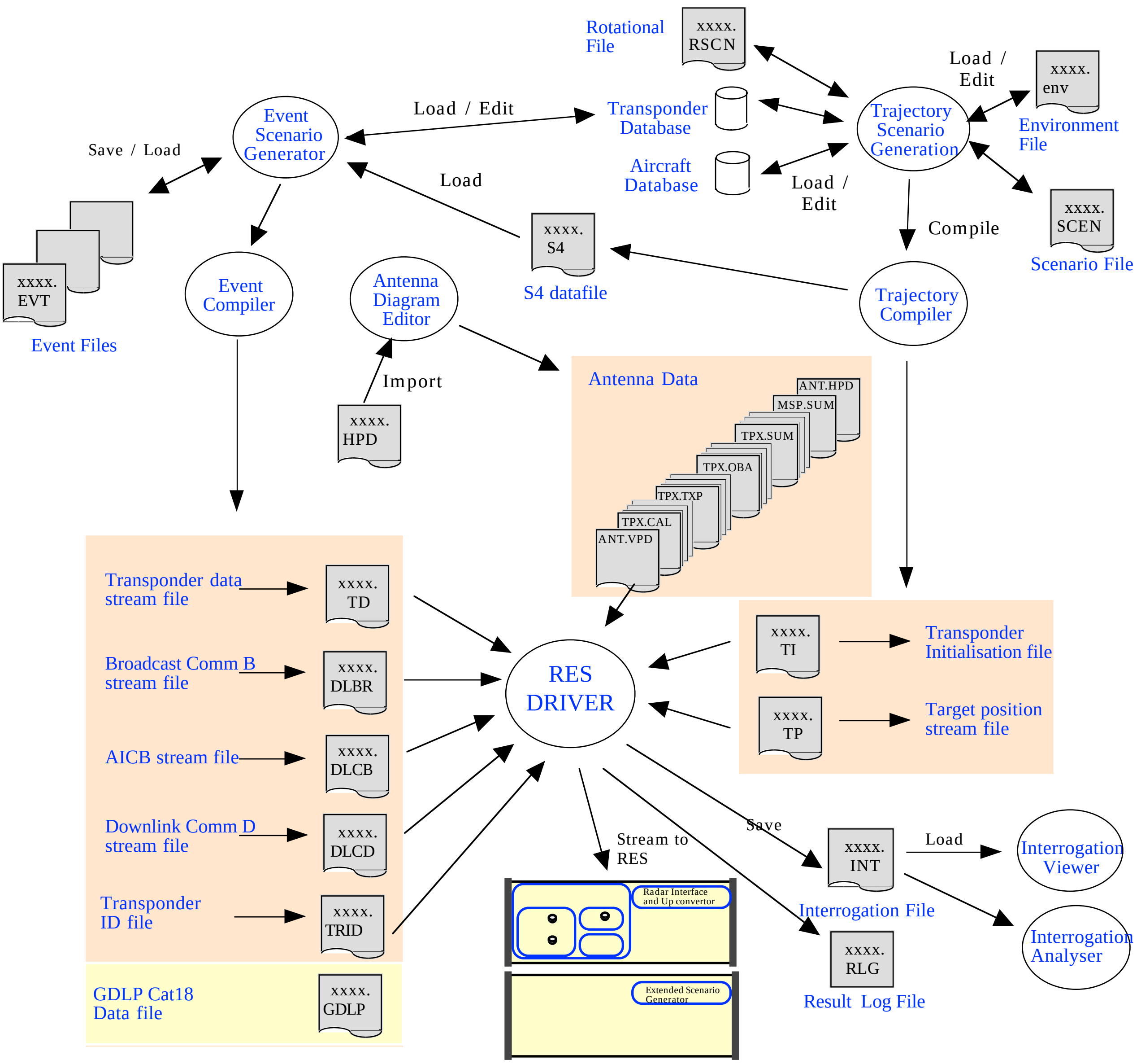


Fig. 4 : RES module overview and created files.

2.3. RES Concepts

2.3.1. Target Position Simulation

The RES is equipped with four independent "Target Boards". Each of these boards can simulate multiple targets separated in time. Overlapping targets (replies to be generated at the same position in time) are always generated by separate target boards.

The Scenario Generator will generate multiple Target reports (plots), by using data supplied by the user. This data consists of trajectory starting positions (both 3d positions and time) and target dynamics information. The target plots are calculated by the scenario generator's compiler and recalculated towards data that can be used by the RES. This consists of the following fields:

-Scan number
-Target ID number for unique Target Identification.
-Target Board number, predefined by the scenario generator
-Target Range at the start and at the end of the beam (in 25 ns resolution steps), in order to accommodate in beam range changes.
-Target bearing at the start of the beam and at the end of the beam (in 16 bit ACP resolution), in order to accommodate in beam bearing changes.
- Azimuthal Speed (Δ Azimuth within beam)
- Range speed (Δ Range within beam)
- Target Transponder ID (transponder related data is set independently from target position data since it is not subject to scan / scan changes)
- Target C code (For SSR and Mode S)
- Target Elevation, for determination of antenna diagram (one of 16 different HPDs)
- Target Power and MTL (see further)

All these fields are combined in a compact format into the Target Position Stream file (.TP file), which is streamed in real time to the RES during the simulation.

2.3.2. Antenna Rotation Simulation

The RES is supplied with a dual ACP / ARP interface: The system can either input ACPs and ARP s from an existing radar system (Site-based) or it can output ACP / ARP information (timing signals) on its ACP / ARP interface.
In both cases, the user must select the resolution of the ACP interface, where he has the choice between 12,14 or 16 bit resolution.
In slaved mode, the RES locks onto the incoming ACPs and hereby tracks the real antennas rotation.
In Master mode, the RES generates the ACPs and ARPs itself, following the fixed or programmable rotational scenario model. This model allows the user to define either a fixed rotation speed (entered as a revolution period) or to define speed changes at fixed time intervals (relative to the start of the scenario) .

2.3.3. Radar -Target Model

If we start from the radar, the interrogations from the radars transmitter pass through the following stages: (Uplink, 1030 Mhz)

Transponder Receiver (MTL)
↑
TP Cable Loss
↑
TP Antenna Gain
↑
Atmospheric attenuation + 1/R^2 Loss
↑
Sensor antenna Gain
↑
Feeder Loss
↑
Interrogator transmitter power
(See Manual of the SSR Systems ICAO Doc 9684; fig 4.1)

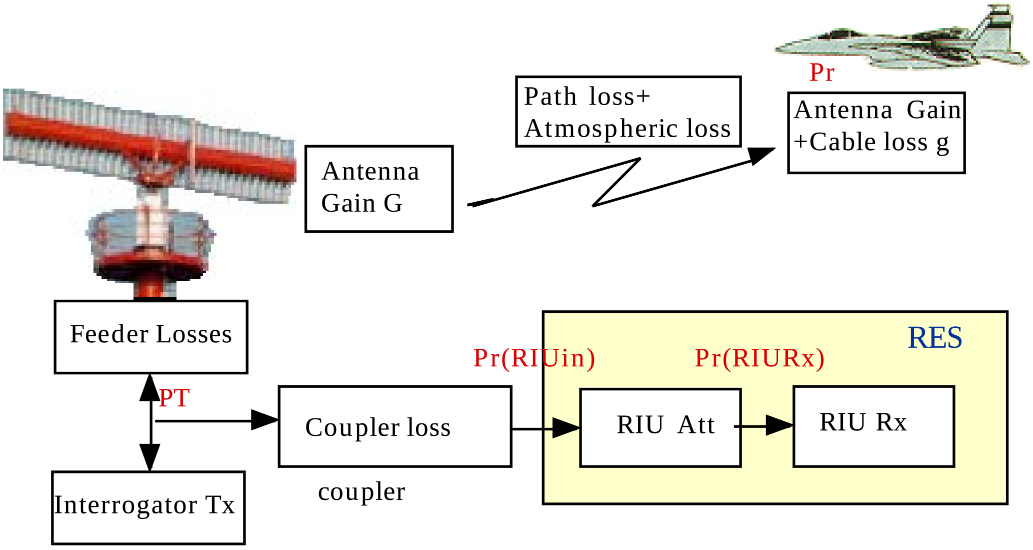


Fig. 5 : RES Uplink power model.

The RES will simulate each of these stages by providing a simulated target with the correct Minimum Trigger level according to the model.

Path loss = 20 log R (Nm) + 98.05
$P_{r(aircraft)} = P_{T(radar)}$ *- Feeder loss + G (Elevation, Azimuth) - Path loss + g (Elevation)*

Using these formulas the Trajectory scenario generator will calculate the required interrogation power at the radar output for the simulated transponder to reply. Next, this power is recalculated towards the input of the RES and next towards the input of the RIU Receiver using the following formulas:
Transponder replies when $P_{r(aircraft)}$ *> Minimum Trigger Level (MTL)*
Or if
$P_{r(RIURx)}$ *> MTL - RIU Att - Coupler loss- Path loss + feeder loss - G (Elevation, Azimuth) - g*

The scenario generator will translate this value into a ADC value, using the internal RIU Calibration table. In this calculation, only the Vertical antenna Gain (VPD diagram) is used, since the horizontal antenna gain changes in real time with sensor (virtual) rotation. This calculated value will be attached to the rest of the targets information (Range, azimuth etc..) in order to determine whether a target should reply or not to a certain interrogation power. The RIU Firmware continuously monitors the interrogation power from the radar and sends this information to the ESG in order to determine whether the system should reply with a transponder reply or not.
The measured interrogation power is attenuated with the Tx (1030 Mhz) antenna pattern (HPD, max=0 dB) at the relative azimuth of the target at the moment of the interrogation (≠ when the interrogation would be received by the target).

The Target MTL is stored in the Target Position Stream file (See 2.1.1).

If we start from the transponder, the replies from the transponder pass through the following stages to reach the receiver: (Downlink, 1090 Mhz)

Transponder Transmitter
↓
TP Cable Loss
↓
TP Antenna Gain
↓
Atmospheric attenuation + 1/R2 Loss
↓
Sensor antenna Gain
↓
Feeder Loss
↓
Interrogator Receiver

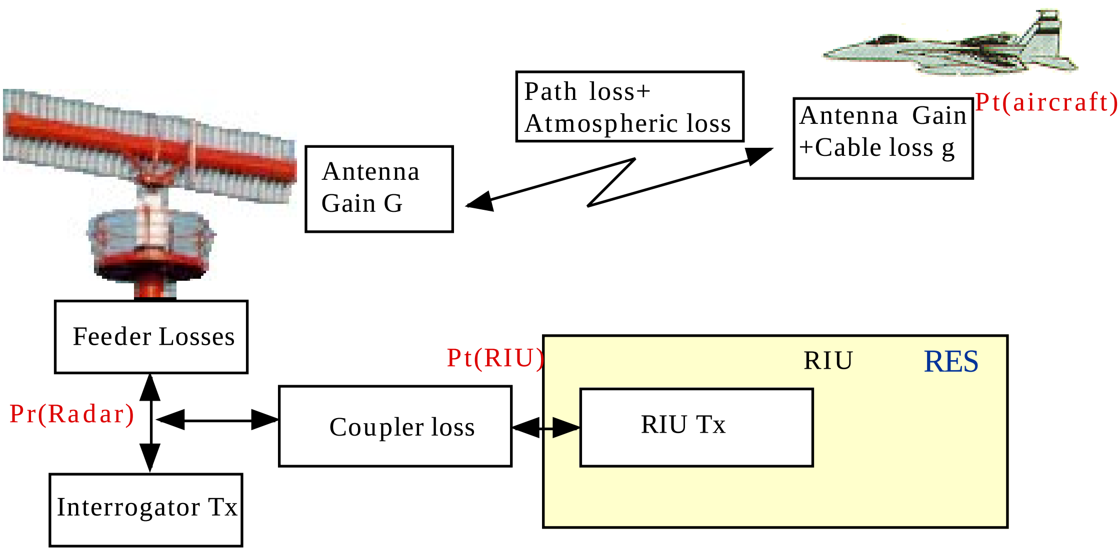


Fig. 6 : RES Downlink power model.

The RES will simulate each of these stages by providing a simulated target with the correct power according to the model.

Path loss = 20 log R (Nm) + 98.54

$P_{r(radar)} = P_{t(aircraft)}$ *- Path loss - Feeder loss + G (Elevation, Azimuth) + g*

Using these formulas the Trajectory scenario generator will calculate the power a real target at the desired position would generate at the radars' interrogator input (receiver). Next, this power is recalculated towards the output of the RES and the required RES output power for the target simulation is determined from:

$P_{t(RIU)} = P_{t(aircraft)}$ *- Path loss - Feeder loss + G + g + Coupler loss*

The RES output power is determined by the individual targets boards modulators, and is supplied to the RES as an index in a preloaded Power Calibration table. Furthermore, the downlink simulation is performed by an HPD attenuation at the moment the reply is received by the radar (≠ the moment when the reply is send by the transponder). The calculated power index is added to the Target Position Stream file.

2.3.4. Use of Hybrid for LVA antenna simulation

At the input of the real monopulse system, a reply with a certain OBA angle q arrives at the LVA antenna. The LVA antenna converts the signal of arrival in two signals, the Σ and the Δ signal, with a phase and amplitude relation according to the functions $G\Sigma(\theta)$ and $G\Delta(\theta)$. The monopulse receiver converts the Σ and Δ signal again to an estimated angle of arrival, which means an application of the inverse functions of $G\Sigma(\theta)$ and $G\Delta(\theta)$.

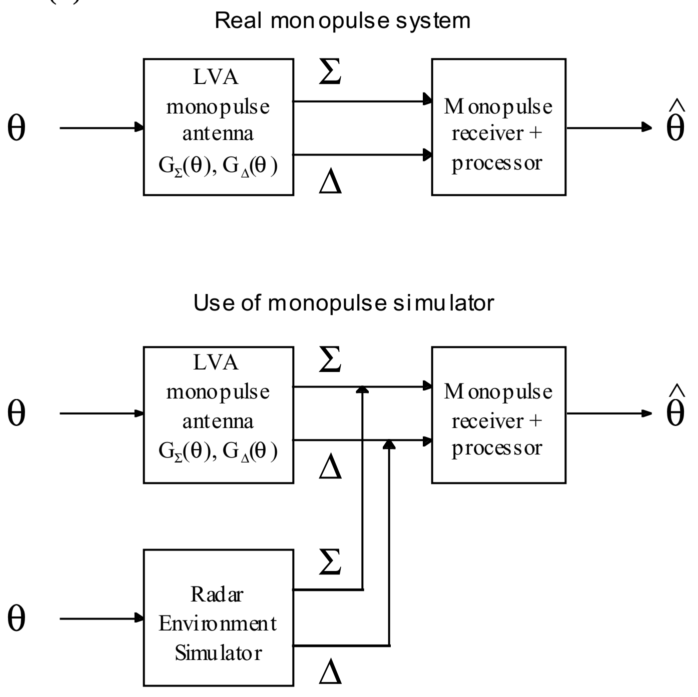


Fig. 7: Monopulse simulation of RES

The “Ideal” Monopulse system used by MSSR Radars can be described as follows:

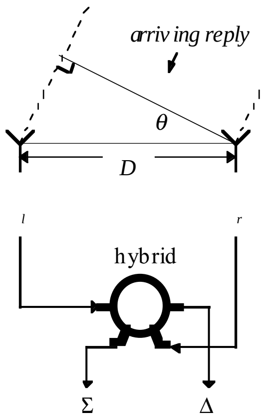


Fig. 8 : The monopulse antenna system.

The antenna of a monopulse SSR interrogator consist of two separate antennas, with the *D* representing the distance between their phase centres. Usually *D* is approximately halve the horizontal size of the antenna. In Figure 8, θ represents the Off-Boresight-Angle (OBA) of the target. The signal **S** that arrives at this system is:

$$\mathbf{S} = As_0(t)e^{j\omega t}$$

with *A* the signal amplitude, the pulse shape s(t) and ω the radial frequency of the carrier.

Due to the propagation delay difference (see figure 8) the signal at the left antenna arrives later in time, which results in a phase difference φ between the **Sl** signals and **Sr**. The two signals can be expressed as:

$$\mathbf{S}_l = AG_l(\theta)s_0(t)e^{j(\omega t - \varphi)}$$

$$\mathbf{S}_r = AG_r(\theta)s_0(t)e^{j\omega t}$$

with $G_l(\theta)$ and $G_r(\theta)$ the antenna pattern of the left and right antenna and

$$\varphi = \frac{2\pi D}{\lambda}\sin\theta \cong 22.8D\theta = 0.40D\theta_{degr}$$

The last approximation is valid for 1090 MHz and for small angles θ. Note that angles and phase shifts are always expressed in radians, unless indicated with a subscript.

In a monopulse SSR antenna the signals are combined using a 3 dB hybrid, which results in a Σ and Δ output. Within an ideal monopulse antenna the antenna patterns Sl and Sr are equal, and an ideal hybrid is used which performs the following operation:

$$\Sigma = \mathbf{S}_l + \mathbf{S}_r = AG(\theta)s_0(t)e^{j(\omega t-\varphi)} + AG(\theta)s_0(t)e^{j\omega t}$$
$$= AG(\theta)s_0(t)e^{j\omega t}\left(e^{-j\varphi}+1\right)$$
$$\Delta = \mathbf{S}_l - \mathbf{S}_r = AG(\theta)s_0(t)e^{j(\omega t-\varphi)} - AG(\theta)s_0(t)e^{j\omega t}$$
$$= AG(\theta)s_0(t)e^{j\omega t}\left(e^{-j\varphi}-1\right)$$

If the Σ and Δ amplitudes are sampled at the pulse maximum, the following values are measured:

$$|\Sigma| = \left|AG(\theta)e^{j\omega t}\left(e^{-j\varphi}+1\right)\right| = AG(\theta)\left|e^{-j\varphi}+1\right| = AG(\theta)\sqrt{2(1+\cos\varphi)}$$
$$|\Delta| = \left|AG(\theta)e^{j\omega t}\left(e^{-j\varphi}-1\right)\right| = AG(\theta)\left|e^{-j\varphi}-1\right| = AG(\theta)\sqrt{2(1-\cos\varphi)}$$

The amplitude relation between the S and D output, known as the OBA curve, can then be expressed as:

$$\left|\frac{\Delta}{\Sigma}\right| = \sqrt{\frac{1-\cos\varphi}{1+\cos\varphi}}$$

It can be shown that the phase relation between Σ and Δ is

$$phase = \arg(\Sigma) - \arg(\Delta) =$$
$$= +\frac{\pi}{2} \text{ if } \theta > 0$$
$$= -\frac{\pi}{2} \text{ if } \theta < 0$$
$$= \text{undefined for } \theta = 0$$

The RES uses digital signal generation with accountable accuracy and uses the same basic principles for monopulse generation as applied inside the LVA antenna.

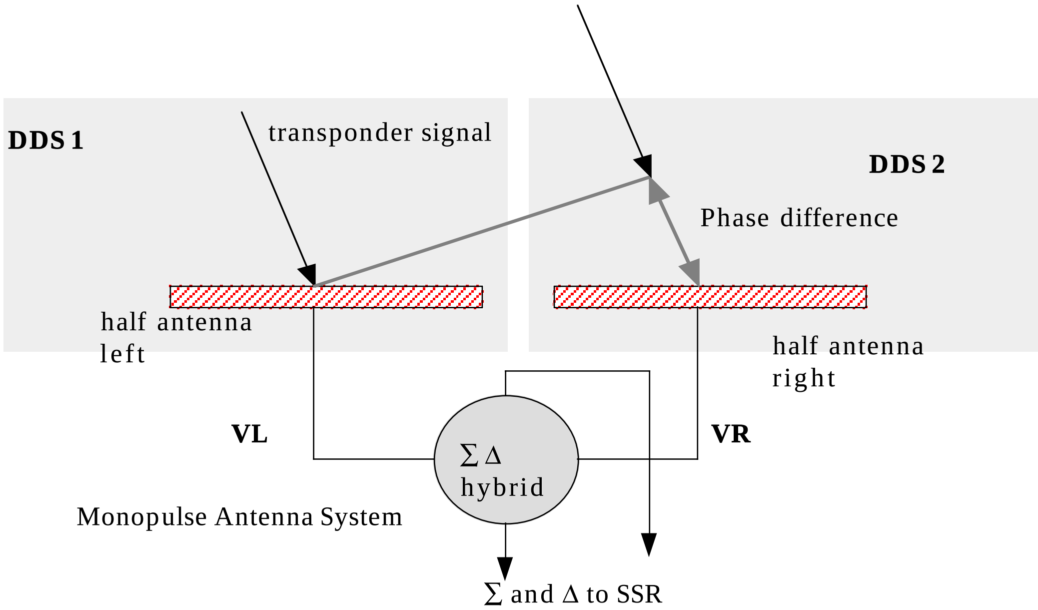


Fig. 9 : Monopulse Antenna System (Accuracy Concepts).

In order to generate a real target, two separate Rf sources (simulating the left and the right half of the antenna) are used to truly simulate eventual overlapping pulses. Both signals are generated by a Direct Digital Synthesis chip capable of instantaneous setting of frequency and phase for a generated vector. The DDS output is up converted in a first step to an IF of 30MHz and then modulated by the required pulse waveform.

In order to maintain accuracy, this is performed by two identical multiplying DACs. Both channels still have the same amplitude and are modulated with the target code in an arbitrary way.
The phase angle between both channels holds the monopulse OBA value (zero degrees of phase corresponds to an OBA of zero). The phase angle is set digitally in the DDSs with a 12 Bit accuracy.

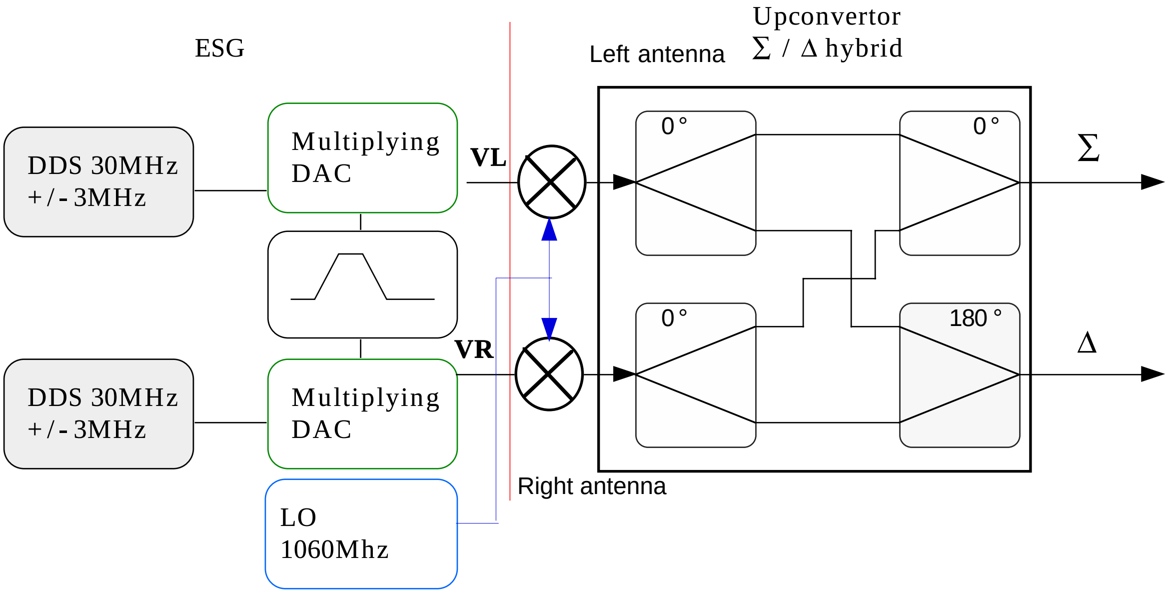


Fig. 10 : Analogy of generation to a Monopulse Antenna System.

The multiple channels are combined at If level and transported closer to the injection point for the radar.That way the connecting cables are insensitive to phase and amplitude changes due to temperature or bending.
Finally an up converter provides the signals at the correct Rf frequency of 1090 MHz.

To provide a perfect monopulse signal two other conditions must be met :
-Both vectors must be of equal amplitude before they enter the combiner hybrid which converts the signals into Σ and Δ signals.
-The hybrid must perform a perfect Σ and Δ calculation.

2.3.5. Radar Antenna Diagram simulation.

The Radar antenna diagram simulation is performed by a combination of several look-up tables in the ESG software. These tables are constructed in the software program called “Antenna Diagram Editor”.

This program allows the user to import Downlink HPD diagrams (as measured using the RASS-S tools), or Text based spreadsheet tables as a source for horizontal antenna diagrams.

Secondly, the Antenna Diagram editor program allows the input of a Vertical diagram. This must be entered in a text based table (maximum gain typically 27 dB).
The column may be entered at regular or irregular intervals, but must contain 16 entries. The table must start at 0 degrees elevation (or at a small negative value) and run up to at least 60 degrees elevation. One HPD diagram is calculated for each entry in the table.
The antenna power for all elevations in between the 16 entries in the table are interpolated.
The real antenna gain used for the RES is determined from the VPD diagram input.
The VPD interpolation value depends on the calculated target elevation. This is calculated using two different models, selected in the “VPD model” parameter:
When set to default "flat earth", the elevation is calculated as arctangent of altitude (C code) devided by projected range =√(X^2 + Y^2).
In the case a 4/3 earth radius model is selected, elevation is determined using the 4/3 earth model.
elevation is arcsine of ((4/3R+h)^2- (4/3R+z)^2+r^2)/(2(4/3R+h)r) with R being the earth radius, r being the slant range of the target, z being the altitude and h being the stations' heigth.
Two other models are implemented, using 1/1 and 5/4 earth. They employ the same formulae.
In all cases, the VPD gain or attenuation is determined by interpolation of the calculated elevation in the user entered VPD diagram (using the antenna diagram edittor).

The Vertical antenna diagram is simulated by calculating the antenna gain for different elevations.
The diagram is written in a file called VPD.ANT and is used by the Scenario compiler to determine the MTL and Tx power for each simulated transponder. See above.

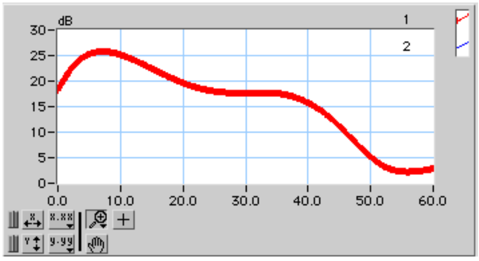


Fig. 11 : VPD diagram used in ESG Default Antenna.

The Horizontal antenna diagram is simulated both in reception as in Transmission (Uplink & Downlink). In this version of the software, no difference between the 1030 and 1090 Mhz patterns of the HPD is simulated, altough this would be possible using the concepts laid out by the tool.

In RIU reception (Uplink), this results in a set of 16 tables called TP_n.SUM, where n stands for any of the four Target Generator boards. These tables contain a number of AD values, which are subtracted from the initial MTL (which is also a AD value) of the RIU. The tables makes sure the target only replies within the beam and allows for interrogation power (after path loss) dependent interrogation acceptance. This will cause targets at far range to narrow their azimuth extension.
The table is calculated from the Sum Horizontal diagram and the RIU receiver calibration table.
16 different tables are build, one for each elevation entry in the VPD diagram table.
A factor can be entered in order to allow for beam widening.

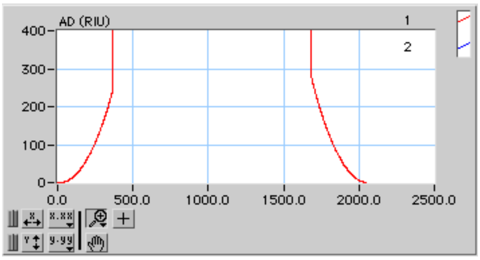


Fig. 12 : TP_n.SUM table.

In RIU transmission (Downlink), the horizontal diagram is created in two ways:
A first modulation of the Sum and Delta signal is performed by the RIU internal Hybrid. This simulates the monopulse behaviour of the simulated LVA.
A second modulation (the actual tapering of the simulated LVA) is performed using the modulators of the ESG Target boards.

The formulas defined in 2.1.4. are used to calculate the tapering function of the antenna A G(θ) and the phase relation of the VL and VR signals:

$$\alpha = \text{phase angle}$$
$$\theta = \text{OBA angle}$$

$$\alpha(\theta) = 2\pi\, D/\lambda \;\; * \sin(\theta)$$
$$|\, \Delta / \Sigma \,| = tg\,(\alpha/2)$$

$$A\,G(\theta) = \frac{|\Sigma|}{\sqrt{2(1+\cos\theta)}}$$

From this, two sets of tables are build:
The TP_n.OBA and TP_n.TXP tables. These tables are calculated from the Sum and Delta Horizontal Diagram. The TP_n.OBA tables contains the Phase information $\alpha(\theta)$ for the DSS channels versus azimuth, while the TP_n.TXP contains the output power modulation A G(θ)) versus azimuth.

All tables have 2048 entries the index is an Integer 12 number (-1024...1023), and the resolution is 2^-16 degree.
The OBA tables contain the phase difference between the two DSS channels, in which 0 stands for 0 degrees and 4096 stands for 360 degrees.

A special compensation is added using the RIU Hybrid correction table. This RIU hybrid correction table is created using the RES Calibration program (see 2.3.4).
The TXP table contains the extra attenuation that is added to the path loss attenuation as a function of azimuth, resulting in a ∑ and ∆ amplitude modulation.
The table contains power in dB/10 resolution.
The tables are calculated for 16 different elevations.

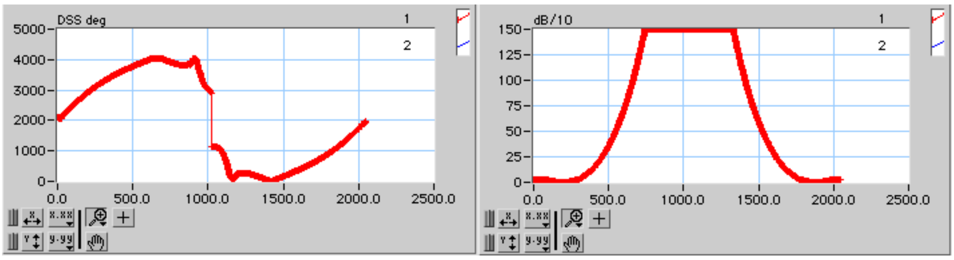


Fig. 13 : TP_n.OBA and TP_n.TXP tables.

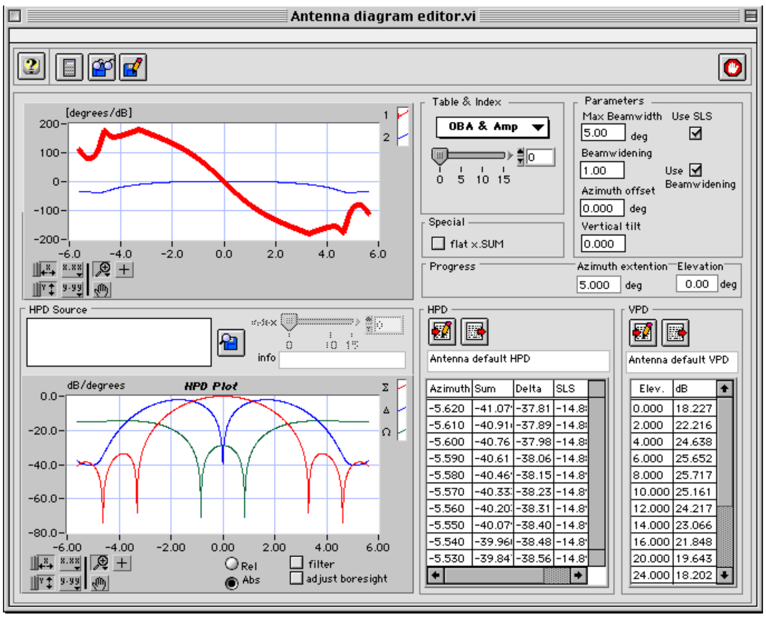


Fig. 14 : Antenna Diagram editor program.

2.3.6. Simulated Target Antenna Characteristics and Cable Loss

The Target's antenna diagram and its cabling losses are not simulated in this phase of the RES software. This implied that the antenna gain gt plus cable loss of the transponder are believed to be 0 dB.

The simulation of real antenna diagrams for targets can be subject of future software enhancement.

2.3.7. Simulated Transponder Mode S Capabilities

The Target's transponders Mode S characteristics are simulated by the RES internal Mode S processor. To the Radar under test, the RES behaves as N (N between 1 and 1080) independent Mode S transponders, each with their own independent Mode S processing (and timers, BDS registers etc..).

The transponders can be programmed to have any Mode S level (1 trough 5) or a combination of mode 1, 2, A or C support.

This implies that all targets shall reply individually to any interrogation send by the radar. The supported interrogations are:

-1, 2, 3 / A,C for SSR operation
-UF4, 5, 11, 20, 21 and 24

Nevertheless, there are a number of differences between the RES transponders and real target transponders:

-The RES transponders will not generate DF 0 or DF 16 ACAS replies, nor will they update their ACAS related BDS registers in an automatic way (related to the aircraft position).

-The RES transponders can support level 5, but do not support the "Enhanced" protocol completely, since the RES is supposed to be connected to a single sensor, having only one II code. Therefore the RES does not support Multi-II code datalinks simultaneously to the same transponder.

-The RES is limited to a 4 level overlap for All Call and SSR (12AC) replies. This implies that All Call interrogations to a fifth target in overlap will not be processed and not cause a valid reply.
The RES will generate up to 2 overlapping Roll Call replies.

-The RES is supposed to be connected to a single radar, so it does not " stack " multiple All call interrogations (e.g. A UF11 and a regular A or C interrogation). It will therefore reply only to the last valid all call interrogation. Any all call transaction being processed will be interrupted by a new all call or SSR interrogation.

-Each RES transponder has 32 BDS registers, which can be selected by the user from the 256 available BDS addresses. The list of these 32 available BDS registers is fixed for all the simulated RES transponders. Each individual target can posses a subset of these 32 BDS registers. The contents of the registers is also individually adjustable.

2.3.8. Simulated Airborne Datalink Processing

The Airborne datalink section is controlled via a predefined scenario, generated by the “Event Scenario Generator”. This implies that the user can define any number of air initiated datalink transactions (AICB or COMMD) to be generated by any target in the simulated environment. The Scan number (or time) this transaction is generated can also be programmed, but the system itself can postpone transactions if datalink handling prevents certain actions to proceed (e.g. if the GDLP does not retrieve certain Air initiated datalink actions).

The data contained in the datalink actions (both the 1-4 segment AICB data as the 2-16 segment COMMD data) is predefined and must be entered manually by the users.
(No interface towards Mode S Sub networks etc. exists yet.

2.3.9. Transponder MMU

No real-time user interface exists for the Transponders. All transponder data is preprogrammed using the scenarios and the transponder database.

2.3.10. Maximum Overlap Processing for A/C and All Call Interrogations

Due to the possibility that a Mode-S system can unexpectedly go in acquisition mode (All-Call), and the fact that the Extended Scenario Generator only consists of four generators, a method has to be provided to handle the situation when more than four targets are to be generated.

The simulation of an environment with more than 1000 aircraft with a limited number of RF generators requires careful examination. To simulate a four overlap, a minimum of four RF generators is required. For a realistic simulation proper algorithms must be used. A special case is a sudden and massive All Call interrogation after a breakdown or antenna stop.

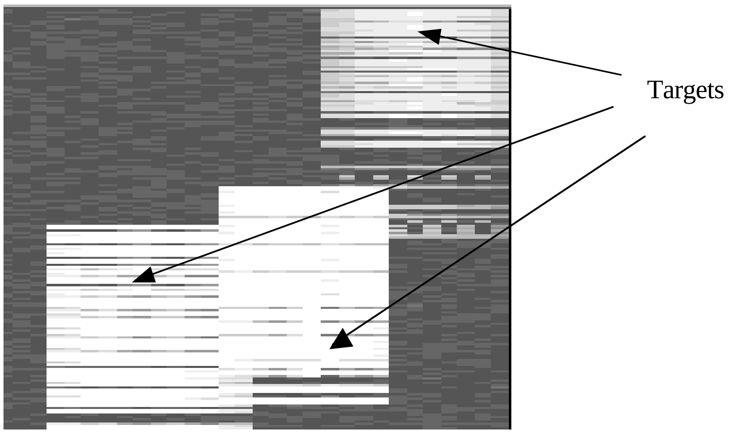


Fig. 15: Four level overlap.

Two targets are considered to be in a possible overlap if the replies need to be generated simultaneously.

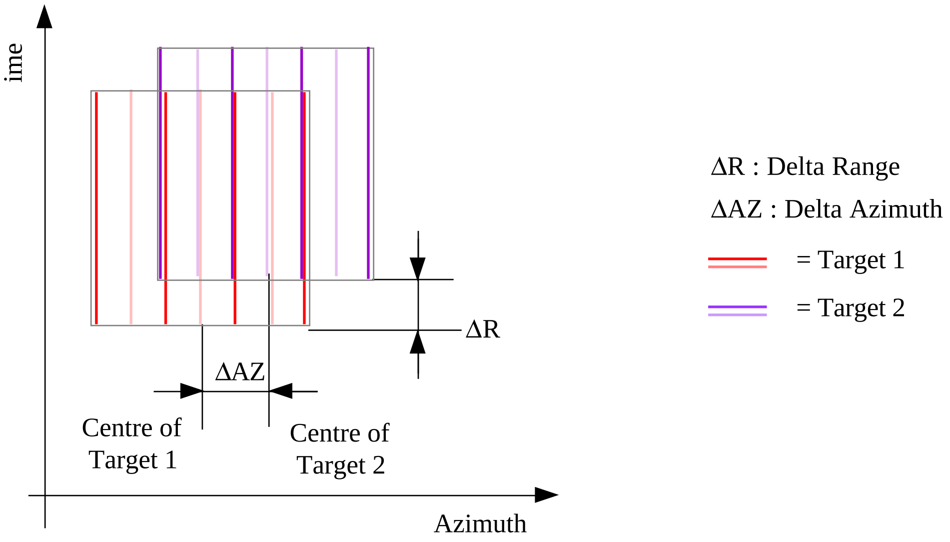


Fig. 16 : 2targets in overlap.

The length of the line corresponds to the reply of the aircraft :

- for Mode A/C this is 20.3 µsec plus a possible SPI = 20.75µsec
- for All Call Mode S this is 64 µsec

Unexpected All Calls can cause problems because the time they use to reply is much longer.

An overlap exists if the difference in range is less than the length of the reply and the difference in azimuth position is less than the antenna SUM/OMEGA crossover beam width. If such a condition occurs, the scenario generation software will select a different target generator for each of the transponders.

There is still a low chance that a more than 4 overlap (the condition shaded in red in Fig. 5.14) will occur. If this occurs the firmware in the target generator will deal with it.

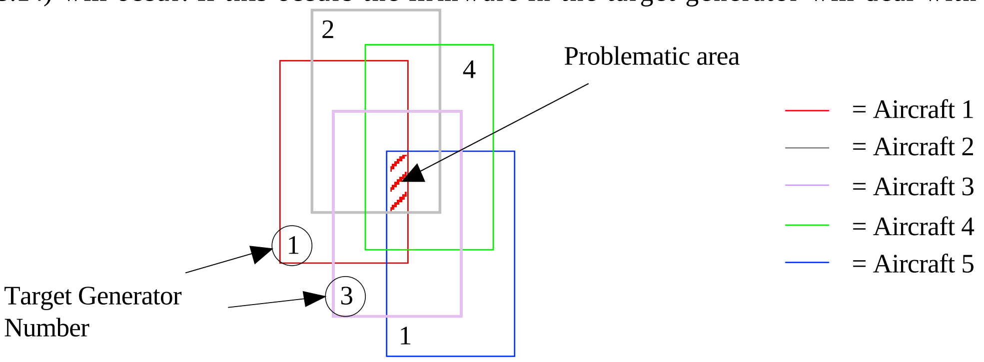


Fig. 17: More than 4 overlaps

The following rule is applied:

> If more than four overlaps occur, the target generator with the earliest azimuth is reselected. In the example given above, aircraft nr.1 and aircraft nr.5 will both be generated by the same target generator nr.1.

In such case, the target generator nr 1 will not generate the replies for target 5 until target 1 is out of the beam.

3.0. RES Hardware

3.1. General

The Radar Environment Simulator (RES) is a dedicated instrument that mimics the behaviour of multiple aircraft (Up to 2000 targets) at antenna level and fully simulates the environment in which a Mode S radar station is operating. The system can be used both for factory acceptance testing and site evaluation testing of Secondary Surveillance Radars (SSR). It consists out of a limited number of lightweight, portable units driven by a laptop computer.

The hardware part consists of two units : the Radar Interface and Up convertor (RIU) and the Extended Scenario generator (ESG).
It is built using state of the art digital and analogue components to achieve an extremely high accuracy of the generated targets: the azimuthal accuracy is 0.022 degrees while the range accuracy is better than 4 meters.
The signals are generated on IF level using Direct Digital Synthesis (DDS) technology in combination with 12 bit multiplying Digital to Analogue Convertors (DAC). Multiple DSP processors take care of timing, communication, pulse amplitude and phase shaping. The system uses the same basic principles for monopulse generation as applied inside an LVA antenna. The pulses generated on IF level are up converted to RF level and injected in the RF receiver part of the radar as if they are received through the LVA antenna.

All signals necessary for the simulation of the radar environment like timing and antenna rotation are also generated by the RES hardware. Therefore the RES is well suited for Factory Acceptance Testing of SSR radar systems. Since the RES is lightweight and easy transportable it is also an indispensable tool for site evaluation testing of SSR radar systems.

Fig. 17 : RES Hardware.

3.2. Product Specification

3.2.1. Radar up convertor (RIU282)

External Equipment Interface

- Rf interface to radar using triple 20dB sliding couplers for phase adjustments
- SCSI interface for remote programming and high speed data throughput.
- ACP / ARP interface
  - ACP : ACP output software selectable : 12Bit, 14Bit, 16Bit
    ACP input from radar
  - ARP : North mark output software selectable
    North mark input from radar
- RVI interface
  - Transfer of ModeS data information
- Video interface
  - Video In : connected to a 20MHz, 12Bit ADC
  - Video Out : Log receiver video output monitor
- ESG interface
  - VL and VR : If input signal interface to the ESG
  - CLK : master clock output to the ESG
- ESG digital I / O
  - Interrogation mode output bus interface
  - ModeS data output interface
  - Serial bus interface
- Rf Interface
  - 3 channel directional coupling interface (23dB coupling)
  - Ext. Rf input channel to measure pulse power at 1090MHz

Connections:

<u>Rf connections:</u>

Front panel :	Δ,Σ,Ω channel, to inject additional Rf signals (e.g. FRUIT) into the radar system
	External Rf input to measure the power of an external Rf signal (Used for calibration)
Back Panel :	precision connections for Δ,Σ, Ω channel to inject Rf signals into the radar system

<u>Digital connections:</u>

Back Panel :	-ESG connection to connect to the ESG
	-ACP / ARP out connector to connect the ACP / ARP output signals to the Radar
	-RVI connection, to input ACP and ARP from a connected RVI
	-SCSI interface to connect to host computer

<u>If connections:</u>

Back Panel :	video output top monitor the interrogations at video level
	video input to sample an external analog video signal
	If signal VL and VR input, to connect to the ESG equipment

General Specifications
video input: maximum 5V
Interfaces : SCSI for remote programming / high speed data throughput.
Power supply : 85-264 V_{AC} / 47-440 Hz or 120-370 V_{DC}

Internal Modules

Transmitter
Frequency Range: 1087MHz - 1093MHz
Synthesiser stabilised; stability 10ppm
Max. Tx Power: +5dBm
Modulator Range: 77dB
Noise Floor: -75dBm
Accuracy of target generation : better than 0.022 degrees over dynamic range +5 ... -35dBm

Receiver
Log receiver
Frequency Range: 1030MHz - 1090MHz
10MHz bandwidth
Sensitivity: -10 ... -90 dBm

ModeS decoder
Real time mode S interrogation decoder
4MHz serial data output stream
Dynamic range : -45...+20dB

Digital interface
Generation and distribution of master clock of 40MHz 2.5ppm
ACP, ARP and digital signal generation
digital ModeS data and Interrogation data processing
serial port interface : 10MHz data transfer
DSP bus interface

Analogue interface
Single channel 12Bit 20MHz ADC
Two channel analogue input multiplexer
Analogue interrupt generation
Motherboard I2C bus interface
DSP bus interface

DSP processing unit
512KWord memory
ADSP2101 20MHz processor
DSP bus interface

3.2.2. Extended Scenario Generator (ESG281)

External Equipment Interface

- SCSI interface for remote programming and high speed data throughput.
- RIU interface
  - VL and VR : If output signal interface to the RIU
  - CLK : master clock input from the RIU
- ESG digital I/O
  - Interrogation mode output bus interface
  - ModeS data output interface
  - Serial bus interface

Internal Modules

Communication Controller - Processor Board
SCSI interface for remote programming and high speed data throughput.
ADSP2101 20MHz processor
Address and on board memory decoding
EEPROM memory

Communication Controller - Interface / Timing Distribution Board
HOST data interface bus termination and driver section
PLL clock distribution
ISP decoder

Mode-S Processor-Target Server
ADSP 2181 32 Mhz processor
ISP decoder
DPR data interface bus termination and driver section
CAM memory
ISP counters low and high resolution
Memory 2MWord

Up to Four Target Server Boards
ADSP 2181 32MHz processor
Dual Ported Memory 8KWord
ISP address decoding
CAM memory
ISP CRC calculation
ISP counters low and high resolution
Memory 256KWord

Target Generator - Analogue Board
Analogue If frequency up convertor

SARAM 8KWord Puls shape memory :	40MHz interface
Four high speed multiplying DAC components :	40MHz bandwidth
Two channel High Speed complete DDS :	50MHz
Hardware controlled pulse timing generation :	25ns resolution
Generated IF Frequency :	30MHz
Dynamic Range :	90dB
Bandwidth :	20MHz

Analogue Combiner
Four channel analogue combiner
Preamplifier : 20dB

3.3. Functional Diagrams

The RES hardware setup consists of two boxes:
-The Radar Interface and Up convertor (RIU) and
-The Extended Scenario Generator (ESG) unit
Both units communicate with the Host computer using a SCSI interface.
The Firmware (DSP programs) will be loaded in the RIU and ESG via the SCSI interface. This is controlled from the RES Main Control program.

3.3.1. RES Hardware Overview

The ESG contains 6 DSP Processors, each one dedicated to a specific task:

-A Communication processor, taking care of all the datastreams between the RES and the controlling PC over the external SCSI bus.
-A Mode S processor, handling most Mode S processes and the distribution of the data over the four target processors (“Target Server”).
-Four Target processors, each one dealing with a subset of the current target list. The Target boards generate the required reply pulses on IF level.

The signals of the 4 target boards are combined and outputted at IF level. They are fed to the RIU for Up conversion and Σ, Δ generation.

The firmware programs for each of these processors will be distributed by the communication processor via the HOST interfaces of the processors.

The ESG receives a number of vital timing and interrogation data from the RIU over the RIU-ESG connection bus (37 pin DB37 connection).
Some of this data is distributed to all the processors, while some data is only intended for the Mode S processor.

The RIU handles the following tasks:
- Up conversion of RES IF signals to Sum and Delta RF signals
- Detection of incoming Mode S and SSR interrogation plus power determination.

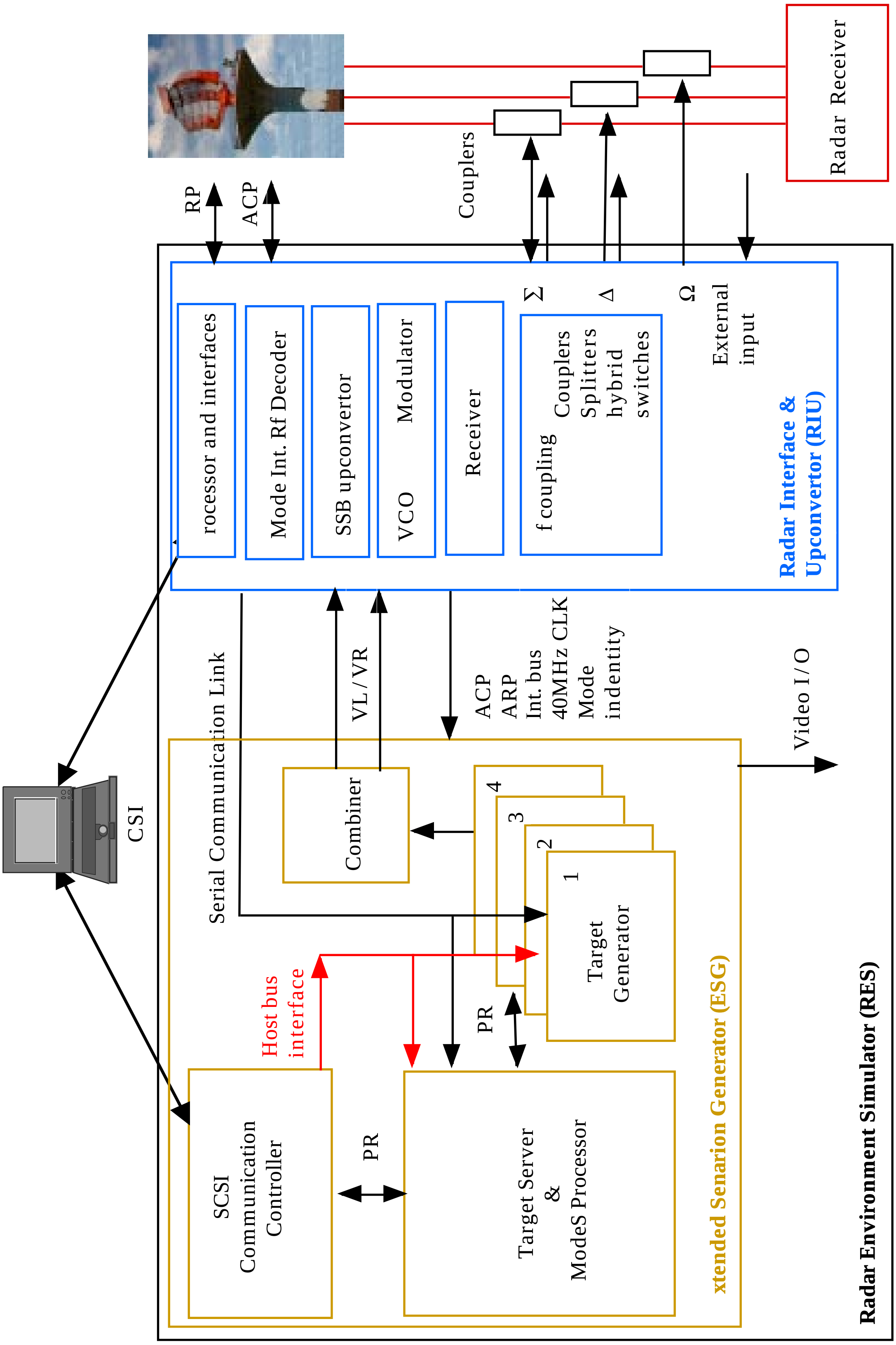
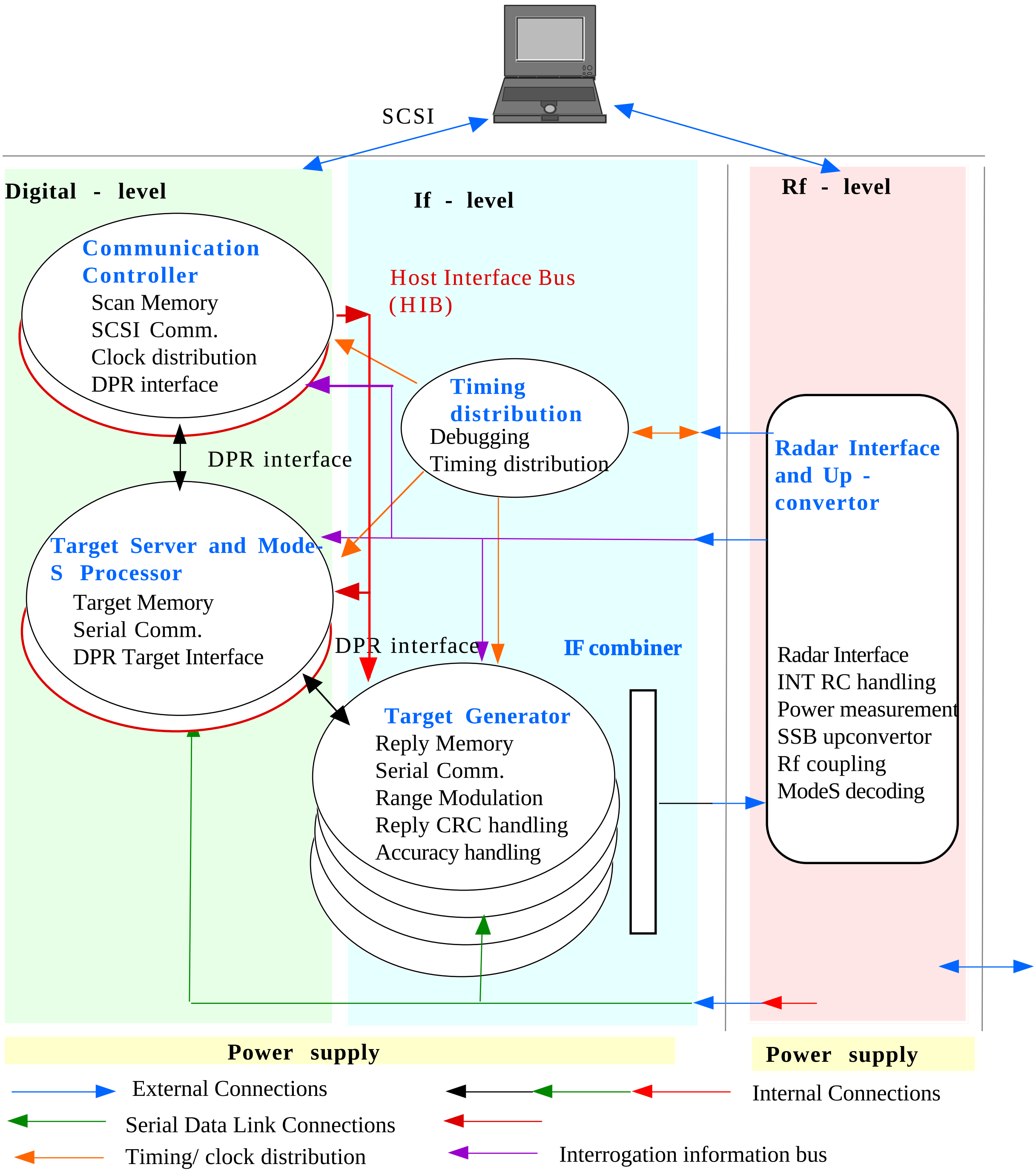


Fig. 18 : RES Block diagram.

- ACP and ARP detection / locking for external ACP input.
- ACP / ARP Generation in case of internal ACP output.

The RIU possesses a number of modules for these purposes, which are illustrated in figure 11.



HOST interface Query Data Link Connections

Fig. 19 : RES Functional Block Diagram.

3.3.2. Functional Diagram

The RES Functional block diagram is given in Fig. 12 on the previous page.
It shows the distribution of the different functions of the target injection throughout the RES.

When stepping through the functional block diagram the time resolution to move data from one module to another will change, along with the size of the buffer memory and speed. Moving data from the workstation to the communication controller (or " scan server" _) or will typically occur every half scan. Target information data will be moved at µs level from the scan server to the modeS processor (or " vector server") and target processor (or "target server").
Information data will also be moved at µs level from the vector server to the beam server or target generator. Finally the pulse shape shall be modulated via a look up table in memory with ns timing resolution. This will be performed through the reply server or target generator.

The internal Host Interface Bus (HIB) between the multiple DSP processors will be used for queries and program exchange from the communication controller to the modeS processor and target generators.

Another internal bus system to create a buffered memory and communication between the different DSP processors is accomplished by high speed Dual Ported Memory.

Two external bus systems are used in the RES environment to interface between the RIU and the ESG: a serial communication link and a high speed parallel bus.
The serial link is used to transport Radar data information (interrogation info, interrogation power level, ...) to the target generators and the Mode-S processor. These high speed data channels will distribute the necessary information to be able to correctly respond to an interrogation.

The interrogation information bus is a parallel bus containing information of the interrogation mode as well as the ACP information. The exact trigger evoked by the interrogation will be distributed via this bus.

The Radar Interface and Up convertor (RIU) is housed in a separate box but is considered to be one entity with the ESG unit.

The communication controller and the modeS processor modules are created by the combination of a DSP board with an interface board containing all the necessary sub modules to create different functionalities.

3.4. ESG Hardware Sub modules

3.4.1. Communication Controller

The Communication processor handles all the in and outgoing data moves over two external connection busses:
-The SCSI connection to the master PC
-The serial link to the RIU

All Target simulation and recorder data will be handled by this module. Also several immediate commands can be distributed via this controller board.

3.4.2. Target Server and Mode-S Processor

The Target Server and Mode-S processor board will receive the transponder data from the workstation via the communication controller board. It can therefore, after initialisation, continuously update the transponder data in the on board SRAM memory.

Interrogation data and radar interface signals are received and processed by this board and are passed to the communication board via a DPR link. After processing the interrogation this target server will pass the transponder information records to the predefined target generator boards via another dual ported data link. In a data link communication the Mode-S processor unit will use this DPR data link to read the corresponding transponder information.

3.4.3. Target Generator

The RES contains four similar Target Generator boards, which are intended to generate the required reply signals.

Target Server data received by the Target Generator module will contain numerous parameters and data. One of the most important parameters is the target range. This parameter will be loaded by the DSP and written to a 40 MHz high resolution time comparator (ISP firmware). The range resolution is equal to 25ns (= 3.75 metres).
A Discrete Digital Synthesis chip is used to generate accurate phase data for the two output channels of each target board. The DDS allows a digital control over phase and amplitude with a resolution of 0.1 degree and 0.02Hz.

3.4.4. If Combiner

The precision combiner will add the incoming If signals to one output channel.

3.5. Radar Interface and Up convertor Hardware

The RIU consists of a number of hardware functionalities, which can be separated into three functionalities:

- Interrogation reception / decoding
- Up conversion and SUM DELTA Hybrid function
-ACP / ARP Locking or generation

For this, the RIU uses the following modules:

-A DSP Board with SCSI interface
-An Analog sampling board
-A Digital control board for module control

-A Receiver
-A Mode S decoder

-Two SSB Up conversion modules (VL an VR channels)

-A hybrid for VL VR to SUM / DELTA conversion
-Some RF Coupling circuitry.

Theoretically, the RES output signals range between +8 and -70 dBm, being maximum power of the RIU and the RIUs Noise floor.
Targets with accuracy within specifications (Azimuth accuracy < 22 mdeg) can be generated with powers between +6 and -45 dBm.

The maximum input power of the without damage to the RIU is +35 dBm.
The minimum input power at which Mode S interrogations can be properly decoded is 10 dBm.

These four levels determine the choice of the exact coupling loss between RIU and the radar.

	Maximum	Minimum	Typical
Power Input	+35 dBm	+10 dBm	+30 dBm
Dynamic range	+8 dBm	-70 dBm	+0 dBm
Accurate generation	+6 dBm	-45 dBm	+0 dBm

The Block diagram of the RIU can be found in figure 20. This also shows the maximum and minimum input and output power levels of the RIU.

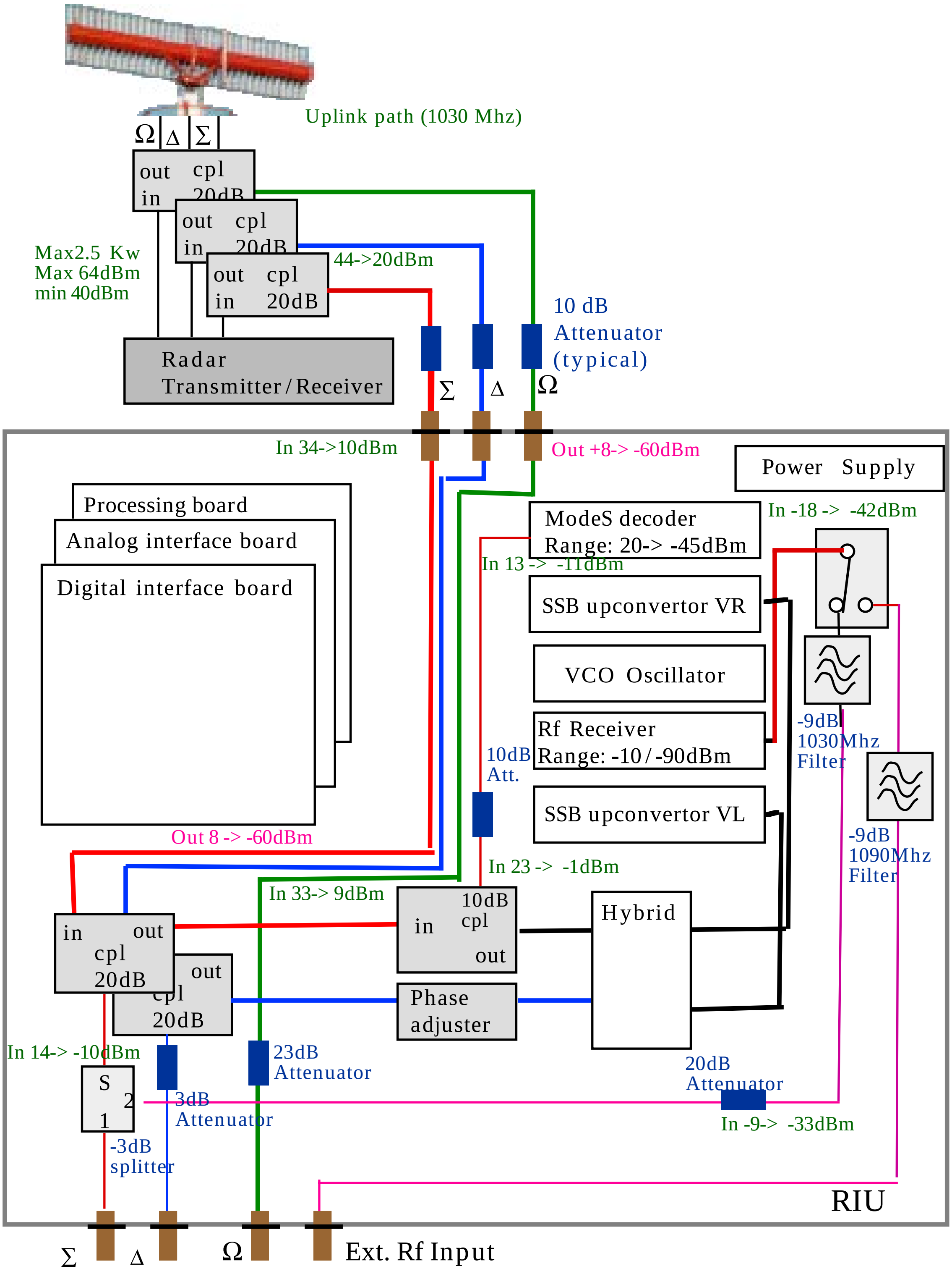


Fig. 20 : RIU Block Diagram

3.5.1. RIU Processing and Analog sampling

The DSP processor on this board will handle the processing as well as the SCSI protocol between the equipment and the computer. The video signal from the receiver or back panel connection is continuously being converted by a 12 bit A-to D convertor at a rate of 20Mhz.

3.5.2. Digital Interface Board

The digital interface board has five major functions:

- ACP Locking or Generation
- Interrogation reception and digitalisation.
- Mode-S decoding and phase synchronisation.
- CRC calculation of the ModeS interrogations.
- Master clock generation, starting from a 40MHz crystal oscillator.

3.5.3. RIU Up convertor

The RIU Up convertor is used to convert the ESG output signals (IF level) to the required 1090 Mhz band.
To avoid a complex (and unstable) bandpass filter, a single sideband filter technique is used.

The hybrid network will combine the VL and VR signal into a Sum and Difference channel.

3.5.4 Receiver and Mode S decoding

The RIU has a double receiver section: One section contains a logarithmic receiver and is used for the measurement of the received power of the interrogations and triggering, while the second section is used for the reception and decoding of the Mode S interrogations.

3.5.5. Rf Coupling

The Rf section consists of a group of SMA Connected modules mounted in the RIU housing.

The connectors at the front panel for the Σ and Δchannel are connected to the couple gate with 20 dB couplers (Fig. 16) plus 3 dB attenuator and power splitter. In total, the power loss between front and back of the Σ and Δ inputs is 24 dB±1 dB. The Ω connector on the front panel is connected to the back panel with a attenuator of 20dB.
These connectors are intended for extra injection or monitoring purposes (e.g. FRUIT injection).
The RIU back plane Σ, Δ and Ω channel are SMA precision connectors and are always connected to the radar system injection point.

When the output of the Rf couplers, installed by the radar manufacturer, are not aligned to zero phase shift, between the Sum and the Difference channel, it will be necessary to use the adjustable couplers designed by Intersoft. These 20dB couplers will replace the installed 20dB couplers. The phase alignment of the adjustable couplers is better then 1 degree. The adjustable couplers have the ability to change the phases between the injected Sum and Difference signals. Doing this enables to adjust a phase unbalance at the coupler injection points.

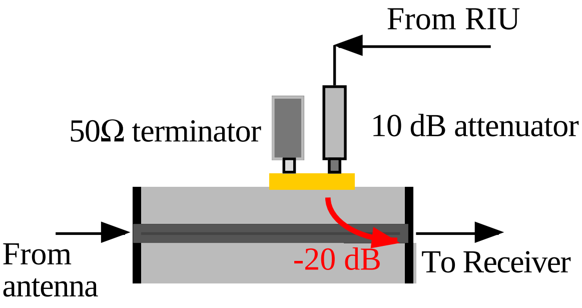


Fig. 21 : Adjustable couplers

4.0. Setting up the Radar Environment Simulator Equipment

4.1. General

For the injection of simulated targets into a life (M)SSR or ModeS radar the RES equipment is to be connected to the radar at different levels:

-RF : ∑, Δ and Ω signals
-Rotational: ACP and ARP input or output signals

The required RES equipment consists of the ESG and the RIU.
Furthermore, in most cases we will require a form of feedback to visualise the generated video and analyse the generated targets. Therefore the Multi level (video pulse) recording will be used in most cases in conjunction with the RES. The Pulse recording requires a video recorder and a RVI box.

Even when no pulse recording is required, the RVI performs signal conditioning for the ACP and ARP inputs of the RIU. Only if no signal conditioning for the input ACP or ARP is required, or in case the RES is in master ACP mode (RES determines revolution of radar), we will not require the RVI box.

4.2. Components

A complete configuration contains the following elements:

1. The ESG (Extended Scenario Generator) and related cables :

-Extended Scenario Generator ESG 281 SN: 24/1/x
-Mains power cable
-Floppy disk with calibration files
-Metal case (P290)

2. The RIU (Radar Interface and Up convertor)

-Radar Interface and Upconverter RIU 282 SN: 25/1/x

-Mains power cable
-floppy disk with calibration files
-Metal case (P291)
-1x SCSI (50p) to SCSI (50p) cable
-1x RIU-ESG Digital IO Cable : 1m DB37(m) to DB37(m)
round shielded flatcable
-SMA (m) to SMA (m) RG316 IF cables 1m (Red)
-SMA (m) to SMA (m) RG316 IF cables 1m (Black)
-SMA (m) to SMA (m) RG316 IF cables 1m (Yellow)
-1x ACP/ARP Output Cable (HD15p (m) to 5x BNC (m))
-1x RIU-RVI Digital Output Cable HD15p (m) to HD15p (m)

To distribute timing signals: ACP/ARP Output cable (left) and RVI-RIU cable (right).

3. RES Interface Kit (P286):

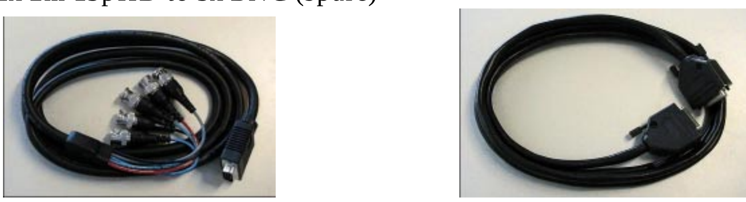
-3x 20 dB Phase adjustable Power Couplers (M110)
-1x SMA 3m SUCOFLEX SF104 high quality RF cable RED
-1x SMA 3m SUCOFLEX SF104 high quality RF cable BLUE
-1x SMA 3m SUCOFLEX SF104 high quality RF cable GREEN

-3x SMA precision attenuator 5 dB DC-3GHz
-3x SMA precision attenuator 10 dB DC-3GHz

-3x SMA precision attenuator 20 dB DC-3GHz
-2x adapter SMA(f) to BNC(m)
-3x BNC precision attenuator 10 dB DC-3GHz
-5x BNC precision attenuator 20 dB DC-3GHz
-2x BNC power splitter/combiner ZFSC-2-5
-1x BNC 10 dB directional coupler ZFDC-10-5

4. The Radar Video Interface and related cables:
- Radar Video Interface RVI299.

- 1x 2m 15p interface cable (to connect the digital signals between RVR and RVI)
- 1x 2m 15pHD to 5x BNC (to connect the analog signals between RVR and RVI)
- 2x 2m 15pHD to 5x BNC (to connect digital and analog radar signals to RVI inputs)
- 1x 2m 15pHD to 5x BNC (spare)



Connection cables between RVR and RVI: analog (left) and digital (right).

5. High Performance Macintosh Powerbook (G3 or G4 type)

- PowerPC-based Macintosh Powerbook.
- Powerbook power supply + power cord.
- HDI-30 Powerbook SCSI System Cable.
- HDI-30 Powerbook Disk Adapter Cable.
- Carrying case.

6. Optionally: The Radar Video Recorder and its accessories:

- Radar Video Recorder RVR183.

- mains power cable.
- SCSI 50p-50p cable.
- SCSI terminator.
- 2x 2m RG223 cables.
- 1x 5m RG223 cable.
- 2x 1 GB cartridges.

6. Optionally: (For RVR) Macintosh Powerbook (any type)

- PowerPC-based Macintosh Powerbook.
- Powerbook power supply + power cord.
- HDI-30 Powerbook SCSI System Cable.
- HDI-30 Powerbook Disk Adapter Cable.
- Carrying case.

4.3. RES Dynamic Range

When setting up the RES, two types of setup can be used in order to test the full range of POEMS specifications. These two setups correspond to two typical surveillance radar usages and are intended to take maximum advantage of the available dynamic range of the RES.

Additionally the user should always take into account that the coupling between the RES and the radar under test should be limited up to safe operating levels in order not to damage the RES.

Therefore the user must first select the test setup :
1) a typical Terminal Approach Radar (TAR) situation or
2) a typical Enroute configuration

The determining factors are:

- Antenna gain.
For Enroute radars typically a high gain LVA antenna will be used. The main beam gain is expected to be more then 28dB.
For a TAR the gain is usually lower (typically) 24dB but the vertical aperture is larger. This parameter will determine, among others, the allowable coupling loss for the scenario.

- Radar transmission power
This will be maximum (2.5 KW or 64 dBm) for long range radars and should be limited to less then 400 W for a TAR. This parameter must be taken into account in order not to burnout the RES.

- Receiver sensitivity and dynamic range:
For a long range radar the highest possible sensitivity is required. Therefore during target injection the noise floor of the RES must remain below the thermal noise level.
For a TAR target injection is performed with stronger signals and the receiver saturation level and associated accuracy behaviour becomes dominant.

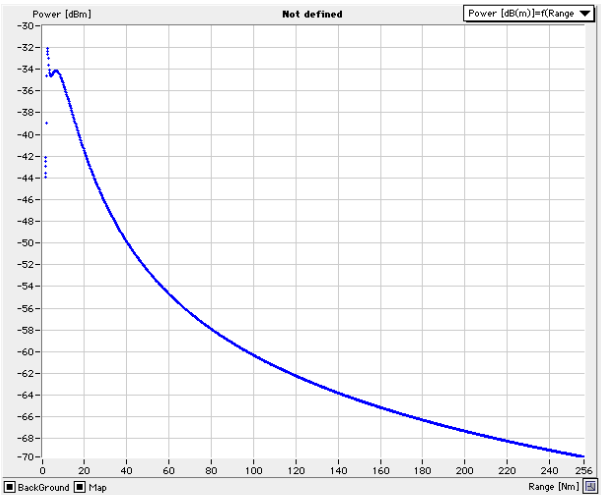
- Rotation speed is usually 4 seconds for a TAR and between 8 to 12 seconds for an Enroute system. This will not effect the setup.

Depending on the expected environment the coupling factors for the RES targets (trajectories) and simulated injected FRUIT must be selected.
For FRUIT the selection is less obvious and the user will need to decide depending on the site expectations.

The setup of Figure 22 should allow to test both situations by changing the corresponding attenuators.

Parameter	TAR Setup	Enroute Setup
Antenna gain	24 dB	28 dB
Attenuator A	5 dB	10 dB
Attenuator B	0 dB	5 dB
Min. range accurate Rx level	.8 Nm / -20 dBm	2.5 Nm / -30 dBm
Max. range accurate Rx level	80 Nm / -60 dBm	250 Nm / -70 dBm
Maximum allowed radar Tx power	400 W	3000 W
Noise on radar Rx due to RIU	-100 dBm	-110 dBm

These values are obtained in the centre of the beam for the antenna gain used and depending on the beam width. 2 to 3 dB less signal can be present at the Sum-Delta crossovers of the beam.
The -70dBm value at 256nM is derived from actual measurements with live traffic and can be verified using a simple RES scenario (radial flight of 256 Nm).



The value is slightly higher then can be found in some radar design textbooks. This is because they use worst case conditions for power budget calculation. If the user wants to simulate these conditions he is free to increase attenuator B with the desired value. Notice that the RES can generate at least 10dB lower values, at the expense of a slightly reduced accuracy.
The example above uses a target at a cst height of 10000ft, which causes a high reduction in power at close range due to the “shoulder “ of the VPD diagram of the LVA (Targets will be generated down to.5Nm). If the maximum amplitude level is reached at close range, the monopulse ratio sum/delta (and hereby the accuracy) will be maintained. However the output level is limited depending on the attenuation used.
Furthermore at short range the real live signals are usually much lower due to the vertical diagram of the transponder antenna on the aircraft fuselage.

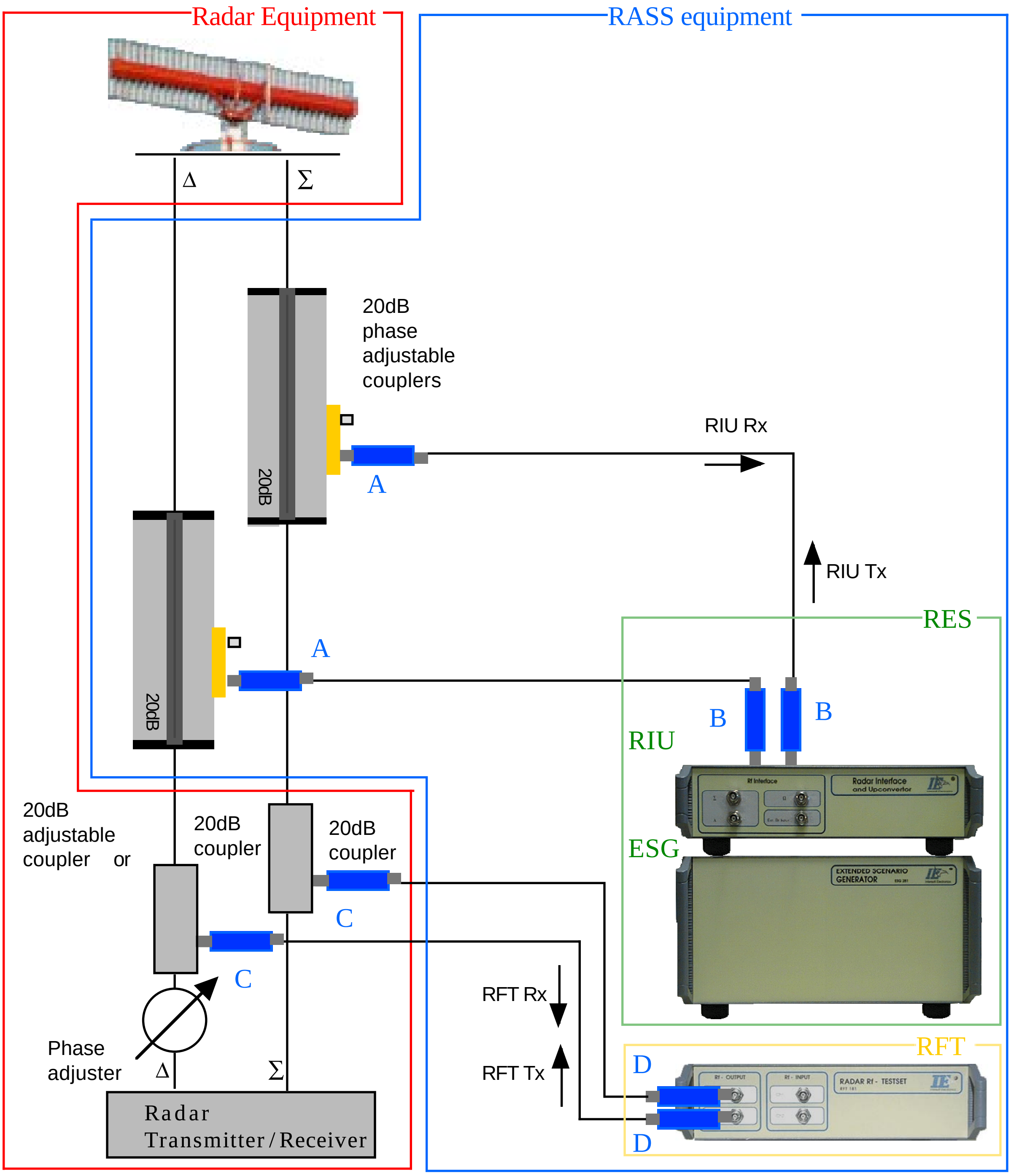


Fig. 22 : Setup for RES on RF side.

Warning :

Precautions must be taken in order not to burn out the RIU unit due to the RF power of the radar transmitter when operated in Mode-S on high duty cycle loads. If the radar can't be guaranteed to produce a duty cycle below 5% and a radar transmitter power limited to maximum 400W then it is prudent to divert to a setup with at least 30dB of coupling attenuation (coupler + attenuator A + attenuator B).

In this setup no damage can occur to the RES due to unexpected radar interrogations. If the combined value of attenuators C and D is at least 10 dB then no harm can be caused to the RFT due to Tx power.

4.4. Connections

This section describes the connections to be made at the radar r side in order to perform a Pulse recording.

For The Target injection, the RES needs to be set up in combination with the RIU. The complete setup is illustrated in fig. 5, showing both front and back panel of the RES and the RIU.

In most cases, the RES Target injection will be accompanied with a Video Pulse recording. (See Vol 3, ChIII). The setup also shows all the connections required for this measurement.

STEP 1 : SCSI Connections - Connecting the host computer to the RES

When setting up the RES, first connect the SCSI port of the ESG to the host computer. A SCSI cable to connect to the 50p SCSI connector of the ESG and a second 50p SCSI to 50p SCSI are included in the standard configuration.

The ESG is foreseen with two 50p SCSI connectors placed at the back panel. It has no internal termination for SCSI.
One connector is needed to connect the RES to the host computer. The second one is used to connect the ESG to the RIU.
1) Connect the RIU to the ESG using the SCSI-SCSI cable
2) Connect the ESG to the host computer using the SCSI-40HD cable.

Please note that the following SCSI addresses are used by default by the RES:
5: RES Communication processor
6: RIU Communication processor

Since the addresses of the RES devices are fixed, make sure that in case more devices are connected to the SCSI bus, they are not conflicting with these addresses. This means that no BSG (SCSI 6), RFA (SCSI 6) or RVR (SCSI 5)

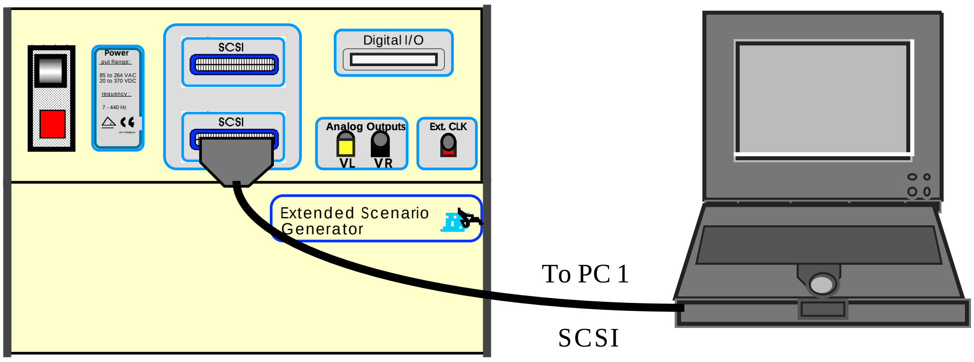


Fig. 23 : Connection of the computer to the ESG

STEP 2 : Connecting the ESG to the RIU

1) Now connect the Analog IF cables between the RES and the RIU:
-Yellow SMA-SMA cable = VL
-Red SMA-SMA cable = VR
-Black SMA-SMA cable = clock signal

2) Connect the ESG Digital I/O cable to the RIU Digital IO using the DB37 round shielded flat cable (Not shown in picture for clarity of image).

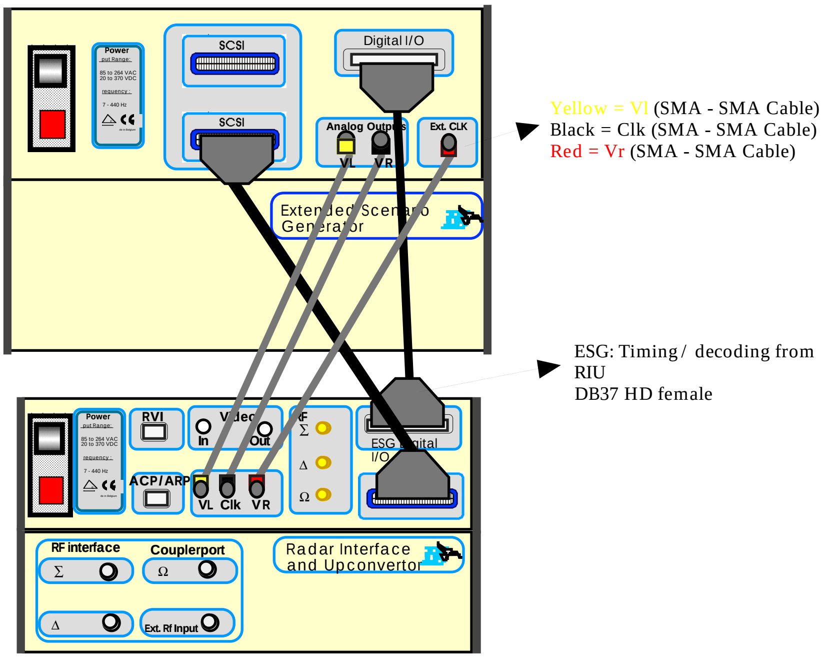
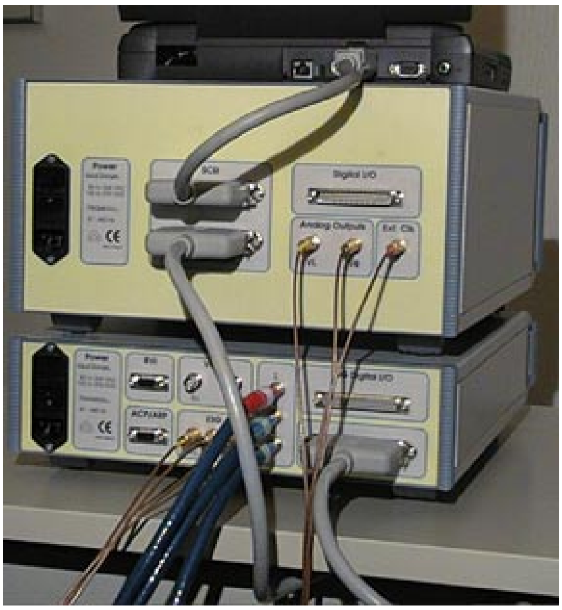


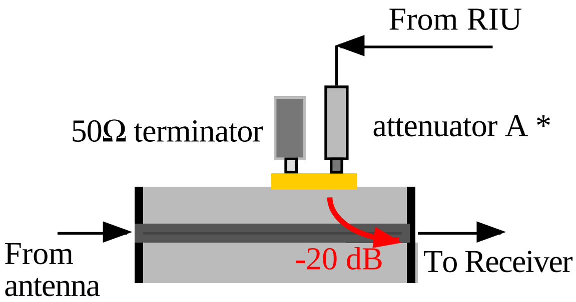
Fig. 24 : Signals from the/to the ESG (Extended Scenario Generator).

STEP 3 : Connecting the RIU to the Radar



1) Connect the Red marked SMA 3m SUCOFLEX SF104 high quality RF cable to the Σ output of the RIU. The other side of this connector links to the precision 20 dB phase adjustable couplers via an attenuator A (Typical value 5 or 10 dB, this value may change depending on the radar's dynamic range and the type of radar used (see 4.3) which has to be matched to the RES dynamic range).
Place the sliding coupler between the Radar antenna and the Σ input/output of the sensor's interrogator.

2) Perform the same action on the Delta channel, using the Blue marked cable and the Δ input of the sensor.
3) Perform the same action on the Omega (SLS) channel, using the Green marked cable and the Ω input of the sensor.



* See 4.3. for details

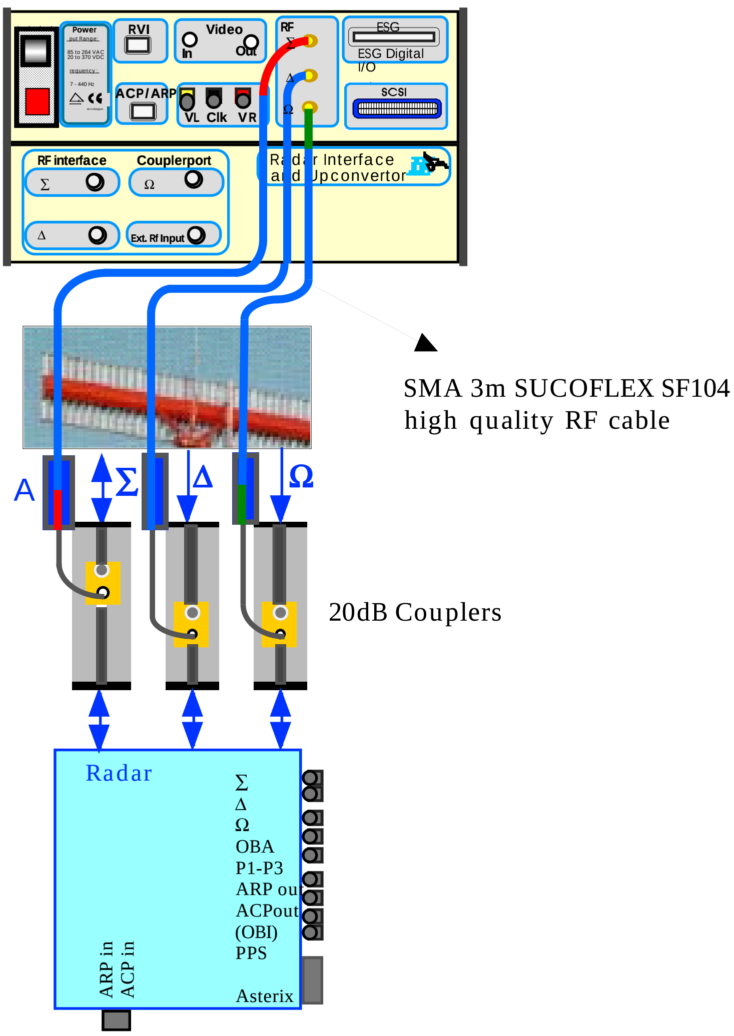


Fig. 25 : Signals from the RIU to the Radar.

STEP 4 : Connecting the second computer to the RVR

Optionally, the pulse recording must be set up using a second computer and a RVR. First connect the RVR to the SCSI port of this second computer.
In no case connect the RVR and the RES to the same SCSI port on the same computer!!!

Connect the SCSI port of the RVR to the host computer.
One connector is needed to connect the Radar Video Recorder to the host computer. The second one must be terminated using an external SCSI terminator (shown in the picture below).

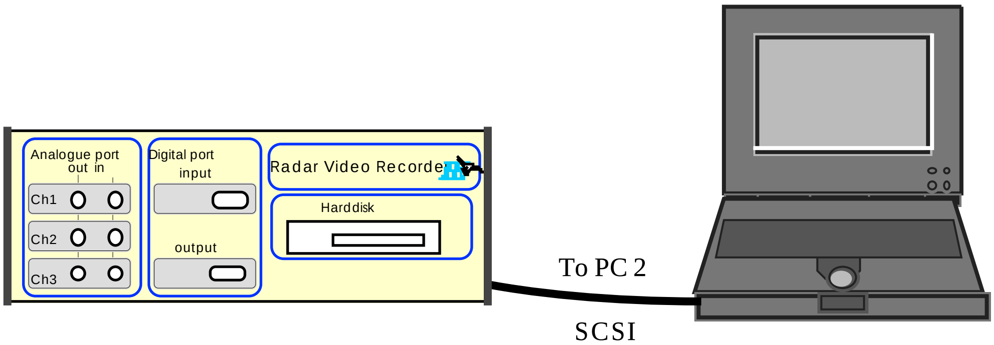


Fig. 26 : Connections from the RVR to the computer.

STEP 5 : Connecting the RVI to the RVR

The RVI analog and digital output connectors are situated on the back panel:

RVI Back Panel Connections.

Two 2m cables connect the RVI with the Radar Video Recorder. The digital cable can be recognised since it has a DB15 connector at both sides. It connects the timing outputs of the RVI to the digital input port of the RVR, and also supplies power to the RVI.

Connection cables between RVR and RVI: analog (left) and digital (right).

The analog outputs of the RVI are connected to the Radar Video Recorder by use of the same type of cable as used for the RVI inputs. At the RVI side it has again the high density DB15 connector. At the RVR side it connects using BNCs.
For the Pulsed Video recording, following signal connections should be made: beware of the monopulse connections:

- Σ, SUM (red) = channel 1
- OBA (grey) = channel 2
-ANALOG TIME (Black) = channel 3

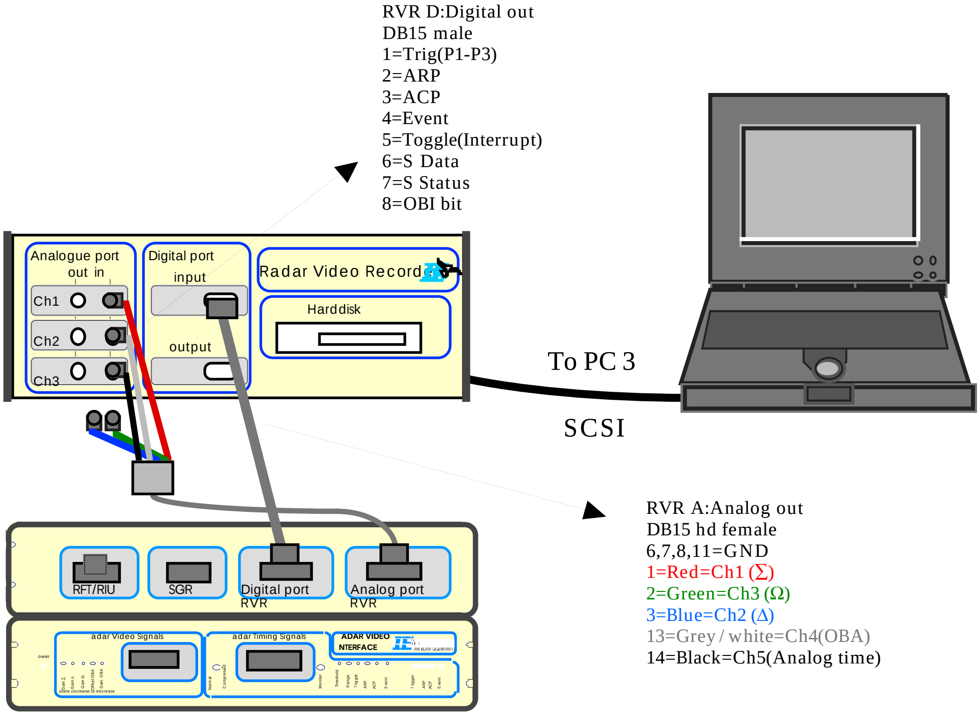


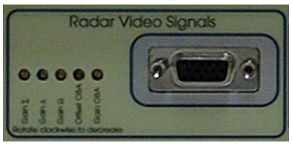
Fig. 27 : Signals from the RVI to the RVR

STEP 6 : Connect the Radar Video signals to the RVI :

The Radar Video Interface (RVI299) is the interface to connect the RASS and RES equipment to radar systems of different manufacturers. It provides signal conditioning, gain and level adjustments in order to adapt and buffer the available radar signals and feed them to the RASS-S equipment. The Radar Video Recorder requires at its analog inputs signal levels between -0.25 and 2.25V. Its digital inputs expect TTL compatible signals.

For video signals, the RVI is equipped with 4 analog inputs to provide signal conditioning for the following signals to be connected from the radar system:

- ∑ video channel (Ri = 10 kΩ, adjustable gain 1..4) RED cable
- Δ video channel (Ri = 10 kΩ, adjustable gain 1..4) BLUE Cable
- Ω video channel (Ri = 10 kΩ, adjustable gain 1..4) GREEN Cable
- OBA video channel (Ri = 1 kΩ, adjustable gain 1..8, adjustable offset -1V..+1V) GREY cable



RVI Video Connector and Trimmers

For the Pulse Recording only ∑ and Δ need to be connected. Optionally, the Ω channel (SLS) can be connected, if Reception Side lobe suppression is to be used. The Side lobe suppression mechanism is integrated in the RVI box, so it is only operational if the SLS is connected to the green input of the RVI.

Most radar systems offer the possibility of tapping the receiver output signals. These signals normally are positive and have an amplitude of less than 2V. Some receivers deliver 4V signals on the monitoring outputs. If you terminate these outputs with a 75 Ω load, the amplitude drops to 2V and the output can be used as such.

The ∑, Δ and Ω inputs have adjustable amplification. On delivery all three channels are adjusted to gain 1. For the OBA input both amplification and offset adjustments can be applied. On delivery it is set to gain 1, offset +1V.
The absolute max. input voltage for all signals (no damage) is 20V.

Please note the RVI is only capable of amplifying the input signals. In case the input signal exceeds the input range of the Radar Video Recorder, use an attenuator to bring the signal level in range.

Signals can be connected to the RVI using one of the accompanying input cables. Following colours are used to identify signals: red for ∑, blue for Δ, green for Ω/SLB, grey for OBA, black for interrogation trigger.

RVI Input Cable

STEP 7 : Connect the RIU to the RVI

The decoded interrogation signals are outputted by the RIU on its “RVI” connector.

Connect this terminal with the “RIU/BSG” input from the RVI box using the RIU-RVI Digital Output Cable HD15p (m) to HD15p (m).

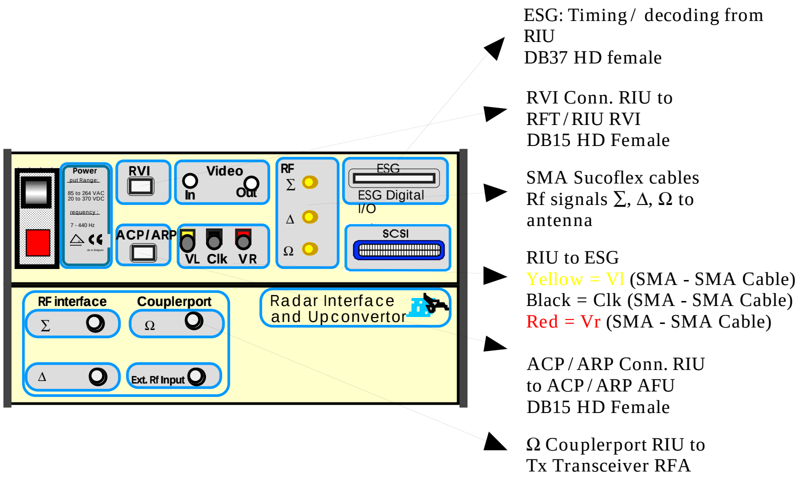


Fig. 33 : Signals from the/to the RIU (Radar Interface Unit).

STEP 8 : Connect the Radar Timing signals to the RVI

This step handles the RES in SAT (Site Acceptance Testing), or in other words in the case where the timing signals are generated by the radar under test. In this case, the RIU must slave its own ACP/ARP counters to the radar.
In case of FAT (Factory Acceptance), where the RIU must generate the ACP and ARP signals, we will use the same setup, but one additional cable is used to connect the ACP/ARP output of the RIU to the radar.

In any case, the RVI will record the ACP/ARP signals from the radar. This means that the RVI shall always be connected to the radar’s ACP/ARP output plugs.

The RVI provides the signal conditioning for the digital radar signals needed by the RES. The digital inputs are fed into a comparator circuit with hysteresis. The threshold level is adjustable from 1V up to 20V. Input impedance is determined by the 1 kΩ trimmer of the input circuitry.

Digital signals that can be connected:

- ACP	RED Cable
- ARP	GREEN Cable
- OBI (not necessary for the Windowed recording)	GREY Cable
- Event input : UTC time mark (not necessary for the Downlink measurement)	BLUE Cable

BEWARE: the Black cable (Trigger input) is NOT to be connected, since the RES will provide the triggering obtained from the RF interrogations.

RVI Connector for digital signals, trimmers and LED indication.

ACP: Use the ACP generator output. This signal can have different duty cycles, depending on the position where you tap it from the radar or depending on the type of radar. The duty cycle is irrelevant for the video recorder, since only the rising edges are used for analysis (Green connector on “Radar Timing Signals” of RVI).

ARP: Use the North reference pulse supplied by the interrogators ACP generator. The signal should be a short positive or negative going pulse. The pulse can be offset sometimes (using software or hardware counters in the radar). Be aware of this if you use the software and note this offset. (Red connector on “Radar Timing Signals” of RVI).

For Systems where the ACP / ARP is provided in a differential way (Thomson), use the special “Thomson” conversion cable. Use the positive signal of the differential output.

The threshold detection level is adjustable between 1V and 20V.
For each of the digital inputs a trimmer is foreseen to adjust the threshold level. The corresponding LED’s indicate the detection of the connected signals.

Figure 23 shows the complete test setup with a RES used for target injection combined with the Pulse Recording setup for SAT.

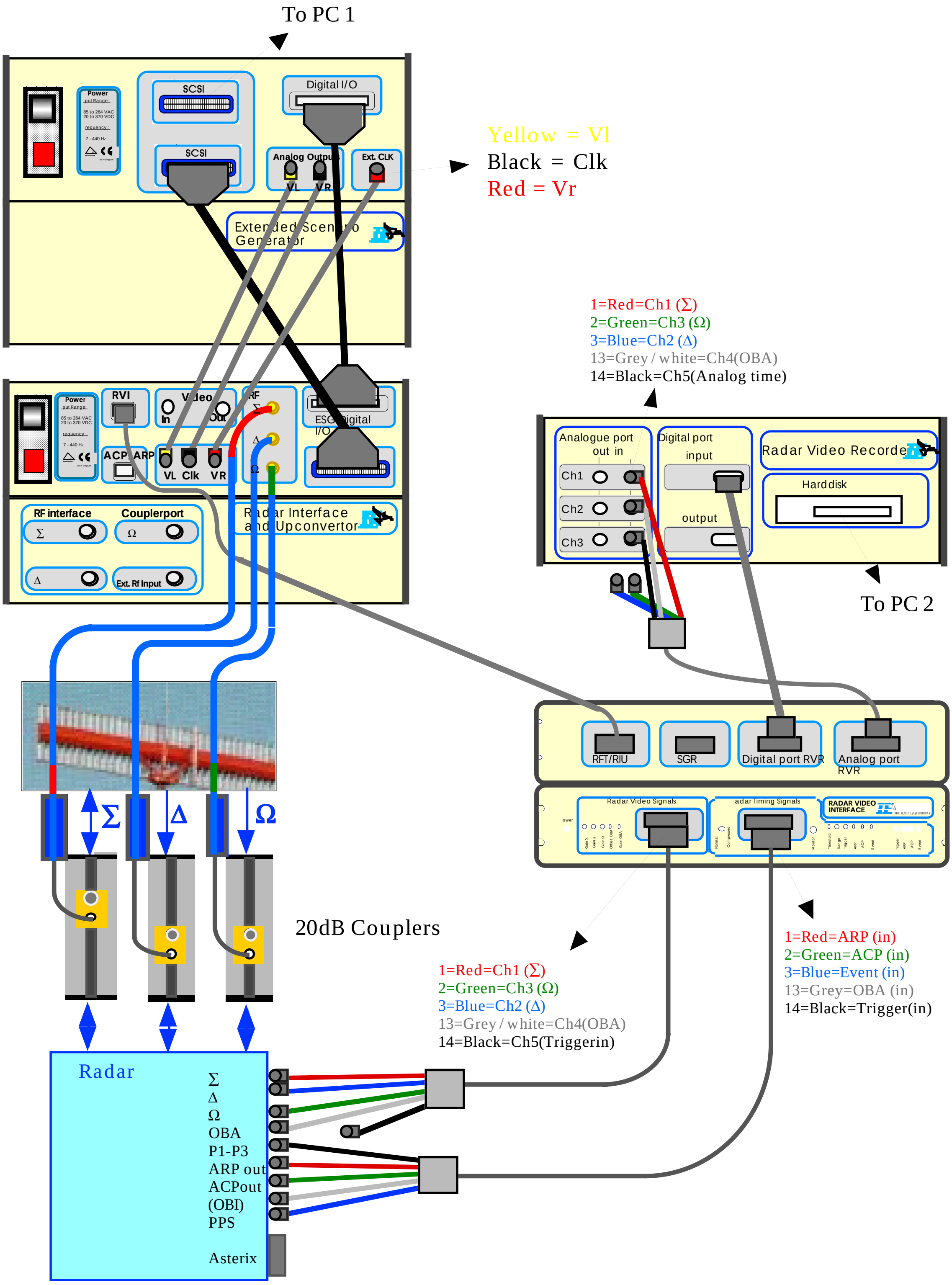


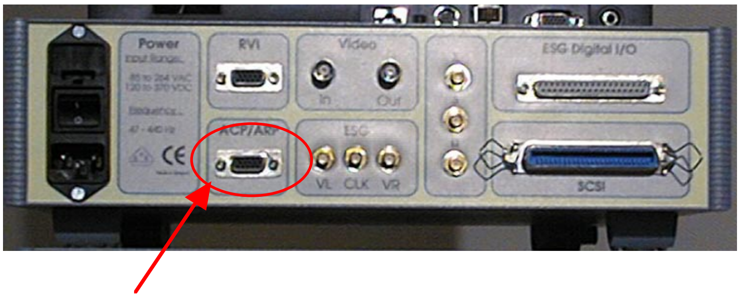
Fig. 23 : Connections for RES Target injection, SAT : No FRUIT

STEP 9 : Connect the RIU Output ACP/ARP to the Radar

This step handles the RES in FAT (Factory Acceptance Testing), or in other words in the case where the Rotational signals are generated by the RIU.
One additional cable is used to connect the ACP / ARP output of the RIU to the radar. In some cases and additional device, called a “Fan Out Unit” is used to distribute the ACP / ARP signals and to condition the signals according to the different manufacturers‘ required signals. (e.g. differential output).

The ACP and ARP signals are present on the HD15 pin connector labelled “ACP / ARP” on the rear panel of the RIU.

These signals can be connected using the 2m 15pHD to 5x BNC cable.



Beware: These signals are TTL (ABT) compatible, which means that they can drive maximum 50 mA each.

Figure24 shows the complete test setup with a RES used for target injection combined with the Pulse Recording setup for FAT.

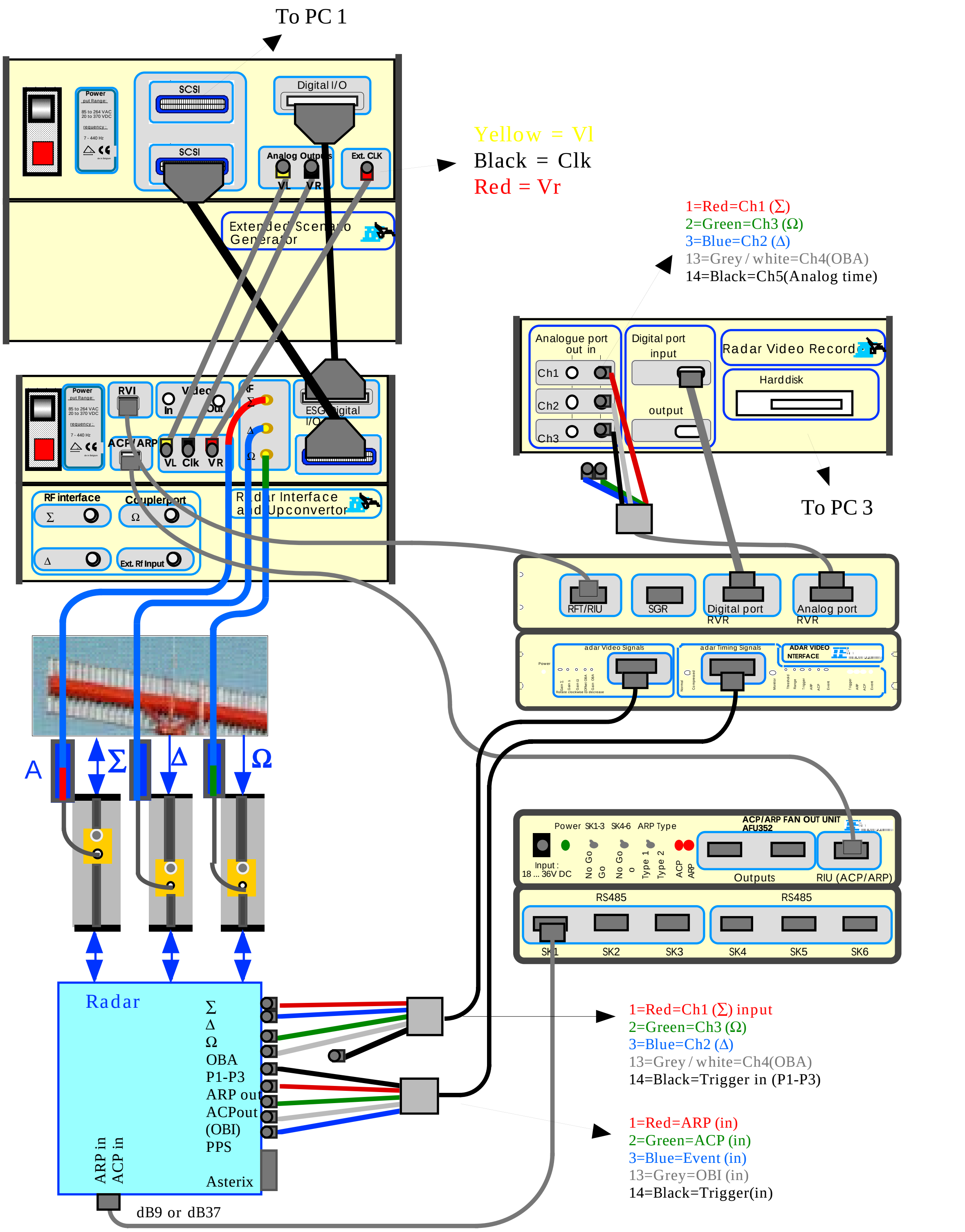


Fig. 24 : Setup for Multi Target Injection with RFA & RFTS FRUIT generation; FAT : No FRUIT.

4.5.Tuning the RF setup

For the tuning of the RF phase to reach maximum accuracy the following procedure is advised:

1. Select the attenuators A and B according to the preferred power budget

2. Select the attenuators C and D according to the maximum in beam FRUIT power required

3.Verify the phasing of the injected in beam FRUIT on the OBA signal for random behaviour. This can be done with an oscilloscope or with one of the RASS video tools before using any RES scenarios. This is not a critical value and can be adjusted by changing the cable length used for injecting the FRUIT or by the radars phase adjuster.

4. Connect a BNC cable to the “Video Input” of the RIU. Connect the other side of this input to the (buffered) outputs of the radar receiver. We will start by using the SUM output, and next use the Delta and OBA output. It is preferred to use the analog output port of the RVI for this purpose. (See connection drawing hereafter).

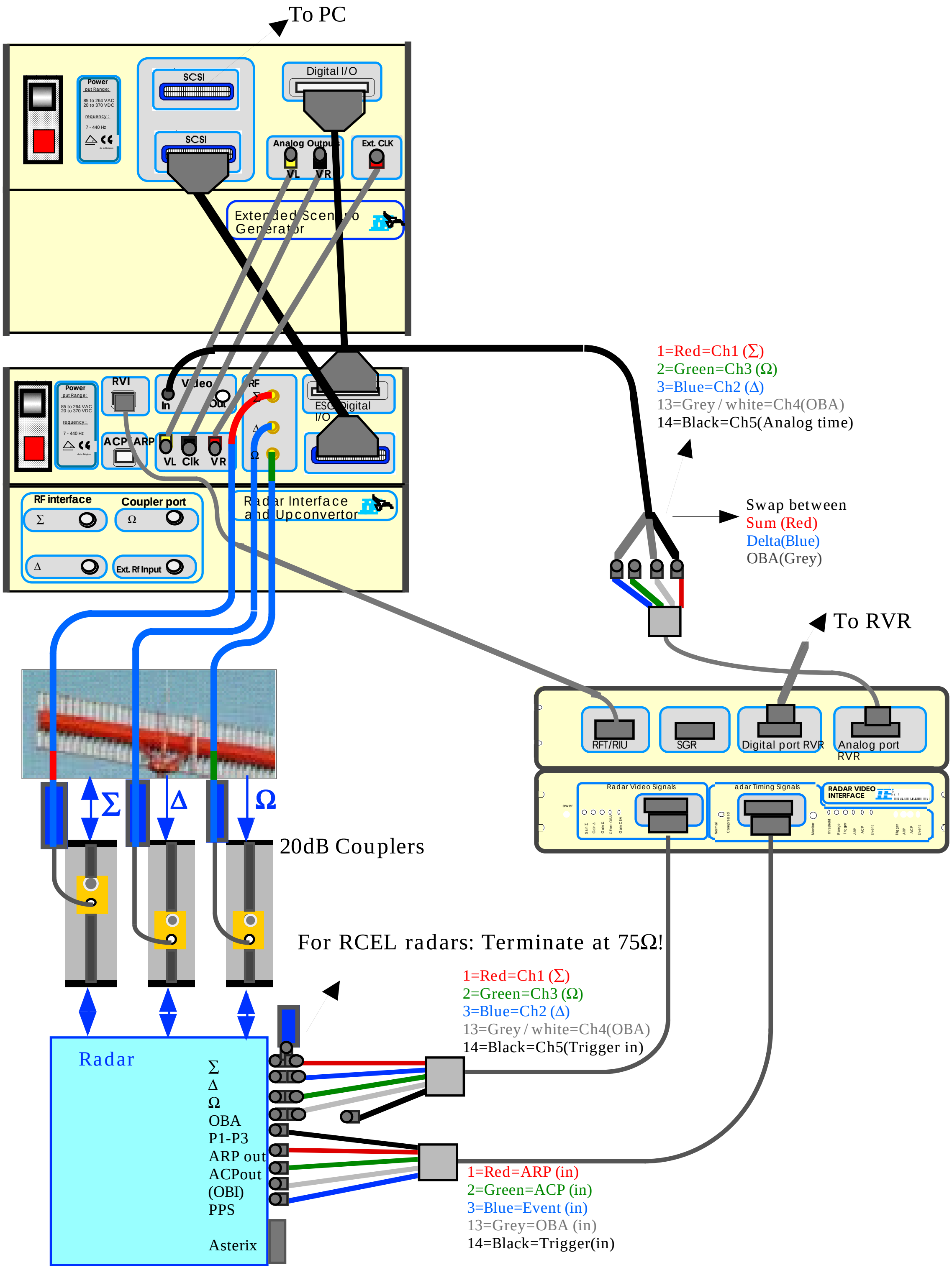
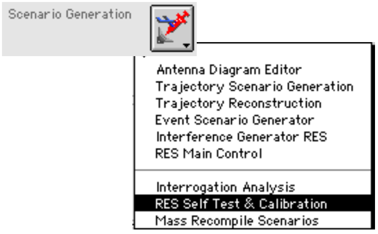
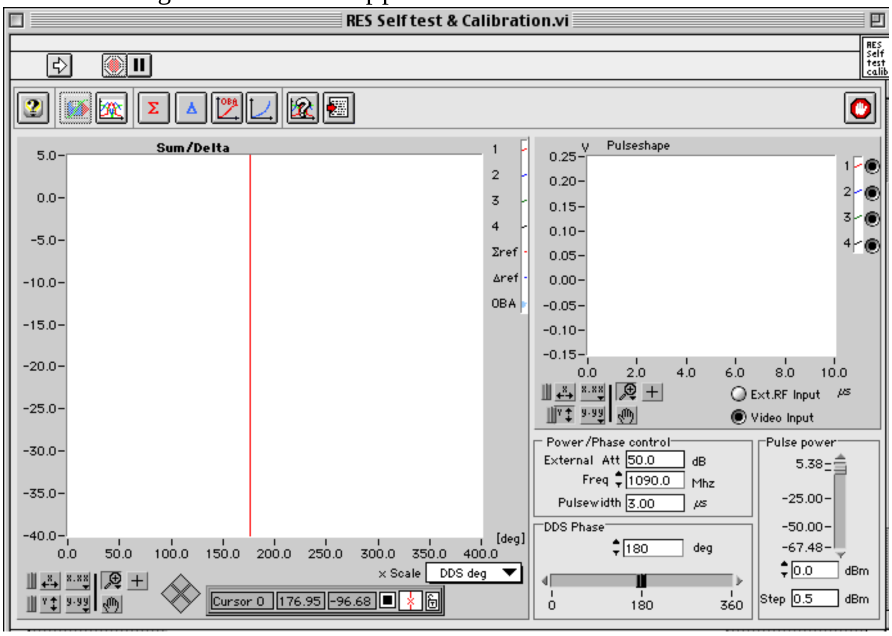


Figure: Connections for RES Self Test and Calibration (Sum channel drawn)

Now load the software called “RES Self test and Calibration” from the RASS-S toolbox.



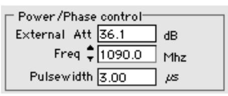
The following window will appear:



This tool allows you to “sweep” the RES trough its full power and phase range.
First set the parameters of the tool correct:

-Set the tool to “Video input”. 

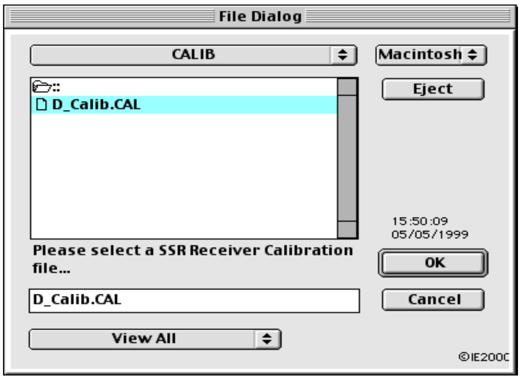
-Set the external attenuator to your “coupler loss” (= total attention of coupler and attenuators between RES output and Radar Rx input)



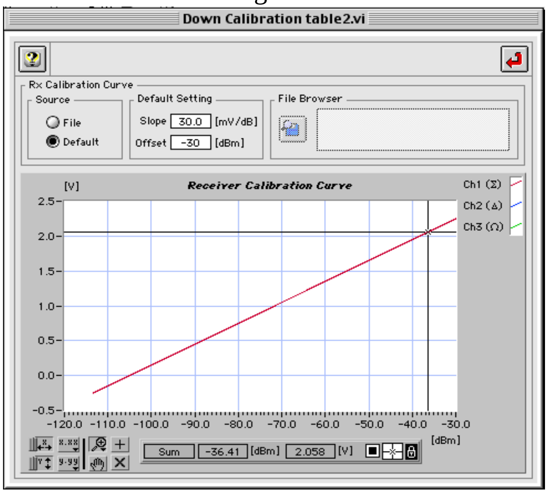
-Set the frequency to 1090Mhz and Pulse width of test pulse to 3µs.
-Set the output power (of the REs) to 0 dBm.

5. Now run the tool. 

The tool will first ask you to supply a Receiver calibration file of your radar Receiver. This calibration file can be build using the RFA (see UM Volume 2, Chapter III) . If you do not have the file, click cancel in the file dialog.

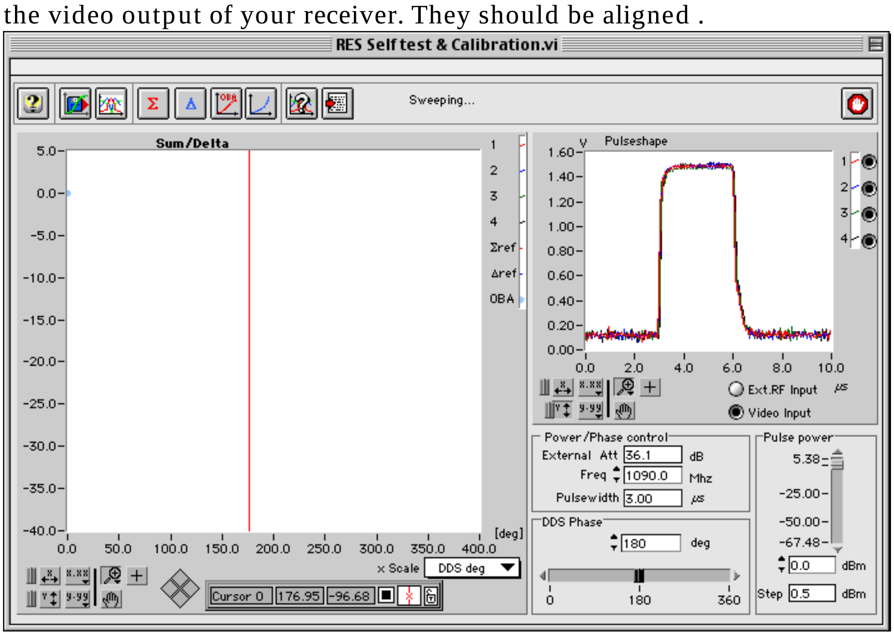


A default calibration curve (Output voltage of Rx versus input power of Receiver) will be presented. If you know the Gain (typical 30 mV/ dB) of your receiver, you van enter this value in the following window:

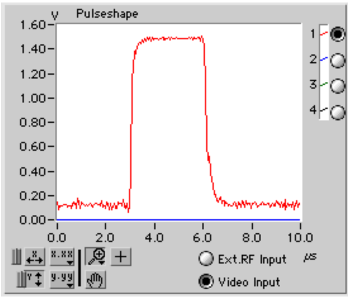


Click the RETURN button after input. 

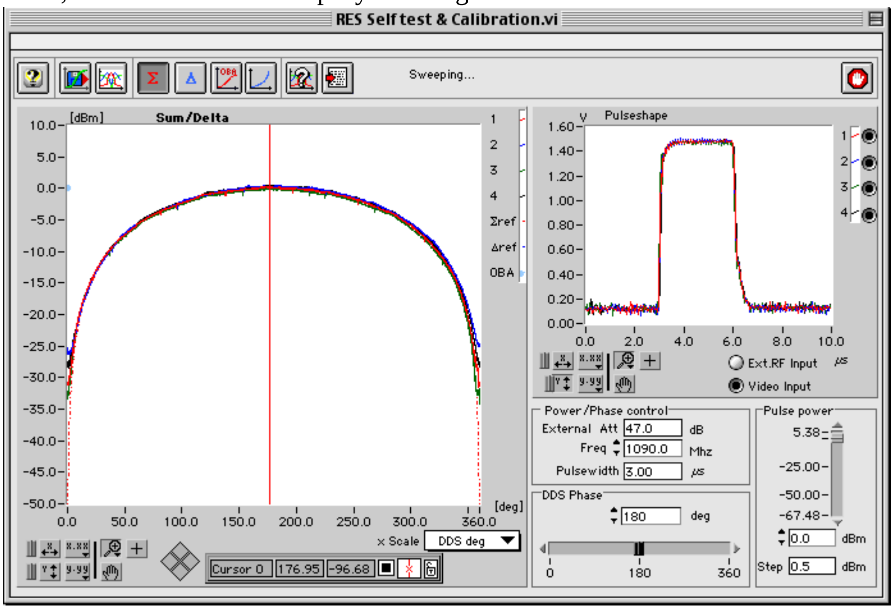
You will now see four test pulses drawn in the right hand display of the window. This is the video output of your receiver. They should be aligned .



You can switch off and on separate channels of the RES target boards by selecting the channels:

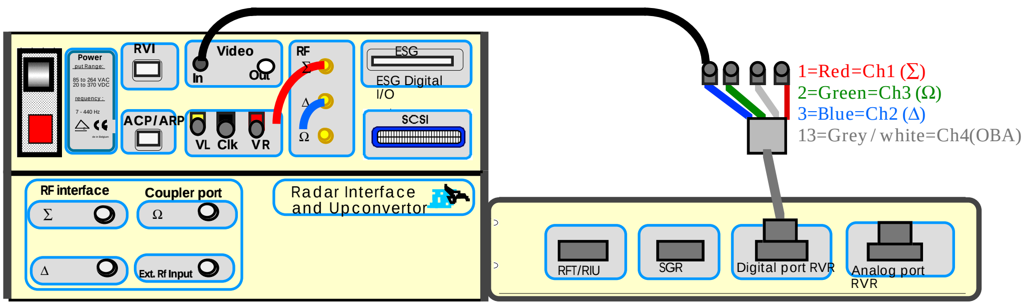


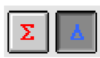
Next, select the **Sum** sweep by clicking the SUM channel. 



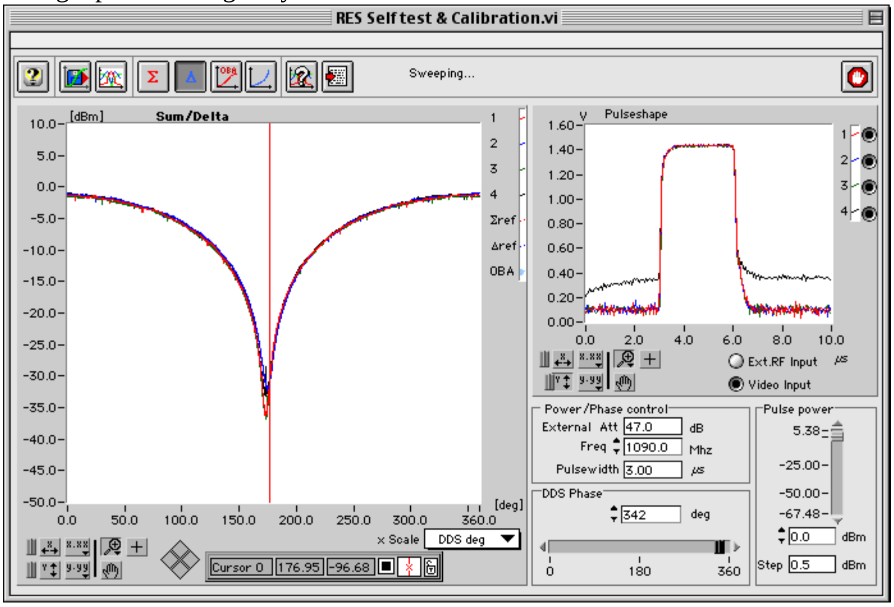
The display on the left should show a nice Sum Curve. The four channels should be aligned and match the theoretical curve by ±1 dB. If this is not the case, or if the Sum maximum is not in the middle, you should verify the calibration date and files on your computer. It could be that the RES received a recalibration and that the software you are using does not contain these files. You might need to copy them from the CD supplied with the RES after its last calibration.

Now, switch the connection . Connect the RVI Delta output to the RIU Video input.



Then click the “delta “ button in the software panel: 

The graph should give you a nice delta curve:

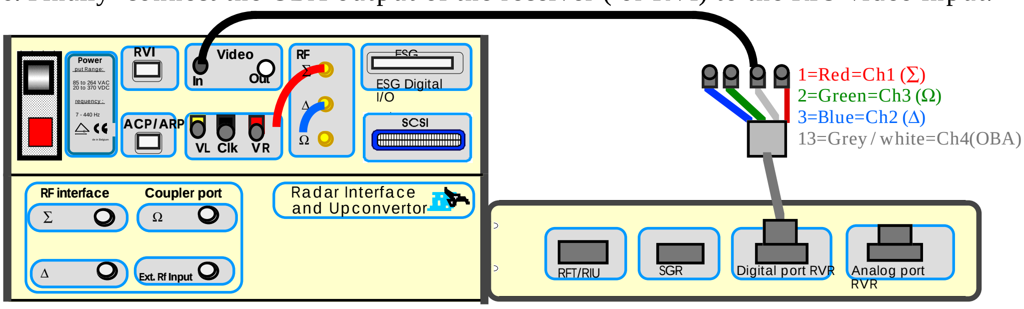


If the delta dip is not in the middle, (±1 degree) , the RES is either out of calibration or not warmed up completely.

Notice : Sometimes the curves show "Notches" . These can be caused by Radar internal test pulses! They can not be removed.

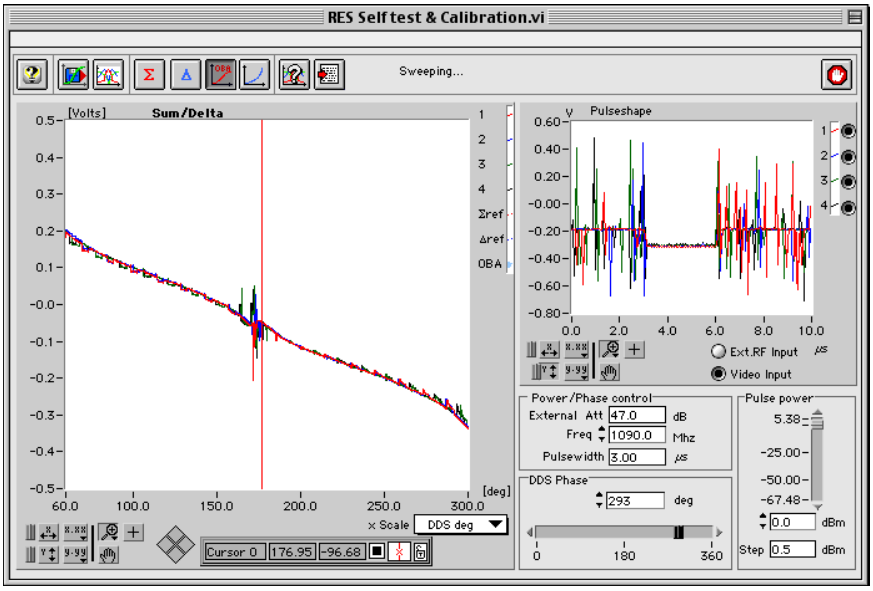
Now verify the amplitude matching of the Sum and Delta channels. The Delta curve should also match the theoretical delta curve (shown in blue dotted lines) by ±1 dB. If this is not the case, it could be that the Radar Receiver is not properly aligned or the Sum and delta path of the RES to receiver have different attenuations. The Delta should have a power of + dB below Sum at + and - 90 degrees OBA (or at Sum-delta crossing).

6. Finally connect the OBA output of the receiver (or RVI) to the RIU video input.



Then click the "OBA " button in the software panel: 

The tool should now show you the OBA curve (Off Boresight Angle) of the Monopulse receiver.



By shifting the phase between the Sum and Delta sliding couplers, the OBA curve will be modified.

-Start with both the phase adjustable couplers in the centre position.

-Change one of the couplers to find the phase reversal point.

The aim of this procedure is to get the phase of the RES SUM and DELTA output signals phase aligned <u>at the receiver's input</u> by exactly 90 degrees difference.

The OBA curve has a "perfect" slope from +1 to -1 V over 180 degrees when Sum -Delta phase is exactly 90 degrees.)

You should now slide the couplers until the OBA curve is FLAT. This typically happens when SUM -DELTA phase is 0 . Once that optimal point is reached, shift the couplers back exactly 90 degrees until the OBA is as shown above. (Negative sloped OBA: positive voltage of OBA corresponds to negative OBA degrees) . If the OBA is the wrong way round, shift the couplers 90 degrees to the other direction. Remember that both couplers allow + and - 90 degrees shift, so you may have to modify both of them to get an optimal difference.

e.g. Both sliders at 0 degrees to start with; OBA has slight positive slope.

Modify SUM slider to = +60 degrees, DELTA slider = 0 degrees => OBA is flat.

Now add 90 degrees to SUM to get correct OBA => Do this by adding 30 degrees to SUM (=+90) and subtracting 60 degrees to Delta (=-60) .

If OBA is still positive; try the other way round : Put SUM to -30 and Delta to +60.

-This should provide an almost linear and stable OBA behaviour for the centre part of the beam and concludes the tuning of the setup.Don't forget to lock the position of the adjustable couplers and take care not to change any cabling or coupling to the RES during the testing. If anything on the hardware setup is modified or replaced the tuning should be repeated in order to have meaningful results.

Switch back to the original setup as described above and try to inject a simple scenario (One target) .

7. <u>Optional step:</u> Generate a stationary SSR target with a RES scenario and zoom in on the OBA video using the windowed video recording.

Optionally the out of beam FRUIT can be added on the front input connectors of the RIU (this setup is not shown here). The main signal should be applied to the SLS input, if required some coupling to the SUM signal can also be used. Phasing is considered irrelevant here.

4.6. Combined ESG-RFA-RFTS System Setup for FRUIT Generation

Several options exist in the RES environment to generate FRUIT:

-Using the RFA for Out of beam FRUIT

-Using the RES channel 4 for in beam FRUIT (limiting the number of channels of overlap to 3)

-Using the RFTS for in beam FRUIT (if all RES channels are required)

This section describes how to set up the RFA together with the RIU/ESG for out of beam and the RFTS for In beam FRUIT generation. In beam FRUIT using the RES does not require a special setup, since it is generated internally in the RES.

The front panel of the RIU (Radar Interface and Upconverter) contains 3 RF monitor ports, being 20dB coupler ports for monitoring the generated ESG signals as they are available on the backplane high accuracy port.

For out of beam FRUIT generation the RFA can be connected to the SLS (Ω) front panel port for injecting the out of beam FRUIT, and to combine it with the in beam FRUIT.

The Interference Generator software controls the generation of out-beam FRUIT using the Radar Field Analyser. Figure 5.1 shows the setup with the RIU and RFA connections.

For in beam FRUIT generation the RFTS can be connected to the radar using aditional couplers in the SUM and Delta path. (see also 4.3 figure 22). These couplers are already in place for most radars. If Not, you can always use the couplers suplied with the RFTS interface kit.

In a normal setup, the RFA Tx output is connected (through the YIG filter) to the Ω input of the RIU using 4m RG223 cables (RFA antenna cable) and optional attenuators, in order to inject FRUIT of an adjustable power level.

The RFA transmitter has a typical modulator range of 60dB (at 1090 MHz), typically ranging from +10 dBm to -50 dBm. The RFA Output cable (coming from the YIG filter) is directly connected to the RIU 20dB Ω-coupler input.

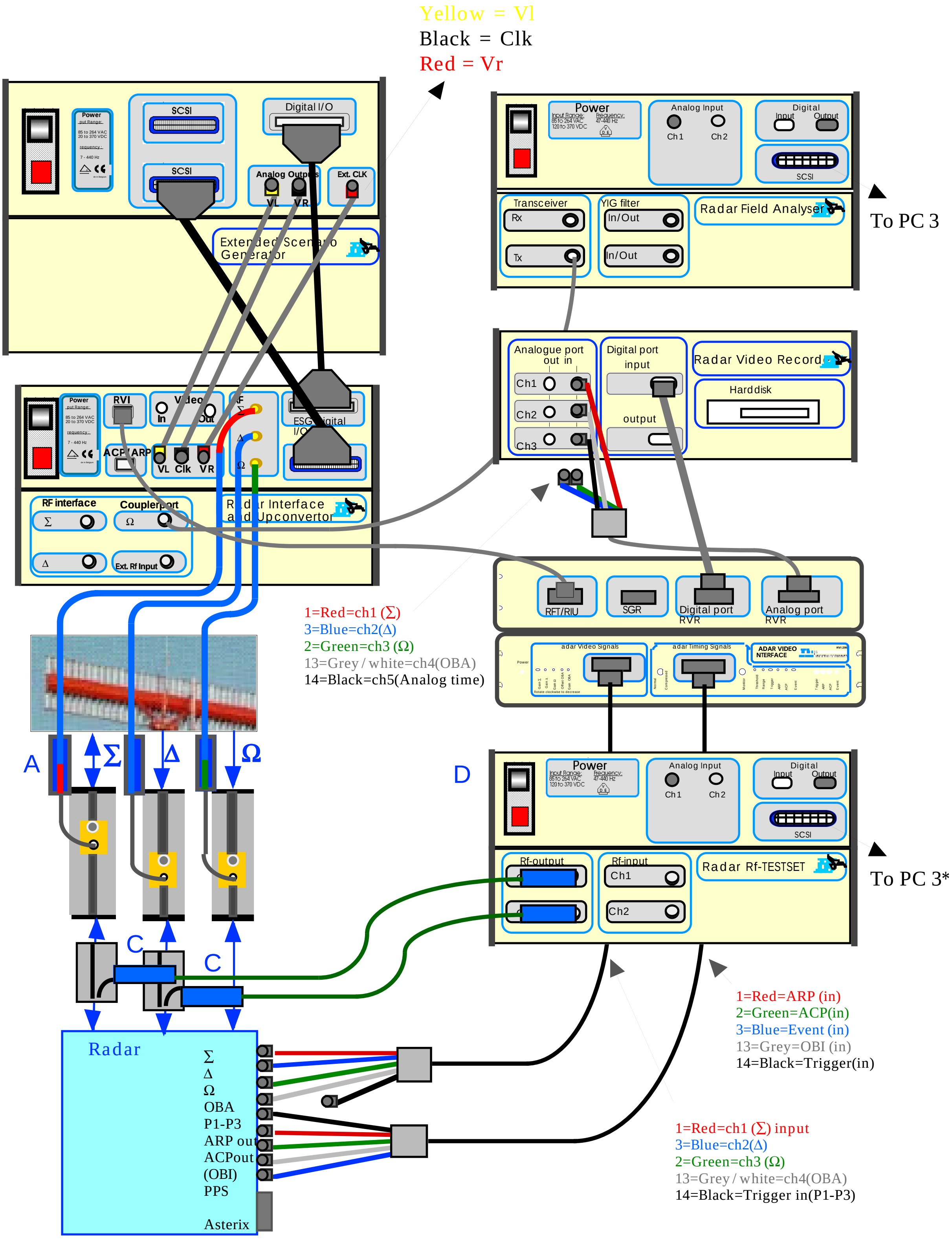
The RFTS Tx outputs are connected to the Σ and Δ couplers in the radar antenna path using 2m RG223 cables and optional attenuators C and D, in order to inject FRUIT of an adjustable power level.

The RFTS transmitter has a typical modulator range of 60dB (at 1090 MHz), typically ranging from +10 dBm to -50 dBm. The RFTS Output is directly connected to the Radar input couplers (typ 20 dB) via attenuators C and D, typical two times 10 dB. This results in a FRUIT power level at the input of the Radar between -30 and -90 dBm.

In order to support the generation of a specific FRUIT or CW interference in a specific azimuth sector, the Interference Generator must be able to slave to the ARP signal of the radar system.

In case this is needed, connect the RFA to the RVI using the appropriate Db9 to dB 15 cable and the RFTS using the 15dB to 15 dB cable. In the later case, use a 3T junction in order to distribute the SGR output of the RIU to the two interference generators.

Also the standard connections between RIU and the radar system are shown. The RIU backplane RF port is connected to the Radar RF couplers on Σ, Δ, and Ω channels. To obtain maximum accuracy, these connections need to be made with great care using SUCOFLEX RF cables, and the ALAN certified precision attenuators, that are specifically selected for these connections.=



* RFTS and RFA cannot be connected simultaneously to the same PC !

RFTS is optional for In beam FRUIT!

Fig. 25 : Connections for RES Target injection, SAT

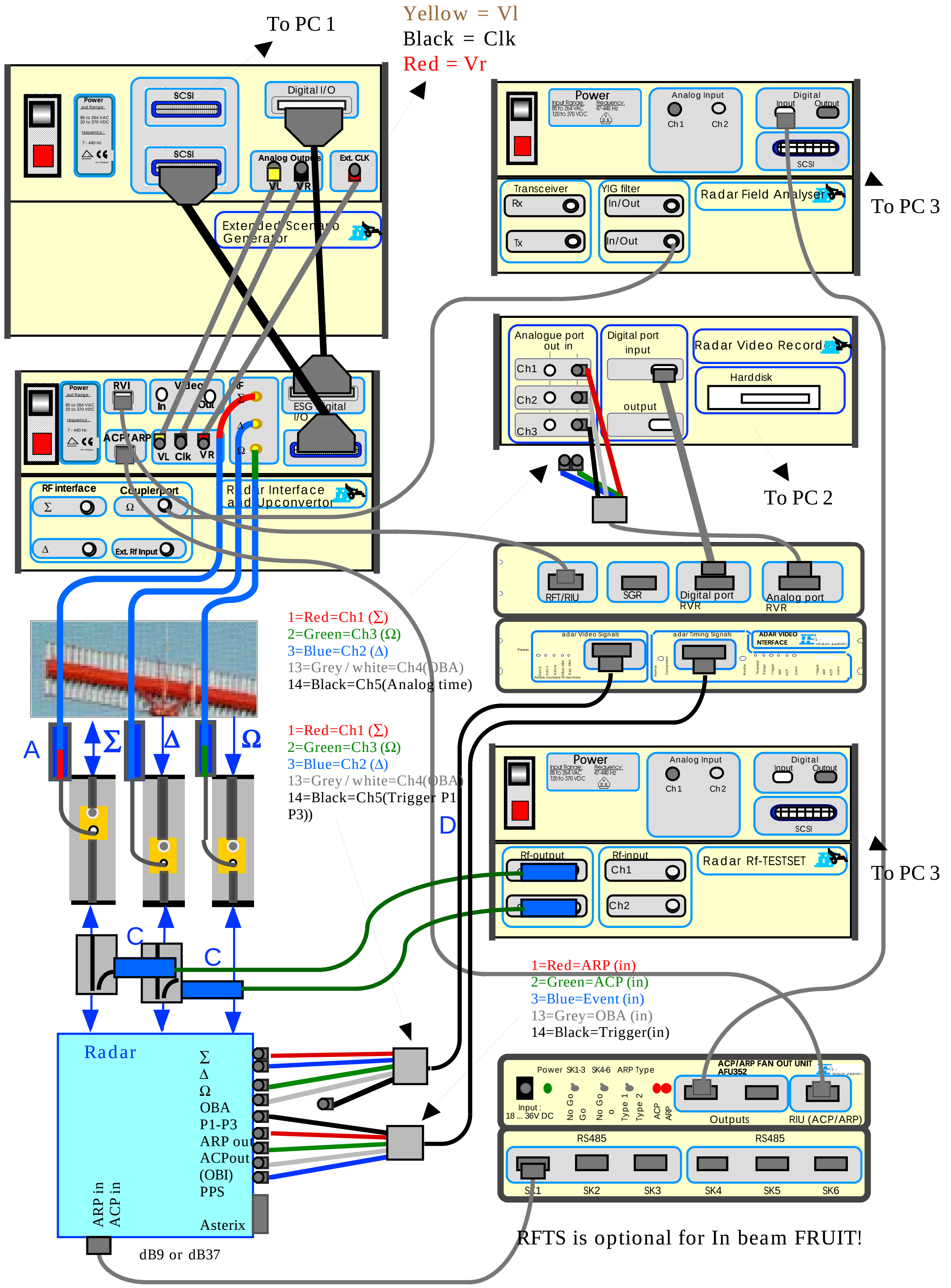


Fig. 26 : Setup for Multi Target Injection with RFA & RFTS FRUIT generation; FAT

In order to support the generation of a specific FRUIT or CW interference in a specific azimuth sector, the Interference Generator must be able to slave to the ARP signal of the radar system.

In case this is needed, connect the RFA digital input to the RVI “SGR” output using the dB15 HD to dB9 cable, supplied with the RVI. This will supply the RFA with north pulses.

In case the same setup is required for the RFTS, use the dB15 HD to dB15 HD cable suplied with your RVI.

The RES Interface Kit (RIK286) contains the accessories to enable you to make the complete setup:

On BNC Connectors

- 3x 2m RG223 RF cable
- 3x 10dB precision attenuator ALAN
- 3x 20dB precision attenuator ALAN
- 2x power splitter ZFSC-2-5
- 1x 10dB coupler ZFDC-10-5 (Not used for FRUIT generation)

On SMA Connectors

- 3x 2m SUCOFLEX high quality RF cable
- 3x 5dB precision attenuator ALAN
- 3x 10dB precision attenuator ALAN
- 3x 20dB precision attenuator ALAN

Additionally three matched phase adjustable couplers of 20 dB (RES_M166) are included in this kit.

4.7. Signals from/to the Equipment

4.7.1. Signals from/to the AFU

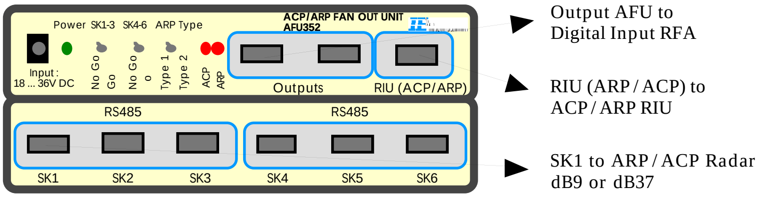


Fig. 30 : Signals from the/to the AFU (ACP/ARP Fan Out Unit).

4.7.2. Signals from/to the RFA

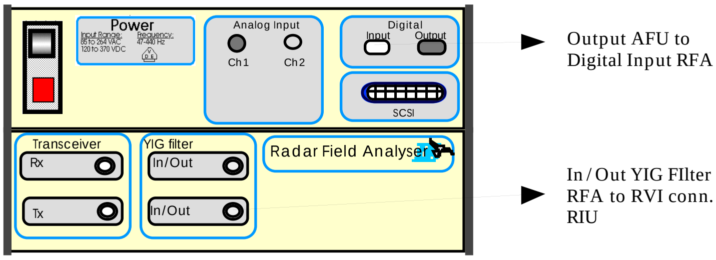


Fig. 31 : Signals from the/to the RFA (Radar Field Analyser).

4.7.3. Signals from/to the RFT

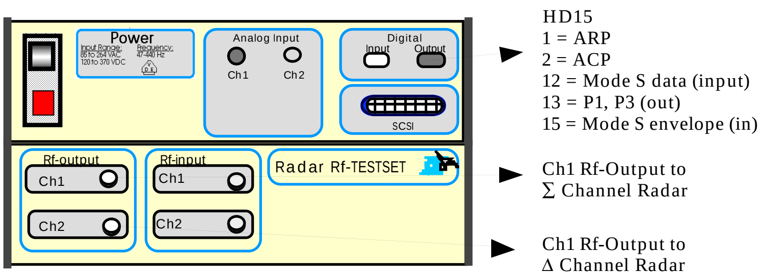


Fig. 32 : Signals from the/to the RFT (Radar RF Testset).

Chapter IV : Scenario Generation Software

1.0. Introduction

1.1. General

The creation of a radar test environment for a radar under test runs through two important entry points to the radar:

-Rf interface
-Radar Data input (X25/LapB/HDLC/LAN)

The RF interface (allong with its auxillary inputs ACP/ARP for rotational slaving) for SSR radar scenario generation is provided through the RES (or Radar Environment Simulator). This hardware device provides the radar with all signals required for the generation of a SSR or Mode S target simulation.
The data interface, consisting of eighter the GDLP-DLF (Asterix cat018), PSR input data (Asterix Cat 001,002) or SSR target simulation (Asterix Cat 034,048) is dealt with by one or more EDR (Extended Data Recorders) devices.

The RASS-S Toolbox provides sufficient software tools to drive these hardware devices with the required data streams plus the tools to create scenario data.

The software consists of several main tools:
-The Trajectory Scenario Generator.
-The Event Scenario Generator
-The RES Main Control
-The GDLP driver
-The Radar Data (PSR/SSR) playback driver

and a number of “special” tools which allow additional editing of analysis of special information for the RES:
-The Antenna Diagram editor
-The RES Calibration Tool
-The Interrogation Viewer & Analyser Tools
-The Interrogation Recorder

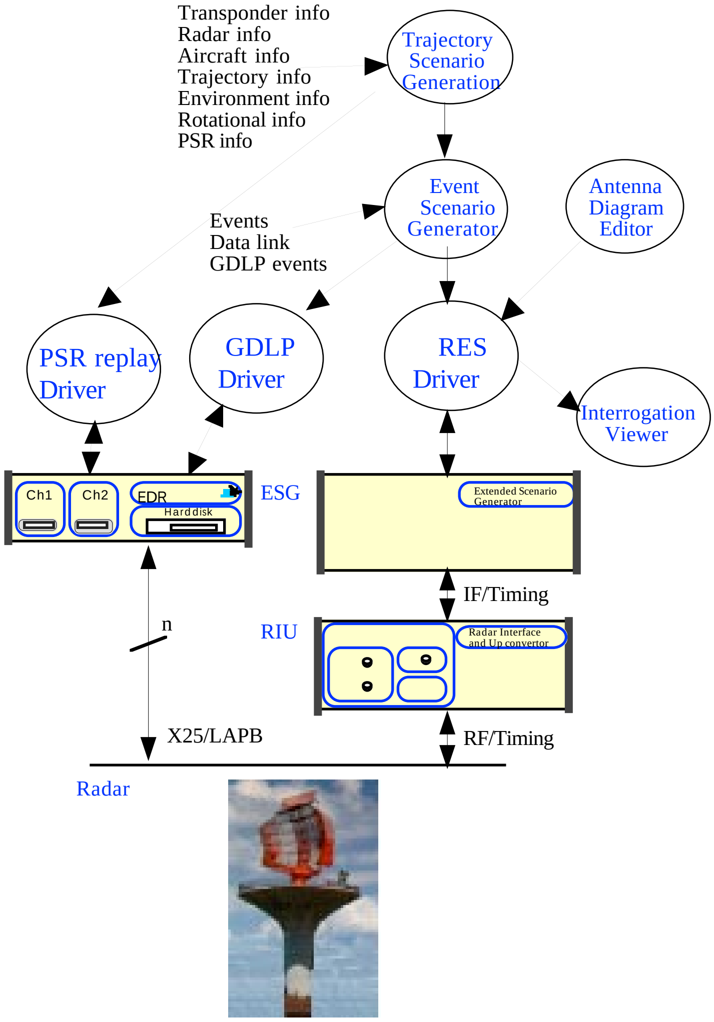


Fig. 1: Scenario generation data stream model

The Trajectory Scenario Generator tool uses a software packet with a fully graphical interface to provide the user a feasible method of creating a realistic radar test environment. The tool uses libraries with aircraft, transponder and trajectory data thereby reducing the time required to enter or edit scenarios. Up to 2000 free flying targets with the possibility of four target overlap situations can be programmed. Features like trajectory duplication and randomise functions are available. Trajectories can be piece wise specified using speed, heading, turn rate, climb rate, and acceleration. Each trajectory is identified with a fully programmable transponder in accordance with ICAO Annex 10. The radar's environment is simulated using specific antenna patterns, rotational speed and reflectors. The outcome of the scenario generator is a file to be compiled and used by the hardware part of the RES.

The SSR or Mode S scenario is used as a input for the PSR radar data to be generated by the EDR PSR replay feature. For this purpose, the original scenario is recalculated towards the (co-located or co-mounted) PSR radar taking into account a number of radar bias and positional offset parameters.

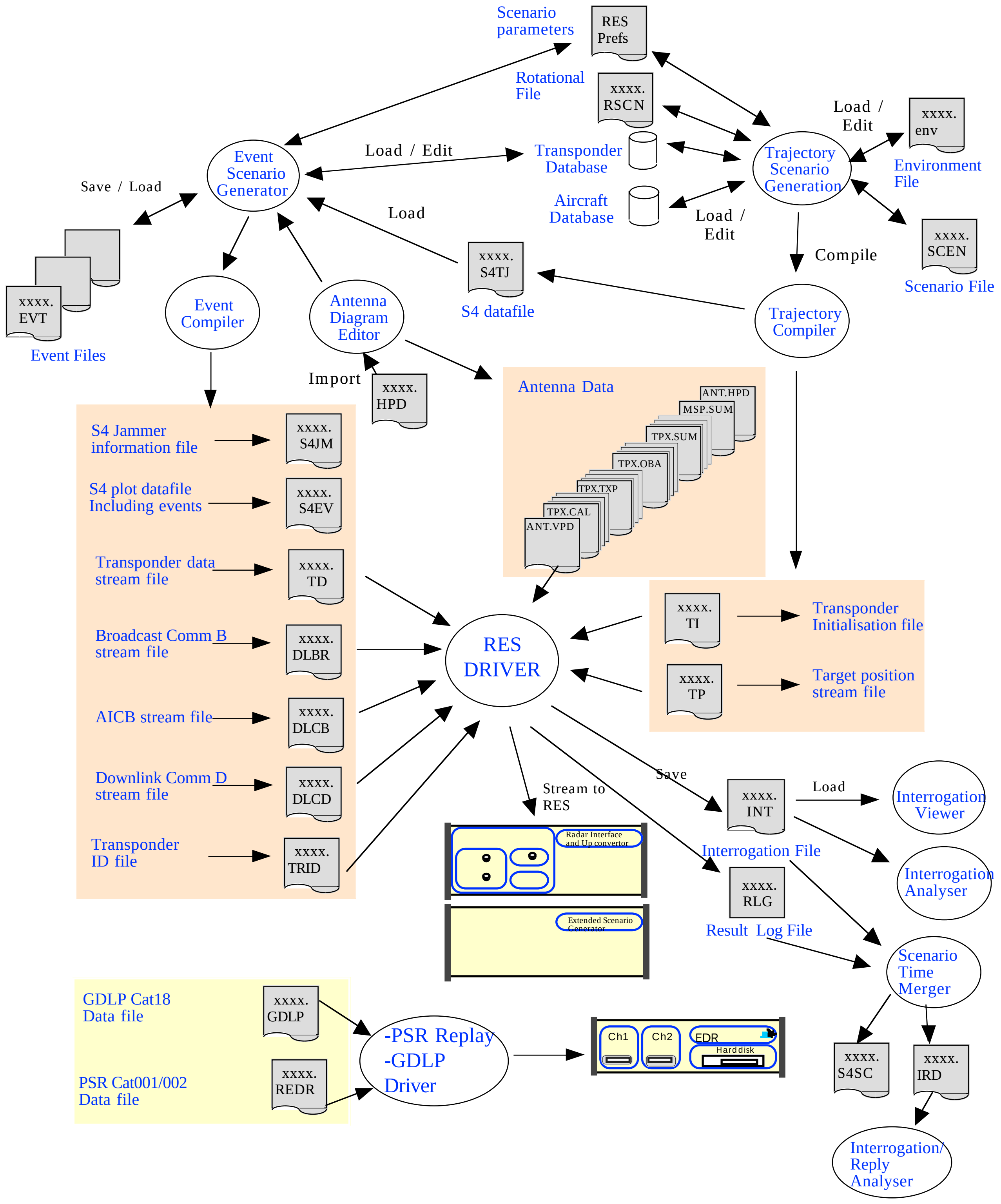


Fig. 2 : RES module overview and created files.

The Event Scenario Generator is a tool using the same graphical user interface as the Trajectory Scenario Generator , but used to create all different sorts of “events”. These events can be a number of transponder parameter changes (like A code), datalink events to be sent by the simulated transponders (Comm B, Comm D , Broadcasts, etc..), misses in the scenario or GDLP events, to be used by the GDLP driver driving the EDR hardware. The tool uses the files created by the trajectory scenario generator to start with, and on top of the generated target plots , the user can define the events. The outcome of the scenario generator is a file to be compiled and used by the hardware part of the RES.
A special feature in the event scenario generator allows the generation of automatic Model B datalink sessions.

The RES can also generate two types of interferences: FRUIT and JAMMER signals. The FRUIT signals are generated by using a separate FRUIT scenario generator . (See Chapter V). The Jammer setup can be done from the event scenario generator.

The RES Main control inputs the compiled data from the scenario generators and feeds the RES hardware with the necessary data. In the meanwhile, the tool saves the results of the generated scenario (uplink data messages etc..) for later analysis.
The Antenna diagram editor provides the RES with the required antenna information, which can be extracted from prerecorded RASS-S antenna diagram measurements.

2.0. Trajectory Scenario Generator

2.1. Introduction

The Trajectory Scenario Generator tool is intended to provide the user with a feasible method of simulating the trajectories of multiple aircraft. The tool is easy to use thereby reducing the time required to enter or edit the input of the Radar Environment Simulator (RES). The result is a file to be compiled in a later stage and to be used by the RES driver.
In this chapter the use of the Trajectory Scenario Generator tool is discussed. The functional working is examined by simply following the instructions below.

Important Notice!

The scenario data is compiled using the RES calibration tables, so compiled scenarios can not be transferred between RES systems or are no longer valid after RES recalibration. Only the uncompiled scenario files (.Scen) and event files (all files contained in the EVENTS subfolder in a Scenario folder) can be copied between RES systems.

Antenna diagram files are RES Calibration independant and must not be recompiled after RES recalibration or when switching RES.

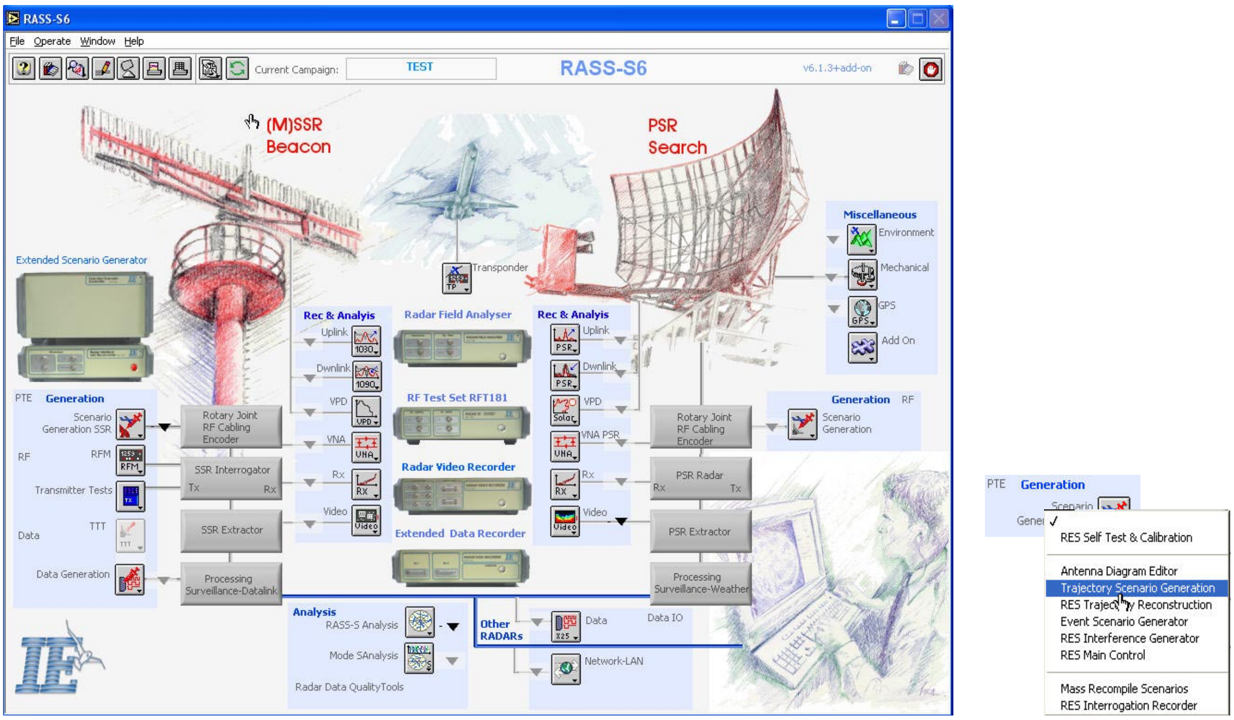
A Mass Compile tool exist to compile a set of scenarios in one folder at once.
See further.

2.2. Using the Trajectory Scenario Generator

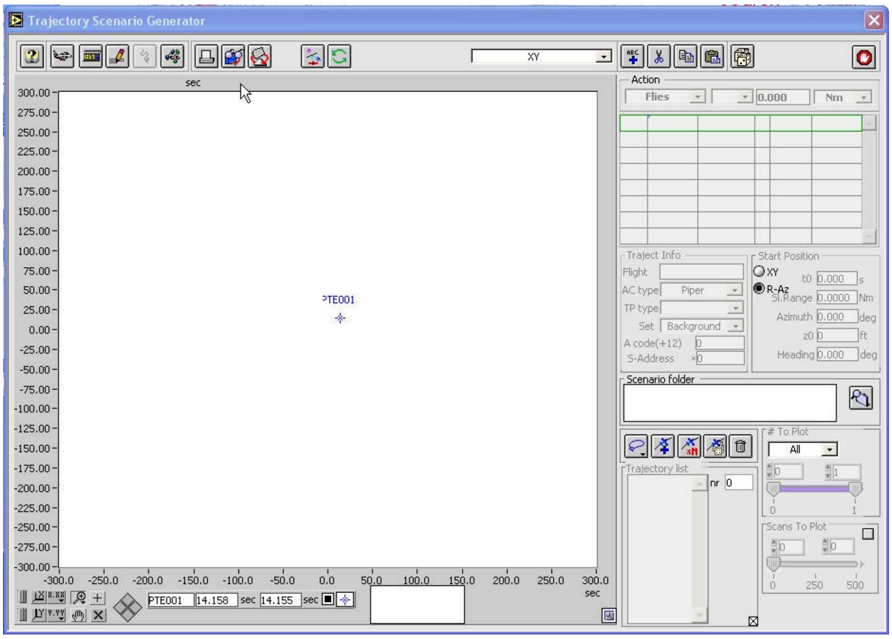
2.2.1. Loading the software

The Trajectory Scenario Generator tool can be loaded from the RASS-S Toolbox.

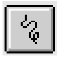
To load the tool, double click the RASS-S Toolbox icon and select “Trajectory Scenario Generation” from the “Scenario Generation” menu in the RASS-S Toolbox.

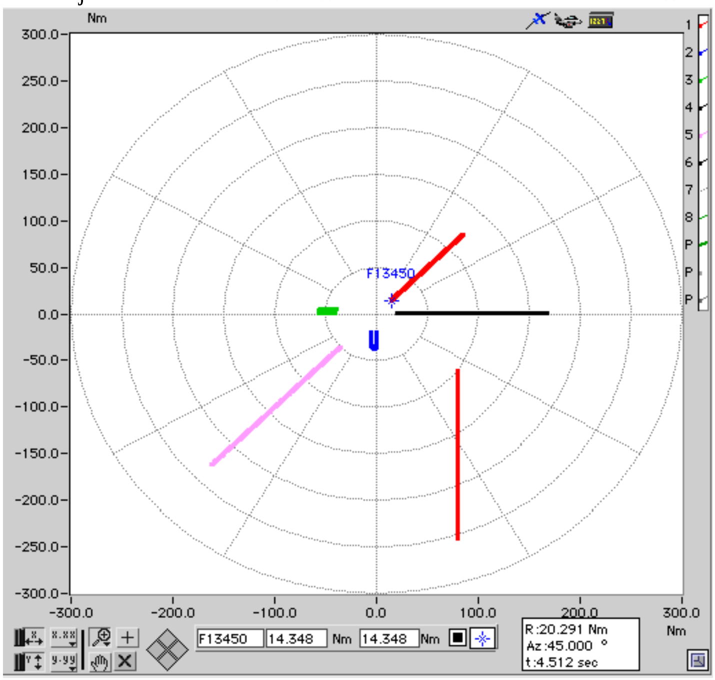


Now the tool is loaded:

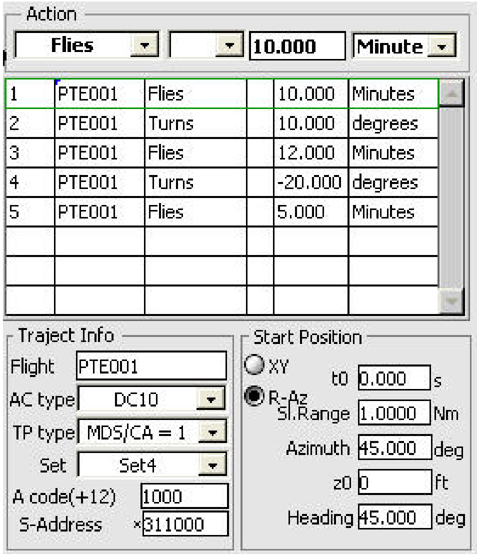


2.2.2. The window objects

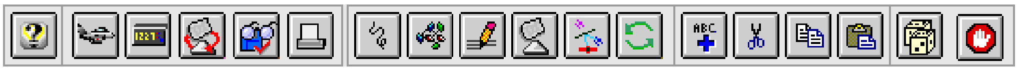
The window contains several fields:
On the left we can observe the plot graph, which contains a graphical representation of the trajectories created by the Trajectory Scenario Generator. When a scenario is build the trajectories are drawn when the user clicks the **Draw**  button.



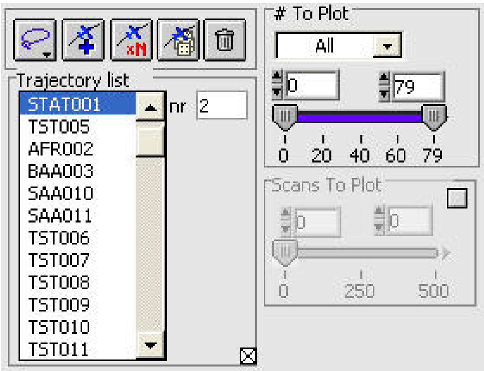
On the right side, the user can enter the data for a trajectory (such as start position, start time, AC type, TP type, Set nr, etc...) and a description of the trajectory in a numerical and structural way.



Furthermore the window contains several buttons which perform a number of functions in the window. (The menu has been removed in this version)



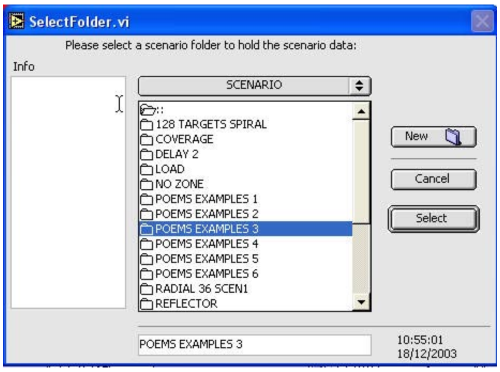
A last group of controls is used to select a specific trajectory (TJ) to be edited (if multiple TJ exist) and to select which TJs and which scans are plotted.

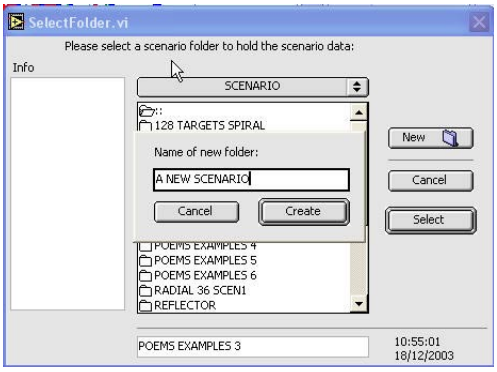


2.2.3. Running the software

Now Click the **Run** arrow in the upper left corner of the window to start the Trajectory Scenario Generator tool.

The tool will start by requesting a Trajectory scenario folder. This folder will be the container of all necessary data for the scenario creation. It will contain the scenario itself, the transponder databases, aircraft databases, rotational scenario, environement definition (reflectors) and the compiled data for the RES Main tool.





The user has the posibility to select an existing scenario from the presented list or select a new scenario.

-If the user selected an existing scenario, all relevant scenario data will automatically be loaded by the tool. The tool will check if the following datafiles are present and will load them: If the file is found, the corresponding icon will appear in the upper right hand corner of the Trajectory graph.

-Scenario file : xxx.scen 

-Transponder database: xxx.TBDB 

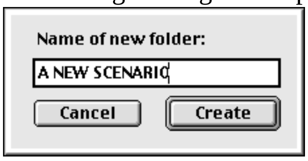
-Aircraft database: xxx.AC 

-Rotational scenario: xxx.rot 

-Environment scenario: xxx.env 

When a new scenario is required, click the **New** button. 

Following dialog will appear:

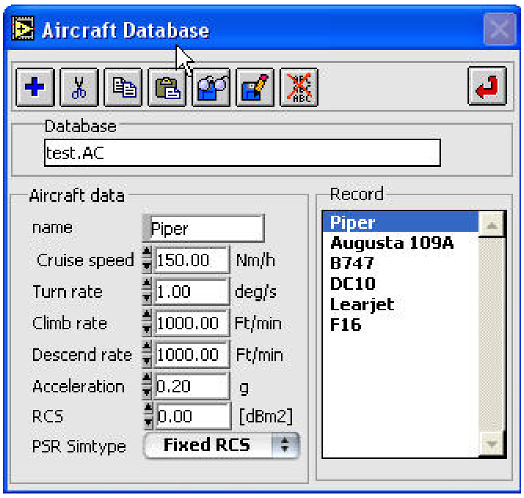


Enter the name of the new scenario folder (max 25 characters) and click **Create**. The new file will appear in the selection window of the folder dialog and can now be selected.

A new scenario will not have any file present. Transponder and aircraft databases can be resident in memory, so they remain visible when selecting a new scenario, given they were already loaded. Otherwise, a new aircraft and transponder database must be selected or created.

2.2.4. The Aircraft Database

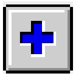
To select an aircraft database, click the **AC Database**  button.
Following window will appear:

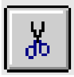


Inside the AC database, the user can enter data defining different Aircraft to be used in the scenario generation:

-AC name
-Cruise speed
-Turn rate
-Climb rate
-Descend rate
-Acceleration

The following buttons control the operation of the AC database:


Enter a new record in the database

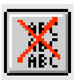

Cut a record (and copy to clipboard)

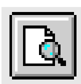

Copy a record to the clipboard

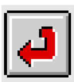

Paste the record from the clipboard to the current index. Data is inserted


Load an existing database from disk


Save a database to disk in a user selected position

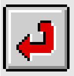

Clear the contents of the database


Search the database for a specific AC


Return to the main trajectory generator tool

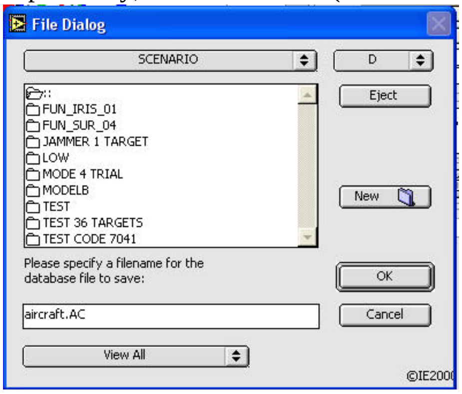
The same functions can also be controlled from the menu or using key-shortcuts.

Enter a number of ACs in the database and use the return button to leave the database.

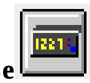


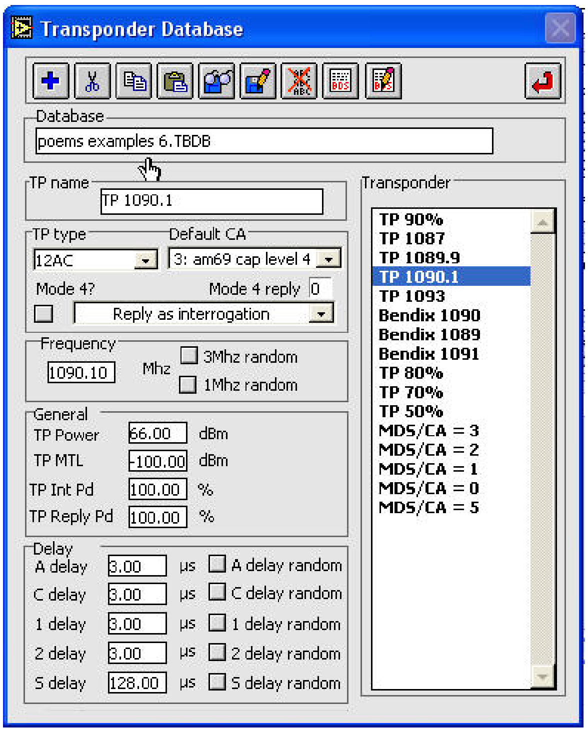
The aircraft database will always be saved automatically in the scenario folder .

Optionally, save it to disk (outside a scenario folder) using the  button.



2.2.5. The Transponder Database

To select a transponder database, click the **TP Database**  button.
Following window will appear:



Inside the TP database, the user can enter data defining different transponders used in the scenario generation.

Following buttons control the operation of the TP database:

Enter a new record in the database

Cut a record (and copy to clipboard)

Copy a record to the clipboard

Paste the record from the clipboard to the current index. Data is inserted

Load an existing database from disk

Save a database to disk under a user selectable name

Clear the contents of the database

Search the database for a specific AC

Define the BDS list used by the current scenario in memory

Define the contents of the BDS registers of a specific transponder

Return to the main trajectory generator tool

Enter a number of TP s in the database.

To do this, first click the **Add** button. Next , enter all relevant data in the fields. Make sure you set the TP capability (1-2-A-C-S level1..5) and type (am 69, am 71, default CA field..) first.

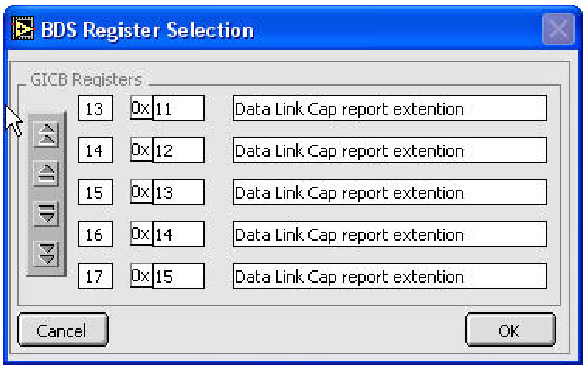
2.2.6. BDS register definition

If the TPs are Mode S, the BDS edit function will become available:

=>

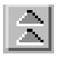
First define the BDS list to be used by the scenario:

To do this click the **BDS Reg List** button. Following window will pop up:



Now, select any of the 32 available BDS memory spaces and select a BDS register to be assigned to that memory space. All BDS registers (numbered 0x05 through 0xFF) can be assigned to any memory space, except for BDS 0x02, 0x03 and 0x04, which are always used by the first 3 spaces. The RES is limited to 32 different BDS registers. [1]

The tool is controlled by the following buttons:

 Scroll up 5 elements in the list (minimum to index 1)

 Scroll up 1 element in the list (minimum to index 1)

 Scroll down 1 element in the list (maximum to index 32)

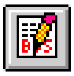
 Scroll down 5 elements in the list (maximum to index 32)

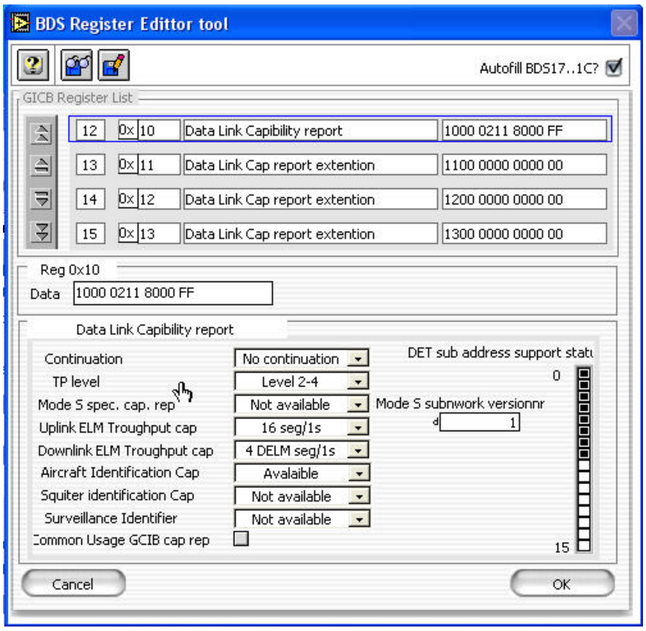
Enter the desired BDS register address (0x00 to 0xFF) in the numeric field. The corresponding BDS name (if known) is shown next to the input field.

Confirms the current input

Cancels the input, previous values are maintained.

After you have inputted a given number of BDS registers (not all 32 must be filled), click the OK button.
The BDS definition window will close. Next, enter the BDS contents:

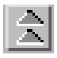
To do this click the **Edit BDS Reg**  button in the transponder database definition window. Following window will pop up:



The tool shows the previously edited list, but this time it is shown with only 4 fields (out of the 32). The list itself is fixed in the Enter_BDS_List tool.

You can select any of the 32 available BDS fields simply by clicking on it. The Blue rectangle around the BDS register entry will show the current input BDS.

The tool is controlled by the following buttons:

 Scroll up 4 elements in the list (minimum to index 1)

 Scroll up 1 element in the list (minimum to index 1)

 Scroll down 1 element in the list (maximum to index 32)

 Scroll down 4 elements in the list (maximum to index 32)

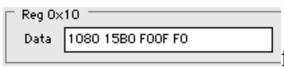
 Load an existing BDS data set from disk

 Save the current BDS data set to disk

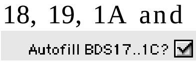
Confirms the current input

Cancels the input, previous values are maintained.

Data in the BDS registers can be entered in two ways:

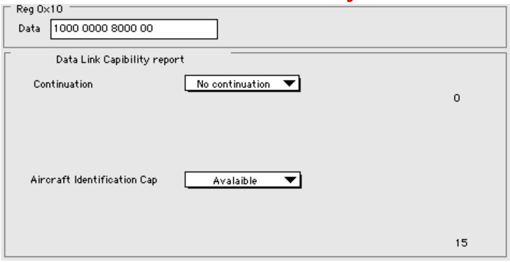
1) Enter the Hexadecimal data directly in the **Data** 

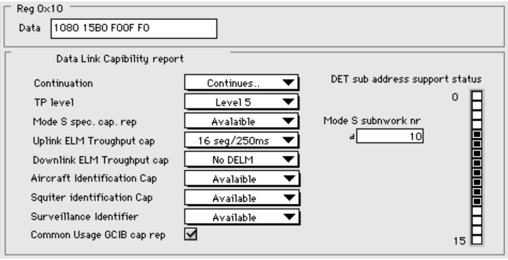
field.

2) Use the detailed control field for the BDS registers which are predefined. This is only valid for BDS regs 10, 20 and 30. This list can be extended in future software releases. BDS 17, 18, 19, 1A and 1B are automatically filled using the BDS list if this option is checked: 

. If the option is not selected, the user can enter a hex value just as any other BDS register. If checked, the data is determined from the available BDS registers.

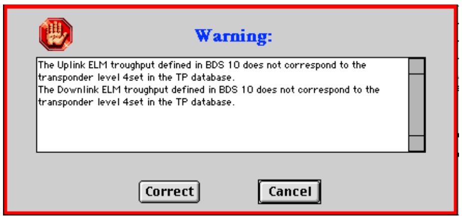
BDS 30 contents is overwritten by the trajectory name at the start of the trajectory. It can still be filled with a user defined data using the event scenario generator.
BDS 10 (Datalink capability) can be filled using a number of menus. Depending on the type of transponder , (am 69 or am 71) , the number of input menus will be different:
In case BDS 10 ; Bit 32 ; Aircraft Identification Cap is set to “Not available”, the contents of BDS 20 will always be set to 0000 0000 0000 00 !



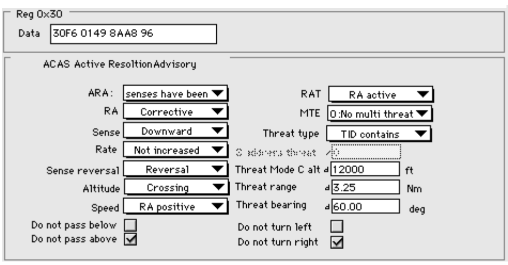


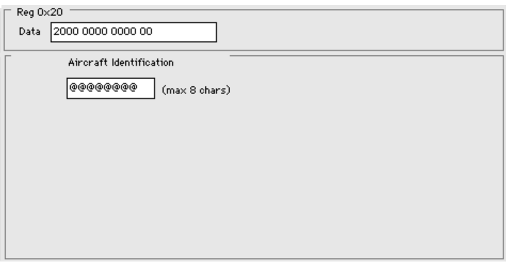
am 69 BDS 10 *am71 BDS 10*

A warning will be issued when the user tries to enter erroneous values in the BDS 10 input fields:



The user can select wheter he wants to correct the data or leave the (erroneous) data unchanged.





BDS 20 *BDS 30*

After entering all relevant BDS data, click the OK button to return to the TP database.

Next, enter all other relevant TP data:

-*TP name :* Any set of characters (max 15)
-*TP type :* Select between any combination of 1,2,3 / A or C transponder or S levl 1 trough 5.
-*Default CA, TP type: select between*

-am69,CA=0 surveillance only level 1
-am 69, CA=1 , level 2
-am 69, CA=2, level 3
-am 69, CA=3, level 4
-am 71, CA=4
-am 71, CA=5
-am 71, CA=7

-*TP frequency [1087...1093,0.3] :* Set the TP frequency
-*Random freq <15 Kft :* This check box creates random frequencies between 1087 and 1093

Mhz.

-*Random freq >15 Kft :* This check box creates random frequencies between 1089 and 1091 Mhz.

-*TP power [0..100,0.1 dBm] :* Sets the simulated Transponder power.
(limited by the RIU output dynamic range)

-*TP Minimum Trigger Level :* Sets the simulated Transponder Minimum Trigger level.
(limited by the RIU input dynamic range)

-*TP interrogation Pd [50...100,1]* Determines the Pd of interrogation acceptance

-*TP reply Pd[50...100,1] :* Determines the Pd of Reply

-*A delay [2.75...3.25,0.025/3] :* Delay for A code replies

-*A random delay :* This check box creates random delays between 3 and 3±x µs, x is given by the A delay field.

-*C delay [2.75...3.25,0.025/3] :* Delay for C code replies

-*C random delay :* This check box creates random delays between 3 and 3±x µs, x is given by the C delay field.

-*1 delay[2.75...3.25,0.025/3] :* Delay for 1 code replies

-*1 random delay :* This check box creates random delays between 3 and 3±x µs, x is given by the 1 delay field.

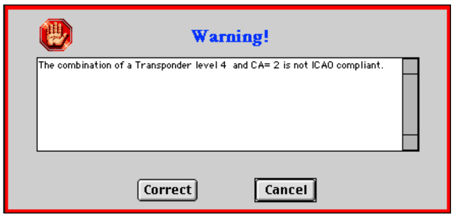
-*2 delay[2.75...3.25,0.025/3] :* Delay for 2 code replies

-*2 random delay :* This check box creates random delays between 3 and 3±x µs, x is given by the 2 delay field.

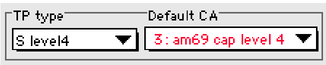
-*S delay [127.75...128.25,0.025/128] :* Delay for S code replies

-*S random delay :* This check box creates random delays between 128 and 128 ±x µs, x is given by the S delay field.

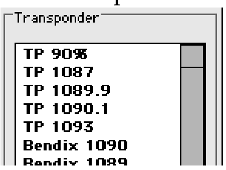
If a wrong combination of TP type and level with default CA data is selected, a warning is issued:

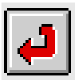


You can choose to correct the level or type. The changed values are put in red.



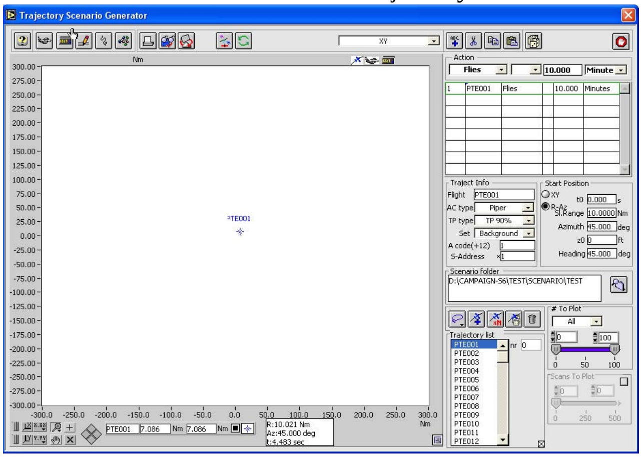
The transponders in the database can be selected using the **Transponder** list:



After editing, return to the trajectory scenario generator using the **return**  button. The transponder database will automatically be saved to disk after editing.

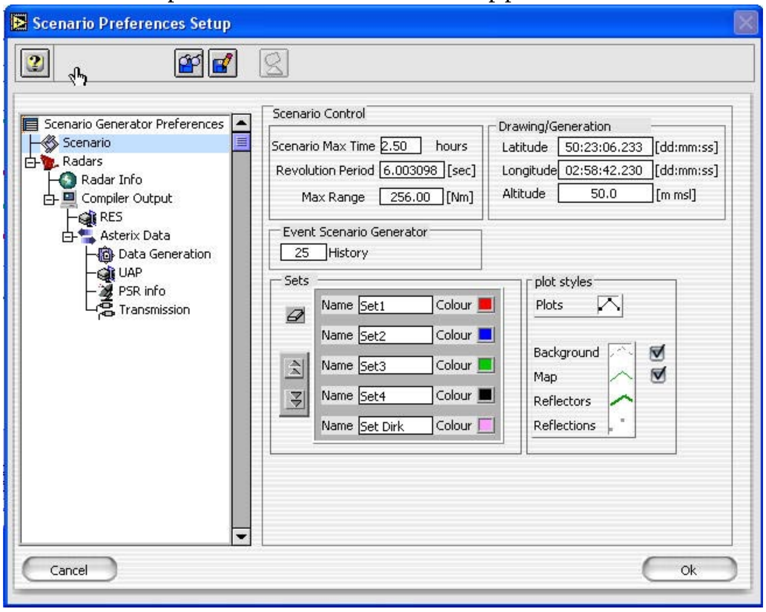
2.2.7. Preferences editing

Now we are back to the main trajectory scenario Generator screen:



Click the **Preferences**  button.

The Scenario preferences window will appear:



If the user selects an existing scenario, the preferences for that scenario as set last time they were opened are shown and can be editted.

If you selected a new scenario (one which has no previous saved preferences) , the last used preferences for the specified campaign folder are loaded. A copy of these are saved in the scenario folder at compilation time.

The preference window has several control fields:

-A button bar with control over the preference window

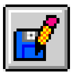
-A selection menu allowing you to “browse” the preferences of the several radars in the scenario

-A field with all the scenario preference input field. Its appearance changes depending on the selected line in the browser.

The buttons in the top bar perform the following:

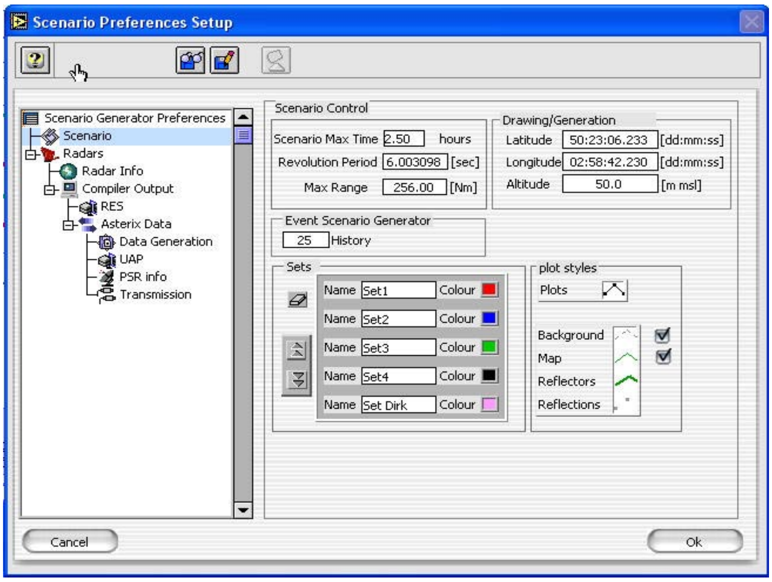
 evoke the online help window

 Load a preference set from a different Scenario folder

 Save the preference set as a file for later use (preferences are automatically saved in the scenario folder when closing the window

The "Browser"
Use the browser to select a parameter subset. each line can be opened into more subsets if an + icon is visble in front of the name.

1. Scenario (= general) preferences.
The general Trajectory scenario generation parameters are mutual for all radars and can not be modified individually. The subset contains the following items:



In the "Scenario" subsection several parameters can be set:

In the "*Scenario Control:*" subsection following parameters can be set:

Scenario Max Time: The maximum time allowed for the complete scenario. All trajectories that would run longer that this value are clipped . [default 2.5 hours, max 24 hours]

Revolution Period : The period at which the scenario is drawn on the display. This is used for drawing only, and has no influence on the real radar rotation speed used for RES or Asterix replay data.

Maximum range [10...512,0.1 / 256 Nm] : Maximum range of the cluster in Nm. No targets are generated beyond this range. This parameter delimits the generation for the whole group of radars (= cluster) to a circle arround the Drawing/Generation center.

In the "*Drawing/generation Center*" subsection following parameters can be set:
The scenario is defined relative to this position, which is assumed to be the center of the radar. If you define target positions in XY or Rho-Theta, the positions are recalculated in case longitude and lattitude are required (e.g. when generating asterix cat 62).

Latitude: The latitude of the radar relative to which the scenario is calculated. The value should be entered as DD:MM:SS.sss, where DD are the degrees, MM the minutes and SS.sss the decimal seconds of latitude.

Longitude: The longitude of the radar relative to which the scenario is calculated.

Altitude: The altitude of the radar relative to which the scenario is calculated.

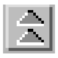
In the "*Event Scenario Generation:*" subsection following parameters can be set:

History : This parameter determines the number of plots drawn at once in the event scenario generator tools.

In the "Sets" subsection following parameters can be set:

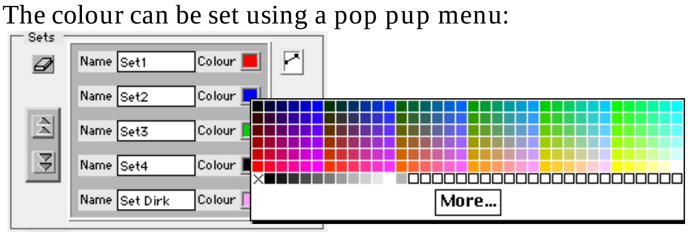
Name: The Sets subsection is an array (of undefined length) filled with the set name and its colour . A "set" is a group of trajectories that are linked by their set number. They can be edited, altered, copied or duplicated as one group.
The array can be paged through using the up and down arrows:

 Erases an entry in the "Sets" array

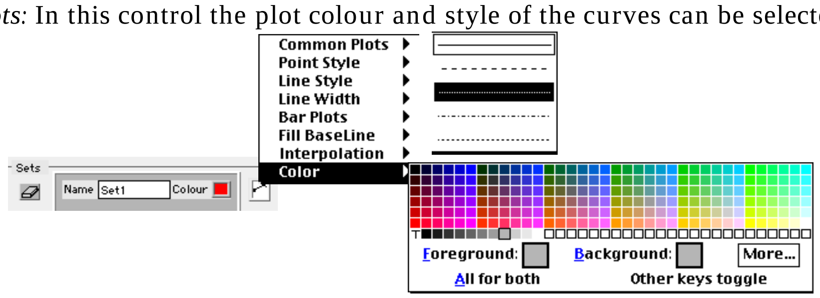
 Scroll up 1 element in the list (minimum to index 1)

 Scroll down 1 element in the list

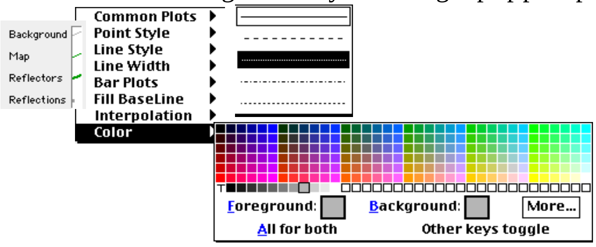
The colour can be set using a pop pup menu:



Plots: In this control the plot colour and style of the curves can be selected.



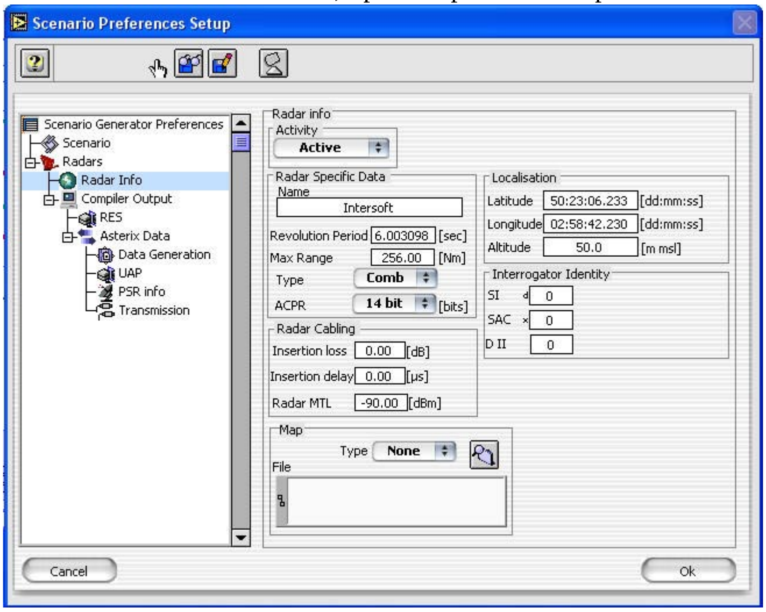
Background [False]: This check box determines whether the background circles are drawn in the scenario generator. In front of this checkbox, the user can determine the "looks" of the background by selecting a popp - up menu:



Map [False]: This check box determines whether the map is drawn in the scenario generator.The map option uses information from the site file to project a background map of Europe. In front of this checkbox, the user can determine the "looks" of the background by selecting a popp - up menu:

Radar Info

In the "Radar Info" section, specific parameters per radar are available.



Activity: Only valid for multi-radar scenarios !

The activity parameter determines whether a certain radar defined in the parameter set is used for compilation or not. Using this control, the user can switch on and off certain radars and therefore only compile data for a subset.

The menu has three options:

-None: This radar is never used.

-Idle: The radar is used, but is not used now for compilation

-Active: The radar is part of the cluster and its data is used for compiler output.

In the "Radar specific Data " subsection following parameters can be set:

Name: Use this control field to name the radar node. The name is used in the compilation and in the parameter list. It simplifies the selection of several Nodes.

Revolution Period:[1...20,0.02614 / 4 ms] revolution time of the radar in seconds. This field has a limited resolution (26.14 ms), which causes the control to coerce

to the nearest value which can be simulated .
Max Range: [0..512,256Nm] The maximum Range for this specific radar, calculated from the radar position. (determined by *Localisation)* .

Type: Parameter of no influence in the trajectory generation.

ACPR: The number of ACPs per revolution output by the ACP encoder. This parameter has an influence on the resolution of the Azimuth value output of the Asterix output.

In the "Radar cabling " subsection following parameters can be set:

Insertion loss [0...30,0.1/0 dBm] : Insertion loss of radar (loss between radar interrogator and antenna).
Insertion delay[0...10,0.010/0µs] : Insertion delay of radar (delay between radar receiver and antenna caused by antenna, cables and receiver).
Radar MTL [-30...-100,-80] : Minimum trigger level of radar. This value is used to determine the minimum power for targets to be generated. Targets lower than this power will not be generated . Especially usefull to limit the number of reflection targets, since all generated reflections are very low in power.

In the "*Localisation*" subsection following parameters can be set:
Remark: in the Mono-radar trajectory scenario generator, these values are the same as the *Drawing/generation Center* .

Latitude: The latitude of the radar relative to which the output data is calculated. The value should be entered as DD:MM:SS.sss, where DD are the degrees, MM the minutes and SS.sss the decimal seconds of latitude.

Longitude: The longitude of the radar relative to which the output data is calculated..

Altitude: The altitude of the cluster center radar relative to which the output data is calculated..

In the "*Interrogator Identity*" subsection following parameters can be set:

SIC : The Site Identification Code : This parameter is used in the output streams for Asterix data (in LAN replay, EDR replay or SASS-C data output) .

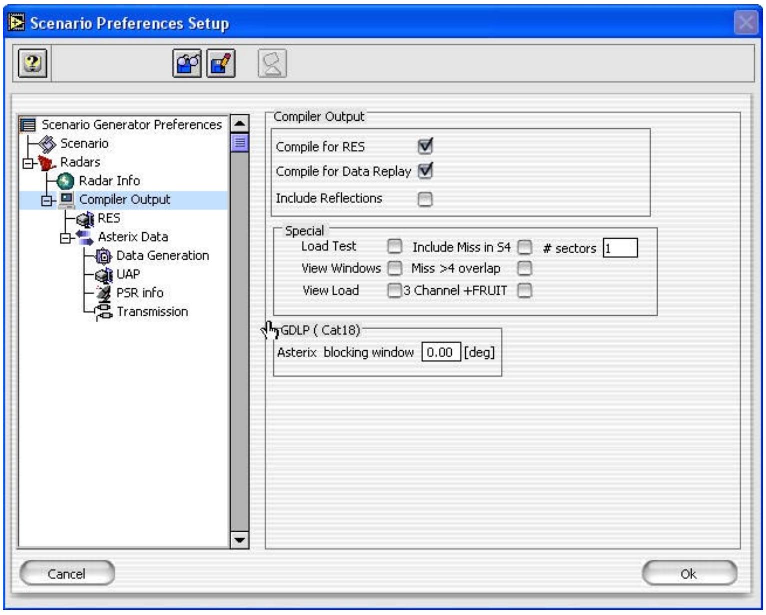
SAC : The Site Area Code : This parameter is used in the output streams for Asterix data .
DII: The II code used for generation of downlink Datalink packets

In the "*Map* " Subsection, following parameters can be set

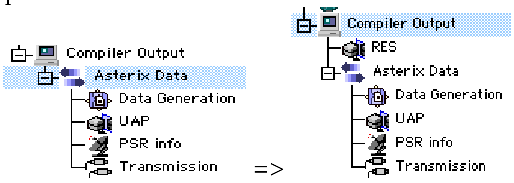
Type: The Map Type: In this version , only "None" or "SMGET " can be selected. Select "SMGET" if you want to use this type of Map to determine the simulated coverage of the target generator.
File: Use the File button to select an existing MAP folder. In this folder, the tool requires at least the following files: "*cluster.dat*" , "*Sysmapxxx.dat*" where xxx stands for the state of the Cluster you want to simulate. (e.g. 007 is state 7 , 3 stations active).

Compiler output

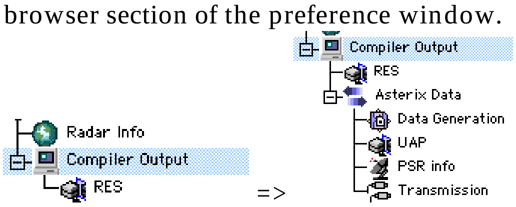
In the “Compiler output” subsection different output formats for the compiler can be selected:



Compile for RES [true] : If this checkbox is True, the scenario generator creates RES output data . If True, the “RES” item becomes available in the browser section of the preference window.



Compile for Data Replay [true] : If this checkbox is True, the scenario generator creates Data Replay output data . This includes LAN replay data, EDR replay data and SASS-C input data. If True, the “Asterix Data” item becomes available in the browser section of the preference window.



Include Reflections[False]: This check box determines whether the reflections are used in the drawing of the scenario. Reflections are always used in the compilation stage of the scenario if a reflection model is incorporated in the scenario.

Load Test: [False] Output of a load table to a spreadsheet style text file. (XXX.LOAD)

View windows [False] : visualisation of the possible overlaps of targets (Not applicable for MR scenarios)

View Load: [False] Visualisation of the load model (Not applicable for MR scenarios)

<u>Include Miss in S4:</u> This option includes all Missed plots in the S4TJ and S4PR datastream, with the correct status bits (Missed) set. This allows you to visualise the missed plots in the inventory display. <u>The option MUST be checked if you want to include missed tracks (coasted tracks) in the asterix output stream.</u>

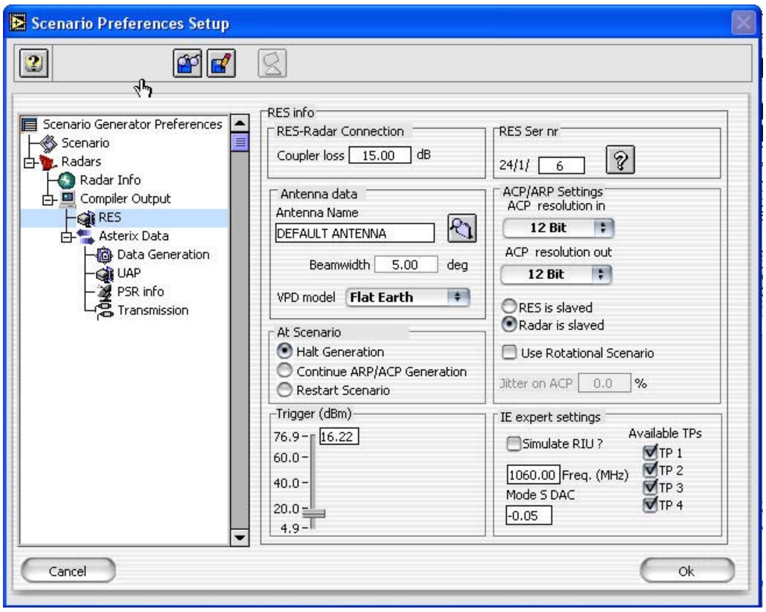
Miss > 4 level overlap.: This option generates misses for all plots which are in a > 4 level overlap situation .

3Channel + FRUIT: This function disables the fourth channel in the RES for target injection and reserves it for FRUIT generation or JAMMER operation. This also implies that a FRUIT scenario for the RES must be created before the RES main is started. (see Chapter V) or alternatively, a JAMMER is defined in the event scenario generator.

#Sectors: This parameter determines the number of sector messages per scan included in the S4TJ file. (Data replay files always include 32 sector messages).

RES Parameters

In the "RES" subsection you define all parameters that are related to the use of the RES. They will not be shown in case the RES compilation output is deselected:

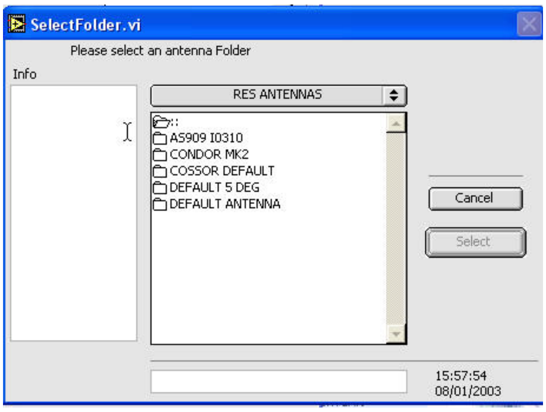


RES-Radar Connection: Coupler loss: This parameter is the total loss between the output of the RIU (Sum channel) and the input of the radar receiver. This includes an attenuator and the phase adjustable coupler value. The exact value of the coupler can be determined from calculations in chapter III of this volume.

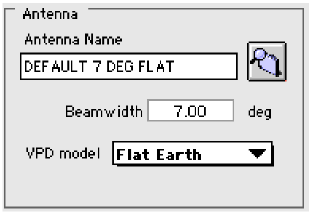
RES Ser nr: This important parameter determined which RES you want to compile the scenario for. Use the button next to the Serial number to query the RES for its serial number. This can only be done when the RES is connected .

Antenna data:

A specific antenna pattern can be selected by name. To do this, click the selection button.



This antenna pattern can be created and edited with the Antenna Diagram Editor in the RASS-S Toolbox. The Beamwidth of this antenna is shown under the selected antenna name. The beamwidth can NOT be editted in the trajectory scenario generator.



The VPD model parameter determines the relation between target range, altitude and its elevation. From elevation, target VPD attenuation is determined.
See chapter II for more details.

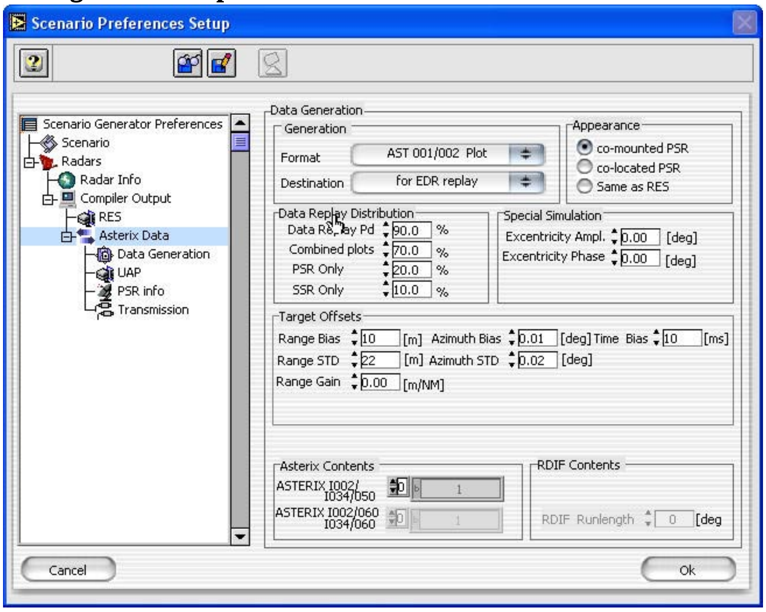
At scenario Completion: This parameter determines what happens at the end of the RES scenario. Typically, the ACP generation stops, but this can continue or the scenario can be restarted automatically.

Trigger Level: The RIU trigger level, measured at the radar transmission output. . Typically, this value should be 15 dB less than the minimum transmission power of the radar. (e.g. radar transmits between 50 and 62 dBm, use 35 dBm as trigger value).

ACP/ARP settings:
ACP resolution in: The resolution of the input ACP / ARP into the RIU. Only used in case the RES rotation is slaved to the radar. (So radar antenna turns).
ACP resolution out; The resolution of the output ACP / ARP from the RIU. Only used in case the Radar rotation is slaved to the RES. (Typical FAT sytuation, No antenna connected).
RES is slaved/Radar is slaved: use this selector to determin the encoder mode. (Which device provides rotation, RES or Radar) .
Use rotational scenario. : Check this box if the rotational scenario is to be used. Not applicable for multi-radar scenarios.
Jitter % on ACP: Use this control to determine the jitter on the ACP output. Only applicable in case of rotational scenario.

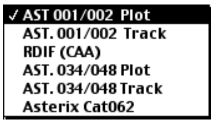
IE expert settings: Explanation is beond the scope of this manual. Controls should be left to default values.

Data generation parameters:

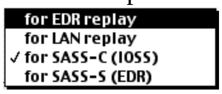


§ Format of generated data [Asterix Cat001/002 plots ;Cat001/002Tracks; RDIF ; Asterix Cat 034/048 Plots; Cat 034/048 Tracks; Asterix cat062 tracks)

This parameter determines wheter the data generated is RDIF or Asterix and what the data categories and UAP will be.



§ Destination of data: select the destinationof the data replay data: This can be eighter
-for EDR replay: creates several EDR replay files
-for LAN replay: creates one multi-channel LAN replay file
-for SASS-C : creates multiple IOSS data files encapsulating the asterix data
-for SASS-S : creates multiple S4PR files for tests in SASS-S or PTE. No replay data



§ *Appearance of the data:*

-(a) *Co-mounted* and synchronised PSR or
- (b) *co-located* and not synchronised or
-(c) *Same as RES:*

This parameter determines wheter the generated radar data is originatingf from a PSR radar which is co - mounted (they have the same pedestal, so same rotation speed, position and heading) or co-located (PSR is placed on a separate pedestal and has different position, rotation speed and heading as SSR). Alternatively, the radar data is ot solenly comming from a PSR, but simulates a SSR , Mode S or combined radar. for this use "*Same as RES:* " this option simply generates a dataset that is the same on asterix level as in the RES scenario,

Data Replay Distribution:

§ -*Data Replay Pd*: The probability of detection of the generated Asterix data. If set to 90 % , only 90 ,% of the programmed scenario targets will also be generated as asterix for this radar.

§ -*Combined plots:* The percentage of all generated plots that is flagged as combined. (

and thus have a SSR or Mode S appearance)

§ -*PSR only plots:* The percentage of all generated plots that is flagged as PSR only. (and thus have a PSR appearance, without Mode A,C,or S address field present)

§ -*SSR only plots:* The percentage of all generated plots that is flagged as SSR only. (and thus have a SSR or Mode S appearance, without PSR info)

Target Offsets: These parameter determin the error model applied to the generated data. The refence data (S4TJ file) is not affected. The errors are applied after calculation of the correct position in the scenario, and are then included in the S4PR output and the eventual Asterix, LAN, EDR or other output.

§ -Range Bias [-150..150,1 m]

The Range offset; The fixed bias added to all scenario positions prior to determining the output position of the target report.

Asterix Range = Scenario Range*Range gain + Range Bias+stochastic Range error

§ -Stochastic Range error STD [0..150,1 m]

The stocastic range error added to all scenario ranges prior to determining the output range of the asterix target report. The stocastic error can be positive or negative.

§ -Azimuth bias (-0.2..0.2,0.01 deg)

The fixed azimuth bias added to all positions prior to determining the position of the outpu target report in asterix.

§ -Stochastic Azimuth error STD [0..0.2, 0.01 deg]

The stocastic azimuth error added to all scenario positions prior to determining the output position of the target report in asterix. The stocastic error can be positive or negative.

§ -Range gain [0..2 ,0.1 m/Nm]

The Range gain is applied to all scenario positions prior to determining the output position of the target report in asterix.

§ -Time stamp bias [0..200 ,1 ms] (asterix time stamp will limit granulity to 1/128 s)

The fixed time bias added to all scenario time of detection values prior to determining the output time of detection (this also affects the time of transmission by the asterix message by the EDR replay driver or the LAN replay driver) of the target report.

§Excentricity Amplitude [0..1,0 deg]

The azimuth dependant azimuth bias added to all positions prior to determining the position of the outpu target report in asterix.

Asterix Azimuth = Scenario Azimuth+ Azimuth Bias+stochastic Azimuth error + Excentricity amplitude* sin (Azimuth + excentricity Phase)

§Excentricity Phase [0..360,0 deg]

The azimuth where the excentricity sine error crosses zero (negative to possitive)

§ Radar Default values for items 002/050, 034/050 and 002/060,034/060 data in North messages in asterix. (Optional)

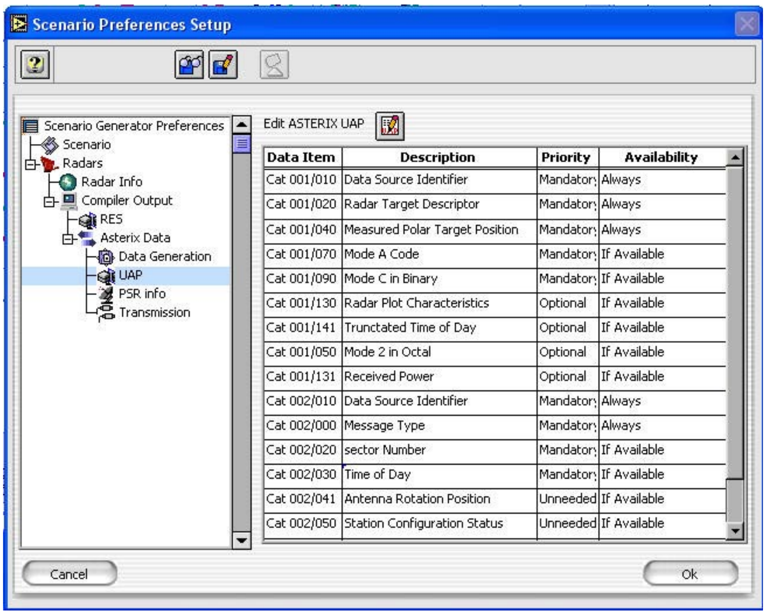
One or more bytes can be included in asterix message items 002/050 and 060 in North message. Beware, the tool does not check the (Hex) contents of the data.

§ RDIF PSR run length [0.1..5,0.1 deg] (to be included in RDIF data format only)

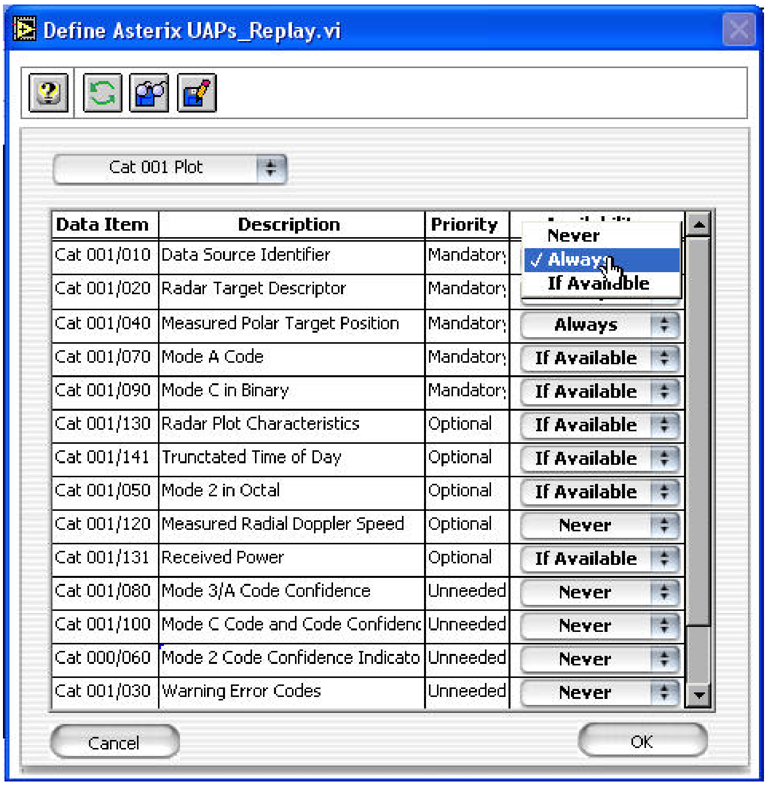
The Runlength parameter included in the RDIF message.

UAP Info: This selection allows the user to view and modify the UAP used by the asterix generator. e.g. the tool allows you to only output Data items 10,20 and 40 for all targets, simply by setting these items to availability = always and the other items to Never.

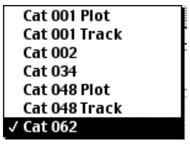
Asterix UAP



§ Edit ASTERIX UAP : Clicking this button will evoke the following window:



This window allows the user to set , for each of the seven possible data formats,



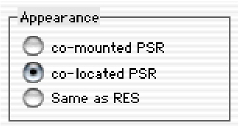
Wheter the related data items should be included or not included in the output data.

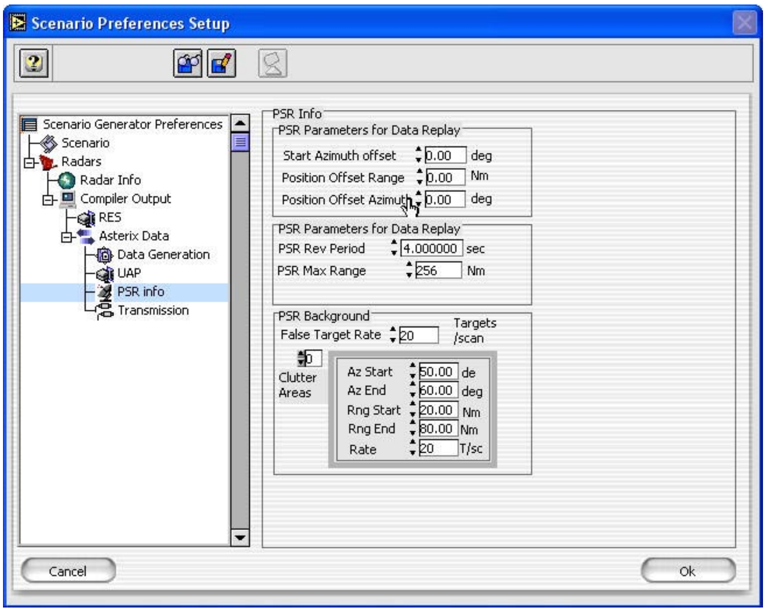
Typically , some data items MUST always be included (e.g. item xx010, Data Source identifier). Set these items to "**Always**" in the menu. Others are only included if they are available (e.g. item 001/070 A code) . Set these items to "**If Available**" in the menu.
After setting all the parameters, click the OK button of the preference window.
Other items you may want never to be included in the data (e.f. item 062/290 System Track Update Ages), simply because they are not available from the scenario. Set these items to "**never**" in the menu.

The factory default values for the scenario generation can always be restored using the "Undo" button. . You can also save and load an existing UAP profile.
Click the OK button to include the profile in your scenario definition.
The set UAP will always be saved in the scenario preferences and thus also in the scenario folder. There is no real need to seperately save them, unless you want them to be copied into other scenarios.
After definition of the UAP click the Ok button.

PSR Generation:

These parameters are only valid in case the "appearance " is set to PSR (co monuted or co-located) .





§ -*PSR Parameters for Data replay*

Start Azimuth offset. : The heading difference between the PSR and SSR antenna, i.o.w., the difference between the generated SSR position (on the RES) and the PSR position (on Asterix replay).

Position Offset Range: The difference in location between the SSR and PSR radar in case of co-located radars, (max 5 Nm)

Position offset Azimuth : The difference in location between the SSR and PSR radar in case of co-located radars, (0..360 deg)

§ -*PSR Parameters for Data replay*

PSR revolution period. : The revolution period used for the PSR radar, in case of co-located PSR radars.

PSR max Range: The maximum range for the targets to be generated for PSR.

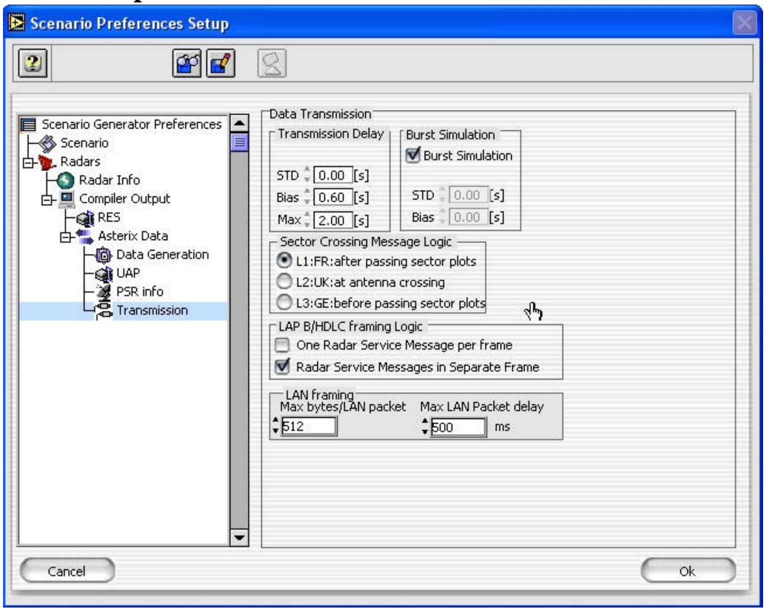
§ *-PSR Background:*

§ *-False Target Rate* : The number of false target reports included in the replay data per scan. The false targets are generated randomely over the entire coverage of the radar.

§ *-PSR clutter area parameters* (min Range, Max range, min Azimuth, Max Azimuth, Rate)

One or more clutter areas can be defined on top of existing background false target rates. Areas are defined using range and azimuth fields. The position of the bclutter area false targets is randomly selected per scan. (each scan new position in range min..max degrees and min .. max range) Notice that the PSR clutter boundaries are not affected by bias

Transmission parameters:



§ Transmission delay bias, Maximum and Standard deviation for plots. **(Not applicable to sector messages;)** for **normal** generation

The time bias added to each calculated PSR time of detection and stored in the time of recording (= time of transmission) . This calculated time is used to send out the target plots.

Time of recording =Max [(Time of detection + Transmission delay bias + Transmission delay stocastic error), Maximum Transmission delay]

§ Transmission delay bias and Standard deviation for plots. **(Also applicable to sector messages !)** for **burst** generation.) See drawings hereafter)

All Asterix data target reports of a given sector are outputed at the same time with a delay composed of a fixed bias and a stochastic random part. The delay is in any case greater than 0.1 second. The delay is defined as the difference between the antenna passing the end azimuth of the sector and the time of transmission of the first bit of the data bock.

§ Sector message sending logic :

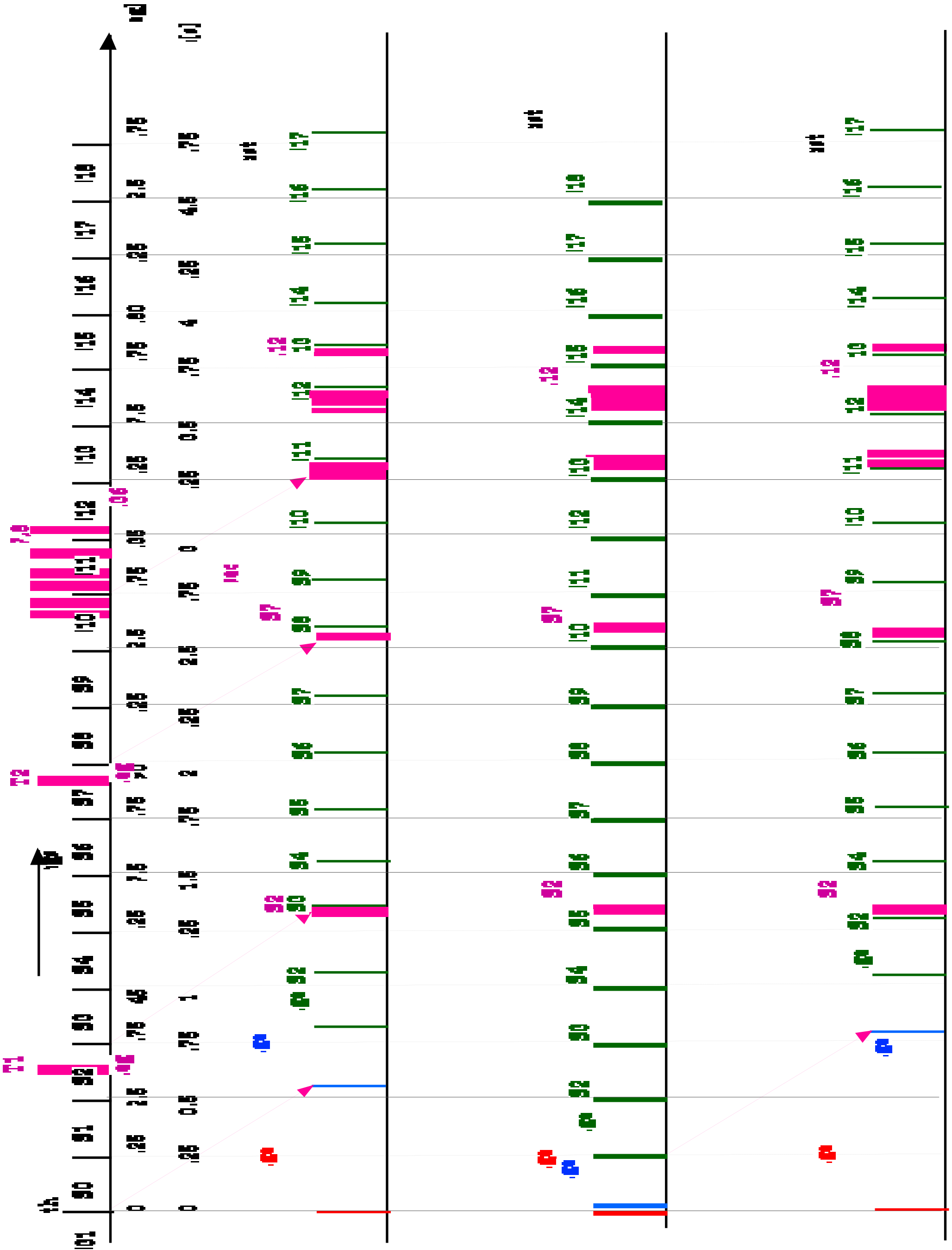
-logic 1(Fr) : Sector message is send after all sector plots of past sector are send.

-logic 2(Uk): Sector messages are send at crossing of antenna.

-logic 3(Ge): Sector messages are send before all sector plots of same sector are send. See picture hereunder

§ LAP B / HDLC Framing logic

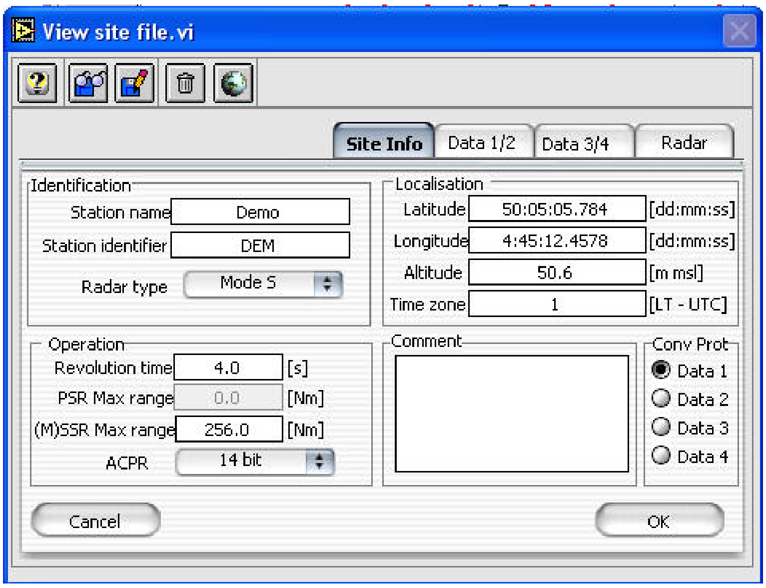
- Maximum one radar service message per LAP B/HDLC frame is used when this option is selected (combination with multiple target messages possible).
- Radar service messages are put in separate frames when this option is selected (in combination with option above = one service messages only)



2.2.8. Site File editing

Click the button to select a site file: This file contains information needed for some of the functions in the Inventory tool. Click the 'Site' button to load a site file.

Site



The top row buttons operate the Site tool.

Toggle "Help" window On/Off

Save site file to disk

Load site file from disk

Empty site file

Display map.

OK Save settings and return to Convert Radar Data tool

Cancel Ignore settings tool and return to Convert Radar Data tool.

The following information can be stored in the site file:

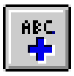
- Station name, Station identifier, Radar type (PSR, (M)SSR, COMB).
- Revolution time, Max range, ACPR.
- Latitude, longitude, altitude, time zone. (Usefull when drawing the Map on the display)
- Comment to be included with the site information

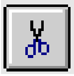
The latitude and longitude fields are used to calculate the background map in the scenario graph (If selected).

2.2.9. Trajectory Functions & Buttons

Now that the AC and the TP data is entered and the preferences are defined, we can proceed by creating a trajectory. This is done in the main screen .

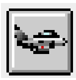
In the main screen, the following buttons can be used:


Enter a new sentence in a trajectory description


Cut sentence from the trajectory description (and copy to clipboard)


Copy a sentence from the TJ description to the clipboard


Paste a sentence from the clipboard to the current index. Data is inserted

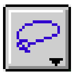

Load AC database from disk


Load TP database from disk

Load an existing BDS data set from disk

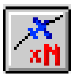

Select a Scenario folder. This folder will contain all scenario data and resulting compiled files.

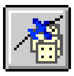

Load an existing scenario from disk and add to the current selected scenario.

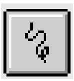

Select all or set of trajectories in the list

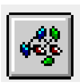

Remove the selected trajectory from the scenario


Add a trajectory to the scenario

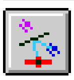

Duplicate trajectory

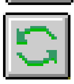

Generate a set of random scenarios .


Plot the current scenario in the graph


Compile the current scenario

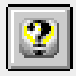

Activate preference window

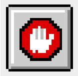

Load Environment Definition window.

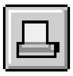

Undo the last editing function

 Call the “Property randomiser” function

 Select site file

 Show help window

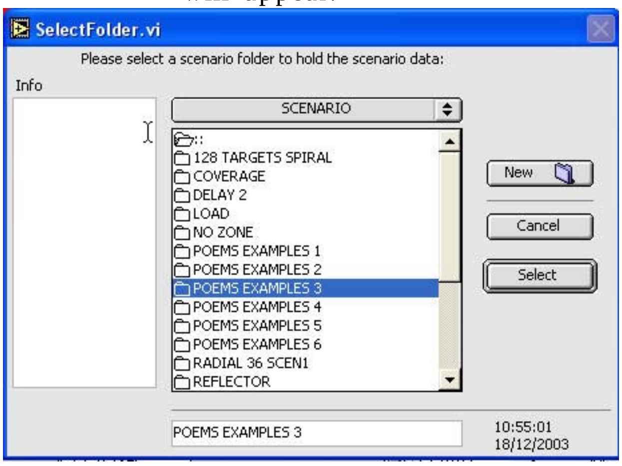
 Quit trajectory scenario generator

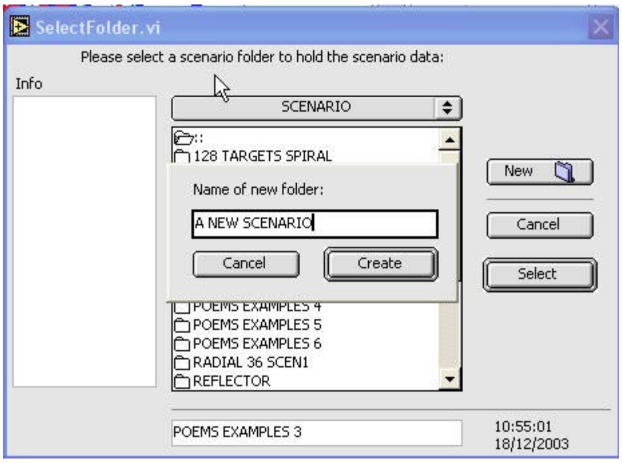
 Print or export the scenario as text file.

2.2.10. The Scenario Folder

At any time , the user can select or create a new scenario folder. The fact that you select a new scenario folder automatically saves the editted data of the previous scenario folder into that old folder and reloads data in the new one.

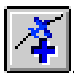
Selecting done by clicking the **Select Folder**  button. The following folder dialog will appear:

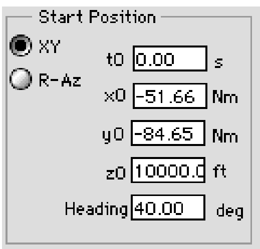


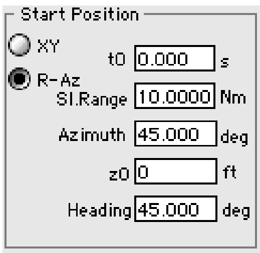


For the creation of a new folder, click the **New** button. Existing folders can be selected from the list.

2.2.11. Scenario Creation

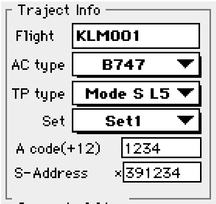
To start the creation of a trajectory click the “Add Trajectory button” .
Next, enter a start position and start time of the trajectory plus a heading in local XYZ coordinates or in Slant-Range , Azimuth coordinates.





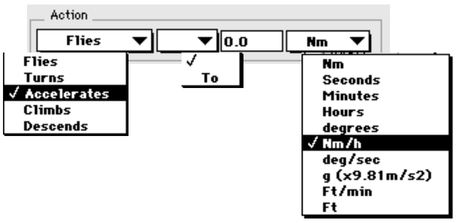
If the entry is invalid (e.g. Height of 30000 ft and range 1 Nm) , the invalid entry shall turn Red and will be corrected by the software. A beep will sound.

-Select an AC and a TP for this particular trajectory and enter the Flight ID (typical 7 character call sign). Also the A code and S address for that TJ is entered, plus the set to use for the plot of that TJ is selected using the set menu. Notice that all items can be edited afterwards.



Note1 : The S address must be between 0x000000 and 0xFFFFFF. If it is higher, the upper byte will be used to determine the target generator (Forced). e.g. Target 0x 0239 1234 will have S address 39123 and will ALWAYS be generated by target processor 02, independantly of the overlap situations.
Note 2: If the AC Type or TP Type menus are dimmed, this means that no Aircraft or Transponder database are present in memory.

- Now use the action tool bar to select the first action of your aircraft :



A scenario is programmed by a sequence of actions.

An AC can perform the following actions:

-Fly
-Turn
-Accelerate
-Climb
-Descend
These actions can be directed or related to a certain parameter.

The parameter is a number, which has a unit. This unit can be :

-Nm	-Nm / h
-Seconds	-deg / sec
-Minutes	-g (9.81 m / s2)
-Hours	-Ft / min
-Degrees	-Ft

For example :

KLM001 flies 10Nm is a command
but
KLM001 flies 100 Nm / h is a parameter setting

A parameter setting is active until a new parameter setting action overrides it, or until a specific command action overrides it.
(This is the case for descend and climb actions)

e.g.
KLM 001 Flies 100 Nm/h
KLM001 Flies 1 hour
KLM001 flies 110 Nm/h
KLM001 Flies 0.1 hour
will cause a trajectory of 1.1 hour covering 111 Nm
(The speed setting is active over the complete trajectory).

An exception is the climb/descend action:
KLM 001 climbs 1000 Ft/min
KLM 001 Climbs To 2000 Ft
KLM 001 Flies 10 Nm
will cause a climb to 1000 Ft during 2 minutes, after which a steady (climb rate 0 Ft/min) flight of 10 Nm follows.

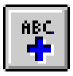
If any parameter is not specified by an action, the default AC parameters in the AC database will be used.

Each action may be combined with any unit, although this might look somewhat irrational.
e.g. :

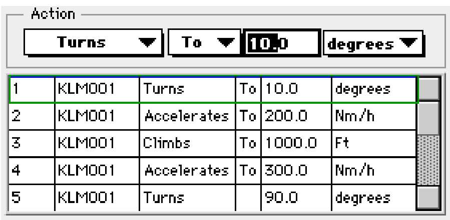
SLR123 Turns 1 minute (a one minute turn)
VIR456 Flies 180 degrees (a 180 deg turn)
BAC135 Turns 0.1 g (sets turn rate relative to current speed)
etc..

Actions can be absolute or relative to a given parameter :
e.g.
KLM001 turns 50 degrees (relative turn)
KLM 001 turns to 50 degrees (absolute turn) heading

The next action can be entered by clicking on the empty line below the previous action, or by using the "Add action" button.



Actions can also be inserted at a given position by positioning the green frame in the action list at the desired position and then using the "Add action" button.



1	KLM001	Turns	To	10.0	degrees
2	KLM001	Accelerates	To	200.0	Nm/h
3	KLM001	Climbs	To	1000.0	Ft
4	KLM001	Accelerates	To	300.0	Nm/h
5	KLM001	Turns		90.0	degrees

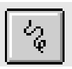
Important Notice:!
In some cases, it might be required to start a scenario with a few "empty " scans in front, in

order to allow the radar to get in its initial state or to drop previous tracks (in case of endless replaying of the same scenario). In this case, the user should include this “dead time “ in its scenario by using a start time of e.g. 20 seconds in stead of 0 seconds for all trajectories.

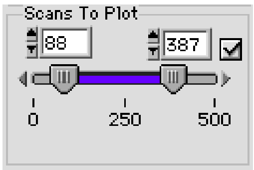
For such “infinite running scenarios”, it is sufficient to create a standard scenario and program the RIU parameter “At scenario completion “ to “ Restart Scanario” (see RES main Control description, §5.0)

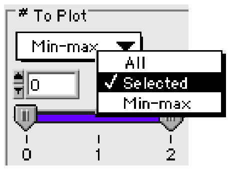
2.2.12. Plotting the scenario

Once the actions are entered, use the plot button to draw the trajectory.



The trajectory will now be drawn in the graph. A cursor appears showing the Flight ID or Call sign for this trajectory. With the  button a scan slider can be activated. With this scan slider a time window can be set for which the scenario is drawn in the graph.





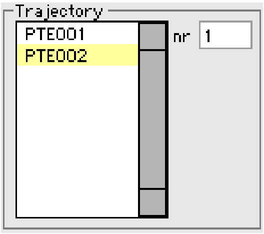
You can draw all plots in the scenario or only a selection. This can be done by using the “# to plot” menu. If “All” is selected, all targets will be drawn. If “Selected” is used, only the trajectories marked in the “Trajectories” list are drawn. This is very handy e.g. to draw sets of data.

The plot speed can be increased by the use of the interpolate option in the preferences dialog box. By using this option straight lines are build up out of less points. An interpolation factor of 10 means that for every 10 calculated points only one is drawn in the graph. In the curves all the points are always used to draw the trajectory. Therefore trajectories with a lot of straight lines can be manipulated faster when this option is turned on. The use of this algorithm has no implications on the accuracy of the calculations. The colour of the plotted curve depends on the selected set .

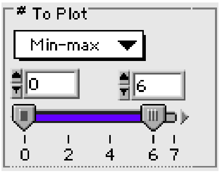
If too many plots are to be drawn on the screen, the program will most certainly slow down a lot . It could even happen that not all plots can be drawn due to memory limitations. This will be automatically checked for by the program, giving a warning to decrease the number of plotted data.

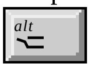
2.2.13. Adding Additional Trajectories

A second trajectory may now be added using the “Add Trajectory button” 
Enter the second TJ and click the plot button.
The Trajectory selector will appear and show that two TJ are present.
The user can switch between the two trajectories. Observe the change of all the TJ info upon the switching of the cursor between the two graphs. Additionally, switching between TJs can be performed by selecting a TJ in the Trajectory selector.



With the # to plot slider a selection of which trajectories are plotted can be made, if the menu above is set to “Min-max”.

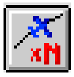


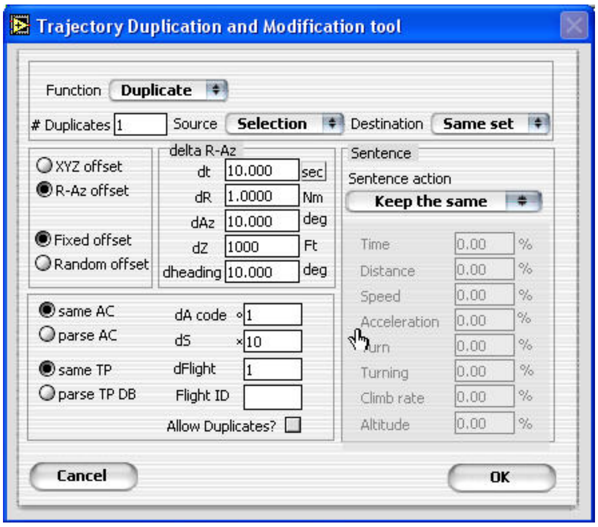
-An easy way to duplicate a trajectory is to “Drag-copy” it. Select a trajectory using the cursor and position the mouse pointer on that cursor. Now hold down the “Alt” (or option) 

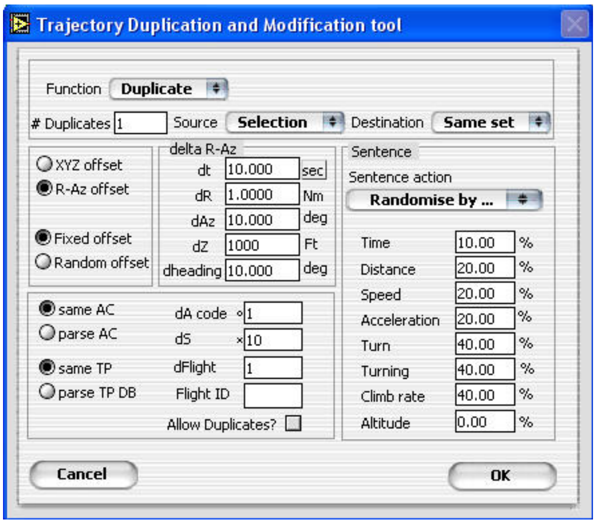
key on your keyboard and shift the mouse pointer to a new position.
The trajectory will be duplicated and redrawn. The start position is automatically altered by the distance travelled by the mouse pointer (in scale).

-The mouse can also be used to move a trajectory to a new position, by performing a “Shift drag”.
Select a trajectory using the cursor and position the mouse pointer on that cursor. Now hold down the “Shift” key on your keyboard and shift the mouse pointer to a new position.
The trajectory will be redrawn on a new position, while the start position is changed.

2.2.14. Duplicating and Modifying Trajectories

-A faster method to duplicate a number of trajectories is to select the “Duplicate Trajectory” option from the “edit” menu or click the  button. First select the trajectory to copy using the slider or the cursor, then select the duplicate trajectory option.
The following window will appear . depending on the set function, you can eighter duplicate or Modify trajectories:





For Duplication, the user can enter how many times the TJ has to be duplicated, what the offset for each consecutive copy will be relative to the previous copy, and what the increment in A code, S code and Call sign will be.

Select the source of the copy: 

This can be

-*Selection:* The last selected trajectory or multiple trajectories will be copied.
-*All:* All trajectories current in memory will be duplicated
-*Setxxx:* All trajectories of a specific set will be copied

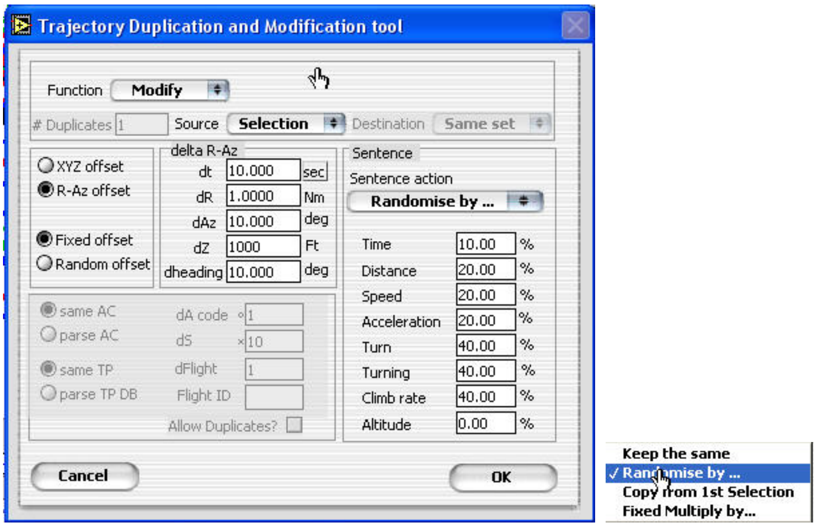
Next select the destination of the copy: 

-*Same set:* Each duplicated trajectory will be attributed to the same set as its source.
-*Set xxx :* All duplicated trajectories will be attributed to the specified set.

The duplicated trajectories can use the same TP properties, or each copy can be attributed with a different TP from the TP database. The same applies for the Aircraft properties. Thus, set the TP and AC selectors accordingly.
-If the duplication results in an A code , Aircraft ID or S address that already exists, the next A code or S address available is checked. for Aircraft ID, the next item with the same Header characters is used. This quest continues until a unique A code ,S address or AC ID is found. (e.g. PTE001 becomes PTE003 if PTE002 already exists.)
-Furthermore, the offset can be programmed in XYZ or R-Theta-Z coordinates. This offset can be fixed or randomised. Set the selector accordingly.
-The different actions of the duplicated trajectory can be kept the same or randomised.
It is also possible to copy the sentences of the selected target into all duplicates.
The randomise factor can be entered in percentages for each type of action.
-After clicking **OK**, the new trajectories will be created and drawn. Cancel leaves the window without an action.
(Remember that all edited trajectories (* including duplication actions) can be undone using the “**Undo”** option.)

The tool can also be used to move trajectories in Range, Azimuth or time! For this , set the function to “Modification” 

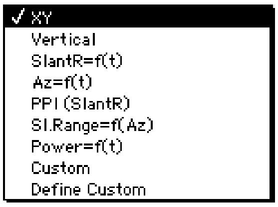
. All targets defined in “Source” are modified with the delta t, R, Az, X or Y. You can also modify the Sentences by a fixed or random function.



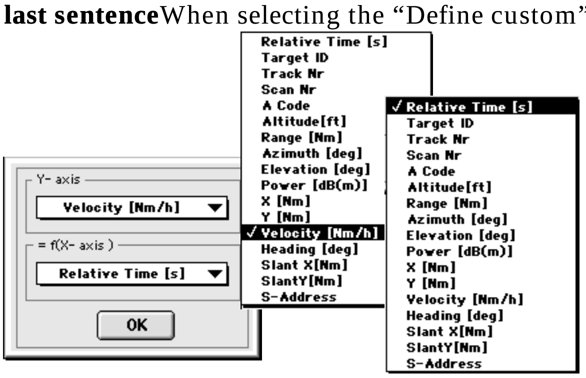
2.2.15. Handling the Trajectory Graph

- The graphs can also be switched between XY mode and five other modes, or a “Custom “ mode.:

The modes are :

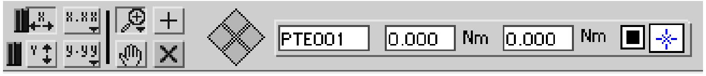


-XY: X (Nm) versus Y(Nm)
-Vertical: Elevation (Ft) =f(R) (Nm)
-Slant Range =f (t) (seconds)
-Azimuth (deg) = f(t) seconds
-PPI: Projected slant range x(Nm) versus y(deg)
-Slant Range =f(azimuth)
-Power=f(t) (Output power of RES targets at Radar Rx level)
-Custom: X and Y scale can contain any field present in the trajectory data.
-Define Custom: This selection is used to define the custom X and Y fileds.
last sentence When selecting the “Define custom” option, following dialog opens:

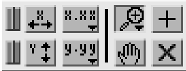


The name “custom” will change in the newly defined custom graph type. X and Y scales are also set accordingly.

All scale, zoom, pan and query functions on the graph can be done using the palette in the lower left corner of the window.



Zooming and panning in the display can be done using the graph palette.



 auto scale X- axis

 auto scale Y-axis

 X-axis settings=> Popp up menu setting X scale format, pression and scale

 Y-axis settings

 Zoom tool

 Pan tool

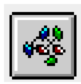
 Select cursor

 Centre cursor

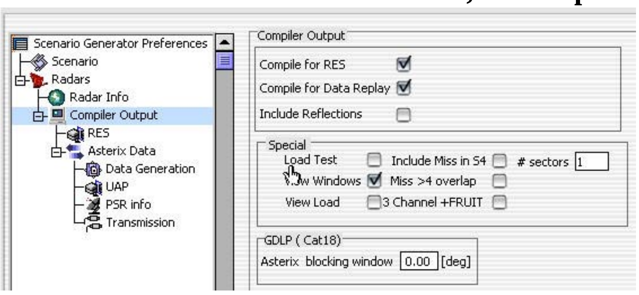
For more details about the graph palette, consult the LabVIEW user manual.

Click the **Square**  button in the lower right corner of the graph to square the display.

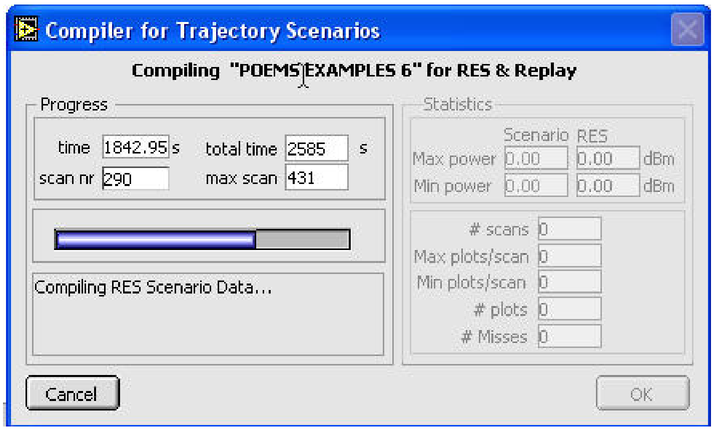
2.2.16. Compiling the scenario

-To create the necessary output files (see chapter II) check the RES / S4TJ Data check boxe in the preference window (Compiler output) for RES related data generation and the PSR / S4PR Data checkbox for PSR (or SSR) replay datasets and click the **compile**  button.

IF none of these two boxes are checked, the compilation will produce no data!

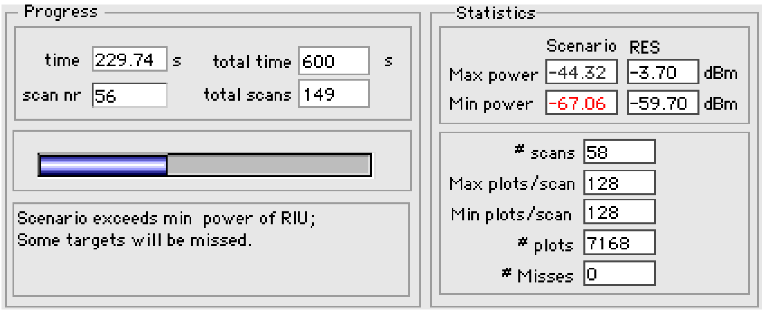


A window will pop up to indicate the progress of the compile process.



All files are saved into the selected scenario folder.

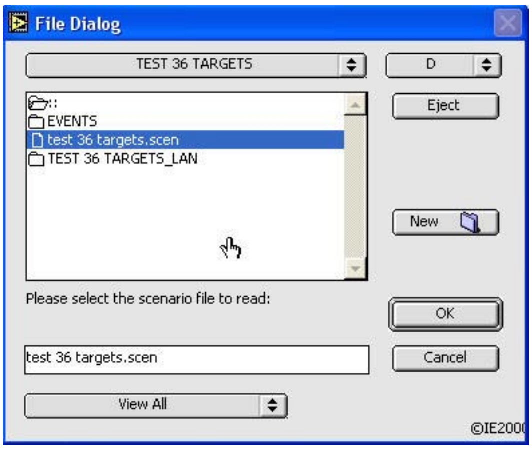
At the end of the compilation, the compile window will render you a number of important information fields:
-Maximum output power of scenario and RES (at Radar Receiver input level)
-Minimum output power
-# of scans
-Max # plots/scan
-Min # plots/ scan
-# of plots
-Total time of scenario
If the output power of the scenario creates problems for the RES to generate the signals, the compiler will present you with a suggestion on the action to take:



2.2.17. Loading and Saving Scenarios

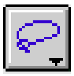
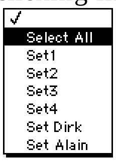
Use the **Load Insert**  button to load a scenario from disk. The scenario can be loaded from any scenario folder and added to the scenario you already created. If you want to create a new scenario and copy scenario data from an other one, first select a New scenario, than use the Load function.

A file dialog will appear: The file dialog will start at the level of "SCENARIO", showing all available scenarios in your campaign. To load a scenario, double click a scenario folder and load the "xxx.Scen" file.



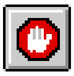
Select a scenario and click OK.

Beware, this scenario will be added on top of the one already in memory. If this not your intention, first clear the scenario complete.

This can be done by clicking first the **Select**  button, and selecting "Select All" from the appearing menu. 

This can be followed by a click on the **Delete**  button.)

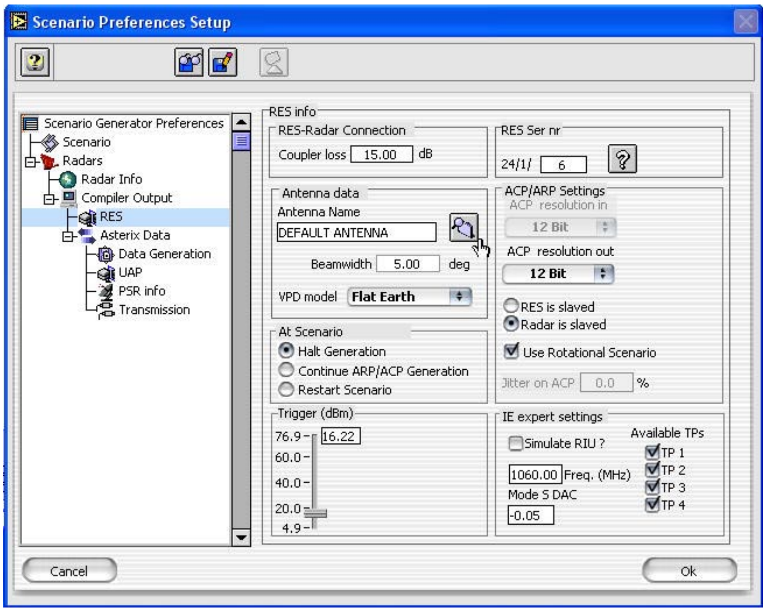
23. The Trajectory scenario generator (like the other scenario edittors) have become Auto-save, which means that all eddited data is automatically saved upon three events:
-Compiling a scenario
-Selection of a new scenario
-Quiting the edittor

Use the  button to quit the Trajectory Scenario Generator.

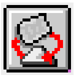
2.3. Special Features of Scenario Generator

2.3.1. Rotational Scenario

If you require a rotational scenario to be included in the scenario, first select the "use Rotational Scenario" option in the preferences under the "RIU" tab.



Next, set the allowable jitter on the ACP generation in % (this value sets the maximum single ended jitter on the ACP period).
Close the preference window.

-Now click the  "Rotational scenario" button to evoke the rotational scenario window:

The rotational scenario can be "written" using " Sentences" , entered in the scenario using a number of menus and numerical controls.

The scenario consists of different points in time, each defining a new rotational speed. The points in time can be entered in seconds, scans (fractional) or degrees rotation .

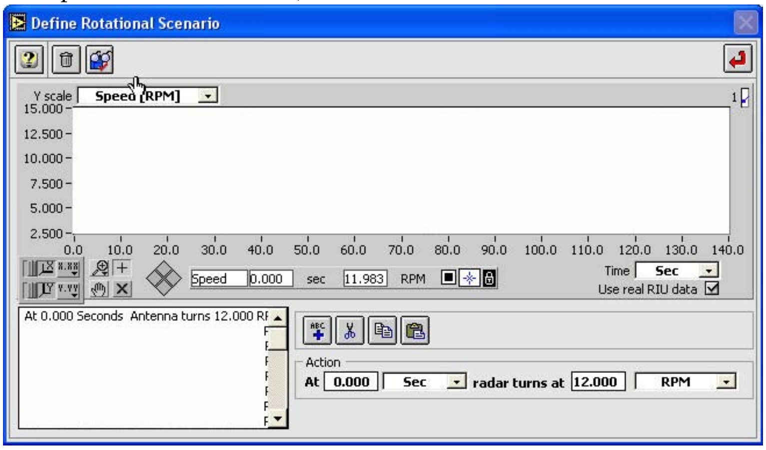
Beware: The rotational speed has a minimum (2.25 RPM) speed . This means that a section with zero speed will always be preceeded and succeded with a point at 2.25 RPM .

The speed can be entered as an RPM, in seconds per revolution, in degrees per second or in radians per second. Each new "action sentence" in the scenario is represented in a speed versus time graph. Again, the Y axis of the graph can represent RPMs, seconds per revolutions or speed in degrees per second or radians per second.

Therefore the scenario allows for generation of
-Fixed speed rotation
- Accelerating rotation speed
-Deceleration rotation speed

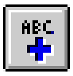
-Standstill of radar

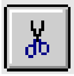
At a predefined azimuth, time or scan.



Following buttons control the operation of the Rotational Scenario editor:

 Toggle the help window on or off

 Enter a new action in the scenario description.

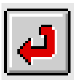
 Cut an action (and copy to clipboard)

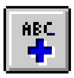
 Copy an action to the clipboard

 Paste the action from the clipboard to the current index. Data is inserted

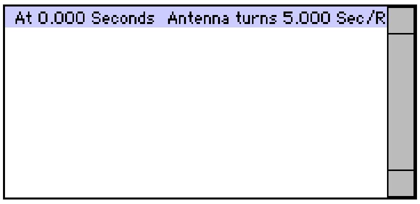
 Load an existing scenario description from disk

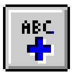
 Clear the contents of the scenario

 Return to the main trajectory generator tool

To create a scenario, first click the  button. An empty line will appear in the sentence list. The first line will always be “At 0 seconds antenna turns x sec/rev”, with x being the revolution period entered in the preference window.
The contents of this line will be copied in the action input field:

Here, adjust the values according to your wishes.



Next, add more sentences using the 

button or the copy and paste function.
In the paste mode, the pasting will be relative to the insertion point.

The scenario is constructed using the following syntax:
Each sentence is created as:

At T UNITTIME Antenna turns V UNITSPEED

T is a time or positional indication. It can be a value in seconds, fractional scan numbers or degrees.

UNITTIME is an enumerated value from {SECONDS,SCANS,DEGREES}

V is a speed value (floating point value) in Revolutions per minute, Sec per revolution, degrees per second or radians per second

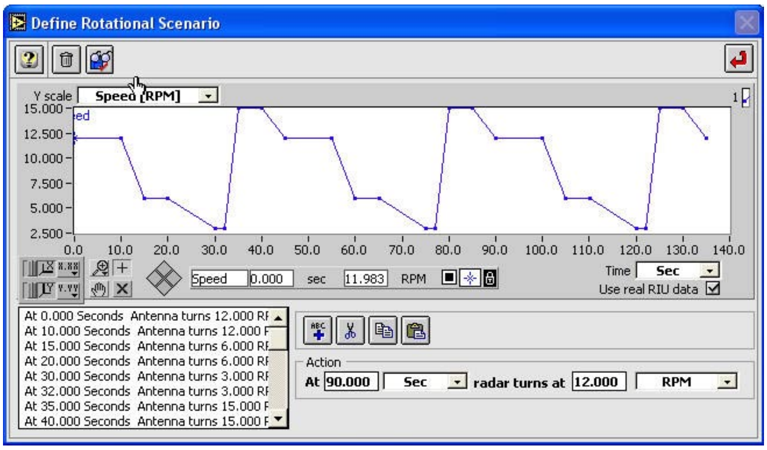
UNITSPEED is an enumerated value from {RPM,SEC/REV,DEG/SEC,RAD/SEC}

The values of T and V can simply be entered by the user using the numerical controls in the window. The Units can be selected from a menu. each time a line is added to the scenario, it is drawn in the scenario graph.

Thus, using these sentences the user can easily create a rotational scenario.

e.g.:

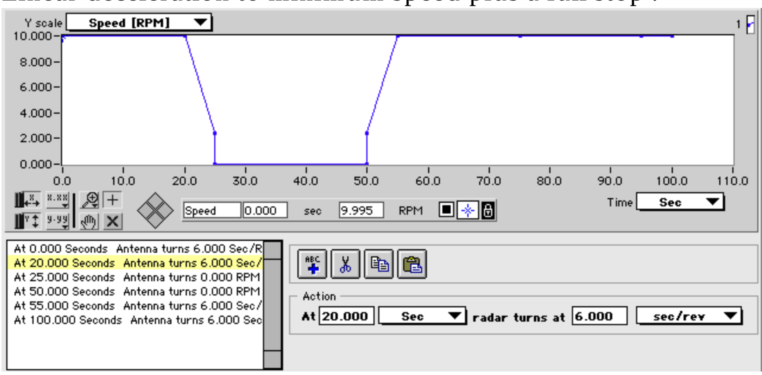
At 0 seconds, radar turns at 12 RPM
At 10 seconds, radar turns at 12 RPM
At 15 seconds, radar turns at 6 RPM
At 20 seconds, radar turns at 6 RPM
At 30 seconds, radar turns at 3 RPM
At 32 seconds radar turns at 3 RPM
At 35 seconds, radar turns at 15 RPM
At 40 seconds , radar turns at 15 RPM
At 45 seconds, radar turns at 12 RPM.



Beware!

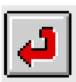
-The scenario must always start with a sentence starting at 0 seconds

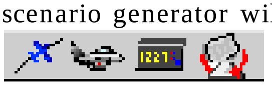
-A zero speed can not be reached in a linear way. The minimum speed of the RES is set at 13.4 degrees/sec (or 2.25 RPM). Therefore a full stop will be created in two steps: Linear deceleration to minimum speed plus a full stop .



-Full stop periods can only be programmed in time , since the radar is not turning.

-If a new Trajectory scenario is loaded from disk and you have previously defined a rotational scenario, first open the rotational scenario window before compiling the scenario!

The scenario will be saved automatically just before leaving the window using the **return**  button.

The scenario generator will add the “rotational scenario present “ icon in the top icon row: 

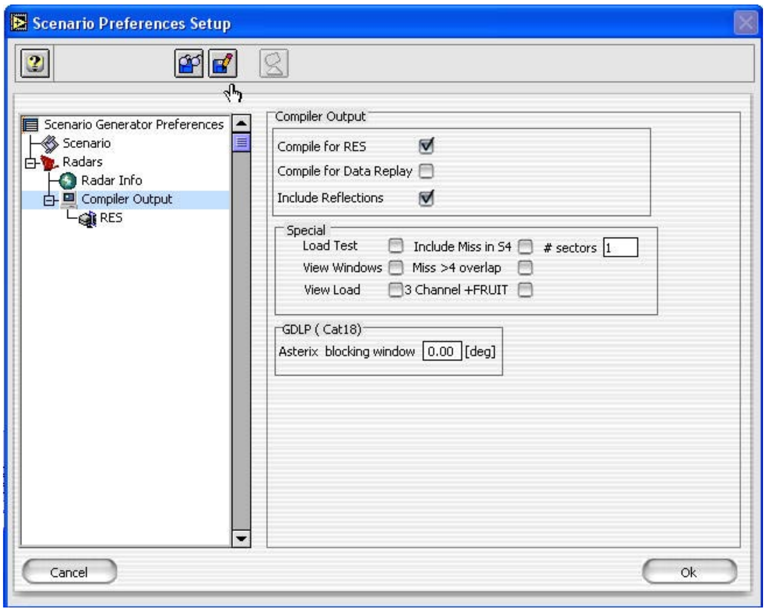
2.3.2. Reflection Model

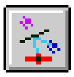
If Reflections are to be added to the scenario this can be done using the “Environment Definition”.

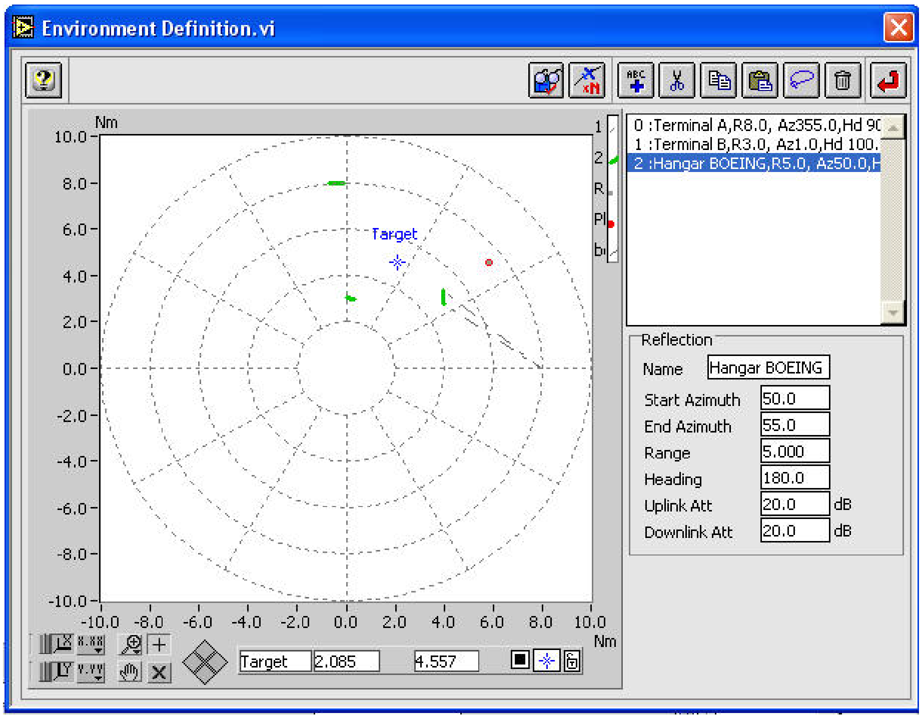
The RES generates reflections on targets by the creation of a second target with the exact same transponder properties as the real target from which it was derived. All transactions based on the transponder data (Mode S address, A code, Frequency, etc..) are automatically copied into the reflected target . These reflections have the same properties as real targets, since they are generated as if they were normal targets.

The reflection targets do not always reply to the radar, but only in those sections were the radar faces the reflector and the signal power path is sufficient.

First enable the reflection implementation in the scenario using the “Reflections” option in the preferences: This can be found under the “Traj.Gen” Tab.



Next, evoke the “environment definition” window using the  button.



A reflector is specified by 7 parameters:

-Name

-Start azimuth

-End azimuth

-Range (centre-radar)

-Heading

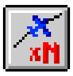
-Uplink attenuation

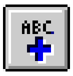
-Downlink attenuation

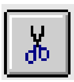
Each of these parameters can be entered in the “Environment Definition “ window.
(Reflectors can also be copied, pasted, duplicated, randomised, saved and loaded)
The tool draws the reflectors on a PPI in order to allow visual inspection and interactive feedback of the position.
Following buttons control the operation of the Environment Definition editor:

 Toggle the help window on or off

 Load an existing scenario description from disk

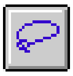
 Duplicate or create a number of reflector randomly

 Enter a new reflector in the scenario description.

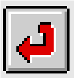
 Cut a reflector (and copy to clipboard)

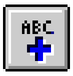
 Copy a reflector to the clipboard

 Paste the reflector from the clipboard to the current index. Data is inserted

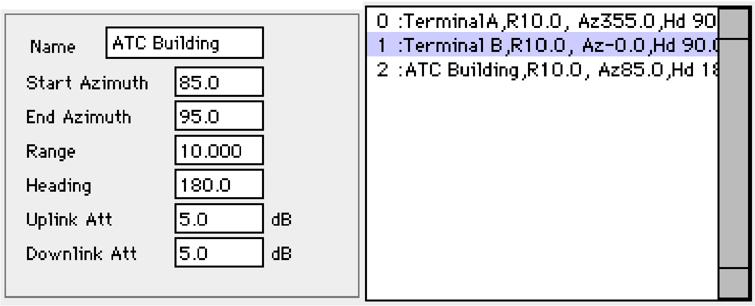
 Select all reflectors in the list

 Clear the contents of the scenario

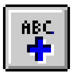
 Return to the main trajectory generator tool (and save data)

To create a scenario, first click the  button. An empty line will appear in the sentence list. The first line will always be “0:NAME,R r,Az a,Hd h”.

The contents of this line will be copied in the reflection input field:



Here, adjust the values according to your wishes.

Next, add more sentences using the  button or the copy and paste function.
In the paste mode, the pasting will be relative to the insertion point.

The scenario is constructed using the following syntax:

Nr, NAME,R r, Az a, Hd h

with NAME being the name of the reflection, r being the range, a being the (average) azimuth, and h being the heading.
Furthermore, following parameters are connected to the reflector:

-*Start azimuth :* Azimuth of first point of interception of the radar and the reflector.

-*End azimuth :* Azimuth of last point of interception of the radar and the reflector.

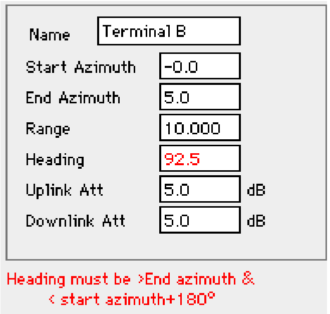
-*Range* :Distance between the centre of the reflector and the radar.

-*Heading :* Heading of the reflector , seen from the radars standpoint. (Definition of heading is same as for targets) Heading must be > End azimuth and < Start azimuth+180

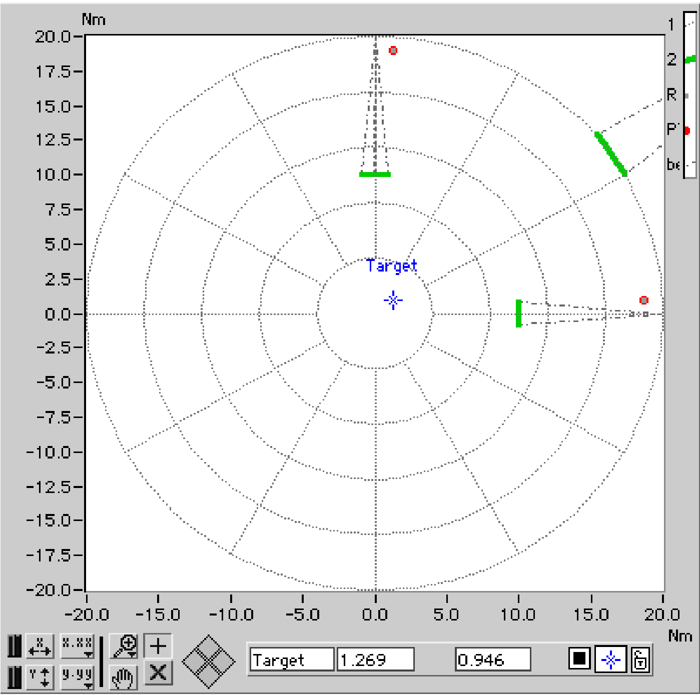
-*Uplink attenuation :* attenuation of the interrogation signal of the radar by the reflector

-*Downlink attenuation:* attenuation of the reply signal of the target by the reflector.

If the heading is not correctly entered, the tool will automatically adjust the value to a reasonable value.

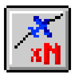


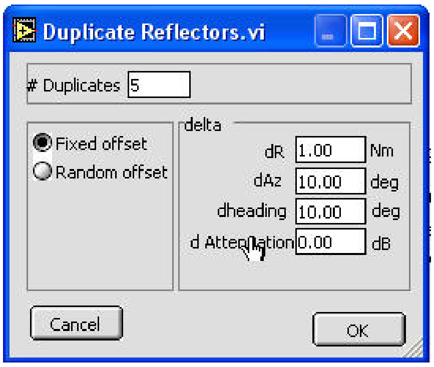
The tool also allows the user to verify the influence of the reflector on a target. To do this, you can select one or more specific reflector(s) from the list and simulate a target position using the mouse cursor. The program than calculates the reflected position of this target and shows whether the reflection will show up on the radar's PPI or not, depending on the position of the reflection. Active reflections show up in red while others show up in grey.

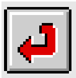


The tools also shows the position of the "image " of the POEMS station as well as the detection beam of this image. Using this information, it is easy to check the validity of the reflector model.

Multiple reflectors can be added to the scenario using the "Add, copy, paste and cut functions.

Duplicate reflectors using the "Duplicate Reflectors" option  . This option will evoke the following window:



Use the window to duplicate the reflectors randomly or fixed.
In fixed mode, the selected (source) reflector will be duplicated N times with each time an offset of dR Nm, dAz degrees and dHeading in heading. The attenuation will also be decreased or increased by the d Attenuation value.
In random mode, the selected (source) reflector will be duplicated N times with each time an offset of N1 times dR Nm , N2*dAz degrees and N3*dHeading in heading. The attenuation will also be decreased or increased by the N4*d Attenuation value. with N1 through N4 being a random value between -1 and 1. Approve the input using the OK button.
The scenario will be saved automatically just before leaving the window using the **return**  button.

The scenario generator will add the “Environment Definition present “ icon in the top icon row: 

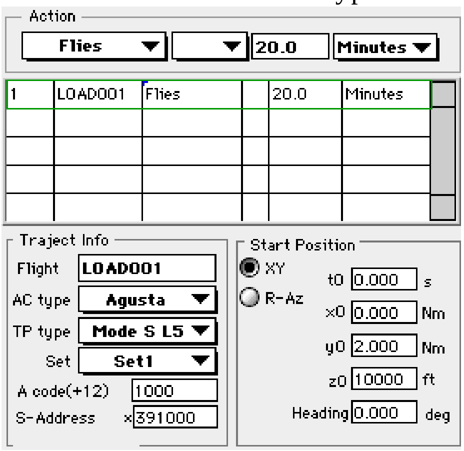
2.3.3. Random Load Scenario Generation

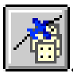
To create complete random scenarios ,use the “Trajectory Randomiser” function.

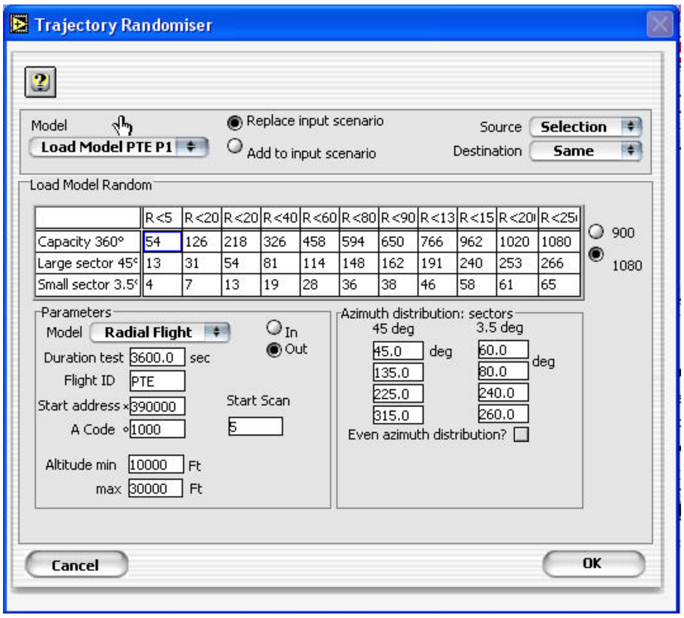
This function will allow you to create a number of random trajectories. These random trajectories can be according to the POEMS load model (to be entered in a load table) or generated in a predefined region.

First, we will discuss the options for the load model.

In order to create a load model, we must first create a “master” target, which can be used as a template by the duplicate function.
Therefore, from the trajectory Scenario generator , create a single target at a random position, but with a valid sentence list (e.g. flies 20 minutes) , a valid height, a valid transponder type and a valid aircraft type . Typically, a load model will require a static target (a helicopter), thus select an aircraft with zero speed. For dynamic scenarios, select the desired aircraft type.

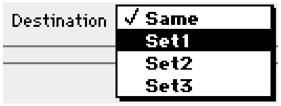


Next, evoke use the “Trajectory Randomiser” window using the button .



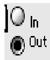
Select the “Load model PTE P1” from the selector in the upper left corner of the window and the “Replace input scenario” option.

Next, select “Selection “ as source and a specific set from the “destination” menu.



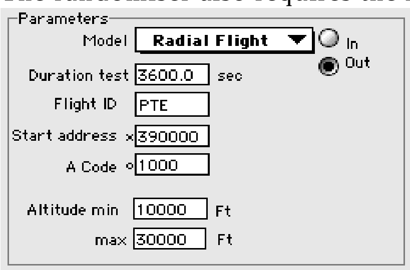
Now enter the desired load model in the table. Beware, the software expects that the load model is valid, meaning that it is feasible. (e.g. If it is required to generate 7 targets in a sector of 3.5 degrees, and one 45 degree sector must contain two such smaller sectors, than the minimal value for the large sector is 14. The same applies for the 360 degree sector. It must be at least 4 times the contents of the 45 degree sector.)
The user can select between two default load models (900 and 1080 targets) or can adapt the input values manually.

Next , enter the model for the scenario:



1) Radial flight	The scenario only creates targets where azimuth= heading or azimuth = -heading, depending on *In/out bound* control.
2) Tangential flight	The scenario creates targets which all fly with the same tangential speed round the radar. (typical circumferences the radar in 3600 seconds)
3) Random heading	The scenario only creates targets where azimuth-90<heading< azimuth+90.
4) Variable speed	Same as 3), but now target speed is a function of its range.

The result of these four models are shown hereafter.
The randomiser also requires the input of the following parameters:

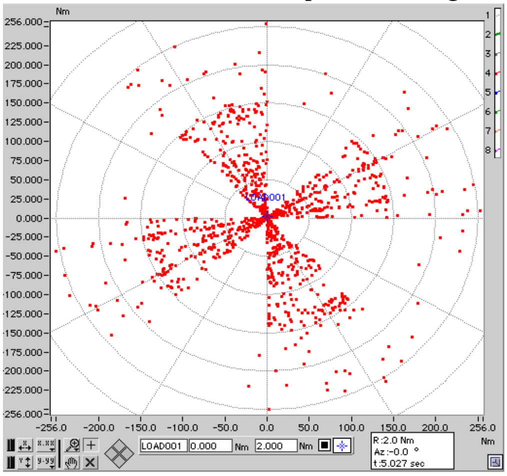


Duration test : this will be used for the insertion of the sentence “ Target Flies x seconds” in the model
Flight ID: This will be used for the flight ID of the randomly created load model. (plus a number from 0 to 1079).
Start address: This S address will be used as the first address of the generated set of targets.
A Code : This A code will be used as the first A code of the generated set of targets.
Altitude Min [ft] : This shall be the minimum altitude used in the C codes of the targets in the load model.
Altitude Max [ft] This shall be the maximum altitude used in the C codes of the targets in the load model.

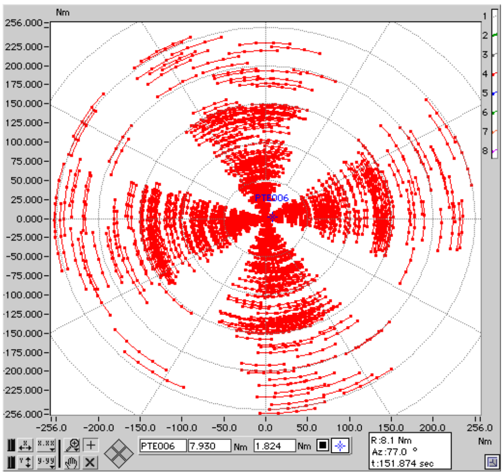
Position large sector: (4 values) The start positions of the large sectors in the load model. (45 degree sectors). (Should only be adjusted with extreme care, since they must fit into

the total 360 degree picture)
Position small sector: (4 values) The start positions of the small sectors in the load model (3.5 degree sectors). Should only be adjusted with extreme care, since they must fit into the first and the third 45 degree sectors.

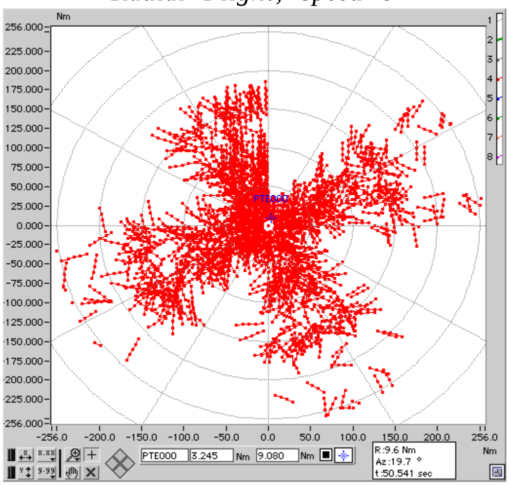
After entering all values, click the **Ok** button to confirm or the **Cancel** button to cancel. The result can be plotted using the "**Plot**" button.



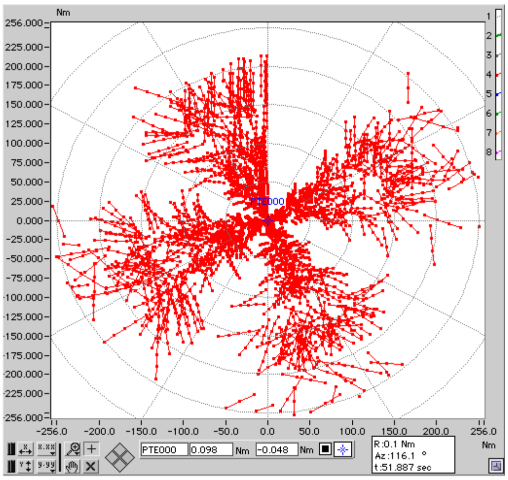
"Radial Flight, speed=0"



"Tangential Flight"



"Random Heading"



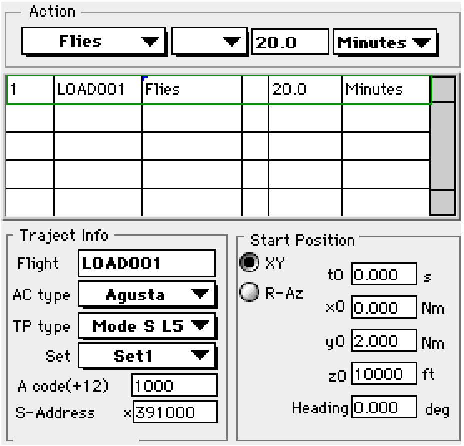
"Variable Speed"

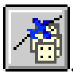
2.3.4. Random Scenario Generation in Region

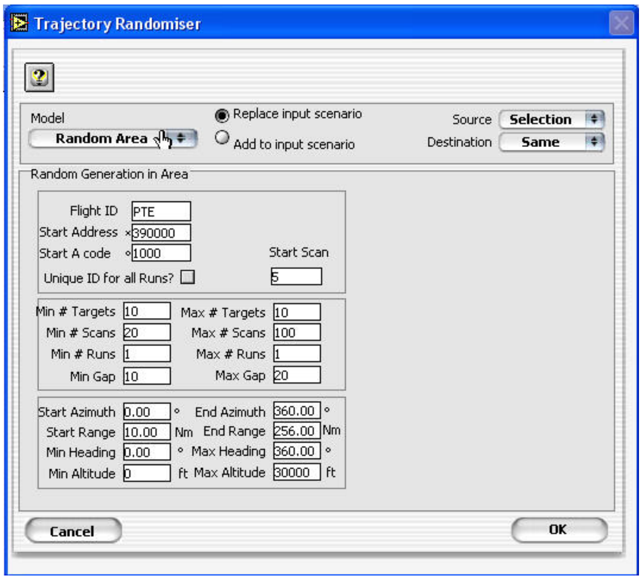
An other option is the generation of targets in a certain region.

In order to create a load in a certain region, we must first create a "master" target, which can be used as a template by the duplicate function.

Therefore, from the trajectory Scenario generator, create a single target at a random position, no sentence list but a valid transponder type and a valid aircraft type .



Next, evoke use the "Trajectory Randomiser" window using the button .



Select the option "Random Area" and "add to input scenario" (unless you want to replace the existing scenario).

Select the source (this can be a set of data or a single "master" target, selected in the trajectory scenario generator) and the destination (typically an other set).

Only the TP type and AC type are copied from the master target.

Next, enter the following parameters:

The random area generation generates a random number of trajectories between "**Min # Targets**" and "**Max # Targets**".
Each trajectory has a length between "**Min # Scans**" and "**Max # scans**".
Each Scenario starts at "**Start Scan**".

The generation is repeated a number of times between "**Min # runs**" and "**Max # runs**".

Each generation has a gap between "**Min gap** "and "**Max Gap**".

The targets are generated between "**Start Azimuth**" and "**End Azimuth**"

The Targets Start Range lies between "**Start Range**" and "**End Range**"

The Targets Heading lies between "**Min Heading**" and "**Max Heading**"

The targets Altitude lies between "**Min Altitude**" and "**Max Altitude**"

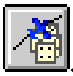
The targets Flight ID starts with "**Flight ID** " plus a sequence number.

The targets S address starts with "**Start S Address**".

The targets A code Starts with "**Start A code**".

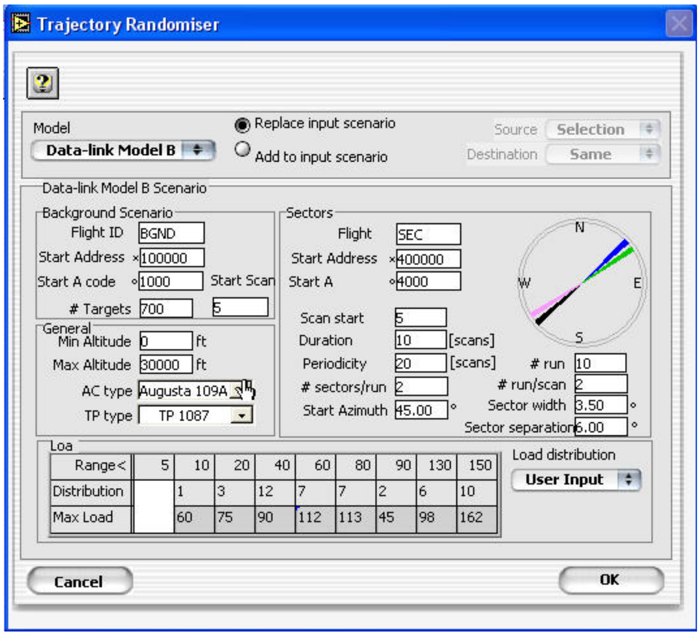
After entering all values, click the **Ok** button to confirm or the **Cancel** button to cancel. The result can be plotted using the "**Plot**" button.

2.3.5. Random Datalink Model B Scenario Generation

An other option is the generation of targets according to the Model B defined by the POEMS requirements.
To create such a scenario, create a new scenario folder and evoke use the "Trajectory Randomiser" window using the button .

The function will assume the user uses a fixed scan rate (no rotational scenario) of N [4..16,0.1 seconds]. Make sure the correct rotation speed is set prior to creating the Model B Scenario.

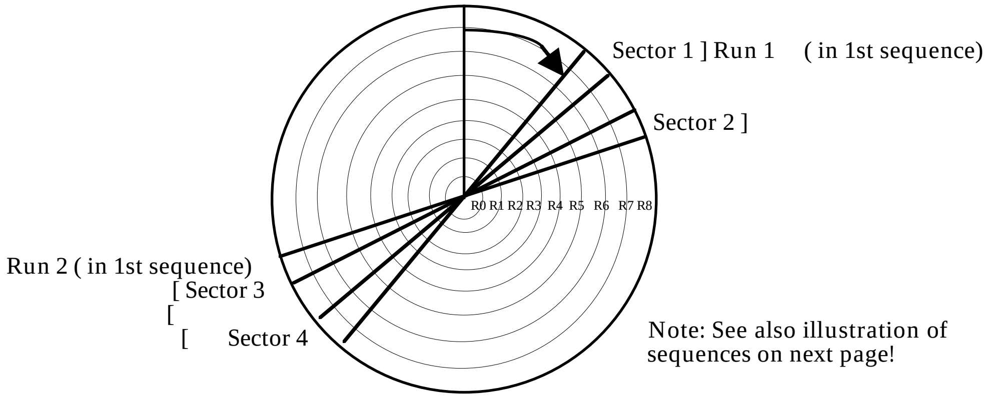
Following window will popp up:



Select the option "DataLink Model B(3015) " option and "Replace input scenario" (unless you want to add targets to the existing scenario).

Source and destination are not used and are grayed out in this mode.

The tool will create a scenario containing 1,2 or 4 sectors with predefined loads per range and azimuth cell. Next to the sectors, a background is defined and in this background a certain load is assumed. Target distribution is always equi azimuth both in background and in the sectors, and no background targets are created whithin the sectors.
The targets are randomly distributed in range according to the load provided per range cell.
The load distribution and maximum load is entered separately for each range cell. The tool ensures the maximum load is not exceeded is each cell.
The generated scenario is a static scenario. (Using the sentence Aircraft... Flies x seconds" for targets with static aircraft (speed = 0) , where x is derived from the Peak sector or background load duration and the rotation speed) .
Each sequence will re-arrange all targets in each sector, but it will maintain the same S address and target ID at a different range and azimuth.
The tool will create five sets in the scenario: Background, sector 1 , sector 2, sector 3 and sector 4. Sector 2 and 4 will not contain data if nr of sectors/run equals 1.
Sector 3 and 4 will not contain any targets if nr of runs/scan equals 1.



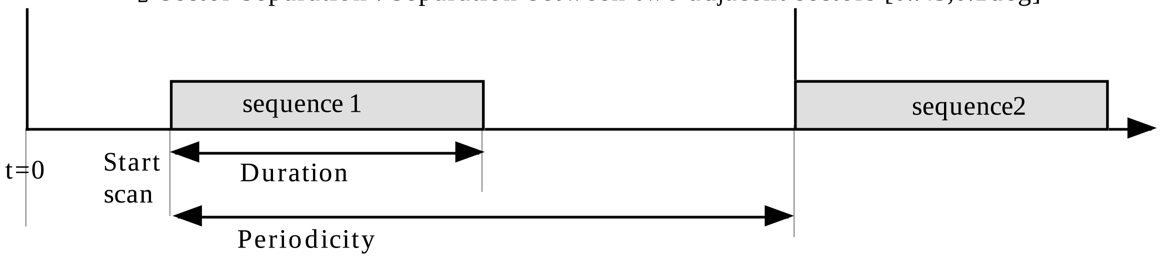
Next, enter the following parameters:

The tool will allow the user to define a background scenario and the contents of sectors.
For Background:
§ Flight ID: The flight ID used for the Background targets
§ Start address: S address of first target in Background
§ Start A code: A code of first target in Background
§ # Targets : Background activity load [1 .. 700 ,1targets]
§ Start Scan: Scan nr of first target in Background

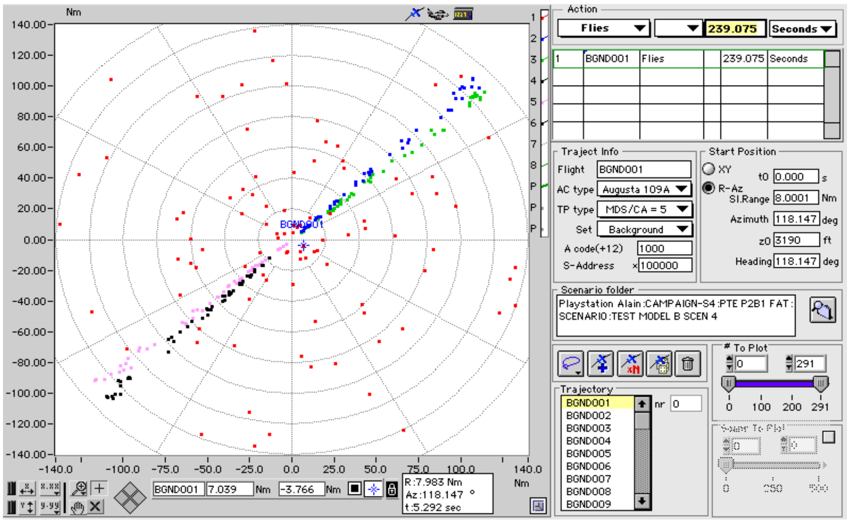
For all targets:
§ Min altitude: Minimum altitude for random altitude creation of all targets.
§ Max altitude: Maximum altitude for random altitude creation of all targets.
§ AC type: Aircraft type (selected from list entered in Aircraft database)
§ TP type: Transponder type: Transponder type used for targets in model.

For the sector targets:
§ Flight ID: The flight ID used for the sector targets
§ Start address: S address of first target in the sectors

§ Start A code: A code of first target in the sectors
§ Scan start : The start scan number at which the first peak sector targets are generated. [1..20,1]
§ Duration: Peak sequence duration [1..20,1]: The number of scans a target is present in one sequence.
§ Periodicity: Sequence periodicity [2..50,1]: The number of scans between the begining of each sequence.
§ # runs: The total number of runs programmed[1..300,1]
§ #run/scan : Number of runs per scan [1..2,1 runs] (or sequence) ; in case 2 runs per scan are programmed, one run is sceduled in the first quadrant and one in the third quadrant.(so one sequence contains two runs!)
§ # sectors/run : Number of sectors in one run. [1..2,1]
§ Start Azimuth: Peak sector start position . (The azimuth of the first target in the first sector.)
§ Sector width : Peak sector width [0..45,0.1deg]
§ Sector Separation : Separation between two adjacent sectors [0..45,0.1deg]



For the load distribution:
§ R_cell i : Range cell distribution range cells[5..150,0.1Nm]: a start and end range is provided for the first cell, an end range is provided for all other cells. All cells are connec ted.
§ T_cell i :Number of targets per sector cell [0..50,1 targets/cell]
§ T_ring_max i : Maximum target load per range ring (for total scenario)
§ S_0 : Scan nr of first sector
All entered randomising parameters are saved along with the scenario preferences. This allows simple checking of the type of scenario that was generated, and this allows the event scenario generator to use some of this information in later event distribution.
The load distribution and maximum load shall be entered separately for each range cell. The tool will ensure the maximum load is not surpassed is each cell.
Once all parameters are entered, click the Ok button and the scenario will be created:
Use the event scenario generator to add the datalink events.



2.3.6. Acquisition Time Scenario

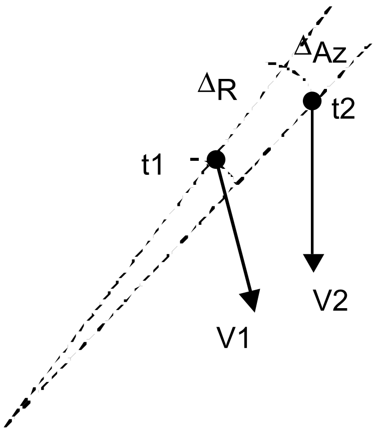
An other option is the generation of targets according to the Acquisition Time Scenario defined by the CEVAP requirements.
The purpose of this scenario is to support the evaluation of the acquisition performance of the POEMS radar, both in Mode S and SSR.

It is the intention to cover as much cases as possible, to investigate the capabilities of the POEMS radar to a large extent.
The scenario consists of a number of different cases:

- Normal
- Take off
- Turn
- Misses
- Close proximity
- Low reply probability

Each case will have a number of different variations.
Because in a number of tests the radar will use stochastic acquisition, each variation of each case must be repeated a sufficient number of times, because the way the transponder will reply will be different. It is proposed to repeat each variation of each case 10 times.
The case of acquisition of close proximity targets is a bit complicated because of the high number of parameters that can be varied. To approach this in a systematic way, first the model of a close proximity acquisition case is presented.

A close proximity acquisition case consists of a pair of targets which have the following characteristics:



- A range and range difference DR=R2-R1
- An azimuth and azimuth difference DAz=Az2-Az1
- A difference in starting time Dt=t2-t1
- A speed v1 and v2
- A heading hd1 and hd2
- An altitude (not relevant in DF11/DF11 garbling)
- Each target has a power

The number of variations is therefore almost unlimited, and a choice has to be made. The following sections present a proposed way of constructing the scenario.

Because the detection of SSR aircraft in resolution is an issue on its own, the discrimination between acquisition and detection for SSR close proximity cases might be difficult. Therefore, it is proposed not to simulate Mode A/C with Mode A/C proximity cases.

General specifications:

- Straight trajectories
- Trajectories generated in pairs of two
- Duration of each trajectory: 30 scans (if it takes longer than 30 scans to acquire a target a serious problem is present)
- Transponder Reply Probability: 90%

Starting scan difference:
0 ,1, 2, 3: 150 cases of each, the other parameters are randomly chosen.
In total 600 different cases are generated, each with a random variation of the parameters described below.

Range difference:
Mode S with Mode S: random between 0 and 5 NM
Mode S with Mode A/C: random between –1.7 and 5 NM (negative means A/C target has shortest range)

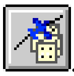
Azimuth difference: random between –3 and 3 degrees

Altitude:
Mode S with Mode S: no variations
Mode A/C with Mode S: A/C number of code pulses 3, 6 or 8
Both targets same altitude to achieve same power (power is varied separately)
30000 ft (3 code pulses)
27900 ft (6 code pulses)
20100 ft (8 code pulses)

Power difference: between –3 and +3 dB
To be programmed using Transponder database. Target 1 of the pair gets a power of 51 dBm, target two gets randomly a power between 51, 52, 53 or 54 dBm.

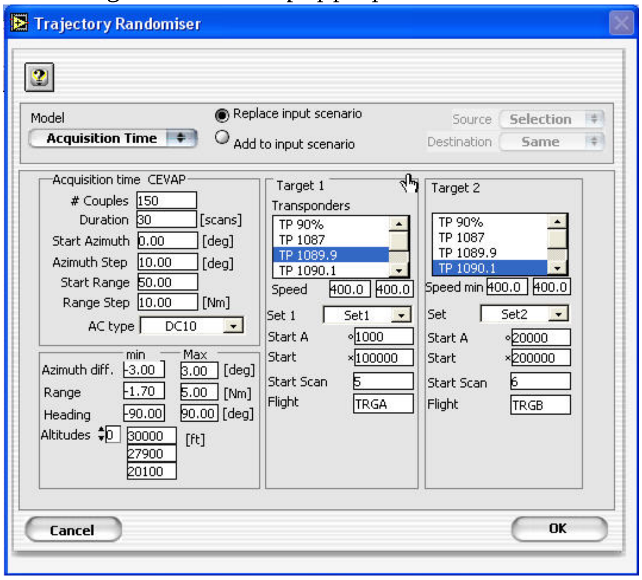
Speed difference: Between 0 and 100 NM/h
One target has fixed speed (400 NM/h), other target has speed that is between 400 an 500 NM/h

Heading difference: Between -90 and 90 degrees
Pairs shall be generated in such way that they have a difference in heading between –90 and 90 degrees

To create such a scenario, create a new scenario folder and evoke use the "Trajectory Randomiser" window once or multiple times using the button .

The function will assume the user uses a fixed scan rate (no rotational scenario) of N [4..16,0.1 seconds]. Make sure the correct rotation speed is set prior to creating the Model B Scenario.

Following window will popp up:



Select " AcquisitionTime" and "Add to input scenario".

Now enter the following parameters:

Couples: The number of couples to be generated in one go.
Duration: The Duration of each (straigt line) trajectory
Start Azimuth: The start azimuth of the first trajectory
Azimuth step: The step (icrement) of azimuth each time a new trajectory is created
Start Range: The range of the first trajectory generated.
Range Step: The range increment (Only aplied when the azimuth wraps)
AC type: The Aircraft selected from the AC database
Azimuth difference: The min and max value of the difference in azimuth between the two targets in the couple.
Range difference : The min and max value of the difference in range between the two

targets in the couple.

Heading difference: The min and max value of the difference in heading between the two targets in the couple.

Altitudes: The list of altitudes from which the altitude of both targets is selected

Transponders: The list of transponders from which the target 1/2 receives a transponder.

Speed min/max: The min and max value of the speed of the target 1/2

Set: The set number attributed to the targets 1/2

Start A code: The A code of the first generated target 1/2 (increment=1) [2]

Start S address The S address of the first generated target 1/2 (increment=1)

Start Scan The Start Scan number of the generated target 1/2

Flight ID: The flight ID (first 4 characters) for the targets 1/2

Click OK to generate the targets.

To generate a CEVAP acquisition scenario, it is required to run the randomiser several times with different start scan number offsets. An example of the scenario is included in the DEMO campaign present on the second CD of the software version 4.3.1 .

2.3.7. CEVAP load Scenario

An other option is the generation of targets according to the Load Scenario defined by the CEVAP requirements.

The scenario consists of three types of patterns:

•Trajectories: Defined pattern for one aircraft. Three different trajectories definitions have been defined. The user can add a fourth “CUSTOM” pattern.

• Radials: Defined fixed distribution of trajectories in range. Three basic radial definitions have been defined. Each radial is defined by its range, the set number and the trajectory type. The set number will be used later to distribute the transponders.

• Azimuth Distribution: Defined distribution of radials, with azimuth spacing according to the specified load for 3.5 and 45 degrees sectors.

Furthermore, each of the three load scenarios consist of three phases:

• Start–up phase: 5 scans (30 seconds)

During this phase no trajectories are present. This allows the radar to start up and synchronise to the generated ACP/ARP of the RES.

• Acquisition phase

Targets are not moving. Not all trajectories start at the same moment. This allows acquisition of all mode S targets, avoiding mode S all call garbling. The load slowly builds up until the full load has been reached.

• Full load phase

At the same moment in time all Targets start slowly moving. Full load is present.

Trajectories

Each trajectory starts non-moving (acquisition phase) and then continues moving. The scenario basically consists of three types of trajectories.

•Trajectory Type 1

Starts non-moving, then circular trajectory clockwise around radar. Angular speed 0.1 degrees per second.

•Trajectory Type 2

Starts non-moving, then circular trajectory counter-clockwise around radar. Angular speed 0.1 degrees per second.

[2] The A codes and S addresses can always be modified using the property randomiser (see 2.3.8)

• Trajectory Type 3
Starts non-moving, then moving in U shape:
1st Segment: Initial speed 0 knots, heading radial towards the radar. Straight line acceleration +0.5g until speed is 100 knots
2nd Segment: Straight line acceleration +0.5g during 30 s
3rd Segment: constant speed, 1000 feet/min climb rate during 30 s
4th Segment: constant altitude, -0.5 g acceleration during 30 s
5th Segment: 180 degrees turn with 1 degree/s angular speed, (during 180 s)
6th Segment: constant speed 1000 ft/min descend rate during 30 s
7th Segment: straight line, constant altitude, constant speed, 200 seconds
• Trajectory Type 4
Custom trajectory, copied from the selected trajectory

Radials
Three different radials can be defined. Defined distribution of radials, with azimuth spacing according to the specified load for 3.5 and 45 degrees sectors.

The 3°5 sector is repeated 4 times : starting at 29°, at 52.5°, at 209° and at 232.5°.
The 45° sector including two 3.5° sectors is repeated twice starting at 20° and 200°.

This 45° sector is based on 12 radials of 18 aircraft :
- R2 at 20 °
- R1 at 29°, R2 at 30°7, R3 at 32.5° (3.5° peak sector)
- R1 at 37.5°, R2 at 42.5°, R1 at 47.5°
- R1 at 52.5°, R2 at 54.25°, R3 at 56 ° (3.5° peak sector)
- R1 at 60.5° and R2 at 65°.

The 45° uniform sector is repeated twice starting at 110° and 290°.
This 45 ° sector is based on 12 radials of 18 aircraft, alternatively R1 and R2, spaced by 4°.
The last two radials of 18 aircraft are at 170° and 350° (R1).

Scenarios

Three scenario types must be created:

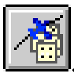
• Model 1 (100% mode S)
• Model 2 (50% mode A/C and 50% mode S)
• Model 3 (25% mode A/C and 75% mode S)

Mode C code distribution
The initial altitude of the targets shall be randomly drawn (as uniformly as possible) from between the following boundaries:

- 1	< Slant Range	<	100 NM	0	<	Flight level	<	500
- 100	< Slant Range	<	135 NM	200	<	Flight level	<	500
- 135	< Slant Range	<	170 NM	300	<	Flight level	<	500
- 170	< Slant Range	<	256 NM	400	<	Flight level	<	500

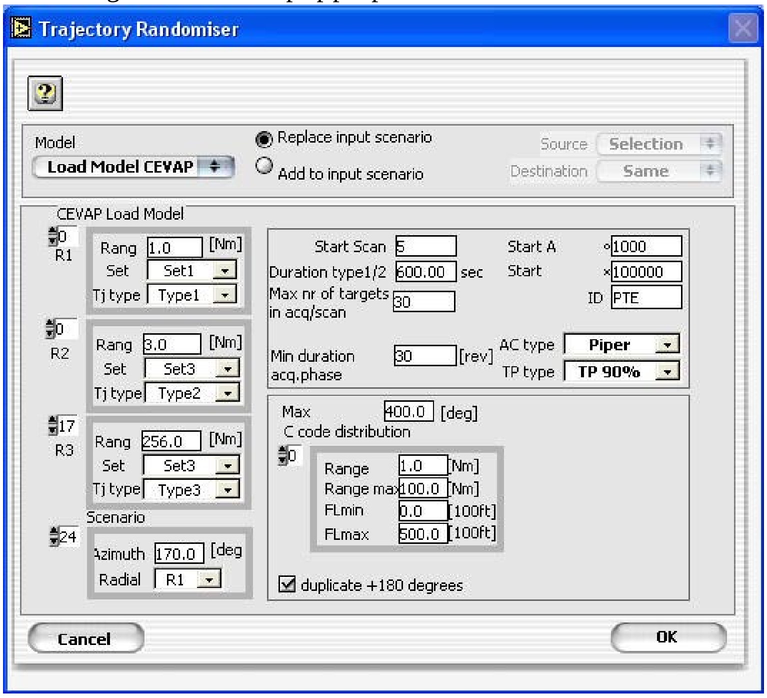
- Cone of silence: There shall be no targets with an elevation angle >40 degrees

To create such a scenario, create a new scenario folder and evoke use the "Trajectory

Randomiser" window once or multiple times using the button .

The function will assume the user uses a fixed scan rate (no rotational scenario) of N [4..16,0.1 seconds]. Make sure the correct rotation speed is set prior to creating the Model B Scenario.

Following window will popp up:



Select " Load Model CEVAP " and "Replace input scenario".

Now enter the following parameters:

R1,R2,R3 The Radials are defined by means of a Range, Set number and Trajectory type. (See above for definitions)

Scenario: The scenario is defined by means of a number of radials. Each radial has an azimuth.
(These two controls are arrays, soo use the arrows to page through the different records of the scenario)

Start Scan : The scan for the first set of N targets. Each scan, N targets are added.

Duration type1/2: The duration of the trajectories of type 1 and 2 in seconds .

Max nr of targets in acq/scan : N

Start A code: The A code of the first generated target 1/2 (increment=1) [3]

Start S address The S address of the first generated target 1/2 (increment=1)

Start Scan The Start Scan number of the generated target 1/2

Flight ID: The flight ID (first 4 characters) for the targets 1/2

AC type : The AC type selected from the AC database

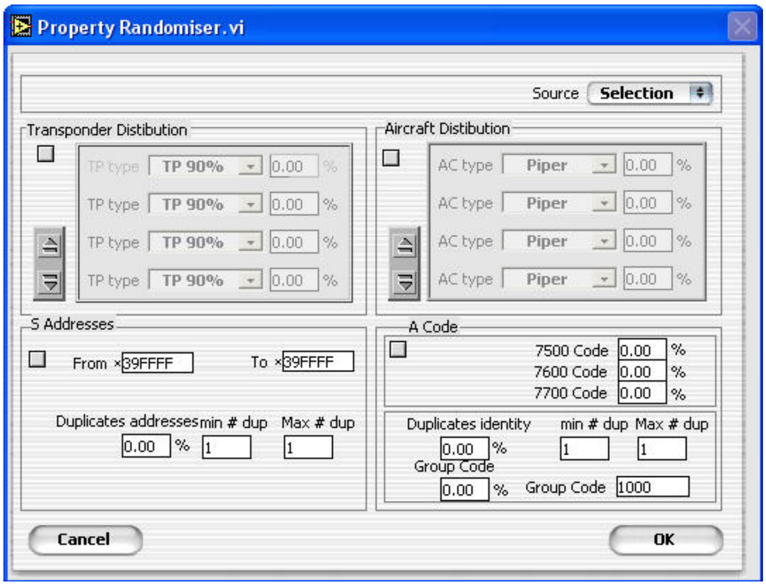
TP type : The TP type selected from the TP database.

Click OK to generate the targets.
After this, you must use the property randomiser (see §2.3.8) to generate the proper transponder distribution for the different sets in the scenario.

[3] The A codes and S addresses can always be modified using the property randomiser (see 2.3.8)

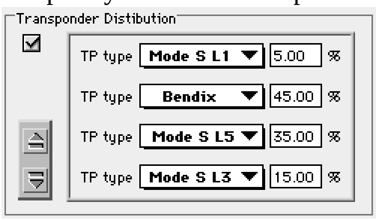
2.3.8. Changing the Scenario properties

If you have a scenario with a given distribution of aircraft, transponders, A codes or S addresses, you can alter this distribution simply by calling the "Property randomiser" function of the trajectory scenario generator  .
This will evoke the property randomiser window:



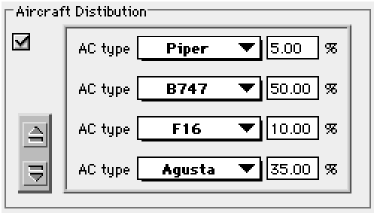
You can randomise the following "properties" of the trajectories:

-*Transponder type*
Specify a list of Transponders and their distribution in % of the total population.



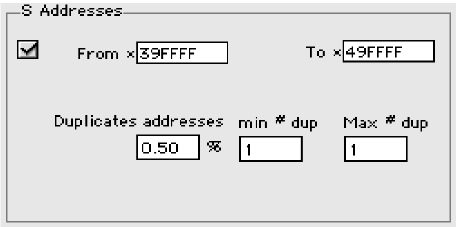
If the transponder population must be altered, check the check box in the left corner of the "Transponder distribution". Next, select a transponder in the first menu list and enter a percentage. Finalise with other desired populations.The list can be extended to more than 4 entries using the Up and Down arrow buttons.

-*Aircraft type*
Specify a list of Aircraft and their distribution in % of the total population.



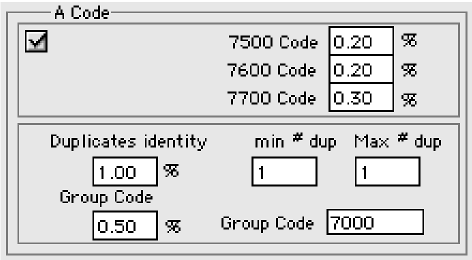
If the aircraft population must be altered, check the check box in the left corner of the "Aircraft distribution". Next, select a transponder in the first menu list and enter a percentage. Finalise with other desired populations.The list can be extended to more than 4 entries using the **Up** and **Down** arrow buttons.

-*S address & Duplicate address creation*
If the S address population must be altered, check the check box in the left corner of the "S addresses" and enter the start and end values of the random S addresses in the two fields "**From**" and "**To**"



if duplicated addresses are desired, enter the percentage of duplicated addresses in the **%** field. "**min # dup** " Defines the minimum number of duplicated values of 1 address, and **Max # dup** defines the maximum number.

-*A code*
-*Special alert conditions of A code*
-*Duplicate A codes*
If the A code population must be altered, check the **check box** in the left corner of the "**A_code**" and enter the percentages of 7500, 7600 and 7700 codes in the respective fields.



if duplicated A codes are desired, enter the percentage of duplicated codes in the **%** field. "**min # dup** " Defines the minimum number of duplicated values of 1 A code, and "**Max # dup**" defines the maximum number.

If a group code is desired, enter the percentage of group codes in the **%** field and enter the group code in the **Group Code** field

If all parameters are entered, click the "**OK**" button to confirm or "**Cancel**"to cancel.

3.0. Event Scenario Generation

3.1. Introduction

The Event Scenario Generator tool is intended to superimpose time and target based events on existing trajectory scenarios previously build with the Trajectory Scenario Generator. These events can be C code changes, SPI, Data link communication, flight status, etc.

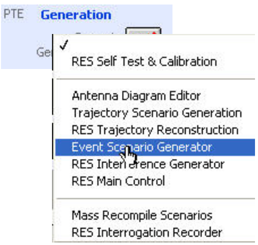
The Event Scenario Generator takes scenario files created with the Trajectory Scenario Generator as input and creates output files, controlled by the user for target injection by the RES Main Control tool.
Beware! Make sure the trajectory scenario generator is not working with the same data as the event scenario generator. Preferably stop the trajectory scenario generator before starting the event scenario generator if you are working on the same data. (No need to close the vi, just stop it.

3.2. Using the Event Scenario Generator

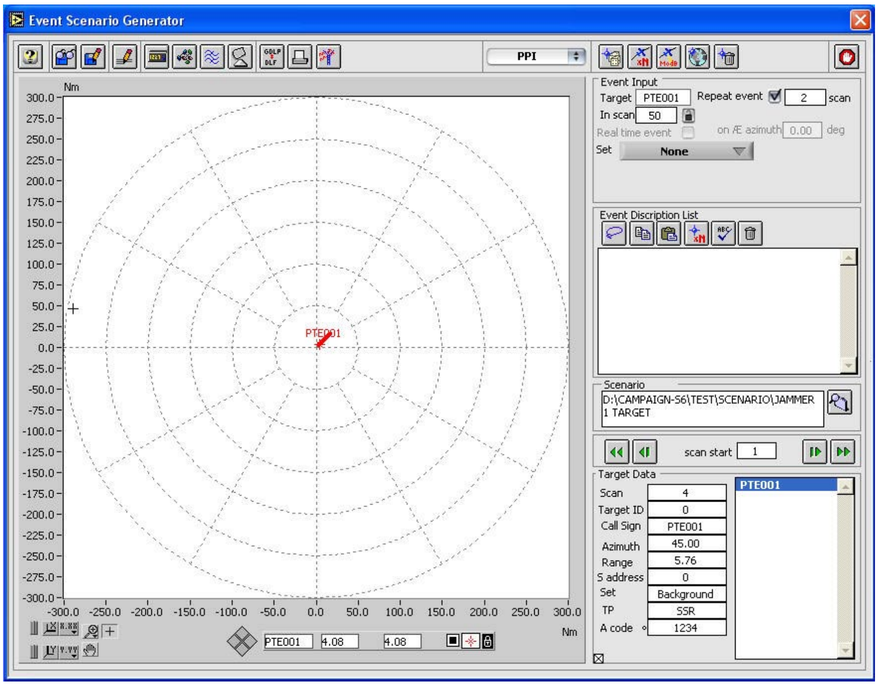
3.2.1. Loading the Software

The Event Scenario Generator tool can be loaded from the RASS-S Toolbox.

To load the tool, double click the RASS-S Toolbox icon and select “Event Scenario Generator” from the “Scenario generation SSR” menu in the RASS-S Toolbox.



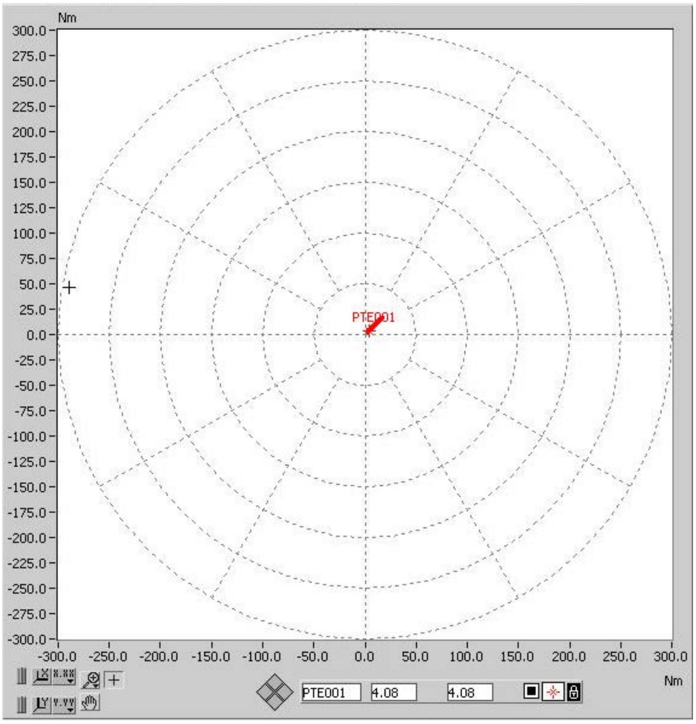
-Now the tool is loaded.

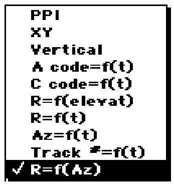


3.2.2. Window Objects

-The window contains several fields:

On the left we can observe the plot graph, which contains a graphical representation of the trajectories previously created by the Trajectory Scenario Generator. The representation of the trajectories can be changed by the selector above the upper right corner of the graph.

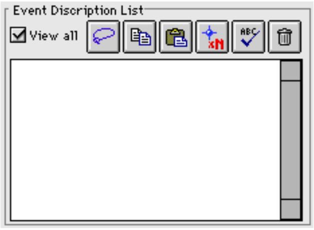




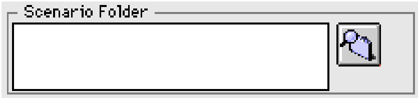
Furthermore the window contains a row buttons at the top of the window to operate the Event Scenario Generator tool.

The top right side of the tool contains the Event Input section. This section allows the input of the events for a selected target at a specified time.

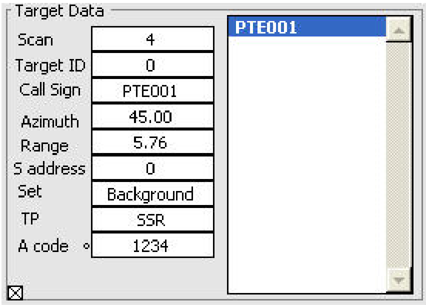
In the lower right corner of the window we can find the Event Description list. Here you can view, edit and duplicate the added events in detail.



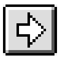
The next in the row is the Scenario folder Section. Using this button you can browse for a scenario folder created by the Trajectory Scenario Generator tool.5.



The final section is the Target Data section. With the top row buttons you can page through the scans of the selected trajectory scenario. The list underneath shows the targets contained in a specific scan. Detailed target information can be recalled by selecting a target from this list.

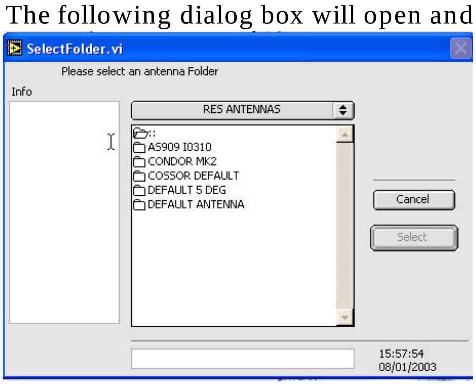


3.2.3. Running software

Now click the  button in the upper left corner of the window to start the tool.

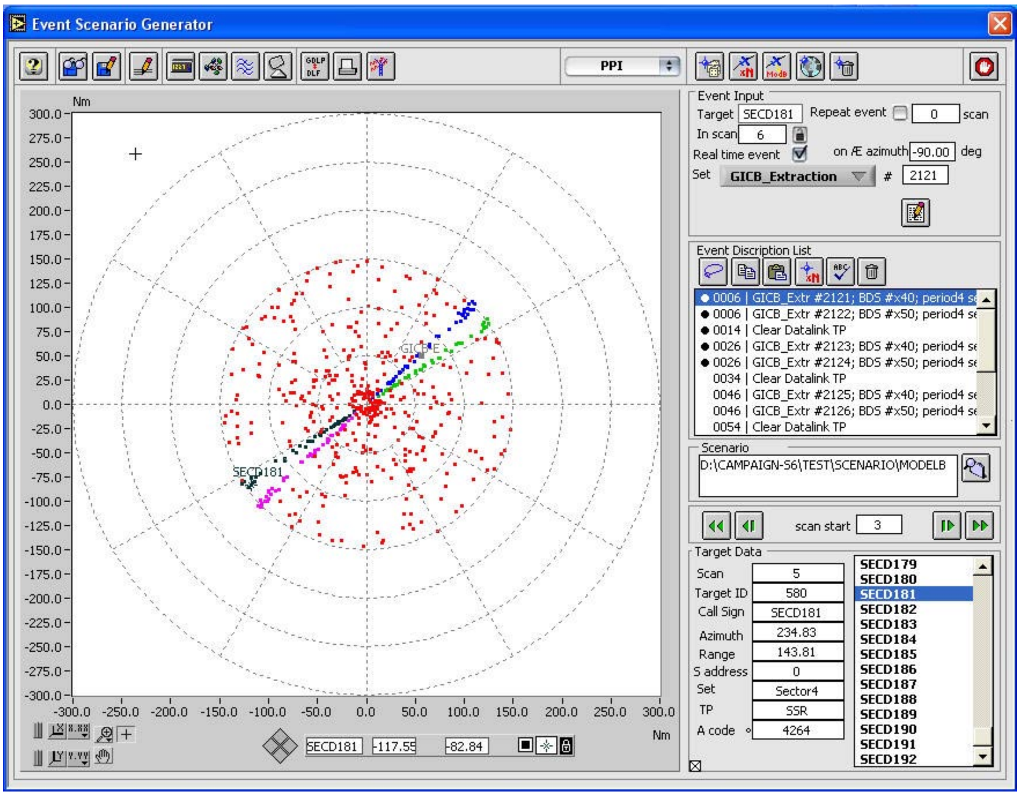
3.2.4. Loading a Scenario

Now select a scenario folder previously made with the Trajectory Scenario Generator tool .
The selected folder must at least contain a valid RASS-S4TJ data file to be able to be used by the Event Scenario Generator tool. This can be done by selecting the scenario in the "Folder Select" vi:
The following dialog box will open and allow you to browse for a scenario folder:



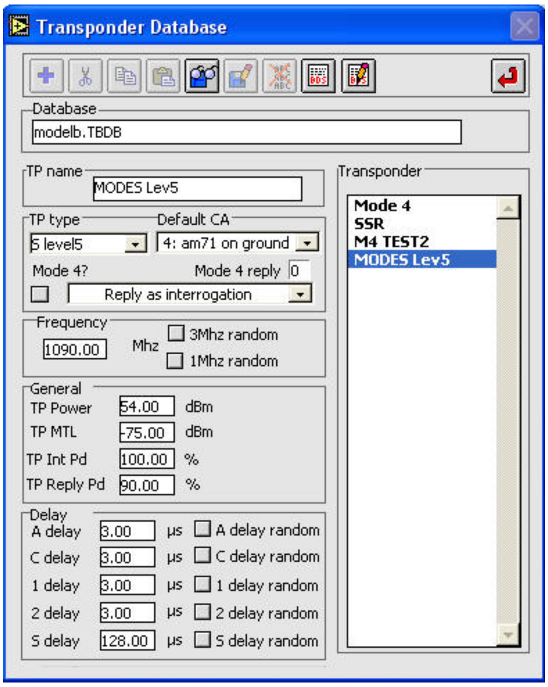
When no RASS-S4 data file is found in the scenario folder the following dialog box will appear:

The scenario will be loaded and shown in the event scenario window:



The tool will load the transponder (TP) database from the scenario file. This database is the same as for the Trajectory Scenario Generator tool.

The function can also be called by clicking the  button in the top row buttons.



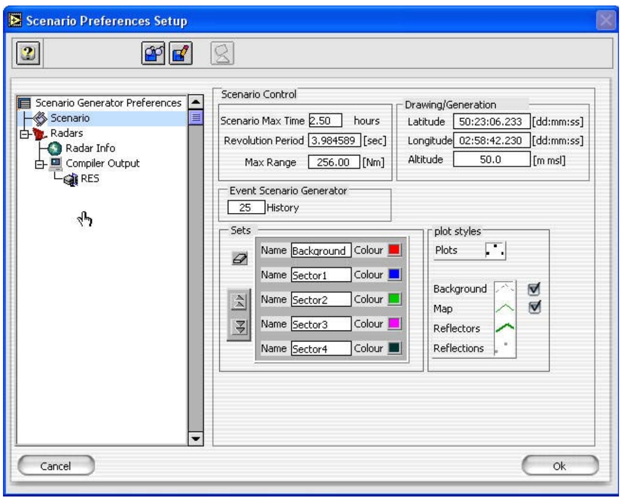
Beware: The TP database can be viewed, but not editted from the Event scenario generator.

For more details on the transponder database, consult the paragraph 2.2.5 of this chapter on the Trajectory Scenario Generator tool.

3.2.5. The Event Scenario Generator Preferences

Click the  button to activate the RES preferences window. The RES preferences window is the same as for the Trajectory Scenario Generator tool and the RES Main Controller tool. Only the Event Gen. , ESG and Traj. Gen. part is accessible from the Event Scenario Generator tool. The other ones are disabled. You can page through them using the tabs. The preferences are loaded from the scenario folder.

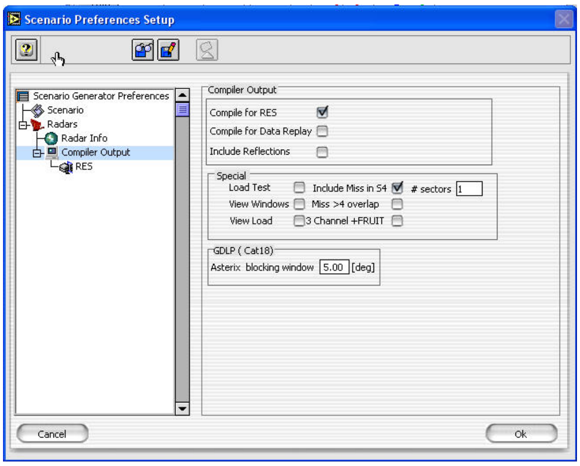
Different parameters can be found in different sections of the tool:



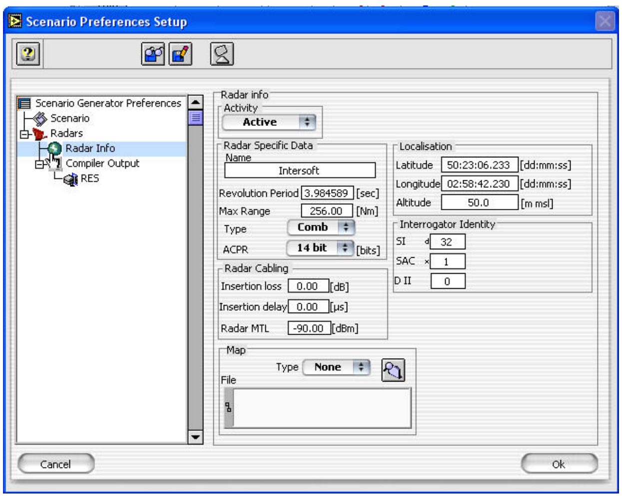
History [10] : number of scans that are shown in the trajectory display. Should be set lower than the number of scans in the scenario. Do not set this value too high, since it will use up a lot of memory.

Background: draws scaling information on the display

Map: draws a background map of the region on the display. The information of the selected site file is used for this map (see later).



Asterix Blocking window:[5deg] Minimum space between two real time GDLP messages in order to seperate them into different Asterix blocks.'



D II: The general II code used for all directed downlink messages (AICB and DELM) if the "Directed" mode is selected. (default), This is handy if the scenario must be used for different II codes.

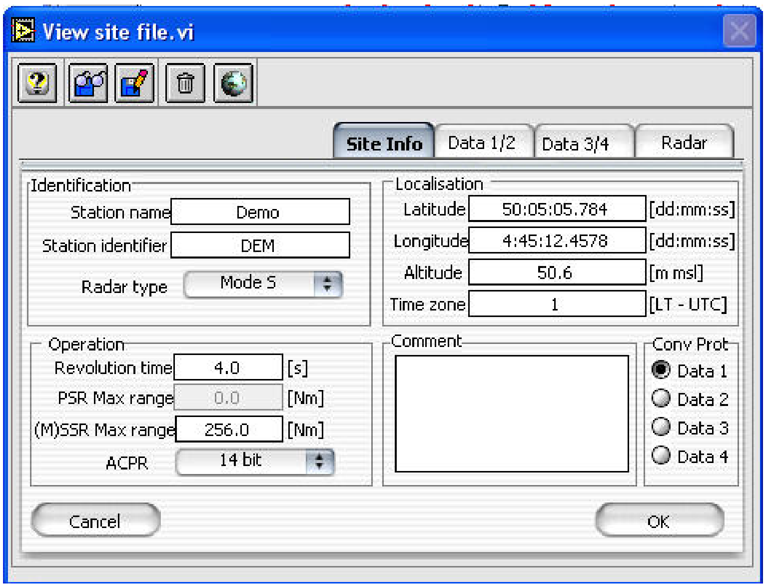
After setting all the parameters, click the OK button of the preference window.

Clicking the Cancel button will ignore all changes made to the preferences.

At compilation, a copy of these parameters are taken and saved again in the scenario folder. This new set of parameters is loaded automatically from the RES main control. This implies that all parameters need to be set correctly at this stage, and can not be changed at generation time. (different to previous versions).

3.2.6. Editing the Site file

Click the **Site** button to select a site file: This file contains information needed for some of the functions in the Inventory tool. Click the 'Site' button to load a site file.



The top row buttons operate the Site tool.

Toggle "Help" window On/Off

Save site file to disk

Load site file from disk

Empty site file

Display map.

OK Save settings and return to Convert Radar Data tool

Cancel Ignore settings tool and return to Convert Radar Data tool.

The following information can be stored in the site file:

- Station name, Station identifier, Radar type (PSR, (M)SSR, COMB).
- Revolution time, Max range, ACPR.
- Latitude, longitude, altitude, time zone.
- Comment to be included with the site information

The latitude and longitude fields are used to calculate the background map in the scenario graph (If selected).

3.2.7. The Event Scenario Generator Functions & Buttons

Now that the TP data and the trajectory data is entered and the preferences are defined, we can proceed by creating events. This is done in the main screen.
In the main screen, the following buttons can be used:

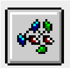

Show help window

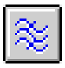

Load an existing event scenario from disk


Save the event scenario to disk


Activate the RES preferences window


Load Transponder database from disk


Compile the current event scenario

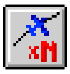

Filter the trajectory data for displaying purposes


Select a site file

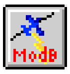
Edit GDLP events not linked to existing targets


Edit the “Jammer” parameters


Randomiser function



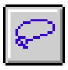
Duplicate selected events to other targets; Not yet implemented



Create a random Model B Datalink event scenario.

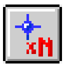

Creates a set of “Global “ events, applicable to all targets in the scenario


Clears all events in the event scenario.

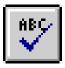

Select all events in event description list


Copy events from the event description list


Paste events in the event description list



Duplicate events in the event description list

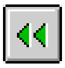


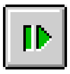
Add event in the events description list

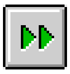

Delete events from the events description list

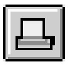

Browse for a scenario folder on disk

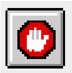

Page 1 scan backward


Page multiple (history length) scans backward


Page 1 scan forward

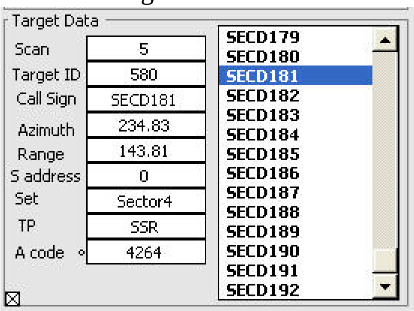

Page multiple (history length) scans forward


Print or export the Event scenario to a text format.


Quit the event scenario generator tool

3.2.8. Paging Trough the Scenario

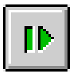
The trajectory data is loaded and displayed automatically when a scenario folder is selected. Notice that only the history length (preferences setting) is displayed on the graph. The list of available targets in the scenario is shown in the target data section at the lower right corner of the screen.

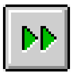


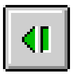
Detailed information for a specific target can be obtained by selecting (clicking) that target from the list. Notice that the cursor on the graph jumps to the corresponding trajectory. By dragging the cursor over the trajectory detailed information about the trajectory becomes available in the indicators next to the list:

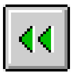
- Scan number
- Target ID
- Call sign
- Azimuth
- Range
- Mode S address
- Set nr
- Transponder Type

Using the row of buttons on top of the target data section you can page through the whole selected trajectory scenario.

Click the  button to page 1 scan forward.

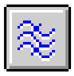
Click the  button to page multiple (history length) scans forward.

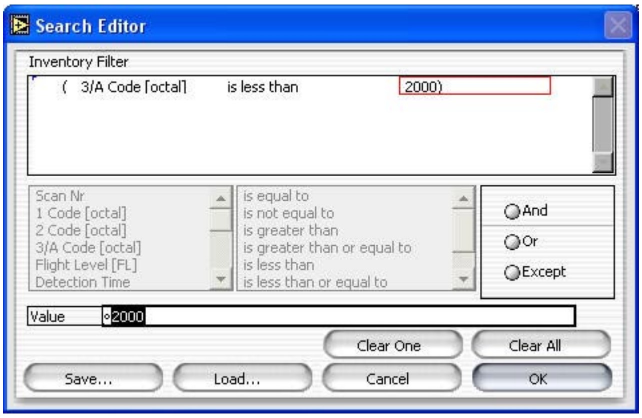
Click the  button to page 1 scan backward.

Click the  button to page multiple (history length) scans backward.

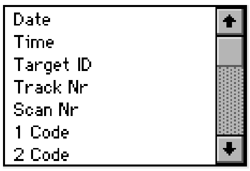
The beginning of the current (history length) displayed selection is controlled in the scan start indicator:

3.2.9. Filtering Scenario Data

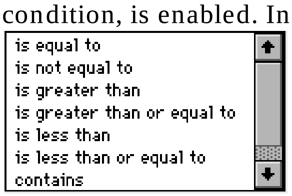
Another way of reducing the amount of information to be displayed is to filter the selected trajectory data by clicking the **Filter**  button in the top row of buttons. Clicking this button activates a filter/search editor function:



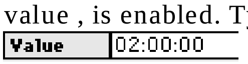
A filter consists of four functional blocks. The first block is the object of filtering. Choose an object of the list. Use the scroll bars to page through the list and click the wanted item.



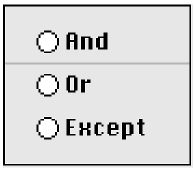
The chosen item is automatically transferred to the filter and the next block, the condition, is enabled. In the same way, select a condition from the list.



The chosen item is automatically transferred to the filter and the next block, the value , is enabled. Type in the desired value and hit the return key.



The chosen value is automatically transferred to the filter and the next block, the logical connection, is enabled. Select a logical operator from the list.



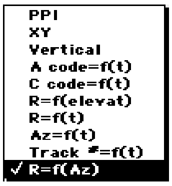
The chosen value is automatically transferred to the filter and the next block. This process is repeated until the filter setting is complete. A filter setting can saved to disk with the Save... button or recalled from disk by clicking the Load... button.

Clicking the Clear One button will clear the selected line from the filter setting, clicking the Clear All button will clear the complete filter setting. The Cancel button will close the window and ignore all changes.

The combination of the history length plotting and the filter/search editor function lets you zoom in in detail on a specific part of the selected trajectories.

3.2.10. The Event Scenario Generator Graph

The selected data can be displayed in different modes . This can be done with the selector at the upper right corner of the display window.



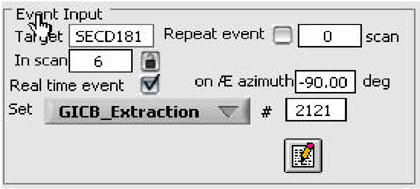
The following views are selectable:

Polar:	azimuth [deg] versus range [Nm]
XY:	X [Nm] versus Y [Nm]
Vertical:	elevation [FL] versus range [Nm]
A code=f(t):	A code versus time [s]
C code=f(t):	C code versus time [s]
R=f(t):	range [Nm] versus time [s]
Azimuth=f(t):	azimuth [deg] versus time [s]
Track #=f(t):	track number versus time [s]
R=f(Az)	Range versus Azimuth (planar)

The color of the graph represents the selected Set number. (as set in the trajectory scenario generator).

3.2.11. Manually Creating Events

An event is created in the Event Input section situated in the upper right corner of the window.



The call sign of the selected target is displayed in the “for” indicator:

A specified scan can be selected by the “in scan” control field

With the lock button  the “in scan” control field is locked to the cursor on the trajectory display. Dragging the cursor from scan to scan will automatically update the “in scan” control field with the correct value.

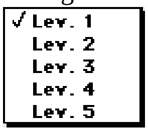
When the target and the scan number are chosen, an event can be attached to it. Choose the desired event from the list:

3.2.12. Event Types

Depending on the kind of event, specific controls will appear and disappear. These specific controls need to be set only for that kind of event. The following events are implemented

None: no event (revert to original situation)

Mode S level: change of Mode S level [1..5]



This event automatically changes BDS 10 contents and evokes a Broadcast of BDS 10 contents (if TP level is sufficient)

Frequency: change of transponder Tx frequency [MHz]

Change is permanent.

Ring: generates aRing of replies , defined by the azimuth over which the ring is to be generated.

1 code: mode 1 code change in octal representation

Change is permanent.

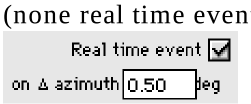
2 code: mode 2 code change in octal representation

Change is permanent.

A code: mode A code change in octal representation

Change is permanent.

There are two ways to program an A code change: for the whole scan (none real time event) or on a specific Δ azimuth (real time event).



The Δ azimuth value can be plus or minus the beamwidth, starting from the position of the target.

C code: mode C code change in octal representation

There are two ways to program an C code change: for the whole scan (none real time event) or on a specific Δ azimuth (real time event).

Real time event ☑
on Δ azimuth 0.50 deg

The Δ azimuth value can be plus or minus the beamwidth , starting from the position of the target.

C code MS: C code change for mode S reply (roll call) in octal representation.
The control contains the C code for the consecutive mode S roll call replies (Max 15)

0 3270 3206 0 0 0

Beware! C code changes and C code Mode S events are not permanent, and should be reset every scan if required.

1 delay: mode 1 transponder reply delay [µs]

3.00 µs

Change is permanent.

2 delay: mode 2 transponder reply delay [µs]

3.00 µs

Change is permanent.

A delay: mode A transponder reply delay [µs]

3.00 µs

Change is permanent.

C delay: mode C transponder reply delay [µs]

3.00 µs

Change is permanent.

SPI: switch SPI on for 18 seconds
(can not be switched off!)

MIL alert: switch military alert on/off

off
✓ on

Change is permanent.

S delay: mode S transponder reply delay [µs]

128.00 µs

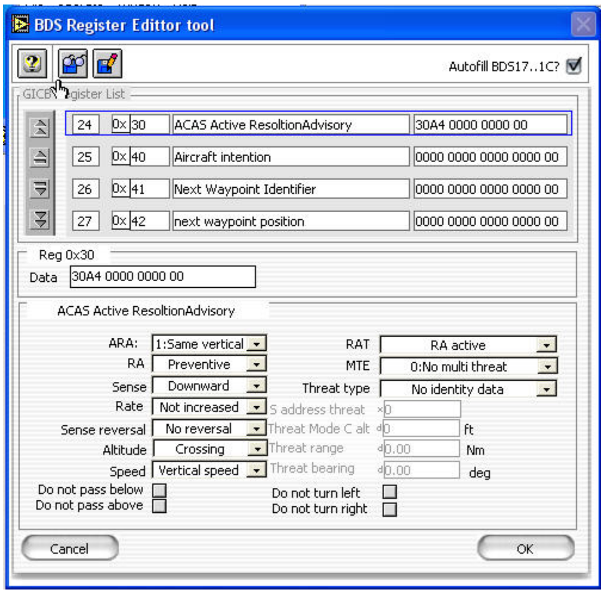
Change is permanent.

BDS reg: BDS register contents change for BDS register number x 10 (in hex).

10DF DF00 DF00 0F0F

Clicking the button allows you to edit the BDS contents in the following dialog box. The selection will only be valid for a BDS register already present in the predefined BDS list (one of 32 available BDS registers).
Editting of BDS 30 overwrites target ID contents.

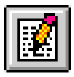
For details on this window, consult paragraph 2.2. of this manual.

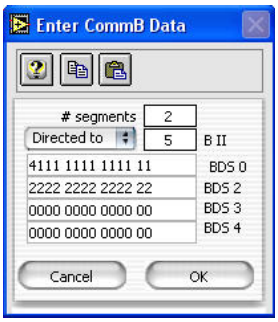


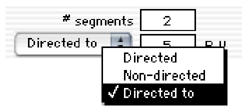
Change is permanent.

Miss: generate a miss for one scan

AICB: generate an AICB

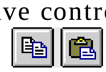
Clicking the  button allows you to edit the AICB and the following dialog box will appear:





Select the method for the use of the II code:
You can send Non Directed AICBs (II=0), Directed to a specific code , or most common, send all AICbs of the scenario to the same II, specified in the preference window.

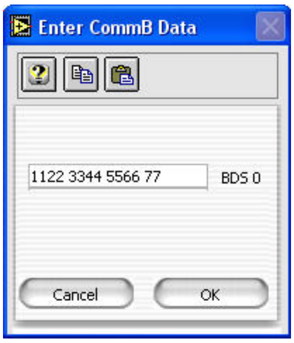
The values for the four segments of the AICB can be entered in hex intheir respective control fields.

Use the Copy  and paste functions to keep data contents in memory and copy to other events.

Broadcast CommB:

Generate a broadcast CommB

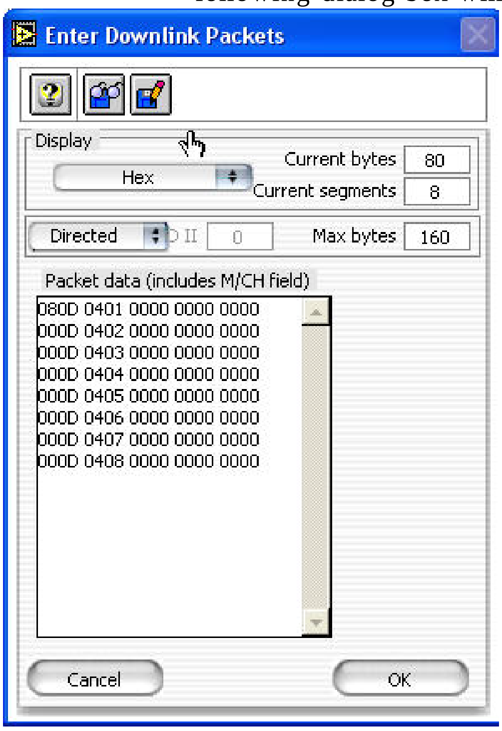
Clicking the  button allows you to edit the Broadcast CommB and the following dialog box will appear:

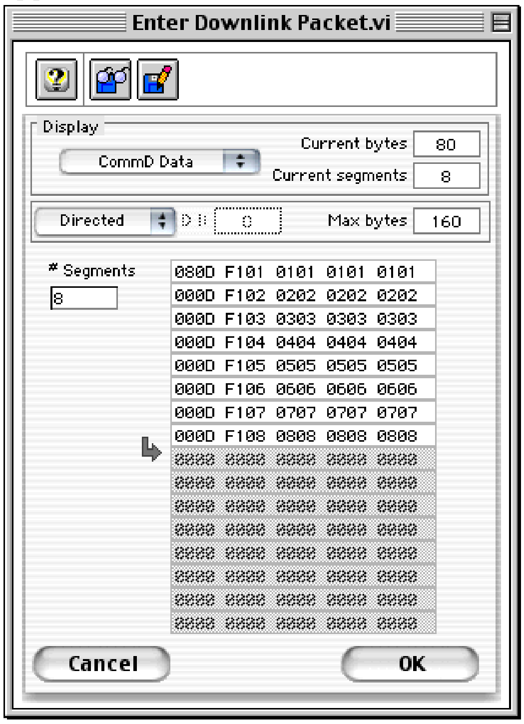


The values for the four segments of the Comm B can be entered in their respective control fields.

Downlink ELM: generate a downlink ELM

Clicking the  button allows you to edit the Downlink ELM and the following dialog box will appear:

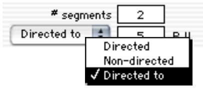




First, select the way to input data:
-HEX: The data is entered as Hex data
-Comm D: The data is mapped into 16 rows of 10 bytes of data as it is end by the Comm D message.
(You can enter the data in one mode and swap to another to see the effect)

In Comm D mode, the user can enter any data in the Comm D replies and

determine the number of segments.
Drag the arrow to select the length of the ELM .



Select the method for the use of the II code:
You can send Non Directed DELMs (II=0), Directed to a specific code , or most common, send all DLEMs of the scenario to the same II, specified in the preference window.

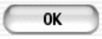
Earlyer versions of software used to have a Channel number in the M/CH field. This data was copied in the first byte of the dowlink packet, but limited the packet type to MSP short packets. This limitation has been removed upon user request.

Following functions are supported from the window:

 Toggle The Help window

 Load a predefined Comm D message from disk

 Save an Comm D message to disk

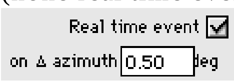


Accept the input data of the Comm D message.

Do not accept the inputted data for the Comm D message.

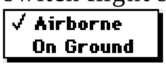
Incorrect C code: generate an incorrect Mode C code

The incorrect Mode C will be generated using the current altitude of that target and adding to this a value between 0 and + or - N feet, N given in the **ft** control.
For Mode S roll calls, the same procedure is used, but the number of incorrect Mode C codes in one scan (in case multiple UF4 or UF20 interrogations are send) is determined by the number of elements in the array given under the event selector.
There are two ways to program an C code change: for the whole scan (none real time event) or on a specific Δ azimuth (real time event).



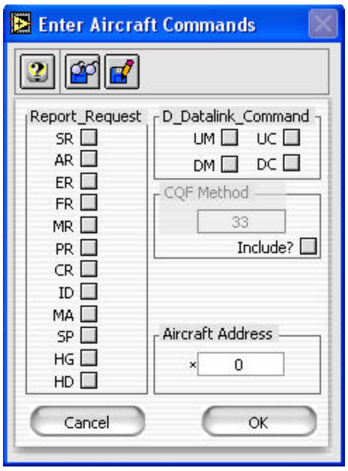
The Δ azimuth value can be plus or minus the beamwidth , starting from the position of the target.
Beware! C code changes and C code Mode S events are not permanent, and should be reset every scan if required.

Flight status: switch flight status between airborne/on ground



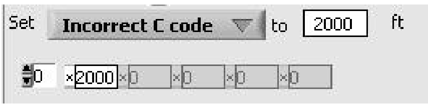
Change is permanent.

Aircraft Command: Send an Aircraft Command to the DLF using the GDLP.
The Aircraft command can be entered using the following menu by clicking the  button.

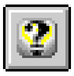


All fields specified in the Asterix Cat 18 messages I018/005, I018/007 and I018/009 can be entered using this menu. (See POEMS Document For ASTERIX Category 18 , Transmission of Mode S Datalink Function Messages)
Each field in the menu is documented using the Help function .

The Event can be programmed in real time by defining a Δ azimuth (-90 to +90 degrees)

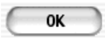


Following functions are supported from the window:

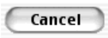
 Toggle The Help window

 Load a predefined Aircraft Command from disk

 Save an Aircraft Command to disk

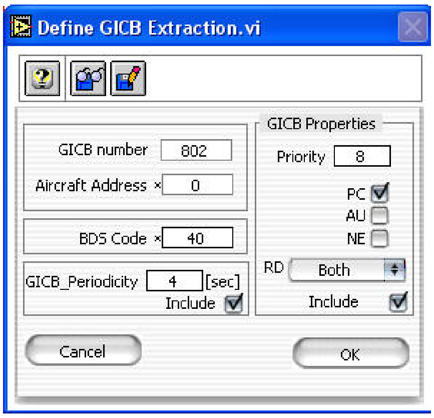


Accept the input data of the Aircraft Command



Do not accept the inputted data for the Aircraft Command

GICB Extraction : Send an GICB Extraction Command to the DLF using the GDLP. The command can be entered using the following menu:



All fields specified in the Asterix Cat 18 messages I018/005, I018/028 ,I018/030, I18/025, I018/027 and I018/002 can be entered using this menu. (See POEMS Document For ASTERIX Category 18 , Transmission of Mode S Datalink Function Messages)
Each field in the menu is documented using the Help function .

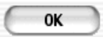
The Event can be programmed in real time by defining a Δ azimuth (-90 to +90 degrees)

Following functions are supported from the window:

 Toggle The Help window

 Load a predefined GICB Extraction command from disk

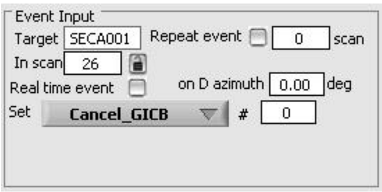
 Save an GICB Extraction command to disk



Accept the input data of the GICB Extraction command

Do not accept the inputted data for the GICB Extraction command.

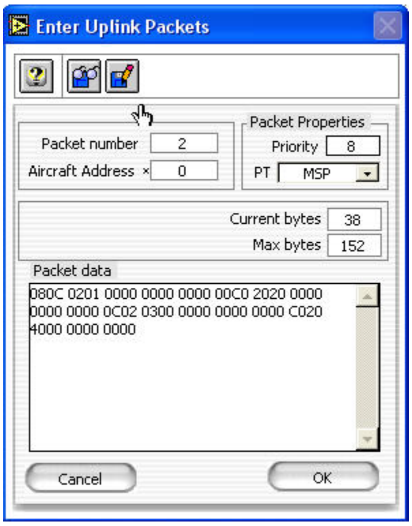
Cancel GICB Extraction : Send a Cancel GICB Extraction Command to the DLF using the GDLP. The Command is created automatically by entering the GICB number : **When the GICB number is equal to -1, the GICB number is not included in the Asterix Cat 18 message (optional field)**



The Event can be programmed in real time by defining a Δ azimuth (-90 to +90 degrees)

Uplink Packet : Send an Uplink Packet Command to the DLF using the GDLP.

The command can be entered using the following menu by clicking the  button.



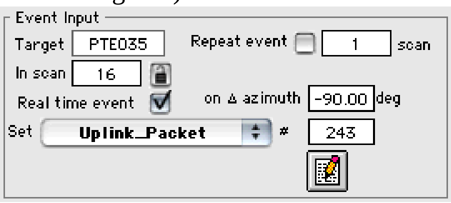
All fields specified in the Asterix Cat 18 messages I018/005, I018/016 ,I018/018 and I018/019 can be entered using this menu. (See POEMS Document For ASTERIX Category 18 , Transmission of Mode S Datalink Function Messages)

The number of bytes entered in the data entry is permanently counted and shown in the "**Current bytes**" indicator. The maximum number of bytes in the uplink packet is limited to 152 bytes.

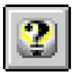
The contents of the Packet data is entered as Hex data. The first bytes should contain the command codes for packet type definitions. (see annex 10)

Beware: In earlyer versions (<4.3.3.) the M/CH field was used as a first byte of the uplink packet. This limited the type of Packet send to short MSP packets. This feature has been removed on demand of the users.

The Event can be programmed in real time by defining a Δ azimuth (-90 to +90 degrees)

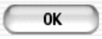


Following functions are supported from the window:

 Toggle The Help window

 Load a predefined Uplink Packet command from disk

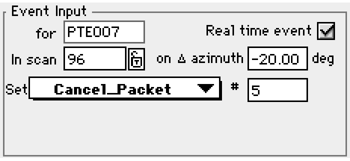
 Save an Uplink Packet command to disk



Accept the input data of the Uplink Packet command

Do not accept the inputted data for the Uplink Packet command.

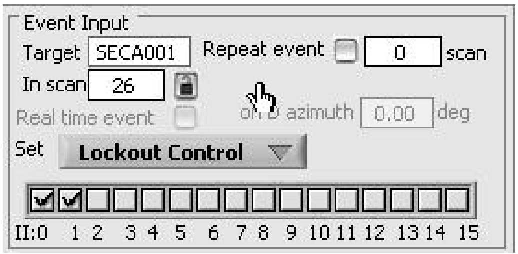
Cancel Uplink Packet : Send a Cancel Uplink Packet Command to the DLF using the GDLP. The Command is created automatically by entering the Uplink Packet number : **When the Uplink Packet number is equal to -1, the number is not included in the Asterix Cat 18 message (optional field).**



The Event can be programmed in real time by defining a Δ azimuth (-90 to +90 degrees)

Lockout Control: The Lockout control bit can be set or reset for each of the 16 II (0..15) codes of the interrogator using an event. If a bit is set, this means that that transponder is automatically locked out for that II code (without the need for the radar to send lockout messages). If the bit is reset after it has been set by an event, the Lockout of the TP is cleared imediately. (No delay of 18 seconds)

This option is required for testing of cluster controlled POEMS stations.



Mode 4: The RES can generate Mode 4 replies without the use of a decriptor. This is done by defining the reply position of the Mode 4 target by means of the transponder database or by an event. The event allows the user to modify the position of the Mode 4 reply , generate random positions or generate railing trains of replies.

There are four different "sets" of replies types:

-Set according to interrogation: In this mode the interrogation datagram (unencripted!) determines the reply. Only the first 6 bits in the 32 bit datagram are interpreted. This forms a number between 0 and 63. Only the first 48 positions are used: The sequence of reply types is the same as in the events.

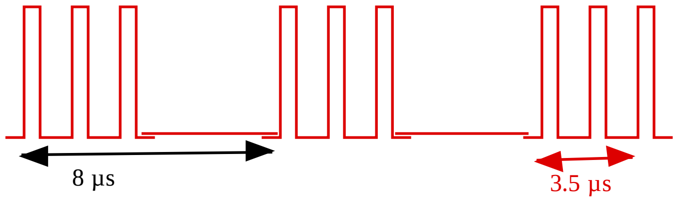
-Reply position 0..15 : The Mode 4 reply is always generated 212µs + N*4µs after trigger.

-All reply positions (16 reply triplets, separated 4µs each)

-Reply position 0..15 + 1..14 random positions: One fixed position and one or more random positions are used to reply.

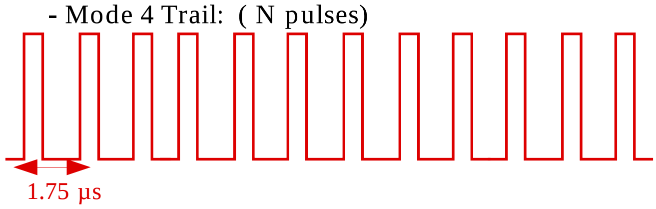
-Random positions: One or more random position (0.N) are used to reply.

- Every 2nd position: 8 reply triplets (every 8µs)

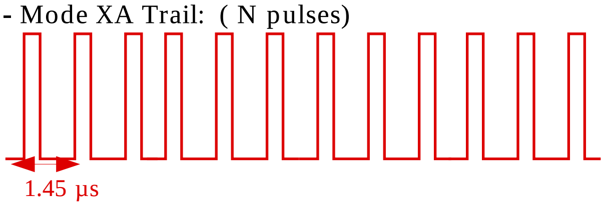


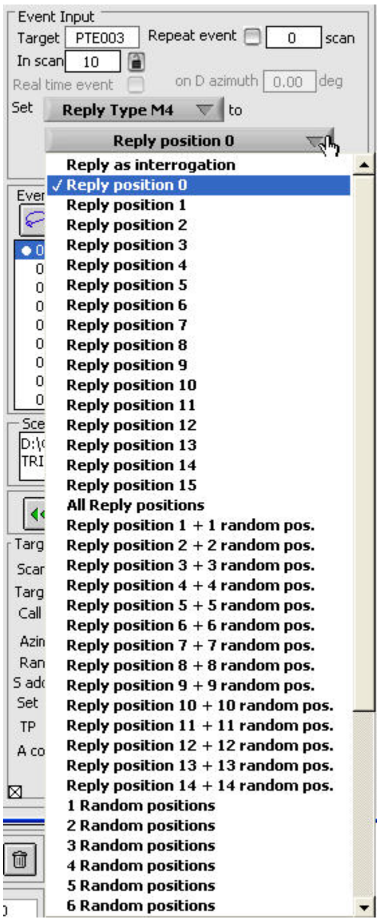
- Every 2nd position x N : 8xN triplets

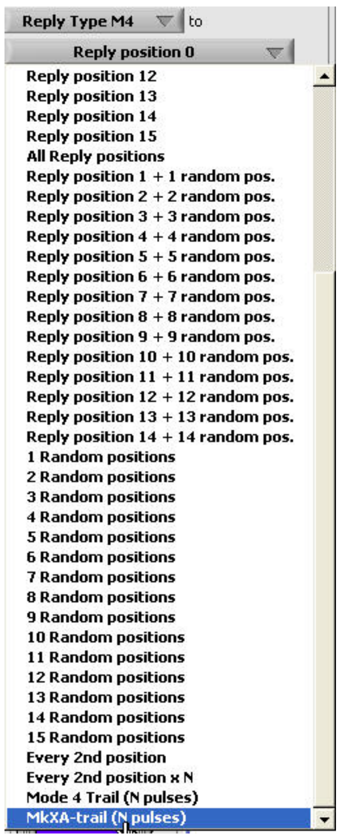
- Mode 4 Trail: (N pulses)



- Mode XA Trail: (N pulses)





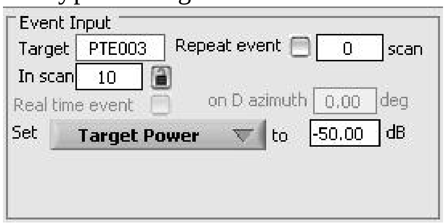


Mode 4 repetition: This event is linked to the Mode 4 reply type event. In three cases (Every 2nd pos x N, Mode 4 Trail and MkXA-Trail) the N Number can be changed using this event. This event must be created before the Mode 4 reply type event.

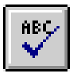
Target Power

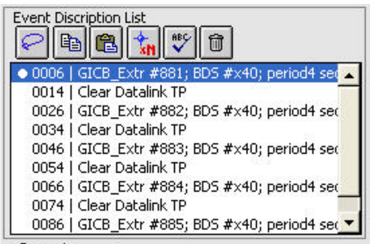
This event re-sets the power of a target. This overrules the original power calculation of the target according to the range, elevation etc..

The power entered is the power as it generated at the input of the radar receiver. The typical range is -30 to -90 dBm.



3.2.13. Viewing Events

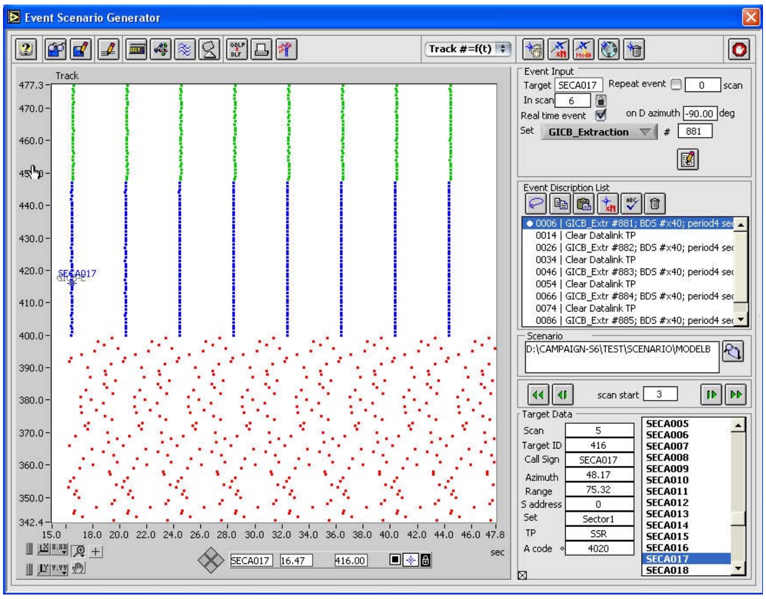
Once an event is selected and edited it can be created by adding it to the event description list by clicking the  button. The event, together with its related parameters is displayed in the list and a mnemonic is added to the trajectory display to indicate that an event is attached to it.



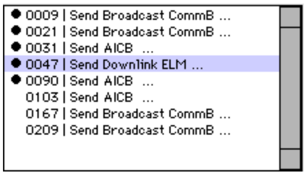
Using the same method other events can be added to the event description list. This way the list represents all the events attached to the displayed part (history length) of a certain trajectory. Drag the cursor to another trajectory to view its event description list.

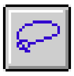
To view the event description list for the whole trajectory check the 

box. All events of a selected target are shown in the inventory graph on the left side of the window as a mnemonic cursor linked to the graph. This way the user can visualise the scenario as a function of time.

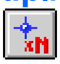


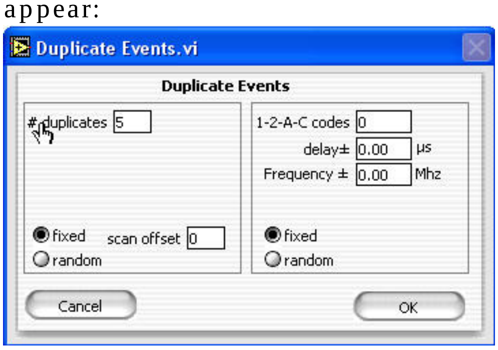
Events can be deleted form the list using the  button. Events can be copied from the list using the  button and pasted into the list using the  button.
All these actions require a selection of a specific event. This can be done by clicking on a certain event.



With the  button all events can be selected at once. By selecting an event in the list, its parameters are projected back to the event input section and can be edited again.

3.2.14. Duplicating Events within the Same Trajectory

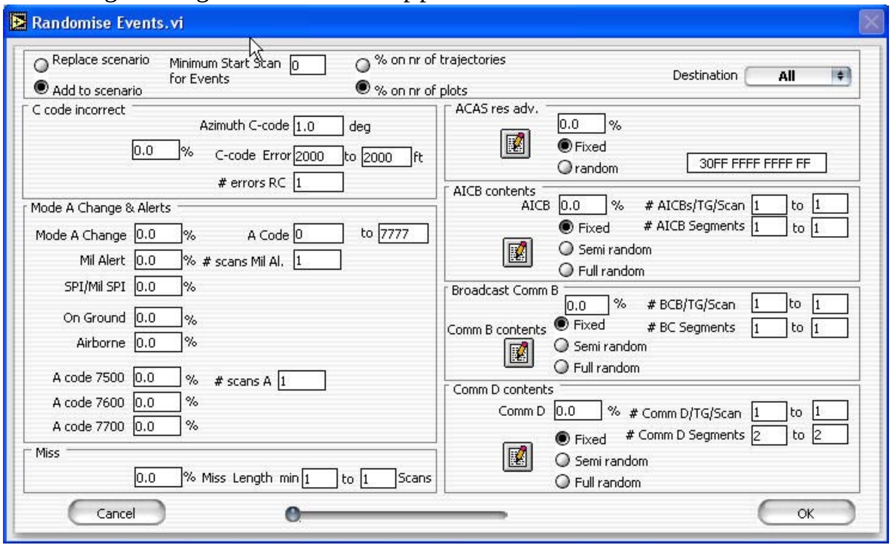
Click the  button to duplicate a selected event. The following dialog box will appear:

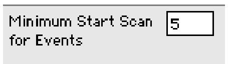


Enter the number of duplicates you want to make and chose a fixed or random offset for each duplicate in number of scans. For each duplicate a number of parameters can also have a fixed or random offset: mode 1-2-A-C code depending on the original event, reply delay and Tx frequency .

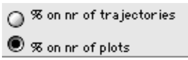
3.2.15. Creating Random Events for a complete Scenario

Instead of creating and assigning the events manually, they can be generated automatically in a random way by clicking the  **randomise events** button. The following dialog window will appear:



First enter the start scan of the random events: 

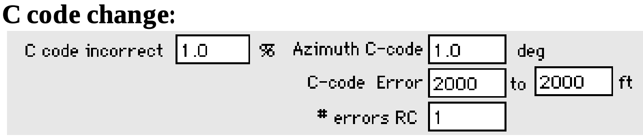
The random events will be generated from that scan onwards.

Next select the generation mode for the % parameters: 

In the first selection ("on Nr of trajectories"), a percentage of the Number of trajectories is used to determine the number of generated events. In the second selection ("on Nr of plots"), a percentage on the number of plots is taken.
e.g. a scenario of 500 targets of 100 scans each . In the first selection, if the user specifies 1% ACAS events, 5 events will be generated in total. In the second selection, 500 events will be generated.

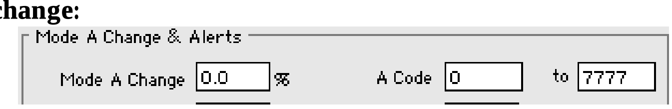
The following events can be generated randomly:

Incorrect Mode C code change:



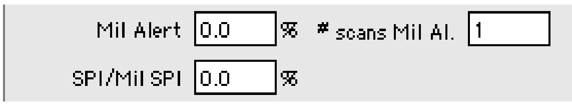
Enter the percentage and the boundaries of the incorrect mode C code changes. Enter the azimuth where the mode C code change has to happen: plus or minus, starting for the position of the target. Enter the number of C code changes for Mode S roll call replies.

Mode A code change:



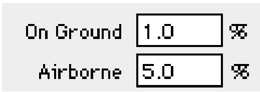
Enter the percentage and the boundaries of mode A code changes.

SPI/MIL alert:



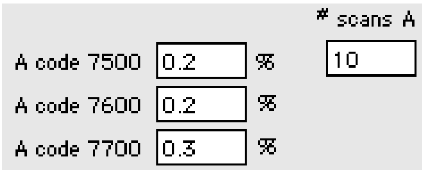
Enter the percentage of SPI / MIL alert events to be generated.
Military Alerts are generated for a fixed number of scans, to be entered in the *"# scans Mil Em. field"*

Flight Status:



Enter the percentage of Targets that will receive the "On ground" status event and the percentage of Targets that will receive the "Airborne" status even.

Special A codes:

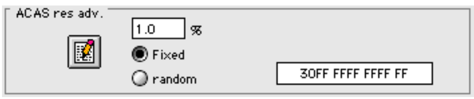


Enter the percentage of Targets that will receive the "A code 7500" , "A code 7600" and "A code 7700" status event.
Also include the number of scans the Alert stage must remain active.

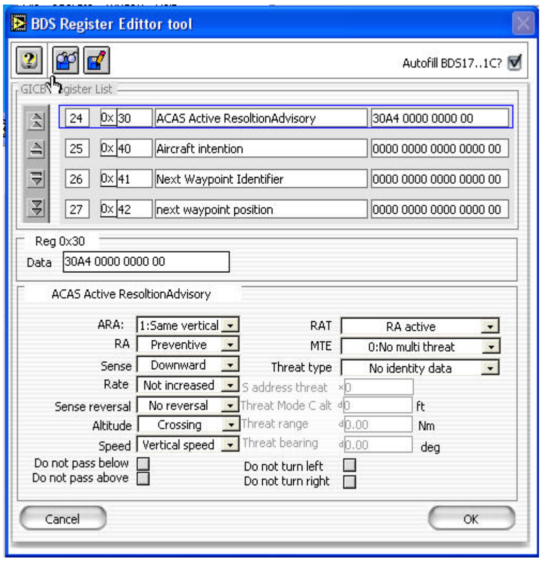
Misses:

Enter the percentage and the length boundaries of the misses.

ACAS Res adv.:



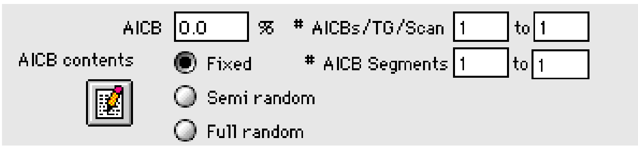
enter the percentage of ACAS resolution advisories and their value . Use the  button to enter the Resolution advisory data in more detail:



Use the menus to select the different actions of the Resolution Advisory. The resulting BDS 30 contents will be shown in the “Data” section in the middle of this window.

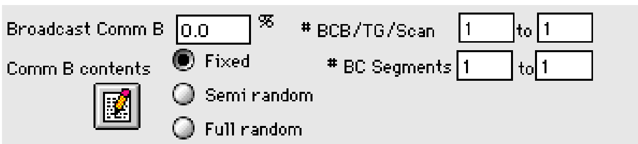
The contents of the RAs can also be random. In this case, the BDS contents will be 30xx xx xx xx xx xx . all xs es are random bytes.
(The contents will not be annex 10 compliant!)

AICB:



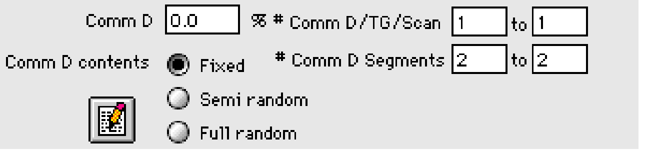
Enter the percentage of AICBs to be generated. Click the  button to edit the contents of the AICB. Chose fixed for the edited values to used as content, semi random for the edited values to used in a random way and full random for random values to be used as content. Enter the boundaries of the number of AICBs per target and per scan together with the boundaries of the number of segments for the AICBs.

Broadcast CommB:



Enter the percentage of broadcast CommBs to be generated. click the  button to edit the contents of the CommB. Chose fixed for the edited values to used as content, semi random for the edited values to used in a random way and full random for random values to be used as content. Enter the boundaries of the number of broadcast CommBs per target and per scan together with the boundaries of the number of segments for the CommBs.

CommD:

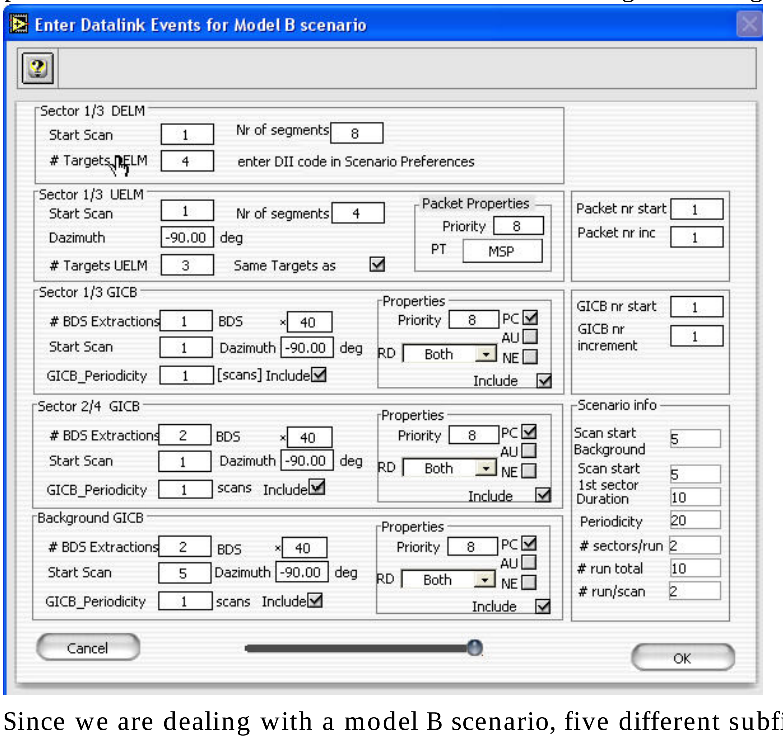


Enter the percentage of CommDs to be generated. click the button to edit the contents of the CommD. Chose fixed for the edited values to used as content, semi random for the edited values to used in a random way and full random for random values to be used as content. Enter the boundaries of the number of broadcast CommDs per target and per scan together with the boundaries of the number of segments for the CommDs.

Click the OK button to start the randomiser function. An indicator will show the progress of the randomising function.

3.2.16. Creating Automatic Model B Scenario Events

16. Instead of creating and assigning the events for a model B scenario manually, they can be generated automatically in a random way by clicking the **randomise events** button. The following dialog window will appear:
This feature only works on a datalink model B scenario, since it uses the "Sets" parameters for determination of the sector and background targets.



Since we are dealing with a model B scenario, five different subfields are to be defined:

1) Sector 1/3 DELM events:

For DELM events, the user can enter the following parameters:

Start scan: The start scan number (relative to the begining of the sequence) for the announcement of the DELM event.

 # Targets DELM: The number of targets, randomly re-positioned in each sequence in sector

1 and 3 (if present) used for a comm D event.
Nr of segements: The number of segments used for the DELM. The contents of the DELM is according to the specifications of the PTE P2B1 Spec. The M/CH is set by default to 8.
A segment is 80 bits, except for the first one, which is only 72 bits.
DII : The II code (included in DELM replies)set by the user. Must be the II code of the radar interrogator.

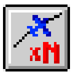
2) Sector 1/3 UELM events:
For UELM events, the user can enter the following parameters:
Start scan: The start scan number (relative to the begining of the sequence) for the announcement of the UELM event.
 # Targets UELM: The number of targets, randomly re-positioned in each sequence in sector 1 and 3 (if present) used for a comm C event or Comm A event.
Δazimuth : The azimuth offset between the announcement of the event by means of the DLF interface and the real target position.
Nr of segements: The number of segments used for the UELM. The contents of the UELM is according to the specifications of the PTE P2B1 Spec. The M/CH is set by default to 8.
A segment is 76 bits, except for the first one, which is only 68 bits.
Same Targets as DELM: This checkbox will put the UELM and DELM events on the same targets. If this is not required, uncheck the marker.

3) Sector 1/3 GICB events:
For GICB events, the user can enter the following parameters:
Start scan: The start scan number (relative to the beginning of the run) for the announcement of the GICB extract event.
 # BDS extractions: The number of BDS extract events.
BDS : The first BDS register extracted ; If multiple BDS registers are extracted, each consecutive BDS register extracted shall be incremented by x10. (default BDS x40,x50,x60, etc.. are extracted.)
GICB Periodicity: The GICB periodicity parameter (as created in asterix cat 018/028) . The parameter is optional.
Include: Determines wheter the GICB periodicity asterix cat 018/028 parameter should be included or not.
Properties Include: Determines wheter the GICB properties asterix cat 018/030 parameter should be included or not.
Priority: GICB priority field (Property bits 16-12)
PC: Priority Constraint;
AU: Asyncronous Update
NE: Non Extracted
RD: Reply Destination : Datalink line, Surveillance line or both..
4) Sector 2/4 GICB events:
Same parameters as above are identified, but for second set of sectors.
5) Background GICB events:
Same parameters as above are identified, but for background targets.

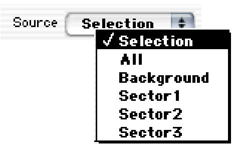
Click Ok when all parameters have been entered. The events will be created and writen to disk. A warning is issued that existing events will be overwritten. Confirm the warning box.

Click the **OK** button to start duplicating. **Cancel** returns without action.

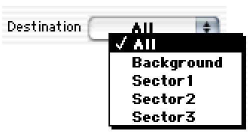
3.2.17. Copying Events to other Trajectories

17. If a list of event is defined, these events can easily be copied to other trajectories using the Duplicate Target Events button  . This function calls the following window:

First select the Source of the events.
This can be either the selected event list (the one currently shown in the Event Scenario Generator), or the events of a given set (in this case, the source set must have the same or smaller size than the destination set).
This can be selected using the source menu:



Next, select the destination of the duplicate:
This can be either all targets in the scenario or only the targets of a given set:



Next, select whether the copy must be absolute or relative. This is important for trajectories which do not start at scan 0.
In relative mode, the scan number of the new copied events is calculated by taking the scan number of the source event, plus the difference in scan numbers of the start of the two trajectories (Source and Destination).

In absolute mode, the scan numbers are not altered.
e.g. If the source set of events starts at scan 1, and the destination trajectory starts at 20, the events must be copied relative.

Also select the (optional) “Increment Packet / GICB numbers” parameter. This parameter will make sure that the Packet or GICB packet numbering in the uplink datalink events will be unique for each duplicated set of events. The number will be added to the existing packet numbers found in the source events.

Finaly, select whether the existing scenario must be overwritten or not. If you select the “replace existing scenario” option, the existing scenario for all selected targets will be overwritten . A warning dialog is issued to warn you about the concequence of this action.

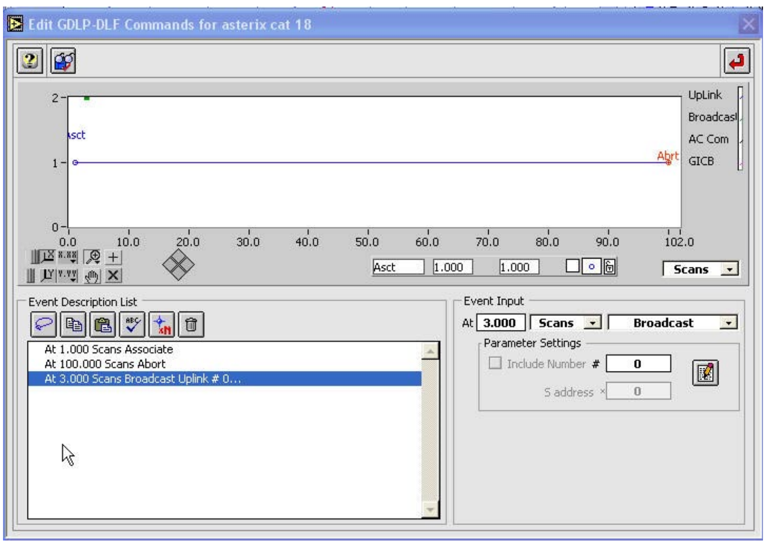
Click the **OK** button to start duplicating. **Cancel** returns without action.

3.2.18. Non Target related GDLP Events

18. The GDLP needs to be programmed with the correct startup sequence, creating connections and aborting of connections. These events are not target related and must as such be programmed seperately. This will be done by means of the “GDLP events” function.

To call this function, click the “GDLP,->DLF” button in the event scenario generator.

The following window will pop up:



This window can be used to edit all GDLP<->DLF interface related events.

Following buttons control the operation of the GDLP-DLF editor:

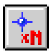
 Toggle the help window on or off

 Enter a new event in the scenario description.

 Cut an event (and copy to clipboard)

 Copy an event to the clipboard

 Paste the event from the clipboard to the current index. Data is inserted

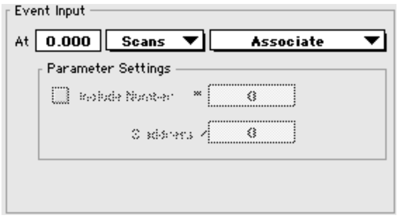
 Duplicate some events

 Clear the contents of the scenario

 Insert load events from a file. The DLF events are automatically saved when closing the window.

 Return to the main trajectory generator tool

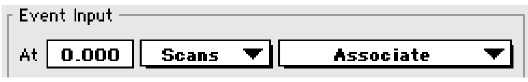
To create the DLF events , first click the  button. An empty line will appear in the event list. The first line will always be “At 0 scans associate”.
The contents of this line will be copied in the event input field:



When you change any parameter in this field, it will be reflected in the event list. Typically, you need to define at least one “associate” command before the first GDLP event and one “abort” command at the end of the scenario.

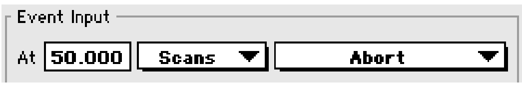
Following events can be programmed:

Associate: Use this event to create an associate command through asterix cat 18.



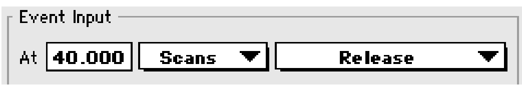
Only enter fractional scan number for start of the command.

Abort: Use this event to create an abort command through asterix cat 18.



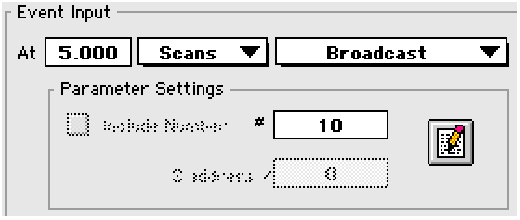
Only enter fractional scan number for start of the command.

Release: Use this event to create a release command through asterix cat 18.

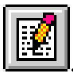


Only enter fractional scan number for start of the command.

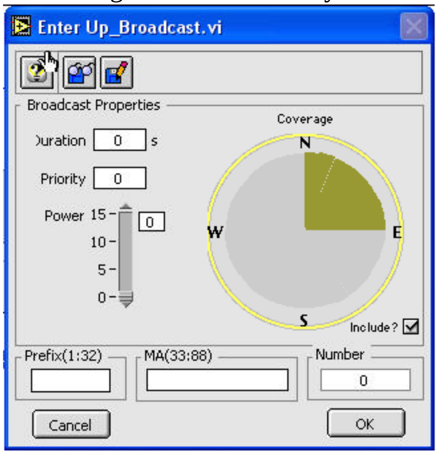
Broadcast : Use this event to create an uplink broadcast command through asterix cat 18. The Broadcast number must be entered in the “Parameter settings” :



All details concerning the Broadcast message can be entered by clicking on the **edit** button.

.

Following window allows you to define the broadcast message in detail:



enter the following parameters:

Include ? This checkbox determines whether the broadcast properties are included. (asterix cat 018/021).

Duration : Duration for the command in seconds.

Power: Relative power figure.

Priority: Relative priority number

Coverage: Coverage control, with 32 sectors defined. Each sector can be switched on or off by clicking on it.

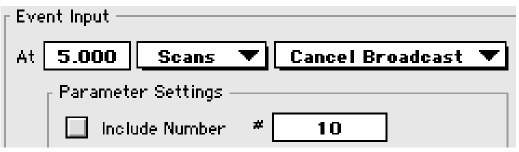
Prefix: bits 1:32 of broadcast message.

MA: Contents of MA field of Broadcast message (bits 33:88)

The tool allows loading and saving of data using the save and load buttons. The data is saved and loaded in the “templates” Floder of the DATA folder in the CAMPAIGN.

Click OK to accept the input data and close the window.

Cancel Broadcast : Use this event to create a cancel uplink broadcast command through asterix cat 18.

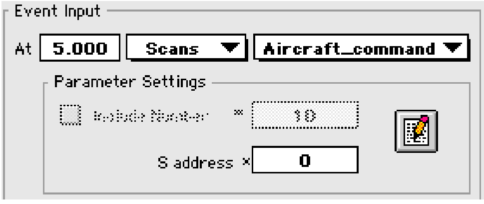


If the “include number “ checkbox is checked, the previous broadcast with the number entered in the # field will be cancelled.

If the “include number “ checkbox is not checked, all past broadcast messages will be cancelled.

Aircraft Command : Use this event to create an aircraft command through asterix cat 18 for a target not in coverage. This function requires you to enter the S address of the target not in coverage.

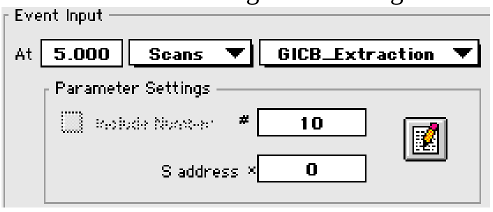
All details concerning the message can be entered by clicking on the **edit** button.



See above for details concerning the Aircraft command event.

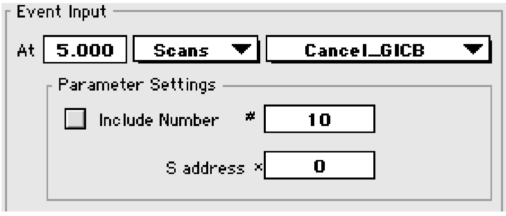
GICB Extract : Use this event to create a GICB extract command through asterix cat 18 for a target not in coverage. This function requires you to enter the S address of the target not in coverage and the GICB extraction message number.

All details concerning the message can be entered by clicking on the **edit** button.



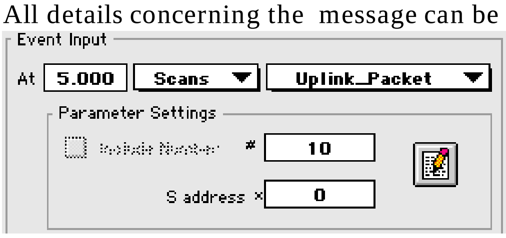
See above for details concerning the GICB extract command event.

Cancel GICB : Use this event to create a Cancel GICB extract command through asterix cat 18 for a target not in coverage. This function requires you to enter the S address of the target not in coverage and the GICB extraction message number.
If the “include number “ checkbox is checked, the previous GICB extract with the number entered in the # field will be cancelled.
If the “include number “ checkbox is not checked, all past GICB extractions will be cancelled.



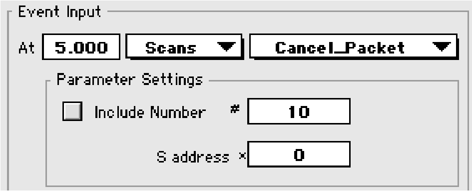
Uplink Packet : Use this event to create an uplink packet command through asterix cat 18 for a target not in coverage. This function requires you to enter the S address of the target not in coverage and the packet message number.

All details concerning the message can be entered by clicking on the **edit** button.



See above for details concerning the uplink packet command event.

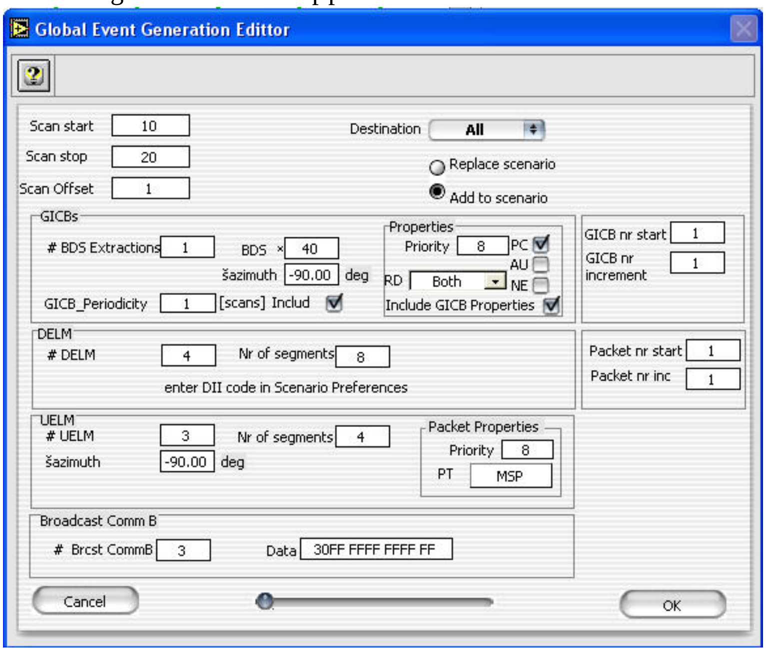
Cancel Packet : Use this event to create a Cancel uplink packet extract command through asterix cat 18 for a target not in coverage. This function requires you to enter the S address of the target not in coverage and the uplink packet number.
If the “include number “ checkbox is checked, the previous uplink packet with the number entered in the # field will be cancelled.
If the “include number “ checkbox is not checked, all past uplink packets will be cancelled.



All events entered in the edittor will be graphically represented in a time graph:
Click the return button to confirm the scenario. 

3.2.19. Creating “Global “event scenario.

 Click the global button to create a number of predefined events for a fixed number of scan numbers and a set or all targets in the scenario.
Following window will appear:



You can enter a start and end scan number for the events to be created. The scan offset determines the interval (in scans) between two consecutive event groups.
The tool creates “groups” of events for all the targets of the “Destination” control. (This can be eighter all targets or a sub-set.)

Each group can consist of 0..n GICB extraction events, DELM events, UELM events and Broadcast Comm B events.

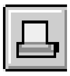
The input of the parameters is similar to the Model B definition. (see above.)

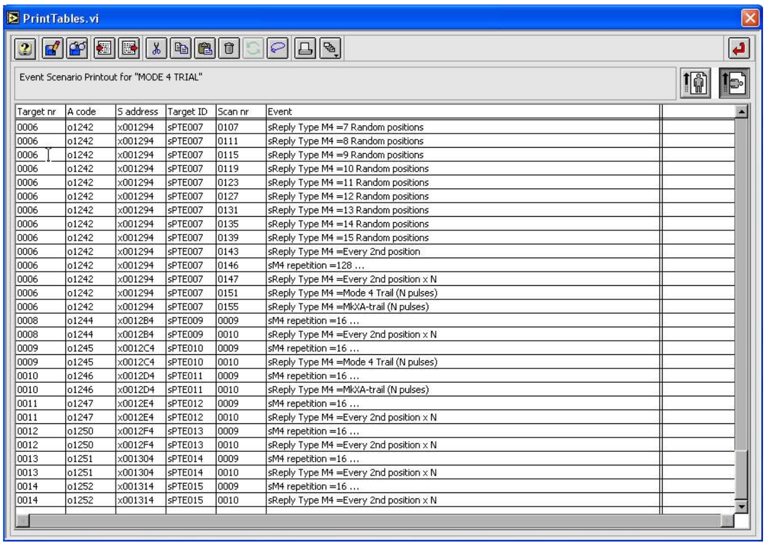
3.2.20. Saving and loading Events

Event scenarios are auto-load and save. The scenario is saved as one file per Target.

When selecting a scenario folder, the events of the first target in the scenario are loaded. Each time a new target is selected, the events of that target are loaded and the ones of the previous target are saved. When quiting the tool or at compliation, the last editted data is also saved.

3.2.21. Printing Events

You can always print an event scenario by clicking the **Print**  button. The event scenario is then listed in a special window, which then allows you to print, export or save in a table the data.

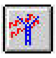


Target nr	A code	S address	Target ID	Scan nr	Event
0006	o1242	x001294	sPTE007	0107	sReply Type M4 =7 Random positions
0006	o1242	x001294	sPTE007	0111	sReply Type M4 =8 Random positions
0006	o1242	x001294	sPTE007	0115	sReply Type M4 =9 Random positions
0006	o1242	x001294	sPTE007	0119	sReply Type M4 =10 Random positions
0006	o1242	x001294	sPTE007	0123	sReply Type M4 =11 Random positions
0006	o1242	x001294	sPTE007	0127	sReply Type M4 =12 Random positions
0006	o1242	x001294	sPTE007	0131	sReply Type M4 =13 Random positions
0006	o1242	x001294	sPTE007	0135	sReply Type M4 =14 Random positions
0006	o1242	x001294	sPTE007	0139	sReply Type M4 =15 Random positions
0006	o1242	x001294	sPTE007	0143	sReply Type M4 =Every 2nd position
0006	o1242	x001294	sPTE007	0146	sM4 repetition =128 ...
0006	o1242	x001294	sPTE007	0147	sReply Type M4 =Every 2nd position x N
0006	o1242	x001294	sPTE007	0151	sReply Type M4 =Mode 4 Trail (N pulses)
0006	o1242	x001294	sPTE007	0155	sReply Type M4 =MkXA-trail (N pulses)
0008	o1244	x0012B4	sPTE009	0009	sM4 repetition =16 ...
0008	o1244	x0012B4	sPTE009	0010	sReply Type M4 =Every 2nd position x N
0009	o1245	x0012C4	sPTE010	0009	sM4 repetition =16 ...
0009	o1245	x0012C4	sPTE010	0010	sReply Type M4 =Mode 4 Trail (N pulses)
0010	o1246	x0012D4	sPTE011	0009	sM4 repetition =16 ...
0010	o1246	x0012D4	sPTE011	0010	sReply Type M4 =MkXA-trail (N pulses)
0011	o1247	x0012E4	sPTE012	0009	sM4 repetition =16 ...
0011	o1247	x0012E4	sPTE012	0010	sReply Type M4 =Every 2nd position x N
0012	o1250	x0012F4	sPTE013	0009	sM4 repetition =16 ...
0012	o1250	x0012F4	sPTE013	0010	sReply Type M4 =Every 2nd position x N
0013	o1251	x001304	sPTE014	0009	sM4 repetition =16 ...
0013	o1251	x001304	sPTE014	0010	sReply Type M4 =Every 2nd position x N
0014	o1252	x001314	sPTE015	0009	sM4 repetition =16 ...
0014	o1252	x001314	sPTE015	0010	sReply Type M4 =Every 2nd position x N

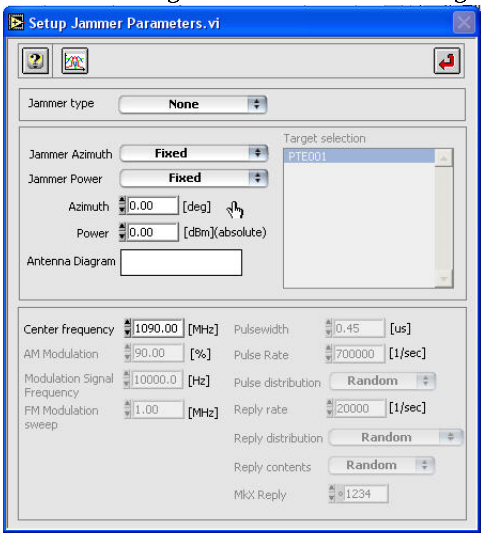
3.2.22. Setting up a Jammer in the scenario

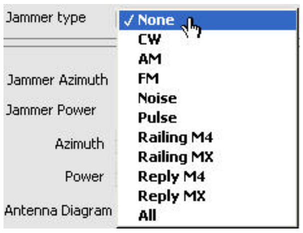
In case you want to set up a jammer in your scenario, you need to set up the parameters of the jammer using the “Jammer Setup Window”.
A jammer is defined as a source of disturbance located in a certain region. Typically, the source will be point in space. Therefore the jammer will behave similar to a real target relating to the power generated in azimuth. In other words: The jammer will present itself having a real antenna diagram.
The user can select between a multitude of jammer types. All types are described hereafter and details on the parameters provided.

Evoke the setup window using the correct button:



This will bring foreward the following window:



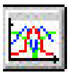


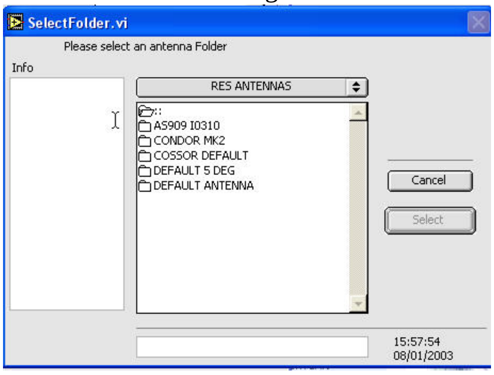
Now select the type of Jamming you want to create.

Next select the Jammer azimuth. This can either be a **fixed** azimuth or an azimuth **locked** to a specific target in the scenario. In that last case, select the proper target from the Target selection list. Finaly, you have the possibiliy to duplicate the jammer 32 times (every 11.25 degrees) , to fascilitate the testing procedures. This option is selected using the **Fixed 32 beams** option.

Next select the Jammer power. This can eighter be a **fixed** value (typically between -30 and -90 dBm) or a power **locked** to a specific target. In that last case, you can select the offset between the selected target and the jammer (typ between 0 and -20 dB offset).
In case you select a fixed value, enter that value in dBm. The value entered in the value as it presented to the radar receiver. (So it takes into account the coupler loss of the RES).

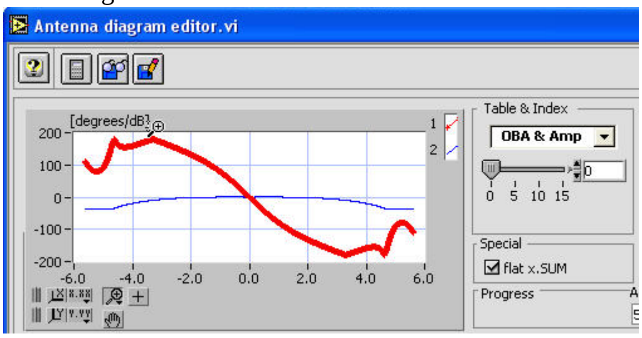
Next, select an antenna diagram (=Optional). In case you require a different antenna diagram for the jammer as for the real targets, here is the place to select it.

Click the Antenna diagram selection button and select an antenna diagram. 



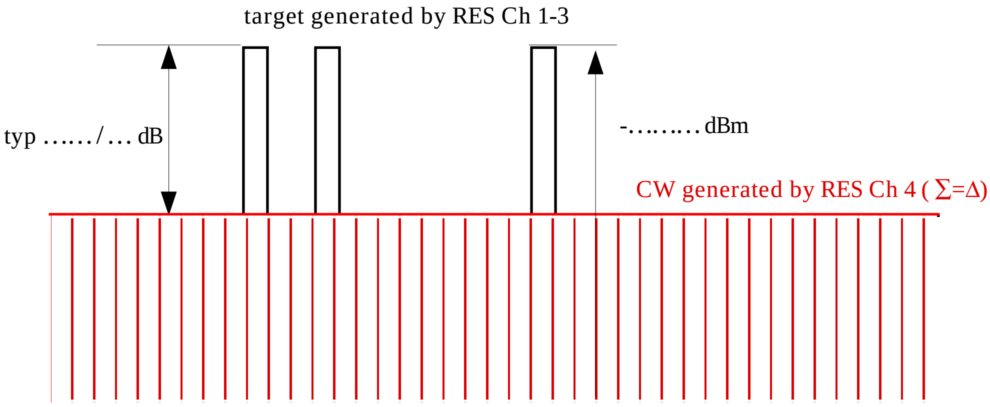
A possible application for this is the simulation of a non-point source of jamming signals.

Using a flat diagram simulates a jammer source that is injected directly into the radar not trought the antenna.

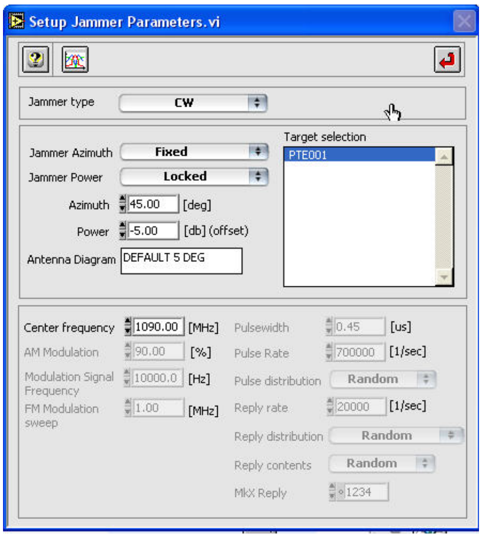


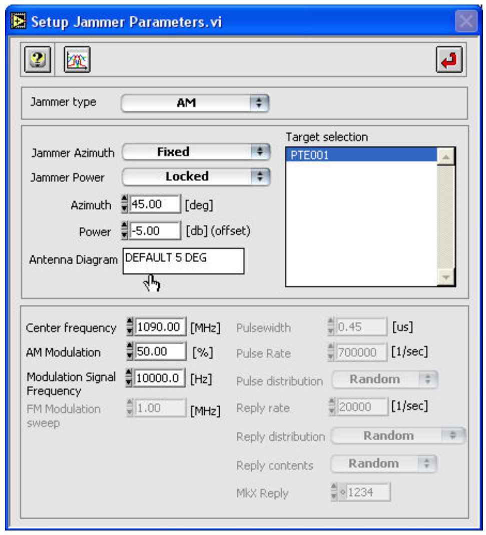
Using a wider antenna diagram than the targets can simulate non-point source jammer. (array of jammers)

a) CW jammer



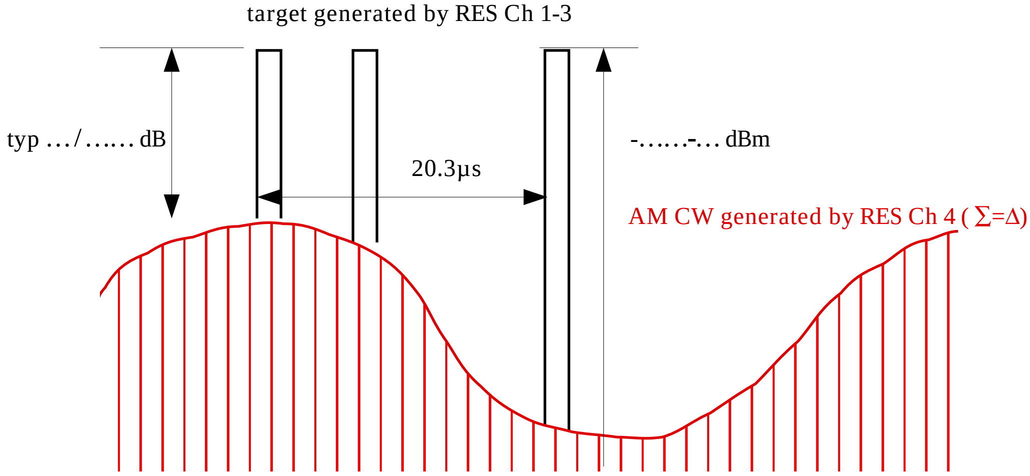
In CW mode, the user can set up
-Jammer Azimuth [0..360,45 deg]
-Jammer Power [+20..-20 dB relative to target or [-30..-90 dBm absolute]
-Jammer Frequency [1085..1095 Mhz,1090 Mhz]





In CW mode, the user can set up
-Jammer Azimuth [0..360,45 deg]
-Jammer Power [+20..-20 dB relative to target or [-30..-90 dBm absolute]
-Jammer Frequency [1085..1095 Mhz,1090 Mhz]

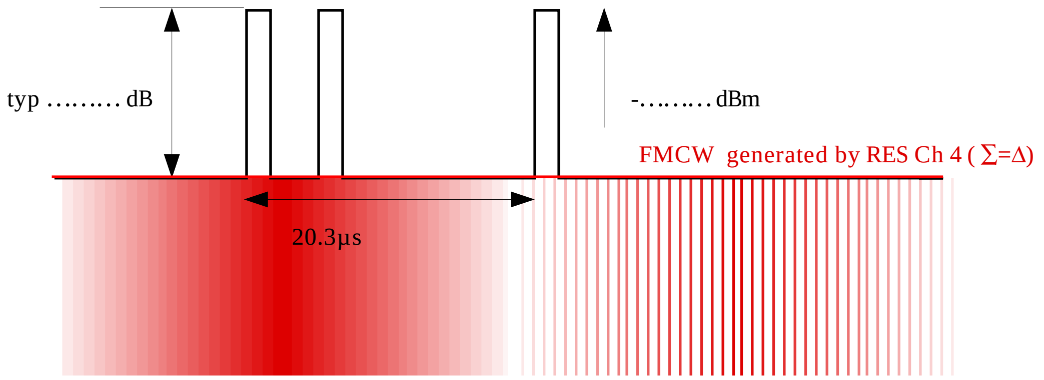
b) AM modulation



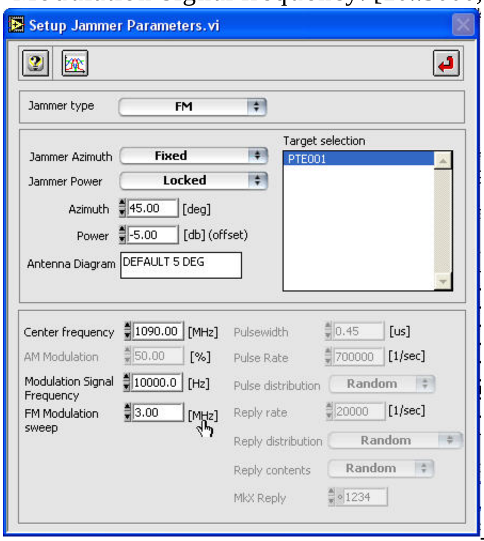
In AW mode, the user can set up
-Jammer Azimuth [0..360,45 deg]
-Jammer Power [+20..-20 dB relative to target or [-30..-90 dBm absolute]
-Jammer Carrier Frequency [1085..1095 Mhz,1090 Mhz]
-AM Modulation depth [10..90 , 50 %]
-Modulation Signal frequency. [10..3000, 10000 Hz]

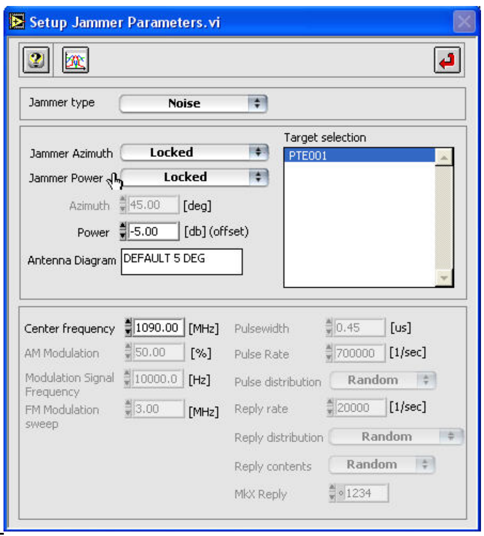
c) FM Modulation

target generated by RES Ch 1-3



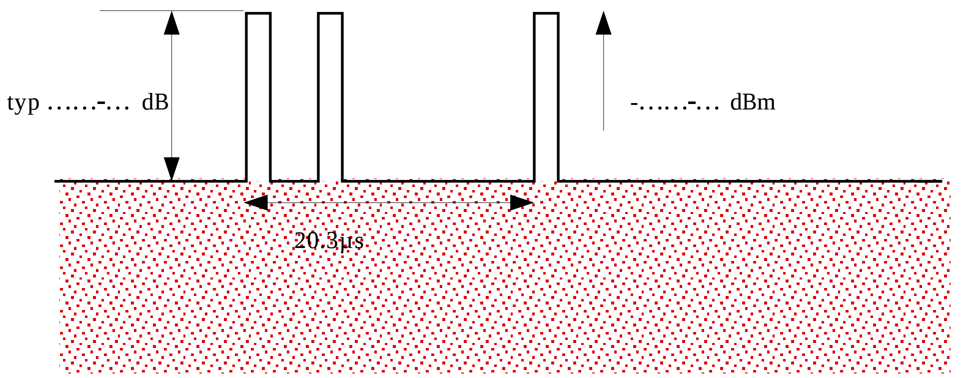
In FW mode, the user can set up
-Jammer Azimuth [0..360,45 deg]
-Jammer Power [+20..-20 dB relative to target or [-30..-90 dBm absolute]
-Jammer Carrier Frequency [1085..1095 Mhz,1090 Mhz]
-FM Modulation Frequency sweep [1..5,3 Mhz]
-Modulation Signal frequency. [10..3000, 10000 Hz]





d) Noise Jamming

target generated by RES Ch 1-3

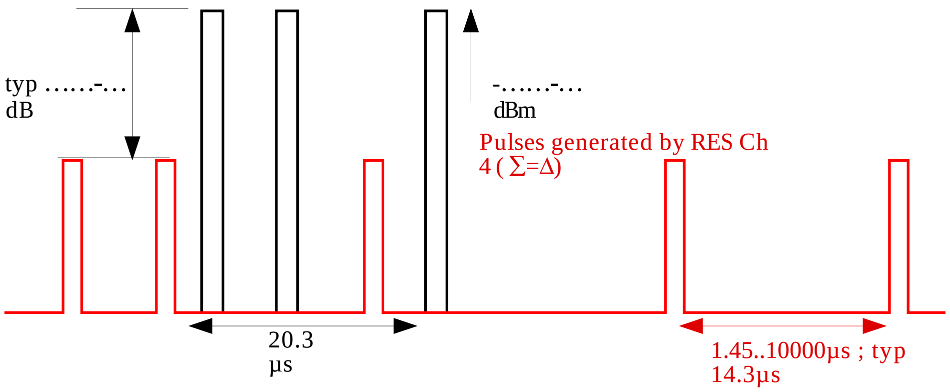


White Noise (25 Mhz BW) generated by RES Ch 4

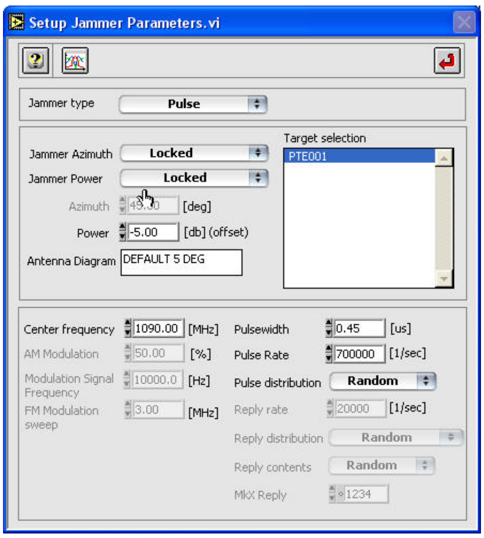
In Noise mode, the user can set up

-Jammer Azimuth [0..360,45 deg]
-Jammer Power [+20..-20 dB relative to target or [-30..-90 dBm absolute]
-Jammer Carrier Frequency [1085..1095 Mhz,1090 Mhz]
The power is measured as an average power.

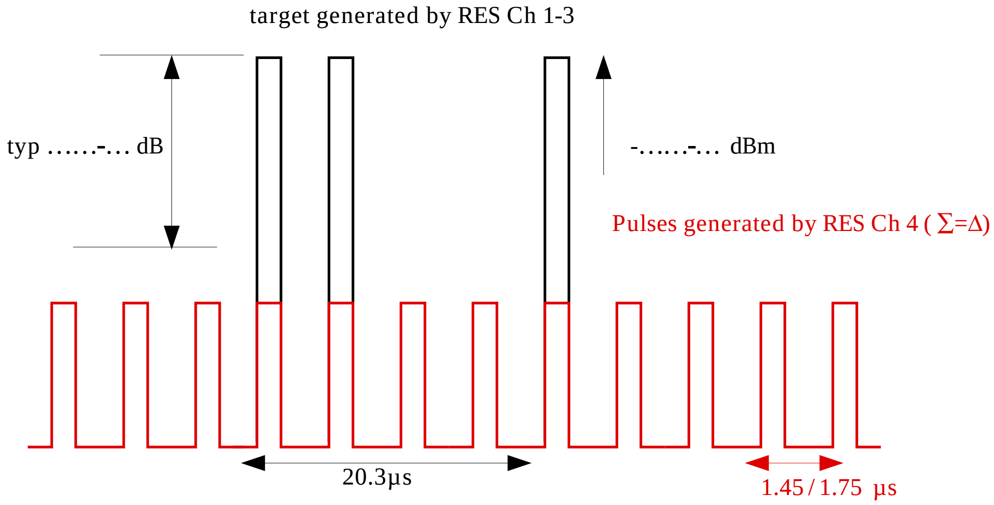
e) Pulse Jamming



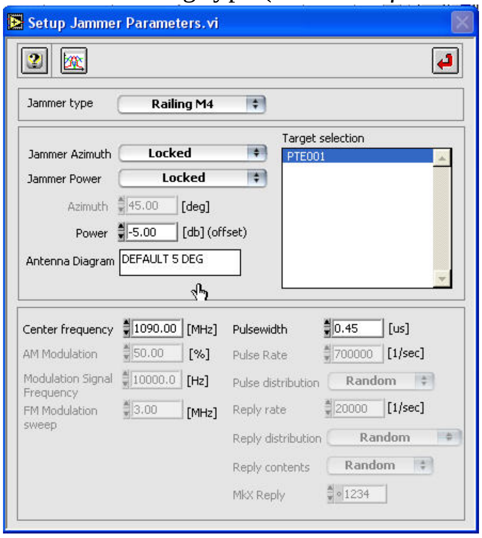
In Pulse mode, the user can set up
-Jammer Azimuth [0..360,45 deg]
-Jammer Power [+20..-20 dB relative to target or [-30..-90 dBm absolute]
-Jammer Carrier Frequency [1085..1095 Mhz,1090 Mhz]
-Jammer Pulse width [0.2..1,0.45µs]
-Jammer Pulse Rate (=repetition frequency)[1000..700 000,700 000 pulses/sec]
-Pulse distribution [Fixed, Random] (In case of random, pulse rate is average)

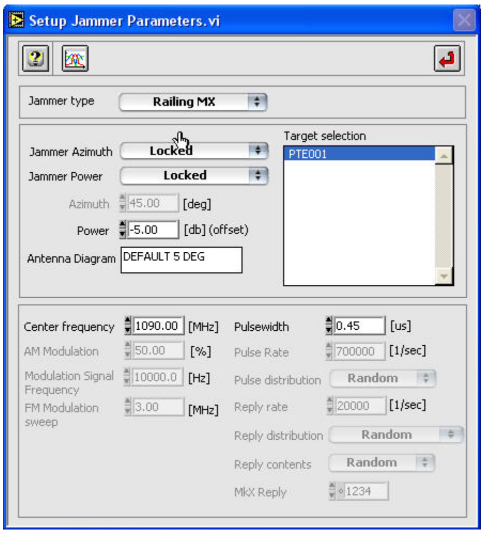


f) Railing Jammer

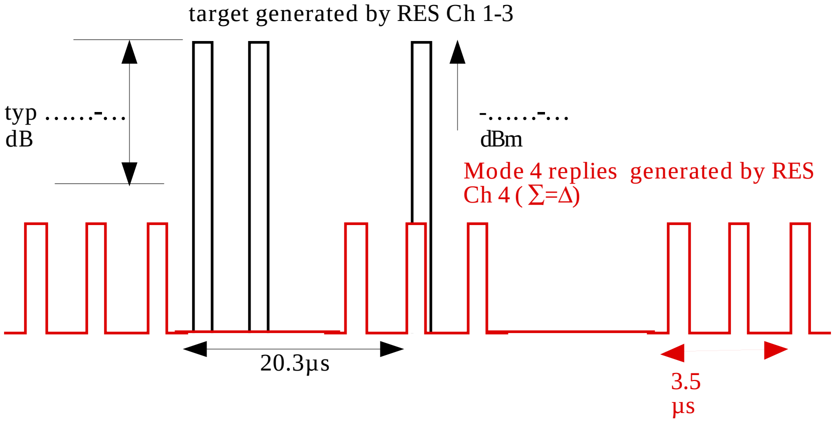


In Railing mode, the user can set up
-Jammer Azimuth [0..360,45 deg]
-Jammer Power [+20..-20 dB relative to target or [-30..-90 dBm absolute]
-Jammer Carrier Frequency [1085..1095 Mhz,1090 Mhz]
-Jammer Pulse width [0.2..1,0.45µs]
-Jammer Railing type (MX : 1.43µs between pulses, M4:1.75 µs between pulses)

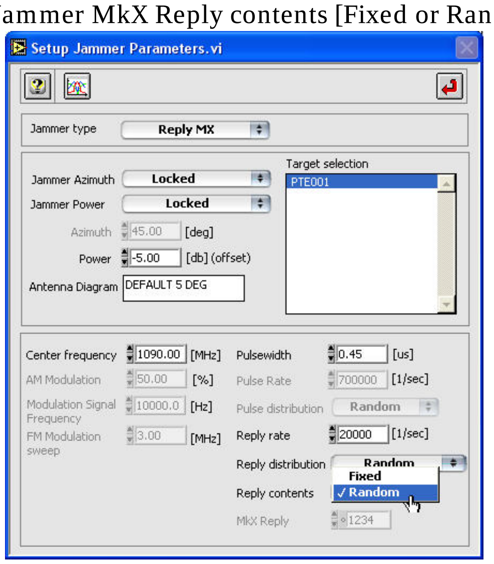




g) Reply Jamming

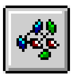


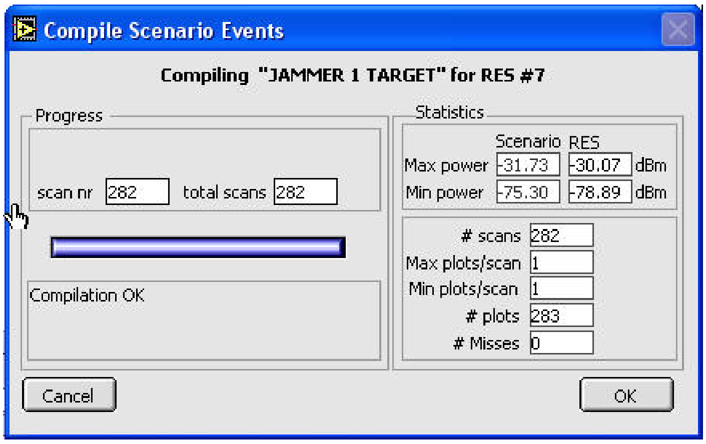
In Reply jamming mode, the user can set up
-Jammer Azimuth [0..360,45 deg]
-Jammer Power [+20..-20 dB relative to target or [-30..-90 dBm absolute]
-Jammer Carrier Frequency [1085..1095 Mhz,1090 Mhz]
-Jammer Pulse width [0.2..1,0.45µs]
-Jammer Reply
-Jammer Reply type (MX : 1.43µs between 15 reply pulses, M4: 1.75 µs between 3 pulses)
-Jammer MkX Reply contents [Fixed or Random]



Don't forget to recompile the event scenario after modifying jammer scenarios.

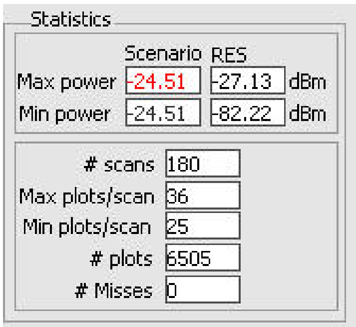
3.2.23. Compiling Events

Finally the event scenario needs to be compiled in order to be used by the RES Main Controller tool. Click the  button to compile the event scenario. The necessary files are automatically stored in the corresponding scenario folder. A window with a compile progress indicator will appear:



At the end of the compilation, the compile window will render you a number of important information fields:
-Maximum output power of scenario and RES (at Radar Receiver input level)
-Minimum output power
-# of scans
-Max # plots / scan
-Min # plots / scan
-# of plots
-# of generated misses (due to out of range targets or programmed misses)
-Total time of scenario

If the output power of the scenario creates problems for the RES to generate the signals, the compiler will present you with a suggestion on the action to take:

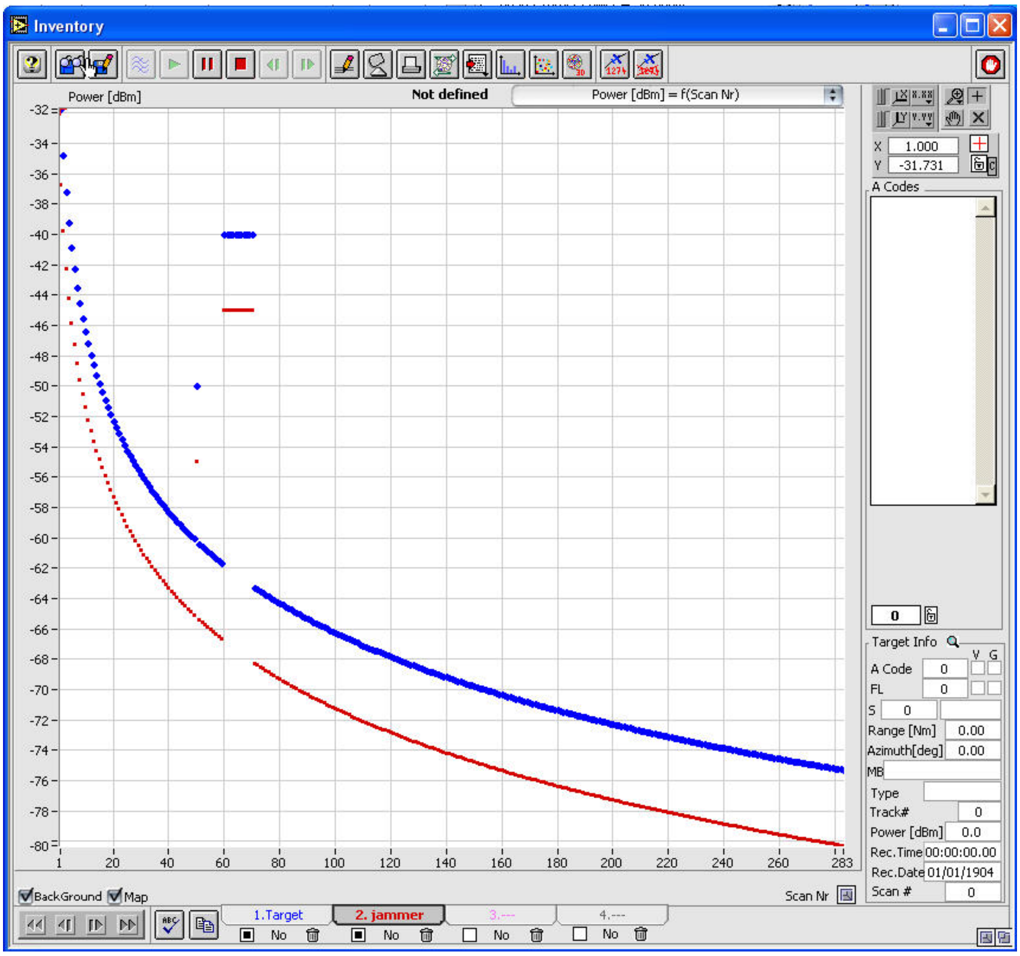


Click the cancel button to interrupt the compile process at any time.

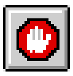
The compilation stage creates a number of files. The first important file is the xxx.S4EV file. This S4 file contains the scenario data after aplication of the events. You can use this file to verify the scenario position, power, A code etc..

One special file is created by the Jammer tool, named xxx.S4JM, where xxx is the scenario name. This file can be loaded in the inventory tool and allows you to verify the jammer position and power.

The example hereafter shows the target power versus scan number of the scenario and the linked jammer signal. A number of "Set Target Power" events were applied to the scenario.



Layer 1 contains the “xxx.S4EV” file, Layer 2 the “xxx.S4JM” file.

- Click the  button to quit the Event Scenario Generator tool.

4.0. Antenna Pattern Editor

4.1. Introduction

The Radar antenna diagram simulation is performed by a combination of several look-up tables in the ESG software. (See Chapter III, 2.4.5). These tables are constructed in the software program called “Antenna Diagram Editor”, which can be called from the RASS-S toolbox.

This program allows the user to import Downlink HPD diagrams (as measured using the RASS-S tools), or Text based spreadsheet tables as a source for horizontal antenna diagrams. The table can be imported from a spreadsheet format or entered manually in the front panel of the program.
The tool also allows you to load previously created antenna diagrams and view or edit them. They can be recompiled with new features (like SLS, other beamwidth, etc..)

Secondly, the Antenna Diagram editor program allows the input of a Vertical diagram. This must be entered in a text based table.

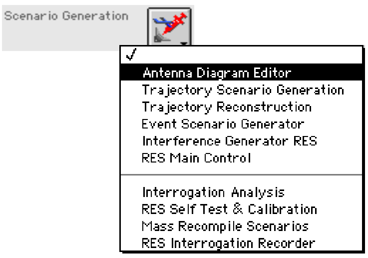
With this data the Antenna Diagram Editor produces the necessary look-up tables to allow the ESG to function.

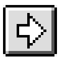
4.2. Use of the Antenna Pattern Editor

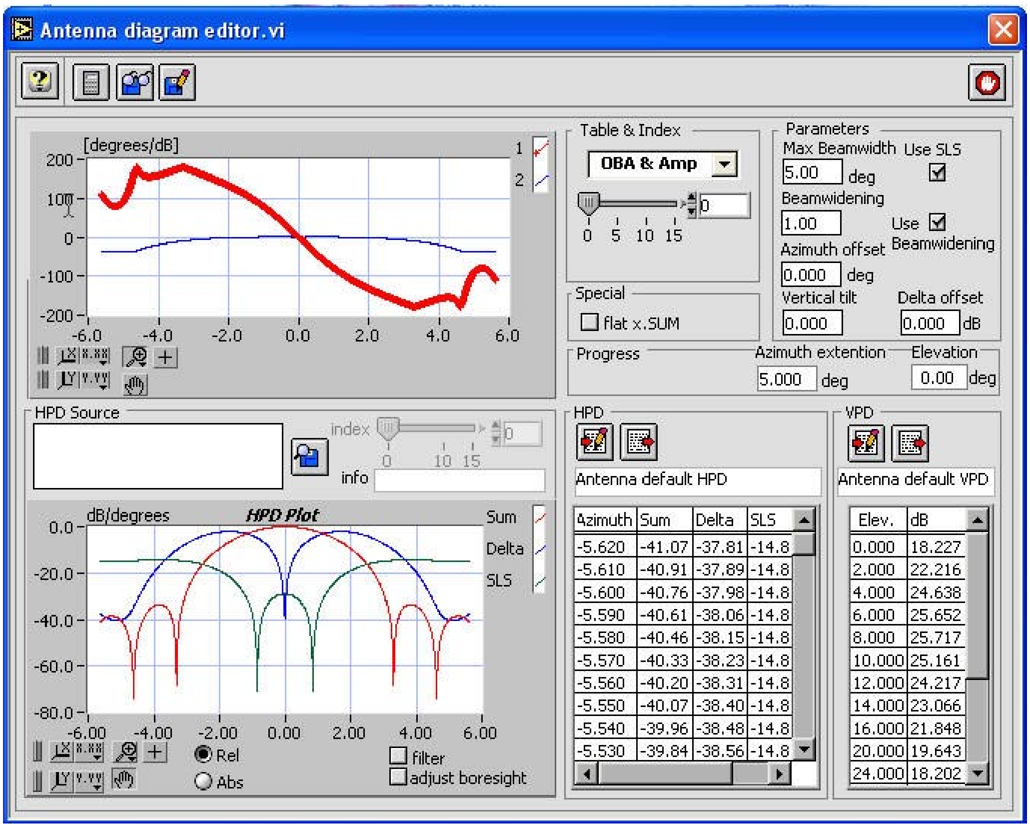
The Antenna Pattern Editor tool can be loaded from the RASS-S Toolbox. The tool must be run before at least once before any trajectory scenario generation can take place.

4.2.1. Loading the software

1. To load the tool, double click the RASS-S Toolbox icon and select “Antenna Diagram Editor” from the “Test Targets” menu in the RASS-S Toolbox.



2. Now the tool is loaded. Click the  button in the upper left corner of the window to start the tool.



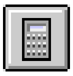
4.2.2. The Antenna Diagram Editor Functions and Buttons

3. The Antenna Diagram Editor is operated by several buttons on the front panel of the tool.

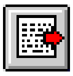

Show help window

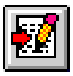

Load previously compiled antenna files from disk

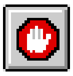

Save antenna diagrams to disk


Calculate antenna diagrams


Load HPD log file from disk

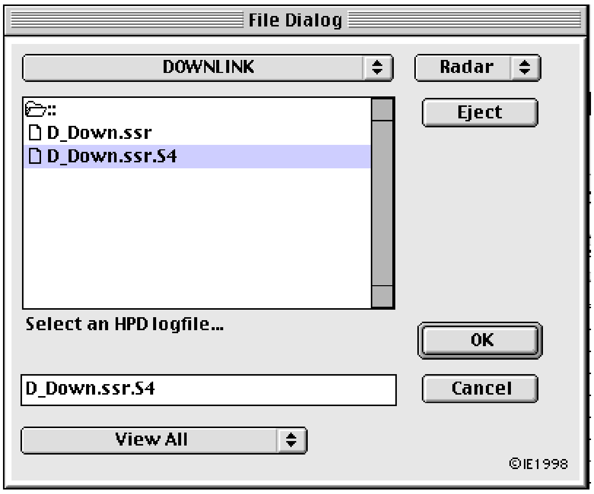

Import text based spreadsheet file with HPD/VPD


Export text based spreadsheet file with HPD/VPD

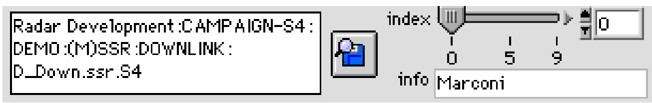

Quit Antenna Diagram Editor

4.2.3. Loading antenna diagrams

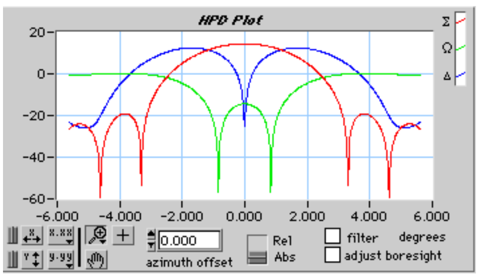
4. Upon starting of the tool there is already a default antenna pattern resident in the Antenna Diagram Editor tool.
To generate a new antenna pattern, several posibilities exist to load an antenna diagram:
a) To load an HPD diagram created by the RASS-S HPD measurement. start by clicking the  button to load a downlink HPD log file from disk. The following dialog box will appear:



The name of the selected HPD log file will be shown. The slider indicates how many HPDs are present in the HPD log file. Select one HPD using this slider or the index indicator.



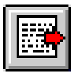
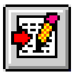
The selected HPD (Σ, Ω and Δ) is shown in the graph.

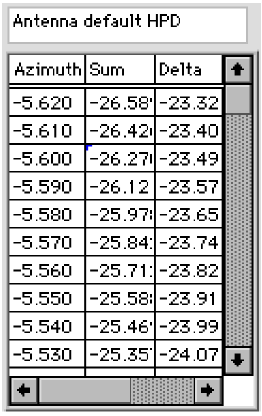


b) To import an HPD diagram from a spreadsheet table , the table must contain valid power measurements for the Sum, Delta and SLS antenna diagram. The values must at least cover an azimuth from -5.625 degrees to 5.625 degrees, with regular intervals. The minimum interval is not limited but 100 mdeg is advised to provide accurate data. The table must contain azimuth in the first column and the Σ, Δ and optionally the Ω

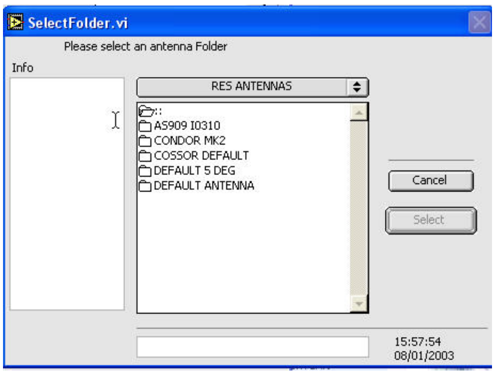
amplitude in dB in the next columns.
The tool will import a text file with Tab separated data.

The table will always be recalculated towards a relative antenna gain maximum of 0 dB.

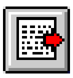
This table can be entered manually or imported by clicking the  button. Once loaded, the HPD table can always be edited manually and exported by clicking the  button.

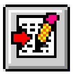


c) Previously compiled antenna diagrams can be loaded from a specified antenna folder by clicking the Load button: . This will allow you to select a folder containing the different antenna data files:



All compiled data , the HPD and the VPD data will be loaded from this folder and entered in the corresponding graphs or tables. To visualise the data, proceed as if the data was calculated by the program. (see 4.2.5).

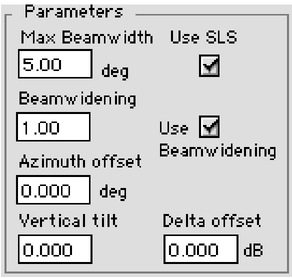
5. The Antenna Diagram editor program allows the input of a Vertical diagram. This must be entered in a text based table, with in the first column elevation and in the next column absolute antenna gain (typically 27 dB). The column may be entered at regular or irregular intervals, but must contain 16 entries. The table must start at 0 degrees elevation (or at a small negative value) and run up to at least 50 degrees elevation. One HPD diagram is calculated for each entry in the VPD table. The VPD table can be entered manually in the window or imported by clicking the  button. Once loaded,

the VPD table can always be edited manually and exported by clicking the  button. The data can also be read from a previously compiled antenna folder. See above.

4.2.4. Antenna Diagram Parameters

6. The next thing to do is to enter a set of parameters needed to calculate the different diagrams. All parameters are entered from the antenna diagram front panel.

Now enter the **Max Beamwidth** data in the correct field. The beamwidth will be used to cut out the HPD diagram. It is a maximum value, since normally the beamwidth is determined by the SUM-SLS crossovers. If the “**Use SLS pattern”** Option is not selected (see below) the real generated beamwidth of the targets will always be set to the **Max Beamwidth** parameter.
If it is set, the **Max Beamwidth** value will be used as a maximum value and the real SLS-Sum crossoverpoints will be used as an azimuth extention as long as they are narrower than Max Beamwidth.



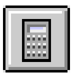
Beam widening: [0...2, 0.1/1]: The beam widening is calculated using a cosine function of the elevation value.

3dB Beamwidth = (3dB Beamwidth default) K*

*K= (1/(Cos elevation) -1)*Beamwidening)+1)*

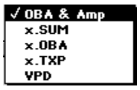
Use Beam widening: This switch determines if the antenna diagram shows beamwidening effects or not.
Azimuth offset: [-5...5,0.1/0] : This is the offset to be added to all the azimuth values in the input HPD diagram. This can be used if the input HPD diagram is not correctly centered.
Vertical Tilt : [-5...5,0.1/0] : This is the tilt to be added to all the elevation values in the input VPD diagram before calculation of the final VPD diagrams.
Use SLS Pattern? [True]: This check box determines whether the real (physical) beamwidth of the RES antenna diagram is cut using the SLS pattern.
Delta offset: This offset (in dBs) is added to the delta channel before the antenna diagram is calculated. It can be used to compensate for Sum-Delta mismatches on coupler level.

4.2.5. Antenna Diagram Calculation & Viewing

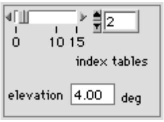
7. Click the  button to start the calculation of the antenna diagrams. A progress bar will indicate the remaining time needed for the calculation.

8. Once the different diagrams are calculated, they can be viewed with the tool. Select

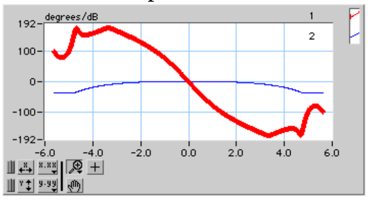
the desired diagram to be viewed with the pull down menu in the upper right corner of the window (x stands for any of the four Target Generator boards):



When consecutive diagrams are calculated for different elevation angles, they can be selected by the slider at the right hand side of the graph. The corresponding elevation angle is automatically indicated.

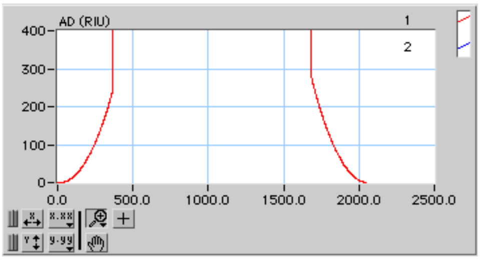


OBA & Amplitude:



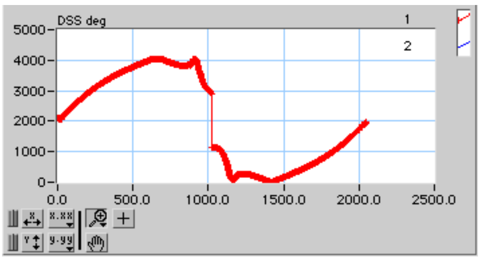
The OBA phase and amplitude are calculated from the Sum and Delta Horizontal Diagram. The table is calculated for 16 different elevations.

x.SUM:



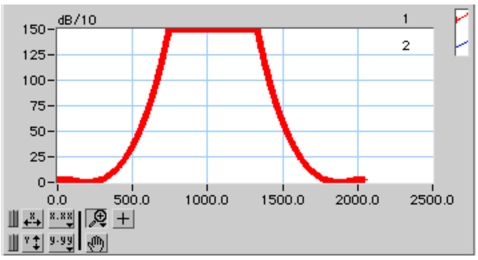
This table contains a number of 12 bit AD numbers, which must be subtracted from the initial Minimum Trigger Level (which is also a AD value) of the RIU. This table makes sure the target only replies within the beam and allows for interrogation power (after path loss) dependent interrogation acceptance. This will cause targets at far range to narrow their azimuth extension. The table is calculated from the Sum Horizontal diagram and the RIU receiver calibration table. 16 different tables are build, one for each elevation entry in the VPD diagram table. Within the beam the value in this table are AD values in the range 0..400 (typically 15 dB). Outside the beam the value is set at 4096, making sure that the target no longer replies to the radar interrogations.

x.OBA:



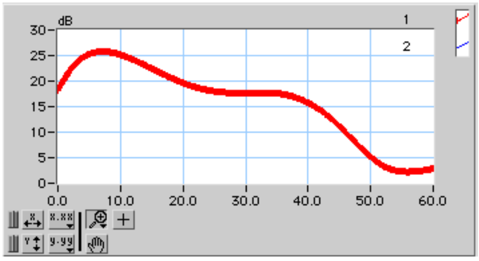
This table is (Y-scaled) calculated from the Sum and Delta Horizontal Diagram. The values in the x.OBA table contains the Phase information for the DSS channel versus azimuth. The table has 2048 entries. The index (or X-scale in the graph) is an Integer 12 number (-1024...1023), and the resolution is 2^-16 degree, 0 stands for 0 degrees and 4096 stands for 360 degrees. The table is calculated for 16 different elevations.

x.TXP:



This table is calculated from the Sum and Delta Horizontal Diagram. The x.TXP table contains the output power modulation versus azimuth, this is the extra attenuation that is added to the path loss attenuation as a function of azimuth, resulting in a ∑ and Δ amplitude modulation. The table contains power in dB/10 resolution. The table is calculated for 16 different elevations.

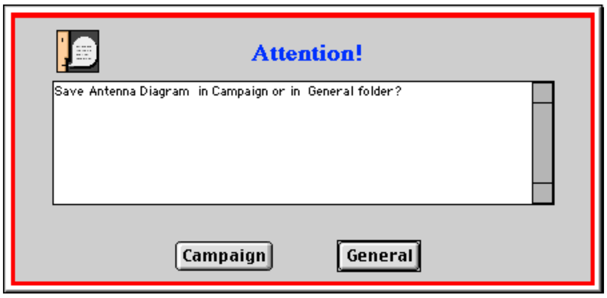
VPD:



This diagram is an interpolation of the VPD table.

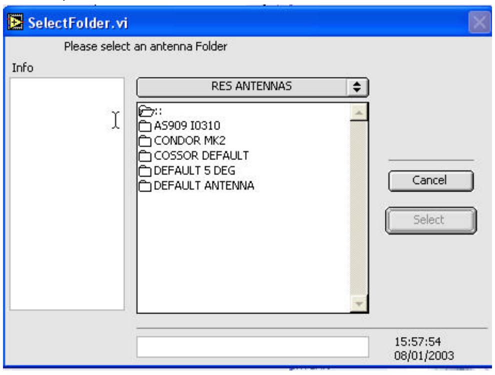
4.2.6. Saving the Antenna Diagram

9. By clicking the  button, the calculated diagrams can be saved to disk. The following dialog box will appear:

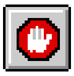


Select where you want to store the antenna files. By default, they should be stored in the "GENERAL" folder, since antenna files belong to your system in stead of a specific campaign.

Next,select a folder:



Now select an existing or new folder to save the antenna diagram files.

11. The Antenna Diagram tool is stopped by clicking the  button.

5.0. RES Controller

5.1. Introduction

The RES Controller tool is intended to control and monitor the different data streams going in and coming out of the RES. The data streams going into the RES represent the result of the compiling of predefined scenarios. The output data stream is an interrogation logging.

The data streams going in the RES are:

- the target data stream: position information of the targets in the scenario
- the transponder data stream: transponder information of the targets in the scenario
- the datalink stream: datalink information of the targets in the scenario

The data stream coming out of the RES is:

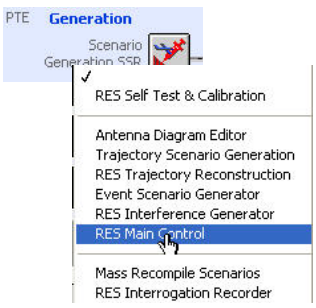
- the interrogation stream: logging of the interrogations

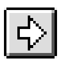
5.2. Using the RES Controller

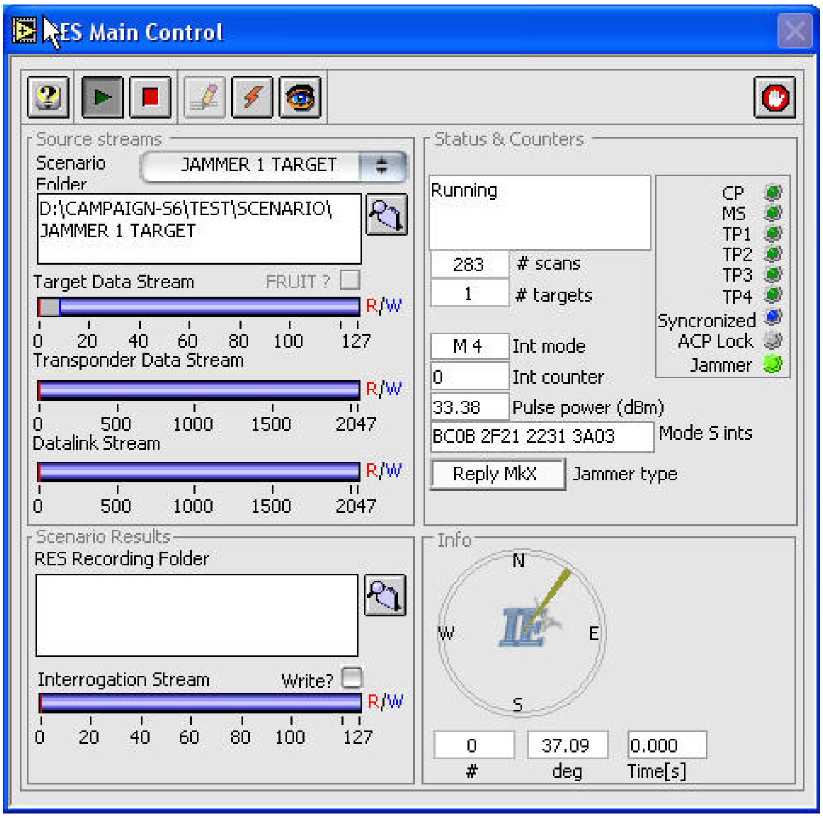
5.2.1. Starting the RES Main Tool

The RES Controller tool can be loaded from the RASS-S Toolbox.

1. To load the tool, double click the RASS-S Toolbox icon and select “RES Main Control” from the “Scenario generation SSR” menu in the RASS-S Toolbox.



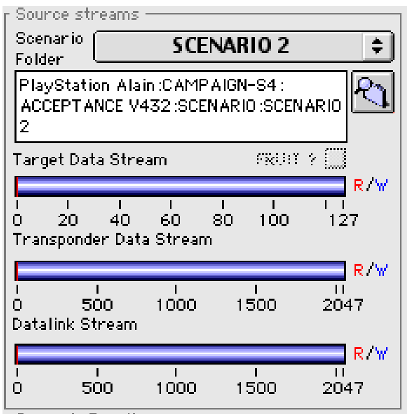
2. Now the tool is loaded. Click the  button in the upper left corner of the window to start the tool.



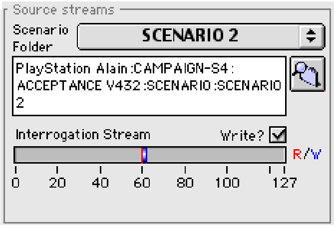
5.2.2. RES Main Components

3. The window contains several fields:

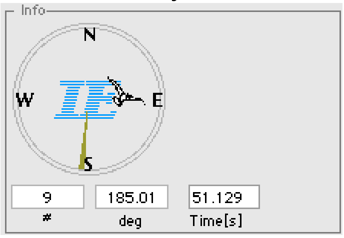
On the left we can observe the source stream monitor sliders and the Scenario selection area. The sliders show the progress of the data streams, which contain the data necessary for the RES to simulate the targets. The "Folder select" button or the Menu allows you to select a proper scenario.



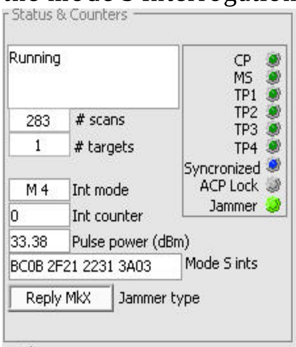
In the lower left corner the result stream progress is shown. This contains the data recorded by the RES during the injection of the targets (Data link results and interrogations).



To the right the window contains a turning indicator showing the revolution count and the momentary azimuth of the RES.



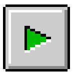
In the top right corner the status of the RES and several counters are indicated. These counters show the interrogation mode, the number of interrogations, the pulse power and the mode S interrogation decoding results.



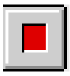
5.2.3. RES Main Functions and Buttons

The RES controller is operated with several buttons situated in the window.

Show help window.



Start the simulation.

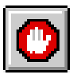


Stop the simulation

Activate the preference window.

Reset RES Controller tool.

Load the Interrogator Viewer Tool



Quit the RES Controller tool.

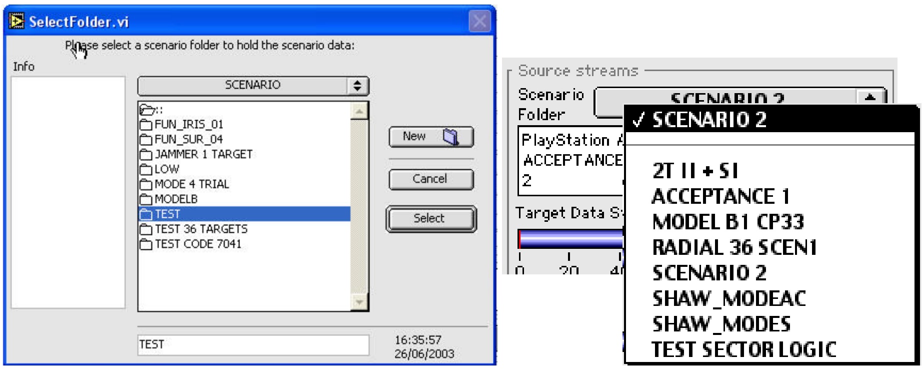
Select a scenario folder (containing all the data stream files) or result folder from disk.

5.2.4. Loading a Scenario

4. The different stages of the boot sequence are shown in the RES status indicator. The boot sequence is completed successful when the RES status indicates “**ready**”.

5. The first thing to do is to select a scenario folder which contains the necessary files to run the simulation. This can be done in Two ways:

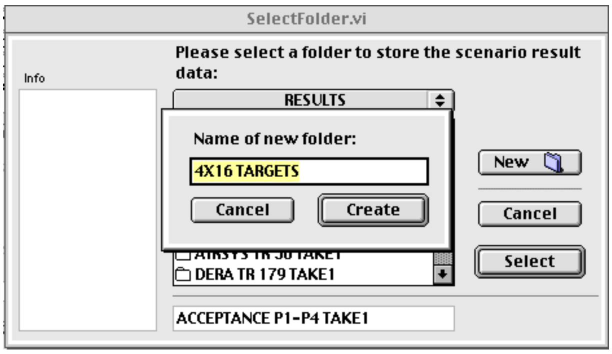
a) Click the **Select Folder**  button in the source streams section to select a new scenario folder. A dialog box will appear to select the desired folder.



b) Select any scenario, contained in your current Campaign, or a scenario from your history (the most recent selected scenarios) from the Scenario menu:

5.2.5. Starting an Interrogation Logging

6. Next, if desired, select a result folder to contain the interrogation logging and the datalink result file by clicking the  button in the “Scenario results” section. The following dialog boxes will appear:



The interrogation recording AUTOMATICALLY selects a new result folder each time the scenario starts <u>when the interrogation recording is switched on</u>.
The interrogation logging can be switched on/off by checking the  box on top of the progress indicator.
The folder is named “SCENARIONAME _YYMMDD_Txx”, where YYMMDD is the date and xx is the take number. This allows you to make multiple runs of the same scenario, each time keeping a unque interrogation recording.

Select a new or existing result folder.
The interrogation logging can be switched on/off by checking the  box on top of the

progress indicator.
The user can select the interrogation folder during scenario generation. If he selects an existing folder, the interrogation recording present in that folder will be purged and the interrogations will be recorded from that moment on. Nevertheless, we feel that it is better to select the result folder prior to starting generation.

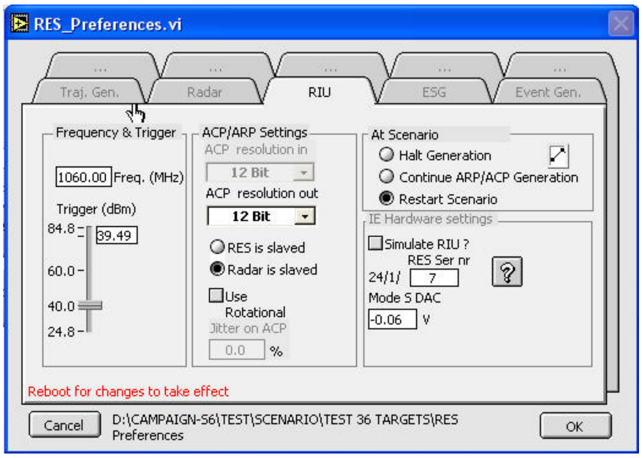
The Interrogator Viewer Tool can be called from the RES Main Control by clicking the **View**  button. More details about this tool can be found under paragraph 6.0. Interrogation Viewer.

5.2.6. Editing the parameters

7. Next click the  button. This will evoke the preference window. Use the tabs to select one of the five sections. Only the **RIU** section is a valid option from the RES Main tool and will therefore also be selected as default.
The Preferences are read from the Scenario folder , so make sure this is selected before proceeding with the preferences.

All other parameters (like Radar: revolution speed) must be adjusted in the scenario generator and require a recompilation. Therefore they are “Write protected” from the RES main control.

Only the parameters of the RIU are shown:



Some of these parameters are not to be changed by the user:
The ones which can be adjusted by the user are the following:

Trigger level: [0..70 dBm,0.1/30] : This parameter determines the trigger level above which the RIU detects interrogations from the radar. If the trigger level is set too high, no interrogations will be detected. If it is set too low, replies, leaking in from the 1090 Mhz band , will possibly be detected and cause false interrogations. As a rule the value should be put 5 to 10 dB lower than the minimum interrogation power used by the radar.
The trigger level is measured at the radar output. This means that the the coupler loss and insertion loss are accounted for.

Slave mode: Use this setting to select whether the radar is slaved to the RES (FAT) or the RES is ACP slaved to the Radar (SAT)

ACP in resolution: The user can select between a 12,14 or 16 bit ACP input (ACPR 4096,16386 or 65536) in case the RES is slaved to the Radar.

ACP out resolution: The user can select between a 12,14 or 16 bit ACP Output (ACPR 4096,16386 or 65536) in case the Radar is slaved to the RES.

Use Rotational Scenario : If this check box is set, the RES Main will load the Rotational Scenario file compiled in the Trajectory scenario Generator
The exact ARP time is determined by the "Radar" parameter **revolution time** if no rotational scenario is selected. This time can ony be set from the trajectory scenario generator.

"At scenario completion" This parameter determines if the RES continues to generate ACP / ARP signals after the scenario has completed, or whether it stops all together, or whether it restarts the scenario.

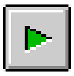
For "Infinite running scenarios", it is sufficient to create a standard scenario and program the RIU parameter "At scenario completion " to " Restart Scanario"

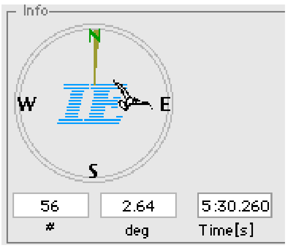
Beware : for Mode-S radars it is advised to add a few "Blank Scans" at the start of a scenario. This way, if the scenario is repeated, the registers in the radar are cleared and the radar tracker list is emptied.
To insert the "Blank Scans" make sure all trajectories in the scenario use a start time of several scan periods.

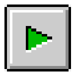
Once the preferences are entered click the 

button to save and close the preferences.

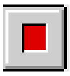
5.2.7. Starting and stopping a Scenario

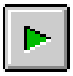
8. Click the **Start**  button to start the simulation. The beam in the PPI will start rotating, indicating that the simulation has started. The actual scenario will start at the beginning of the second revolution. The revolution number and azimuth of the beam are also displayed digitally under the rotating Dial.



9. During the simulation the different sliders display the actual position in the respective data streams. The blue indicator shows the "writer" pointer while the red line shows the "reader" position. The RES has a limited amount of memory reserved for each of the data streams. At startup (after clicking the  button) the data buffers are filled to their full capacity. The ESG will start reading the buffers. The position of the "reader" in the file can be observed by the red pointer. Once the ESG is has reached half of the buffer size, the RES controller software will fill up the buffers with new data, changing the position of the "writer" pointer.

10. The simulation can be restarted at any time by clicking the following buttons:

1) Click the **Stop**  button to halt the scenario.

2) Click the **Start**  button and the simulation will restart from the beginning.

11. The RES Main tool can also be used to create additional FRUIT on top of the injected scenario. In order to do this , a number of conditions must be met:

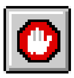
a) A FRUIT scenario must be present in the selected scenario folder. (See Chapter V)

b) The original (trajectory) scenario must be compiled using the "3Channel +FRUIT" option set, since this limits the RES channels to 3 and allows channel 4 to generate FRUIT. (See Ch IV 2.2.7)

c) The "**FRUIT?** " button on the RES main must be set. 

This button can be set and reset during generation, enabeling or disabeling the FRUIT.

The **FRUIT?** button will be grayed (disabled) if the "3Ch+FRUIT" option was not originaly set in the RES preferences during the scenario compilation.

12. The RES Controller tool is stopped by clicking the  button.

6.0. Interrogation Viewer

6.1. Introduction

The Interrogation viewer tool is used to examine recorded interrogation/Reply data. This data can either be recorded by the ESG (see above) or can be created from the Analyse Pulse Recording tool.

The tool allows the visualisation of interrogations versus time or scan number in a Δt-t diagram (stagger pattern).

The tool can retrieve data from file or can run real time getting its data straight from the RES.

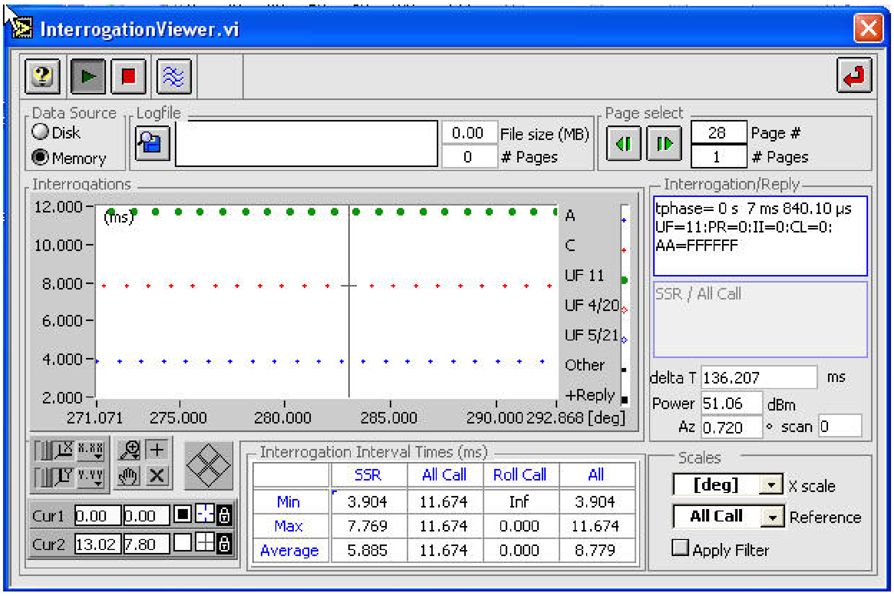
A more detailed analysis of the data can be performed using the “Interrogation Analyser”, described in Volume III, chapter IV Interrogation Analysis.

6.2. Using the Interrogation Viewer

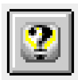
The RES Main control tool can be loaded from the RASS-S Toolbox.

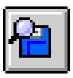
1. The Interrogator Viewer Tool can be called from the RES Main Control by clicking the **View**  button.

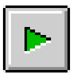
2. Now the tool is loaded.

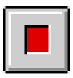


3. The tool is controlled by the following buttons:

 Show help window.

 Load an existing interrogation file from disk (only in “file” mode).

 Start the monitoring of the RES data (only in “Memory” mode).

 Halt the monitoring of the RES data (only in “Memory” mode).

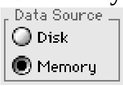
Filter the interrogation data for displaying purposes.

Scroll 1 page (64 interrogations) backward in the file.

Scroll 1 page (64 interrogations) forward in the file.

Quit the Interrogation View tool.

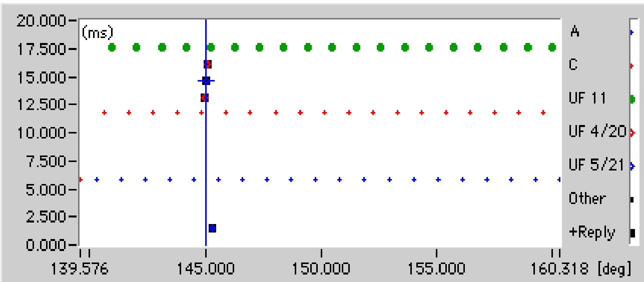
4. Start by selecting the Source for the data.



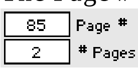
In case the source is “Memory”, the data is read directly from the RES. In order to get proper data, the RES must be running a scenario. If no RES is connected and the interrogation viewer is started, no data is shown.

Now start the tool by clicking the **Start** button. The data will continuously be read and displayed in the graph. The continuous reading of the data can be halted by deselecting the **Start** button or by clicking the **Halt** button.

In this pause mode, it is still possible to retrieve previously recorded data, simply by clicking the **Previous page** or **Next page** buttons.

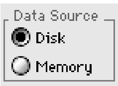


The Page # control can also be entered manually to scroll trough the recorded data.



The # Pages control determines how many pages (of 64 interrogations) are read and displayed.

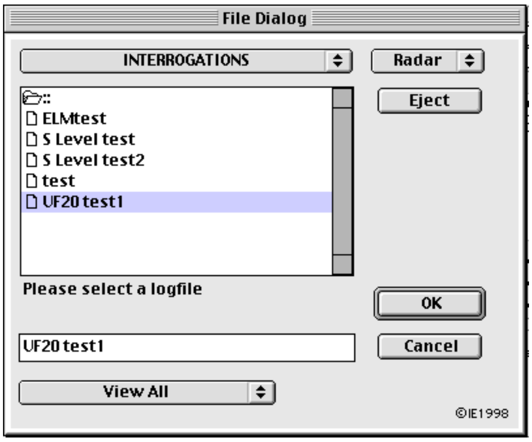
5. In case the data source is “Disk”, the operation is less complicated.



Here the **‘Start’** and **‘Halt’** buttons are dimmed, and the tool must be controlled using the **Previous page’** or **Next page’** buttons.

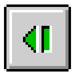
First, select a file using the **‘File’**  button.

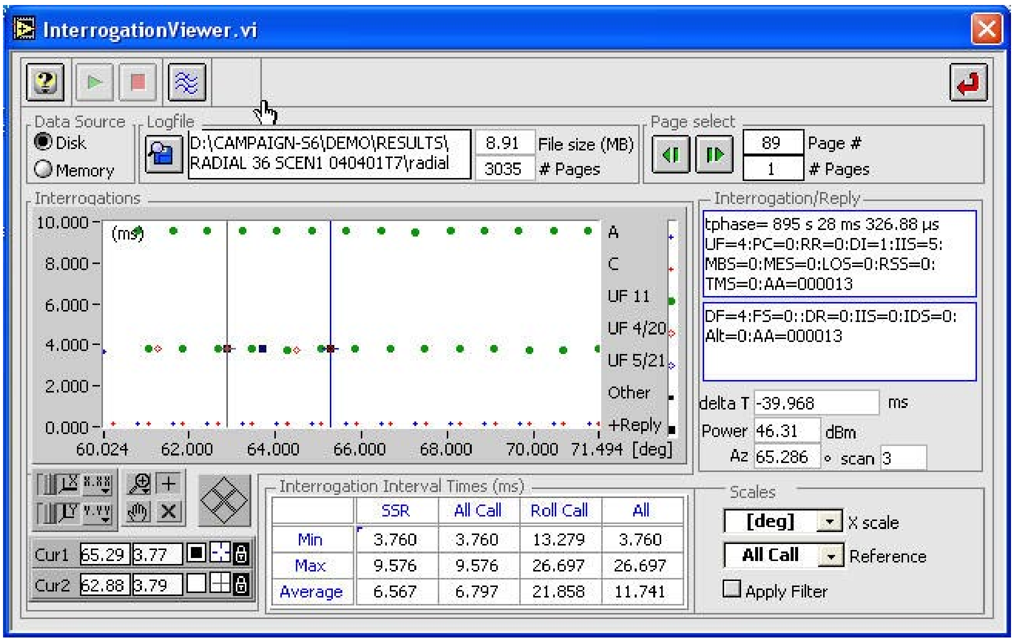
The following file dialog will appear:



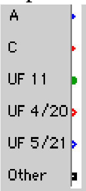
Select a file and click the **‘OK’** button.

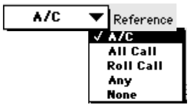
The File size in Mb, in number of pages (recorded in blocks of 64 interrogations) and the filename is given in the Log file information field:

Now page trough the data by clicking the **‘Previous page’**  or **‘Next page’**  buttons.



6. The Graph represents each recorded interrogation as a dot. The colour and type of dot represents the type of interrogation:



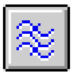


The X axis of the graph is an azimuth scale. The Y axis is the time between two interrogations. The exact interpretation depends on the "**Reference**" control.
There are four modes:

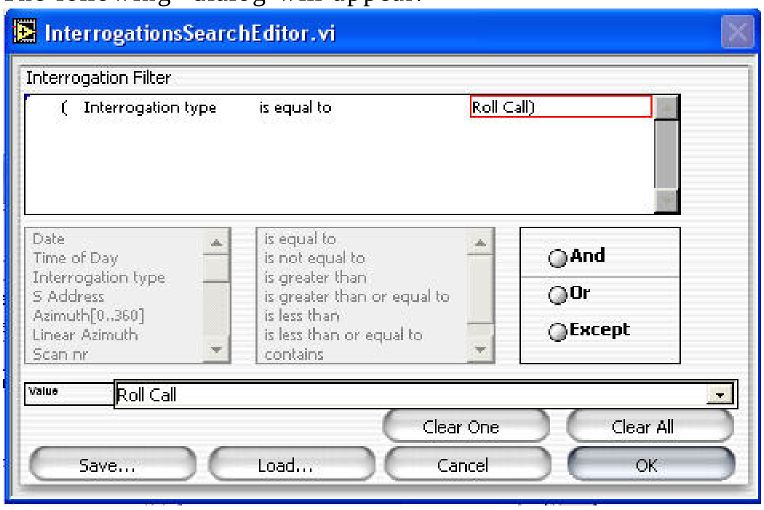
AC:	The Y axis time is the time of the drawn interrogation minus the time of the last encountered A or C interrogation.
All Call:	The Y axis time is the time of the drawn interrogation minus the time of the last encountered All Call (UF11) interrogation.
Roll Call:	The Y axis time is the time of the drawn interrogation minus the time of the last encountered Roll Call interrogation.
Any:	The Y axis time is the time of the drawn interrogation minus the time of the last encountered interrogation (Any type) .
None:	The Y axis time is the time of the drawn interrogation minus the time of the first interrogation in that window section .

7. The interrogations can be filtered, for example to look at the interrogations of to single target. In order to apply the filter, enable the **'Apply Filter'** 

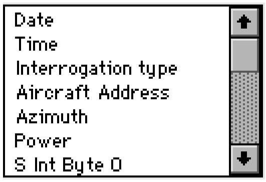
button.

Next, click the **'Filter'**  button to edit the filter conditions.

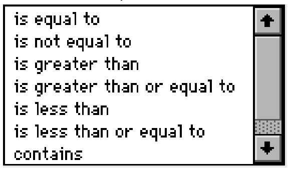
The following dialog will appear:



A filter consists of four functional blocks. The first block is the object of filtering. Choose an object of the list. Use the scroll bars to page through the list and click the wanted item.

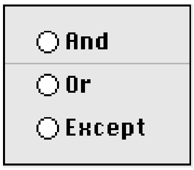


The chosen item is automatically transferred to the filter and the next block, the condition, is enabled. In the same way, select a condition from the list.



The chosen item is automatically transferred to the filter and the next block, the value , is enabled. Type in the desired value and hit the return key.

The chosen value is automatically transferred to the filter and the next block, the logical connection, is enabled. Select a logical operator from the list.



The chosen value is automatically transferred to the filter. This process is repeated until the filter setting is complete. A filter setting can saved to disk with the **Save...** button or recalled from disk by clicking the **Load...** button.

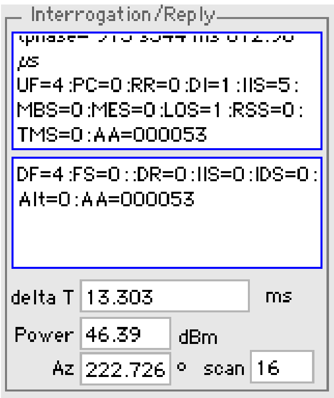
Clicking the **Clear One** button will clear the selected line from the filter setting, clicking the **Clear All** button will clear the complete filter setting. The **Cancel** button will close the window and ignore all changes.

8. The average, Maximum and minimum timing between SSR interrogations (1,2,A,C), All call interrogations and Roll Call interrogations are calculated for the presented section of data. The result is shown in the Interrogation Internal Timing field:

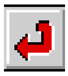
Interrogation Interval Times (ms)

	SSR	All Call	Roll Call	All
Min	5.875	17.587	1.466	1.466
Max	11.712	17.587	89.387	89.387
Average	8.868	17.895	31.750	19.504

9. If the graph contains Roll calls, the user can query on these roll calls and see the generated reply to these roll calls. This is done by positioning the cursor on such interrogation. The interrogation display will then present you with the detailed decoded interrogation data (UF,PC,etc..) , the reply display will present you with the decoded reply data. Beware! The RES only saves the first 32 bytes of the reply, so replies containing MB or MD data will be cut off at bit 32.



10. Using the two cursors in the interrogation viewer (Blue and Grey) , you can query on the time difference between the two cursors. This can be handy to know the time between e.g. two roll call interrogations, or to measure the stagger time of the SSR interrogations.

11. Leave the viewer by using the **return**  button. For RES operation, the tool can remain open while the RES is operational, and can as such be used a s monitor function for correct RES operation.

7.0. The Mass-Compile tool for Scenarios.

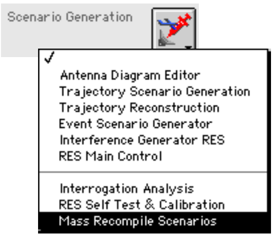
7.1. Introduction

When you have created many scenarios, it might happen that you want to use these scenarios for an different RES that the one you originally created it on. Each scenario was compiled for a specific RES. For this purpose, the RES's own calibration tables (RIU calib tables) are used. This means that scenarios MUST be recompiled when switching RESes. This action can now be automated.
The tool can (Since v 4.3.3.) also be used to modify a number of "vital" parameters for the scenario, such as Antenna diagram used, trigger level, Coupler loss, Mode S DAC setting and Radar MTL.

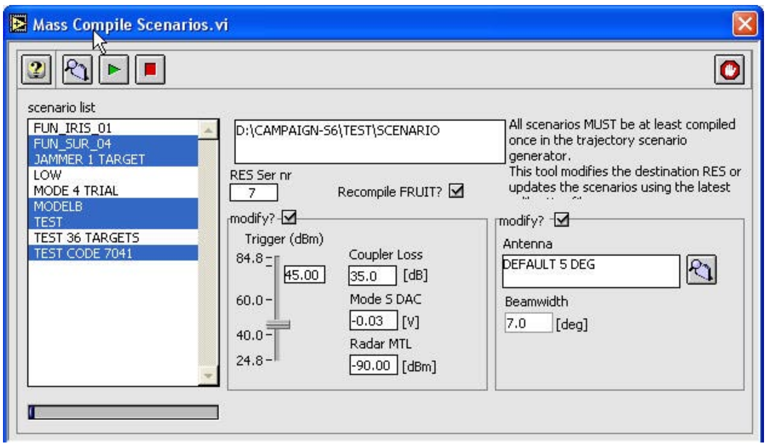
This can be done by using the "Mass Compile Scenarios" tool.
The tool allows you to select a Folder with many scenarios. Then, you can select a number of these scenarios and recompile them all at once.
A number of conditions apply:
-The scenario folders must contain correct parameters, e.g. Antenna diagrams, Trigger levels. etc..
-The scenarios must have been compiled once before in the Trajectory scenario generator.
(The Mass compiler tool uses the S4TJ file for re-compilation).
-st set the new RES serial number.

7.2. Using the Mass-Compile tool

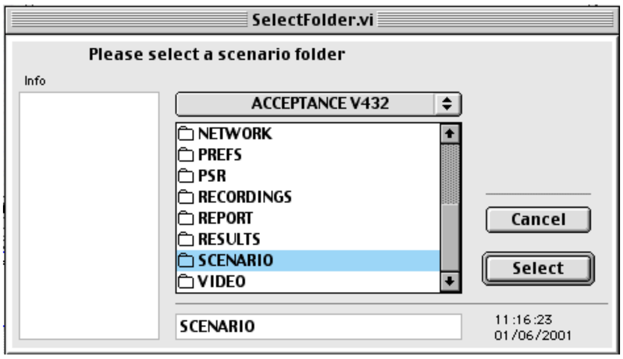
1. Load the Mass Compile tool using the RASS-S toolbox.



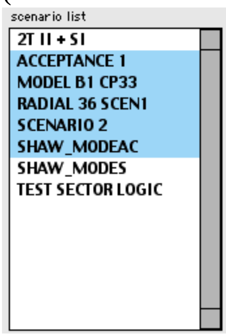
2. Run the tool.



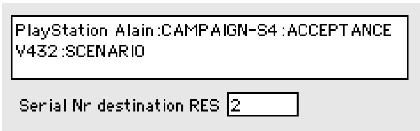
Next, Select a scenario folder



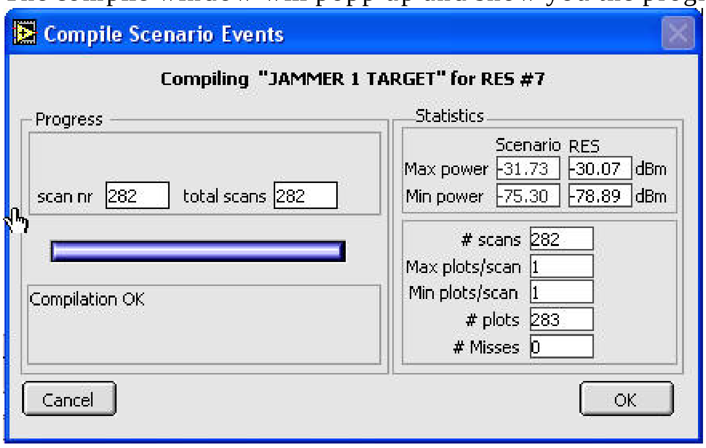
Next, Select the scenarios you want to compile:
(Use shift-click to select multiple scenarios:)



Next, enter the new RES serial number and all relavant parameters:



Finaly, click the START button 
The compile window will popp up and show you the progress of the compilation.



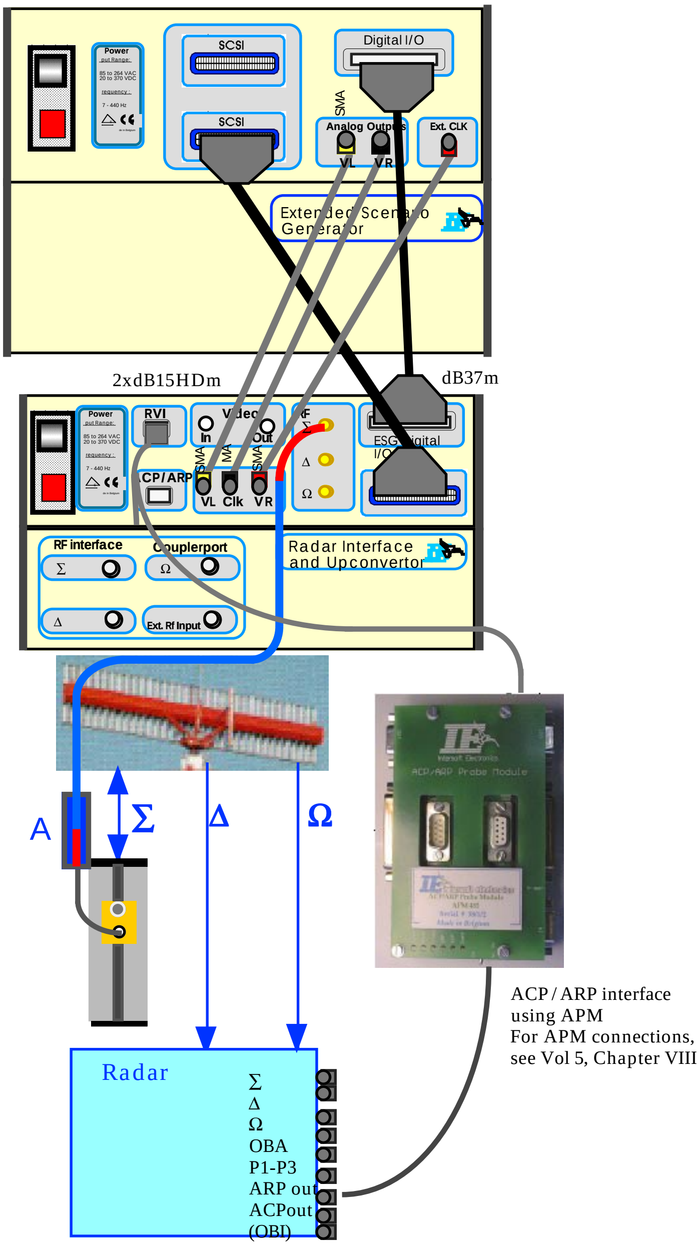
8.0. The RES Interrogation Recording Tool for Live Usage

8.1. Introduction

In some cases, we need to record the interrogations of the radar when it operates in Live mode. This can be done eighter by using the RES or the RFTS in interrogation recording mode.

In previous versions, this had to be done by running an “empty” scenario. This is no longer required. The new software handles the recording independantly from a scenario and provides compatible files for the interrogation analysis and Time merger and L:inker (DLF analysis).

8.2. Connections



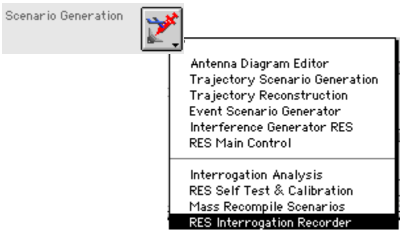
The RES must be connected to the radar with its Sum RF port (for interrogation decoding) and it needs ARP / ACP information. A typical connection diagram is shown here.

For a more detailed connection diagram, including the EDR for data recording (e.g. for use with PTE P5) , We refer to Vol 4, Chapter X, which describes the connections.

8.3. Software

The RES Interrogation recording software is used to record the interrogations.

1. Load the tool

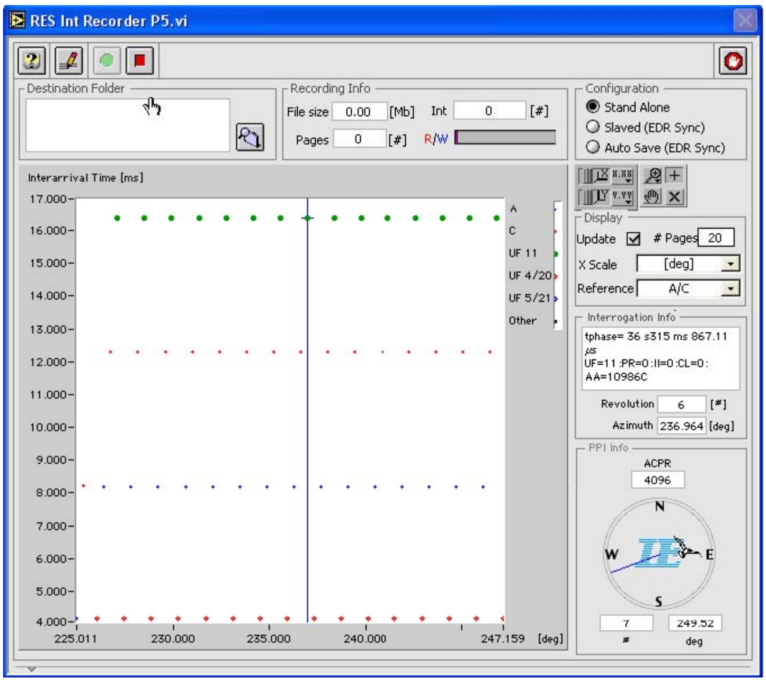


2. Run the tool while the RES is connected to the Radar. Make sure the RES is fed with ACP / ARP data either via an APM or RVI.

The "interrogation" window will immediately show the decoded interrogations if the "Display" checkbox is marked. If the decoding is not correct, reset the trigger level of the RES.

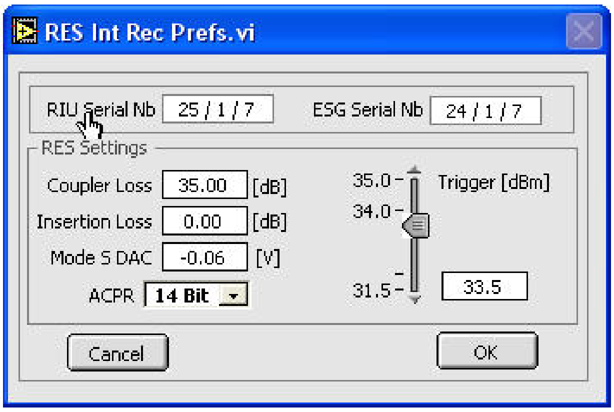
You can select the X scale and refrence for drawing the graph in the same way as in the RES interrogation Viewer.

The "PPI info" shows the rotational information (ACP / ARP) . If this doesn't turn, make sure your ACP / ARP signals are correctly connected.



3. Before starting the recording, first set the RES trigger settings correctly. Therefore

click the **preferences** button. 
following window will appear:



Select the trigger level ±15 dB below the radar output power (typ 60 to 63 dBm), so a value of 45 dBm is good.

Enter the correct "coupler loss" in the prefs window. This is the total attenuation between the RES and the radar output (including the 20 dB sliding coupler if applicable) .

Enter the correct "ACPR " (number of ACPs per revolution.)
12 bit is 4096, 14 bit is 16384 and 16 bit is 65536 ACPs per revolution.

Click Ok to leave the window.

4. Next, select the recording Mode:

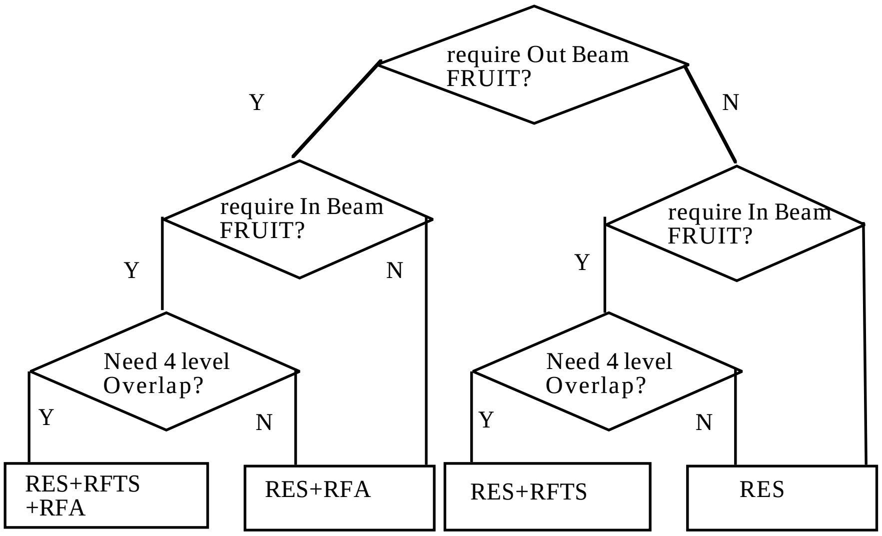
-Stand Alone: The recording starts and stops using the Record buttons of the tool
-Slaved EDR: The Recording starts and stops simultaneously with the EDR, given that the EDR computer and the RES computer are linked using the network
-Auto Save (EDR Sync) : The recording starts simultaneously with the EDR, and creates interrogation files every N minutes, as set in the EDR recording software.

5. Then start the recording using the record button.
The RES will create interrogation files every period defined by the EDR recording software.

Chapter V: FRUIT Generation

1.0. Introduction

The generation of FRUIT in the PTE project can be performed by three different equipment:
The RES, RFA and the RFTS.
The RFA Interference Tool is intended for generation of out beam FRUIT and/or CW interference scenarios.
The RFTS Interference Tool is intended for generation of in beam FRUIT and/or CW interference scenarios in those cases where all 4 RES channels are required.
The RES Interference tool is intended for generation of in beam FRUIT and/or CW interference scenarios in case where 3 RES channels for target injection are sufficient.
The figure below shows you how to select which equipment you require:



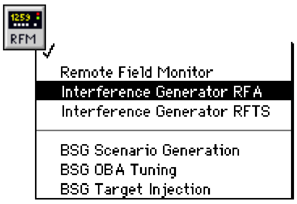
All tools have an easy to use identical MMI to enter the interference specifications. After compiling, the scenario is downloaded to the Radar Field Analyser (RFA) or Radar RF Test Set (RFTS) for injecting the interference signals in the RF section of the radar. For the RES, a FRUIT file (identical to the filetypes used for standard target injection) is generated and added in the scenario folder. The FRUIT scenario is downloaded and run using the RES Main tool. For this to hapen, the trajectory scenario obviously must be compiled for 3 channel + FRUIT operation, since target generator 4 is ocupied by the FRUIT program and can not be sceduled by the trajectory scenario.

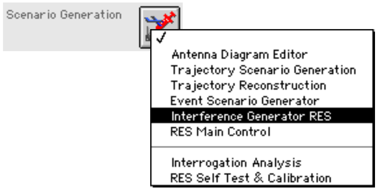
In this paragraph the use of the Interference Tool is discussed by using snapshots of the different front panels. The functional operation is explained step by step with several examples. The user interface can be used the RES, RFA and RFTS. In the case where there are differences, this is noted.

2.0. Use of the Interference Generator

The Interference Generator tools can be loaded from the RASS-S Toolbox.

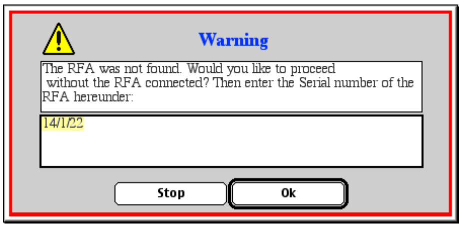
1. To load the RFA Interference Tool, select "RFA Interference Generator" from the "RF" menu. To load the RFTS (in beam) Interference Tool, select "RFTS Interference Generator" from the "RF" menu.

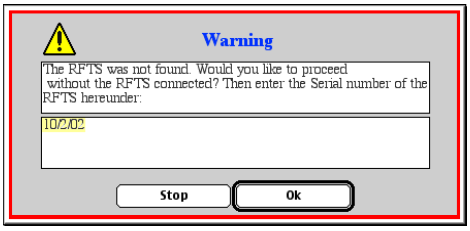


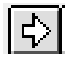


To load the RES interference generator, use the RES interference generator from the "Scenario Generation" menu.

When you run the RFA or RFTS fruit generators and no equipment is connected, you will see the following message: Enter the serial number of the RFA or RFTS before proceeding. This allows you to perform the scenario generation without the equipment being connected.



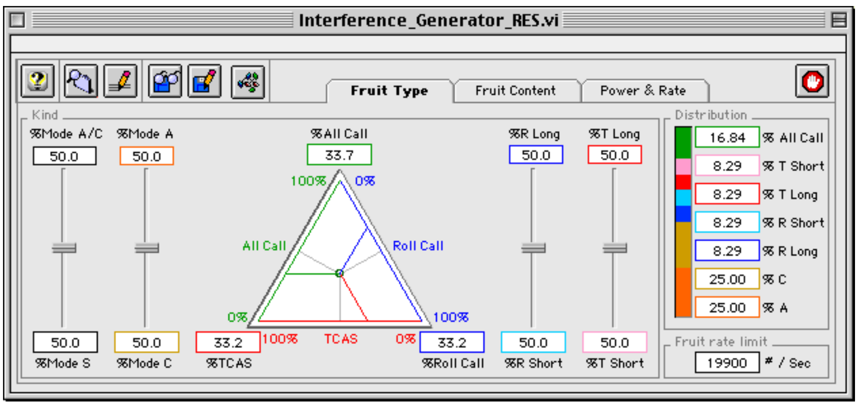


When the loading is finished, start the tool by clicking the  button in the upper left corner of the window. Make sure the RFA or RFTS is connected to the SCSI port of the computer. The compilation for the RES is independant from the tool, so the RES must not be connected.

The Interference Generator software (in Three versions : Interference Generator_RES,Interference Generator_RFA and Interference Generator_RFTS) is used to set FRUIT Type, FRUIT Content, and Power and Rate to select the characteristics of the out of beam FRUIT to be generated by the RFA.

The Interference generator window has three "views", (Fruit type, Fruit Contents and "Power & rate") which can be selected using the tabs.

When selecting a FRUIT composition, the software will recalculate the 'Fruit Rate Limit' which is displayed in the left corner of the FRUIT Type window.



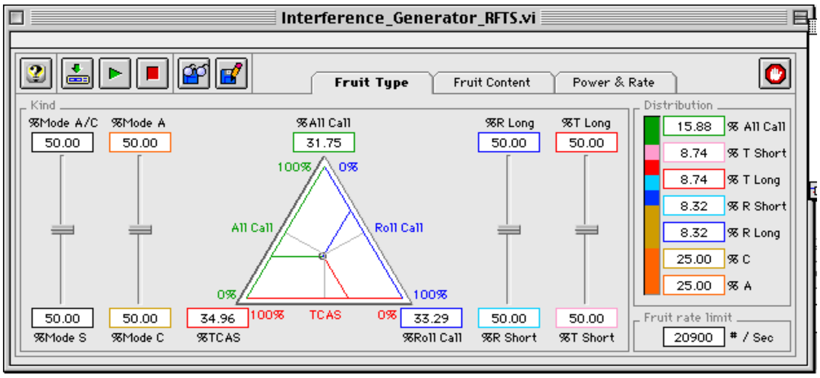


fig.3.1 : FRUIT Type setup window.

Calculation of this limit is performed according to the selected percentage of each type of FRUIT, and the associated reply duration.

In the tests is always a test at maximum rate included.

The FRUIT Content window allows you to select the code information contained in the generated FRUITs.

For both Mode A en Mode C, a limited code group or the complete code group can be randomly generated.

For Mode A FRUITS the possibility is available to generate A codes with a minimum number of bits.

For Mode S, the II code contents can be selected, in percentage. The codes inserted into the II fields to be generated randomly can be selected using a checkbox.

The relevant information to these tests is the Mode A information. It is setup so that only A code 7777 is generated. The other settings are left default.

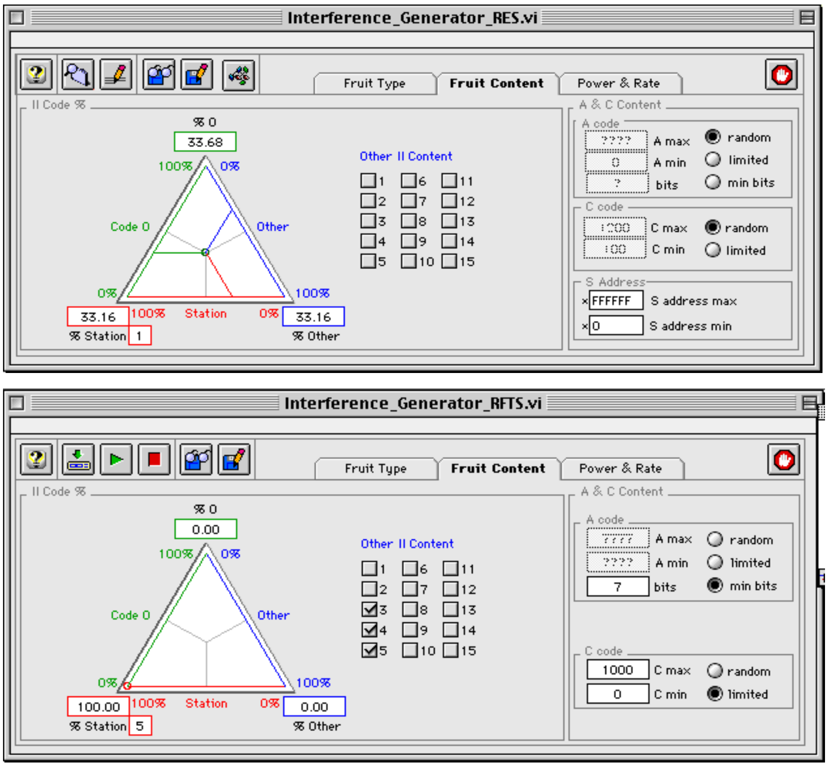


fig.3.2 : FRUIT Content setup window.

The Power & Rate window allows you to select Generation Frequency, Max. and Min. Reply Power, Max. and Min. CW Power, Reply Rate in a defined sector and out of that sector, and Reply Distribution vs. time.

CW signals will only be generated in a defined sector. A sector can be defined at the 'Sector' section at the right of the window. The dial represents one complete revolution and the instantaneous angle is continuously indicated. The revolution time can be selected (default 12 sec), and at the top portion the start angle and the sector size can be filled in. The selected sector is indicated in green.

All tests have been performed in sector and out sector (360 degrees), except for the CW related tests, these all have been executed using a 360 degrees sector.

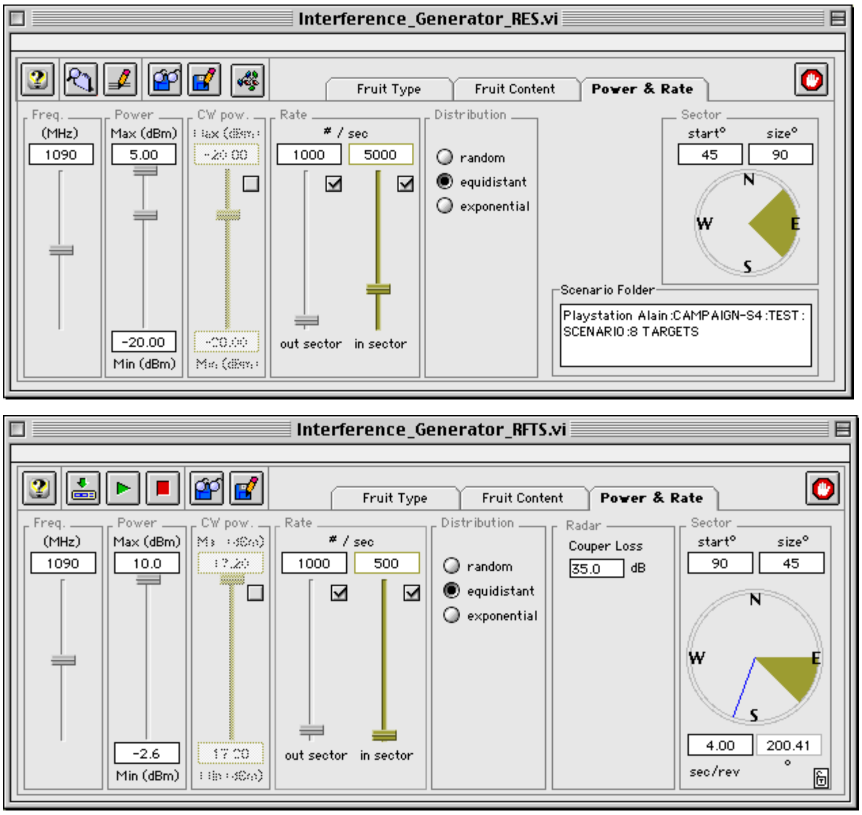
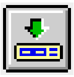


fig.3.3 : Power & Rate setup window.

The lock in the right bottom corner must be switched on in case the Interference Generator has to lock onto the ARP signal coming from the radar under test (which is surely the case when a sector is used).

Notice that the top row buttons are identical for the three panels. These buttons perform a number of functions to operate the Interference Tool:

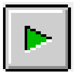
Show help window.

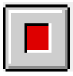


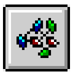
Download interference scenario to the RFA or RFTS (via SCSI).

Select a Scenario Folder (For the RES)

 Change the RES preferences (e.g. Coupler losses, etc..)

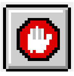
 Play interference scenario in RFA or RFTS (RF injection).

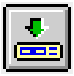
 Stop interference scenario in RFA or RFTS (RF injection)

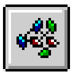
 Compile the scenario and write it to a scenario file (RES only)

 Save interference scenario to disk.

 Load interference scenario from disk.

 Stop Interference Tool (does not stop the scenario in RFA).

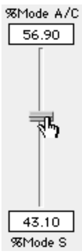
Notice that the  button is dimmed during the first three revolutions after the start up of the Interference Tool. Therefore no interference scenario can be downloaded to the RFA during that time.

For the RES, there is no need to download a scenario, but the user must first select a scenario folder using the Select Scenario Folder  button. Next, he can compile the scenario to a file using the Compile  button.

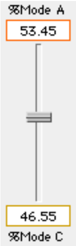
At start up the controls on the front panels are in their default setting. The default front panel is the FRUIT Type panel. All controls can be set in randomly order, no hierarchical or chronological order has to be respected.

On the FRUIT Type panel, the following settings are possible:

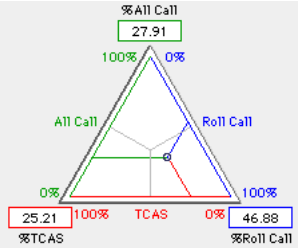
Percentage of Mode S and Mode A/C FRUIT.



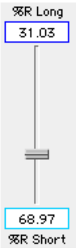
Percentage of Mode A and Mode C FRUIT for the percentage of Mode A/C FRUIT.



Percentage of All Call, Roll Call and TCAS FRUIT for the percentage of the Mode S FRUIT. The percentages can be changed by moving the intersection point of the green, red and blue line in the triangle.

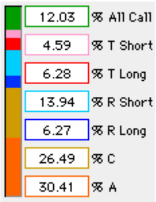


Percentage of Long Roll Call and Short Roll Call FRUIT for the percentage of the Roll Call FRUIT.



Percentage of Long TCAS and Short TCAS FRUIT for the percentage of the TCAS FRUIT.

All percentages are instantaneously calculated and updated when new settings are chosen. The Distribution indicator displays a graphical overview of all the settings on the FRUIT Type panel.

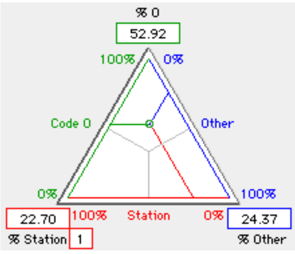


The FRUIT rate limit indicator 

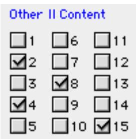
shows the maximal number of FRUITs per second for the chosen settings.

On the FRUIT Content panel, the following settings are possible:

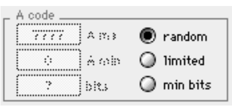
Percentage of station II code, “0” II code and other II codes in the Mode S FRUIT. The stations II code can be set in the Station II code control at the lower left corner of the triangle.

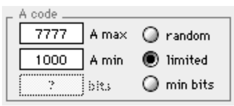


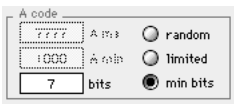
Several other II codes can be selected by clicking their respective check boxes in the Other II Content control. The percentages can be changed by moving the intersection point of the green, red and blue line in the triangle.



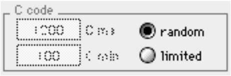
For the content of the mode A FRUIT, there is a choice between a random distribution using the whole range of legal A codes (click the random radio button), a random distribution over a limited set of A codes (click the limited button) and a random distribution of A codes with a minimal number of bits set (click the min bits button). The boundaries for the limited set of A codes can be set using the A min and A max controls. The minimal number of bits to be set can be selected using the min bits control. When the random button is chosen, the A min, A max and min bits controls are dimmed.







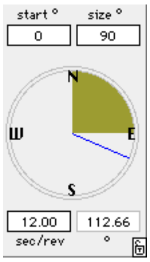
For the content of the mode C FRUIT, there is a choice between a random distribution using the whole range of legal C codes (click the random radio button) or a random distribution over a limited set of C codes (click the limit button). The boundaries of the limited set of C codes can be set using the C min and C max controls. When the random option is chosen, the C min and C max controls are dimmed.

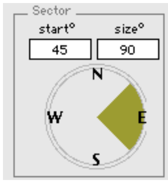


For the content of the mode S FRUIT, ther S adressses are randomely selected between the "S address max" and "S address min" parameters.

On the Power & Rate panel, the following settings are possible.

There are two different sectors for the generation of interference: "in sector" and "out sector". The "in sector" is defined by a start angle and a size angle. The "in sector" is represented in a different colour on the azimuth indicator. The "out sector" is then automatically the full circle minus the "in sector".

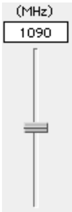




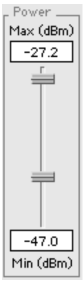
The blue line indicates the current azimuth which is also digitally indicated below the analog azimuth indicator (RFA and RFTS only).
There are two different methods of ACP/ARP generation for the RFA and RFTS FRUIT generation. Either the revolution speed of the Interference Tool is set with the sec/rev control. In this case ACP and ARP are generated internally and the Interference Generator runs asynchronous to the radar. The other possibility is to slave the Interference Tool on the ARP/ACP of the radar under test with the lock to ARP button  in the lower right corner of the PPI indicator. In this case the ARP/ACP of the radar under test is used to synchronise the interference scenario. The ARP/ACP of the radar can be fed to the RFA via the digital input on the back panel.

In case of the RES, the FRUIT is always slaved on the internal RES (16 bit) ACPs, which can eigther be derived from the radar (if RES is in slaved mode) or from the Rotational scenario (if RES is master).

Carrier frequency of the FRUIT and CW.

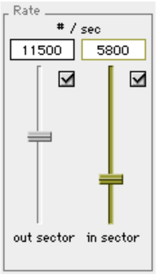


The FRUIT power is randomly generated, defined by a uniform range distribution between the Minimum and Maximum boundaries in accordance with a 20 dB/dec propagation law. The minumum and maximum power values are the powers at the radar input. To determine these correctly, the software needs the user to input the coupler loss between the output of the RFTS or RFA and the input of the Radar. (= Attenuator C + Attenuator D + Coupling factor Coupler C in figure 26 Ch III.)

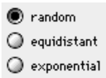


The CW interference power is randomly distributed between the Minimum and Maximum boundaries. When the minimum differs from the maximum, the amplitude of the CW interference signal changes at a 2 KHz rate. CW interference can only be generated "in sector". The CW interference can be switched off with the check box ☑

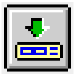
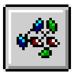
The "in sector" and "out sector" FRUIT rates can individually be switched off with their respective check boxes ☑. Notice that the combination of FRUIT and CW is only possible "in sector". The time gaps between the FRUITs are then filled with CW interference.



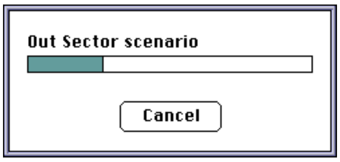
It is possible to chose between a random, an equidistant or an exponential FRUIT distribution in time. The Interference Tool can not generate overlapping FRUIT. Therefore inter arrival times (exponential distribution) smaller than the previous FRUIT length are not possible.

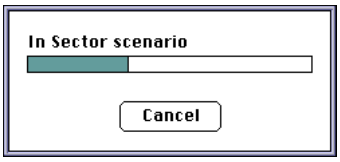


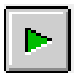
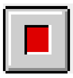
Remember that it is also possible to load an interference scenario from disk with the **'Load'**  button. On the other hand, an interference scenario can be stored to disk using the **'Save'**  button.

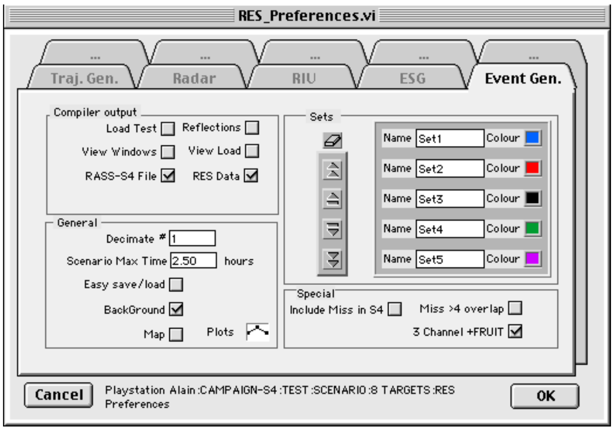
Once all interference parameters are set, the scenario can be downloaded via the SCSI connection to the RFA or RFTS using the  button or can be compiled for the RTES using the  button. (Given that a scenario folder is selected).

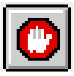
The progress for "in sector"as well as for "out sector" is displayed while the downloading is in process.





When the scenario is downloaded to the RFA, it can be played with the  button and stopped with the  button. The scenario is automatically generated by the RES if the FRUIT file is present in the Scenario folder and if the 3Channel+FRUIT option is active. This must be set from the trajectory scenario generator software (see Vol 5, Chapter IV, §2.2.7.



Once an interference scenario is running on the RFA or RFTS, the Interference Tool can be stopped using the  button, the SCSI connection can be disconnected and the work station can be switched off. The RFA or RFTS keeps playing the scenario as long as it is powered.

The RES FRUIT scenario will start or stop allong with the trajectory scenario if the FRUIT? option is set (See Chapter IV 5.2.7).

Chapter VI : Ground Data Link Processor (GDLP)

1.0. Introduction

This chapter will explain you how to establish a communication link with the POEMS ground station Data Link Function (DLF) interface. This communication takes place using the LAP B/X25 serial communication protocol and makes use of the ASTERIX Cat018 data format for exchanging information.

The GDLP tool streams a data link scenario created with the Event Scenario Generator to the DLF and acts according the DLF-GDLP protocol. For more information about creating data link scenario files, consult chapter IV of this volume, Chapter IV RES Software. The GDLP tool makes use of the EDR (RDR 339) hardware to establish a LAP B/X25 communication link. with the DLF of the POEMS ground station. For more information about the EDR and LAP B/X25, consult chapter IV of Volume 4 Data Recording & Analysis, Chapter IV Serial Communication on LAP B/X25.

2.0. Data Link communication: Checklist

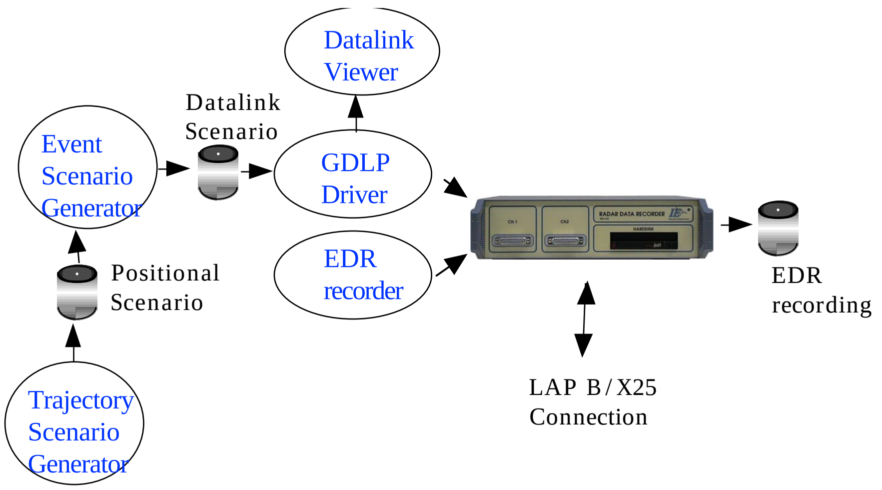
2.1. Procedure

Establishing a Data Link connection will be done in several discrete steps:

a) Create a Data Link Scenario
b) Make a LAP B/X25 communication link
c) Run the Data Link Scenario and record the result

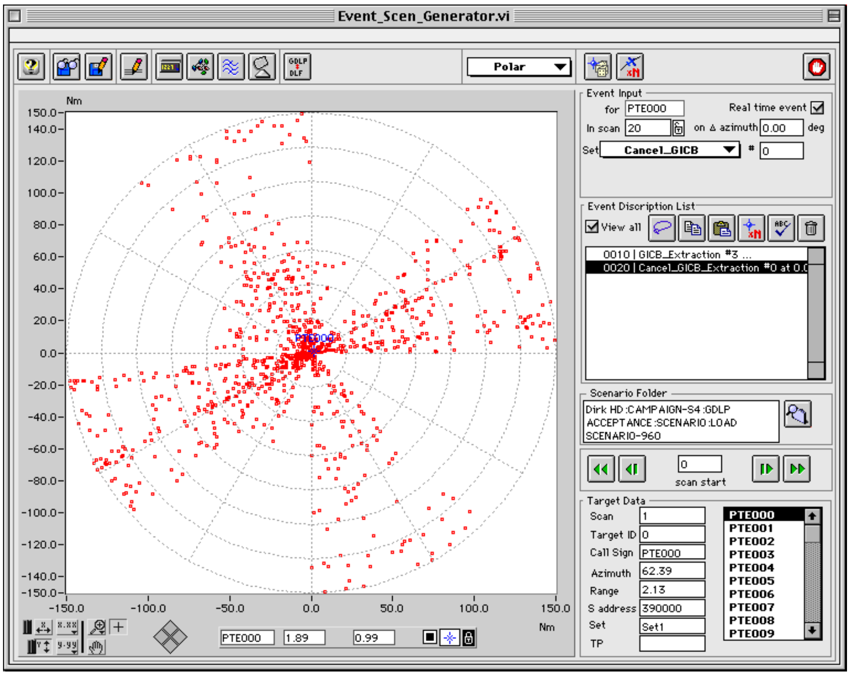
Corresponding to each step one or more tools (virtual instruments) will be used :

a) Trajectory and Event Scenario Generator tool
b) EDR Recording Tool
c) GDLP Tool

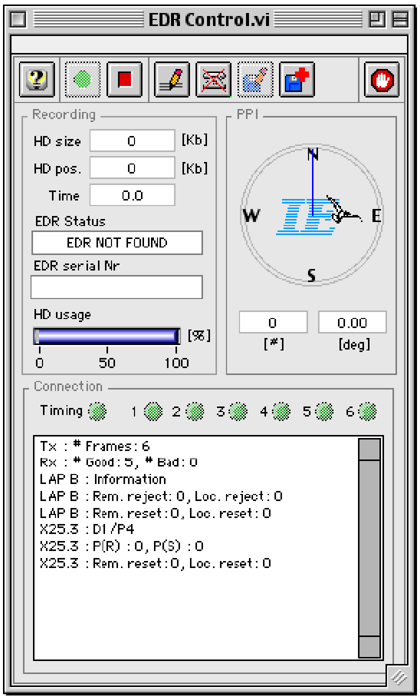


2.2. Creating a Data Link Scenario

A data link scenario is created using the Trajectory Scenario Generator and the Event Scenario Generator software and stored in a scenario folder. It is this scenario folder that is used by the GDLP software. For more information about creating a data link scenario, consult chapter IV of this volume, Chapter IV RES Software.



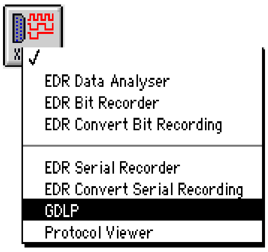
2.3. Making a LAP B/X25 communication link



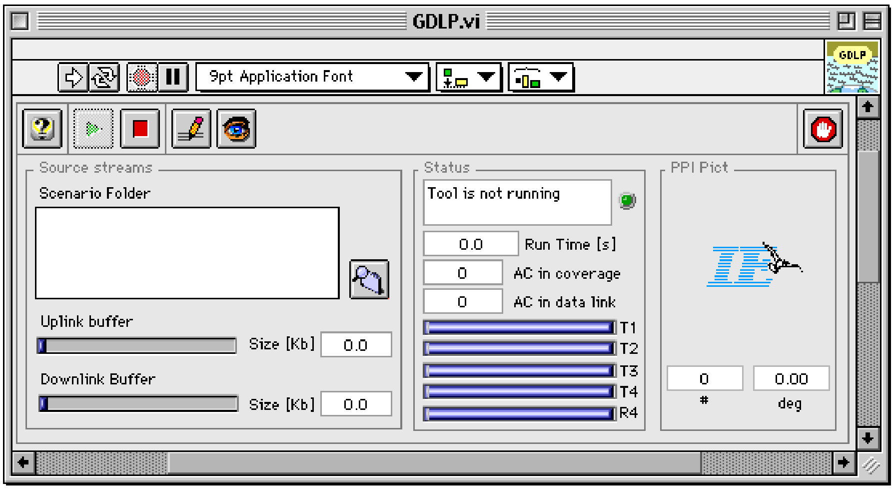
The Extended Data Recorder (RDR 339) is used to make a LAP B/X25 communication link between the GDLP and the POEMS ground station DLF. The EDR Serial recording tool is defines the parameters and sets up the link. For more information about the EDR and LAP B/X25, consult chapter IV of Volume 4 Data Recording & Analysis, Chapter IV Serial Communication on LAP B/X25.

2.4. Running the data link scenario

1. Load the GDLP tool from the RASS-S toolbox.



The following window will appear on the screen.



The user interface of the GDLP tool is divided into several functional panels. At the top of the window, there is a row of buttons to operate the tool.

 Toggle “Help” window on/off

 Start the data link scenario

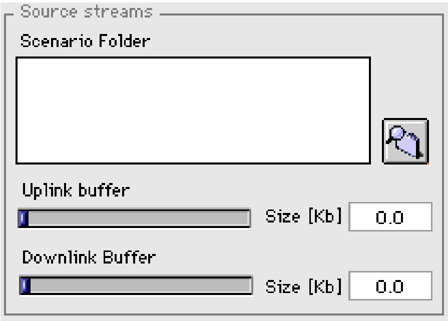
 Stop the data link scenario

 Open the Preferences window

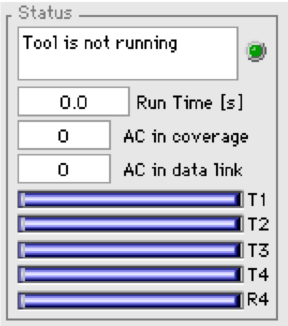
 Open data link viewer

 Stop the GDLP tool

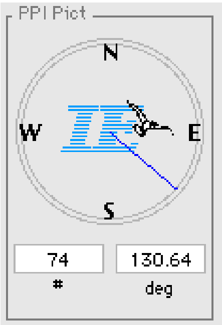
At the left side of the window there is the source streams panel. This panel is used to select a data link scenario folder and to display the size and status of the different data stream buffers.



In the middle there is the status panels which indicates the status of the communication link, the status of the data link and some parameters of the GDLP-DLF protocol (see later)



At the right side there is a PPI panel which indicates the turning information (ACP / ARP).



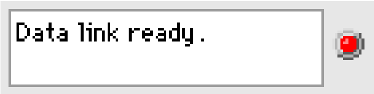
2. Before proceeding make sure you have a data link scenario ready and that there is a LAP B / X25 communication link established with the POEMS ground station DLF interface..

3. Run the GDLP tool using the button in the upper left corner of the window.

4. First thing to do is to select a scenario folder by clicking the **Browse** button or by entering a file path name in the source streams panel. Scenario folders are stored in the *RASS-S Campaigns:Campaign_name:SCENARIO:...* folder.

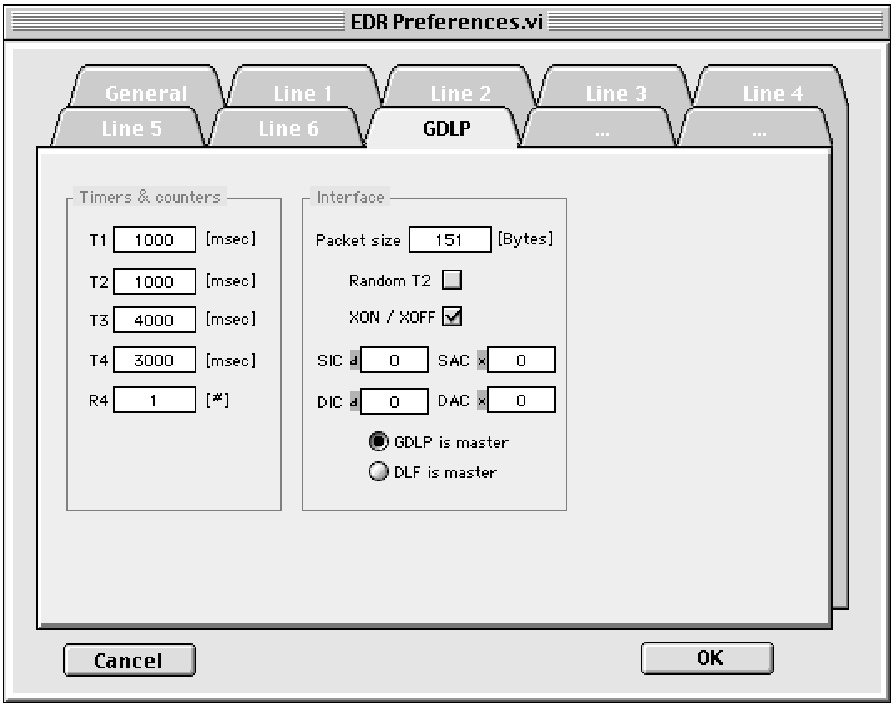
5. If you have selected a scenario folder containing a valid data link scenario and the

LAP B/X25 communication link is functioning, the status panel should indicate the following.



The red LED means that the GDLP-DLF protocol is not yet running.

6. Now click the **Preferences**  button to open the preferences window. The following window will appear.



At the left side there is a Timers & counters panel which allows the setting of the GDLP-DLF protocol parameters.

T1 = associate request retransmission timer
T2 = Keep alive periodicity in the absence of traffic
T3 = GDLP connection time out
T4 = release request retransmission timer
R4 = number of retransmission of release request

Beware when changing these parameters because they can have a major impact on the performance of the data link.

In the middle there is the Interface panel. This panel allows the setting of the following parameters.

Packet size (bytes) = maximum size of the Uplink packets that are send to the DLF.
This is NOT the X25 packet size.
Random T2 = if checked, a random value between 0 and T2 is used during the protocol

Xon / Xoff = if checked, the Xon / Xoff rules of the protocol are followed

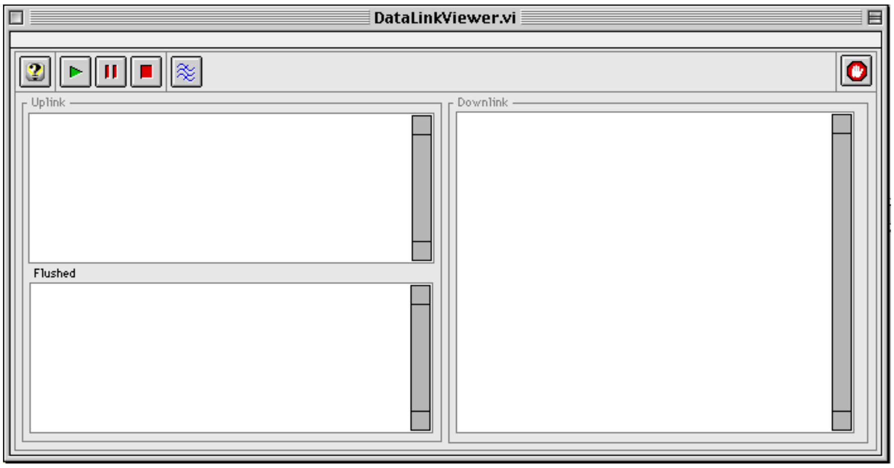
SIC, SAC, DIC & DAC = codes used in the ASTERIX Cat018 for data link.

GDLP is master / DLP is master = if GDLP is master, the GDLP will not obbey to associate and relaease request command send by the DLF until programmed to do so. If DLF is master, the GDLP will slave to the associate and release commands send by the DLF

Click OK to save these settings or click Cancel to discard them and return to the GDLP tool.

7. Make sure that the radar timing signals are connected to the EDR (from the RVI) and that the PPI is rotating. If this is not the case, check the timing signals.

8. Click the **View** button to open the data link viewer window. The following window will appear.



Use the top row button to operate the tool.

Toggle “Help” window on / off

Start the data link viewer tool

Pause the data link viewer tool

Stop the data link viewer tool

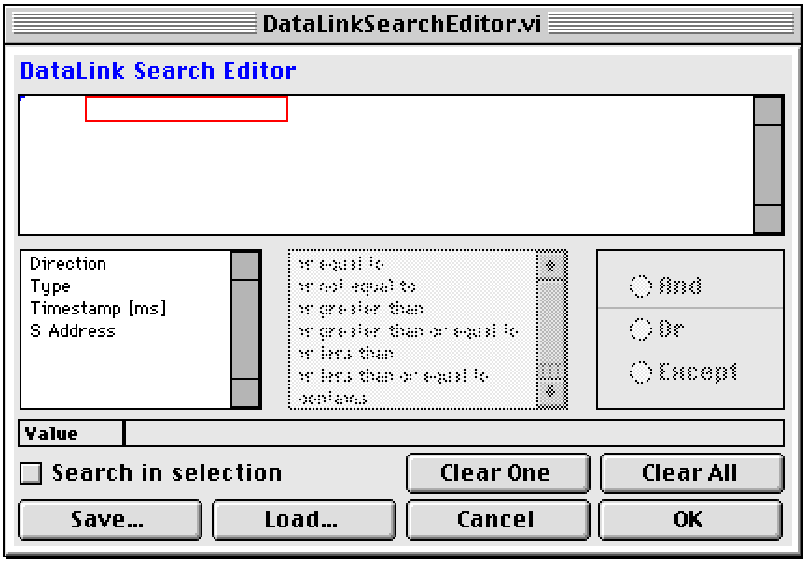
Edit data link viewer filter

Stop the data link viewer tool

The viewer display is divided into three parts: Uplink, Downlink and Flushed. The Uplink display will show all uplink data link transactions (one at a time), the downlink display will show all downlink data link transactions (one at a time) and the Flushed display will show all Uplink data link transactions which could not be executed due to circumstances. Data link transactions are only displayed when the **Start** button is clicked

Notice that the Data Link Viewer runs concurrently with the GDLP tool. This means that it can be manipulated without any interference on the GDLP tool.

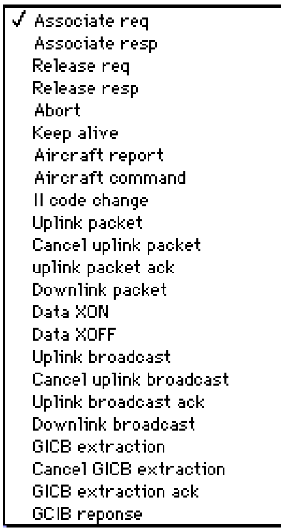
Clicking the  button opens the viewer filter editor window.



This is the standard filter editor layout that is also used in the other RASS-S tools (Inventory). For more information on how to edit such a filter, consult the RASS-S user manual Volume 4, Chapter III Radar Data Analysis. The fields on which can be filtered are:

1. Direction

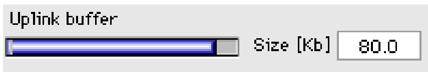
2.Type



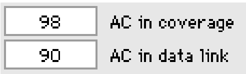
3. Timestamp
4. S Address

The filter can be edited at any time and the changes will take place immediately. Filters can be saved and loaded.

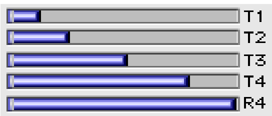
9. Click the **Start** button to run the data link scenario. The GDLP tool is based on ARP/ACP timing signals. As long as they are not present, the scenario is held in a buffer until the ARP/ACP time of transmission for the messages is reached. Therefore, the user can start the GDLP tool and it will hold until the RES is started. This way the datalink scenario and the RES scenario are synchronised. This ARP/ACP algorithm also implies that for each run of the datalink scenario, the serial line needs to be reset in order to reset the ARP counter.



During the data link scenario, the protocol parameters are update continuously on the screen.



AC in coverage are the number of targets announced by the GDLP
AC in data link are the number of targets announced with a Xon status



These are the timers & counters set in the preferences window.

The status indicator will show the different stages of the protocol.

The LED will turn green when the GDLP and DLF are logically connected. From this moment on data link transactions will start according to the data link scenario.

10. The data link scenario can be interrupted at any time by clicking the **Stop** button.

11. The GDLP tool can be stopped at any time by clicking the **Halt** button.

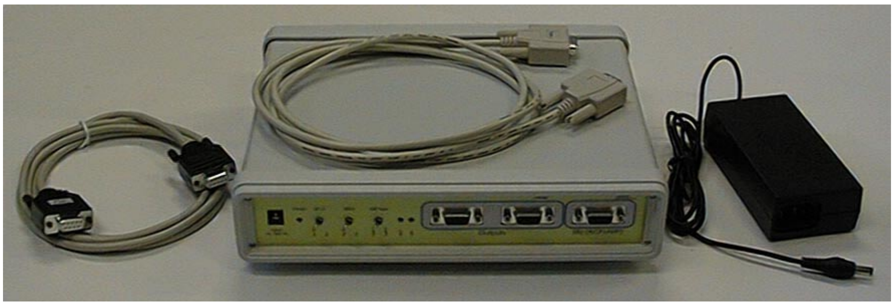
Chapter VII : ACP/ARP Fan out Unit and ACP/ARP Probe Module

1.0 ACP/ARP Fan out Unit

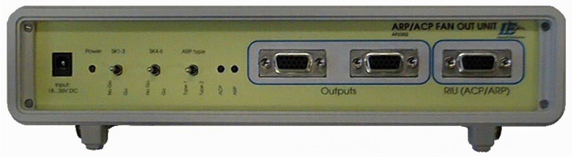
1.1. Introduction

The ACP / ARP Fan Out Unit consists of :

- 1 x AFU box
- 1 x Power Supply (Input AC 100-240V - Output DC 24V)
- 1 x 15p HD SubD female to 15p HD SubD male cable
- 3 x 9p SubD



The unit is meant to transform the ACP / ARP signals of the Radar Interface Unit (RIU) into differential ARP / ACP signals for the radar.

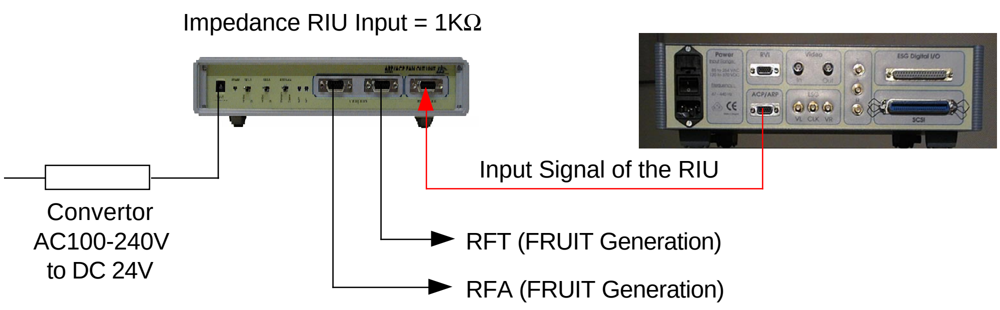


- a connector for the power supply
- a green LED indication if the power is switched on
- a GO-NO GO switch for SK1-3
- a GO-NO GO switch for SK4-6
- switch type 1 - type 2
- a red LED indication if a ARP signal is present
- a red LED indication if a ACP signal is present
- 1 x input for signals coming from the RIU and 2 x signal outputs (T-junction)

The backpanel is foreseen of :
- 6 x 9p SubD connectors outputs to the radar

1.2. Setup

The AFU gets its power through an external power supply, a convertor (18 ... 36V_{DC}). When the power is on, a green LED indicator will light up.



There is also a LED indication for the ARP / ACP Signal. When one of them is present, the related LED will light up.

The type of ARP / ACP can be chosen by using the switch, dependent on the type of radar that is used (Airsys / RCEL).

The signals used as input for the AFU are generated by the Radar Interface Unit (RIU).

The input (CON7) and the two output connectors (CON8 and CON9) form a T-junction.

Each connector at the backpanel is foreseen of a GO - NO GO signal. This signal can be changed by using the 2 switches at the frontpanel.

When the switch is in the “GO position” the “minus PIN” (PIN8) is positive in relation to the “plus PIN” (PIN3).

When the switch is in the “NO GO position” the “minus PIN” (PIN8) is negative in relation to the “plus PIN” (PIN3).

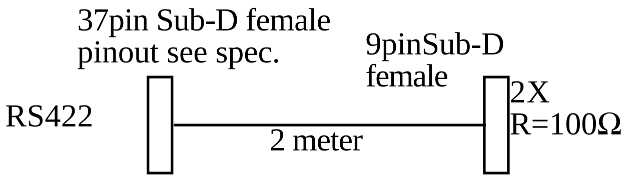
1.3. Manufacturer Dependant Interfaces

Depending on the radar used, the interface cable is different :

1.3.1. Type 1 : RCEL (Raytheon - Cossor)

For the RCEL radar, a DB37 female to DB9 female cable with an output impedance of 100Ω is used.

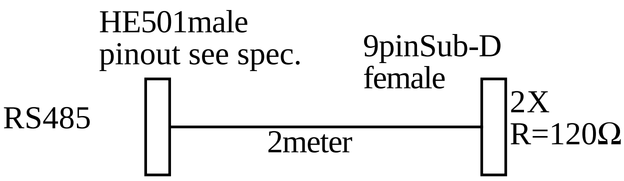
Raytheon Cossor ACP/ARP interface cable



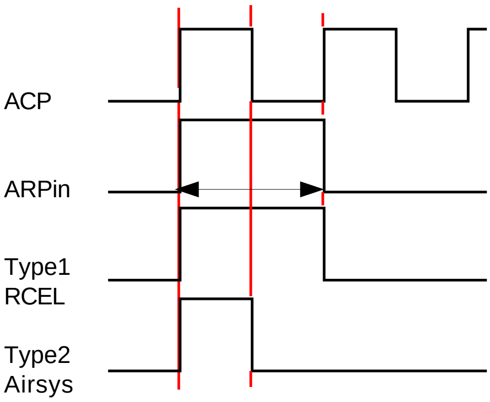
1.3.2. Type 2 : Airsys

For the Airsys radar, the AFU box will be connected directly via standard cables DB9 female to DB9 female (standard cable), with an output impedance of 120Ω.

Airsys ACP/ARP interface cable



1.3.3. Signals

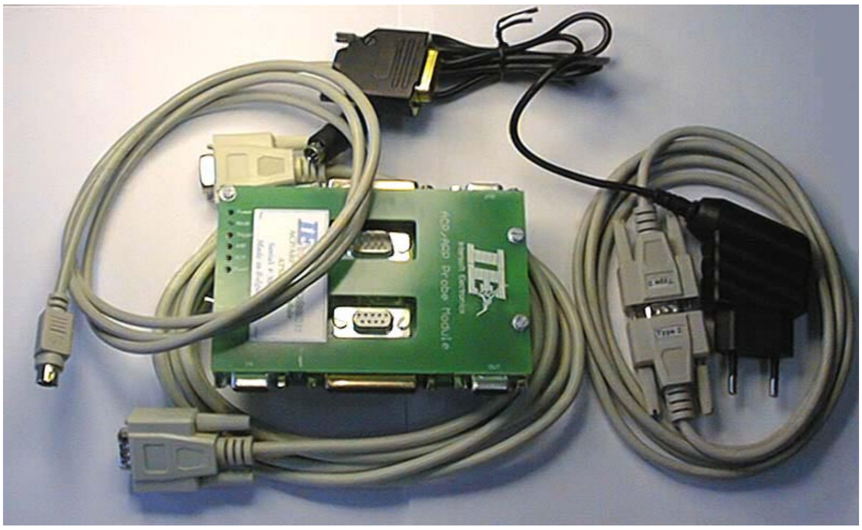


2.0 ACP/ARP Probe Module

2.1. Introduction

The ACP / ARP Probe Module consists of :

- 1 x ACP / ARP Probe Module
- 1 x Power Supply (Input AC 100-240V - Output DC 9V) MiniDin
- 1 x 15p HD SubD male to 15p HD SubD male cable
- 1 x 9p SubD male to 9p SubD female
- 1 x MiniDin male to 15p SubD male



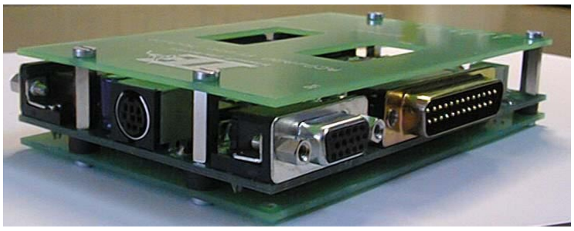
The unit performs two functions:

1. It converts the differential azimuth input to single ended TTL signals
2. It converts the timing of the ARP and ACP so that it is independent of the type of radar (cfr. type 1 and type 2 discussed with the AFU). Note that this was found especially usefull in combination with the EDR, and RES.

When to use the ACP / ARP Probe Module:

1. When using the RES to inject a scenario, and EDR to record the raw, plot and track data, it is best to use the Probe Module, in order to be able to easier synchrozise the data recording with the played scenario for comparison.
2. In some cases it is possible to replace the RVI with the APM. The main difference is that the RVI is absolutely necessary for video recording using the pulse compression mode.
3. Whenever a differential ACP / ARP signal from the radar is to be interfaced with a single ended RASS-S or PTE input.

The ACP / ARP Probe Module connections :



- a MiniDin connector for the power supply input and ACP,ARP,event, and trigger output
- a green LED indication if the power is switched on
- a red mode LED indicating that the internal logic is working
- 4 red LED's, for ACP, ARP, Event, and Trigger
  the ARP, Event, and Trigger LED light up on a change of level
  the ACP led lights up when ACP is high
- a GO-NO GO switch which is not used for this application
- one DB15HD connector marked input for single ended ACP,ARP,event, and trigger input
- a male and female DB9, and a male and female DB25 for diffential ACP,ARP,event, and trigger input. Note that these are meant to put between the radar azimuth cable.
- two DB15HD connectors to output ACP,ARP,event, and trigger to two different loads
- a trimmer to set the trigger level of the Trigger input (so also interfaces to non-TTL triggers)

2.2. Setup and Connections

The pinout and levels of the DB15HD's is compatible with the other DB15HD connectors used by Intersoft equipment:

pin 1:ARP (red) pin2:ACP(green) pin3:Event(blue) pin14:Trigger(black)
pin4,6,7,8,10,11: Gnd
TTL level, 1kOhm input impedance, 100 Ohm output impedance

The pinout and levels of the DB9:

pin1:ACP+ pin6:ACP-
pin2:ARP+ pin7:ARP-
pin3:GoNogo+ pin8:GoNogo-
pin5:Gnd
Differential RS422, 1kOhm input impedance

The pinout and levels of the DB25:

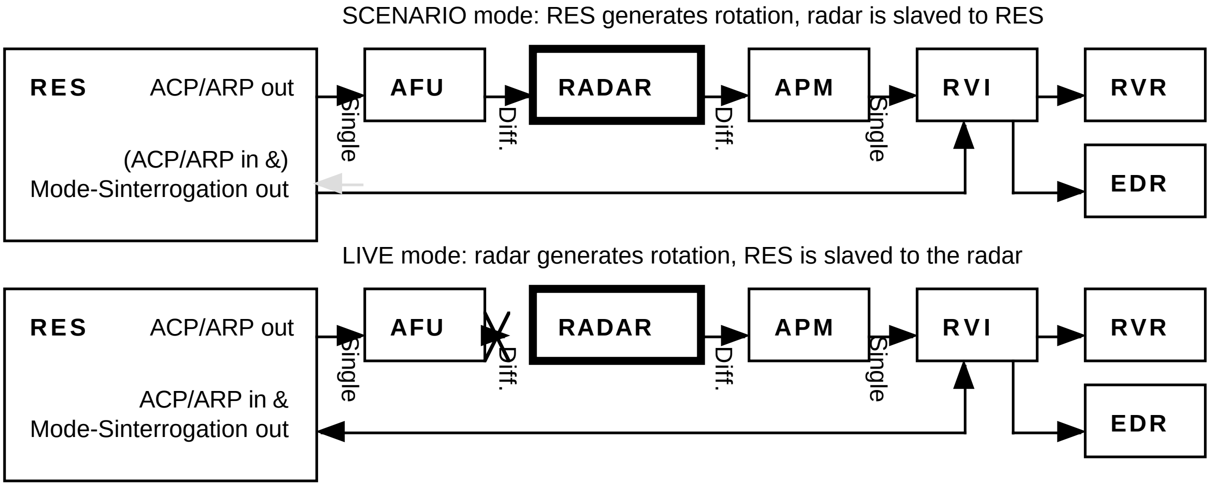
pin1:ACP+ pin2:ACP-
pin3:ARP+ pin4:ARP-
pin9:GoNogo+ pin10:GoNogo-
Differential RS422, 1kOhm input impedance

The pinout and levels of the MiniDin:

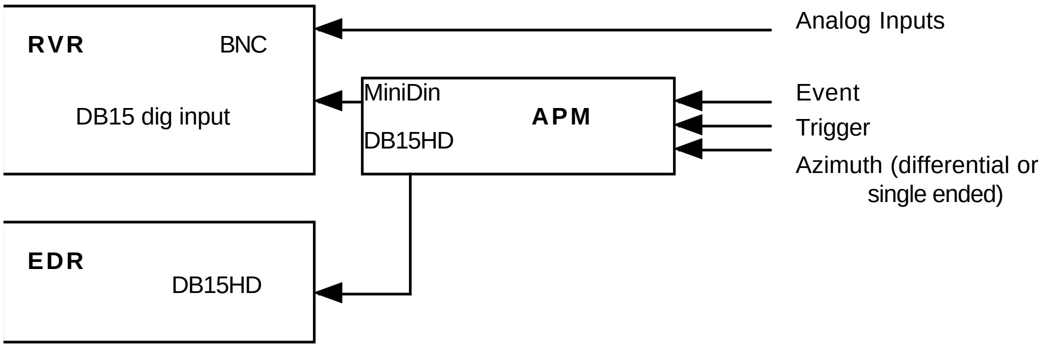
pin1: mode (NC) pin2: Trigger out
pin3:ACP out pin4: Gnd
pin5:-12V pin6:ARP out
pin7: Event out pin8: +12V

The power connection is either made via the power supply, or an other device connected to the MiniDin connector (for example a video recorder).

There are different utilizations possible for the Probe Module. In the following pictures, a connection with the RES setup is demonstrated, and a connection with the RVR.

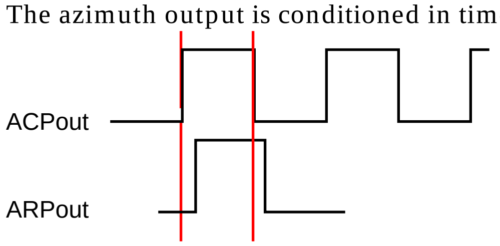


This picture shows the connection of the APM in scenario and live mode of the PTE analysis.



This picture shows a possible connection of the APM ito a RVR and EDR.

The azimuth output is conditioned in time, ARP is generated about 10us later than ACP:



2.3. Cables

Several cables can be used with the APM, the most important once are given below :

2.3.1. DB15HD male to DB15HD male

This cable is used to connect for example the EDR to the APM, or to connect the APM to the digital input of the RVI, or to connect a RFT to the APM, or to connect a RIU azimuth input to the APM.

2.3.2. DB15 to MiniDin

This cable is used to connect the RVR to the APM, note that the RVR is then also acting as power supply.

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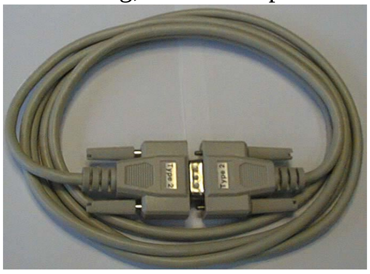
2.3.3. Power Supply

The power supply delivers 9 Volt to the APM via a MiniDin connector.

2.3.4. DB9male to DB9female

This cable connects the differental azimuth lines of the radar to the APM. Before connecting, check the pinout of the radar with the one of the APM.



Chapter VIII: Interrogation Analysis

1.0. Introduction

The Interrogation Analyser tool allows the user to do an in depth investigation of recorded interrogations. These interrogations can be recorded in several ways, namely by the RES during a scenario generation, by the Reference extractor during opportunity traffic recording of from the TTT Interrogation Scenario generator. Extensive filtering and zooming tools make it possible to pinpoint a specific problem. Multiple statistical functions result in an easy analysis of the interrogations.
An difference must be made between the “standard” version interrogation analyser and the P2A version, which adds a number of Transmitter Test Tool specific analysis functions to the palette of this tool. The P2A Interrogation analyser is described in Volume 7.

2.0. Making an interrogation analysis source file

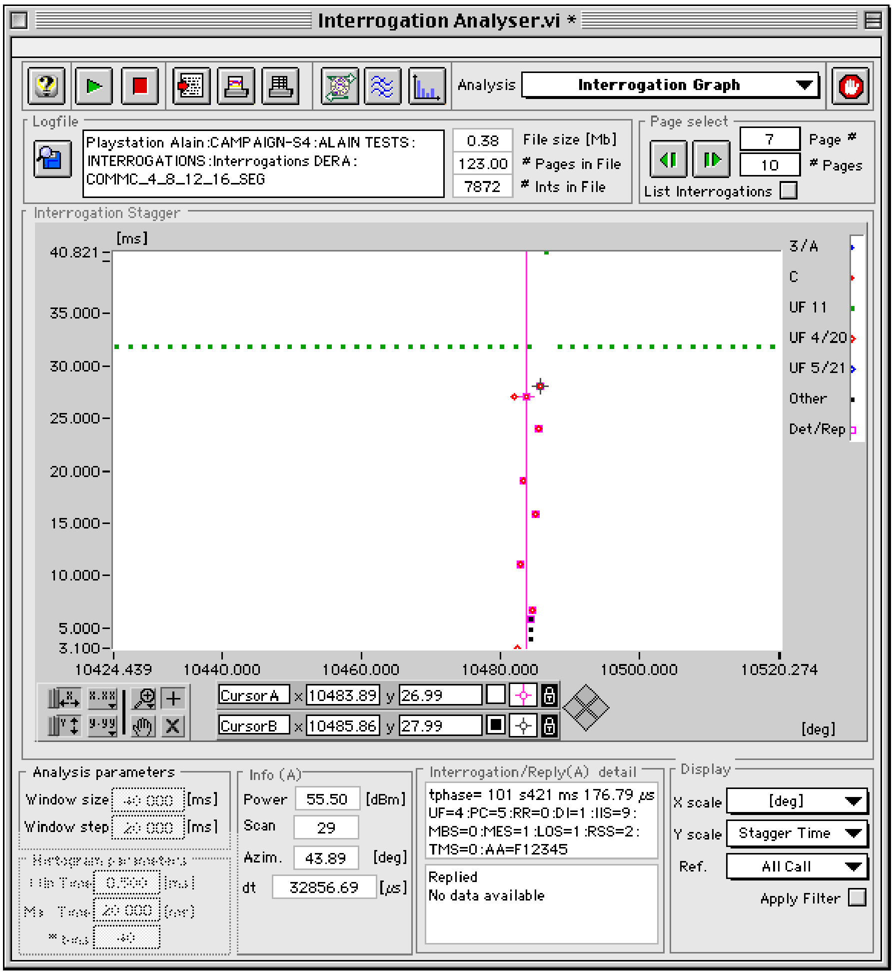
The starting point of an Interrogation Analysis is an interrogation recording file. This interrogation log file can be created with the RES Main Controller tool , it can be the result of a multi level analysis (Reference extractor) or it can be the result of an TTT interrogation Generator session.

More details about making an interrogation log file with the RES Main Controller tool can be found in the RASS-S User Manual Vol 5 Radar Environment Simulation. More details on making an interrogation log file using a multi level analysis can be found the RASS-S User Manual Vol 3 Reply Recording and Analysis.
More details on creating an interrogation log file using the TTT interrogation generator can be found in chapter II of volume 7.

3.0. Interrogation Analyser tool

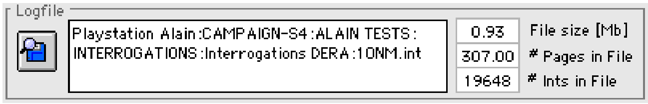
3.1 User Interface Overview

The user interface of the Interrogation Analyser tool is divided into several functional panels. At the top there is a set of buttons and controls to operate the tool.

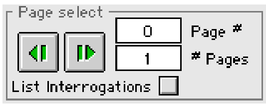


- Toggle “Help” window on/off
- Start the analysis
- Stop the analysis
- Export data to spreadsheet
- Print graph
- Print Table
- Link with multi level analysis
- Edit filter
- Call the histogram function
- Stop the Interrogation Analyser tool

Select analysis type

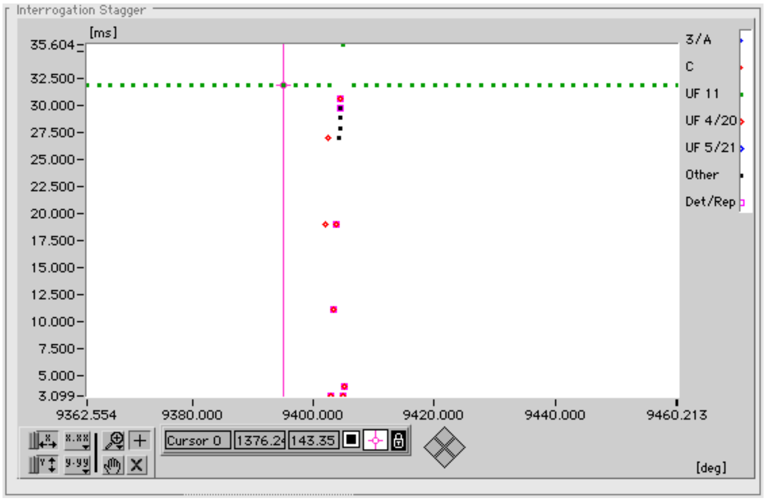


Select interrogation file

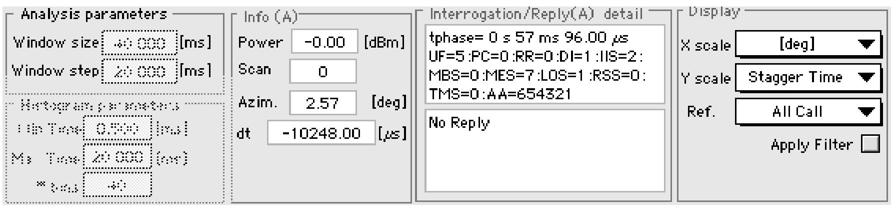


Select interrogations to be displayed

The middle part of the tool displays s a graph/table which presents the results of the analysis.

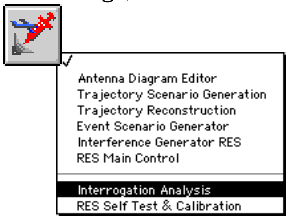


At the bottom of the window there are some analysis and display settings which become available upon selection of a specific analysis type.



3.2 Starting the Tool

1. Load the Interrogation Analyser tool from the RASS-S toolbox.
The standard interrogation analyser, which can be used for RES and Reference extractor recordings, can be found under the "Scenario generation" menu



2. Run the Interrogation Analyser tool using the button in the upper left corner of the window.

3. Select an interrogation log file by clicking the **Browse** button or by entering a file path name. Interrogation recording files are stored in the *RASS-S Campaigns: Campaign_name:RESULTS:...* Folders. (inside a RESULT folder.)

The file size will be displayed in Mbytes and in # Pages. The tool also shows the number of pages and interrogations in the file. A page consists of 64 interrogations

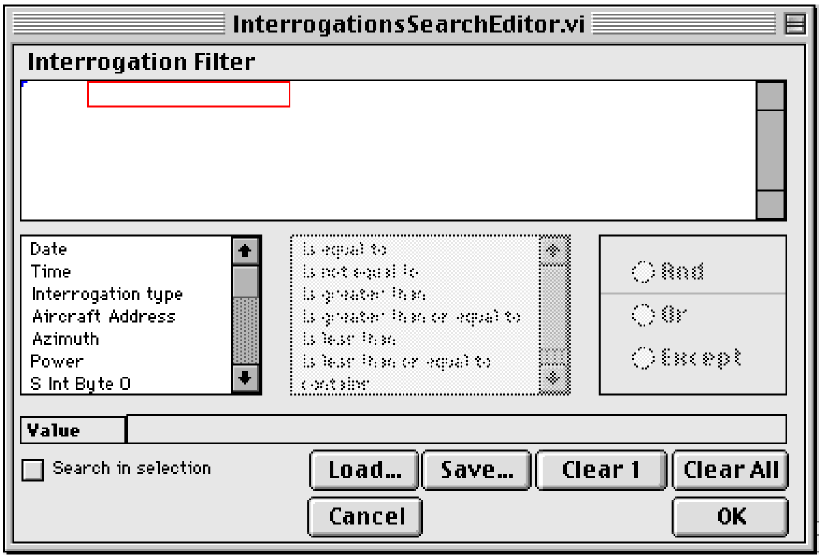
3.3 General Tool Functions

4. A filter can be applied to all data being processed in the the interrogation analyser.
For the filtering function, two actions must be taken:

-The filter must be defined (or loaded from disk)
-The filter must be activated.

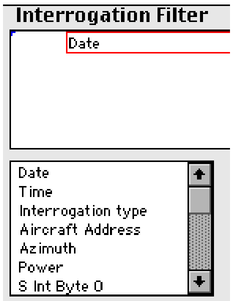
To define the filter, click the **Edit Filter** button.

The following window will appear.

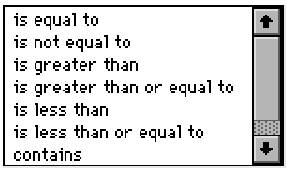


Enter the specific search criteria for the filter.

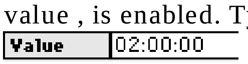
A filter consists of four functional blocks. The first block is the object of filtering. Choose an object in the list. Use the scroll bars to page through the list and click the wanted item.



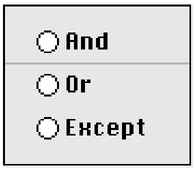
The chosen item is automatically transferred to the filter and the next block, the condition, is enabled. In the same way, select a condition from the list.



The chosen item is automatically transferred to the filter and the next block, the value , is enabled. Type in the desired value and hit the return key.



The chosen value is automatically transferred to the filter and the next block, the logical connection, is enabled. Select a logical operator from the list.



The chosen value is automatically transferred to the filter. This process is repeated until the filter setting is complete.

A filter setting can saved to disk with the Save... button or recalled from disk by clicking the Load... button.
This function is important to allow certain analysis functions to be repeated under certain conditions. Therefore we advise that all filters used for a certain analysis are saved along with the result data.

Clicking the Clear One button will clear the selected line from the filter setting, Clicking the Clear All button will clear the complete filter setting. The Cancel button will close the window and ignore all changes.
Click the OK button accept the filter and close the filter editing window.

Beware: the "Power" filter only works on RES recorded files, recorded with version 4.0.44 or later , since TTT recorded files store the power in a separate result file!

When paging through the data or making analysis, only the interrogations which comply with the search criteria are be displayed or processed.

Following fields can be used as filter criteria:

Date	MES
Time	LOS
Interrogation type	RSS
Aircraft Address	TMS(b30..32)
Azimuth[0..360]	TCS
Linear Azimuth*	RCS
Scan nr	SAS
Power	SIS
S Interrogation	LSS
UF	RRS
RL	PR
AQ	II
PC	MA
RR	NC
DI	RC
SD	MC
IIS	
MBS	

For the field "S Interrogation" , a hexadecimal representation of the interrogation can be used as filter criteria. The filter supports * and ? wild cards. (* selects all that follows, ? replaces a specific half byte.

Beware for Azimuth data : e.g.:
"Azimuth[0..360] > 45 AND Azimuth[0..360] < 90" uses the wrapped azimuth: all ints with azimuth between 45 and 90 degrees for any scan are selected.

"Linear Azimuth > 45 AND Linear Azimuth< 90" uses the unwrapped azimuth: all ints with azimuth between 45 and 90 degrees for the first scan are selected.

“Scan nr >2 AND Scan nr <3” select all interrogations of scan 2.
“Scan nr >2.1 AND Scan nr >2.2” selects all interrogations of scan 2 between 36 and 72 degrees.

Once defined, the filter must be activated: Check the apply filter check box Apply Filter ☑ in the main window to activate the filter.

5. Throughout the tool, data is presented in a table:

	time[sec]	Azim[°]	Scan	S address	Data
	3.310100	148.955	0	FFFFFF	UF=11 :PR=0 :II=2 : :AA=FFFFFF
	3.310600	148.977	0	FFFFFF	UF=11 :PR=0 :II=2 : :AA=FFFFFF
	3.311200	149.004	0	FFFFFF	UF=11 :PR=0 :II=2 : :AA=FFFFFF
	3.313700	149.117	0	FFFFFF	UF=11 :PR=0 :II=2 : :AA=FFFFFF
	3.316200	149.229	0	FFFFFF	UF=11 :PR=0 :II=2 : :AA=FFFFFF
	3.318700	149.342	0	FFFFFF	UF=11 :PR=0 :II=2 : :AA=FFFFFF

This table can be scrolled using the scroll bars to the right of the table. Its contents can also be printed or exported by clicking the **export table** button. The following window will appear.

PrintTables.vi

Interrogation Stagger

time[sec]	Azim[°]	Scan	S address	Data
8.191579	129.816	1	FFFFFF	UF=11 :PR=1 :II=1 : :AA=FFFFFF
8.194942	130.020	1	39034C	UF=4 :PC=0 :RR=17 :DI=1 :IIS=3 :MBS=0 :MES=0 :LOS=1 :RSS=0 :TMS=0 :AA=39034C
8.195230	130.036	1	39030A	UF=4 :PC=0 :RR=17 :DI=1 :IIS=3 :MBS=0 :MES=0 :LOS=1 :RSS=0 :TMS=0 :AA=39030A
8.195392	130.047	1	390340	UF=4 :PC=0 :RR=17 :DI=1 :IIS=3 :MBS=0 :MES=0 :LOS=1 :RSS=0 :TMS=0 :AA=390340
8.195998	130.080	1	3902D8	UF=4 :PC=0 :RR=17 :DI=1 :IIS=3 :MBS=0 :MES=0 :LOS=1 :RSS=0 :TMS=0 :AA=3902D8
8.196526	130.113	1	39029A	UF=4 :PC=0 :RR=17 :DI=1 :IIS=3 :MBS=0 :MES=0 :LOS=1 :RSS=0 :TMS=0 :AA=39029A
8.201827	130.432	1	FFFFFF	UF=11 :PR=1 :II=1 : :AA=FFFFFF
8.205190	130.635	1	39034C	UF=5 :PC=0 :RR=18 :DI=1 :IIS=3 :MBS=0 :MES=0 :LOS=1 :RSS=0 :TMS=0 :AA=39034C
8.205478	130.651	1	39030A	UF=5 :PC=0 :RR=18 :DI=1 :IIS=3 :MBS=0 :MES=0 :LOS=1 :RSS=0 :TMS=0 :AA=39030A
8.205640	130.662	1	390340	UF=5 :PC=0 :RR=18 :DI=1 :IIS=3 :MBS=0 :MES=0 :LOS=1 :RSS=0 :TMS=0 :AA=390340
8.206246	130.695	1	3902D8	UF=5 :PC=0 :RR=18 :DI=1 :IIS=3 :MBS=0 :MES=0 :LOS=1 :RSS=0 :TMS=0 :AA=3902D8
8.206774	130.728	1	39029A	UF=5 :PC=0 :RR=18 :DI=1 :IIS=3 :MBS=0 :MES=0 :LOS=1 :RSS=0 :TMS=0 :AA=39029A
8.212075	131.047	1	FFFFFF	UF=11 :PR=1 :II=1 : :AA=FFFFFF
8.222323	131.662	1	FFFFFF	UF=11 :PR=1 :II=1 : :AA=FFFFFF
8.225686	131.865	1	3902B0	UF=4 :PC=0 :RR=17 :DI=1 :IIS=3 :MBS=0 :MES=0 :LOS=1 :RSS=0 :TMS=0 :AA=3902B0
8.232571	132.277	1	FFFFFF	UF=11 :PR=1 :II=1 : :AA=FFFFFF
8.235934	132.481	1	3902DB	UF=4 :PC=0 :RR=17 :DI=1 :IIS=3 :MBS=0 :MES=0 :LOS=1 :RSS=0 :TMS=0 :AA=3902DB
8.236788	132.530	1	3902B0	UF=5 :PC=0 :RR=18 :DI=1 :IIS=3 :MBS=0 :MES=0 :LOS=1 :RSS=0 :TMS=0 :AA=3902B0
8.242819	132.893	1	FFFFFF	UF=11 :PR=1 :II=1 : :AA=FFFFFF
8.246182	133.096	1	3902DB	UF=5 :PC=0 :RR=18 :DI=1 :IIS=3 :MBS=0 :MES=0 :LOS=1 :RSS=0 :TMS=0 :AA=3902DB
8.253067	133.508	1	FFFFFF	UF=11 :PR=1 :II=1 : :AA=FFFFFF
8.256430	133.711	1	390371	UF=4 :PC=0 :RR=17 :DI=1 :IIS=3 :MBS=0 :MES=0 :LOS=1 :RSS=0 :TMS=0 :AA=390371
8.257676	133.783	1	39032B	UF=4 :PC=0 :RR=17 :DI=1 :IIS=3 :MBS=0 :MES=0 :LOS=1 :RSS=0 :TMS=0 :AA=39032B

This window allows the user to load and save the listed data, export to and import from spreadsheet, cut, copy and paste the data and to print the table.

To export the data, the user can click the Export button . This creates a Tab separated text file, which can be imported into any spreadsheet application (e.g. MS Excel).

The top row buttons operate the window.

Toggle "Help" window On/Off

Save list to disk

Load list from disk

Import list from spreadsheet (text based file)

Export list to spreadsheet (text based file)

Cut item from list

Copy item from list

paste item in list

Empty list

Undo last delete

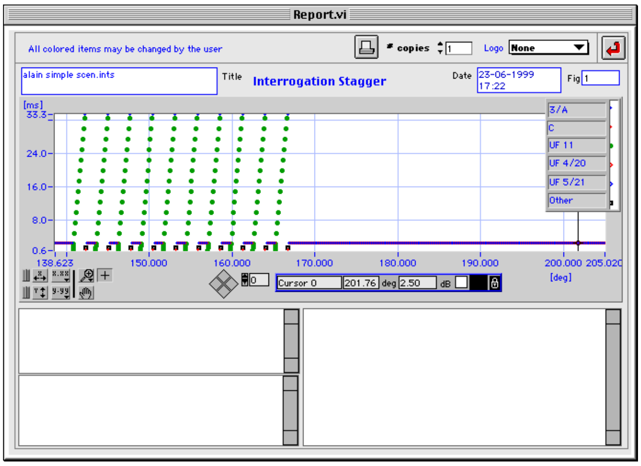
Select all

Print list

Close list window and return to the Interrogation analyser

6. Throughout the tool, data is presented in a graph. This graph can be zoomed, panned or scaled using the LabVIEW tool set for Graphs:

Its contents can also be printed or exported by clicking the **print Graph** button. The following window will appear:

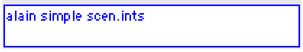


In the report window, all the blue items can be changed to fit the user.
This applies for the following items:

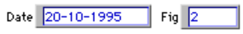
-The header of the page:

Interrogation Stagger

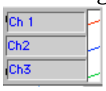
-The title of the page:



-The date and figure number:



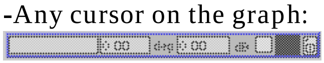
-The Legend for the different graphs:



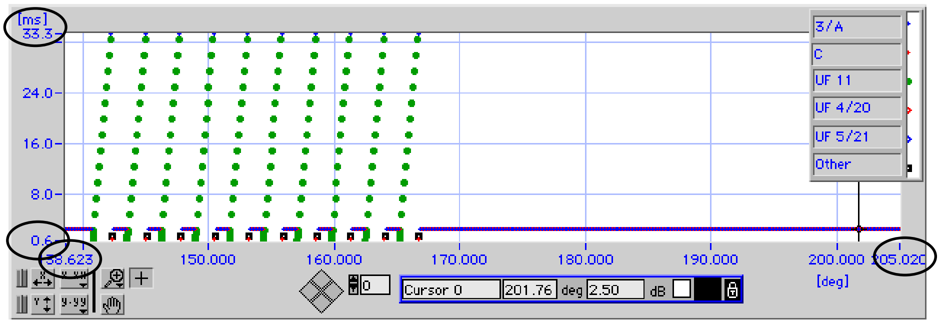
-The number of copies for the page

-The X and Y scale names:

-Any cursor on the graph:

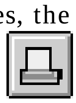


-TheX and Y scales and graph positioning.

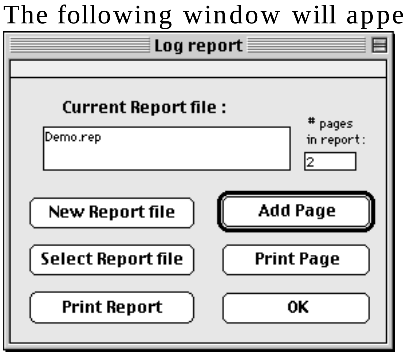


-All 3 comment and OTD parameter fields.

-The Logo

Once the scales, the axis, the plot names , the header etc, is edited to your satisfaction, click the **Print**  button on the report manager.

The following window will appear:



You have the following choices to make:

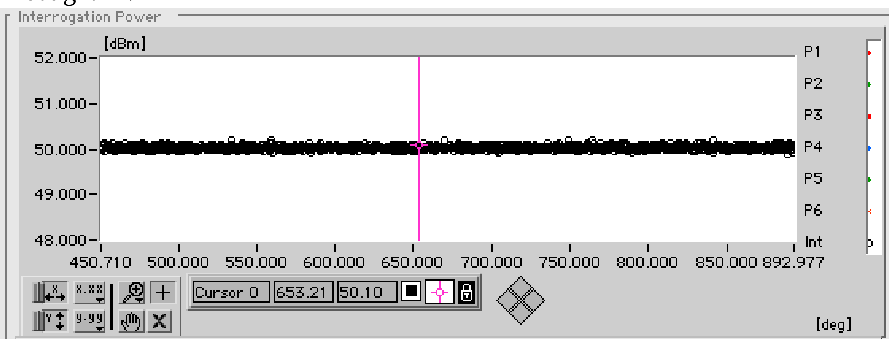
Print Page -Print the page you were looking at.

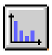
New Report File	-Create a new report file
Open Report File	-Open an existing report file
Add Page	-Add this page to the report file
Print Report	-Print the complete report you selected.
Ok	-Leave this window

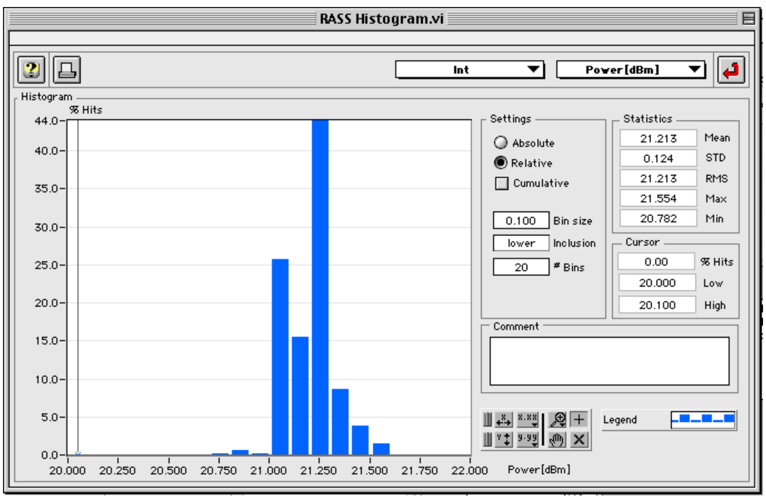
In order to print the current page, use the **Print Page button.**
If you want to save the page (with the complete layout and options) , first open or create a new report file, using the **New Report File** or **Open Report File** , then add the page using the **Add Page** button. A complete report can be printed using the **Print Report** button.
If a report file is opened, or a page is added to a new one, the "# Pages in report" indicator will be updated.
Leave the window using the **OK** button.

The printout will now be printed on the printer or saved to disk.
Printing can be stopped using the Command-point ([,]+[.]) keys.

7. Throughout the tool, data is presented in a graph. The data in the graph can be represented in a histogram if this representation makes sence.
An example is the power versus azimuth graph, which can be shown as a power histogram:



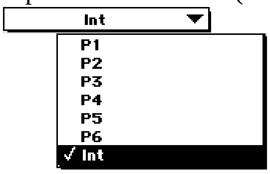
Now click the Histogram button: 
The following window appears:



An histogram shows the number of hits (occurrences) of a specific data item in a particular bin. The size of this bin is defined by the user, as well as the number of bins.

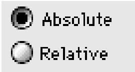
Data from one of the two axis (In this case Power versus Azimuth, so a selection between power and azimuth is offered) can be selected using the selector in the top right corner of the window.

Also the layer of graph (if available) can be selected using the selector in the middle top of the window. (e.g. P1,P2, ... Int power)



The following settings can be done in the histogram function:

Relative or absolute value representation



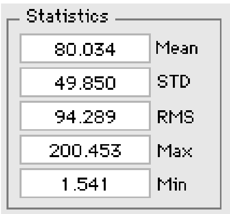
Cumulative value representation

Bin size value. The # Bins indicator is directly coupled with the Bin size value, since the complete range of the data is fixed by the X scale of the histogram(which in turn is copied from the original selected section of the input graph)

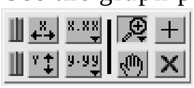
Boundary inclusion

These parameters can be altered at any time and this will result in an immediate recalculation and redisplaying of the histogram.

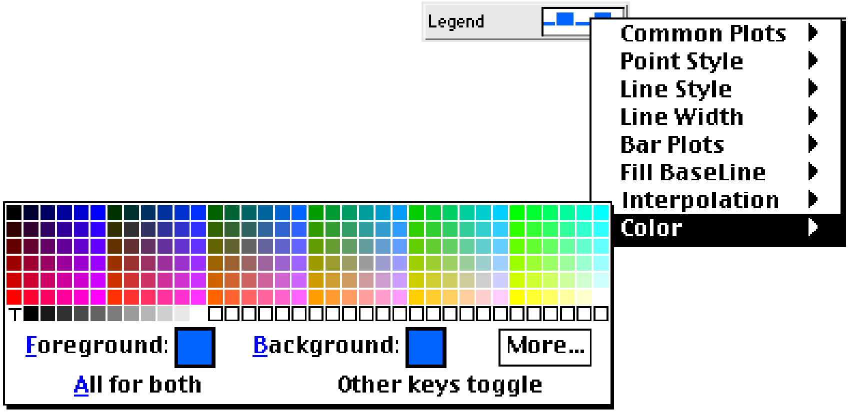
Some statistics are automatically calculated on the selected data set and are displayed at the right hand side of the histogram window.



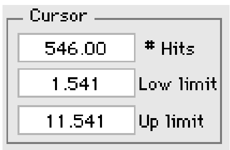
Use the graph palette to zoom and pan in the data, centre and select the cursor.



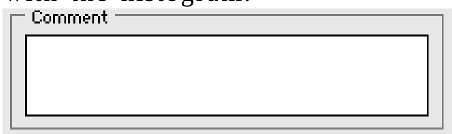
Use the legend palette to change the appearance of the histogram.



The cursor display shows the value, the upper and lower boundary of the selected histogram bin. A bin can be selected by dragging the cross cursor to it. The cursor will automatically be placed in the centre of the bin and the cursor display will be updated at the same time.



The histogram can be printed by clicking the print  button. The RASS-S reporting function is enabled which allows you to store or print the histogram. Information about the histogram can be entered in the comment field. This field will be printed together with the histogram.



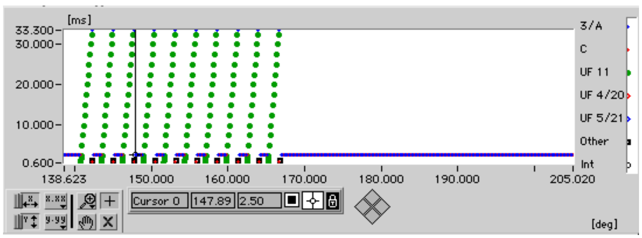
Click the return  button to close the histogram function and return to the Interrogation tool

3.4 Timing and Interrogation Contents Analysis

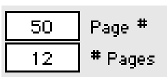
7. A first analysis function of the Interrogator Analyser is to display the recorded interrogations and their contents according to their type and position in time. For this function choose Interrogation graph from the analysis menu. The Interrogation Graph function is the only selection which does not need proceeding before the result can be displayed.

The Y scale should be set to "stagger" for this type of graph . (For other possibilities, see further).

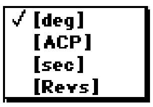
A set of recorded interrogations will be displayed in the graph each time a new page is selected:



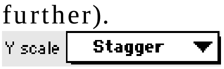
This set can be controlled using the Page Up or Page Down button. Alternatively, a specific start page and the number of pages to be displayed can be entered directly in the respective controls. The graph will be update immediately.



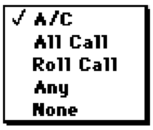
The X-axis scale unit can be selected from the following list, and may show time or azimuthal data . (Azimuth, ACP, Time or Scan numbers)



The Y scale is set to "stagger" for this type of graph . (For other possibilities, see further).



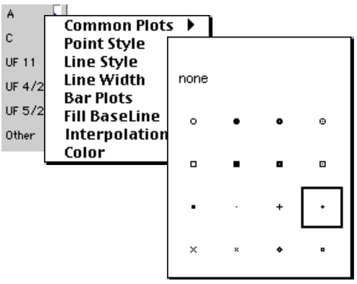
The Y-axis zero reference can be selected form the following list.



This means that each time the selected interrogation type is encountered, the Y-axis value (time) is reset to zero. This results in a specific "stagger" patterns.

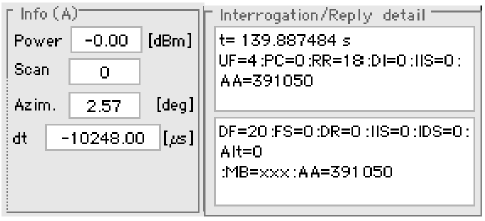
•in **AC**, the Y scale time is reset each time an A or C interrogation is encountered, showing the SSR interrogation schedule.
•in **All Call**, the Y scale time is reset each time an Mode S All call interrogation is encountered, showing the Mode S All Call interrogation schedule.
•in **Roll Call**, the Y scale time is reset each time an Mode S Roll call interrogation is encountered, showing the Mode S Roll Call interrogation schedule. This option has less importance.
•in **Any**, the Y scale time is reset each time an interrogation is encountered, showing the time periods between any interrogation.
•in **None**, the Y scale time is never reset, showing the interrogation timing in the Y scale. This option allows the viewing of interrogation time versus azimuth.

The different interrogation types are displayed according to the legend.

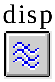


This legend can easily be adapted to the preference of the user.

Details and the contents of the interrogation and roll call reply selected with the first cursor are displayed below the graph. This information data also provides you with reading of power, scan nr and azimuth of the selected interrogation. Using the second cursor, a delta time value (time difference between two selected interrogations can be determined.



A filter can be applied to the interrogation display function. Check the apply filter check box 

and click the **Edit Filter**  button.
Enter the specific search criteria for the filter. See above for detail.
Checking the **List Interrogations** 

check box will add a table with details about the interrogations displayed in the graph. The graph will shrink to half its size on the window and the interrogations are shown in a graphical table.
The selected interrogation (using the cursor in the graph) is also highlighted in the table.

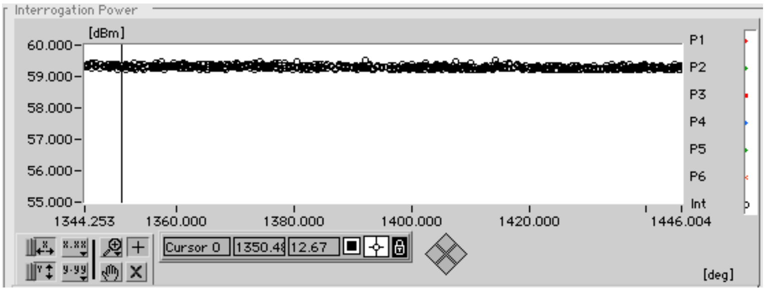
	time[sec]	Azim[°]	Scan	S address	Data
	3.310100	148.955	0	FFFFFF	UF=11 :PR=0 :II=2 : :AA=FFFFFF
	3.310600	148.977	0	FFFFFF	UF=11 :PR=0 :II=2 : :AA=FFFFFF
	3.311200	149.004	0	FFFFFF	UF=11 :PR=0 :II=2 : :AA=FFFFFF
	3.313700	149.117	0	FFFFFF	UF=11 :PR=0 :II=2 : :AA=FFFFFF
	3.316200	149.229	0	FFFFFF	UF=11 :PR=0 :II=2 : :AA=FFFFFF
	3.318700	149.342	0	FFFFFF	UF=11 :PR=0 :II=2 : :AA=FFFFFF

3.5 Interrogation Power Analysis

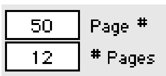
8. The Interrogator Analyser allows us to display the recorded interrogations power as a function of time or azimuth. For this function choose Interrogation Graph from the analysis menu.

The Y scale should be set to "Power [dBm]" for this type of graph . (For other possibilities, see above).

A set of recorded interrogation powers will be displayed in the graph each time a new page is selected:
For RES recorded data, only one power sample per interrogation is taken. For multiple samples (e.g. one sample per pulse, P1,P2,P3,P4, etc..), a TTT recording (P2A) is required.



The pages can be controlled using the Page Up or Page Down buttons. Alternatively, a specific start page and the number of pages to be displayed can be entered directly in the respective controls. The graph will be update immediately.

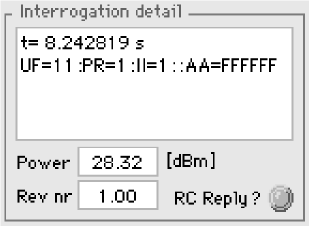


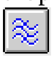
The X-axis scale unit can be selected from the following list, and may show time or azimuthal data . (Azimuth, ACP, Time or Scan numbers)

The power is shown a graph containing the average power of the interrogation (on Sum channel).

The graph has a legend which can be adapted accordingly.
This legend can easily be adapted to the preference of the user.

Details and the contents of the interrogation selected with the cursor are displayed below the graph.



A filter can be applied to the interrogation display function. Check the apply filter check box  and click the **Edit Filter**  button.
Enter the specific search criteria for the filter. See above for detail.

When paging through the data, only the interrogations which comply with the search criteria will be displayed.

Checking the **List Interrogations**  check box will add a table with details about the interrogations displayed in the graph. The graph will shrink to half its size on the window and the interrogations are shown in a graphical table.
The selected interrogation (using the cursor in the graph) is also highlighted in the table.

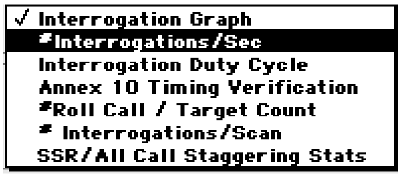
3.6 BITE Data Analysis

This function only works for TTT generated files on S2 (Airsys) type POEMS radars. See Ch IV of Vol 7.

3.7 Transmitter Load Analysis

This Type of analysis calculates the load (# interrogations per second) in a specific sliding window for a complete interrogation file.

10. Select # Interrogations / sec from the analysis selection menu.

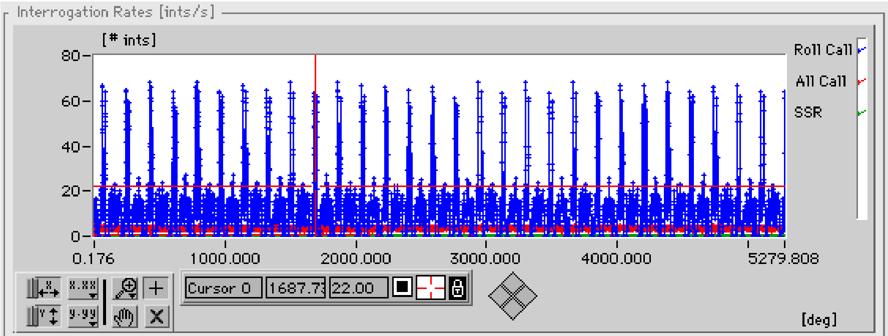


This selection requires processing before any results can be displayed. Some extra analysis parameters need to be set before processing the data.

The window size parameter determines the interval in which the processing is done. In this case, the number of interrogations of a specific type are counted in that interval. The window step parameters defines the step size that the calculation window takes for each calculation.
Window size can vary between 50 µs and 15 seconds. Window step can vary between 50µs and 15 seconds.
The window size also depends the number of measurement points per second. If a large section of data is analysed, only load changes are plotted, hereby reducing the number of points to be displayed.

Click the **Start**  button to start the processing. A progress indicator will appear to show the processing.

The processing can be stopped at any time by clicking the **Stop**  button. The results of the data already processed will be displayed in the graph and in the table.



	Roll Call	All Call	SSR	
Min	0.0	0.0	0.0	
Max	68.0	5.0	0.0	
Average	11.7	3.8	0.0	
Std Dev	12.3	0.5	0.0	

The Y-axis scale unit can be selected from the following list.

[ints/sec]
✓ [#Ints]

[# Ints] means the number of interrogations of a specific type counted in an interval defined by the window size .
[# Ints/sec] means the the number of interrogations in the window is recalculated to an interval of 1 second. In the window size is set to 1 second, both results will be the same.

Filtering, printing and exporting the data is available in this analysis mode.

3.8 Transmitter Duty Cycle Analysis

This Type of analysis calculates the duty cycle (Time transmitter is sending power / total time) in a specific sliding window for a complete interrogation file.
Each type of interrogation is given a fixed time "on-time" duration.
Times are shown hereunder:
1,2,A,C : 1.6µs
SSR only All Call : 2.4 µs
Intermode S All Call : 3.2 µs
S Short : 17.85µs
S long: 31.85 µs

11. Select Interrogation Duty Cycle from the analysis selection menu.

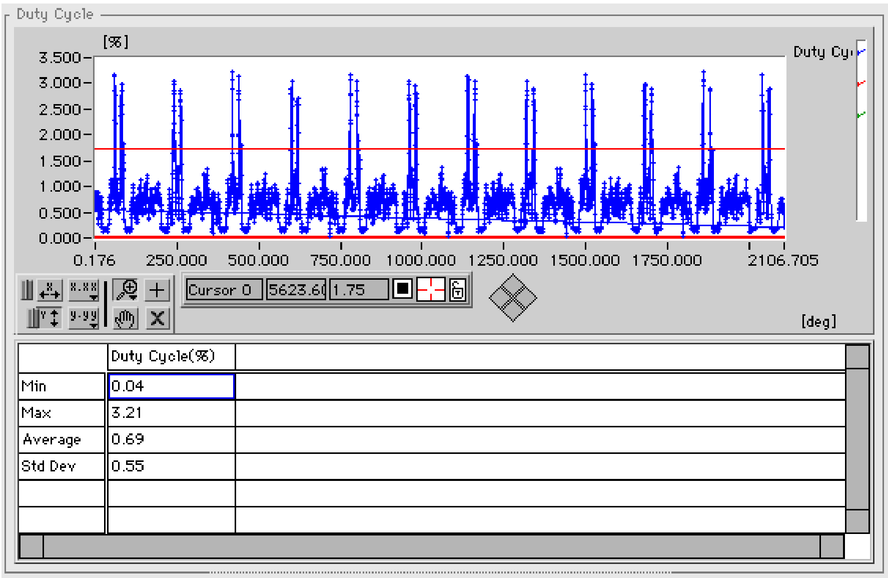
Interrogation Graph
✓ #Interrogations/Sec
Interrogation Duty Cycle
Annex 10 Timing Verification
#Roll Call / Target Count
Interrogations/Scan
SSR/All Call Staggering Stats

This selection requires processing before any results can be displayed. Enter the preferred analysis parameters settings.

Some extra analysis parameters need to be set before processing the data:

The window size parameter determines the interval in which the processing is done. In this case, the number of interrogations of a specific type are counted in that interval. The window step parameters defines the step size that the calculation window takes for each calculation. Window size can vary between 50 µs and 15 seconds. Window step can vary between 50µs and 15 seconds.

Click the **Start** button to start the processing.
The following window shows the result. Remember that the duty cycle statistics are calculated with the window size as time interval.



Filtering, printing and exporting the data is available in this analysis mode.

3.9 TTT Result Power and Presence Analysis

This Type of analysis checks all the interrogations generated by the TTT main tool and recorded in a Tres -file for errors interrogations or patterns . The analysis does not work on RES recorded data. See Vol 7, Chapter IV

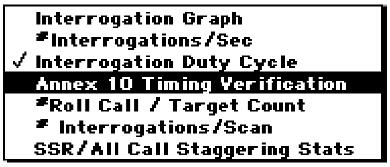
3.10.P6 power Drop analysis versus Duty cycle

This Type of analysis calculates the power drop of each P6 pulse (Mode S interrogation) and the power drop allong the 16 interrogations of an UELM and displays it versus time, azimuth or duty cycle before the interrogation in a specific sliding window for a complete interrogation file. The analysis does not work on RES recorded data. See Vol 7, Chapter IV

3.11 Annex 10 Problem Analysis

This Type of analysis checks for two types of Annex 10 Rules: The analysis is not intended for use with TTT, since no real interrogations are scheduled to real aircraft in coverage. (most S addresses are identical).
-Two non ELM interrogations to the same aircraft must be separated by at least 400 µs
-Two consecutive interrogations may not be separated closer than 50 µs

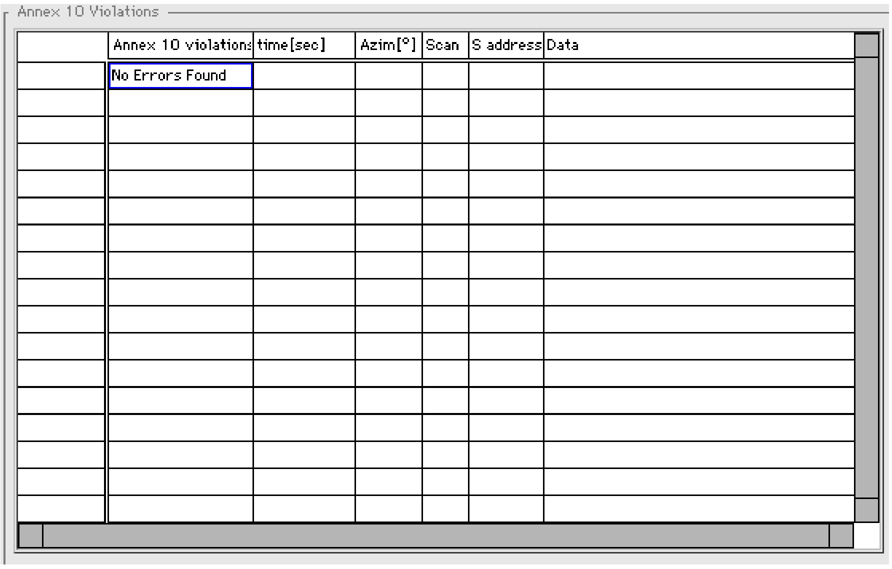
1. Select Annex 10 timing verification from the analysis selection menu.



This selection requires processing before any results can be displayed. No further analysis parameters need to be set.

2. Click the **Start**  button to start the processing.

3. The following window will appear (if no violations were found).



Filtering, printing and exporting the data is available in this analysis mode.

3.12 Roll Call Count per Target Analysis

This Type of analysis checks the number of roll calls send to each target in a complete recording and averages this data per scan. The analysis is not intended for use with TTT, since no real interrogations are scheduled to real aircraft in coverage. (most S addresses are identical). The analysis is intended to be used with interrogation recordings made by the RES.

1. Select Roll Call/target count from the analysis selection menu.

- Interrogation Graph
- #Interrogations/Sec
- Interrogation Duty Cycle
- ✓ Annex 10 Timing Verification
- #Roll Call / Target Count
- # Interrogations/Scan
- SSR/All Call Staggering Stats

This selection requires processing before any results can be displayed. No further analysis parameters need to be set.

2. Click the **Start** button to start the processing.

The following window will appear after processing the data.

Roll Call Target Count

	Address	Total	#Scans	min	Max	Average	Min RCbfr	Max RCbfr	Av RCbfr	PdReply	#scansNR
	390020	95	19	5	5	5.000	1	5	2.467	23.2	4
	390040	95	19	5	5	5.000	1	4	2.105	42.1	0
	390060	95	19	5	5	5.000	1	3	1.556	56.8	1
	390080	95	19	5	5	5.000	1	2	1.316	77.9	0
	390100	95	19	5	5	5.000	1	1	1.000	100.0	0

3. The tables represent the following:
Address: The Mode S address of the target (Must be unique, since it is the only criteria for target separation)
Total: Total number of Roll call interrogations detected for that specific target.
 # Scans: Number of scans the specific roll target was detected in the interrogation data set.
min:The minimum number of roll calls detected for that specific target in a specific scan.
Max: the maximum number of roll calls detected for that target in a specific scan.
Average: The average number of roll calls per scan for that target.
Min RCBFR : Minimum number of Roll Calls Before First Reply. : The minimum number of roll calls counted for that target before a reply was detected. (This implies that the minimum for this value is 1 and maximum is the same as the maximum number of roll calls per scan, in which case no or one reply was detected.)
Max RCBFR : Maximum number of Roll Calls Before First Reply. : The maximum number

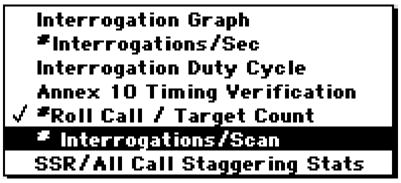
of roll calls counted for that target before a reply was detected. (same rule as above)
Av RCBFR : Average number of Roll Calls Before First Reply. : The average number of roll calls counted for that target before a reply was detected. (same rule as above)
PdReply: The Probability of reply counted for all interrogations and replies to the specific target. (# replies / # interrogations to this target)
NrScanNR: Number of scans with no reply

Filtering, printing and exporting the data is available in this analysis mode.

3.13 Interrogations per Scan Analysis

This Type of analysis checks the number of interrogations, divided per type, send by the radar per scan in a complete recording . The analysis can be performed on all types of recorded data, but is intended for RES recorded data, since no real scan numbers exist in TTT data.

1. Select # Interrogations/scan from the analysis selection menu.



2. This selection requires processing before any results can be displayed.

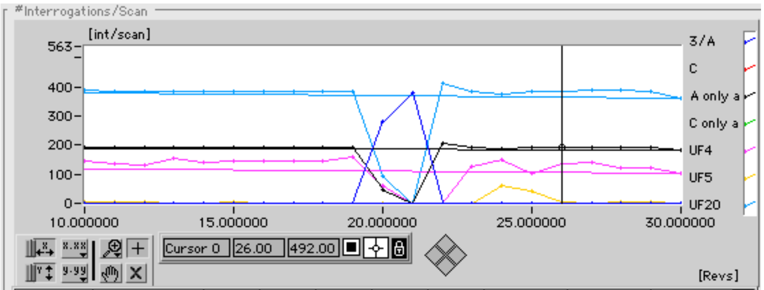
The reference control 

lets you choose between a table entry for each interrogation type individually or for a combined table entry for All Call, SSR and Roll Call interrogations.

Single Type: An entry is foreseen for each type of interrogation found in the recording: e.g. A, C, UF4, UF 5, UF11, UF24
SSR/AC/RC: Three curves are drawn: One for SSR type interrogations (1,2,A,C,A-SP4,C SP4), One for All Calls (UF 11, A LP4,C LP4) and one for all types of Roll Calls (UF4,5,20,21,24)

3. Click the **Start** button to start the processing.

The following graph will be calculated:



	Interrogation	Total	#Scans	min	Max	Average	MinΔT[ms]	MaxΔT[ms]	AvgΔT[ms]
	3/A	1739	35	0	968	51.1	8.240	82451.640	55.680
	C	1739	35	0	968	51.1	8.240	82443.400	55.676
	A only all call	16375	35	0	691	473.8	15.009	13987.602	17.009
	C only all call	16365	35	0	688	473.5	10.689	13991.922	17.019
	UF4	11206	35	0	473	323.2	0.420	23893.578	24.854
	UF5	502	35	0	152	14.8	0.476	33908.827	541.086

The graph shows the number of interrogations per scan for each type of interrogation.

The table shows the average values of these rates sorted per interrogation.
The colons in the table read the following data:
Interrogation: The type of interrogation (A, C, UF4, etc..
total: Total number of interrogations of this type counted.
 # Scans: Total number of Scans used in the analysis
Min: Minimum of interrogations of this type detected in any scan. Scan 0 is always skipped, since no targets are generated by the RES anyway.
Max: Maximum number of interrogations of that type detected in any scan.
Average: Average number of interrogations of that type detected in all scans.
Min ΔT [ms] : Minimum delay detected between two interrogations of that type in any scan.
Min ΔT [ms] : Maximum delay detected between two interrogations of that type in any scan.
Average ΔT [ms] : Average delay detected between two interrogations of that type in all scans.

Filtering, printing and exporting the data is available in this analysis mode.

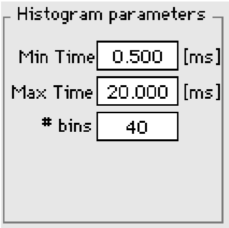
3.14 SSR/All Call Staggering Statistics Analysis

This Type of analysis calculates the delay between interrogations, divided per type, send by the radar per scan in a complete recording and puts the result in a histogram function. The analysis can be performed on all types of recorded data.

1. Select SSR/All Call Staggering Stats from the analysis selection menu.

Interrogation Graph
#Interrogations/Sec
Interrogation Duty Cycle
Annex 10 Timing Verification
#Roll Call / Target Count
✓ # Interrogations/Scan
SSR/All Call Staggering Stats

2.For this histogram type of analysis, you must enter the upper and lower histogram boundary and the histogram bin size in the histogram parameters.



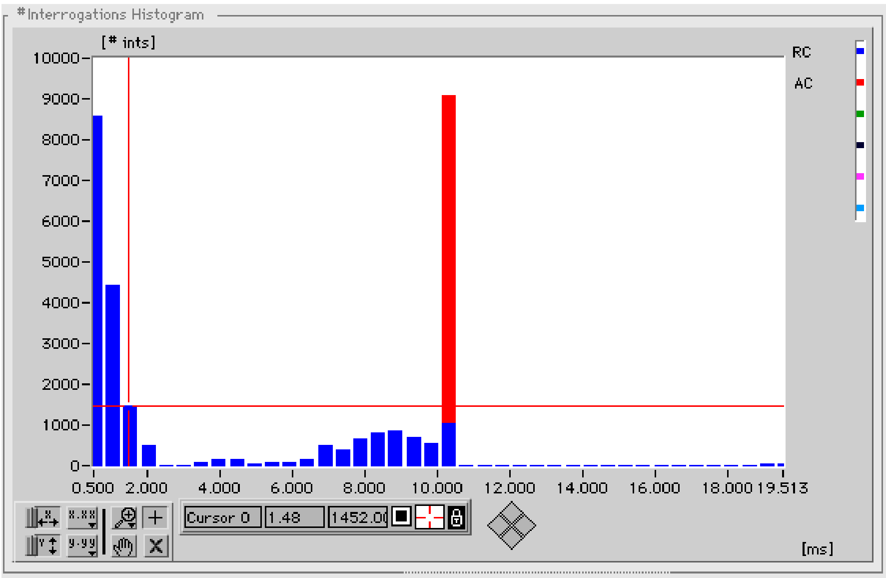
The reference control Ref. SSR/AC/RC lets you choose between a histogram for each interrogation type individually or for a combined histogram for All Call, SSR and Roll Call interrogations.

Single Type
√ SSR/AC/RC

Single Type: An histogram is foreseen for each type of interrogation found in the recording: e.g. A, C, UF4, UF 5, UF11, UF24
SSR/AC/RC: Three histograms are drawn: One for SSR type interrogations (1,2,A,C,A-SP4,C SP4), One for All Calls (UF 11, A LP4,C LP4) and one for all types of Roll Calls (UF4,5,20,21,24)

3. Click the **Start** button to start the processing.

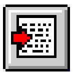
The following window will appear:

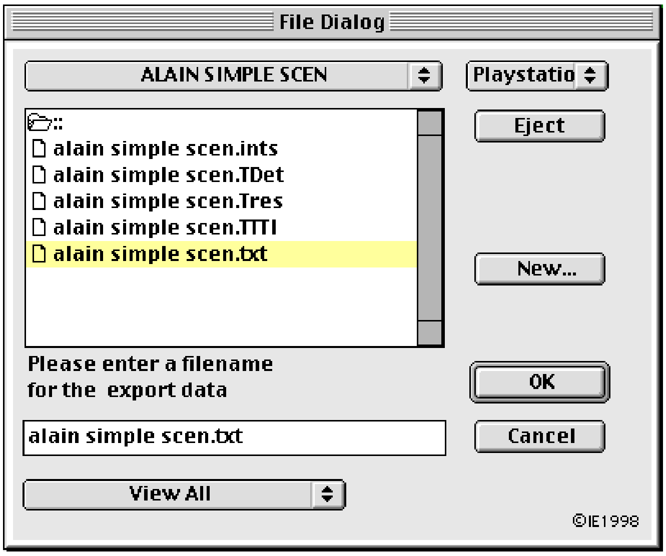


Filtering, printing and exporting the data is available in this analysis mode.

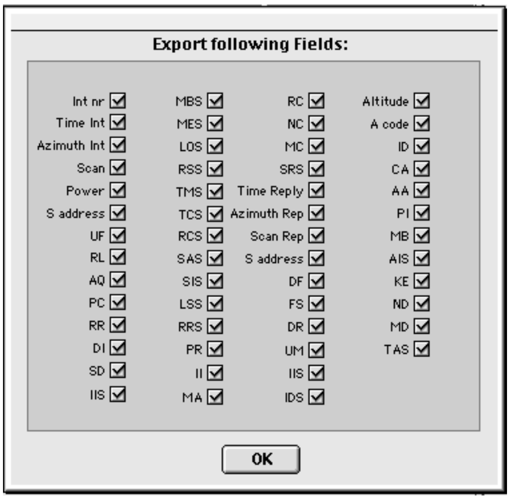
3.15 TTT Result Exporting to Spreadsheet Data

The interrogation analyser allows the exporting of interrogation data to a spreadsheet style table which can be imported into Excel or any other type of spreadsheet program.
The tool includes as many data as possible in the exported table.

1. Click the **Export**  button to start the processing.
Next, enter a filename for the export file:



Next, a dialog box allows you to specify all fields to be exported.
Every field will generate one column. Beware: replies are only recorded for ROLL CALLS, so All Call interrogations will not include a reply section. This does not mean that no reply was generated for that All call.



Click OK to agree.

The file can be imported by excel using the following steps:
File; Open; Using Tab delimited text import function

Example of exported file:

DERA TR 180 TAKE1.txt

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
1	Int nr	Time[s]	Azimuth[deg]	Scan	Power[dBm]	S address	UF	RL	AQ	PC	RR	DI	SD	IIS	MBS	MES	LOS	RSS	TMS	TCS	RCS	SAS	SIS	LSS	RRS
2	119	292.387698	244.79	1	49.9	E5D186	4			0	0	0	0												
3	120	292.390063	244.933	1	49.8	E5D186	4			0	0	0	0												
4	121	292.391529	245.021	1	49.9	E5D186	4			0	0	0	0												
5	123	292.39446	245.197	1	49.9	E5D186	4			0	0	0	0												
6	124	292.395924	245.285	1	49.9	E5D186	4			0	0	0	0												
7	24	292.554774	254.81	1	49.8	E5D0C6	4			0	0	0	0												
8	26	292.558606	255.041	1	49.9	E5D0C6	4			0	0	0	0												
9	27	292.560071	255.128	1	49.9	E5D0C6	4			0	0	0	0												
10	28	292.561537	255.216	1	49.9	E5D0C6	4			0	0	0	0												
11	30	292.564468	255.392	1	49.9	E5D0C6	4			0	0	0	0												
12	58	292.721853	264.829	1	49.9	E5D056	4			0	0	0	0												
13	59	292.724219	264.972	1	49.8	E5D056	4			0	0	0	0												
14	60	292.725684	265.06	1	49.9	E5D056	4			0	0	0	0												
15	62	292.728616	265.236	1	49.9	E5D056	4			0	0	0	0												
16	63	292.730081	265.324	1	49.9	E5D056	4			0	0	0	0												
17	91	292.887466	274.761	1	49.9	E5D066	4			0	0	0	0												
18	92	292.889832	274.904	1	49.9	E5D066	4			0	0	0	0												
19	94	292.892763	275.08	1	49.9	E5D066	4			0	0	0	0												
20	95	292.894229	275.168	1	49.8	E5D066	4			0	0	0	0												
21	96	292.895694	275.256	1	49.9	E5D066	4			0	0	0	0												
22	125	293.056011	284.869	1	49.9	E5D036	4			0	0	0	0												
23	126	293.058376	285.012	1	49.9	E5D036	4			0	0	0	0												
24	127	293.059842	285.1	1	49.9	E5D036	4			0	0	0	0												
25	1	293.062773	285.275	1	49.9	E5D036	4			0	0	0	0												
26	2	293.064239	285.363	1	49.9	E5D036	4			0	0	0	0												
27	80	298.390794	244.79	2	49.9	E5D186	4			0	0	0	0												
28	81	298.39316	244.933	2	49.9	E5D186	4			0	0	0	0												
29	82	298.394625	245.021	2	49.9	E5D186	4			0	0	0	0												
30	84	298.397557	245.197	2	49.8	E5D186	4			0	0	0	0												
31	85	298.399022	245.285	2	49.9	E5D186	4			0	0	0	0												
32	113	298.557873	254.81	2	49.8	E5D0C6	4			0	0	0	0												
33	115	298.561704	255.041	2	49.8	E5D0C6	4			0	0	0	0												
34	116	298.56317	255.128	2	49.9	E5D0C6	4			0	0	0	0												
35	117	298.564635	255.216	2	49.9	E5D0C6	4			0	0	0	0												
36	119	298.567567	255.392	2	49.8	E5D0C6	4			0	0	0	0												
37	19	298.724952	264.829	2	49.9	E5D056	4			0	0	0	0												

DERA TR 180 TAKE1.txt

Chapter IX : Asterix Data Replay and Scenario Generation

1.0. Introduction

This chapter will explain you how to stream Asterix data (e.g. PSR data) corresponding with a scenario or converted from a serial EDR recording to a radar, plot combiner, radar display or SDPS (Surveillance Data Processing System). We will refer to these components as the Data Destintion (DD) The data is presented to the DDs using a LAP B or U-HDLC serial communication protocol and makes use of the ASTERIX Cat001/002, asterix cat 034/48 , Asterix cat 62 or RDIF data format for representing the radar data.

The EDR Replay tool streams an Asterix scenario created with the Trajectory Scenario Generator or EDR serial Convert to the DD. For more information about creating a scenario, consult *Chapter IV RES Software* , or *Chapter XI, Multi-radar scenario generation*, of this volume .
for more information about the serial convert, please consult *Chapter IV : Serial Communication on LAP B/X25* of *Volume 4 Data Recording & Analysis*

The EDR Replay tool makes use of the EDR (RDR 339) hardware to establish a LAP B/U-HDLC serial communication link with the DD. For more information about the EDR hardware and LAP B/U-HDLC serial communication, consult *Chapter IV Serial Communication on LAP B/X25*. of *Volume 4 Data Recording & Analysis*,

Important restrictions for Asterix Scenario Generation:

- The Asterix Scenario Generation can not be run simultaneously with the PTE P1 GDLP function.
- PSR simulation Scenario Generation (sub function of the general case) can only be executed with ARP/ACP signals comming from the RES (Radar is slaved to the RES).
- Asterix Scenario Generation can only be executed with a constant radar rotation speed (no rotational scenario).
- Asterix Scenario Generation is only supported on LAP B/HDLC or LAN, not X25

We will explain the specific case of generation asterix from a scenario . Obviously, when applying these rules to PSR scenarios, (generation of asterix cat 001/002 , originating from a PSR radar) , the tool can be used to fulfill some of the PTE requirements for replay of PSR data for POEMS integration testing.

2.0. Asterix Scenario Generation: Checklist

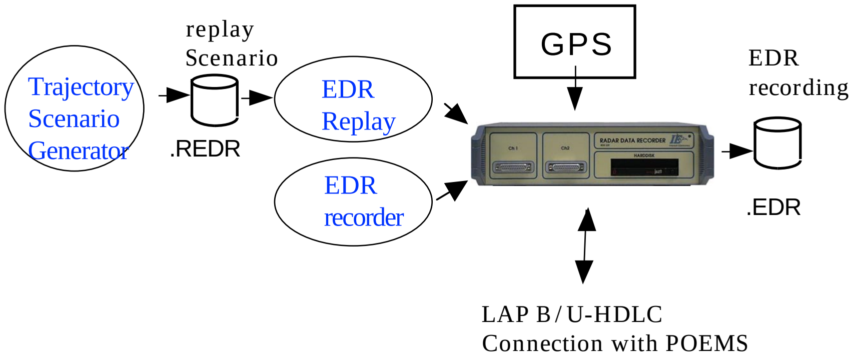
2.1. Procedure

Asterix Scenario Generation will be done in several discrete steps:

a) Create a Replay Scenario using the scenario generator. (More specifically a PSR scenario)
b) Make a LAP B / U-HDLC serial communication link with POEMS
c) Run the Replay Scenario and record this with the EDR

Corresponding to each step one or more tools (virtual instruments) will be used :

a) Trajectory Scenario Generator tool
b) EDR Recording Tool
c) EDR Replay Tool



2.2. Creating a Replay Scenario

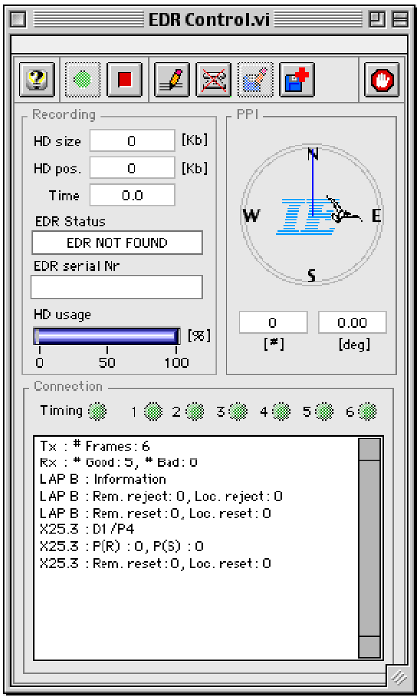
An Asterix replay scenario is created using the Trajectory Scenario Generator software and is stored in a scenario folder together with the RES scenario. It is this scenario folder that is used by the EDR Replay software. The file created for replay is called xxx.REDR or **REDR file** , where xxx stands for the name of the scenario. For more information about creating a PSR scenarios for POEMS integration tests, consult *Chapter IV RES Software* of this volume.

2.3. Creating an REDR file from an EDR recording

An REDR replay file can be created from a standard EDR recording using the EDR serial convert software and should also be stored in a scenario folder.
Beware ! In this version, the REDR tool can only replay ONE channel at a time, so the convert tool should convert only one line at a time into an REDR file. For more information about creating REDR files from EDR recordings, consult *Chapter IV : Serial Communication on LAP B/X25* of *Volume 4 Data Recording & Analysis.*

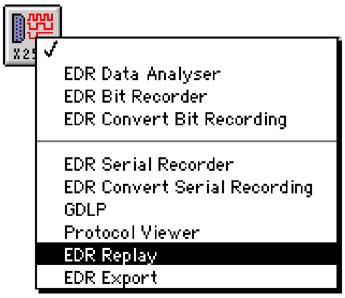
2.4. Making a LAP B/X25 Communication link

The Extended Data Recorder (RDR 339) is used to make a LAP B/U-HDLC (No X25) communication link between the EDR Replay and the DD. The EDR Serial recording tool is defines the parameters and sets up the link. For more information about the EDR and LAP B/U-HDLC, consult chapter IV of Volume 4 Data Recording & Analysis, Chapter IV Serial Communication on LAP B/X25.

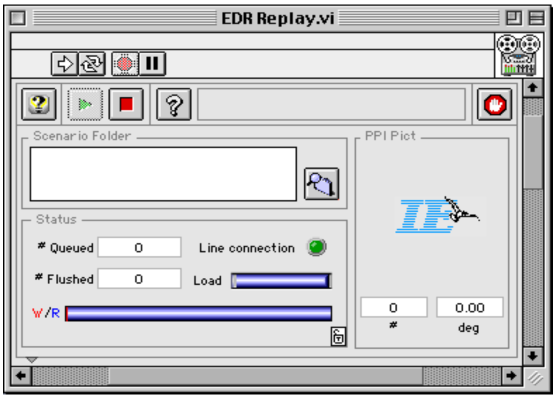


2.5. Running the EDR Replay

1. Load the EDR Replay tool from the RASS-S toolbox.



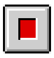
The following window will appear on the screen.



The user interface of the EDR Replay tool is divided into several functional panels. At the top of the window, there is a row of buttons to operate the tool.

 Toggle “Help” window on / off

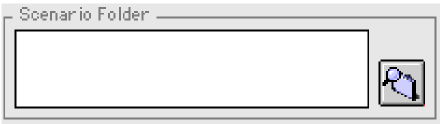
 Start the EDR replay

 Stop the EDR replay (data steam)

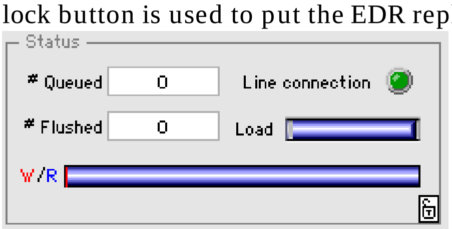
 Error display with detail button

 Stop the EDR Replay tool

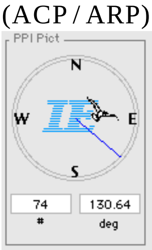
At the left top side of the window there is the scenario folder panel. This panel is used to browse for a scenario folder.



At the lower left side there is the status panels which indicates the status of the communication link, the number of messages queued (= read from file) , the number of messages flushed messages that could not be transmitted due to transmission failure or lack of bandwidth) and the progress of the EDR replay, including the replay buffer. The lock button is used to put the EDR replay in an endless loop mode,



At the right side there is a PPI panel which indicates the turning information (ACP / ARP).



2. Before proceeding make sure you have an REDR file ready (see *Chapter IV RES Software of this volume,*) and that there is a LAP B/U-HDLC serial communication link established with the POEMS using the EDR Recording tool (see *Chapter IV Serial Communication on LAP B/X25* of *Volume 4 Data Recording & Analysis.*)

3. Run the EDR Replay tool using the button in the upper left corner of the window.

4. First thing to do is to select a scenario folder by clicking the **Browse** button. Scenario folders are stored in the *RASS-S Campaigns:Campaign_name:SCENARIO:...* folder. Typically, all REDR files will be stored in SCENARIO folders.

5. If you have selected a scenario folder containing a valid REDR file and the LAP B/U-HDLC serial communication link is functioning properly, the line connection LED should turn to green Line connection and the **Start** button should be enabled.
A red LED means that the serial communication is not functioning properly and a disabled Start button means that there is no REDR file present. Both fault messages will appear sequencial in the info display next to the top row buttons. For more details about a specific fault messages click the button next to the text display when the corresponding messages is shown.

6. Make sure that the radar timing signals are connected to the EDR (from the RVI).

7. Make sure that the PPS pulse of the GPS is connected to the EDR and that the async communication between the the GPS and the workstation is functioning properly. For more details about these topics, consult *Chapter VI Data Recording & Analysis*, *Chapter VI Pd & Accuracy* of Volume 4

8. Make sure the proper host line is selected in the EDR recording preferences. The host should be the one on which the PSR data is outputted.

10. The REDR replay can be started by clicking the button. The EDR replay tool is based on ARP/ACP timing signals. As long as they are not present, the data is held in a buffer until the ARP/ACP time of transmission for the messages is reached. Therefore, the user can start the data Replay and it will hold until the RES is started. This way a PSR scenario replay, used for integration tests and the RES scenario are synchronised. This ARP/ACP algorithm also implies that for each run of the REDR , the serial line needs to be reset in order to reset the ARP counter. (See also point 13: endless loop mode)

11. During the REDR replay, information about the progress and integrity of the replay is available in the user interface. The progress and file buffer status are indicated in a progress bar. The total progress bar represents the complete REDR file length. The Red line indicates the current position of the pointer in the file on disk. The Blue line indicated the position of the pointer for the data streamed to the EDR. Therefore the blue bar represents the file buffer size and position during the replay.

The number of messages queued to the transmission buffer is indicated in the user interface. A messages is queued from the moment it is placed in the transmission buffer. This is done (under normal circumstances) half a scan before the moment of transmission. It will remain there until its ARP/ACP moment of transmission is arrived.

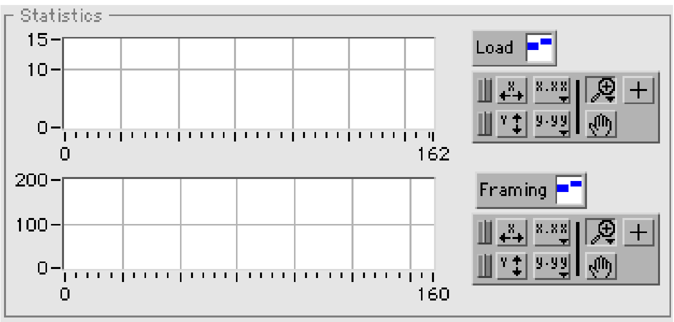
A load indicator displays how much of that half scan margin there is left for each message at the time of its manipulation.

If for some reason (limited throughput, heavy load, protocol problems...) a message can not be transmitted, it will remain in the tranmsission buffer until the situation is cleared. All other pending messages will also be held in the transmission buffer. If this situations remains and the transmission buffer is full (8 Kb), messages will be fllushed when their ARP/ACP time of tranmission has past and they can not be put into the transmission buffer. The number of messages “flushed” this way is indicated in the user interface.

While flushing, the load indicator will indicate a full scale load. This means no margin is left from the half scan lead.

If for some reason, the problem dissapears, the transmission buffer will be streamed out and new messages will be put into the transmission buffer and the PSR scenario generation or REDR replay will resume its normal pattern. The load indicator will indicated this.

12. By clicking the  button in the lower left corner of the EDR Replay tool, some statistic information comcerning the current REDR replay are displayed.



The top graph gives an indication of the load history in percentage of maximum (

theoretical) load. The second graph gives an indication of the history of the size in bytes of the LAP B / HDLC frames that were send.

13. The REDR replay can be put into wrap around mode by clicking the button. This allows the user to run an REDR replay as long as there ACP / ARP signals present. Each time the scenario data has ended, it will restart without restarting the EDR serial control tool. This feature can be used in combination with the restart of scenario feature of the RES main control tool.

14. The PSR scenario replay can be interrupted at any time by clicking the **Stop** button.

15. The EDR Replay tool can be stopped at any time by clicking the **Halt** button.

Chapter X : IRS Data Export

1.0. Introduction

This chapter will explain you how to transfer a RES result and interrogation/reply recording into a IRD (Interrogation Reply data) datafile and further into a IRS text file, which can be loaded by excel for analysis usage.

The contents and format of the exported spreadsheet file is according to the PTE P2B1 ICD. There is no limit on the size of the exported files.
For the export, two steps need to be taken:

1) Merging of scenario data, interrogation recordings, reply recordings and UTC timestamping files into one “IRD” file containing interrogation-reply records which are UTC timestamped.

2) Export of the IRD file into the IRS text file using the PTE P2B1 “Interrogation-reply viewer” .

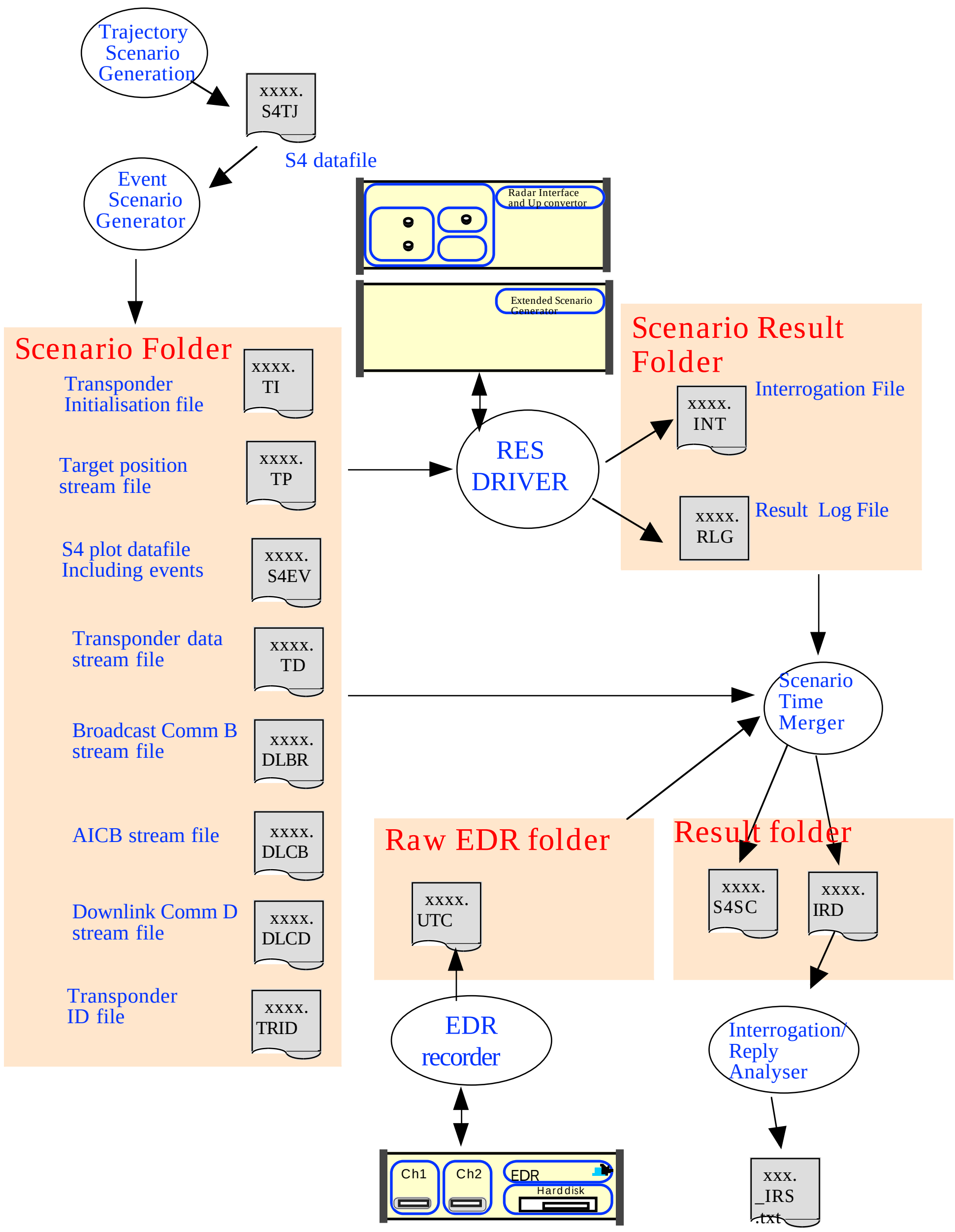
The sequence of data is illustrated in the next pages:

The Trajectory scenario generator creates a scenario positional file (xxx.S4TJ).
This file is read by the event scenario generator, which adds the datalink events.
This one creates all required scenario files, including the required datalink stream files for the RES and an S4EV file.

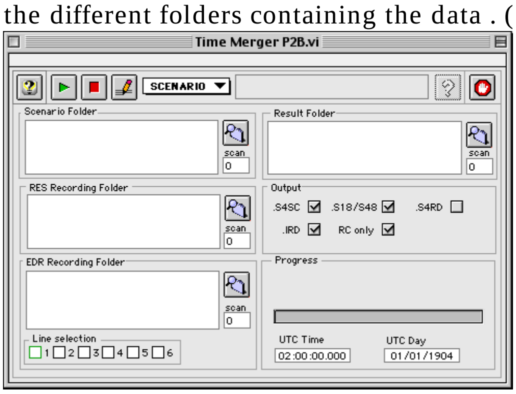
The RES replays the scenario on RF and creates in turn a result log file , which contains information such as the closeout of certain datalink events, the number of all calls received by a target etc... and an “interrogation” file. This file is relatively timestamped, relative to the start of the scenario. (using a 2 byte counter with resolution of 25 ns). The data in the file contains each received interrogation with its corresponding timestamp, ACP, ARP and Mode S contents, plus for Roll Call interrogations, the first 32 bits of the reply data.

This interrogation file forms the starting point of the IRD datafile, created by the “Scenario Time Merger” tool. This tool in fact combines all the above files with an EDR recorded UTC timestamp file. This file timestamps each ARP pulse of the radar to a 1µs resolution UTC. The file is created by means of a GPS, connected to the same computer as the EDR. (This setup is always required, since we want to record the asterix output of the radar anyway.)

The Scenario time merger starts with the interrogation recording of the RES (which already contains the first 32 bits of the reply in case of roll call) and puts this information in the IRD records. In case of SSR or All Call interrogations, no reply part is created. In case of Roll call short reply, the last 24 bits of the reply are taken from the ModeS address strored in the interrogation. In case of a long reply, the missing 56 bits are determined from the reult log and the datalink scenario files. This depends on the type of datalink transactions. (AICB, GICB, Broadcasts, ELMs..).
The range and azimuth values of the replies are determined from the scenario S4EV or S4TJ file, correlated with the target list.



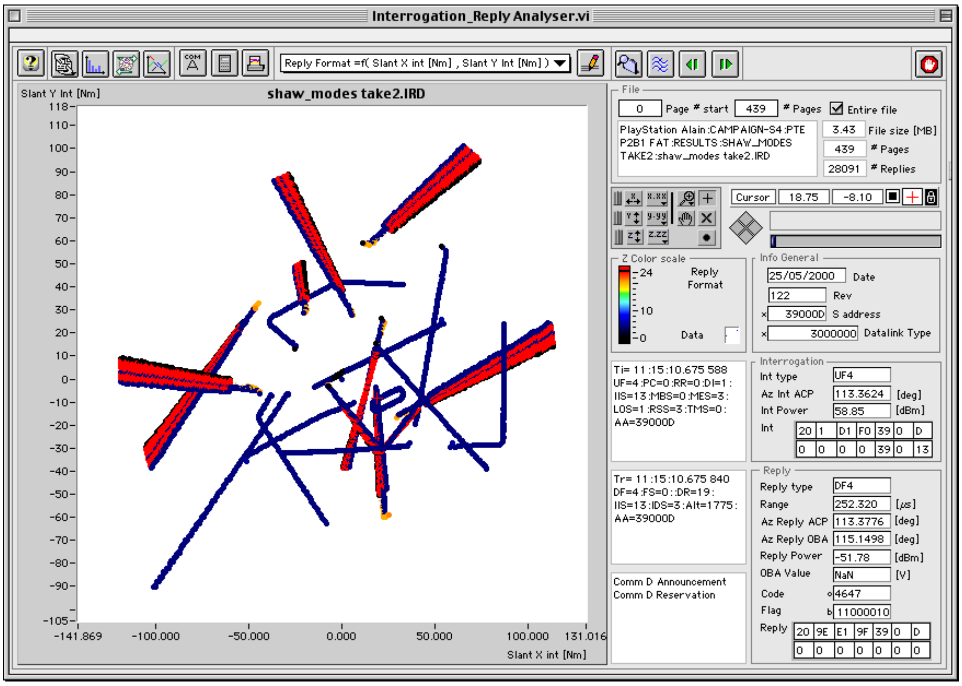
The process of linking all data seems complex, but in fact the user only needs to specify the different folders containing the data . (The ones written in red above.)



Finaly, an IRD record is created containing the following datafields:

Bytes	Type	Contents	Unit
8	Sgl	Range Reply	µs
8	Dbl	Azimuth(ACP) Interrogation	deg
8	Dbl	UTC Time of day Int	sec
8	Dbl	Azimuth Reply (ACP)	deg
8	Dbl	Azimuth Target	deg
2	U16	Scan nr	
1	U8	Interrogation type	List
1	U8	Reply Type	list
4	U32	S address	
2	U16	ID/SSR Code	
4	Sgl	Interrogation Power	dBm
4	Sgl	Reply Power	dBm
4	Sgl	OBA Value	V
1	U8	Reply Flag	Status field
1	U8	#SSR/All Call Replies	
4	U32	Data link type	Status field
14	14*U8	Interrogation	
14	14*U8	Reply or Code	
4	U32	Index	
32	8*U32	Spare IRD1..IRD8	

These datafields can then be exported into an RFS file using the " Interrogation-reply analyser".



This tool also allows you to examine the interrogation-reply data in great detail.
The tool acceps IRD (created by RES and Scenario time merger), IRDV (created by Reference extractor) and IRS data as an input.

2.0. Connections required for "Closed Loop" Measurements

The Scenario time merging tool requires several input files. In order to obtain these files, two separate "branches" of the PTE system must run simultaneously:
-The RES generation section
-The EDR recording section

2.1. ESG Connections

For details on the connections of the RES generation tool , we refer to Volume 5, chapter III of the RASS-S User manual.
The user has the option of choosing between the FAT or SAT setup, or opting for FRUIT injection or no FRUIT injection. **The IRD generation performs in any setup, as long as the EDR ACP and ARP input is connected to the ACP/ARP output of the RES.**
This output can be found on several places, but the best location is to tap it from the AFU unit.
If the AFU is not used, you can use the ACP/ARP output of the RES directly.

2.2. EDR Connections

The EDR can be used in passive or active recording mode. One to Six Serial channels can be connected to the EDR input channels. Use the supplied dB25 cables or build your own matching connector.
For details on the serial pins, see Volume 4, Chapter IV.

Connect the EDR ACP and ARP input to the RIU ACP / ARP output . Preferable use the AFU in between . Use a High Density dB15 extension cable (Male to Male) to perform this action.
An other possibility is to use a High Density dB15 to five BNC video cable. In that case, use the Red (ARP) and Green (ACP) cable.

2.3. GPS Connections

Connect the GPS according to the drawing made on the next page.
If for any reason, you can not use the GPS, make sure that the computers connected to the simulation RES and the recording EDR have the correct UTC time set (try to sync them to whithin one second). The results will not be that accurate as when GPS recording is provided.

The GPS antenna must be put outside such that it has free sight of the sky.
Connect the serial port directly or using the RJ45 extension cable plus the RJ 45 to PPS breakout box.
The serial cable is a dB25 male to mini din male cable.
In order to operate correctly the mini-din connector must be plugged into your computers serial port. (Or if your PC only has USB bus, plug the serial port into the USB to serial convertor)

Next, plug the dB25 into the female dB25 to RJ45 convertor. This item also serves as breakout box to supply the PPS pulse to the EDR and to feed the GPS permanently with 12 V power.
Now plug the RJ45 extension cable (5 m or 50 m) in the breakout box and connect the other side to the male RJ45 to dB25 convertor. Finally, this connects to the dB25 input of the GPS.
Also connect the PPS pulse (provided by the breakout box) to the "event" input of the

EDR.

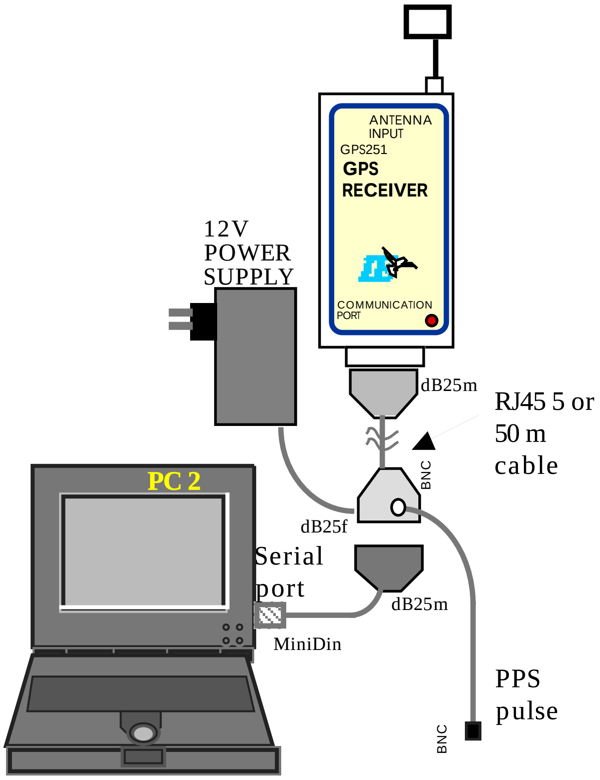
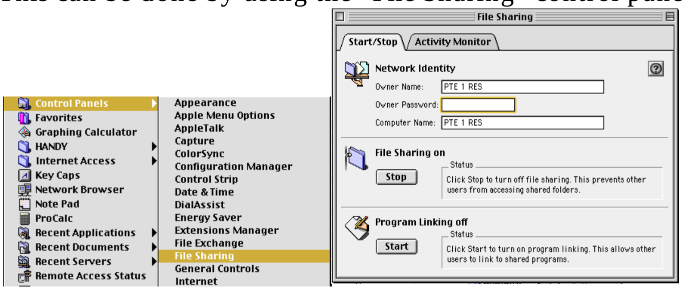


Fig 3: Connections for GPS recording

Once the EDR recording is started, a dialog will appear, controlling the GPS. Make sure the GPS is “UTC sync” before proceeding, because otherwise no proper UTC data is provided by the tool. This can be verified by checking the colour of the dialog text: if it is red, the GPS is not time sync'-ed!

2.4. Network Connections

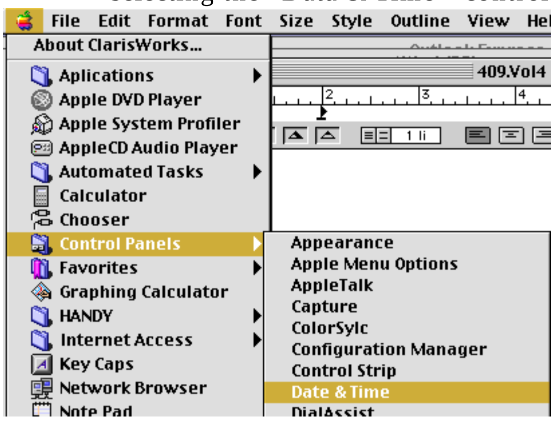
The two PC systems running both the EDR and the RES must be put into a local area Network.
This can be done using a simple “twisted” RJ 45 cable (network using two computers) or using a simple Hub.
Once the ethernet connections are present, put both PCs in “sharing” mode.
This can be done by using the “File Sharing” control panel:

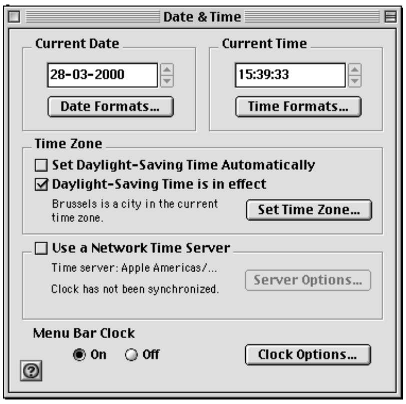


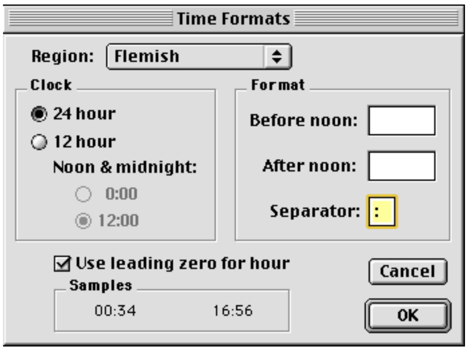
Name each computer differently and use names that remind you of the configuration.

2.5. Date and Time considerations

The operation of the Scenario time merger and the correctness of timestamping of the IRD data depends also on the correct setting of the computer clocks. This can be done by selecting the “Data & Time “ control panel, selectable from the apple menu.

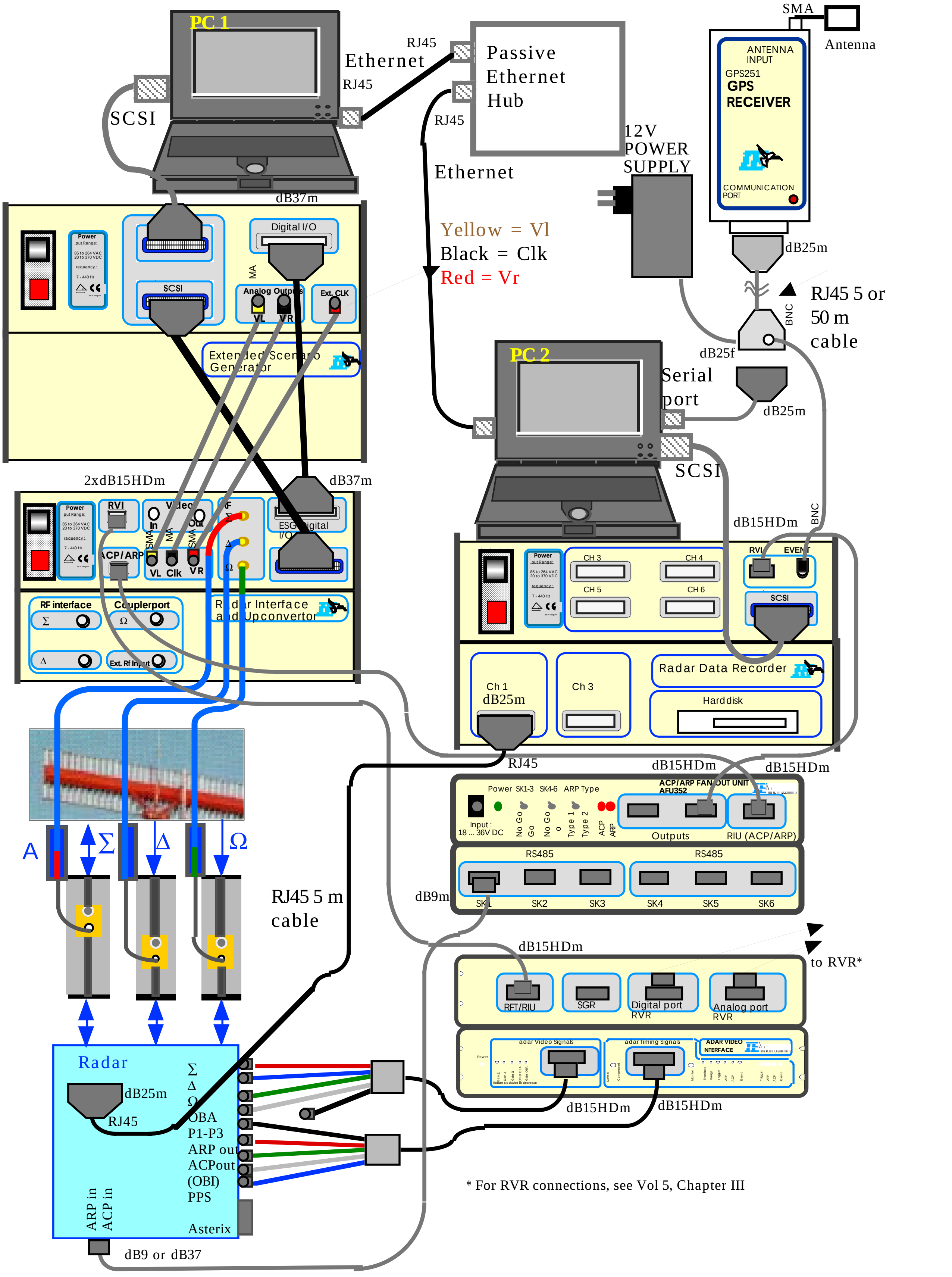






The tool is preferably used in a 24 hour clock mode (in stead of the US or British standard of AM and PM) . For this, select “Flemish” as region in the “Time Formats” selection from the data and Time control panel. Make sure the two computers have a time difference of less than a few seconds.

2.6. Overview of Connections:

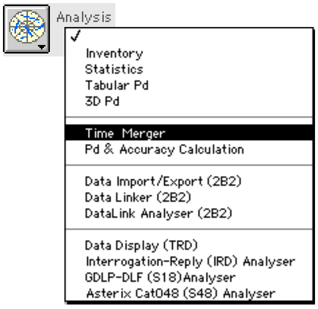

PC 1
SCSI
RJ45
Ethernet
RJ45
Passive
Ethernet
Hub
RJ45
Ethernet
12V
POWER
SUPPLY
SMA
Antenna
ANTENNA
INPUT
GPS251
GPS
RECEIVER
COMMUNICATION
PORT
dB25m
RJ45 5 or
50 m
cable
BNC
dB25f
dB37m
Digital I/O
SCSI
Analog Outputs
VL VR
Ext. CLK
Extended Scenario
Generator
Yellow = Vl
Black = Clk
Red = Vr
PC 2
Serial
port
dB25m
SCSI
2xdB15HDm
dB37m
RVI
Video
In Out
ACP/ARP
VL Clk VR
ESG Digital
I/O
RF interface
Coupler port
Ext. Rf Input
Radar Interface
and Upconvertor
dB15HDm
BNC
CH 3
CH 4
CH 5
CH 6
RVI
EVENT
SCSI
Radar Data Recorder
Ch 1
dB25m
Ch 3
Harddisk
RJ45
dB15HDm
dB15HDm
Power SK1-3 SK4-6 ARP Type
ACP/ARP FAN OUT UNIT
AFU352
Input :
18 ... 36V DC
Outputs
RIU (ACP/ARP)
RS485
RS485
SK1
SK2
SK3
SK4
SK5
SK6
dB9m
A
Σ
Δ
Ω
RJ45 5 m
cable
dB15HDm
to RVR*
RFT/RIU
SGR
Digital port
RVR
Analog port
RVR
dB15HDm
dB15HDm
Radar
dB25m
RJ45
Σ
Δ
Ω
OBA
P1-P3
ARP out
ACPout
(OBI)
PPS
Asterix
ARP in
ACP in
dB9 or dB37
* For RVR connections, see Vol 5, Chapter III

3.0 Scenario playback.

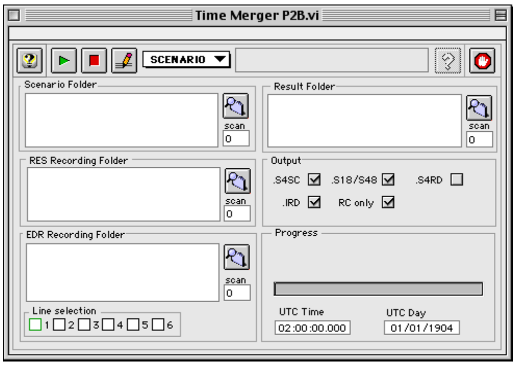
The scenarios are played back using the RES Main tool. For details, refer to Volume 5, Chapter IV. Make sure you properly select the scenario result folder, for it to contain the interrogation and result data.
Beware! The RES main overwrites the same interrogation and result data each time you rerun the scenario. This means that you need to reselect a new interrogation log each time you rerun the scenario, or your previous data will be lost!

4.0.Scenario Time Merging

The first step in exporting data is to use the scenario time merger:
1. Load the tool from the RASS-S toolbox.



The following window will appear on the screen:



2. Run the Time merger tool using the  button in the upper left corner of the window. The user interface of the tool is divided into several functional panels.

At the top of the window, there is a row of buttons to operate the tool.

Menu to switch between LIFE and SCENARIO operation

Toggle “Help” window on/off

Start merging

Stop process

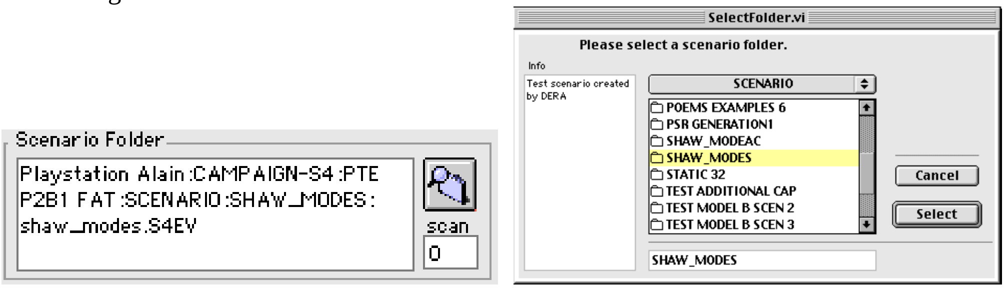
Open the EDR recording and Conversion Parameter window

(4x) select one of the source destination folders for the process.

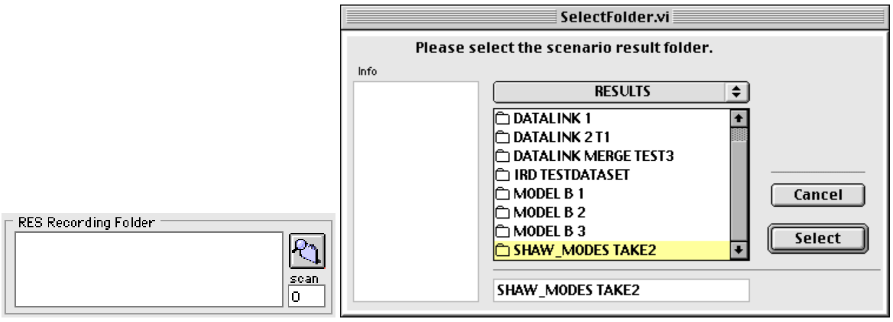
Stop the tool

3. First , select the SCENARIO option in the Time Merger.

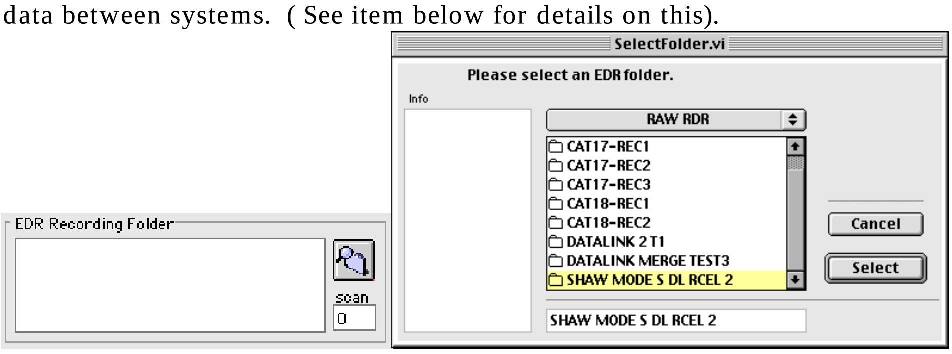
Now select the scenario folder. This is the same folder as the one you selected in the scenario generators and in the RES main.



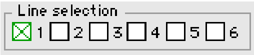
4. Next, select the RES recording folder. This is the folder you selected prior to running the RES main in the “Scenario results” section. This folders stores the interrogation and result data of the scenario you selected.
Beware, the same scenario might have multiple “scenario result” folders, since it can be run several times.



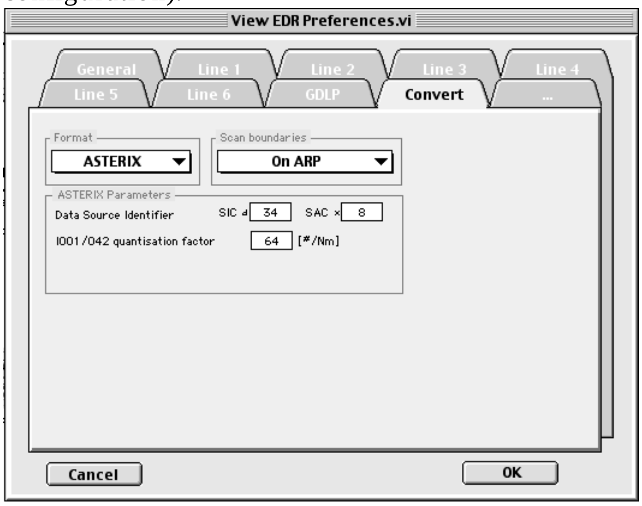
5. Now select the EDR recording folder.
This folder contains the EDR data recording of the scenario you selected. This folder also contains the .ARP file, and .UTC file, which are used to time stamp the IRD data. Make sure you always name these folders correct, since they often will reside on different computers. Typically, the EDR folder will reside on the computer driving the EDR, whereas the two folders above reside on the RES computer. Use your LAN to transfer data between systems. (See item below for details on this).



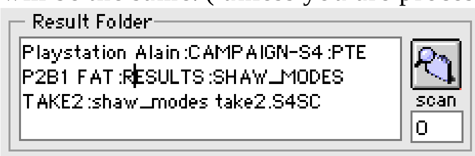
Next, select the proper lines for the EDR recording. The lines which have been recorded have a green color, non-used lines have black color.



After selection of the EDR data, you should open the EDR preferences  and select the “Convert” Tab. This allows you to select the proper recording format (RDIF / ASTERIX) and the SIC / SAC code of the radar. Also select the proper “ Scan Boundary” parameter. (Typically use “On ARP” . This works always, since ARP / ACP must be recorded in this configuration).

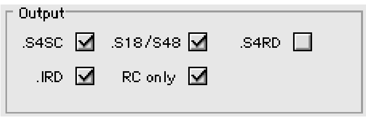


6. Finally, make sure the result folder that will contain the IRD data is correct. Upon selecting the “Scenario Result folder”, the “result folder” is also selected as the same folder. The user still has the option of changing this , but in most cases, the two folders will be the same. (unless you are processing your data on several computers in a LAN).



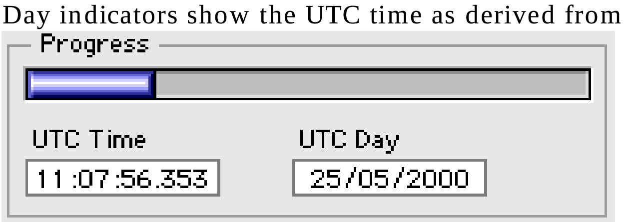
7. Next, select the output files to be created.

The S4SC file is the time merged scenario file, the .IRD file is the interrogation and Reply data , the S48 is the asterix surveillance data and the S18 are the asterix data link commands.



8. Click the start button and wait until the end of the process. 

The Progress bar will indicate the processed part of the file, while the UTC time and Day indicators show the UTC time as derived from the UTC file.



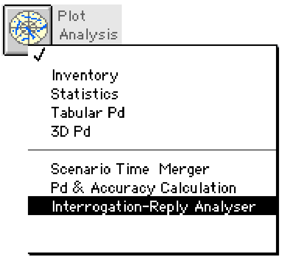
9. Once the file is completely processed, the different files can be viewed with their relevant viewers, or the next step, data linking, can be taken.

5.00 Interrogation-Reply analysis

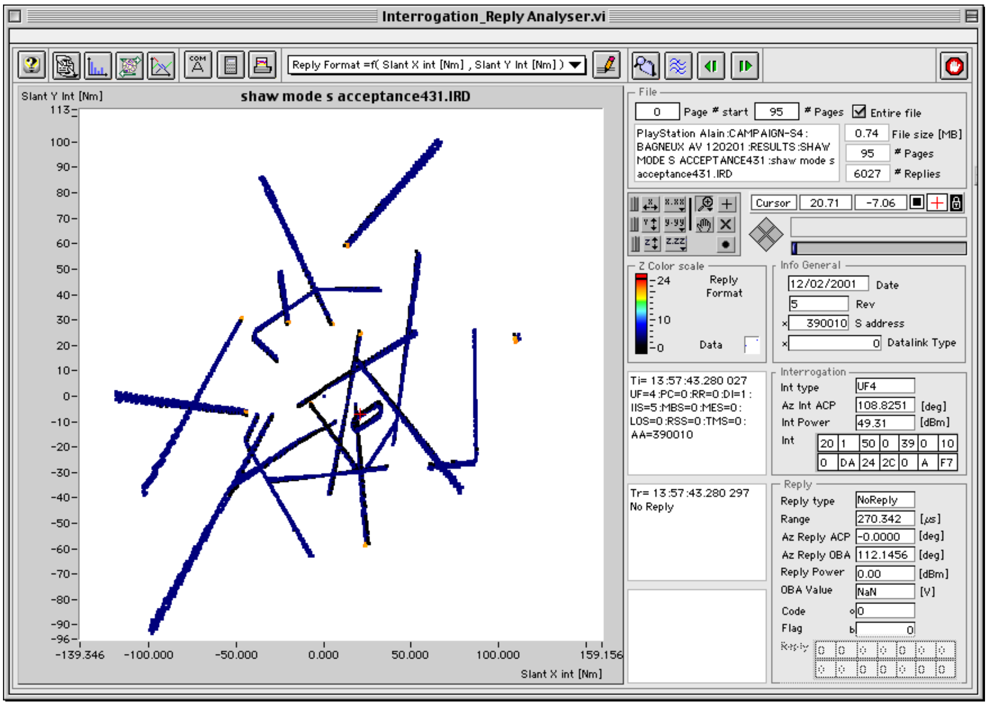
Once the IRD data is build, the data can be loaded in the "Interrogation-Reply analyser tool. This tool is build as a starting point for PTE P2B2 analysis, and as such will be subject to a lot of improvements during the PTE P2B2 development. For the moment, we will merely explain how to use the tool and how to create an RFS export datafile.

Details on the tool and its analysis features will not be explained yet.

1. First load the tool from the RASS-S toolbox:

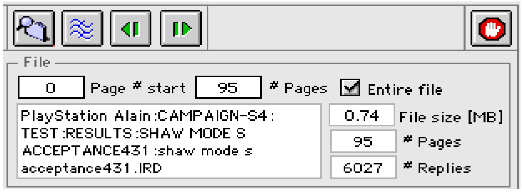


The following window will popp up:



The window has several main areas of interest:
First, the toolbar contains the usual set of buttons:

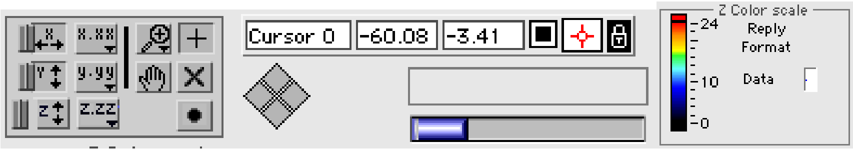
The tool works with one file or layer at a time and needs you to input the folder containing the .IRD or IRDV file manually:



The file is dealt with as a combination of a number of pages, where each page consists of

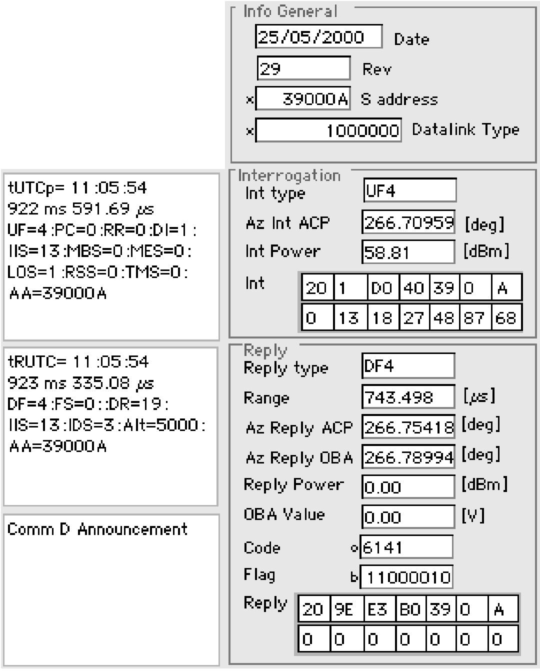
64 interrogations. (Later implentations will allow selection through scan numbers).
The user can “page” through the file using the foreward and backward arrows.

Next, there is the graph with ist control pallete:
This pallete controls the X, Y and Z scaling of the tool and all the zoom and pan actions.



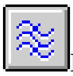
The cursor positions are also shown in these control fields.

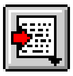
Finaly, some general and detailed information fields are available on the user interface:

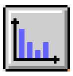


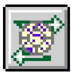
Following buttons control the operation of the tool:

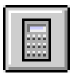
 Evokes the help window

Evokes the “Define filter” window, allowing you to define a filter

 Evokes the “Import” or “Export” functions (menu, IRS or regular import/export)

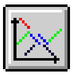
 Evokes the “Histogram” function, allowing you to count certain parameters.

 Multi level linking: Creates a multi level link with plot data and video data

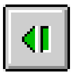
 Calls an analysis module to count a number of features of the data

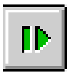
 Creates a printout of the data

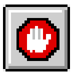
 Evokes the Graph definition window

 Evokes the Roll Call Scedule window

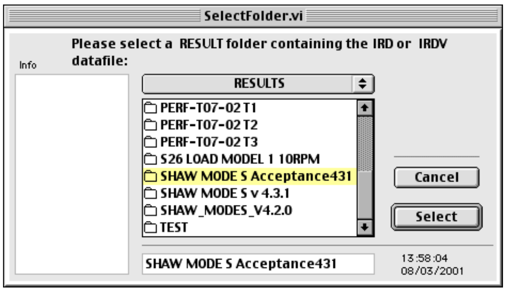
 Allows you to select an FOLDER containing an IRD or IRDV file

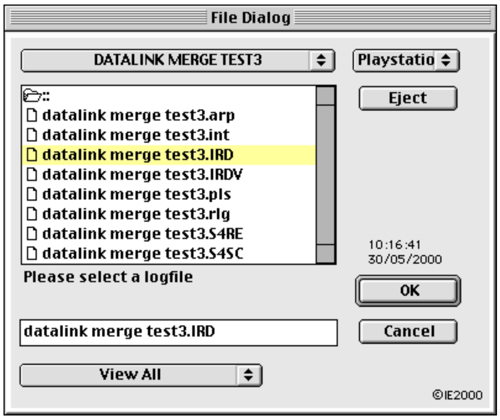
 Pages back N pages in the file

 Pages foreward pages in the file

 Halts the tool

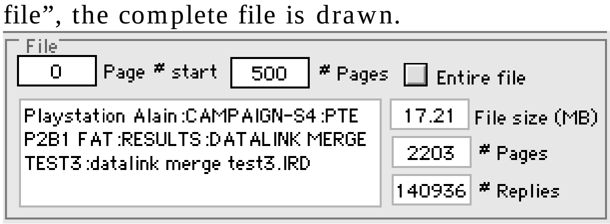
2. Now start by selecting a folder containing a dataset:





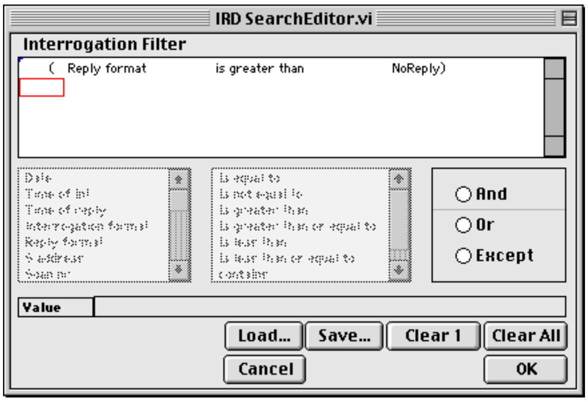
The tool allows you to select two types of files:
-IRD file (created by the Scenario Time merger)
-IRDV files (created by the Reference extractor)
Therefore, it will present you with a File dialog if more than one .IRD*
In this example, we will select an IRD file.

The size of the file , the number of pages and the number of Interrogation/reply records is shown in the indicator next to the filename.
Now select how many pages you want to put in your display at once. If you select “Entire file”, the complete file is drawn.



3. Prior to displaying large amounts of data, it is a good idea to enter a proper filter in your input. This can be done by clicking the “Filter” button. 
This will evoke the filter definition window:

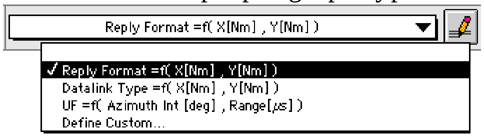
The filter allows you to filter on any provided fields in the interrogation or reply. (Positional information, scan nr, time, interrogation data, reply data, all Mode S subfields, etc..)



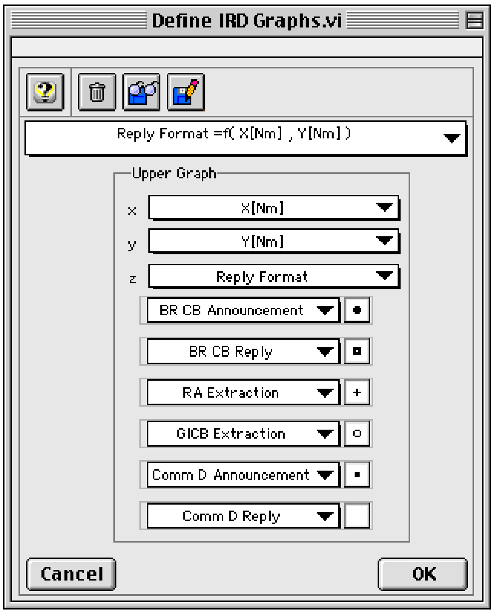
(The operation of these filters has been explained numerous times in this manual, e.g. Vol 4, Ch Ch III Radar Data Analysis)

The filter will be filled by default with the filter “ Reply format > No Reply”, to filter out all unwanted non reply interrogations . (UF 11 and SSR). Beware, if you use the export and you want these to be included in the export, remove the first line of the filter. (using Clear all).

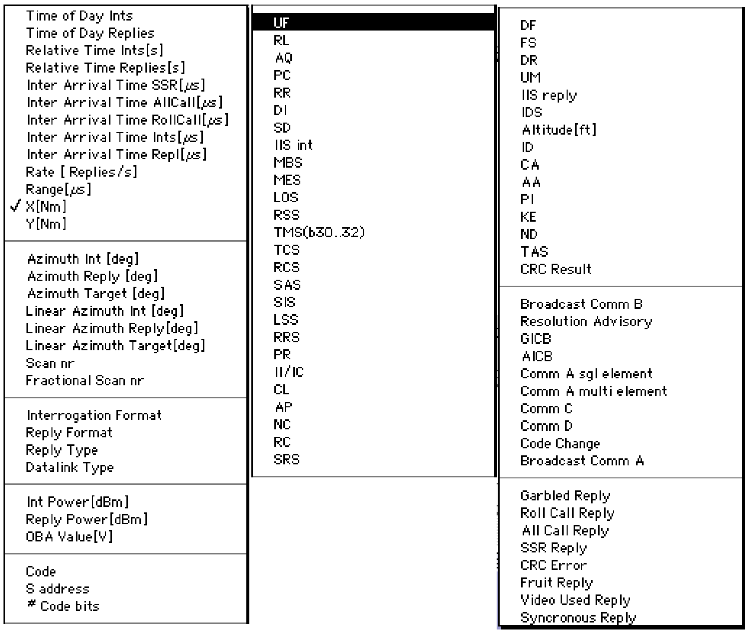
4. Now define a proper graph type or select one from the list:



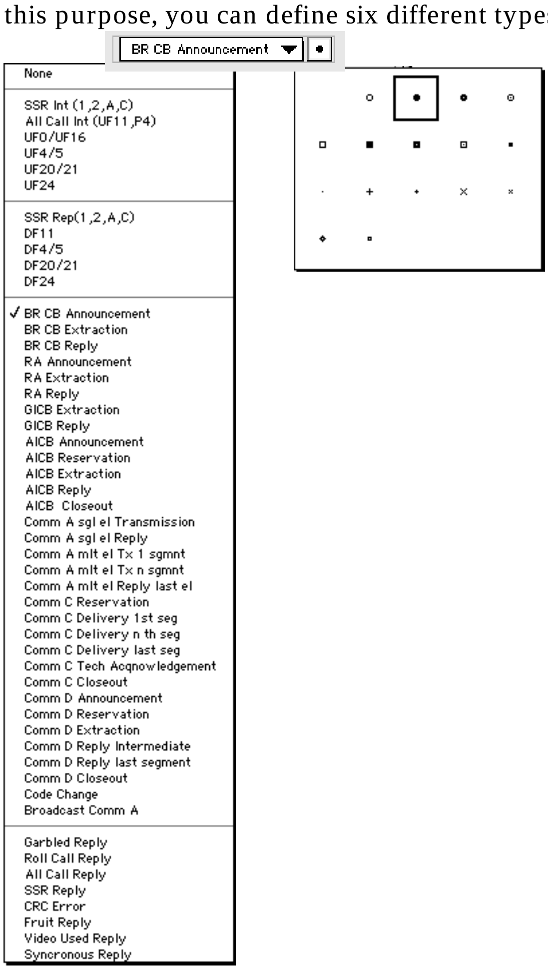
The graphs can be defined or redefined by clicking on the edit button  or by selecting “Define Custom “ in the list. The following window pops up:



Next, Select the x, y and z scales for the graph. The user has a wide selection between following fields for all scales:

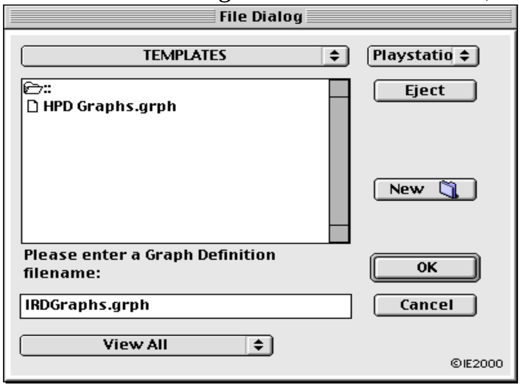


The tool also allows you to define different symbols (or point types) per type of data. For this purpose, you can define six different types using the following menu:



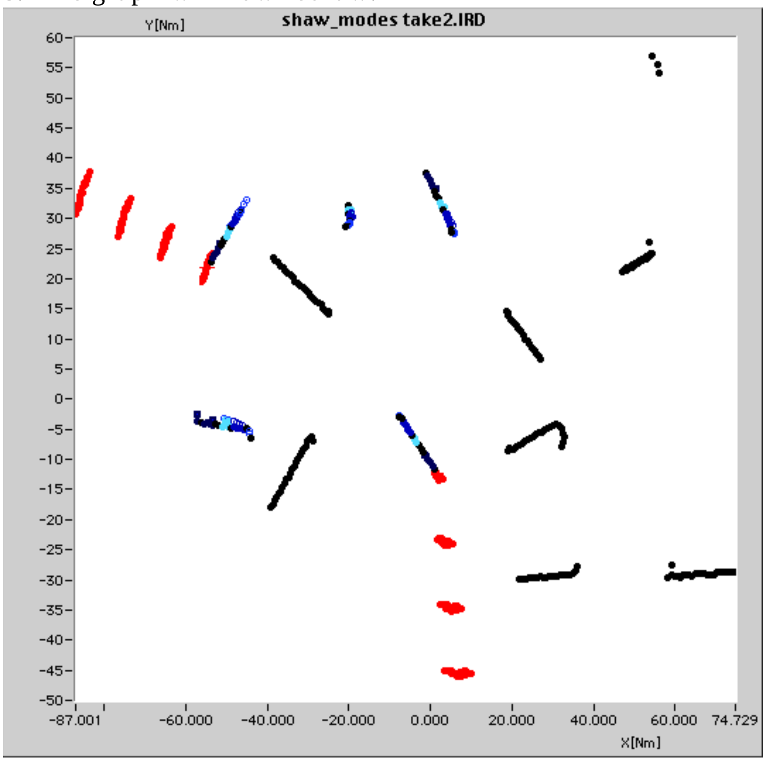
Once the graphs are defined, you can save the list of graphs to a template file. This can be handy for later analysis of the same datasets.

Save the data using the save button  , load it using the load  button.

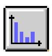


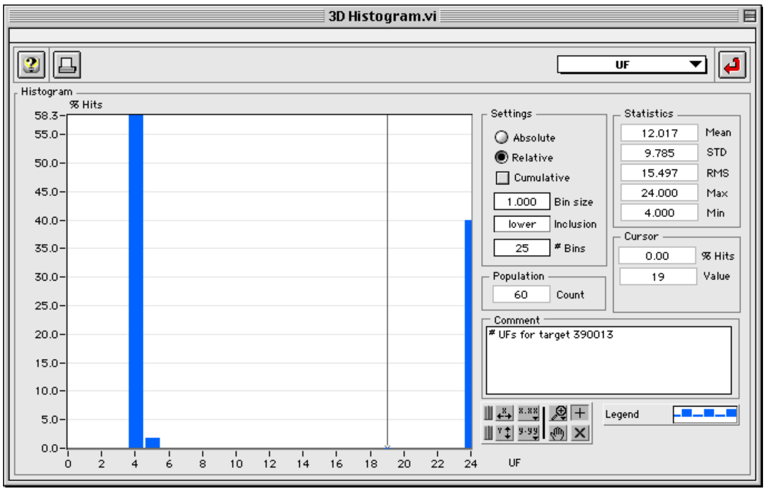
Clear one graph from the list using the delet button. 
Confirm your editting using the OK button: 

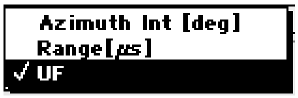
5. The graph will now redraw.



6. Further features include a histogram function, which counts the number of events in a selected (zoomed) area of the graph.

To use the histogram, select a section of the graph and click the histogram  button.

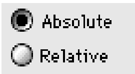


One of the three axis can be selected using the selector 

in the top right corner of the window.

The following settings can be done in the historgram function:

Realtive or absolute value representing



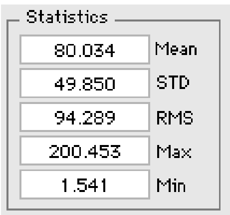
Cummulative value representing

Bin size value. The # Bins indicator is directly coupled with the Bin size value

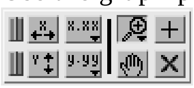
Boundary inclusion

These parameters can be altered at any time and this will result in an immediate recalculation and redisplaying of the histogram.

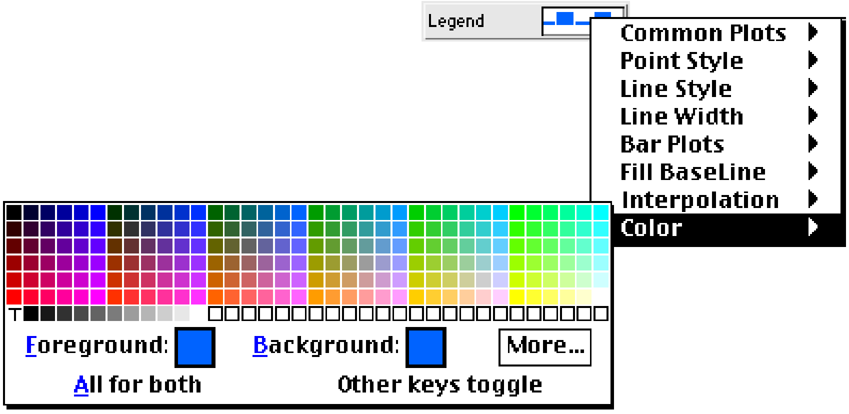
Some statistics are automatically calculated on the selected data set and are displayed at the right hand side of the histogram window.



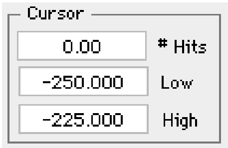
Use the graph palette to zoom and pan in the data, centre and select the cursor.



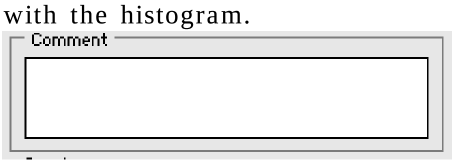
Use the legend palette to change the appearance of the histogram.



The cursor display shows the value, the upper and lower boundary of the selected histogram bin. A bin can be selected by dragging the cross cursor to it. The cursor will automatically be placed in the center of the bin and the cursor display will be updated at the same time.



The histogram can be printed by clicking the **print**  button. The RASS-S reporting function is enabled which allows you to store or print the histogram. Information about the histogram can be entered in the comment field. This field will be printed together with the histogram.



Click the return  button to close the histogram function and return to the Inventory tool

7. Next , we will explain how to export the data into an IRS or IVS datafile. We will assume you have selected a dataset and a proper filter.
If you want to select a certain section of data (e.g. between two scan numbers or in a given timeframe) also use the filter to make the selection.

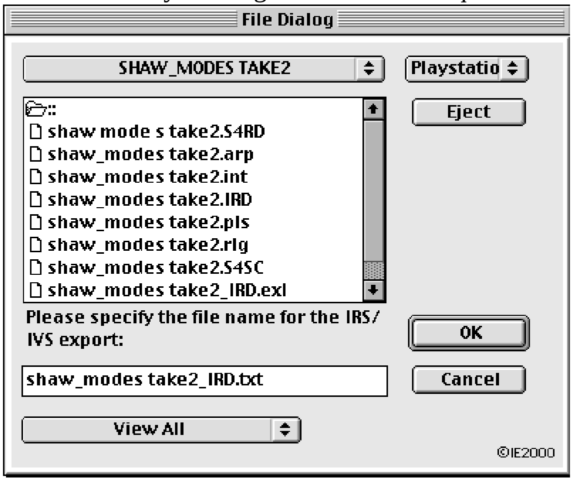
Next, use the “export” menu, which can be found in the menu bar:

 **export**

This menu allows you to select between two types of export: IRD export and export list. The first one creates an IRS or IVS datafile. The second one creates a custom export list.

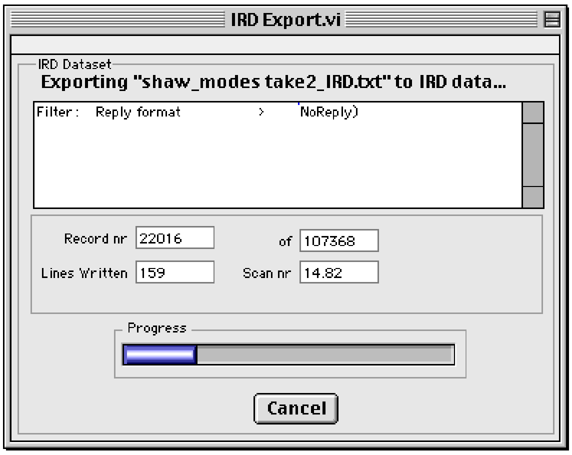
Select IRD Export.

The tool will now request you to define the IRS datafile. The file will be named by default xxxx_IRS.txt, with xxx the name of the IRD datafile (and the result folder). You can always change the name if required.



Click OK.

The progress of the export can be seen in the following window:

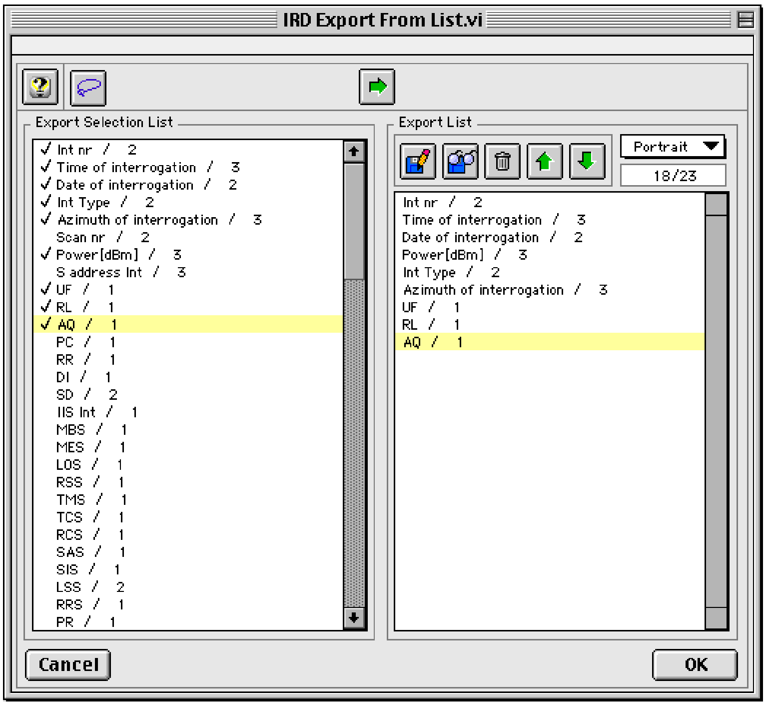


The window will also show you the filter used for the export.

Cancel will halt the export and the export file will be written up to that point.

Inport the file in excel and examine.

8. If you select List Data the following window will appear:



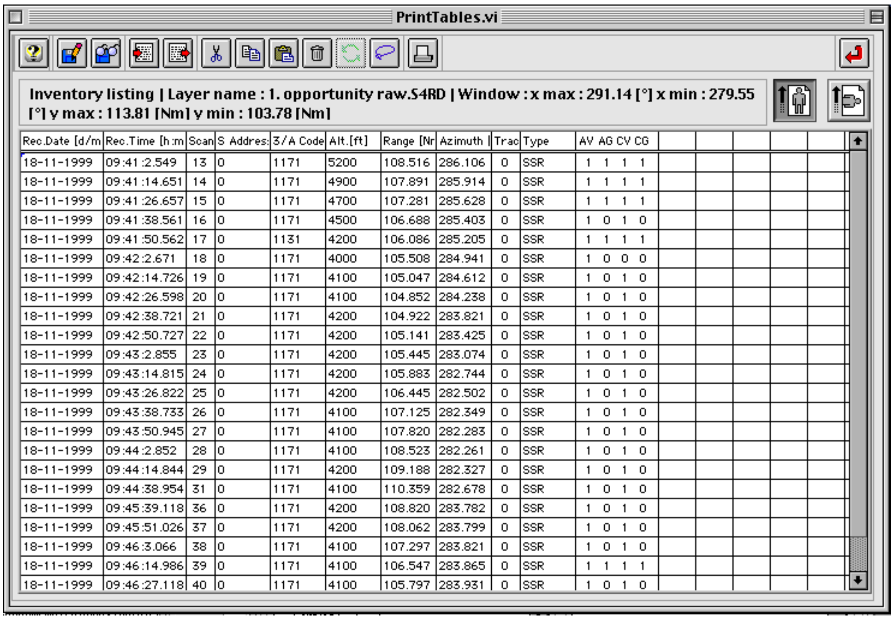
The user can select a number of items to be listed from the Export Slection List at the left side of the window by double clicking the item of interest or by selecting it and clicking the button. The selected item is transferred to the Export List and a checkmark is added to the corresponding item in the Export Selection list. A predefined number of items is by default enabled to be exported. This list corresponds with the Export function in previous software version.

A selected item in the Export list can be shifted up or down . Use the button to delete the selected item from the Export list. An Item can be selected by clicking it in the list. Once the contents of the Export list is defined, it can be saved to disk. Use the button to load an earlier saved Export list.

The current width of the list is calculated and displayed . The second number is the maximum width that can be used for printing the list according to the selected printing type . For viewing purposes only, wider list can be used.

The value behind each item is the individual width the item will take in the list. Items with a width equal to zero are currently not implemented.

To view the list click on the button. To leave the DataExport window and return to the Inventory, click the button. Depending on the selected items the following window will appear (notice the the data is sorted in ascending order according to the consequetive selected items):



Rec.Date [d/m	Rec.Time [h:m	Scan	S Addres:	3/A Code	Alt.[ft]	Range [Nr	Azimuth [	Trac	Type	AV AG CV CG
18-11-1999	09:41:2.549	13	0	1171	5200	108.516	286.106	0	SSR	1 1 1 1
18-11-1999	09:41:14.651	14	0	1171	4900	107.891	285.914	0	SSR	1 1 1 1
18-11-1999	09:41:26.657	15	0	1171	4700	107.281	285.628	0	SSR	1 1 1 1
18-11-1999	09:41:38.561	16	0	1171	4500	106.688	285.403	0	SSR	1 0 1 0
18-11-1999	09:41:50.562	17	0	1131	4200	106.086	285.205	0	SSR	1 1 1 1
18-11-1999	09:42:2.671	18	0	1171	4000	105.508	284.941	0	SSR	1 0 0 0
18-11-1999	09:42:14.726	19	0	1171	4100	105.047	284.612	0	SSR	1 0 1 0
18-11-1999	09:42:26.598	20	0	1171	4100	104.852	284.238	0	SSR	1 0 1 0
18-11-1999	09:42:38.721	21	0	1171	4200	104.922	283.821	0	SSR	1 0 1 0
18-11-1999	09:42:50.727	22	0	1171	4200	105.141	283.425	0	SSR	1 0 1 0
18-11-1999	09:43:2.855	23	0	1171	4200	105.445	283.074	0	SSR	1 0 1 0
18-11-1999	09:43:14.815	24	0	1171	4200	105.883	282.744	0	SSR	1 0 1 0
18-11-1999	09:43:26.822	25	0	1171	4200	106.445	282.502	0	SSR	1 0 1 0
18-11-1999	09:43:38.733	26	0	1171	4100	107.125	282.349	0	SSR	1 0 1 0
18-11-1999	09:43:50.945	27	0	1171	4100	107.820	282.283	0	SSR	1 0 1 0
18-11-1999	09:44:2.852	28	0	1171	4100	108.523	282.261	0	SSR	1 0 1 0
18-11-1999	09:44:14.844	29	0	1171	4200	109.188	282.327	0	SSR	1 0 1 0
18-11-1999	09:44:38.954	31	0	1171	4100	110.359	282.678	0	SSR	1 0 1 0
18-11-1999	09:45:39.118	36	0	1171	4200	108.820	283.782	0	SSR	1 0 1 0
18-11-1999	09:45:51.026	37	0	1171	4200	108.062	283.799	0	SSR	1 0 1 0
18-11-1999	09:46:3.066	38	0	1171	4100	107.297	283.821	0	SSR	1 0 1 0
18-11-1999	09:46:14.986	39	0	1171	4100	106.547	283.865	0	SSR	1 1 1 1
18-11-1999	09:46:27.118	40	0	1171	4100	105.797	283.931	0	SSR	1 0 1 0

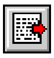
The top row buttons operate the window.

 Toggle “Help” window On/Off

 Save list to disk (RASS-S file)

 Load list from disk (RASS-S file)

 Import list from spreadsheet

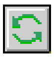
 Export list to spreadsheet

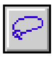
 Cut item from list

 Copy item from list

 paste item in list

 Empty list

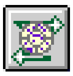
 Undo last delete

 Select all

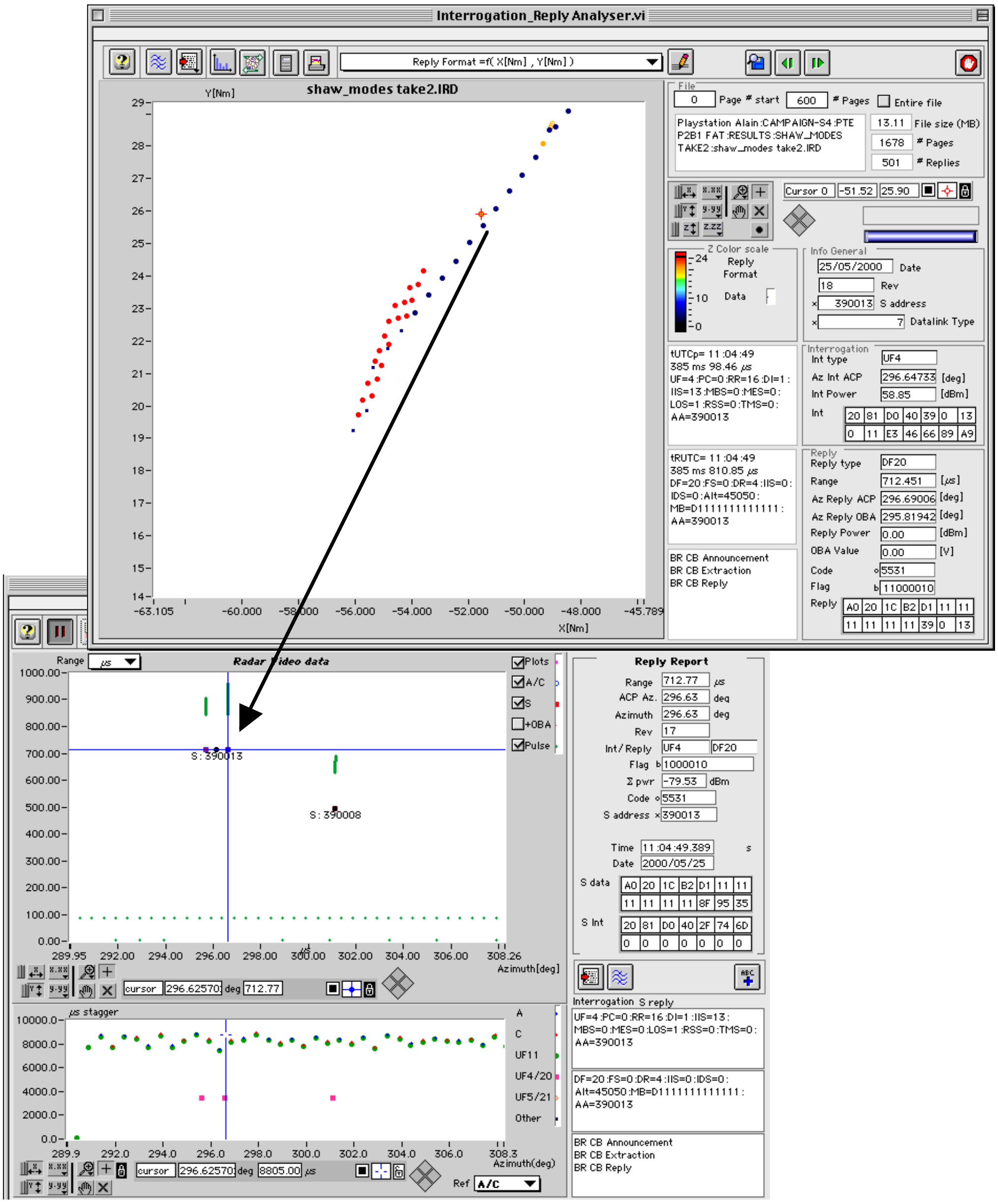
 Print list

 Close window

9. In the Interrogation reply analyser the multi level link will link interrogation - reply records with Video reply data. For this purpose, you can load a corresponding pulse recordingin the reference extractor tool (Analyse Pulse Recordings.vi) .
When you then select a reply in the interrogation_reply analyser and click the multi level link button, the corresponding video data will be available.



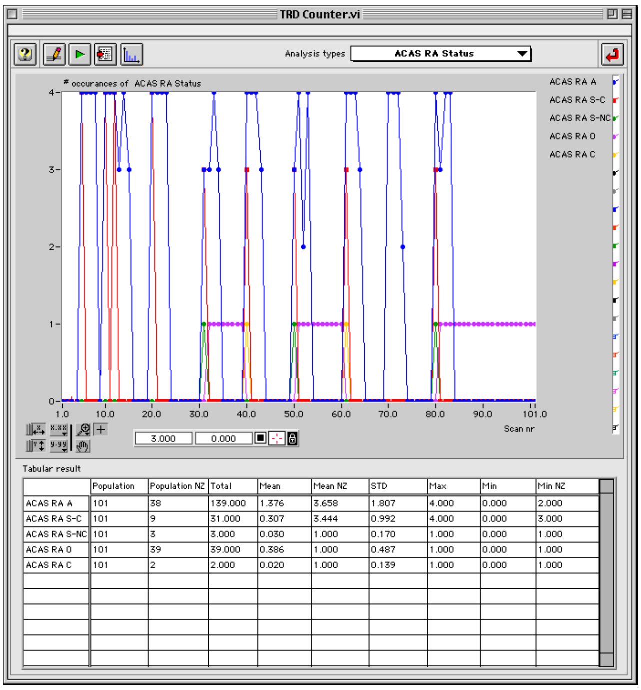
This can be usefull to verify timing, contents and FRUIT presence.



Beware: The multi level link requires the scan numbering to be correct between the video recording and the IRD data. If the video data is not started simultaneously (or prior to in case of RES driven scenarios) with the scenario, there might be one scan offset between the two recordings. In this case, the user must “browse” back one scan in the pulse recording in order to find the corresponding video.

10. All graphs in the tool can be printed using the  **print** button.

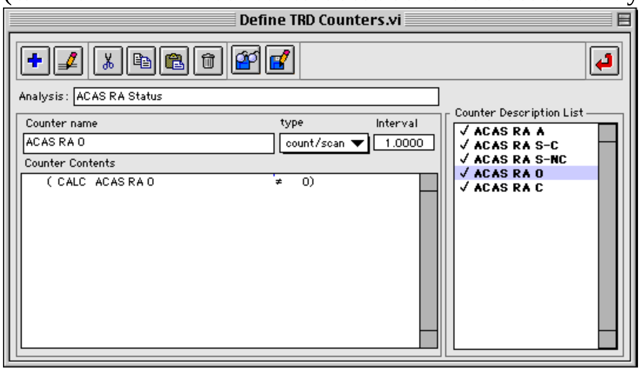
11. Click the button to open the Calculate window. This tool allows the calculation of certain (user defined) parameters per scan or part of a scan. The following window will appear (with a different contents):



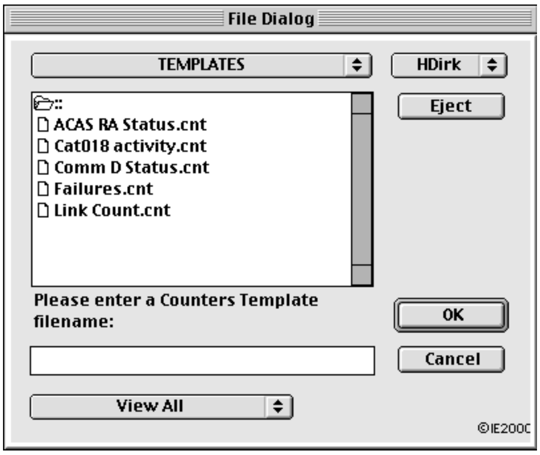
The tool mainly consists of a graph and a tabular display representing the results of the calculation according to the selected analysis type. To select a specific analysis, use the Analysis types selector in the upper right corner of the window.

- ✓ **ACAS RA Status**
- **Cat018 activity**
- **Comm D Status**
- **Failures**
- **Link Count**

This list contains all the Calculate analysis types which are at that moment present in the CAMPAIGN:GENRAL:TEMPLATES directory. An individual analysis type from the list can be edited by clicking the button. The following window will appear (with a different contents because the selected analysis type is displayed by default):

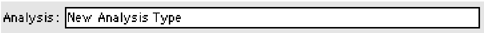


Click the button to load another analysis type. The following dialog will appear:

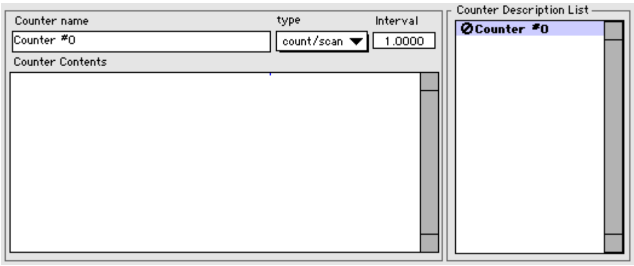


Select the prefered analysis type to be edited.

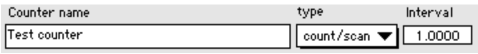
Click the  button to clear the display and start from scratch to buid a new analysis. Type in a new name for the new analysis type.



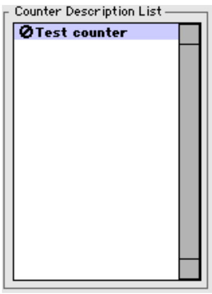
Click the  button to add a counter definition to the analysis type. The counter definition window to define the first counter is enabled.



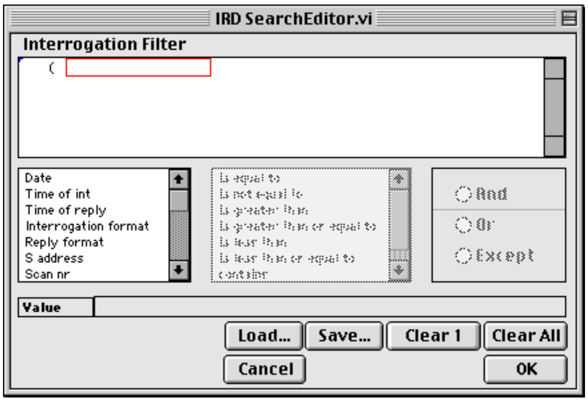
Type in the counter name and decide the interval for which the counter has to be calculated.



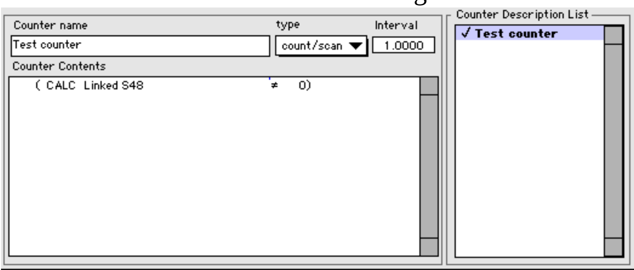
Click the  button to define the contents of the counter or doubleclick the name of another counter in the counter description list.



The following window will appear:



This is in fact the same window as the filter definition window in the Interrogation-Reply Analyzer tool. For more information about this window, please consult the user manual on this topic. Use this window to define a specific counting function and click the OK button to add this new counting function to the new analysis type.



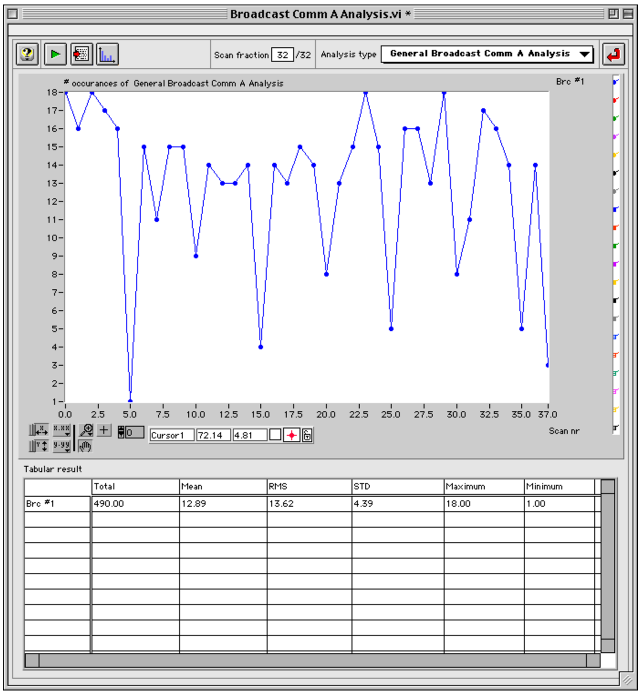
In the same way multiple counters can be added to a single type of Analysis. Each counter is represented by a line in the graphical display or by a line in the tabular display of the main window.

Use the  button to cut a counter from the counter definition list, use the  button to copy a counter from the counter definition list or use the  button to paste a counter into the counter definition list.

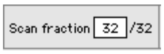
Once the analysis definition is finished, use the  button to save the analysis in the CAMPAIGN:GENRAL:TEMPLATES directory. The new type of analysis will be added to the Analysis types list and will appear from now on each time that the calculate window is opened.

Click the  button to close the Calculate window and return to the Interrogation-Reply Analyzer tool.

12. Click the  button to open the Data link Broadcast Comm A Analysis window. The following window will appear.



Use the scan fraction selector to define the scan fraction (step =1/32) to be used in the Data link Broadcast Comm A Analysis (32/32 is a complete scan)

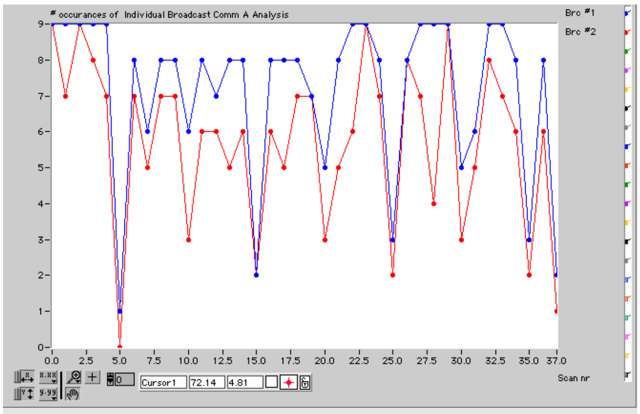


Use the Analysis types selector to define the kind (general/individual) of Data link Broadcast Comm A Analysis.

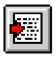
General means that all broadcast comm A events are counted and individual means that each different (in contents) broadcast comm A is counted individually.

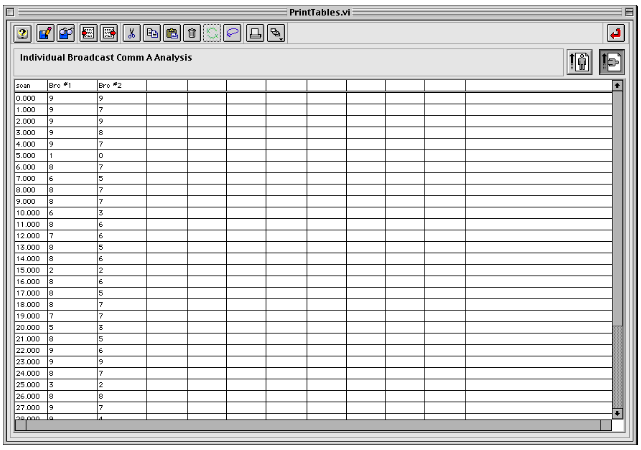
The Data link Broadcast Comm A Analysis is recalculated and redrawn each time one of the parameters above is changed. Click the  button to force a recalculation and redraw of the analysis

Every broadcast comm A analysis is represented by a sigle line in the graph with the scan fraction number on the x-axis. For example, with two different (in contents) broadcast comm A events, the following graph may appear:

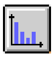


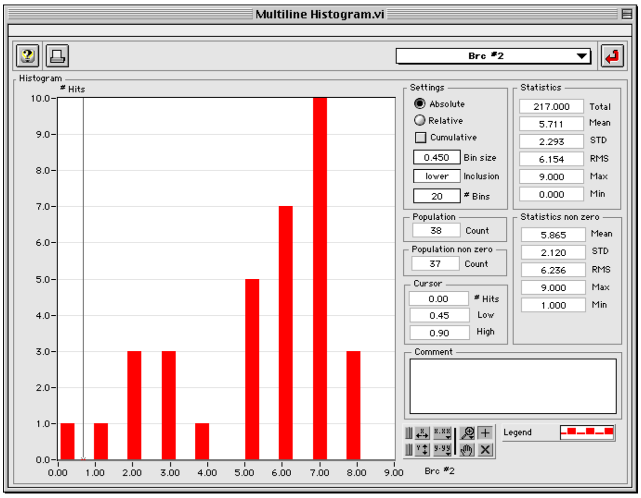
	Total	Mean	RMS	STD	Maximum	Minimum
Brc #1	273.00	7.18	7.52	2.23	9.00	1.00
Brc #2	217.00	5.71	6.15	2.29	9.00	0.00

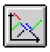
Use the  button to represent the data link broadcast comm A analysis in a tabular display. Each column represents a different broadcast comm A. Each row represents a scan fraction.



scan	Brc #1	Brc #2
0.000	9	9
1.000	9	7
2.000	9	9
3.000	9	8
4.000	9	7
5.000	1	0
6.000	8	7
7.000	6	5
8.000	8	7
9.000	8	7
10.000	6	3
11.000	8	6
12.000	7	6
13.000	8	5
14.000	8	6
15.000	2	2
16.000	8	6
17.000	8	5
18.000	8	7
19.000	7	7
20.000	5	3
21.000	8	5
22.000	9	6
23.000	9	9
24.000	8	7
25.000	3	2
26.000	8	8
27.000	9	7

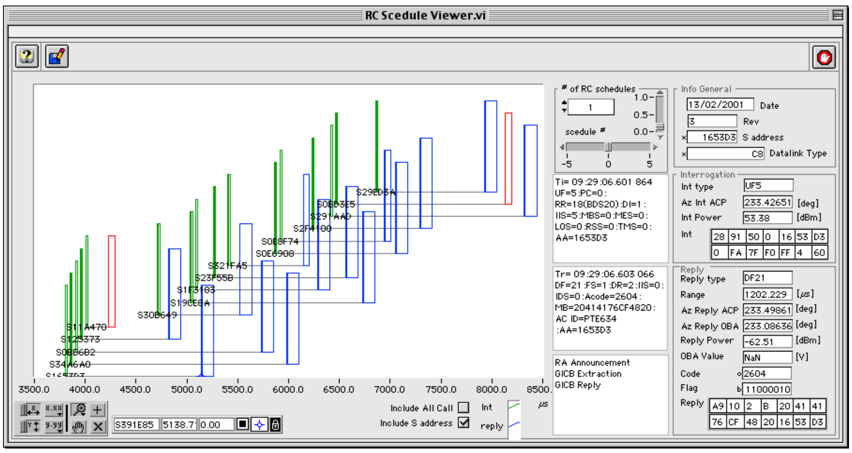
Use the  button to represent the data link broadcast comm A analysis in histogram format.



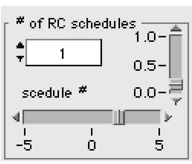
12. Click the  button to open the Roll Call Scedule Viewer window.
This tool only works on IRD files, NOT on IRDV files!

This tool allows the viewing of the Roll Call Scedule in time.
Prior to calling this window , position the cursor arround a section of the scedule you want to examine.
For this purpose, it is best to put the graph in a proper mode (e.g. Y scale = range, X scale = fractional scan number or time). This simplifies the searching of the correct scedule.

Once the window is open, use the cursor to query on the interrogations.
The info presented at the right of the window is the same as that on the main interrogation-reply analyser.



Use the horzontal “Schedule #” slider to select previous or next schedules .



Use the vertical slider to separate the different interrogations /reply pairs.

Chapter XI : Multi-Radar Scenario Generation Software for RES and LAN replay or SASS-C Test Data generation

1.0. Introduction

1.1. General

The creation of a radar test environment for a radar under test runs through two important entry points to the radar:

-Rf interface
-Radar Data input (X25/LapB/HDLC/**LAN**)

The RF interface (allong with its auxillary inputs ACP/ARP for rotational slaving) is provided through the RES (or Radar Environment Simulator). This hardware device provides the radar with all signals required for the generation of a SSR or Mode S target simulation. The software required for the RES is described in Chapter IV of this volume.

This section deals with the extension of the generation software towards multi-radar output. This extension allows the generation of RF or Data output of up to 32 radars, each having their own position and rotation speed. Each Radar can also have its own error (systematic and random) modeling for the output data.

The data interface, consisting of eighter the GDLP-DLF (Asterix cat018), PSR input data (Asterix Cat 001,002) , SSR plot simulation (Asterix Cat 034,048) , Asterix Track simulation (Cat 001/002 Track, Cat 034/048 track or Cat 062) is dealt with by one or more EDR (Extended Data Recorders) devices or by means of LAN replay software (TCP_IP or UDP_IP).
The same data can optionally also be created in a SASS-C compatible input format (IOSS Mayer).
An extension for other asterix data formats (ARTAS cat 30/32 format, ADSB Cat 21 data) is foreseen for future versions.

The RASS-S Toolbox provides sufficient software tools to drive these hardware devices with the required data streams plus the tools to create scenario data.

Additionalliy, this software allows us to generate test data for e.g. a clustered environment. For this purpose, version 4.4.6 and 6.1.0 have been updated with a function allowing to import map files as used in the European Mode S Programme and POEMS. These maps are typically built using a tool called “SM-GET” (Not part of RASS-S, can be purchased through Eurocontrol) .

The Scenario generation software consists of several main tools:
-The Multi-radar Trajectory Scenario Generator.
-The Multi - Radar Event Scenario Generator
-The RES Main Control
-The GDLP driver
-The EDR replay driver
-The TCP_IP or UDP-IP replay driver

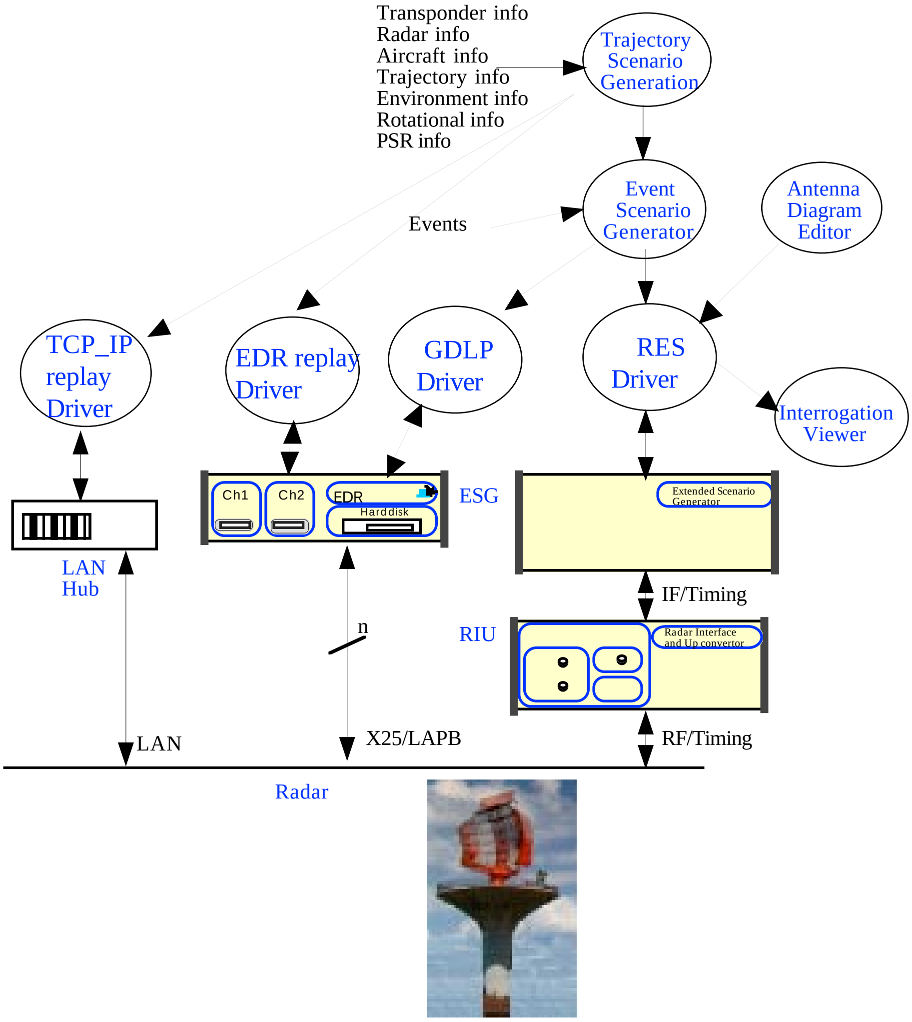


Fig. 1: Scenario generation data stream model

The (Multi-Radar)Trajectory Scenario Generator tool uses a software packet with a fully graphical interface to provide the user a feasible method of creating a realistic radar test environment. The tool uses libraries with aircraft, transponder and trajectory data thereby reducing the time required to enter or edit scenarios. Up to 2000 free flying targets can be programmed. Features like trajectory duplication and randomise functions are available. Trajectories can be piece wise specified using speed, heading, turn rate, climb rate, and acceleration. Each trajectory is identified with a fully programmable transponder in accordance with ICAO Annex 10. The radar's environment is simulated using specific antenna patterns, rotational speed and reflectors. The outcome of the scenario generator is a file to be compiled and used by the hardware part of the RES.

The SSR or Mode S scenario is used as a input for the Asterix replay radar data to be generated by the EDR PSR replay or LAN replay feature. For this purpose, the original scenario is recalculated towards the real positions of one or more radars taking into account a number of radar bias and positional offset parameters and the positions (Long-Lat) of these radars.

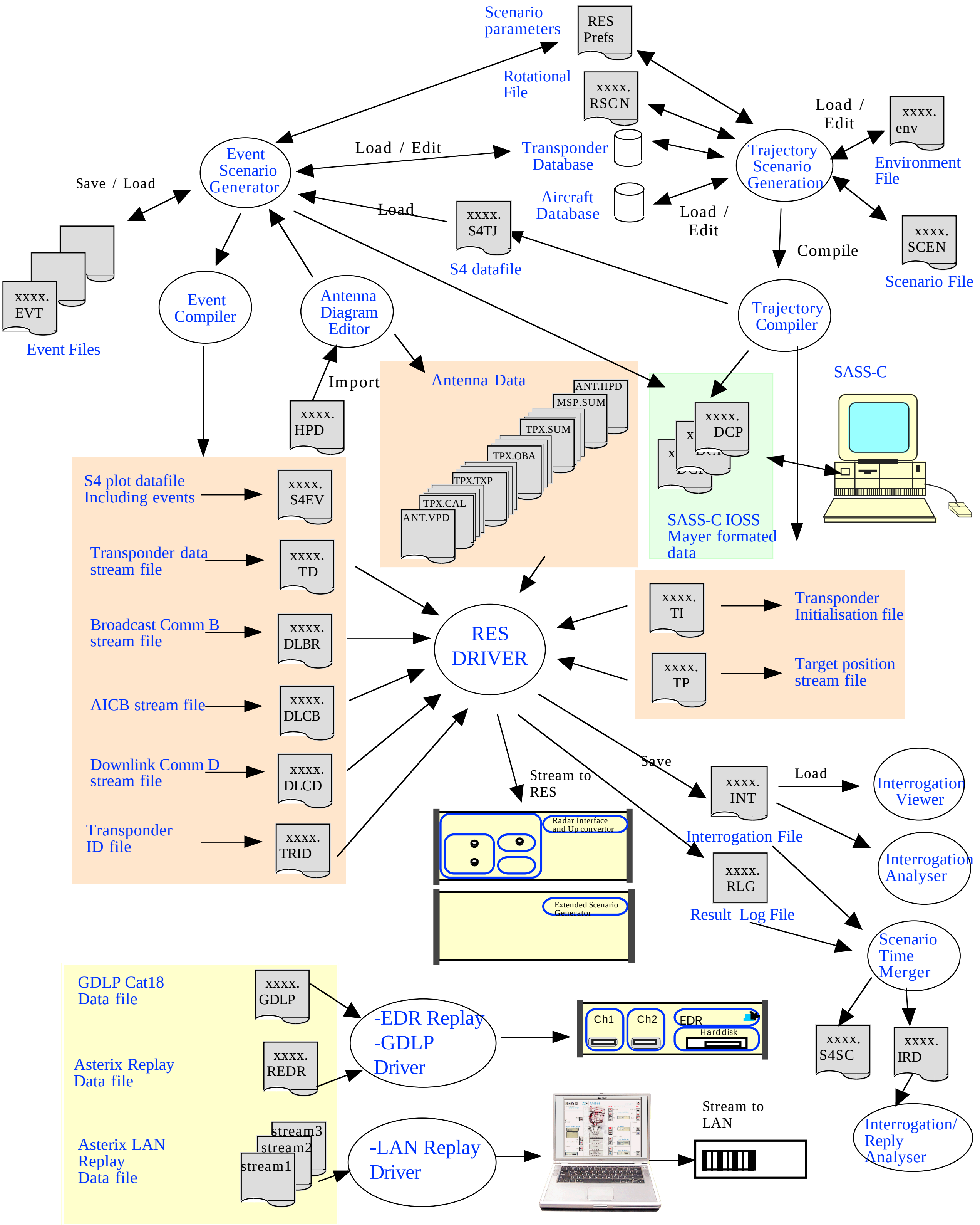


Fig. 2 : module overview and created files.

The Event Scenario Generator and Data Replay Event Scenario Generator is a tool using the same graphical user interface as the (Multi-Radar) Trajectory Scenario Generator , but used to create all different sorts of “events”. These events can be a number of transponder parameter changes (like A code), misses in the scenario or special events like alerts and SPIs . The tool uses the files created by the trajectory scenario generator to start with, and on top of the generated target plots , the user can define the events. The outcome of the scenario generator is a file to be compiled and used by the hardware part of the RES or the EDR or LAN replay function.

The RES Main control inputs the compiled data from the scenario generators and feeds the RES hardware with the necessary data. In the meanwhile, the tool saves the results of the generated scenario (uplink data messages etc..) for later analysis.

The Antenna diagram editor provides the RES with the required antenna information, which can be extracted from prerecorded RASS-S antenna diagram measurements.

The EDR replay driver allows the user to make Lap-B or X25.3 connections and replay earlyer recordings or scenarios created by the Multi-radar trajectory scenario generator using the EDR. This feature is described in detail in volume 5 , chapter IX.

The LAN replay driver allows the user to make TCP_IP or UDP-IP connections and replay earlyer recordings or scenarios created by the Multi-radar trajectory scenario generator.

2.0. Multi Radar Trajectory Scenario Generator

2.1. Introduction

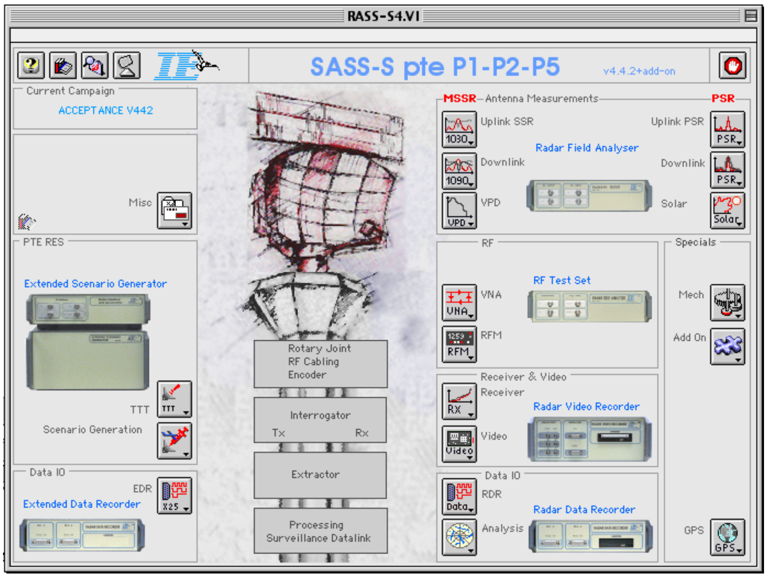
The Multi Radar Trajectory Scenario Generator tool is intended to provide the user with a feasible method of simulating the trajectories of multiple aircraft seen from multiple radars. The tool is easy to use thereby reducing the time required to enter or edit the input of the Radar Environment Simulator (RES) or Data replay tools. The result is a file to be compiled in a later stage and to be used by the RES driver, EDR replay driver or LAN replay driver(s).

In this chapter the use of the Multi Radar Trajectory Scenario Generator tool is discussed. The functional working is examined by simply following the instructions below.

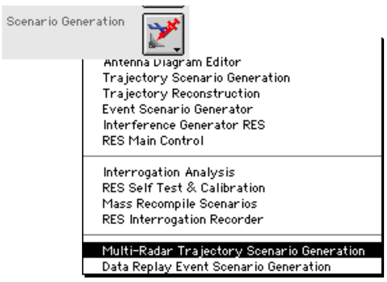
2.2. Using the Multi Radar Trajectory Scenario Generator

2.2.1. Loading the software

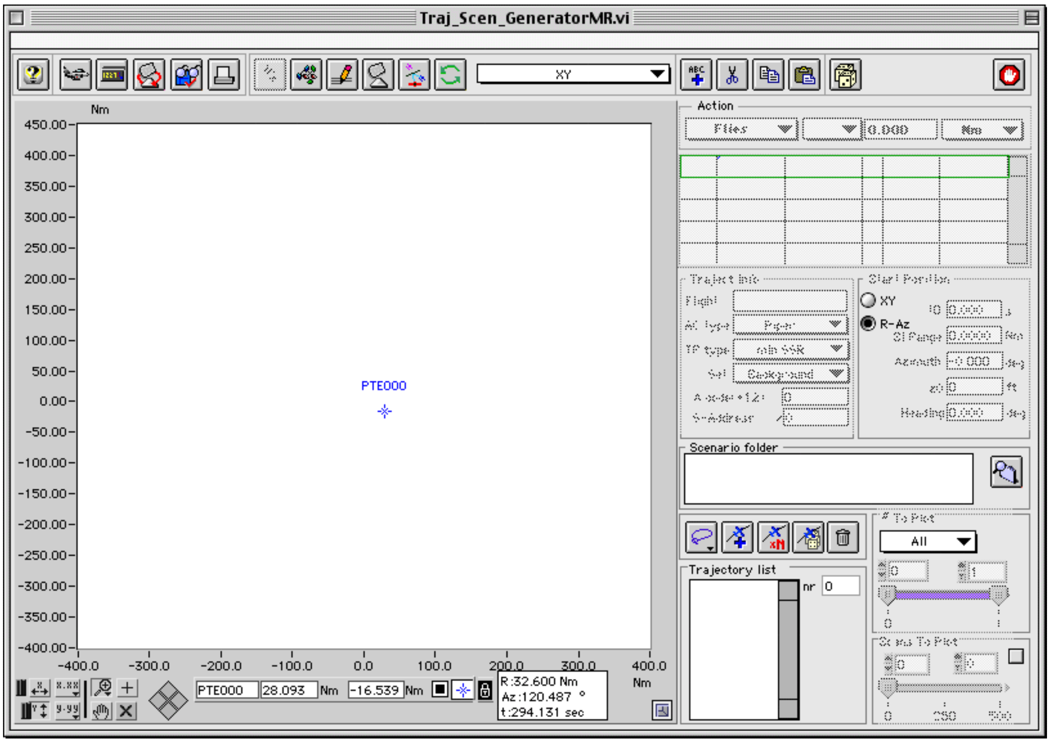
The Trajectory Scenario Generator tool can be loaded from the RASS-S Toolbox.



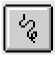
1. To load the tool, double click the RASS-S Toolbox icon and select “Multi-Radar Trajectory Scenario Generation” from the “Scenario Generation” menu in the RASS-S Toolbox.

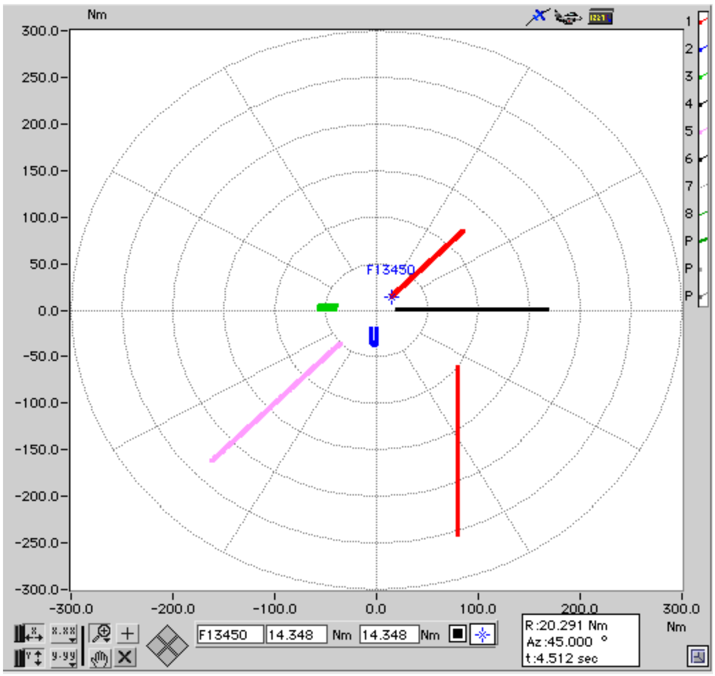


2. Now the tool is loaded:

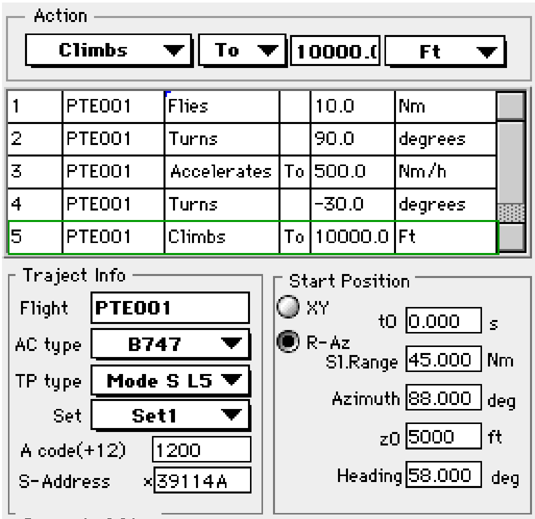


2.2.2. The window objects

3. The window contains several fields:
On the left we can observe the plot graph, which contains a graphical representation of the trajectories created by the Trajectory Scenario Generator. When a scenario is build the trajectories are drawn when the user clicks the **Draw**  button.

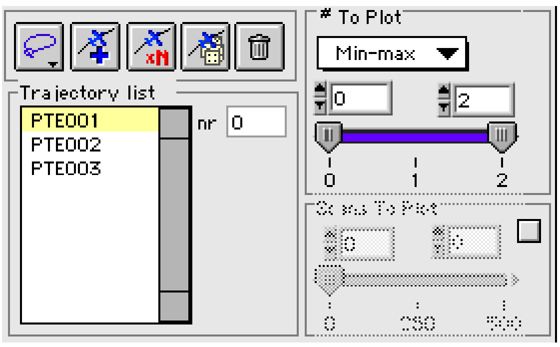


On the right side, the user can enter the data for a trajectory (such as start position, start time, AC type, TP type, Set nr, etc...) and a description of the trajectory in a numerical and structural way.



Furthermore the window contains several buttons which perform a number of functions in the window. (The menu has been removed in this version)

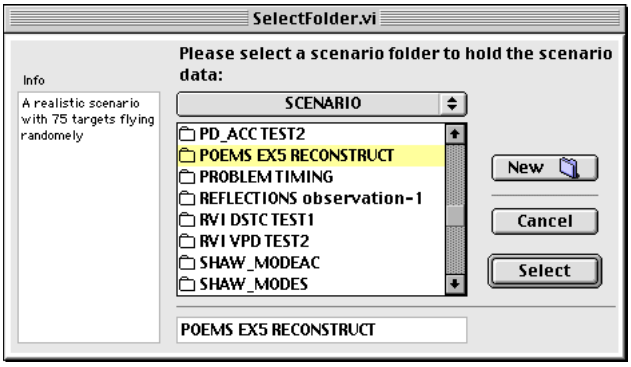
A last group of controls is used to select a specific trajectory (TJ) to be edited (if multiple TJ exist) and to select which TJs and which scans are plotted.



2.2.3. Running the software

3. Now Click the **Run**  arrow in the upper left corner of the window to start the Trajectory Scenario Generator tool.

The tool will start by requesting a Trajectory scenario folder. This folder will be the container of all necessary data for the scenario creation. It will contain the scenario itself, the transponder databases, aircraft databases, rotational scenario, environement definition (reflectors) and the compiled data for the RES Main tool.



The user has the posibility to select an existing scenario from the presented list or select a new scenario.

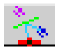
-If the user selected an existing scenario, all relevant scenario data will automatically be loaded by the tool. The tool will check if the following datafiles are present and will load them: If the file is found, the corresponding icon will appear in the upper right hand corner of the Trajectory graph.

-Scenario file : xxx.scen 

-Transponder database: xxx.TBDB 

-Aircraft database: xxx.AC 

-Rotational scenario: xxx.rot 

-Environment scenario: xxx.env 

When a new scenario is required, click the **New** button. 

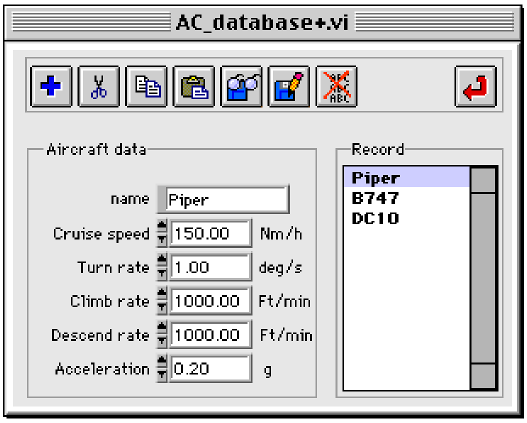
Following dialog will appear:

Enter the name of the new scenario folder (max 25 characters) and click **Create**. The new file will appear in the selection window of the folder dialog and can now be selected.

A new scenario will not have any file present. Transponder and aircraft databases can be resident in memory, so they remain visible when selecting a new scenario, given they were already loaded. Otherwise, a new aircraft and transponder database must be selected or created.

2.2.4. The Aircraft Database

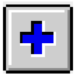
To select an aircraft database, click the **AC Database**  button.
Following window will appear:

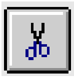


Inside the AC database, the user can enter data defining different Aircraft to be used in the scenario generation:

-AC name
-Cruise speed
-Turn rate
-Climb rate
-Descend rate
-Acceleration

The following buttons control the operation of the AC database:


Enter a new record in the database

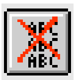

Cut a record (and copy to clipboard)

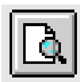

Copy a record to the clipboard

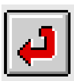

Paste the record from the clipboard to the current index. Data is inserted


Load an existing database from disk


Save a database to disk in a user selected position

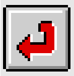

Clear the contents of the database


Search the database for a specific AC


Return to the main trajectory generator tool

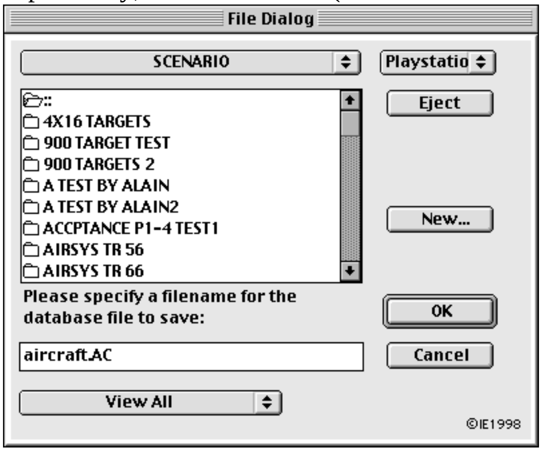
The same functions can also be controlled from the menu or using key-shortcuts.

Enter a number of ACs in the database and use the return button to leave the database.



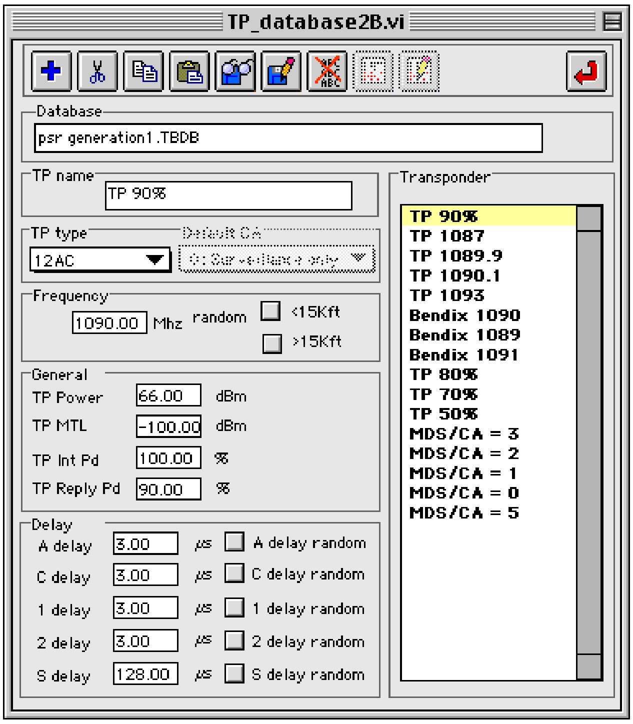
The aircraft database will always be saved automatically in the scenario folder .

Optionally, save it to disk (outside a scenario folder) using the  button.



2.2.5. The Transponder Database

To select a transponder database, click the **TP Database**  button.
Following window will appear:



Inside the TP database, the user can enter data defining different transponders used in the scenario generation.

Following buttons control the operation of the TP database:

Enter a new record in the database

Cut a record (and copy to clipboard)

Copy a record to the clipboard

Paste the record from the clipboard to the current index. Data is inserted

Load an existing database from disk

Save a database to disk under a user selectable name

Clear the contents of the database

Search the database for a specific AC

Define the BDS list used by the current scenario in memory

Define the contents of the BDS registers of a specific transponder

Return to the main trajectory generator tool

Enter a number of TP s in the database.

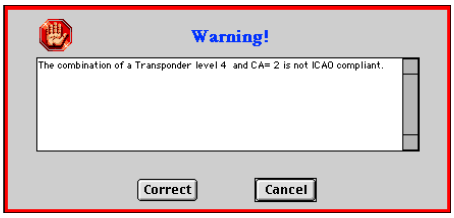
To do this, first click the **Add** button. Next , enter all relevant data in the fields. Make sure you set the TP capability (1-2-A-C-S level1..5) and type (am 69, am 71, default CA field..) first.

Next, enter all other relevant TP data:

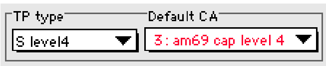
-*TP name :* Any set of characters (max 15)
-*TP type :* Select between any combination of 1,2,3/A or C transponder or S levl 1 trough 5.
-*Default CA, TP type: select between*
-am69,CA=0 surveillance only level 1
-am 69, CA=1 , level 2
-am 69, CA=2, level 3
-am 69, CA=3, level 4
-am 71, CA=4
-am 71, CA=5
-am 71, CA=7
-*TP frequency [1087...1093,0.3] :* Set the TP frequency
-*Random freq <15 Kft :* This check box creates random frequencies between 1087 and 1093 Mhz.

-*Random freq >15 Kft :* This check box creates random frequencies between 1089 and 1091 Mhz.
-*TP power [0..100,0.1 dBm] :* Sets the simulated Transponder power.
(limited by the RIU output dynamic range)
-*TP Minimum Trigger Level :* Sets the simulated Transponder Minimum Trigger level.
(limited by the RIU input dynamic range)
-*TP interrogation Pd [50...100,1]* Determines the Pd of interrogation acceptance
-*TP reply Pd[50...100,1] :* Determines the Pd of Reply
-*A delay [2.75...3.25,0.025/3] :* Delay for A code replies
-*A random delay :* This check box creates random delays between 3 and 3±x µs, x is given by the A delay field.
-*C delay [2.75...3.25,0.025/3] :* Delay for C code replies
-*C random delay :* This check box creates random delays between 3 and 3±x µs, x is given by the C delay field.
-*1 delay[2.75...3.25,0.025/3] :* Delay for 1 code replies
-*1 random delay :* This check box creates random delays between 3 and 3±x µs, x is given by the 1 delay field.
-*2 delay[2.75...3.25,0.025/3] :* Delay for 2 code replies
-*2 random delay :* This check box creates random delays between 3 and 3±x µs, x is given by the 2 delay field.
-*S delay [127.75...128.25,0.025/128] :* Delay for S code replies
-*S random delay :* This check box creates random delays between 128 and 128 ±x µs, x is given by the S delay field.

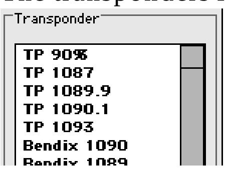
If a wrong combination of TP type and level with default CA data is selected, a warning is issued:

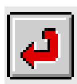


You can choose to correct the level or type. The changed values are put in red.



The transponders in the database can be selected using the **Transponder** list:



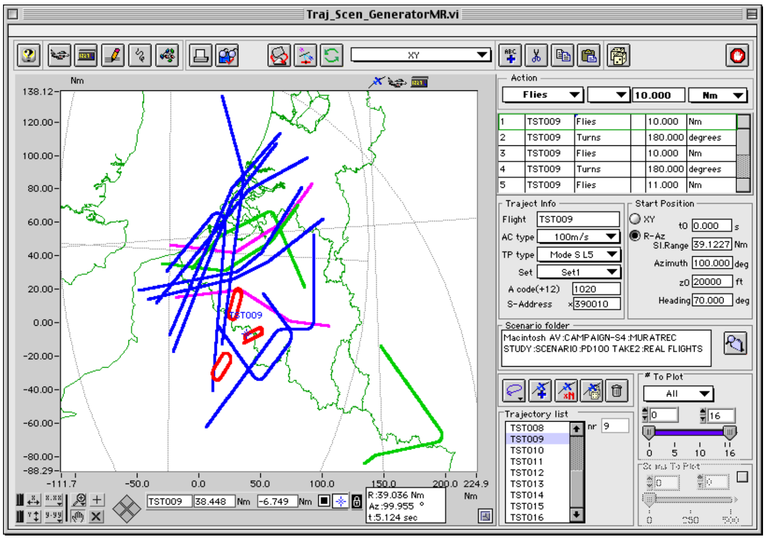
After editing, return to the trajectory scenario generator using the **return**  button. The transponder database will automatically be saved to disk after editing.

2.2.6 . BDS register Definition

The definition of the BDS data (specific for Mode S scenario generation using RES) is explained in detail in item 2.2.6 of Chapter IV of this volume).

2.2.7. Preferences editing

Now we are back to the main trajectory scenario Generator screen:

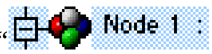


6. Click the **Preferences**  button.
The Scenario preferences window will appear:
If the user selects an existing scenario, the preferences for that scenario as set last time they were opened are shown and can be editted.
If you selected a new scenario (one which has no previous saved preferences) , the last used preferences for the specified campaign folder are loaded. A copy of these are saved in the scenario folder at compilation time.

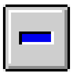
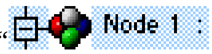
The preference window has several control fields:
-A button bar with control over the preference window
-A selection menu allowing you to “browse” the preferences of the several radars in the scenario
-A field with all the scenario preference input field. Its appearance changes depending on the selected line in the browser.

The buttons in the top bar perform the following:

 evoke the online help window

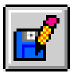
 Add a Radar Node (only in “Node “ 

definition mode)

 remove a Radar Node (only in “Node “ 

definition mode)

 Load a preference set from a different Scenario folder

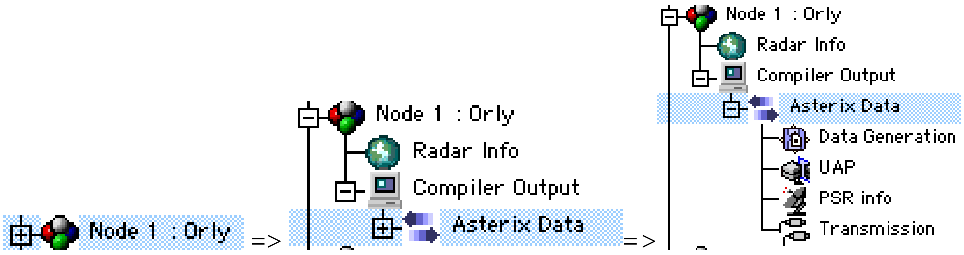
 Save the preference set as a file for later use (preferences are automatically saved in the scenario folder when closing the window)

 Multi radar Site info load. Use this button to import the Node positions from a multi-site file (used in e.g. PTE P5)

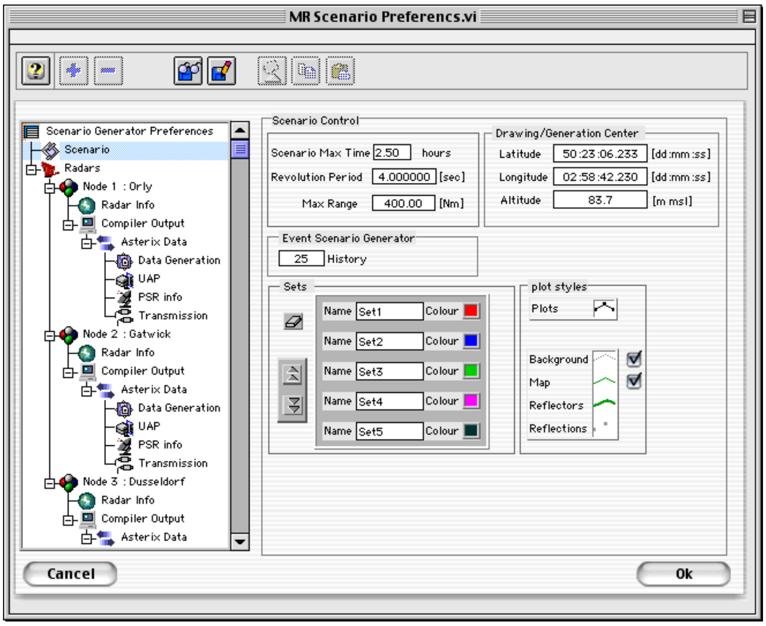
 Copy: copies the contents of the selected parameters into the scrap book.

 Paste: Pastes the contents of the scrap book into the selected parameters. Only operational if scrapbook contains same subset of parameters as selected item in browser.

The “Browser”
Use the browser to select a parameter subset. each line can be opened into more subsets if an + icon is visble in front of the name.



1. Scenario (= general) preferences.
The general Trajectory scenario generation parameters are mutual for all radars and can not be modified individually. The subset contains the following items:



In the “General” subsection several parameters can be set:

In the “*Scenario Control:*” subsection following parameters can be set:

Scenario Max Time: The maximum time allowed for the complete scenario. All trajectories that would run longer that this value are clipped . [default 2.5 hours, max 24 hours]

Revolution Period : The period at which the scenario is drawn on the display. This is used for drawing only, and has no influence on the real radar rotation speed used for RES or Asterix replay data.

Maximum range [10...512,0.1 / 256 Nm] : Maximum range of the cluster in Nm. No targets are generated beyond this range. This parameter delimits the generation for the whole group of radars (= cluster) to a circle arround the Drawing/Generation center.

In the "*Drawing/generation Center*" subsection following parameters can be set: BEWARE: The scenario is defined relative to this position. If you define target positions in XY or Rho-Theta, the positions are relative to the cluster center, NOT to the Radar. (As it is in the Mono-radar scenario generator.)

Latitude: The latitude of the cluster center relative to which the scenario is calculated. The value should be entered as DD:MM:SS.sss, where DD are the degrees, MM the minutes and SS.sss the decimal seconds of latitude.

Longitude: The longitude of the cluster center relative to which the scenario is calculated.

Altitude: The altitude of the cluster center relative to which the scenario is calculated.

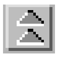
In the "*Event Scenario Generation:*" subsection following parameters can be set:

History : This parameter determines the number of plots drawn at once in the event scenario generator tools.

In the "Sets" subsection following parameters can be set:

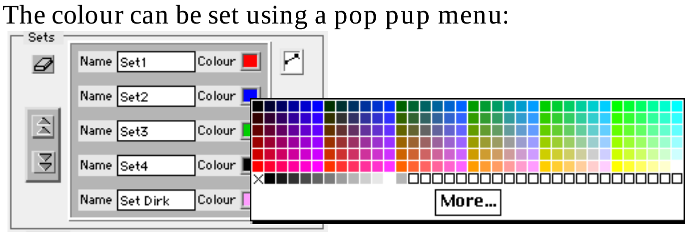
Name: The Sets subsection is an array (of undefined length) filled with the set name and its colour . A "set" is a group of trajectories that are linked by their set number. They can be edited, altered, copied or duplicated as one group.
The array can be paged through using the up and down arrows:

 Erases an entry in the "Sets" array

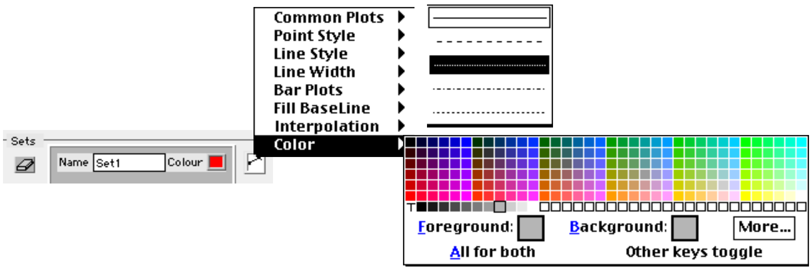
 Scroll up 1 element in the list (minimum to index 1)

 Scroll down 1 element in the list

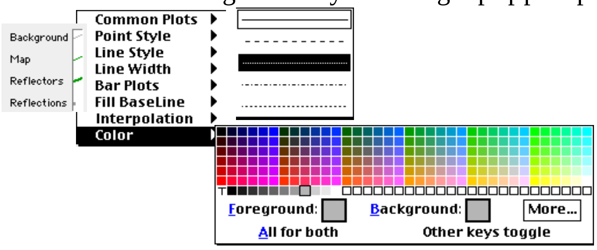
The colour can be set using a pop pup menu:



Plots: In this control the plot colour and style of the curves can be selected.

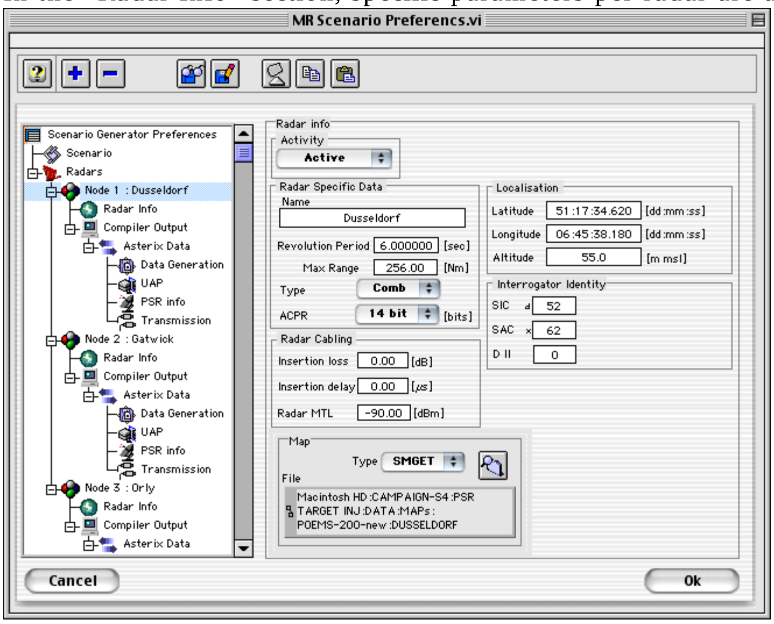


Background [False]: This check box determines whether the background circles are drawn in the scenario generator. In front of this checkbox, the user can determine the "looks" of the background by selecting a popp - up menu:



Map [False]: This check box determines whether the map is drawn in the scenario generator.The map option uses information from the site file to project a background map of Europe. In front of this checkbox, the user can determine the "looks" of the background by selecting a popp - up menu:

In the "Radar Info" section, specific parameters per radar are available.



Activity: The activity parameter determines whether a certain radar defined in the parameter set is used for compilation or not. Using this control, the user can switch on and off certain radars and therefore only compile data for a subset. The menu has three options:

-None: This radar is never used.

-Idle: The radar is used, but is not used now for compilation

-Active: The radar is part of the cluster and its data is used for compiler output.

In the “Radar specific Data ” subsection following parameters can be set:

Name: Use this control field to name the radar node. The name is used in the compilation and in the parameter list. It simplifies the selection of several Nodes.

Revolution Period:[1...20,0.02614 / 4 ms] revolution time of the radar in seconds. This field has a limited resolution (26.14 ms), which causes the control to coerce to the nearest value which can be simulated .

Max Range: [0..512,256Nm] The maximum Range for this specific radar, calculated from the radar position. (determined by *Localisation)* .

Type: Parameter of no influence in the trajectory generation.

ACPR: The number of ACPs per revolution output by the ACP encoder. This parameter has an influence on the resolution of the Azimuth value output of the Asterix output.

In the “Radar cabling ” subsection following parameters can be set:

Insertion loss [0...30,0.1/0 dBm] : Insertion loss of radar (loss between radar interrogator and antenna).
Insertion delay[0...10,0.010/0µs] : Insertion delay of radar (delay between radar receiver and antenna caused by antenna, cables and receiver).
Radar MTL [-30...-100,-80] : Minimum trigger level of radar. This value is used to determine the minimum power for targets to be generated. Targets lower than this power will not be generated . Especially usefull to limit the number of reflection targets, since all generated reflections are very low in power.

In the “*Localisation*” subsection following parameters can be set:

Latitude: The latitude of the radar relative to which the output data is calculated. The value should be entered as DD:MM:SS.sss, where DD are the degrees, MM the minutes and SS.sss the decimal seconds of latitude.

Longitude: The longitude of the radar relative to which the output data is calculated..

Altitude: The altitude of the cluster center radar relative to which the output data is calculated..

In the “*Interrogator Identity*” subsection following parameters can be set:

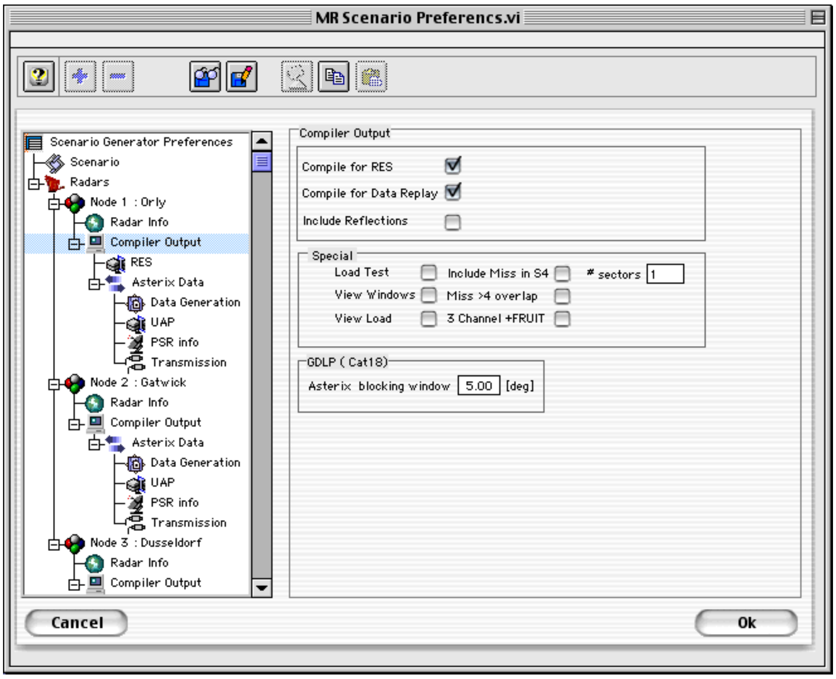
SIC : The Site Identification Code : This parameter is used in the output streams for Asterix data (in LAN replay, EDR replay or SASS-C data output) .

SAC : The Site Area Code : This parameter is used in the output streams for Asterix data .
DII: The II code used for generation of downlink Datalink packets
In the “*Map* “ Subsection, following parameters can be set

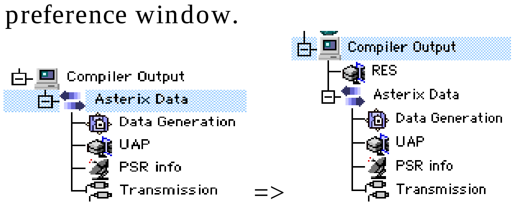
Type: The Map Type: In this version , only “None” or “SMGET “ can be selected. Select “SMGET” if you want to use this type of Map to determine the simulated coverage of the target generator.

File: Use the File button to select an existing MAP folder. In this folder, the tool requires at least the following files: “*cluster.dat*” , “*Sysmapxxx.dat*” where xxx stands for the state of the Cluster you want to simulate. (e.g. 007 is state 7 , 3 stations active).

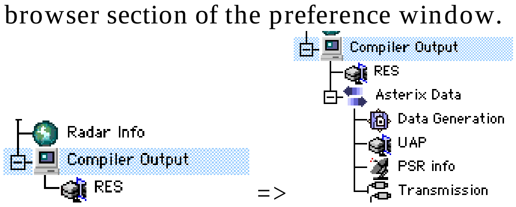
In the “Compiler output” subsection different output formats for the compiler can be selected:



Compile for RES [true] : If this checkbox is True, the scenario generator creates RES output data . If True, the “RES” item becomes available in the browser section of the preference window.



Compile for Data Replay [true] : If this checkbox is True, the scenario generator creates Data Replay output data . This includes LAN replay data, EDR replay data and SASS-C input data. If True, the “Asterix Data” item becomes available in the browser section of the preference window.



Include Reflections[False]: This check box determines whether the reflections are used in the drawing of the scenario. Reflections are always used in the compilation stage of the scenario if a reflection model is incorporated in the scenario.

Load Test: [False] Output of a load table to a spreadsheet style text file. (XXX.LOAD)

View windows [False] : visualisation of the possible overlaps of targets (Not applicable for MR scenarios)

View Load: [False] Visualisation of the load model (Not applicable for MR scenarios)

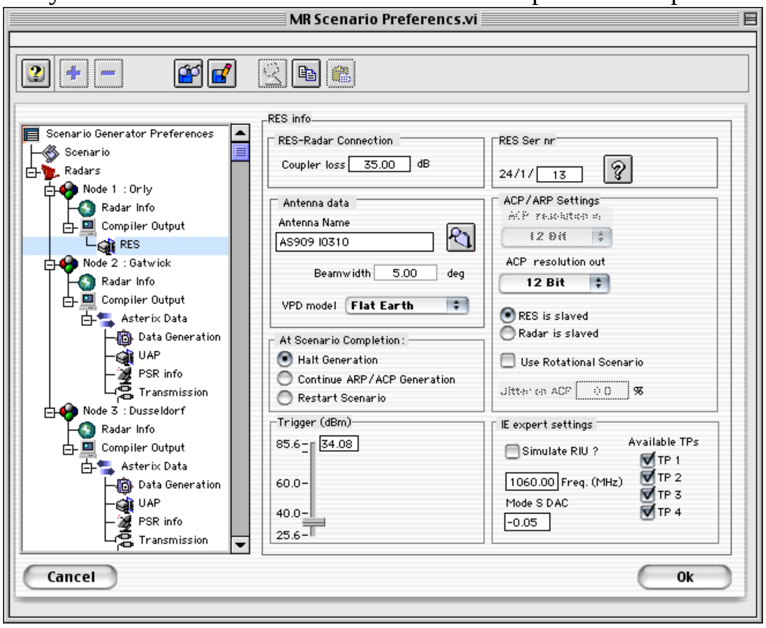
<u>Include Miss in S4:</u> This option includes all Missed plots in the S4TJ and S4PR datastream, with the correct status bits (Missed) set. This allows you to visualise the missed plots in the inventory display. <u>The option MUST be checked if you want to include missed tracks (coasted tracks) in the asterix output stream.</u>

Miss > 4 level overlap.: This option generates misses for all plots which are in a > 4 level overlap situation .

3Channel + FRUIT: This function disables the fourth channel in the RES for target injection and reserves it for FRUIT generation. This also implies that a FRUIT scenario for the RES must be created before the RES main is started. (see Chapter V)

#Sectors: This parameter determines the number of sector messages per scan included in the S4TJ file. (Data replay files always include 32 sector messages).

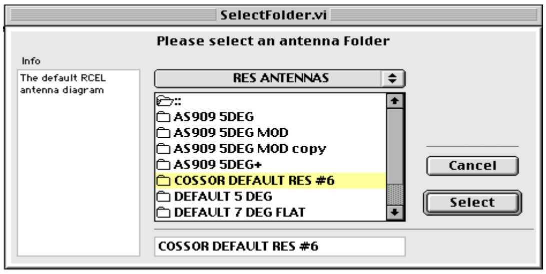
In the “RES” subsection you define all parameters that are related to the use of the RES. They will not be shown in case the RES compilation output is deselected:



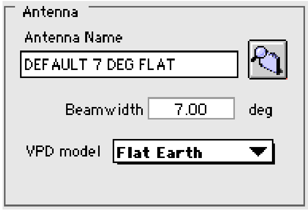
RES-Radar Connection: Coupler loss: This parameter is the total loss between the output of the RIU (Sum channel) and the input of the radar receiver. This includes an attenuator and the phase adjustable coupler value. The exact value of the coupler can be determined from calculations in chapter III of this volume.

RES Ser nr: This important parameter determined which RES you want to compile the scenario for.

A specific antenna pattern can be selected by name. To do this, click the selection button.



This antenna pattern can be created and edited with the Antenna Diagram Editor in the RASS-S Toolbox. The Beamwidth of this antenna is shown under the selected antenna name. The beamwidth can NOT be editted in the trajectory scenario generator.



The VPD model parameter determines the relation between target range, altitude and its elevation. From elevation, target VPD attenuation is determined.
See chapter II for more details.

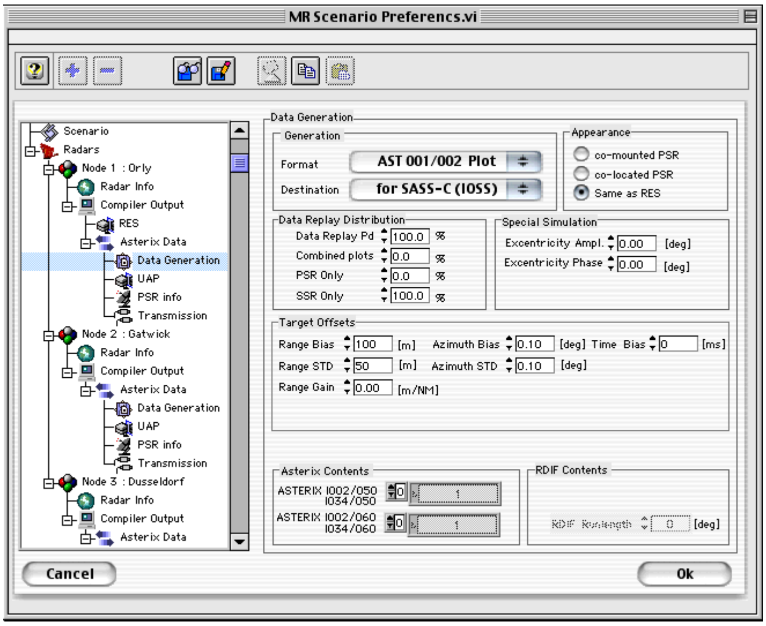
At scenario Completion: This parameter determines what happens at the end of the RES scenario. Typically, the ACP generation stops, but this can continue or the scenario can be restarted automatically.

Trigger Level: The RIU trigger level, measured at the radar transmission output. . Typically, this value should be 15 dB less than the minimum transmission power of the radar. (e.g. radar transmits between 50 and 62 dBm, use 35 dBm as trigger value).

ACP/ARP settings:
ACP resolution in: The resolution of the input ACP / ARP into the RIU. Only used in case the RES rotation is slaved to the radar. (So radar antenna turns).
ACP resolution out; The resolution of the output ACP / ARP from the RIU. Only used in case the Radar rotation is slaved to the RES. (Typical FAT sytuation, No antenna connected).
RES is slaved/Radar is slaved: use this selector to determin the encoder mode. (Which device provides rotation, RES or Radar) .
Use rotational scenario. : Check this box if the rotational scenario is to be used. Not applicable for multi-radar scenarios.
Jitter % on ACP: Use this control to determine the jitter on the ACP output. Only applicable in case of rotational scenario.

IE expert settings: Explanation is beond the scope of this manual. Controls should be left to default values.

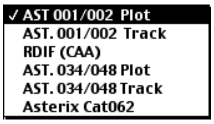
Data Generation parameters:



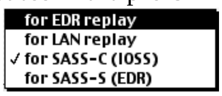
Data generation parameters:

§ Format of generated data [Asterix Cat001/002 plots ;Cat001/002Tracks; RDIF ; Asterix Cat 034/048 Plots; Cat 034/048 Tracks; Asterix cat062 tracks)

This parameter determines wheter the data generated is RDIF or Asterix and what the data categories and UAP will be.



§ Destination of data: select the destinationof the data replay data: This can be eighter
-for EDR replay: creates several EDR replay files
-for LAN replay: creates one multi-channel LAN replay file
-for SASS-C : creates multiple IOSS data files encapsulating the asterix data
-for SASS-S : creates multiple S4PR files for tests in SASS-S or PTE. No replay data



§ *Appearance of the data:*

-(a) *Co-mounted* and synchronised PSR or
- (b) *co-located* and not synchronised or
-(c) *Same as RES:*

This parameter determines wheter the generated radar data is originatingf from a PSR radar which is co - mounted (they have the same pedestal, so same rotation speed, position and heading)
or co-located (PSR is placed on a separate pedestal and has different position, rotation speed and heading as SSR). Alternatively, the radar data is ot solenly comming from a PSR, but simulates a SSR , Mode S or combined radar. for this use “*Same as RES:* “ this option simply generates a dataset that is the same on asterix level as in the RES scenario,

Data Replay Distribution:

§ -*Data Replay Pd*: The probability of detection of the generated Asterix data. If set to 90 % , only 90 ,% of the programmed scenario targets will also be generated as asterix for this radar.

§ -*Combined plots:* The percentage of all generated plots that is flagged as combined. (and thus have a SSR or Mode S appearance)
§ -*PSR only plots:* The percentage of all generated plots that is flagged as PSR only. (and thus have a PSR appearance, without Mode A,C,or S address field present)
§ -*SSR only plots:* The percentage of all generated plots that is flagged as SSR only. (and thus have a SSR or Mode S appearance, without PSR info)

Target Offsets: These parameter determin the error model applied to the generated data. The refence data (S4TJ file) is not affected. The errors are applied after calculation of the correct position in the scenario, and are then included in the S4PR output and the eventual Asterix, LAN, EDR or other output.

§ -Range Bias [-150..150,1 m]

The Range offset; The fixed bias added to all scenario positions prior to determining the output position of the target report.

Asterix Range = Scenario Range*Range gain + Range Bias+stochastic Range error

§ -Stochastic Range error STD [0..150,1 m]

The stocastic range error added to all scenario ranges prior to determining the output range of the asterix target report. The stocastic error can be positive or negative.

§ -Azimuth bias (-0.2..0.2,0.01 deg)

The fixed azimuth bias added to all positions prior to determining the position of the outpu target report in asterix.

§ -Stochastic Azimuth error STD [0..0.2, 0.01 deg]

The stocastic azimuth error added to all scenario positions prior to determining the output position of the target report in asterix. The stocastic error can be positive or negative.

§ -Range gain [0..2 ,0.1 m/Nm]

The Range gain is applied to all scenario positions prior to determining the output position of the target report in asterix.

§ -Time stamp bias [0..200 ,1 ms] (asterix time stamp will limit granulity to 1/128 s)

The fixed time bias added to all scenario time of detection values prior to determining the output time of detection (this also affects the time of transmission by the asterix message by the EDR replay driver or the LAN replay driver) of the target report.

§Excentricity Amplitude [0..1,0 deg]

The azimuth dependant azimuth bias added to all positions prior to determining the position of the outpu target report in asterix.

Asterix Azimuth = Scenario Azimuth+ Azimuth Bias+stochastic Azimuth error + Excentricity amplitude* sin (Azimuth + excentricity Phase)

§Excentricity Phase [0..360,0 deg]

The azimuth where the excentricity sine error crosses zero (negative to possitive)

§ Radar Default values for items 002/050, 034/050 and 002/060,034/060 data in North messages in asterix. (Optional)

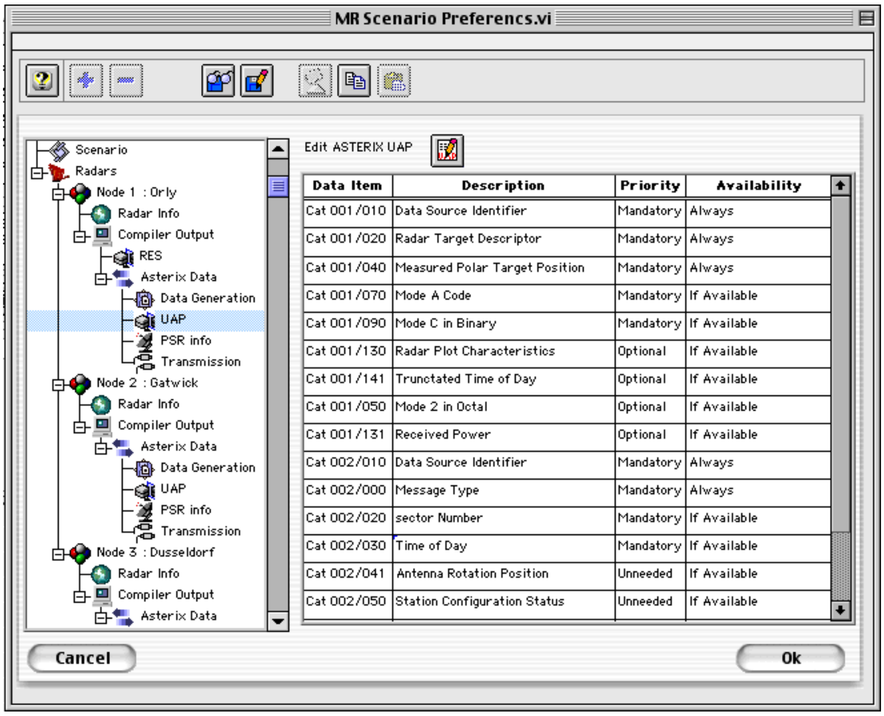
One or more bytes can be included in asterix message items 002/050 and 060 in North message. Beware, the tool does not check the (Hex) contents of the data.

§ RDIF PSR run length [0.1..5,0.1 deg] (to be included in RDIF data format only)

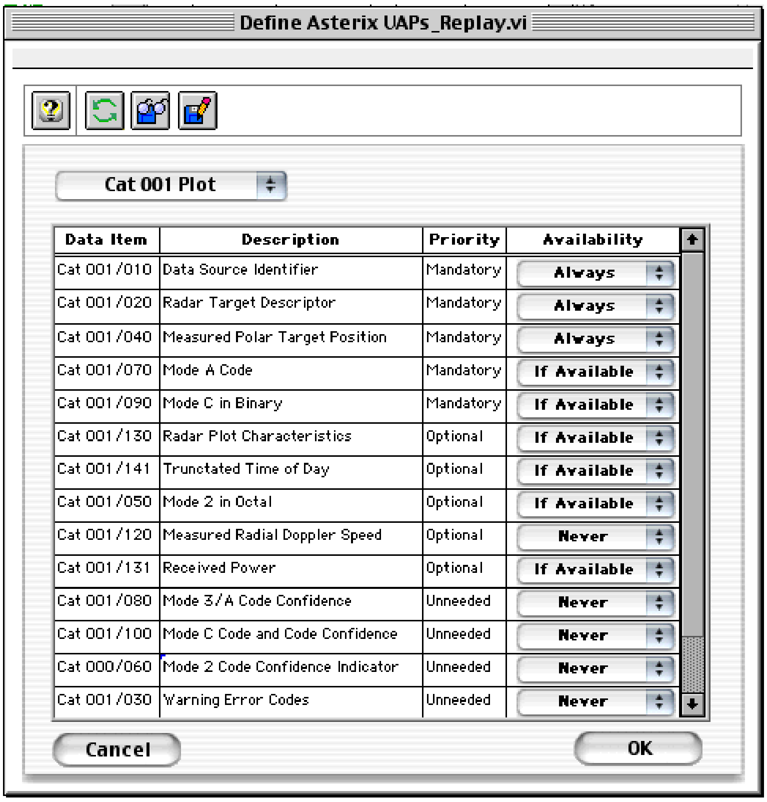
The Runlength parameter included in the RDIF message.

UAP Info: This selection allows the user to view and modify the UAP used by the asterix generator. e.g. the tool allows you to only output Data items 10,20 and 40 for all targets, simply by setting these items to availability = always and the other items to Never.

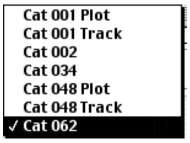
Asterix UAP



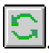
§ Edit ASTERIX UAP : Clicking this button will evoke the following window:



This window allows the user to set , for each of the seven possible data formats,

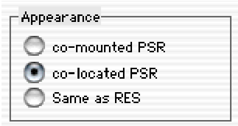


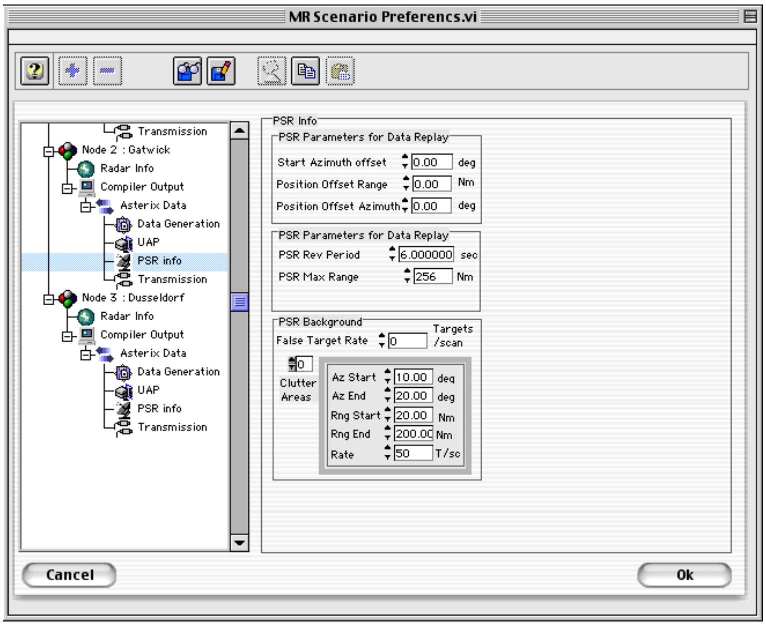
Wheter the related data items should be included or not included in the output data. Typically , some data items MUST always be included (e.g. item xx010, Data Source identifier). Set these items to "**Always**" in the menu. Others are only included if they are available (e.g. item 001/070 A code) . Set these items to "**If Available**" in the menu.
After setting all the parameters, click the OK button of the preference window.
Other items you may want never to be included in the data (e.f. item 062/290 System Track Update Ages), simply because they are not available from the scenario. Set these items to "**never**" in the menu.

The factory default values for the scenario generation can always be restored using the "Undo" button. . You can also save and load  an existing UAP profile.
Click the OK button to include the profile in your scenario definition.
The set UAP will always be saved in the scenario preferences and thus also in the scenario folder. There is no real need to seperately save them, unless you want them to be copied into other scenarios.
After definition of the UAP click the Ok button.

PSR Generation:

These parameters are only valid in case the "appearance " is set to PSR (co monuted or co-located) .





§ -*PSR Parameters for Data replay*

Start Azimuth offset. : The heading difference between the PSR and SSR antenna, i.o.w., the difference between the generated SSR position (on the RES) and the PSR position (on Asterix replay).

Position Offset Range: The difference in location between the SSR and PSR radar in case of co-located radars, (max 5 Nm)

Position offset Azimuth : The difference in location between the SSR and PSR radar in case of co-located radars, (0..360 deg)

§ -*PSR Parameters for Data replay*

PSR revolution period. : The revolution period used for the PSR radar, in case of co-located PSR radars.

PSR max Range: The maximum range for the targets to be generated for PSR.

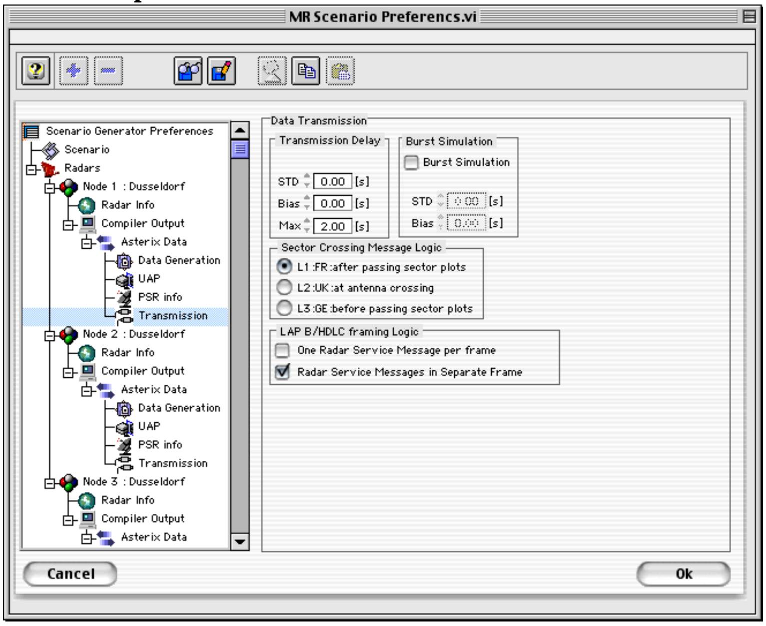
§ -*PSR Background:*

§ -*False Target Rate* : The number of false target reports included in the replay data per scan. The false targets are generated randomely over the entire coverage of the radar.

§ -*PSR clutter area parameters* (min Range, Max range, min Azimuth, Max Azimuth, Rate)

One or more clutter areas can be defined on top of existing background false target rates. Areas are defined using range and azimuth fields. The position of the bclutter area false targets is randomly selected per scan. (each scan new position in range min..max degrees and min .. max range) Notice that the PSR clutter boundaries are not affected by bias

Transmission parameters:



§ Transmission delay bias, Maximum and Standard deviation for plots. **(Not applicable to sector messages;)** for **normal** generation

The time bias added to each calculated PSR time of detection and stored in the time of recording (= time of transmission) . This calculated time is used to send out the target plots.

Time of recording =Max [(Time of detection + Transmission delay bias + Transmission delay stocastic error), Maximum Transmission delay]

§ Transmission delay bias and Standard deviation for plots. **(Also applicable to sector messages !)** for **burst** generation.) See drawings hereafter)

All Asterix data target reports of a given sector are outputed at the same time with a delay composed of a fixed bias and a stochastic random part. The delay is in any case greater than 0.1 second. The delay is defined as the difference between the antenna passing the end azimuth of the sector and the time of transmission of the first bit of the data bock.

§ Sector message sending logic :

-logic 1(Fr) : Sector message is send after all sector plots of past sector are send.

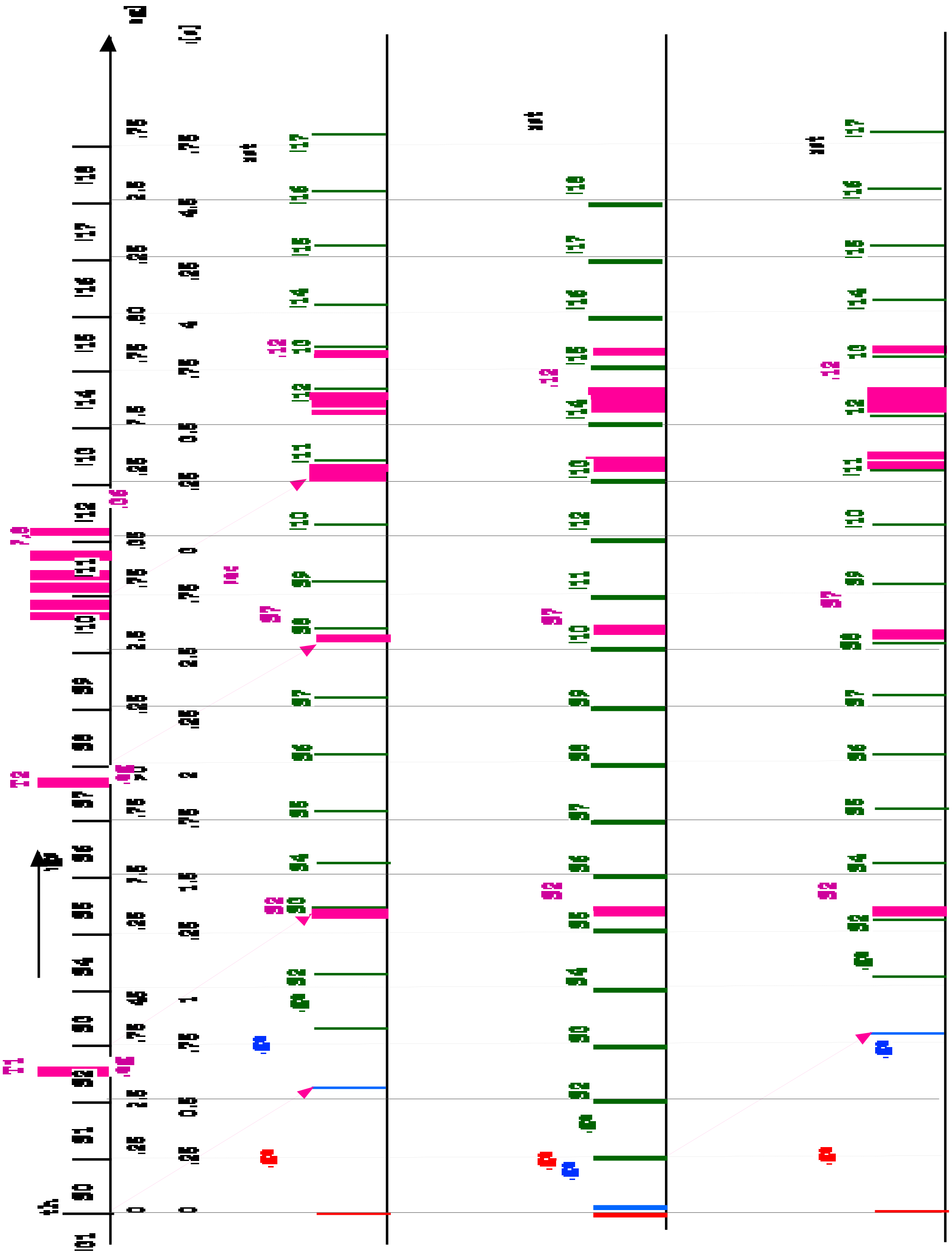
-logic 2(Uk): Sector messages are send at crossing of antenna.

-logic 3(Ge): Sector messages are send before all sector plots of same sector are send. See picture hereunder

§ LAP B / HDLC Framing logic

- Maximum one radar service message per LAP B / HDLC frame is used when this option is selected (combination with multiple target messages possible).

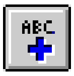
-Radar service messages are put in separate frames when this option is selected (in combination with option above = one service messages only)



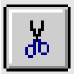
2.2.9. Trajectory Functions & Buttons

8. Now that the AC and the TP data is entered and the preferences are defined, we can proceed by creating a trajectory. This is done in the main screen .

In the main screen, the following buttons can be used:

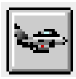


Enter a new sentence in a trajectory description


Cut sentence from the trajectory description (and copy to clipboard)


Copy a sentence from the TJ description to the clipboard

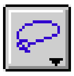

Paste a sentence from the clipboard to the current index. Data is inserted

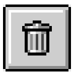

Load AC database from disk


Load TP database from disk
Load an existing BDS data set from disk

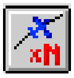

Select a Scenario folder. This folder will contain all scenario data and resulting compiled files.


Load an existing scenario from disk and add to the current selected scenario.

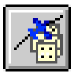

Select all or set of trajectories in the list

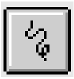

Remove the selected trajectory from the scenario

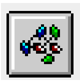

Add a trajectory to the scenario



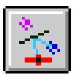
Duplicate trajectory

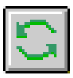

Generate a set of random scenarios .


Plot the current scenario in the graph


Compile the current scenario

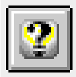

Activate preference window

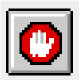

Load Environment Definition window.

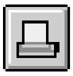

Undo the last editing function

 Call the “Property randomiser” function

 Select site file

 Show help window

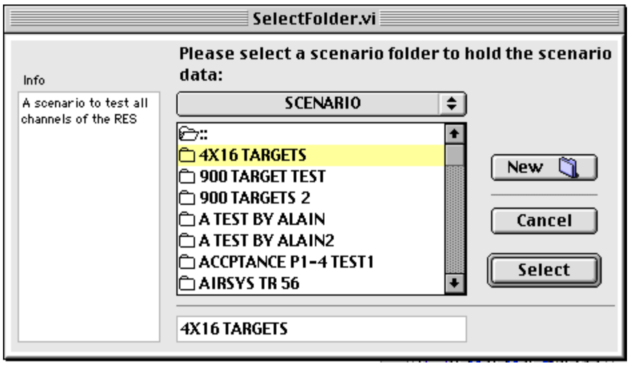
 Quit trajectory scenario generator

 Print or export the scenario as text file.

2.2.10. The Scenario Folder

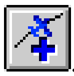
9. At any time , the user can select or create a new scenario folder. The fact that you select a new scenario folder automatically saves the editted data of the previous scenario folder into that old folder and reloads data in the new one.

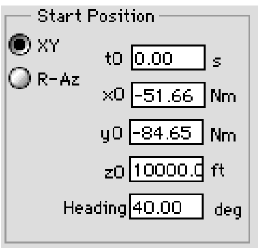
Selecting done by clicking the **Select Folder**  button. The following folder dialog will appear:

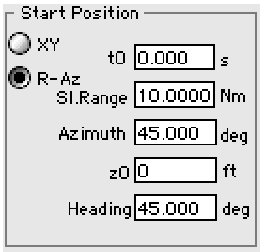


For the creation of a new folder, click the **New** button. Existing folders can be selected from the list.

2.2.11. Scenario Creation

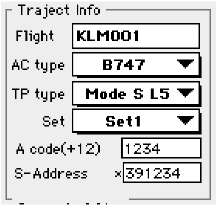
10 . To start the creation of a trajectory click the “Add Trajectory button” .
Next, enter a start position and start time of the trajectory plus a heading in local XYZ coordinates or in Slant-Range , Azimuth coordinates. <u>Local coordinates are relative to the center of cluster defined in the Multi-site file.</u>





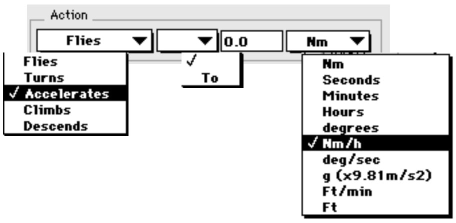
If the entry is invalid (e.g. Height of 30000 ft and range 1 Nm) , the invalid entry shall turn Red and will be corrected by the software. A beep will sound.

11. Select an AC and a TP for this particular trajectory and enter the Flight ID (typical 7 character call sign). Also the A code and S address for that TJ is entered, plus the set to use for the plot of that TJ is selected using the set menu. Notice that all items can be edited afterwards.



Note1 : The S address must be between 0x000000 and 0xFFFFFF. If it is higher, the upper byte will be used to determine the target generator (Forced). e.g. Target 0x 0239 1234 will have S address 39123 and will ALWAYS be generated by target processor 02, independantly of the overlap situations.
Note 2: If the AC Type or TP Type menus are dimmed, this means that no Aircraft or Transponder database are present in memory.

12. Now use the action tool bar to select the first action of your aircraft :



A scenario is programmed by a sequence of actions.

An AC can perform the following actions:

-Fly
-Turn
-Accelerate
-Climb
-Descend
These actions can be directed or related to a certain parameter.

The parameter is a number, which has a unit. This unit can be :

-Nm	-Nm/h
-Seconds	-deg/sec
-Minutes	-g (9.81 m/s2)
-Hours	-Ft/min
-Degrees	-Ft

For example :

KLM001 flies 10Nm is a command
but
KLM001 flies 100 Nm/h is a parameter setting

A parameter setting is active until a new parameter setting action overrides it, or until a specific command action overrides it.
(This is the case for descend and climb actions)

e.g.
KLM 001 Flies 100 Nm/h
KLM001 Flies 1 hour
KLM001 flies 110 Nm/h
KLM001 Flies 0.1 hour
will cause a trajectory of 1.1 hour covering 111 Nm
(The speed setting is active over the complete trajectory).

An exception is the climb/descend action:
KLM 001 climbs   1000 Ft/min
KLM 001 Climbs To 2000 Ft
KLM 001 Flies 10 Nm
will cause a climb to 1000 Ft during 2 minutes, after which a steady (climb rate 0 Ft/min) flight of 10 Nm follows.

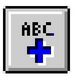
If any parameter is not specified by an action, the default AC parameters in the AC database will be used.

Each action may be combined with any unit, although this might look somewhat irrational.
e.g. :

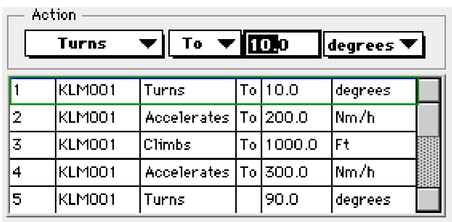
SLR123 Turns 1 minute (a one minute turn)
VIR456 Flies 180 degrees (a 180 deg turn)
BAC135 Turns 0.1 g (sets turn rate relative to current speed)
etc..

Actions can be absolute or relative to a given parameter :
e.g.
KLM001 turns 50 degrees (relative turn)
KLM 001 turns to 50 degrees (absolute turn) heading

The next action can be entered by clicking on the empty line below the previous action, or by using the “Add action” button.



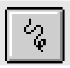
Actions can also be inserted at a given position by positioning the green frame in the action list at the desired position and then using the “Add action” button.



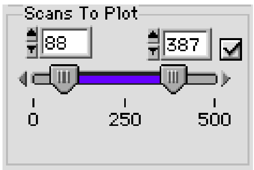
1	KLM001	Turns	To	10.0	degrees
2	KLM001	Accelerates	To	200.0	Nm/h
3	KLM001	Climbs	To	1000.0	Ft
4	KLM001	Accelerates	To	300.0	Nm/h
5	KLM001	Turns		90.0	degrees

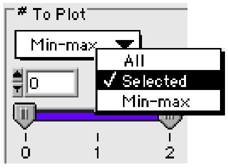
2.2.12. Plotting the scenario

13. Once the actions are entered, use the plot button to draw the trajectory.



The trajectory will now be drawn in the graph. A cursor appears showing the Flight ID or Call sign for this trajectory. With the  button a scan slider can be activated. With this scan slider a time window can be set for which the scenario is drawn in the graph.

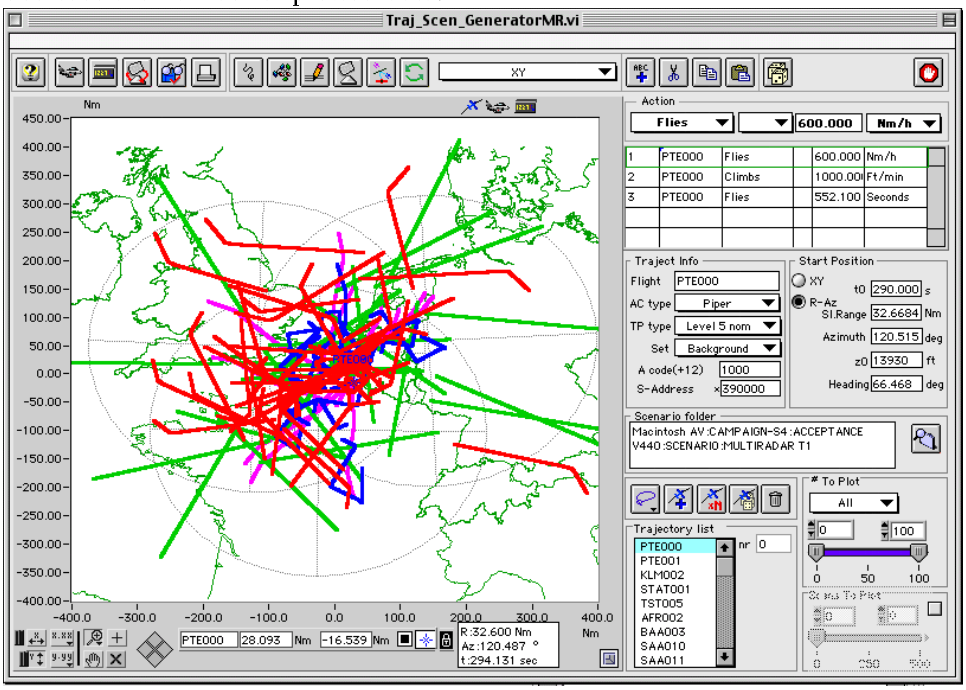




You can draw all plots in the scenario or only a selection. This can be done by using the "# to plot" menu. If "All" is selected, all targets will be drawn. If "Selected" is used, only the trajectories marked in the "Trajectories" list are drawn. This is very handy e.g. to draw sets of data.

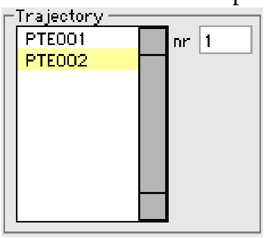
The plot speed can be increased by the use of the interpolate option in the preferences dialog box. By using this option straight lines are build up out of less points. An interpolation factor of 10 means that for every 10 calculated points only one is drawn in the graph. In the curves all the points are always used to draw the trajectory. Therefore trajectories with a lot of straight lines can be manipulated faster when this option is turned on. The use of this algorithm has no implications on the accuracy of the calculations. The colour of the plotted curve depends on the selected set .

If too many plots are to be drawn on the screen, the program will most certainly slow down a lot . It could even happen that not all plots can be drawn due to memory limitations. This will be automatically checked for by the program, giving a warning to decrease the number of plotted data.

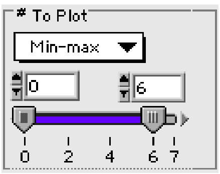


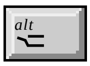
2.2.13. Adding Additional Trajectories

14. A second trajectory may now be added using the "Add Trajectory button" 
Enter the second TJ and click the plot button.
The Trajectory selector will appear and show that two TJ are present.
The user can switch between the two trajectories. Observe the change of all the TJ info upon the switching of the cursor between the two graphs. Additionally, switching between TJs can be performed by selecting a TJ in the Trajectory selector.



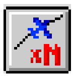
With the # to plot slider a selection of which trajectories are plotted can be made, if the menu above is set to "Min-max".

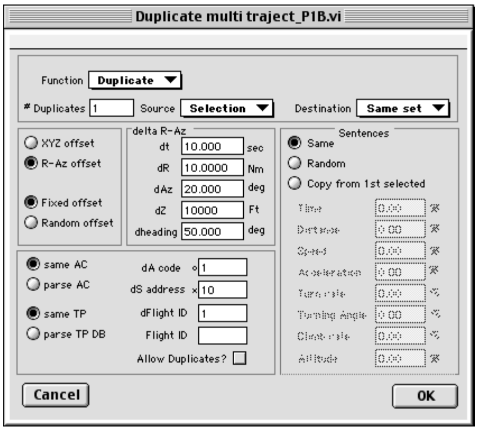


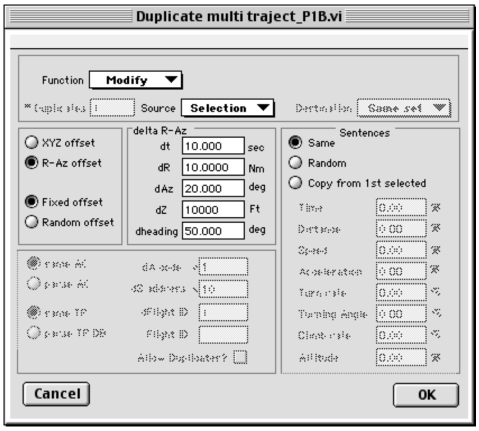
15. An easy way to duplicate a trajectory is to "Drag-copy" it. Select a trajectory using the cursor and position the mouse pointer on that cursor. Now hold down the "Alt" (or option)  key on your keyboard and shift the mouse pointer to a new position.
The trajectory will be duplicated and redrawn. The start position is automatically altered by the distance travelled by the mouse pointer (in scale).

16. The mouse can also be used to move a trajectory to a new position, by performing a "Shift drag".
Select a trajectory using the cursor and position the mouse pointer on that cursor. Now hold down the "Shift" key on your keyboard and shift the mouse pointer to a new position.
The trajectory will be redrawn on a new position, while the start position is changed.

2.2.14. Duplicating and Modifying Trajectories

17. A faster method to duplicate a number of trajectories is to select the "Duplicate Trajectory" option from the "edit" menu or click the  button. First select the trajectory to copy using the slider or the cursor, then select the duplicate trajectory option.
The following window will appear . depending on the set function, you can eighter duplicate or Modify trajectories:





For Dupliaction, the user can enter how many times the TJ has to be duplicated, what the offset for each consecutive copy will be relative to the previous copy, and what the increment in A code, S code and Call sign will be.

Select the source of the copy: 

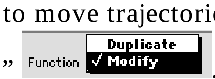
This can be

-*Selection:* The last selected trajectory or multiple trajectories will be copied.
-*All:* All trajectories current in memory will be duplicated
-*Setxxx:* All trajectories of a specific set will be copied

Next select the destination of the copy: 

-*Same set:* Each duplicated trajectory will be attributed to the same set as its source.
-*Set xxx :* All duplicated trajectories will be attributed to the specified set.

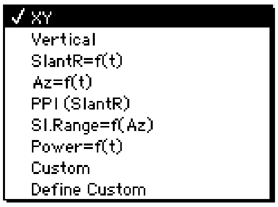
The duplicated trajectories can use the same TP properties, or each copy can be attributed with a different TP from the TP database. The same applies for the Aircraft properties. Thus, set the TP and AC selectors accordingly.
-If the duplication results in an A code , Aircraft ID or S address that already exists, the next A code or S address available is checked. for Aircraft ID, the next item with the same Header characters is used. This quest continues until a unique A code ,S address or AC ID is found. (e.g. PTE001 becomes PTE003 if PTE002 already exists.)
-Furthermore, the offset can be programmed in XYZ or R-Theta-Z coordinates. This offset can be fixed or randomised. Set the selector accordingly.
-The different actions of the duplicated trajectory can be kept the same or randomised.
It is also possible to copy the sentences of the selected target into all duplicates.
The randomise factor can be entered in percentages for each type of action.
-After clicking **OK**, the new trajectories will be created and drawn. Cancel leaves the window without an action.
(Remember that all edited trajectories (* including duplication actions) can be undone using the "**Undo**" option.)

The tool can also be used to move trajectories in Range, Azimuth or time! For this , set the function to "Modification" 

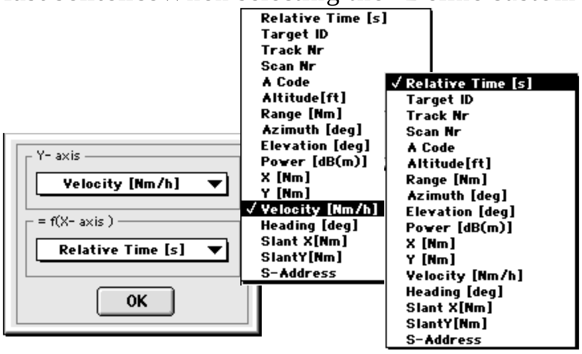
. All targets defined in "Source" are modified with the delta t, R, Az, X or Y. You can also modify the Sentences by a fixed or random function.

2.2.15. Handling the Trajectory Graph

18. The graphs can also be switched between XY mode and five other modes, or a "Custom " mode.:
The modes are :



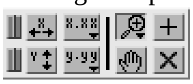
-XY: X (Nm) versus Y(Nm)
-Vertical: Elevation (Ft) =f(R) (Nm)
-Slant Range =f (t) (seconds)
-Azimuth (deg) = f(t) seconds
-PPI: Projected slant range x(Nm) versus y(deg)
-Slant Range =f(azimuth)
-Power=f(t) (Output power of RES targets at Radar Rx level)
-Custom: X and Y scale can contain any field present in the trajectory data.
-Define Custom: This selection is used to define the custom X and Y fileds.
last sentence When selecting the “Define custom” option, following dialog opens:



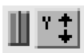
The name “custom” will change in the newly defined custom graph type. X and Y scales are also set accordingly.

All scale, zoom, pan and query functions on the graph can be done using the palette in the lower left corner of the window.

Zooming and panning in the display can be done using the graph palette.



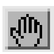
 auto scale X- axis

 auto scale Y-axis

 X-axis settings=> Popp up menu setting X scale format, pression and scale

 Y-axis settings

 Zoom tool

 Pan tool

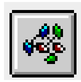
 Select cursor

 Centre cursor

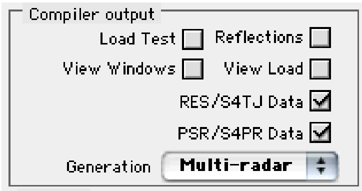
For more details about the graph palette, consult the LabVIEW user manual.

Click the **Square**  button in the lower right corner of the graph to square the display.

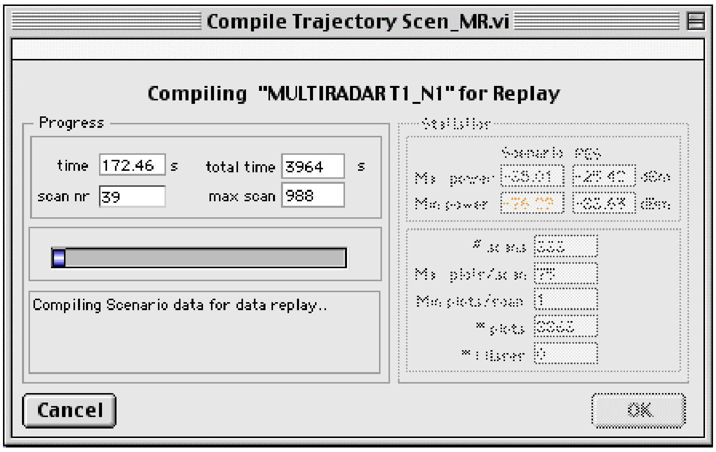
2.2.18. Compiling the scenario

21. To create the necessary output files (see chapter II) check the RES / S4TJ Data check boxe in the preference window (Compiler output) for RES related data generation and the PSR / S4PR Data checkbox for EDR or LAN replay datasets and click the **compile**  button.

IF none of these two boxes are checked, the compilation will produce no data!



A window will pop up to indicate the progress of the compile process.



All files are saved into the selected scenario folder.

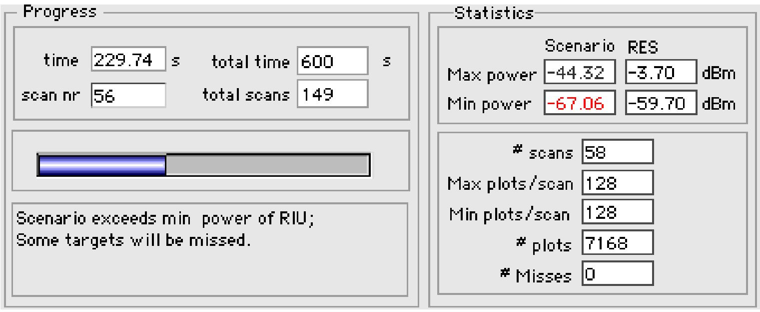
In case of multi radar scenario generation, The selected scenario folder will contain multiple sub-folders , names XXXX_N1,XXXX_N2, etc.. , each containing the related files for every simulated radar (eighter RES or Asterix replay data) . (XXXX is the name of the original Scenario Folder

In Case of output selection of LAN Files (see preferences , Data Replay TAB) , a special Folder entitled XXXX_LAN will be created . This will contain the LAN replay streams. (To be selected when replaying the data.)

At the end of the compilation, the compile window will render you a number of important information fields:

-Maximum output power of scenario and RES (at Radar Receiver input level)
-Minimum output power
-# of scans
-Max # plots / scan
-Min # plots / scan
-# of plots
-Total time of scenario

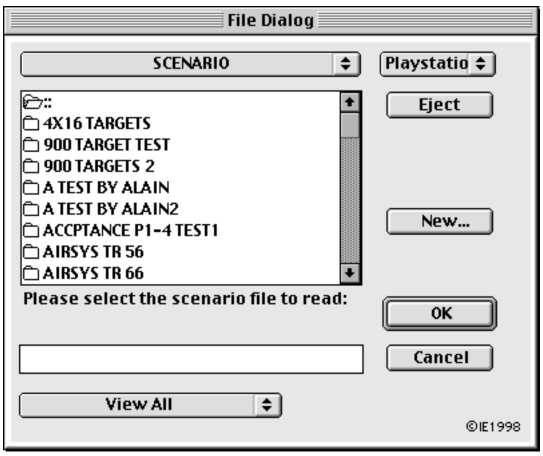
If the output power of the scenario creates problems for the RES to generate the signals, the compiler will present you with a suggestion on the action to take:



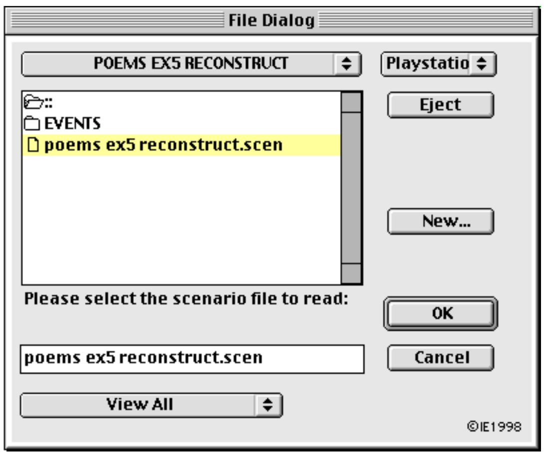
2.2.19. Loading and Saving Scenarios

22. Use the **Load Insert**  button to load a scenario from disk. The scenario can be loaded from any scenario folder and added to the scenario you already created. If you want to create a new scenario and copy scenario data from an other one, first select a New scenario, than use the Load function.

A file dialog will appear: The file dialog will start at the level of "SCENARIO", showing all available scenarios in your campaign. To load a scenario, double click a scenario folder and load the "xxx.Scen" file.

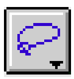
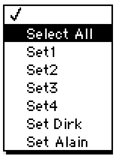


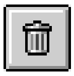
=>



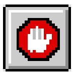
Select a scenario and click OK.

Beware, this scenario will be added on top of the one already in memory. If this not your intention, first clear the scenario complete.

This can be done by clicking first the **Select**  button, and selecting "Select All" from the appearing menu. 

This can be followed by a click on the **Delete**  button.)

23. The Trajectory scenario generator (like the other scenario edittors) have become Auto-save, which means that all eddited data is automatically saved upon three events:
-Compiling a scenario
-Selection of a new scenario
-Quiting the edittor

24. Use the  button to quit the Trajectory Scenario Generator.

2.3. Special Features of Scenario Generator

2.3.1. Rotational Scenario

24. If you require a rotational scenario to be included in the scenario, refer to par 2.3.1 of Chapter IV. This only applies for Mono- Radar RES scenarios.

2.3.2. Reflection Model

26. If Reflections are to be added to the scenario this can be done using the “Environment Definition”. refer to par 2.3.2 of Chapter IV. This only applies for Mono- Radar RES scenarios.

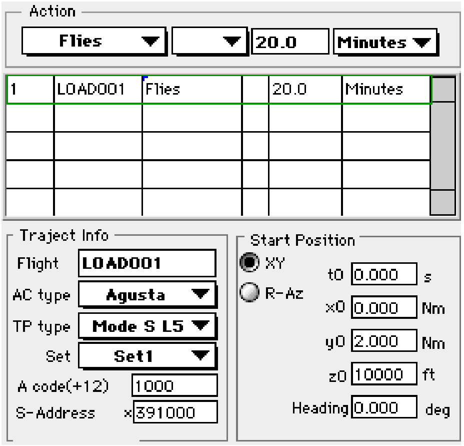
2.3.3. Random Load Scenario Generation

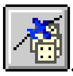
27. To create complete random scenarios ,use the “Trajectory Randomiser” function.

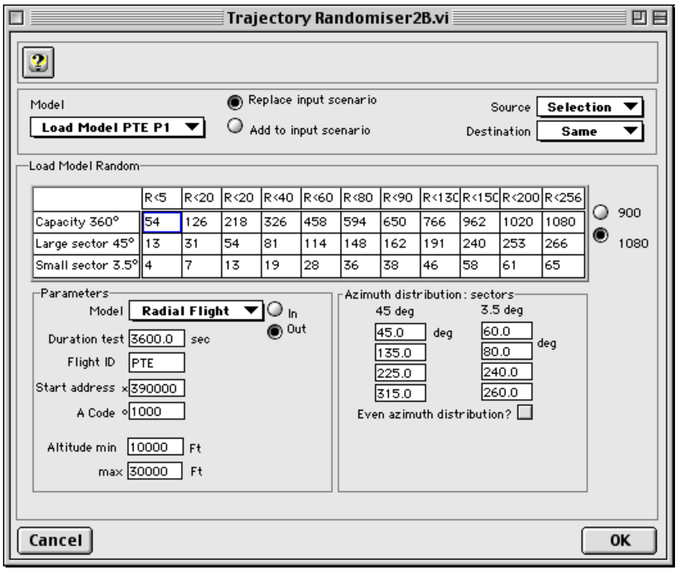
This function will allow you to create a number of random trajectories. These random trajectories can be according to the POEMS load model (to be entered in a load table) or generated in a predefined region.

First, we will discuss the options for the load model.

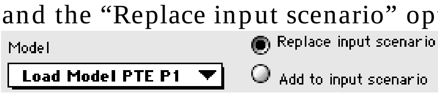
In order to create a load model, we must first create a “master” target, which can be used as a template by the duplicate function.
Therefore, from the trajectory Scenario generator , create a single target at a random position, but with a valid sentence list (e.g. flies 20 minutes) , a valid height, a valid transponder type and a valid aircraft type . Typically, a load model will require a static target (a helicopter), thus select an aircraft with zero speed. For dynamic scenarios, select the desired aircraft type.



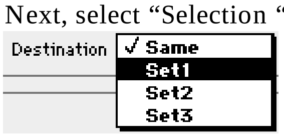
Next, evoke use the “Trajectory Randomiser” window using the button .



Select the “Load model PTE P1” from the selector in the upper left corner of the window and the “Replace input scenario” option.

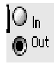


Next, select “Selection “ as source and a specific set from the “destination” menu.



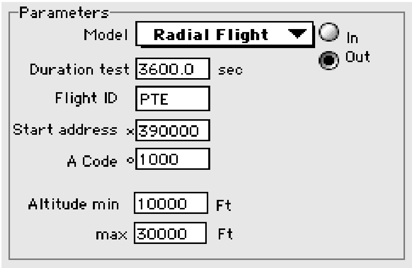
Now enter the desired load model in the table. Beware, the software expects that the load model is valid, meaning that it is feasible. (e.g. If it is required to generate 7 targets in a sector of 3.5 degrees, and one 45 degree sector must contain two such smaller sectors, than the minimal value for the large sector is 14. The same applies for the 360 degree sector. It must be at least 4 times the contents of the 45 degree sector.)
The user can select between two default load models (900 and 1080 targets) or can adapt the input values manually.

Next , enter the model for the scenario: 



1) Radial flight	The scenario only creates targets where azimuth= heading or azimuth = -heading, depending on *In/out bound* control.
2) Tangential flight	The scenario creates targets which all fly with the same tangential speed round the radar. (typical circumferences the radar in 3600 seconds)
3) Random heading	The scenario only creates targets where azimuth-90<heading< azimuth+90.
4) Variable speed	Same as 3), but now target speed is a function of its range.

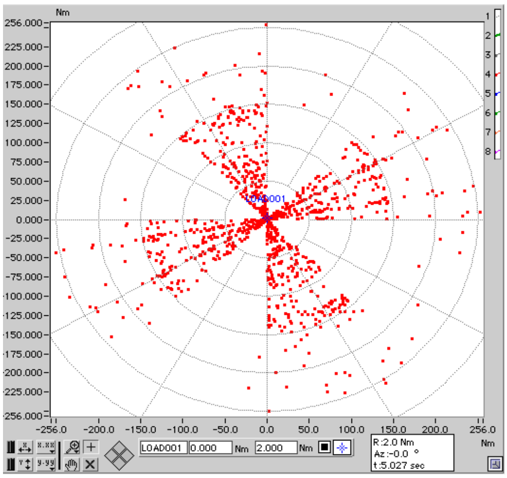
The result of these four models are shown hereafter.
The randomiser also requires the input of the following parameters:



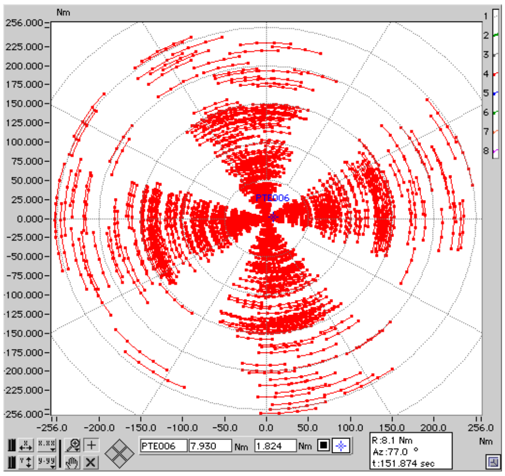
Duration test : this will be used for the insertion of the sentence " Target Flies x seconds" in the model
Flight ID: This will be used for the flight ID of the randomly created load model. (plus a number from 0 to 1079).
Start address: This S address will be used as the first address of the generated set of targets.
A Code : This A code will be used as the first A code of the generated set of targets.
Altitude Min [ft] : This shall be the minimum altitude used in the C codes of the targets in the load model.
Altitude Max [ft] This shall be the maximum altitude used in the C codes of the targets in the load model.

Position large sector: (4 values) The start positions of the large sectors in the load model. (45 degree sectors). (Should only be adjusted with extreme care, since they must fit into the total 360 degree picture)
Position small sector: (4 values) The start positions of the small sectors in the load model (3.5 degree sectors). Should only be adjusted with extreme care, since they must fit into the first and the third 45 degree sectors.

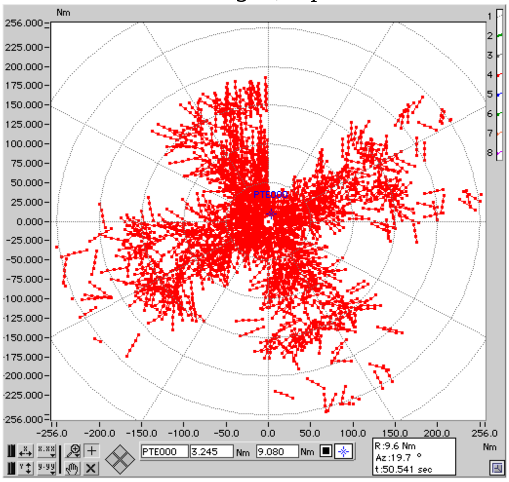
After entering all values, click the **Ok** button to confirm or the **Cancel** button to cancel. The result can be plotted using the "**Plot**" button.



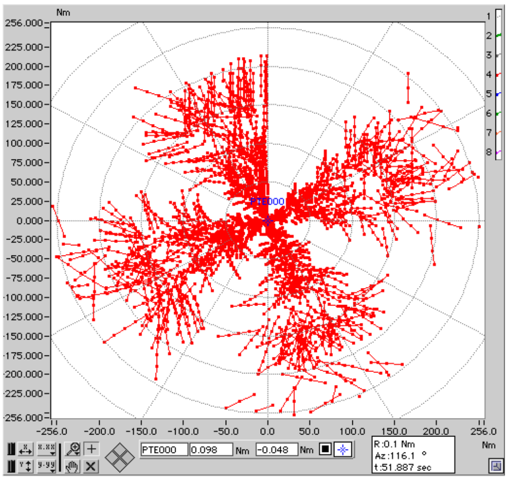
"Radial Flight, speed=0"



"Tangential Flight"



"Random Heading"



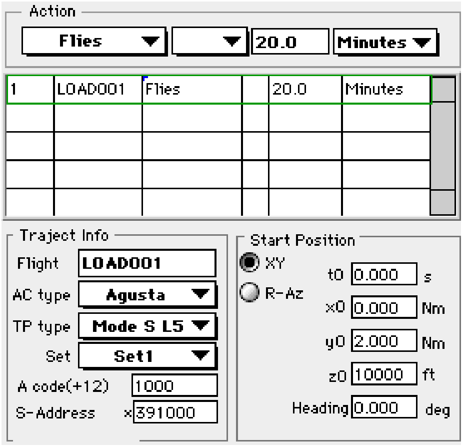
"Variable Speed"

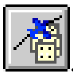
2.3.4. Random Scenario Generation in Region

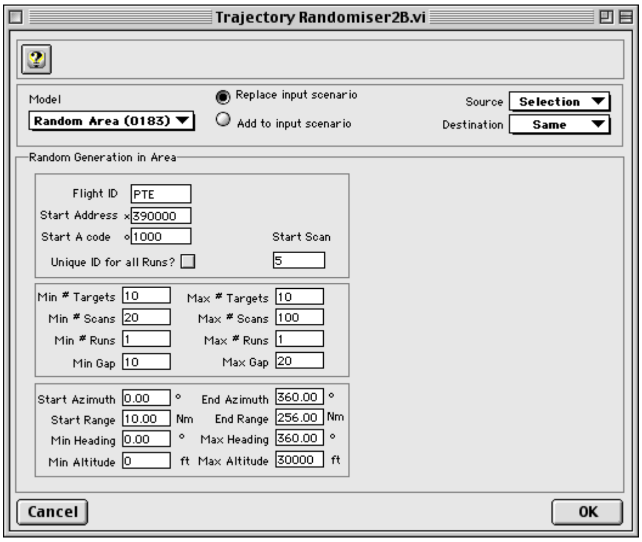
An other option is the generation of targets in a certain region.

In order to create a load in a certain region, we must first create a "master" target, which can be used as a template by the duplicate function.

Therefore, from the trajectory Scenario generator, create a single target at a random position, no sentence list but a valid transponder type and a valid aircraft type .



Next, evoke use the “Trajectory Randomiser” window using the button .



Select the option “Random Area” and “add to input scenario” (unless you want to replace the existing scenario).

Select the source (this can be a set of data or a single “master” target, selected in the trajectory scenario generator) and the destination (typically an other set).

Only the TP type and AC type are copied from the master target.

Next, enter the following parameters:

The random area generation generates a random number of trajectories between “**Min # Targets**” and “**Max # Targets**”.
Each trajectory has a length between “**Min # Scans**” and “**Max # scans**”.
Each Scenario starts at “**Start Scan**”.

The generation is repeated a number of times between “**Min # runs**” and “**Max # runs**”.

Each generation has a gap between “**Min gap** “and “**Max Gap**”.

The targets are generated between "**Start Azimuth**" and "**End Azimuth**"

The Targets Start Range lies between "**Start Range**" and "**End Range**"

The Targets Heading lies between "**Min Heading**" and "**Max Heading**"

The targets Altitude lies between "**Min Altitude**" and "**Max Altitude**"

The targets Flight ID starts with "**Flight ID** " plus a sequence number.

The targets S address starts with "**Start S Address**".

The targets A code Starts with "**Start A code**".

After entering all values, click the **Ok** button to confirm or the **Cancel** button to cancel. The result can be plotted using the "**Plot**" button.

2.3.5. CEVAP load Scenario

An other option is the generation of targets according to the Load Scenario defined by the CEVAP requirements.

The scenario consists of three types of patterns:
•Trajectories: Defined pattern for one aircraft. Three different trajectories definitions have been defined. The user can add a fourth “CUSTOM” pattern.
• Radials: Defined fixed distribution of trajectories in range. Three basic radial definitions have been defined. Each radial is defined by its range, the set number and the trajectory type. The set number will be used later to distribute the transponders.
• Azimuth Distribution: Defined distribution of radials, with azimuth spacing according to the specified load for 3.5 and 45 degrees sectors.

Furthermore, each of the three load scenarios consist of three phases:
• Start–up phase: 5 scans (30 seconds)
During this phase no trajectories are present. This allows the radar to start up and synchronise to the generated ACP/ARP of the RES.
• Acquisition phase
Targets are not moving. Not all trajectories start at the same moment. This allows acquisition of all mode S targets, avoiding mode S all call garbling. The load slowly builds up until the full load has been reached.
• Full load phase
At the same moment in time all Targets start slowly moving. Full load is present.

Trajectories
Each trajectory starts non-moving (acquisition phase) and then continues moving. The scenario basically consists of three types of trajectories.
•Trajectory Type 1
Starts non-moving, then circular trajectory clockwise around radar. Angular speed 0.1 degrees per second.
•Trajectory Type 2
Starts non-moving, then circular trajectory counter-clockwise around radar. Angular speed 0.1 degrees per second.
• Trajectory Type 3
Starts non-moving, then moving in U shape:
1st Segment: Initial speed 0 knots, heading radial towards the radar. Straight line acceleration +0.5g until speed is 100 knots
2nd Segment: Straight line acceleration +0.5g during 30 s
3rd Segment: constant speed, 1000 feet/min climb rate during 30 s
4th Segment: constant altitude, -0.5 g acceleration during 30 s
5th Segment: 180 degrees turn with 1 degree/s angular speed, (during 180 s)
6th Segment: constant speed 1000 ft/min descend rate during 30 s
7th Segment: straight line, constant altitude, constant speed, 200 seconds
• Trajectory Type 4
Custom trajectory, copied from the selected trajectory

Radials
Three different radials can be defined. Defined distribution of radials, with azimuth spacing according to the specified load for 3.5 and 45 degrees sectors.

The 3°5 sector is repeated 4 times : starting at 29°, at 52.5°, at 209° and at 232.5°.
The 45° sector including two 3.5° sectors is repeated twice starting at 20° and 200°.

This 45° sector is based on 12 radials of 18 aircraft :
- R2 at 20 °
- R1 at 29°, R2 at 30°7, R3 at 32.5° (3.5° peak sector)
- R1 at 37.5°, R2 at 42.5°, R1 at 47.5°
- R1 at 52.5°, R2 at 54.25°, R3 at 56 ° (3.5° peak sector)
- R1 at 60.5° and R2 at 65°.

The 45° uniform sector is repeated twice starting at 110° and 290°.
This 45 ° sector is based on 12 radials of 18 aircraft, alternatively R1 and R2, spaced by 4°.
The last two radials of 18 aircraft are at 170° and 350° (R1).

Scenarios

Three scenario types must be created:

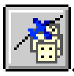
- Model 1 (100% mode S)
- Model 2 (50% mode A / C and 50% mode S)
- Model 3 (25% mode A / C and 75% mode S)

Mode C code distribution

The initial altitude of the targets shall be randomly drawn (as uniformly as possible) from between the following boundaries:

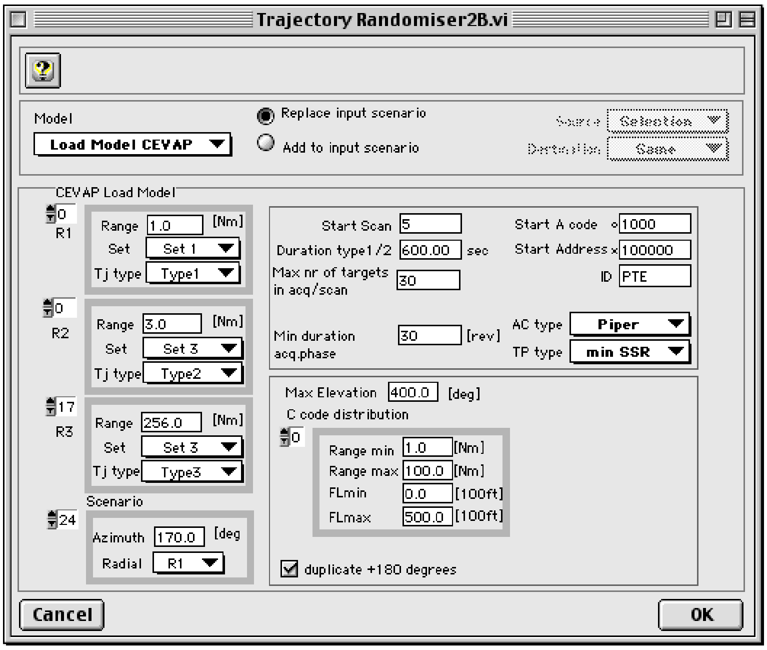
- 1	< Slant Range	<	100 NM	0	<	Flight level	<	500
- 100	< Slant Range	<	135 NM	200	<	Flight level	<	500
- 135	< Slant Range	<	170 NM	300	<	Flight level	<	500
- 170	< Slant Range	<	256 NM	400	<	Flight level	<	500

- Cone of silence: There shall be no targets with an elevation angle >40 degrees

To create such a scenario, create a new scenario folder and evoke use the “Trajectory Randomiser” window once or multiple times using the button .

The function will assume the user uses a fixed scan rate (no rotational scenario) of N [4..16,0.1 seconds]. Make sure the correct rotation speed is set prior to creating the Model B Scenario.

Following window will popp up:



Select " Load Model CEVAP " and "Replace input scenario".

Now enter the following parameters:

R1,R2,R3 The Radials are defined by means of a Range, Set number and Trajectory type. (See above for definitions)

Scenario: The scenario is defined by means of a number of radials. Each radial has an azimuth.
(These two controls are arrays, soo use the arrows to page through the different records of the scenario)

Start Scan : The scan for the first set of N targets. Each scan, N targets are added.

Duration type1/2: The duration of the trajectories of type 1 and 2 in seconds .

Max nr of targets in acq/scan : N

Start A code: The A code of the first generated target 1/2 (increment=1) [1]

Start S address The S address of the first generated target 1/2 (increment=1)

Start Scan The Start Scan number of the generated target 1/2

Flight ID: The flight ID (first 4 characters) for the targets 1/2

AC type : The AC type selected from the AC database

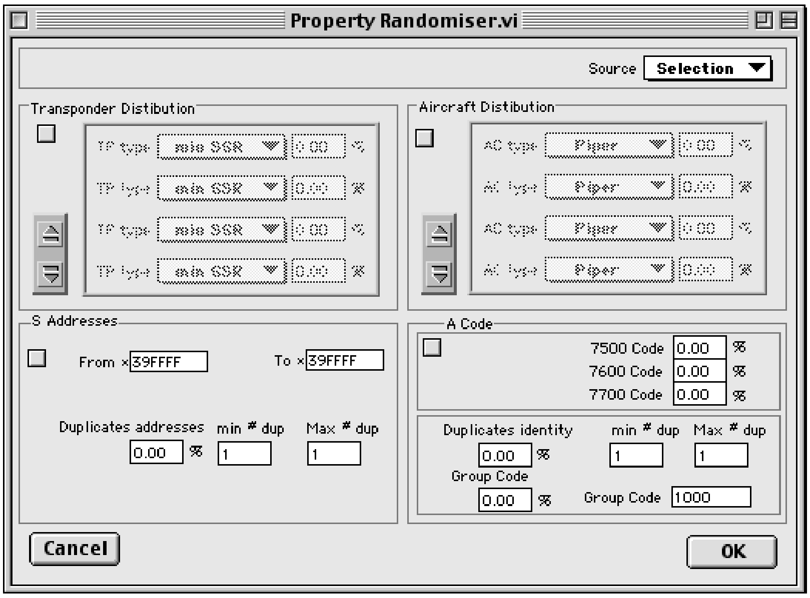
TP type : The TP type selected from the TP database.

Click OK to generate the targets.
After this, you must use the property randomiser (see §2.3.8) to generate the proper transponder distribution for the different sets in the scenario.
An example of the scenario is included in the DEMO campaign present on the second CD of the software version 4.3.1 .

[1] The A codes and S addresses can always be modified using the property randomiser (see 2.3.8)

2.3.6. Changing the Scenario properties

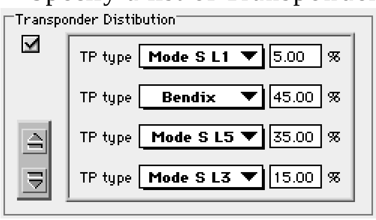
28. If you have a scenario with a given distribution of aircraft, transponders, A codes or S addresses, you can alter this distribution simply by calling the "Property randomiser" function of the trajectory scenario generator .
This will evoke the property randomiser window:



You can randomise the following "properties" of the trajectories:

-*Transponder type*

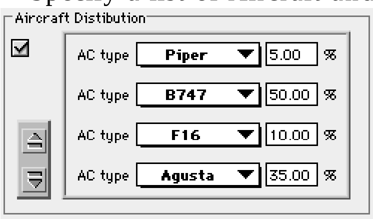
Specify a list of Transponders and their distribution in % of the total population.



If the transponder population must be altered, check the check box in the left corner of the "Transponder distribution". Next, select a transponder in the first menu list and enter a percentage. Finalise with other desired populations.The list can be extended to more than 4 entries using the Up and Down arrow buttons.

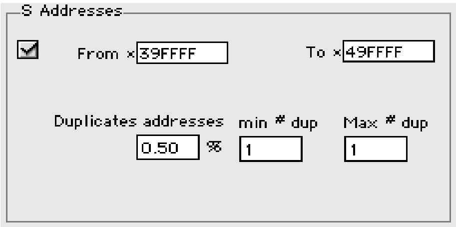
-*Aircraft type*

Specify a list of Aircraft and their distribution in % of the total population.



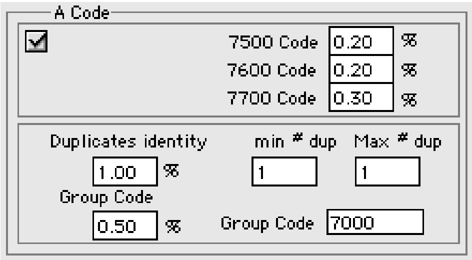
If the aircraft population must be altered, check the check box in the left corner of the "Aircraft distribution". Next, select a transponder in the first menu list and enter a percentage. Finalise with other desired populations.The list can be extended to more than 4 entries using the **Up** and **Down** arrow buttons.

-*S address & Duplicate address creation*
If the S address population must be altered, check the check box in the left corner of the “S addresses” and enter the start and end values of the random S addresses in the two fields “**From**” and “**To**”



if duplicated addresses are desired, enter the percentage of duplicated addresses in the **%** field. “**min # dup** ” Defines the minimum number of duplicated values of 1 address, and **Max # dup** defines the maximum number.

-*A code*
-*Special alert conditions of A code*
-*Duplicate A codes*
If the A code population must be altered, check the **check box** in the left corner of the “**A_code**” and enter the percentages of 7500, 7600 and 7700 codes in the respective fields.



if duplicated A codes are desired, enter the percentage of duplicated codes in the **%** field. “**min # dup** ” Defines the minimum number of duplicated values of 1 A code, and “**Max # dup**” defines the maximum number.

If a group code is desired, enter the percentage of group codes in the **%** field and enter the group code in the **Group Code** field

If all parameters are entered, click the “**OK**” button to confirm or “**Cancel**”to cancel.

3.0. Multi Radar Event Scenario Generation

3.1. Introduction

The Multi Radar Event Scenario Generator tool is intended to superimpose time and target based events on existing trajectory scenarios previously build with the Trajectory Scenario Generator **For EDR or LAN replay only**. These events can be C code changes, SPI,Emergencies, etc.
For RES related event scenarios (more features) , refer to chapter IV.

The Multi Radar Event Scenario Generator takes scenario files created with the Multi Radar Trajectory Scenario Generator as input and creates LAN or EDR output files, controlled by the user for target injection by the EDR or LAN replay tools.

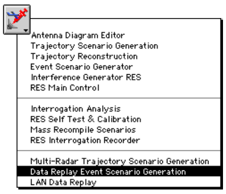
The Event Scenario generator works on Single Radar Output files. (Because the scan rate of several radars can be different. You can copy the events from one scenario to an other, if the scan rates are the same)

3.2. Using the Multi Radar Event Scenario Generator

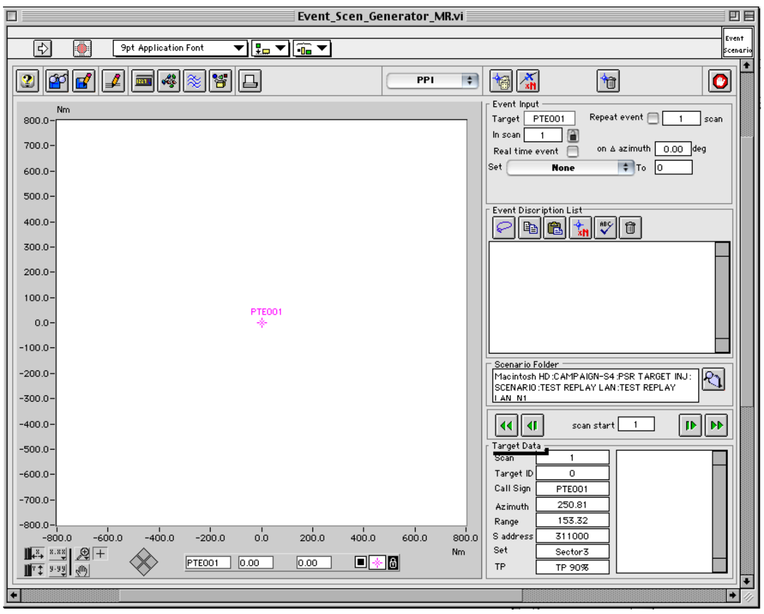
3.2.1. Loading the Software

The Event Scenario Generator tool can be loaded from the RASS-S Toolbox.

1. To load the tool, double click the RASS-S Toolbox icon and select “Multi Radar Event Scenario Generator” from the “Add-On ” menu in the RASS-S Toolbox.



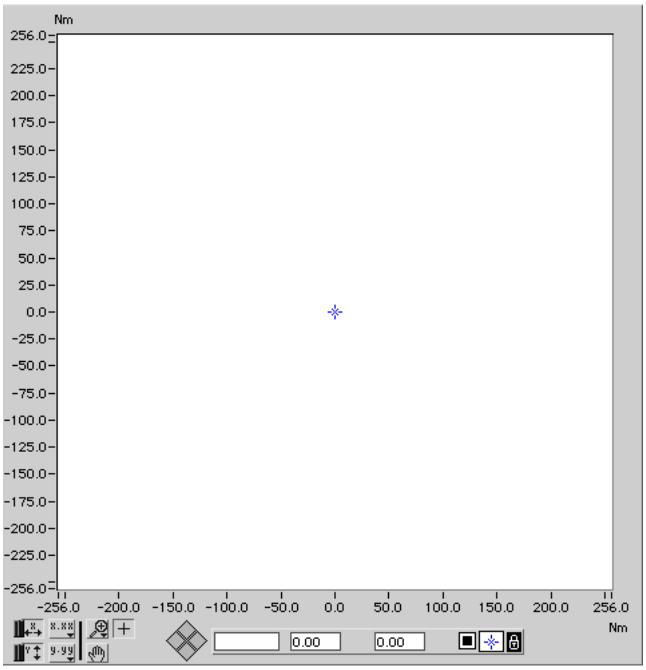
2. Now the tool is loaded.

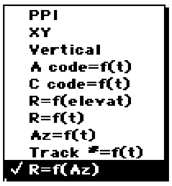


3.2.2. Window Objects

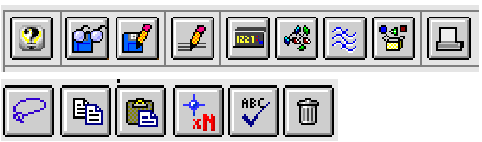
3. The window contains several fields:

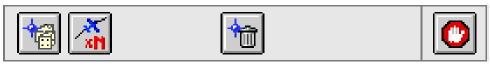
On the left we can observe the plot graph, which contains a graphical representation of the trajectories previously created by the Trajectory Scenario Generator. The representation of the trajectories can be changed by the selector above the upper right corner of the graph.



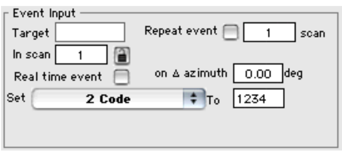


Furthermore the window contains a row buttons at the top of the window to operate the Event Scenario Generator tool.

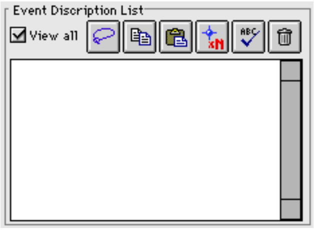




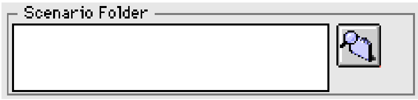
The top right side of the tool contains the Event Input section. This section allows the input of the events for a selected target at a specified time.



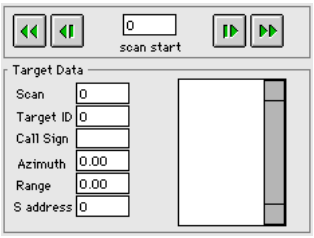
In the lower right corner of the window we can find the Event Description list. Here you can view, edit and duplicate the added events in detail.



The next in the row is the Scenario folder Section. Using this button you can browse for a scenario folder created by the Trajectory Scenario Generator tool.



The final section is the Target Data section. With the top row buttons you can page through the scans of the selected trajectory scenario. The list underneath shows the targets contained in a specific scan. Detailed target information can be recalled by selecting a target from this list.

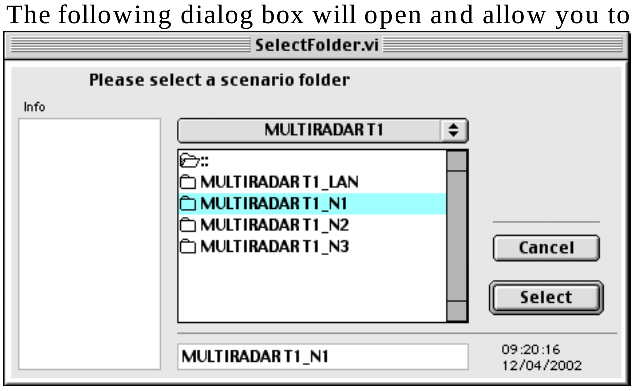


3.2.3. Running software

4. Now click the  button in the upper left corner of the window to start the tool.

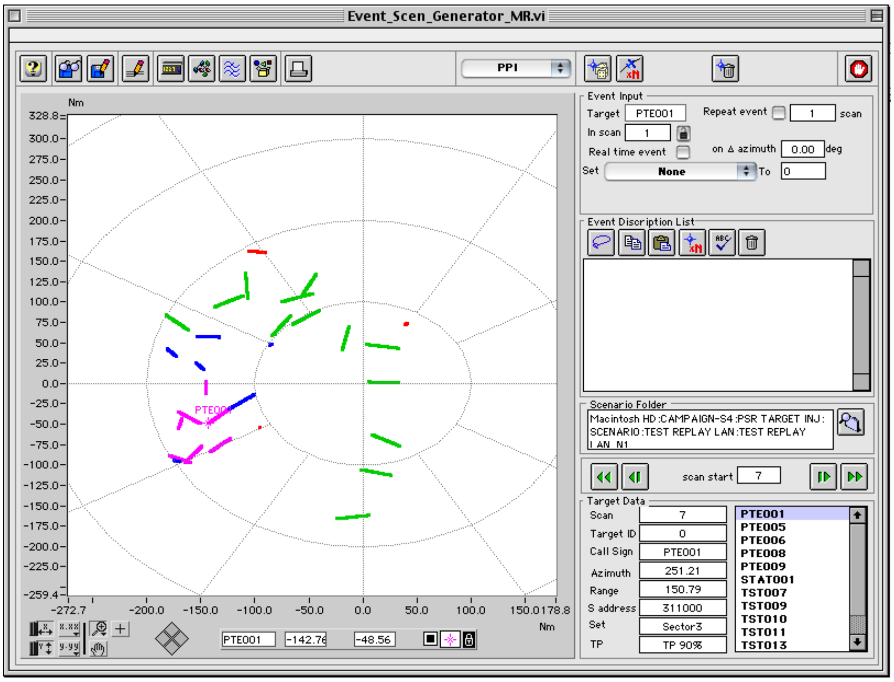
3.2.4. Loading a Scenario

5. Now select a scenario folder previously made with the Multi-Radar Trajectory Scenario Generator tool .
The selected folder must at least contain a valid .S4PR data file to be able to be used by the Multi-radar Event Scenario Generator tool. This can be done by selecting the scenario in the “Folder Select” vi: **Beware! The Scenario data is stored one level deeper than the original Trajectory scenario. This is due to the multi-radar generation.**
The following dialog box will open and allow you to browse for a scenario folder:



When no RASS-S4 data file is found in the scenario folder the following dialog box will appear:

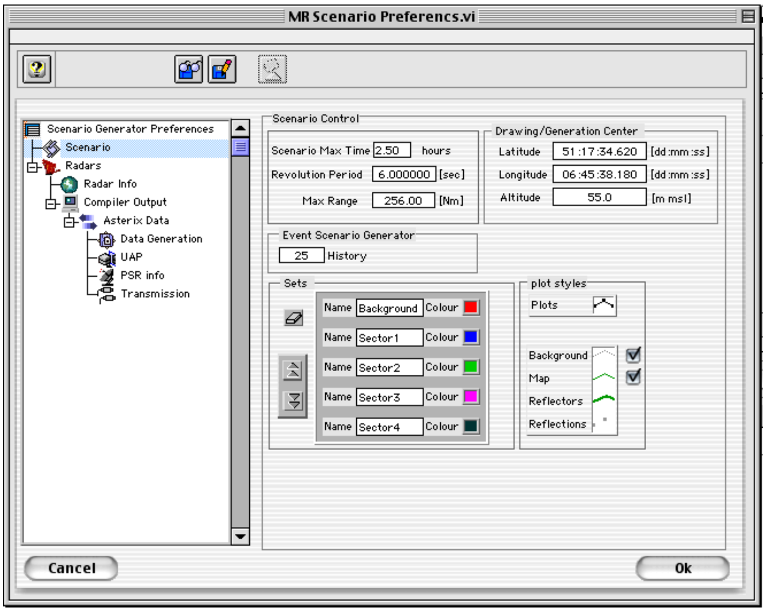
The scenario will be loaded and shown in the event scenario window:



The TP database can be viewed, but not editted from the Event scenario generator.
For more details on the transponder database, consult the paragraph 2.2.5 of this chapter on the Trajectory Scenario Generator tool.

3.2.5. The Event Scenario Generator Preferences

7. Click the  button to activate the Scenario Generation preferences window. The preferences window is the same as for the Trajectory Scenario Generator tool . Only the Event Gen. , ESG and Traj. Gen. part is accessible from the Event Scenario Generator tool. The other ones are disabled. You can page through them using the tabs. The preferences are loaded from the scenario folder.



In the Event Scenario part the following parameters can be entered:

History [10] : number of scans that are shown in the trajectory display. Should be set lower than the number of scans in the scenario. Do not set this value too high, since it will use up a lot of memory.

After setting all the parameters, click the OK button of the preference window.

Clicking the Cancel button will ignore all changes made to the preferences.

3.2.6. The Event Scenario Generator Functions & Buttons

9. Now that the TP data and the trajectory data is entered and the preferences are defined, we can proceed by creating events. This is done in the main screen.
In the main screen, the following buttons can be used:

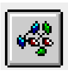

Show help window

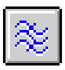

Load an existing event scenario from disk


Save the event scenario to disk


Activate the RES preferences window

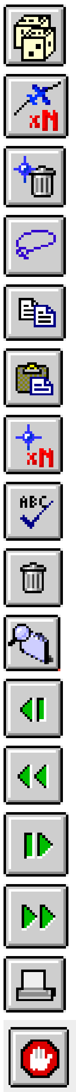

Load Transponder database from disk


Compile the current event scenario


Filter the trajectory data for displaying purposes


Edit User defined ASTERIX messages


Select a site file



Randomiser function

Duplicate selected events to other targets; Not yet implemented

Clears all events in the event scenario.

Select all events in event description list

Copy events from the event description list

Paste events in the event description list

Duplicate events in the event description list

Add event in the events description list

Delete events from the events description list

Browse for a scenario folder on disk

Page 1 scan backward

Page multiple (history length) scans backward

Page 1 scan forward

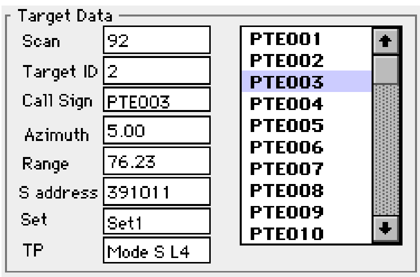
Page multiple (history length) scans forward

Print or export the Event scenario to a text format.

Quit the event scenario generator tool

3.2.7. Paging Trough the Scenario

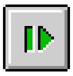
10. The trajectory data is loaded and displayed automatically when a scenario folder is selected. Notice that only the history length (preferences setting) is displayed on the graph. The list of available targets in the scenario is shown in the target data section at the lower right corner of the screen.

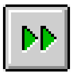


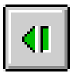
Detailed information for a specific target can be obtained by selecting (clicking) that target from the list. Notice that the cursor on the graph jumps to the corresponding trajectory. By dragging the cursor over the trajectory detailed information about the trajectory becomes available in the indicators next to the list:

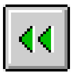
- Scan number
- Target ID
- Call sign
- Azimuth
- Range
- Mode S address
- Set nr
- Transponder Type

Using the row of buttons on top of the target data section you can page through the whole selected trajectory scenario.

Click the  button to page 1 scan forward.

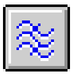
Click the  button to page multiple (history length) scans forward.

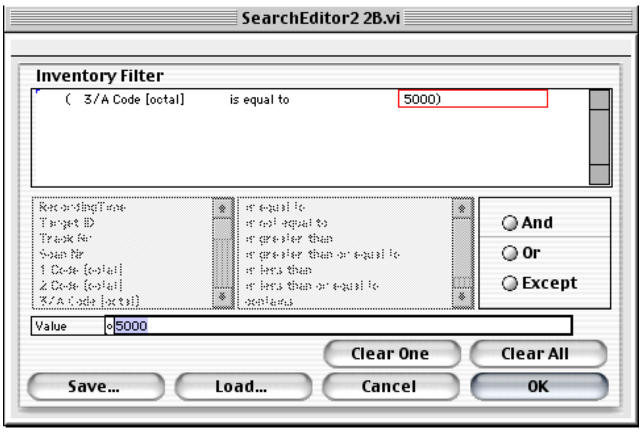
Click the  button to page 1 scan backward.

Click the  button to page multiple (history length) scans backward.

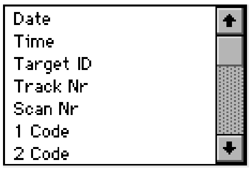
The beginning of the current (history length) displayed selection is controlled in the scan start indicator:

3.2.8. Filtering Scenario Data

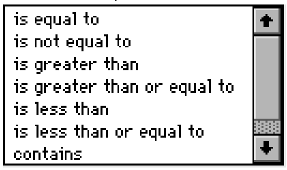
11. Another way of reducing the amount of information to be displayed is to filter the selected trajectory data by clicking the **Filter**  button in the top row of buttons. Clicking this button activates a filter/search editor function:



A filter consists of four functional blocks. The first block is the object of filtering. Choose an object of the list. Use the scroll bars to page through the list and click the wanted item.

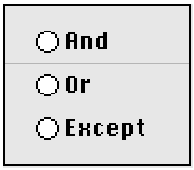


The chosen item is automatically transferred to the filter and the next block, the condition, is enabled. In the same way, select a condition from the list.



The chosen item is automatically transferred to the filter and the next block, the value , is enabled. Type in the desired value and hit the return key.

The chosen value is automatically transferred to the filter and the next block, the logical connection, is enabled. Select a logical operator from the list.



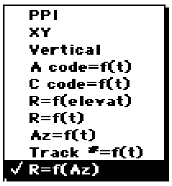
The chosen value is automatically transferred to the filter and the next block. This process is repeated until the filter setting is complete. A filter setting can saved to disk with the **Save...** button or recalled from disk by clicking the **Load...** button.

Clicking the **Clear One** button will clear the selected line from the filter setting, clicking the **Clear All** button will clear the complete filter setting. The **Cancel** button will close the window and ignore all changes.

The combination of the history length plotting and the filter/search editor function lets you zoom in in detail on a specific part of the selected trajectories.

3.2.9. The Event Scenario Generator Graph

12. The selected data can be displayed in different modes . This can be done with the selector at the upper right corner of the display window.



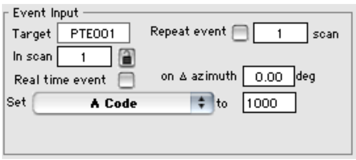
The following views are selectable:

Polar:	azimuth [deg] versus range [Nm]
XY:	X [Nm] versus Y [Nm]
Vertical:	elevation [FL] versus range [Nm]
A code=f(t):	A code versus time [s]
C code=f(t):	C code versus time [s]
R=f(t):	range [Nm] versus time [s]
Azimuth=f(t):	azimuth [deg] versus time [s]
Track #=f(t):	track number versus time [s]
R=f(Az)	Range versus Azimuth (planar)

The color of the graph represents the selected Set number. (as set in the trajectory scenario generator).

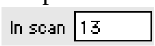
3.2.10. Manually Creating Events

13. An event is created in the Event Input section situated in the upper right corner of the window.



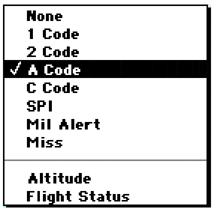
The call sign of the selected target is displayed in the “for” indicator:

A specified scan can be selected by the “in scan” control field



With the lock button  the “in scan” control field is locked to the cursor on the trajectory display. Dragging the cursor from scan to scan will automatically update the “in scan” control field with the correct value.

When the target and the scan number are chosen, an event can be attached to it. Choose the desired event from the list:



3.2.11. Event Types

Depending on the kind of event, specific controls will appear and disappear. These specific controls need to be set only for that kind of event. The following events are implemented

None: no event (revert to original situation)

1 code: mode 1 code change in octal representation

Change is permanent.

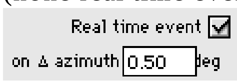
2 code: mode 2 code change in octal representation

Change is permanent.

A code: mode A code change in octal representation

Change is permanent.

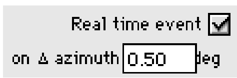
There are two ways to program an A code change: for the whole scan (none real time event) or on a specific Δ azimuth (real time event).



The Δ azimuth value can be plus or minus the beamwidth, starting from the position of the target.

C code: mode C code change in octal representation

There are two ways to program an C code change: for the whole scan (none real time event) or on a specific Δ azimuth (real time event).



The Δ azimuth value can be plus or minus the beamwidth , starting from the position of the target.

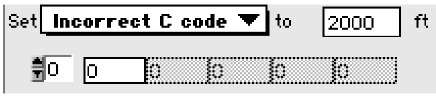
SPI: switch SPI on for 1 scan

MIL alert: switch military alert on / off

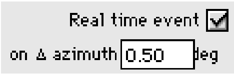
Change is permanent.

Miss: generate a miss for one scan

Incorrect C code: generate an incorrect Mode C code



The incorrect Mode C will be generated using the current altitude of that target and adding to this a value between 0 and + or - N feet, N given in the **ft** control.
For Mode S roll calls, the same procedure is used, but the number of incorrect Mode C codes in one scan (in case multiple UF4 or UF20 interrogations are send) is determined by the number of elements in the array given under the event selector.
There are two ways to program an C code change: for the whole scan (none real time event) or on a specific Δ azimuth (real time event).

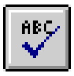


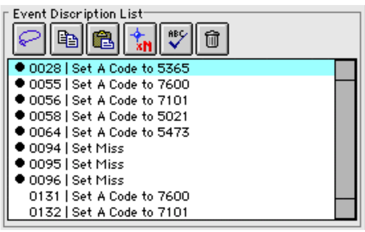
The Δ azimuth value can be plus or minus the beamwidth , starting from the position of the target.
Beware! C code changes and C code Mode S events are not permanent, and should be reset every scan if required.

Flight status: switch flight status between airborne / on ground

Change is permanent.

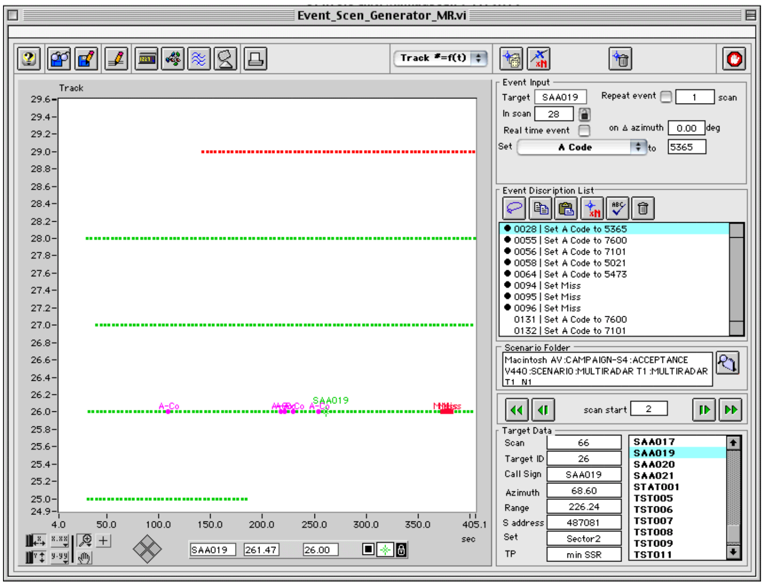
3.2.12. Viewing Events

14. Once an event is selected and edited it can be created by adding it to the event description list by clicking the  button. The event, together with its related parameters is displayed in the list and a mnemonic is added to the trajectory display to indicate that an event is attached to it.

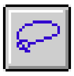


Using the same method other events can be added to the event description list. This way the list represents all the events attached to the displayed part (history length) of a certain trajectory. Drag the cursor to another trajectory to view its event description list.

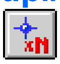
All events of a selected target are shown in the inventory graph on the left side of the window as a mnemonic cursor linked to the graph. This way the user can visualise the scenario as a function of time.

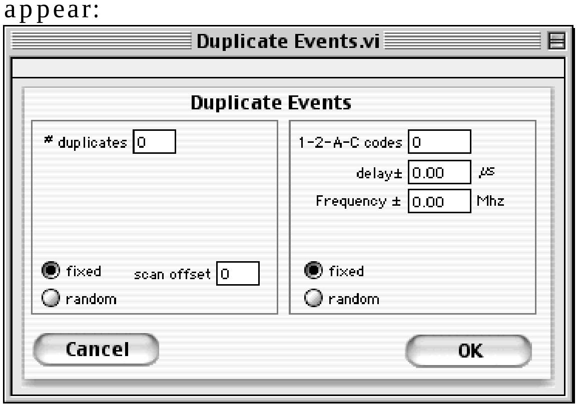


Events can be deleted form the list using the  button. Events can be copied from the list using the  button and pasted into the list using the  button.
All these actions require a selection of a specific event. This can be done by clicking on a certain event.

With the  button all events can be selected at once. By selecting an event in the list, its parameters are projected back to the event input section and can be edited again.

3.2.13. Duplicating Events within the Same Trajectory

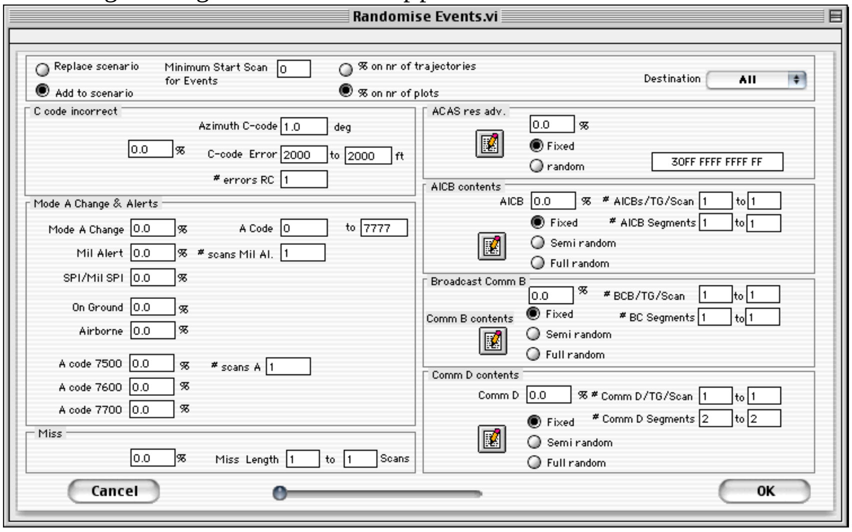
Click the  button to duplicate a selected event. The following dialog box will appear:



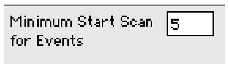
Enter the number of duplicates you want to make and chose a fixed or random offset for each duplicate in number of scans. For each duplicate a number of parameters can also have a fixed or random offset: mode 1-2-A-C code depending on the original event, reply delay and Tx frequency .

3.2.14. Creating Random Events for a complete Scenario

15. Instead of creating and assigning the events manually, they can be generated automatically in a random way by clicking the **randomise events** button. The following dialog window will appear:

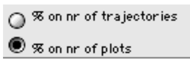


First enter the start scan of the random events:



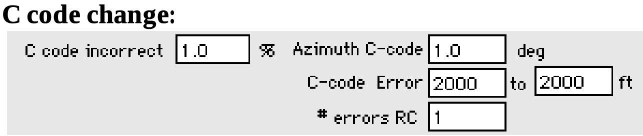
The random events will be generated from that scan onwards.
The right hand side of this window is not used in Multi-radar Mode!

Next select the generation mode for the % parameters:



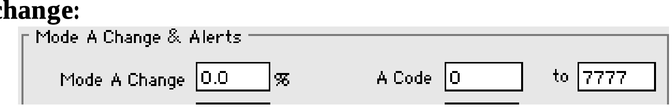
In the first selection ("on Nr of trajectories"), a percentage of the Number of trajectories is used to determine the number of generated events. In the second selection ("on Nr of plots"), a percentage on the number of plots is taken.
e.g. a scenario of 500 targets of 100 scans each . In the first selection, if the user specifies 1% ACAS events, 5 events will be generated in total. In the second selection, 500 events will be generated.

The following events can be generated randomly:
Incorrect Mode C code change:



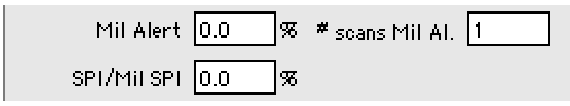
Enter the percentage and the boundaries of the incorrect mode C code changes. Enter the azimuth where the mode C code change has to happen: plus or minus, starting for the position of the target. Enter the number of C code changes for Mode S roll call replies.

Mode A code change:



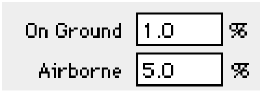
Enter the percentage and the boundaries of mode A code changes.

SPI/MIL alert:



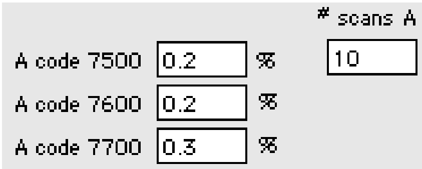
Enter the percentage of SPI / MIL alert events to be generated.
Military Alerts are generated for a fixed number of scans, to be entered in the *"# scans Mil Em. field"*

Flight Status:



Enter the percentage of Targets that will receive the "On ground" status event and the percentage of Targets that will receive the "Airborne" status even.

Special A codes:



Enter the percentage of Targets that will receive the "A code 7500" , "A code 7600" and "A code 7700" status event.
Also include the number of scans the Alert stage must remain active.

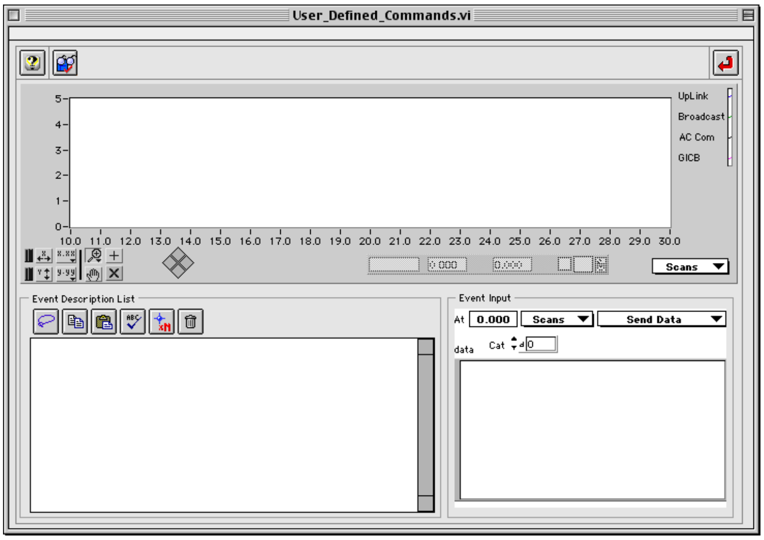
Misses:

Enter the percentage and the length boundaries of the misses.

3.2.15. Adding Specific ASTERIX messages in your replay stream

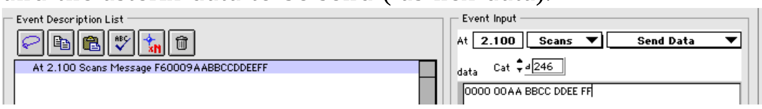
A special function exists to create user defined ASTERIX messages in your replay data stream at specific positions.
To create these, open the "User Defined Commands " window using the following button:

This window allows you to define once or multiple times a specific ASTERIX message and include this message in the replay stream.
The tool will only add the first 3 bytes of the asterix data automatically, because these are vital for the correct playback of the dataset.

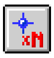


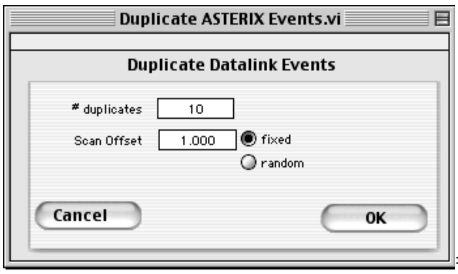
Start entering events by clicking the “*Insert Event*” button. 

The event description list will be ammended with one line.
Now use the Event input fields to enter a Scan number (fractional), a Cat item (e.g. 253) and the asterix data to be send (as hex data).

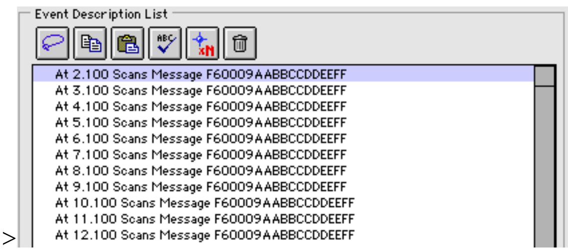


The tool will automatically overwrite the first 3 bytes with the Cat byte and the LENGTH bytes.
The data will be inserted at scan 2.1. (Scan 1 starts after the second North pulse in replay of a RES scenario)

Add multiple messages as you wish.
The messages can be duplicated a number of times using the duplicate function. Use the “duplicate” button for this purpose. 

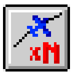


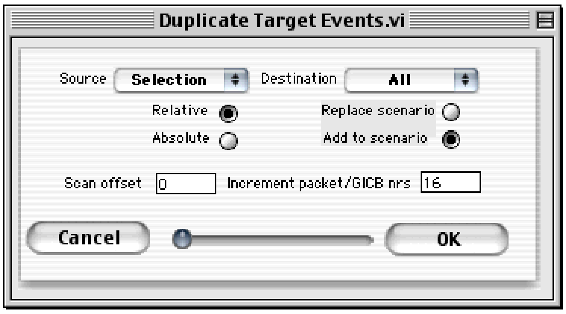
=>



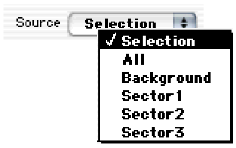
Enter the number of duplicates and the Scan offset in the window. Click OK to accept.
Close the window when ready.

3.2.16. Copying Events to other Trajectories

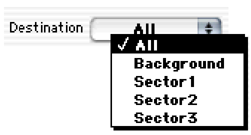
17. If a list of event is defined, these events can easily be copied to other trajectories using the Duplicate Target Events button  . This function calls the following window:



First select the Source of the events.
This can be either the selected event list (the one currently shown in the Event Scenario Generator), or the events of a given set (in this case, the source set must have the same or smaller size than the destination set).
This can be selected using the source menu:



Next, select the destination of the duplicate:
This can be either all targets in the scenario or only the targets of a given set:



Next, select whether the copy must be absolute or relative. This is important for trajectories which do not start at scan 0.
In relative mode, the scan number of the new copied events is calculated by taking the scan number of the source event, plus the difference in scan numbers of the start of the two trajectories (Source and Destination).
In absolute mode, the scan numbers are not altered.
e.g. If the source set of events starts at scan 1, and the destination trajectory starts at 20, the events must be copied relative.

Finaly, select whether the existing scenario must be overwritten or not. If you select the “replace existing scenario” option, the existing scenario for all selected targets will be overwritten . A warning dialog is issued to warn you about the concequence of this action.

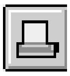
Click the **OK** button to start duplicating. **Cancel** returns without action.

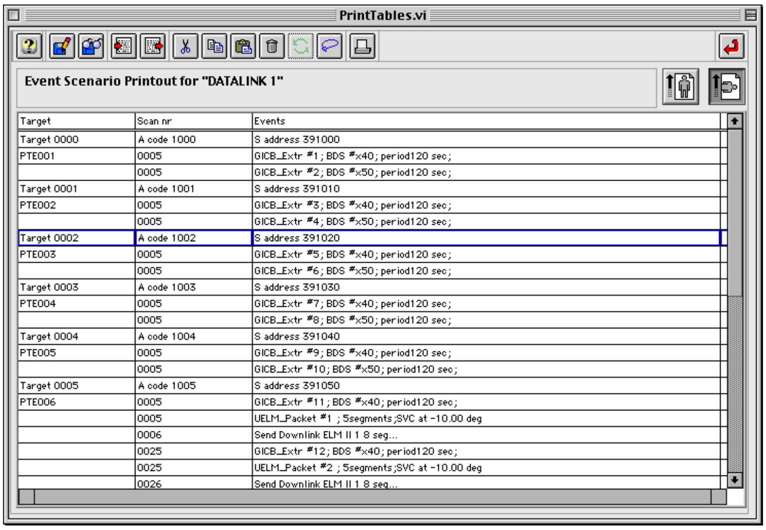
3.2.17. Saving and loading Events

Event scenarios are auto-load and save. The scenario is saved as one file per Target.

When selecting a scenario folder, the events of the first target in the scenario are loaded. Each time a new target is selected, the events of that target are loaded and the ones of the previous target are saved. When quiting the tool or at compliation, the last editted data is also saved.

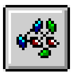
3.2.18. Printing Events

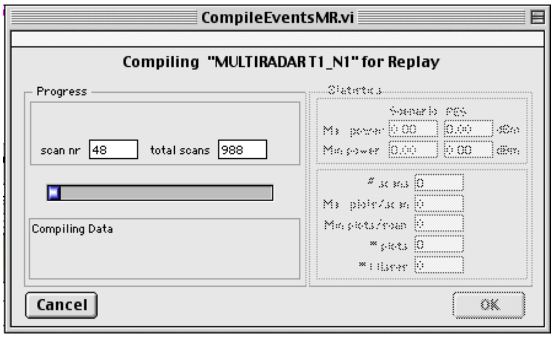
You can always print an event scenario by clicking the **Print**  button. The event scenario is then listed in a special window, which then allows you to print, export or save in a table the data.



Target	Scan nr	Events
Target 0000	A code 1000	S address 391000
PTE001	0005	GICB_Extr #1 ; BDS #x40; period120 sec;
	0005	GICB_Extr #2; BDS #x50; period120 sec;
Target 0001	A code 1001	S address 391010
PTE002	0005	GICB_Extr #3; BDS #x40; period120 sec;
	0005	GICB_Extr #4; BDS #x50; period120 sec;
Target 0002	A code 1002	S address 391020
PTE003	0005	GICB_Extr #5; BDS #x40; period120 sec;
	0005	GICB_Extr #6; BDS #x50; period120 sec;
Target 0003	A code 1003	S address 391030
PTE004	0005	GICB_Extr #7; BDS #x40; period120 sec;
	0005	GICB_Extr #8; BDS #x50; period120 sec;
Target 0004	A code 1004	S address 391040
PTE005	0005	GICB_Extr #9; BDS #x40; period120 sec;
	0005	GICB_Extr #10; BDS #x50; period120 sec;
Target 0005	A code 1005	S address 391050
PTE006	0005	GICB_Extr #11 ; BDS #x40; period120 sec;
	0005	UELM_Packet #1 ; 5segments;SVC at -10.00 deg
	0006	Send Downlink ELM II 1 8 seg...
	0025	GICB_Extr #12; BDS #x40; period120 sec;
	0025	UELM_Packet #2 ; 5segments;SVC at -10.00 deg
	0026	Send Downlink ELM II 1 8 seg...

3.2.19. Compiling Events

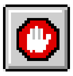
20.Finally the event scenario needs to be compiled in order to be used by the RES Main Controller tool. Click the  button to compile the event scenario. The necessary files are automatically stored in the corresponding scenario folder. A window with a compile progress indicator will appear:



At the end of the compilation, the compile window will render you a number of important information fields:

-Maximum output power of scenario (at Radar Receiver input level)
-Minimum output power
-# of scans
-Max # plots / scan
-Min # plots / scan
-# of plots
-# of generated misses (due to out of range targets or programmed misses)
-Total time of scenario

Click the cancel button to interrupt the compile process at any time.

20. Click the  button to quit the Event Scenario Generator tool.

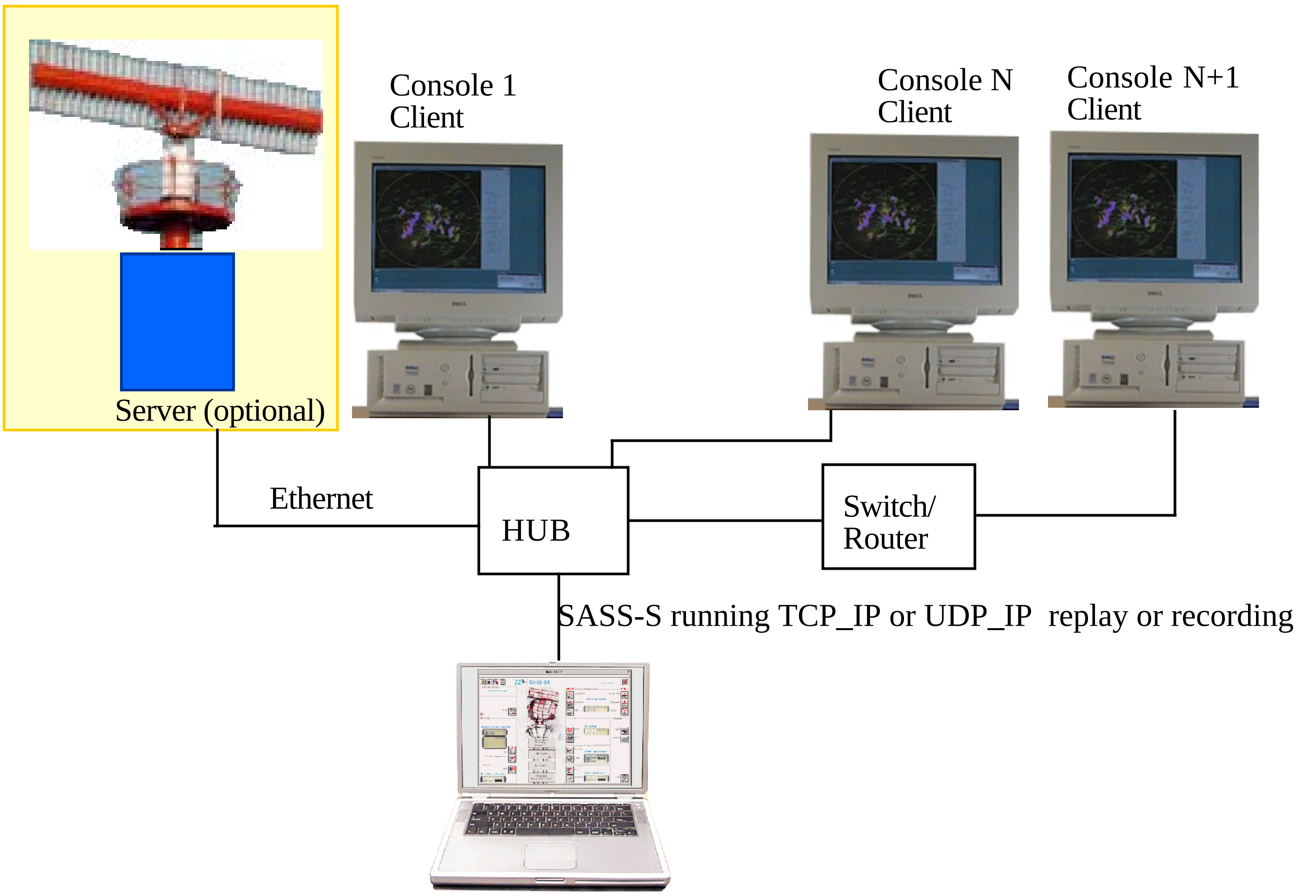
4.0. LAN Replay Driver

4.1. Introduction

The LAN replay tool is intended to control and monitor the different data streams going out of the Sofware into the LAN (Eighter under TCP_IP or UDP_IP) . The data streams going into the LAN represent the result of the compiling of predefined scenario.

Alternatively, this tool can also be used to replay any EDR recording (be it recorded using EDR, UDR or LAN)

It is of great importance that the connection of the computer running the generation is connected to a HUB feeding the rest of the network. The computer will simulate Mutiple radars, and can serve allongside other existing radars. Do NOT connect the computer straigth into a switch.

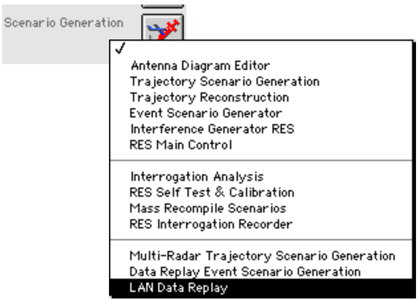


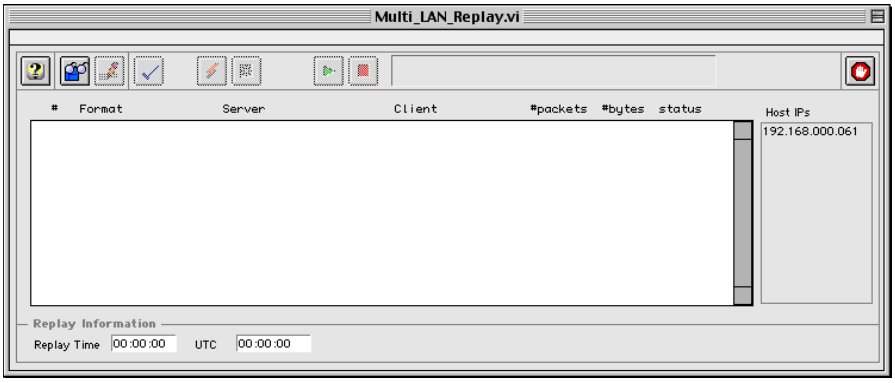
4.2. Using the LAN Replay driver

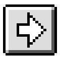
4.2.1. Starting the Tool

The LAN Driver tool can be loaded from the RASS-S Toolbox.

1. To load the tool, double click the RASS-S Toolbox icon and select “LAN Data Replay” from the “Trajectory Generator” menu in the RASS-S Toolbox.



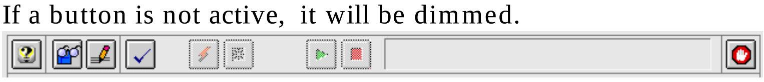


2. Now the tool is loaded. Click the  button in the upper left corner of the window to start the tool.

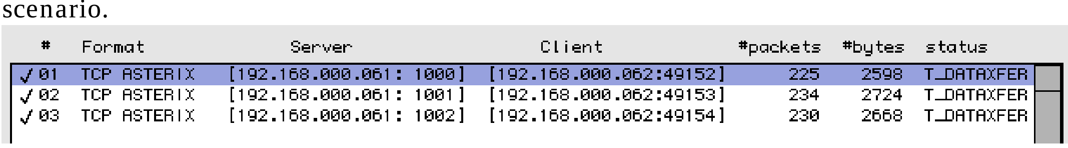
4.2.2. Tool Components

3. The window contains several fields:

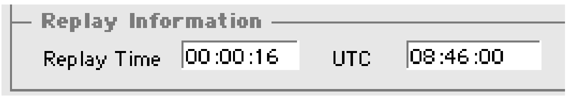
In the top we can see a number of buttons, controlling the program. these Buttons will be dimmed or highlighted according to the possible actions to take.
If a button is not active, it will be dimmed.



Under the button bar, we have the stream info field. This shows a selection of all “filters” defined for the replay. Each filter contains a TCP_IP server address, a port number and a data type. The filters can be defined in a special window.
The info window will show the status of the different output streams defined in the scenario.



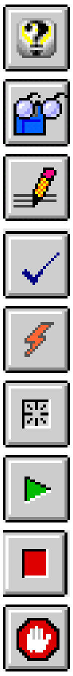
Under the info window, the user can read the relative and absolute replay time of the data.



To know the host computer own TCP-IP address(es) , look at the Host-IP field.

4.2.3. LAN-Replay driver Functions and Buttons

The RES controller is operated with several buttons situated in the window.



Show help window.

Loads a scenario or recorded EDR data file

Defines the settup of the different streams

Activates or de-activates a stream

Starts the LAN server action

Stops the LAN server action

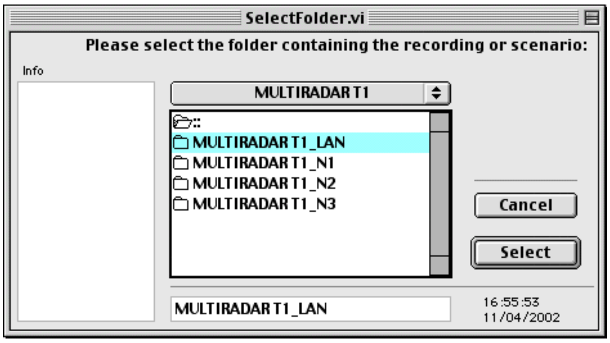
Start the playback.

Stop the simulation

Quit the LAN replay tool.

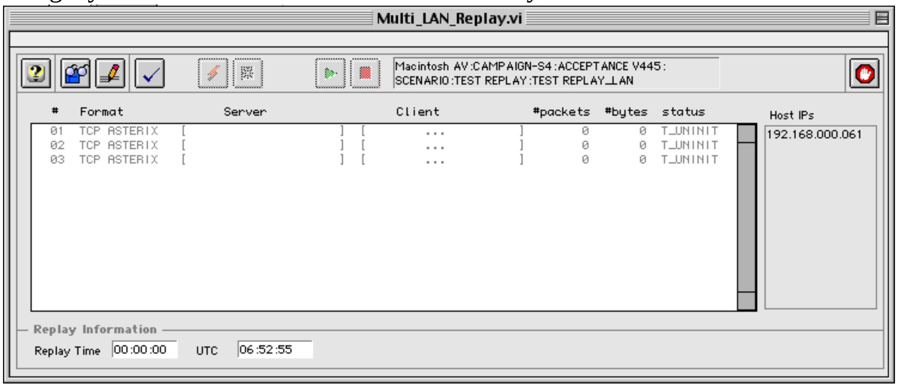
4.2.4. Loading a Scenario

4. The first thing to do is to select a LAN replay folder (or previously recorded EDR folderP which contains the necessary files to run the simulation.) This can be done by selecting the proper scenario folder by clicking on the "**load" button.** 
Beware! The LAN replay files are stored INSIDE the actual scenario folder, in a folder named "SCENARIONAME_LAN". So you have to go inside the scenario folder to select the proper folder.



4.2.5. Setting up the parameters

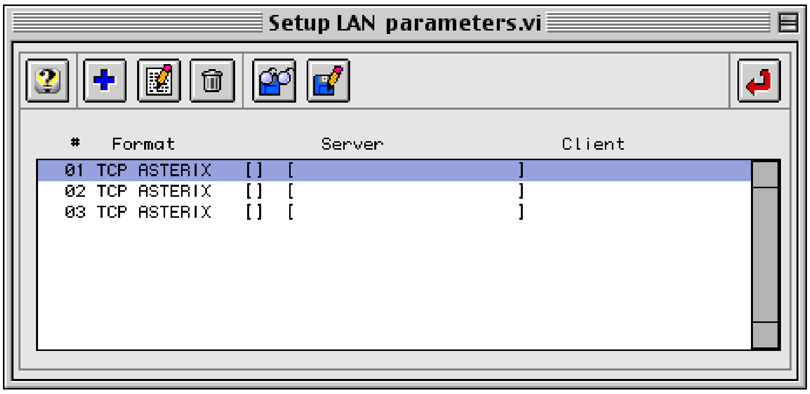
5. The data found in the selected folder will be shown as filters in the info fields. The fields are grey because the filters are not defined yet.



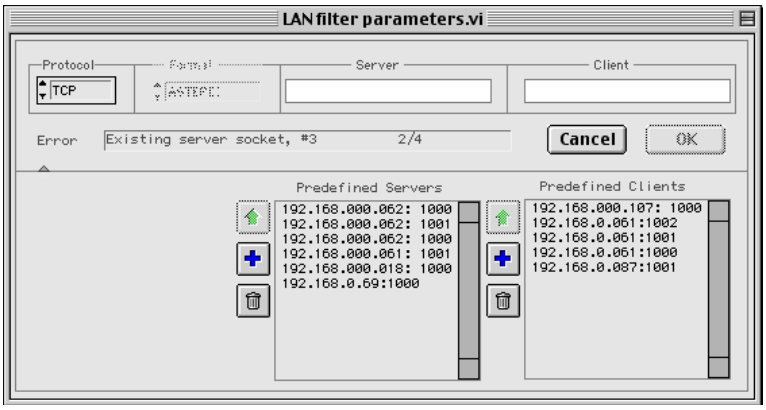
Now click the "**preferences**" button  to define the TCP_IP settings for the filters.

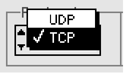
Following window will pop up:

Now double click the first filter or select it click the **Setup** button 



Again a new window will appear:



First select the replay protocol (UDP or TCP). 

Now enter the host IP parameters (Address in dot notation plus port) in the “Server” field.

Typically, private addresses should be used, e.g. 192.168.yyy.xxx . xxx and yyy are network specific addresses.
The port is entered after a collon-character. e.g. 192.168.000.077 : 1000 uses address 192.168.000.077 and port 1000.

The host address can be found in the main LAN replay window: 

. It can be set using the LAN setup of your computer. (TCP-IP control panel in Mac-OS 9 ®, LAN control panel in Windows XP®.) This should be done **before** launching the RASS-S toolbox.

If you previously already defined some server addresses, you can copy them by clicking the “**up”** button. 

Copy the server address in the list for later use by using the “**add”** button**.** 

The client address does not need to be entered. It is automatically entered upon connection with a client.

Close the “LAN filter parameters.vi” window by clicking OK. If Ok is dimmed, the Error indicator will identify what is wrong. Typically, this indicates a wrong IP address or a typing error in the IP address string .

Perform the action for all streams contained in the scenario. Typically, you will have one stream per radar in the multi-site file.