VMA Simple Spectrum Analyser

User Guide

Contents

User Guide Version 2016-12-27

1.   Disclaimer

The SMA Simple Spectrum Analyser software was written by Vitor Martins Augusto to control devices sold on eBay with the following description: "138M-4.4G USB SMA signal source/signal generator/simple spectrum analyser".

The software is compatible with different variants of this device, using either ADF4350 or ADF4351 synthesizer IC's, as well as, the NWT-4000 series featuring two ADF4350/ADF4351 synthesizer IC's for simultaneous signal input and output.

The software and this manual are provided as is, without support or warranty.

The author refuses responsibility to any direct or indirect damages or accidents, which may result from the use of this software and manual.

The software and the underlying hardware devices offer no reliable precision or calibration. All measurements are to be considered a rough representation of the relevant frequency spectrum.

The purpose of this software is to offer a tool to visualize a real-time frequency spectrum and to introduce the user to sweep spectrum analysis (SSA).

It is not recommended to use this software for any commercial application, especially if the outcome of the measurements can represent a risk to safety.

2.   Abbreviations and acronyms

- FFT – Fast Fourier Transformation: the math used in spectrum analysis to derive from time domain to frequency domain
- GPS – Global Positioning System
- IF – Intermediate Frequency
- LOF – Local Oscillator Frequency
- NMEA – National Marine Electronics Association, set the standards of communication between marine electronics. GPS is one of such devices, along with sonars, echo sounder, etc.
- NWT500 – "Netzwerk Tester" (Network Tester): the original design of the device family used with the VMA Simple Spectrum Analyser Software
- RBW – Resolution Bandwidth
- RF – Radio Frequency
- SMA – Sub Miniature version A connector, designed for use with frequencies from DC up to 18GHz, with an impedance of 50Ω
- SSA – Sweep Spectrum Analyser
- SWR – Standing Wave Ratio: measurement of impedance matching of loads to the characteristic impedance of a transmission line or waveguide[1]

[1] - https://en.wikipedia.org/wiki/Standing_wave_ratio

3.   Introduction

Since the beginning of RF electronics, mankind had the urge to understand and visualize the radio frequency spectrum.

Spectrum analysers exist for a long time and use one of two methods:

- A swept-tuned analyser uses a super heterodyne receiver to down-convert a portion of the input signal spectrum to the centre frequency of a narrow band-pass filter, whose instantaneous output power is recorded or displayed as a function of time. By sweeping the receiver's centre-frequency (using a voltage-controlled oscillator) through a range of frequencies, the output is also a function of frequency. But while the sweep centres on any particular frequency, it may be missing short-duration events at other frequencies.
- An FFT analyser computes a time-sequence of periodograms. FFT refers to a particular mathematical algorithm used in the process. This is commonly used in conjunction with a receiver and analogue-to-digital converter. As above, the receiver reduces the centre-frequency of a portion of the input signal spectrum, but the portion is not swept. The purpose of the receiver is to reduce the sampling rate that the analyser must contend with. With a sufficiently low sample-rate, FFT analysers can process all the samples (100% duty-cycle), and are therefore able to avoid missing short-duration events.

SOURCE: WIKIPEDIA - https://en.wikipedia.org/wiki/Spectrum_analyzer

However, spectrum analysers are very expensive and even second hand devices reach prices, which are often inaccessible for amateurs.

The aim of this software was to replicate all functionality commonly available on a professional swept-tuned spectrum analyser, based on an affordable hardware platform.

4.   About this manual

This manual will explain all functions of the VMA Simple Spectrum Analyser and include brief explanations on how to use them.

This manual is updated regularly, however it might not be up to date with the latest software release. Please consult the Change Log field in the About Tab of the software, to see the latest additions or changes in the software.

```
VMA Simple Spectrum Analyser - (C)2016 Vitor Martins Augusto                                                    x

Spectrum  Trigger Log  Log on Maps  Signal Source  Sweep Generator  Power Meter  Setup  About


                                    ©2016 Vitor Martins Augusto

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                            Visit my blog: http://vma-satellite.blogspot.pt

Changelog:

2016-12-15: Added keyed input on frequency input form
2016-12-14: Added frequency input form, allowing frequency input in KHz or MHz - this fixes unverified user input crashing the software
            Frequency is now shown in MHz with 3 decimal places
2016-12-13: Satellite identification shows missed transponders in red
            Added colour map with 256 colours for Log on Maps
2016-12-12: Improved automatic satellite identification
2016-12-11: Added automatic satellite identification
2016-12-10: Added transponder pattern recognition
2016-12-05: Added e-mail alarm alert on trigger
2016-12-04: Added TRIGGER functionality
2016-12-02: Added PRINT SCREEN button to print the entire Form to the default printer (only available on the Spectrum Tab)
            Added PRINT MAP button to print single frequency signal power map on LOG ON MAPS tab
2016-12-01: Added time stap and GPS position to recorded spectrum
            Frequency log can be created from recorded spectrum, including GPS data
            Enhanced GPS functionality
2016-11-29: Frequency log with GPS position and display on Google Maps
2016-11-28: Initial GPS functionality added
2016-11-27: Added recording and playback of the whole spectrum
2016-11-25: Added MINIMIZE button to hide main window, while spectrum keeps running
2016-11-23: Added Min, Max & Avg measurement with optional horizontal line display
2016-11-22: Corrected Power Meter calculation
2016-11-13: Implemented Auto Scale in Y
2016-11-10: Fully implemented inverted spectrum - if a negative LOF is entered, the spectrum is drawn inverted
            Inverted the changelog - new changes on top for better visibility
2016-11-09: Small bug fixes:
            Frequency of mouse position now without negative sign for inverted spectrum
            Spectrum load window only shows *.ssa files
2016-11-08: Increased preset buttons to a total of 9
```
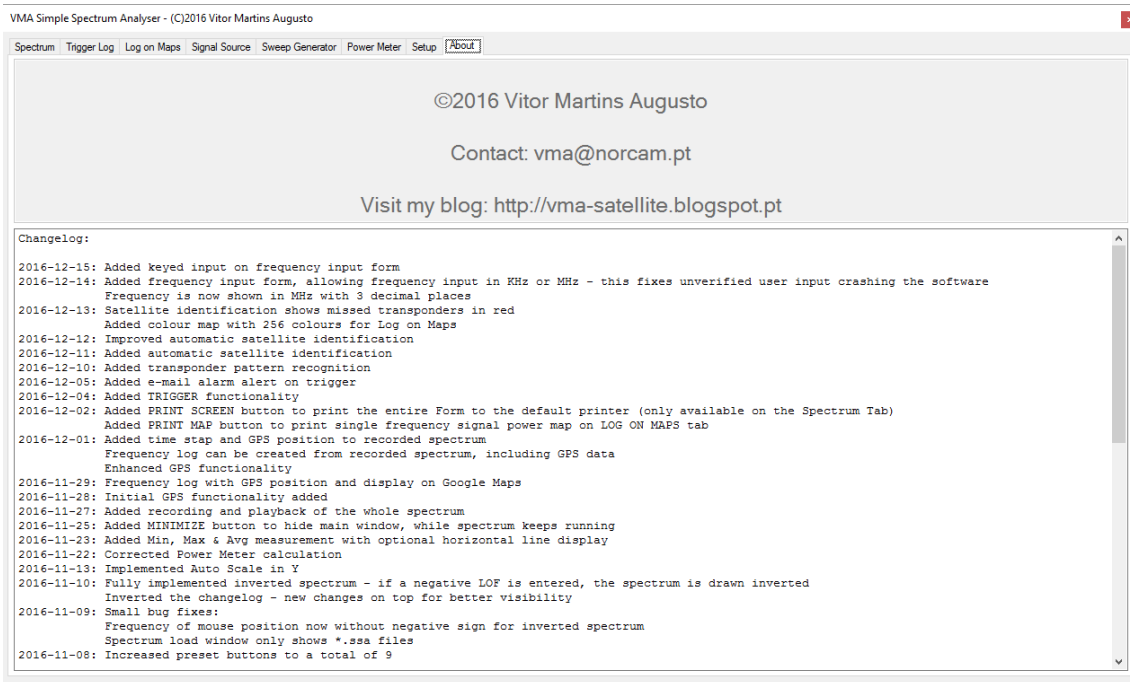
Fig. 4-1

Some screenshots of this manual may show a slightly different GUI layout. They were taking on earlier versions of the software and have not been updated.

5.   Safety

While there are no additional security hazards resulting from the use of the VMA Simple Spectrum Software, the following list mention all potential risks which need to be taken into account when using this software:

- The SMA device allows connection of cables carrying a live signal. Be aware that this cable could potentially carry a high voltage due to a defect in active elements of the distribution network!
- Likewise, never leave the signal cable connected to the device on bad weather, especially thunderstorms!
- Always use a DC Blocker to protect the input stage of the SMA device, when voltage is present on the signal cable. This is for instance the case, when connecting the SMA device to the Loop Through port of a satellite receiver. It may be wise to use the DC Blocker in cable networks (CATV).
- Using the trigger function with automatic e-mail alarm delivery can cause an e-mail being sent every five minutes, if the trigger mask is set wrong. This could eventually flag your e-mail provider.
- The VMA Simple Spectrum Analyser software does not encrypt your e-mail password, when storing it in the Registry. This can be considered a safety issue and should be taken into account. You can opt to not have the password stored. Anyway, it is recommended to get a free dummy e-mail account for this application, as the e-mail account only serves the purpose of sending mail through an STMP server (they generally require a valid account nowadays).
- The VMA Simple Spectrum Analyser Software was not designed for professional use. While there is nothing preventing such use, there are no liabilities whatsoever.
- The VMA Simple Spectrum Analyser Software does not provide calibrated or compensated measurements. All measurements are as precise as the SMA device itself. If you rely on precise measurements, consider a professional spectrum analyser and/or a professional power meter.

6.   Hardware

On eBay a device called "138M-4.4G USB SMA signal source/signal generator/simple spectrum analyser" is being sold at around 60 Euro.

This is a cut-down version of the similar looking NWT4000 device, which again is an enhanced clone of the NWT500 series of devices. These were originally developed for amateur radio enthusiasts to allow for SWR antenna tuning.

The following table lists the main differences:

Model	Frequency Range	Synthesizer IC	Supported
SMA Simple Spectrum Analyser Version 1	138MHz-4.4GHz	ADF4350	Yes
SMA Simple Spectrum Analyser Version 2	35MHz-4.4GHz	ADF4351	Yes
NWT4000 Version 1	138MHz-4.4GHz	ADF4350	Yes
NWT4000 Version 2	35MHz-4.4GHz	ADF4351	Yes
NWT4000 Version 3	50KHz-4.4GHz	ADF4351 (*)	Yes
NWT6000	138MHz-6GHz	MAX2870	No
NWT500	0.1MHz-550MHz	AD9858	No
NWT7	unknown	AD9851	No
FA-NWT	unknown	AD9951	No

(*) Apparently uses a frequency converter for 50KHz to 35MHz – not confirmed

The hardware connects through USB with the PC. It uses an FTDI 232 IC, which almost certainly is a fake one. Using the latest FTDI drivers will probably not work, so you need to find old FTDI drivers that do not check if the hardware is original.

Most devices are shipped with a CD containing the required drivers.

Note that the NWT series of devices are sold with or without a matching aluminium case. It is recommended to only operate the device when contained in such an aluminium case, otherwise there is a real risk to accidentally damaging the PCB, due to casual contact with the metallic connectors of cables.

It is recommended to have the following accessories, to successfully operate the device and this software:

- **DC Blocker**: the device does not support the presence of any voltage. Directly connecting the device to i.e. the Loop Through connector of a satellite receiver WILL break the device!
- **SMA to F adapter**: in order to use the device for any TV, CATV or SAT related measurements, you need to connect F-type connectors to the SMA input port of the device.
- **SMA to SMA adapter**: the device is normally shipped with two SMA cables. These are pretty useless in most cases, but I do recommend to use them, in order to not wear out the devices' SMA connector. However, to be able to attach the SMA to F adapter on said cable, you will need a male SMA to male SMA adapter. This will reduce the interferences you will get over time when attaching connectors directly to the SMA input port.
- **Attenuator**: the device should not be directly connected to any cable carrying a signal with more than +5 dBm signal power. Note that this value represents the TOTAL power of the whole frequency range! Because this total power is normally not know

beforehand, the correct approach is to start with a great enough attenuation, which is then reduced until an adequate signal power is passed to the input port.

Other useful accessories include:

- **Noise source**: available on eBay are cheap noise sources covering the whole frequency range of the device. Newer devices are sold with a matching aluminium case. They are better, as the ones delivered as a plain PCB can accidentally touch some metal parts of cables, etc. lying around on the desk, producing a short. Also, using the noise source without proper shielding may interfere with other sensitive equipment, producing false measurements.
- **Antennas**: It is recommended to use proper antennas! Using a simple stick antenna from a USB DVB-T receiver will not allow good reception.
- **Cables**: You will need an assortment of cables to connect all the components

The following pictures shows the complete hardware setup:

For RF measurements, including mobile "on-the-road" measurements:
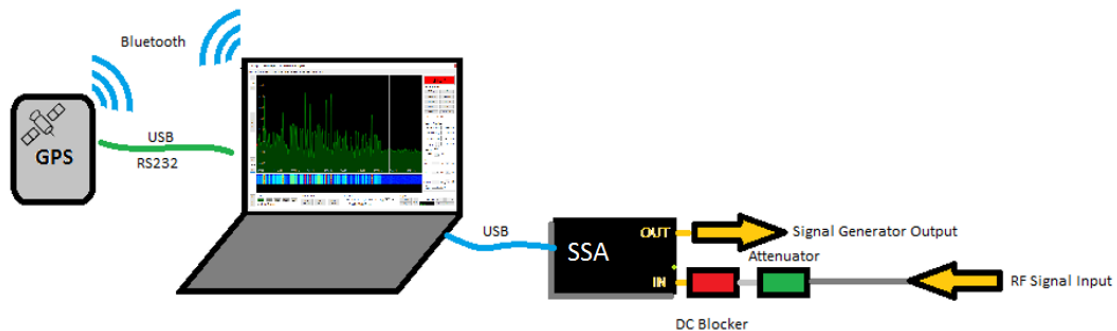
Fig. 6-1

1) The spectrum analyser is connected to the PC, laptop or tablet by means of a USB connection. Use the included USB A-B cable.
2) To ensure protection of the spectrum analyser input stage, a DC blocker is mandatory if connecting a cable carrying a voltage!
3) To ensure protection of the spectrum analyser input stage, an appropriate attenuator has to be connected when the global signal power exceeds +5 dBm.
4) Optionally, a GPS receiver can be used to add the latitude and longitude to recorded spectrums or frequency logs. Such GPS receiver must support the NMEA standard and can be connected to a PC, laptop or tablet through Bluetooth, USB or RS232. Please consult the user guide provided with the GPS receiver, regarding connection. All GPS receivers will communicate through a COM-port (virtual or hardware).

For satellite measurements:
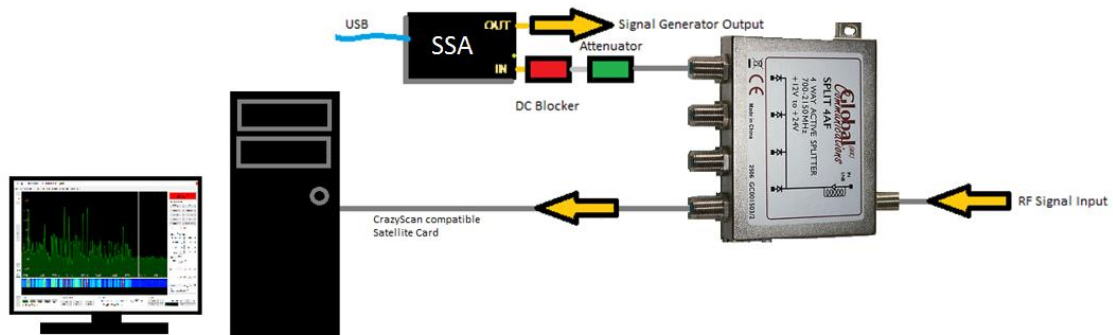
Fig. 6-2

1) The signal cable is fed into a splitter. This should be an active splitter like the Global Communications SPLIT 4AF or similar, separating each input connector from the other input connectors through a diode, but allowing the voltage and DiSEqC commands to be passed to the LNB.
2) The spectrum analyser is connected to the PC, laptop or tablet by means of a USB connection. Use the included USB A-B cable.
3) To ensure protection of the spectrum analyser input stage, a DC blocker is mandatory if connecting a cable carrying a voltage! The SPLIT 4AF already blocks DC, but other splitters may not.
4) To ensure protection of the spectrum analyser input stage, an appropriate attenuator has to be connected when the global signal power exceeds +5 dBm. If you are unsure about the signal power, start by using a high attenuation, for instance by chaining several -5dB attenuators, removing them one by one until a reasonable attenuation is obtained.
5) From another port of the splitter, a cable connects directly to a PC satellite receiver (PCI, PCI-e or USB). It is recommended to use one that is compatible with CrazyScan or other similar tools. More info at: https://sourceforge.net/projects/crazyscan

7.   Installation and activation

The software is provided at the current state as a simple executable that does not require any installation. Just extract the executable file and run it – it is that simple!

To use the software, you will require an activation code. Without a valid activation code, the software will show the system code in a pop-up message and copy this system code to the clipboard.

You need to request an activation code to the author, by sending an e-mail with the system code (remember, just do a CTRL-V to paste the system code).

When starting the software for the first time, you need to go to the setup tab and specify the correct COM-port of the device.

Upon email request, free activation codes are issued. These free codes will terminate on the last day of March, June, September or December, respectively. You always get activation codes for the next deadline.

Donations (10€, 10£, 10US$ - whichever is more convenient and cheaper) are accepted via PayPal account. In return a permanent code is issued.

The following rules apply:

- You may request as many activation code renewals as you want.
- You may request several codes for your main PC, laptop, tablet, etc., within a reasonable limit.
- Donations are NOT mandatory at all, they will not give any extra functionality, except for a ***permanent activation code*** for your main PC, laptop, tablet, etc., within a reasonable limit.
- "Permanent activation codes" are issued with an expiry date of December, 31st 2099. It is planned to have the software recognize and display this date as permanent – please check future software versions.
- Donations will NOT entitle to any special support or feature request - all functionality can be extensively tested with free activation codes and new functionality is implemented according to my ideas, people's suggestions, feasibility, etc.
- Donations will help paying for additional devices, to better support different devices.
- Donation instructions are available within software releases published after November, 25th 2016.

8.   Setup

To setup the software, select the SETUP tab:
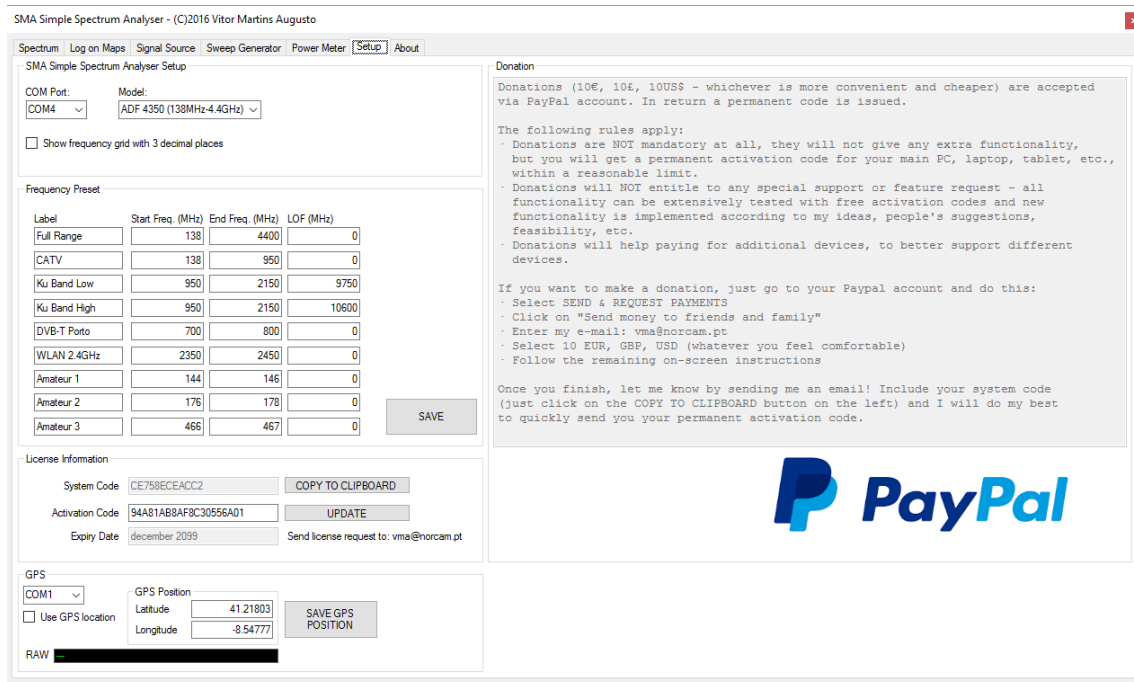
Fig. 8-1

The first item of the setup tab allows selection of the relevant COM-port. Here you can specify which hardware version you are using. Both ADF4350 and ADF4351 synthesizer IC are supported.
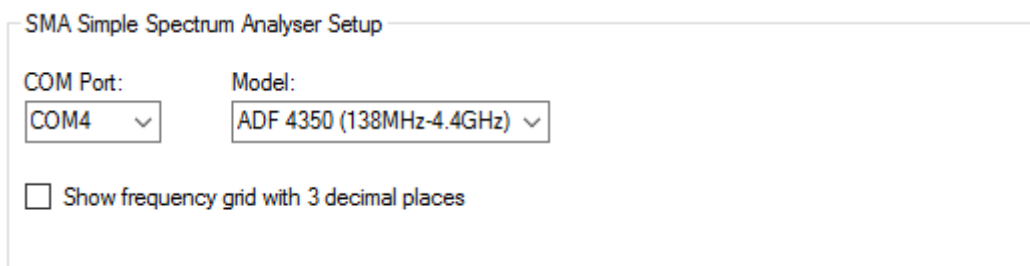
Fig. 8-2

A checkbox allows to toggle the display of three decimal places on/off. Please note that this setting is NOT stored in the registry and thus will always default to on.

The setup screen allows specifying up to 9 pre-sets. Each pre-set has a label and configures the start and end frequency, as well as, a LOF (Local Oscillator Frequency) value.

Fig. 8-3

The SAVE button will store the settings of the 9 pre-sets into the registry.

The LOF value is useful so that the true RF (Radio Frequency) received by the SSA for instance by a satellite dish LNB is displayed instead of the IF (Intermediate Frequency).

If a negative LOF is input, then the software will consider a spectrum inversion and correctly show the spectrum in mirrored form. This would be the case when using for example a C-band LNB.

The GPS group allows configuration of a GPS receiver and/or the input of the current latitude and longitude:

Fig. 8-4

The GPS receiver needs to be connected to the PC, laptop or tablet through a COM-port. This COM-port can be mapped by Bluetooth, USB or a physical RS-232 connection. Please consult the user guide of your GPS receiver. No support can be given for this step.

The GPS receiver needs to be NMEA compatible (most, if not all, are) and setup accordingly. You need to discover which COM-port the GPS receiver is mapped to.

Activate the "Use GPS location" checkbox. If the connection can be established correctly, you should see raw dumps of the live NMEA protocol and as soon as a satellite lock is established, the Latitude and Longitude text boxes are filled with your geographic position.

These two text boxes can alternatively be filled in manually. Press the SAVE GPS POSITION to store this position in the registry and make it the default geographic position. This is important for live spectrum recordings or frequency log files, as the geographic position is stored.

The following picture shows an active GPS connection:

Fig. 8-5

 WARNING	The GPS functionality allows on the road measurements. These can be used to produce reception maps, by setting up a car with a laptop/tablet, an antenna and the spectrum analyser. However, this setup needs to be tested prior to start driving, as setting up all cables and especially the GPS connection can be tricky. Driving with a laptop/tablet turned on, together with all cables, can be distracting and may constitute a driving offense! Always carry out such measurements with a second person in the car or make sure the setup is safe and legal to use!

The e-mail group allows configuration of an e-mail account. This will be used by the trigger function (see chapter x) to send automatic e-mail notifications when a trigger alarm event happens.

You need to provide the address of your e-mail server, your login and password. Naturally, you need to provide to which e-mail you want to send the trigger notifications.

Once you inserted the information, you can test them with the "Send test e-mail" button.

Pressing the "Save e-mail Settings" button will store the e-mail data (except the state of the check box labelled "Send e-mail on trigger alarm") in the registry.

 WARNING	The e-mail account information is stored in plain text in the registry. **This is a potential security threat.** It is recommended to create a dummy Hotmail account to act as the SMTP server, used to send out the e-mail messages. Do not use your regular e-mail settings or refrain from storing your password! You can fill out all fields except the password field and press the "Save e-mail Settings" button. You then enter the password every time you start the software and want to use the send e-mail on trigger event function.

	In order to avoid mass e-mail messages, whenever an alarm e-mail is sent, a timer will count 5 minutes, before a new alarm e-mail can be sent.

NOTE	Still, you need to setup the trigger mask in such way, that no alarm is permanently triggered, as this would result in an e-mail being sent every 5 minutes. This could potentially be considered e-mail SPAM and the e-mail provider could blacklist your account!

As mentioned in chapter 4 – Installation and activation, it is required to input an activation code to run the software.

Fig. 8-6

It is possible to request or insert a new activation code, but note that doing so will shut down the application, which needs to be restarted. See chapter 5 for more information on how to obtain a permanent license.

⚠️ **NOTE**	The cheaper "SMA" devices only feature one ADF4350/ADF4351 IC and thus cannot simultaneously input and output a signal. The included SMA to SMA cables are useless on these devices and SWR measurements cannot be carried out using the WinNWT software.

Please read the DONATION section, which explains the procedure to make a donation:


```
Donation

Donations (10€, 10£, 10US$ - whichever is more convenient and cheaper) are accepted
via PayPal account. In return a permanent code is issued.

The following rules apply:
· Donations are NOT mandatory at all, they will not give any extra functionality,
  but you will get a permanent activation code for your main PC, laptop, tablet, etc.,
  within a reasonable limit.
· Donations will NOT entitle to any special support or feature request - all
  functionality can be extensively tested with free activation codes and new
  functionality is implemented according to my ideas, people's suggestions,
  feasibility, etc.
· Donations will help paying for additional devices, to better support different
  devices.

If you want to make a donation, just go to your Paypal account and do this:
· Select SEND & REQUEST PAYMENTS
· Click on "Send money to friends and family"
· Enter my e-mail: vma@norcam.pt
· Select 10 EUR, GBP, USD (whatever you feel comfortable)
· Follow the remaining on-screen instructions

Once you finish, let me know by sending me an email! Include your system code
(just click on the COPY TO CLIPBOARD button on the left) and I will do my best
to quickly send you your permanent activation code.
```

Fig. 8-7

9.   Spectrum

The main operations of the software are done in the first SPECTRUM tab:
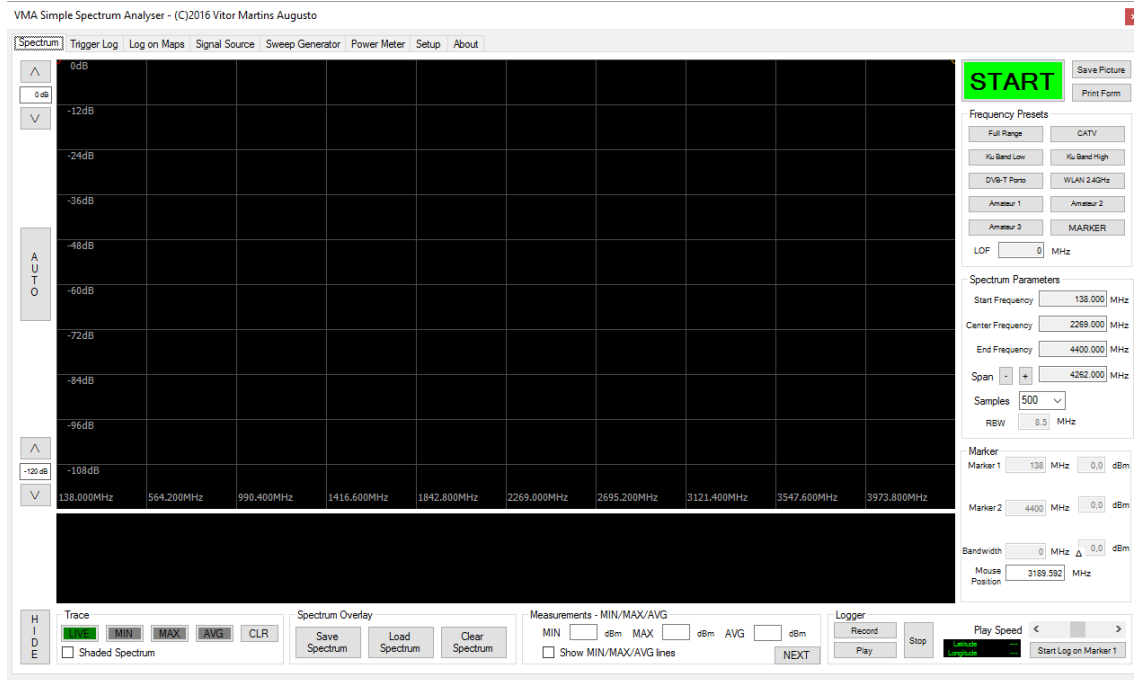
Fig. 9-1

a.   Start/Stop

Fig. 9-2

The START/STOP button initiates the live spectrum analysis. Pressing this button again will stop the live spectrum, effectively freezing the graphic screen.

⚠️ NOTE	Please note that the spectrum has to be stopped to use the Signal Source Sweep Generator and Power Meter tabs.

b.   Frequency Pre-sets
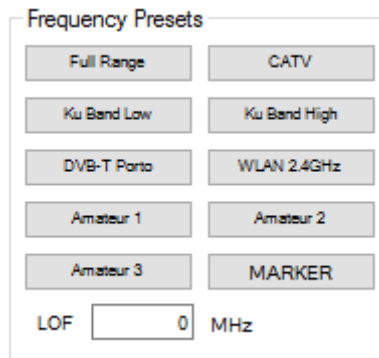
Fig. 9-3

Click any of the pre-set buttons to instantly configure the start frequency, stop frequency and LOF value. The pre-sets can be configured in the Setup tab.

The marker pre-set is special and cannot be modified: it will set the start and stop frequencies at the marker 1 and marker 2 positions, respectively.

c.   Spectrum Parameters
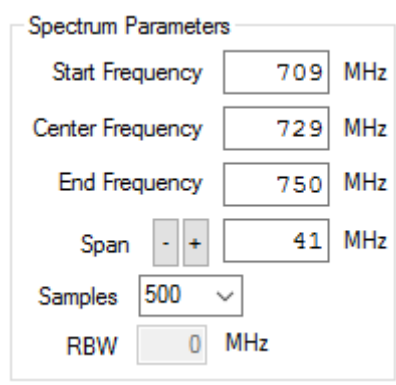
Fig. 9-4

This group allows to control the spectrum being rendered. Any parameter can be freely changed during the live spectrum and any changes are immediately taken into consideration by the software.

To input a frequency value, click on the respective field. A frequency input form will open.

Fig. 9-5

You can either enter the frequency value with the numeric keys on the keyboard or by clicking the relevant buttons on the form. The keyboard supports the backspace key.

To validate your input, click the MHz or KHz button. This will accept the frequency in MHz or KHz unit, respectively. The software always works in MHz, but will display three decimal places.

Pressing the ENTER key on the keyboard will on default accept the entry in MHz, which is the highlighted button.

Press the TAB key on the keyboard to highlight the KHz button. This allows for quick frequency input with the keyboard.

Press the CANCEL button, if you want to cancel the frequency input.

The user can choose how the required frequency span is setup. You can either enter the start and stop frequencies or you can enter the centre frequency and the span. In fact, you can change any of the fields and the remaining fields will adjust in a smart way.

The frequencies entered are however Intermediate Frequencies (IF): enter them without consideration of the LOF value! If you want to work for instance with a Ku-LNB using a LOF of 9750MHz, you can use the markers (see section d.) to set the frequency span.

In order to facilitate "zooming in and out" of the spectrum, you can press the +/- buttons. The "+" button will double the span, while the "-" button halves the span.

i.   Start & End Frequency

You can directly set the start and end frequencies by writing in the relevant text boxes or use the pre-set buttons.

Please note that at this moment, no verification of the input is made. If invalid frequencies or characters are written in the textboxes, the software may behave strange, produce an error message or simply crash.

ii.   Centre Frequency

If you prefer, you can type in the centre frequency. The start and end frequencies will adjust automatically, taking the current span value into consideration.

iii.   Span

The span value defines the frequency range between the start and end frequencies. This value is adjusted automatically when the start or end frequencies are changed. If the span value changed, the start and end frequencies also adjust automatically.

Notice that selecting a span of 0 MHz will invoke the "Zero Span" mode, in which the software changes from frequency domain to time domain at the selected centre frequency.
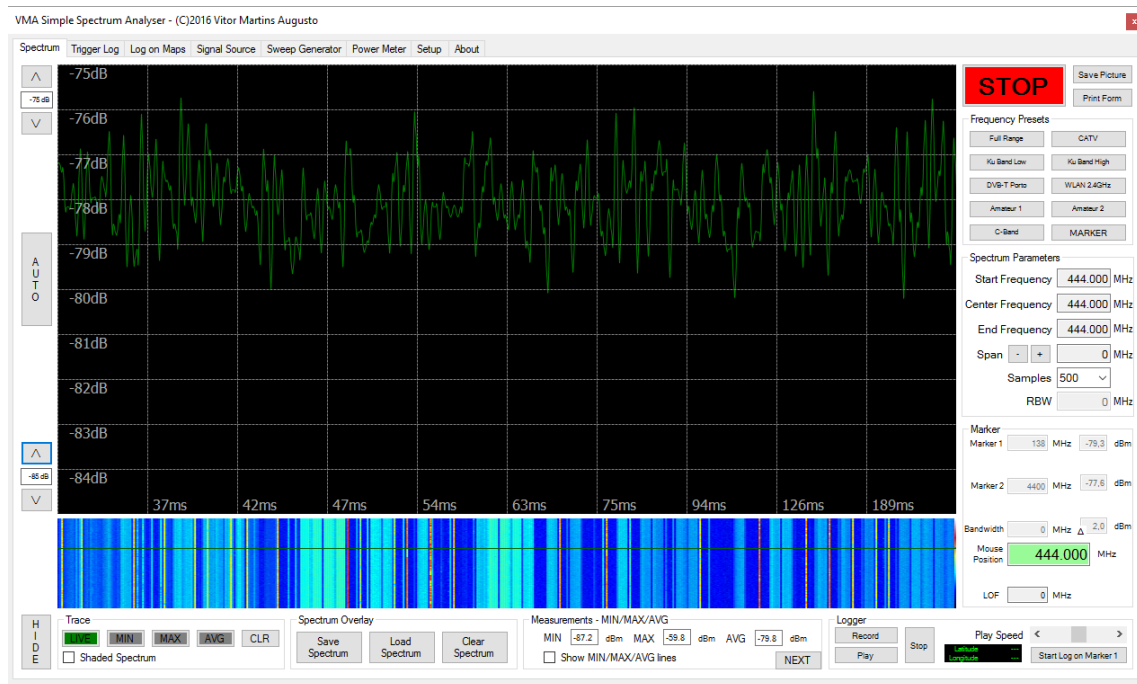
Fig. 9-6

To change into "Zero Span" mode, either enter directly a frequency span of 0 MHz or click twice on the live spectrum at the required frequency. This will cause Marker 1 and Marker 2 to share the same frequency value. Select the "MARKER" button in the "Frequency Presets" group to effectively change into "Zero Span" mode.

The software will display the signal power against time in milliseconds.

⚠ **Info**	The "Zero Span" mode suffers from a much reduced sample rate, compared to a regular Spectrum Analyser or an Oscilloscope. These offer samples rates of 1GS/s (Giga-Samples per second), which is around 300.000 times the sample rate that can be achieved with the SSA device. This functionality has been implemented, anyway, for educational purposes and for applications where the low sample rate is still adequate.

Enter any span value bigger than 0 MHz or call a frequency preset to return to normal spectrum mode in frequency domain.

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iv.   Samples

The "Samples" selection box sets the number of single frequency measurements are made to create the life spectrum. The more samples are taken, the slower the resulting spectrum refresh rate. However, more samples will produce a higher defined spectrum.

It is possible to select 100, 200, 250, 500 or 1000 samples. Note that all are common divisors of 1000, in order to facilitate rendering the spectrum on screen.

v.   RBW

The RBW value is shown under the samples selection combo box. This is an information, only, and cannot be directly set. It allows getting an idea of what the equivalent RBW would be on a swept spectrum analyser (SSA).

A SSA works by converting the frequency span into the input frequency of a band pass filter. This filter will allow only a given frequency range to pass. The resulting signal is then measured.

The smaller the filter window, the more precise the resulting measurement. However, with a small filter setting, the sweep will have to be divided into many more pieces and as a result, the refresh rate of the spectrum is reduced.

If the filter window is bigger, the sweep will be done faster, as the whole frequency span needs to be "cut" in less pieces. The catch is, that the power measurement will consider a bigger frequency range passing the filter, effectively averaging the result.

The small devices supported by this software work in a slightly different way. They measure the power at a given frequency with a very narrow filter setting. Measurement of the spectrum is done by specifying a given amount of discrete frequency measurements, called samples.

Even at a low sampling rate, each sample is measured with a narrow bandwidth filter setting.

The averaging happens because the spectrum is drawn as a best-fit polynomial curve.

Because the approaches are slightly different, by design, the software does not allow a direct RBW setting, as this would lead to a false impression of what the software is doing.

The end result, however, is still very comparable, if not equal, to a regular sweep spectrum analyser.
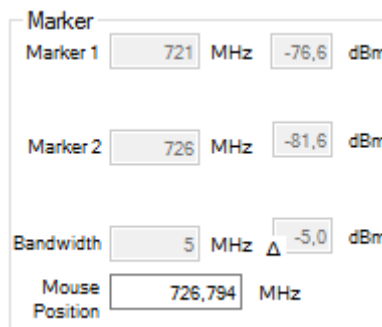
d.   Marker

Fig. 9-7

The software supports two markers. These are set by clicking on the relevant position within the upper graphic area, independently if the "spectrum" or "waterfall diagram" is rendered.

The markers are labelled as "1" and "2" and clicking on screen will alternate between both markers. Once the marker is set, you can read the following details on the right side of the window, within the MARKER group:

- For each marker, the frequency (MHz) and measured power (dBm) are displayed
- The frequency difference between marker 1 and marker 2 is displayed as "Bandwidth"
- For the "Bandwidth" the corresponding difference in power is displayed

If a LOF (Local Oscillator Frequency) value other than "zero" has been set, then the marker frequencies are shown as RF (Radio Frequencies), as well.

e.   Trace

Fig. 9-8

The software supports four different traces: the live trace (turned on by default) and the MIN, MAX and AVG traces.

The latter three traces show the min-hold spectrum, the max-hold spectrum and the average spectrum.

Data is continuously recorded to calculate the min, max and average values. Press the CLR button to reset the min, max and average data.

The traces can be rendered as single curves or as shaded areas: if the SHADED SPECTRUM option is active, each sample point is additionally drawn as a vertical line. At high sample rates, these lines will appear as a shaded area. On low sample relates, the individual lines become visible and allow easy recognition of the actual measured frequencies.

The spectrum itself is drawn as a best-fit polynomial curve, adjusting to the sampled points.

f.   Spectrum Overlay
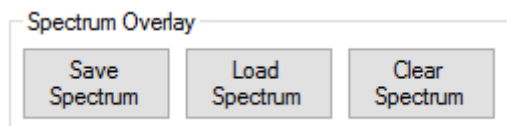
Fig. 9-9

It is possible to save the current live spectrum into a file. After pressing the SAVE SPECTRUM button, you will be asked for a file name as soon as the current sweep is finished. The software will write only the spectrum data.

This data can then be read back into the software as a spectrum overlay using the LOAD SPECTRUM button. It will behave just like a trace and is displayed in yellow colour. It will be rendered as a single curve or in shaded mode, according to what setting is in use.

This function is useful to compare a previously recorded spectrum with the live spectrum. For example, you may record the spectrum on a perfect aligned satellite dish to use as a template for further alignment jobs.

The picture shows another example: the live spectrum of a CATV signal was saved and then used as a spectrum overlay. A -5dB attenuator was connected and the spectrum screen now shows the live attenuated spectrum against the previously stored spectrum, allowing for instance to measure the performance of the attenuator.
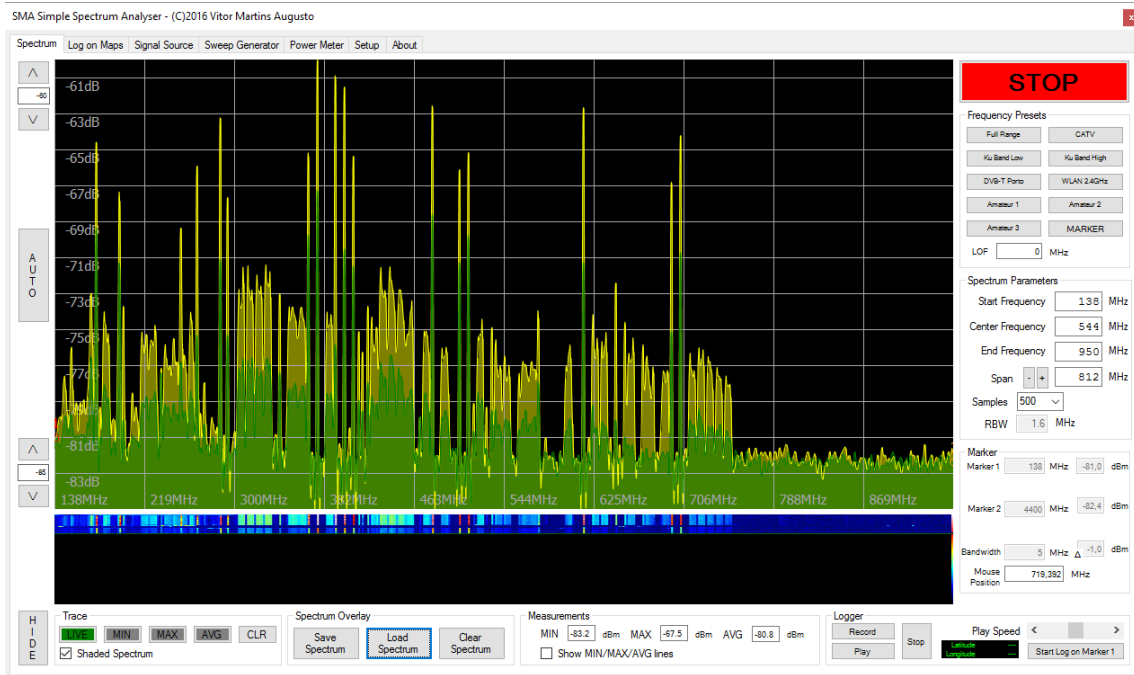
Fig. 9-10

Press the CLEAR SPECTRUM button to remove the spectrum overlay.

g.   Save Picture and printing

Fig. 9-11

Use this option to save a picture file of the upper graphics area (showing the spectrum or the waterfall diagram) in *.png format.

This is useful to create reports, as the *.png file can be easily inserted into Office applications.

Alternatively, if you need to grab the whole application window, because you want to show both spectrum and waterfall diagram or the different parameters, just use ALT+PRTSC and paste the image to Paint, Word or any other suitable application of your choice.

The "Print Form" button will allow printing the form contents to a printer or directly to PDF.

Finally, the Windows "Snipping Tool" can be a great way to grab exactly the desired screen area. This tool is part of Windows 7, Windows 8 and Windows 10.
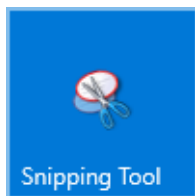
Fig. 9-12
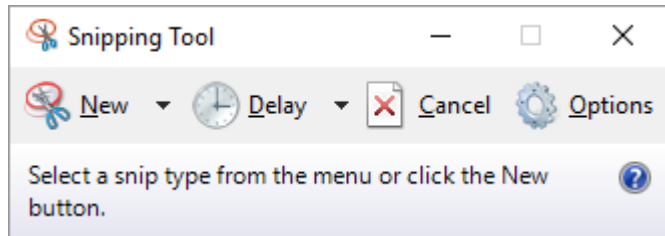
Fig. 9-13

h.   Spectrum vs. Waterfall

In live spectrum mode, a waterfall diagram is drawn under the main spectrum graphic area.
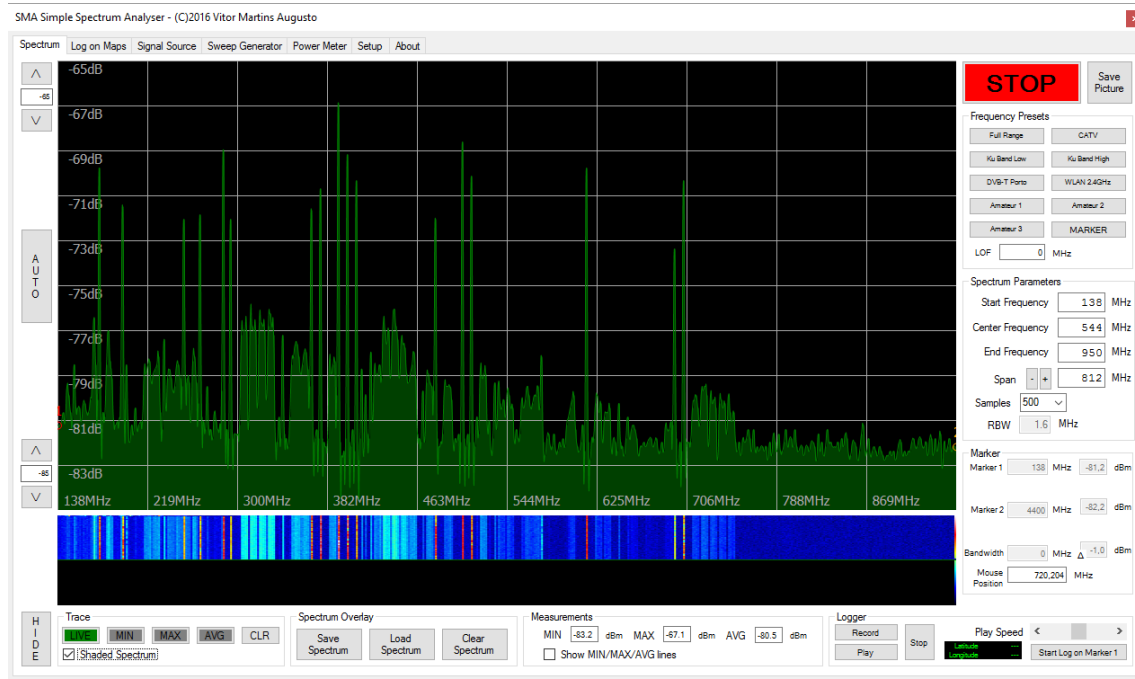
Fig. 9-14

The waterfall diagram represents the current spectrum as a single colour coded line. The colour scale is drawn in a single pixel column on the right side. The upper colour represents the maximum amplitude value, while the lower colour represents the minimum amplitude value.

The waterfall diagram is constantly drawn line by line in top down mode. Once the bottom is reached, the waterfall diagram starts again at the top. A black horizontal line shows where the waterfall diagram is currently being updated.

This allows for a long term monitoring of the spectrum. Intermittent signals are made visible, as well as trends, interferences, etc.

The default size of the waterfall diagram is 100 lines. If you need to monitor the spectrum over a longer period, you can do so, by clicking on the waterfall diagram. This will swap the spectrum on the top graphic with the waterfall diagram in the lower graphic: you will get a big waterfall diagram on top and a small spectrum on the bottom.
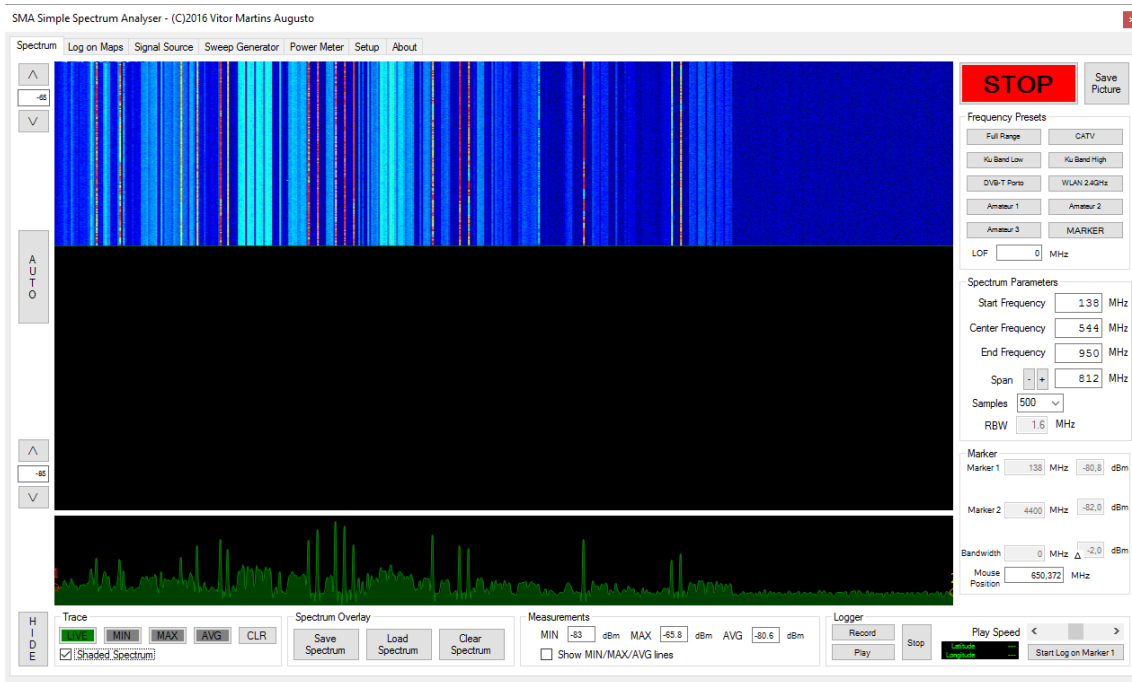
Fig. 9-15

Clicking again the bottom graphic area will revert to standard view.

Every time the waterfall diagram is swapped with the spectrum, the waterfall diagram is reset, starting again from the top line. This allows a simple trick to clear the waterfall diagram, for example after positioning the antenna: just press the lower graphics area twice to clear the waterfall diagram.

i.   Logger

Fig. 9-16

The logger function allows recording of the current life spectrum to a file. Select the destination file and the recording starts immediately. The live spectrum is continuously written with a time stamp and GPS location to the selected file until the STOP button is pressed.

The recorded spectrum can then be replayed by pressing the PLAY button. Select the *.SAL logger file and the recorded spectrum will be replayed in a loop until the STOP button is pressed. In this case, the PLAY button will show the current time stamp and the black window will show latitude and longitude.

The replay speed can be adjusted with the PLAY SPEED slider.

NOTE	Please note that when you share or upload a *.SAL spectrum log file, you need to inform the relevant users about the purpose of this file and its contents! A *.SAL spectrum log can only be replayed by the VMA Simple Spectrum Analyser software. Any user can request a free activation license and to run the software and no hardware device is required to playback a *.SAL file.

During spectrum recording or replay, it is not possible to change frequency ranges or samples. Therefore, the relevant groups are disabled until recording or play is stopped.

It is, however, possible to change amplitude and trace settings during recording or play.

The "Start Log on Marker 1" button will create a log file containing the successive measurements of the frequency selected by the marker 1. This log file will write the power level with time stamp and GPS location.

Info	The "Start Log on Marker 1" functionality is available in both live spectrum mode and playback of recorder spectrum mode! This means that it is possible to capture the live spectrum on the road (for example with a car) and then, in the office, produce individual frequency logs with time stamp and GPS position. Please consult chapter 7 for frequency log display.

j.   Measurements – MIN/MAX/AVG
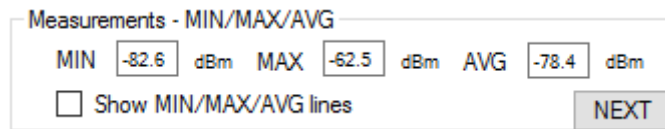
Fig. 9-17

This field shows the MIN, MAX and AVG values on the current live spectrum. Check the "Show MIN/MAX/AVG lines" check box to have those values shown graphically as colour coded horizontal lines.

Press the "NEXT" button for the next measurements screen.
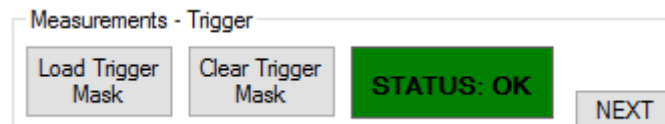
k.   Measurements – Trigger

Fig. 9-18

This field shows the trigger options.

Use the "Load Trigger Mask" button to load a previously stored trigger mask image file. This can be created in a bitmap editor or within the VMA Simple Spectrum Analyser software. See

Chapter 10 – Trigger Log for further information. Loading a trigger mask will immediately activate this function.

If the "Send e-mail on trigger alarm" check box is selected (in the setup tab), e-mail alerts will be sent with a spectrum screen shot.

The alarm will be shown in the status panel:

- Green: STATUS: OK
- Blue: ALARM MAX
- Red ALARM MIN

These alarms will be logged in the list box on the "Trigger Log" tab, with the following information:

- Date and Time of the occurrence
- MIN or MAX ALARM
- Trigger Frequency
- Signal Power on trigger frequency

Press the "Clear Trigger Mask" button to stop the trigger function.

Press the "NEXT" button for the next measurements screen.

l.   Measurements – Pattern Recognition
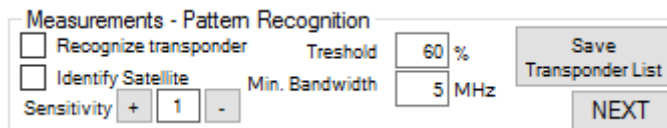
Fig. 9-19

This function will determine the frequency of the currently displayed transponders.

Activate the "Recognize transponder" checkbox and immediately the frequency of the transponders is shown.

This function can be used with any frequency range and on any kind of transponder:
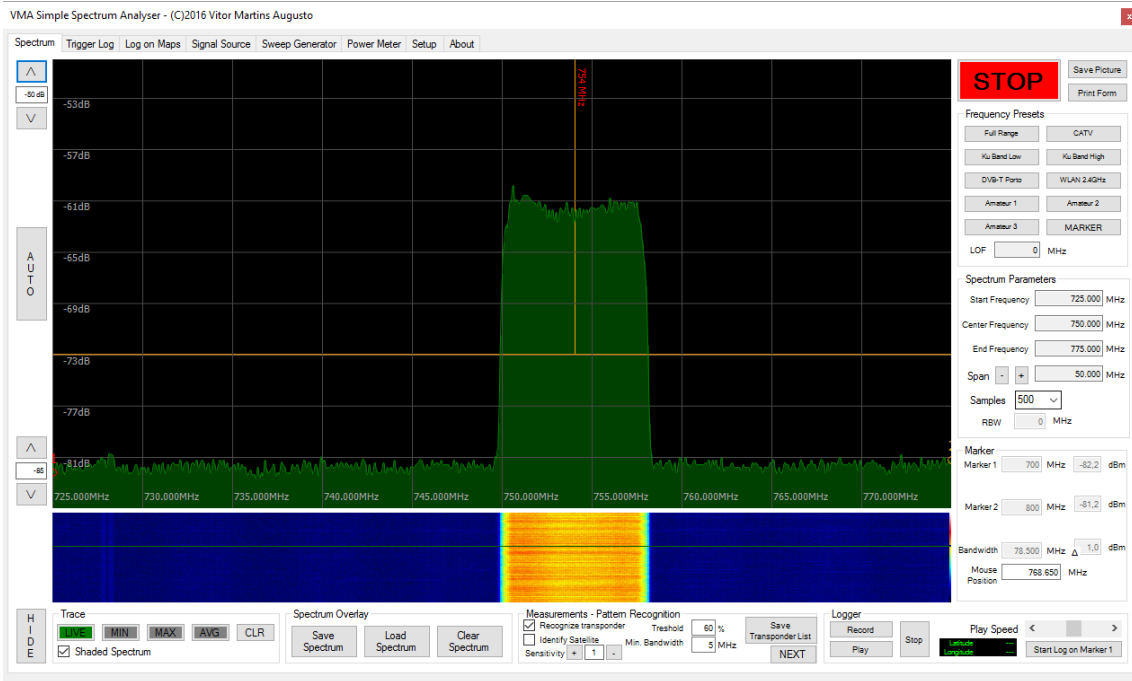
Fig. 9-20

Example 1: Automatic determination of a DVB-T transponder frequency
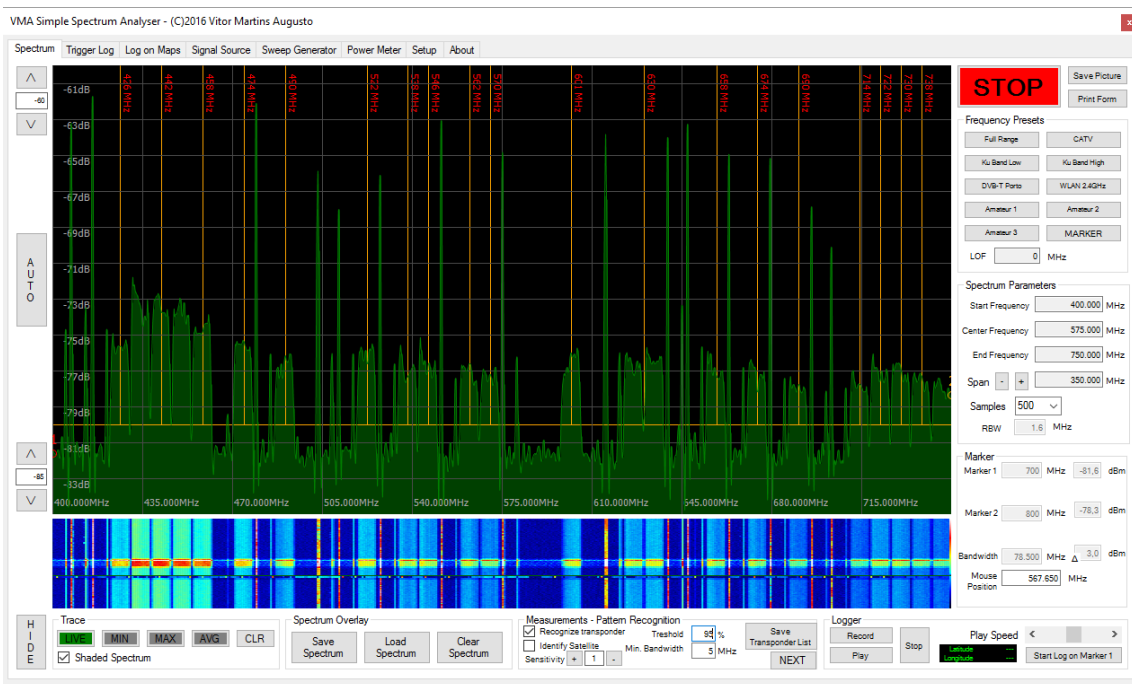
Fig. 9-21

Example 2: Automatic determination of all digital transponders in a CATV network

For best results, it may be necessary to adjust the "Threshold" and "Min. Bandwidth" field. The "Threshold" field controls the orange horizontal line, which marks the amplitude were the transponders are determined. This threshold is calculated as an average signal power and the user defined percentage specified a deviation to that average value. The default setting is 60%, which normally originates good results. Sometimes, it can be necessary to reduce this value to 70%-90%.

The "Min. Bandwidth" field allows filtering out all potential transponders with less bandwidth than the one specified. In the above example 2, the spectrum of a CATV network is shown. This is composed of analogue and digital transponders. By setting a minimum bandwidth of 5 MHz, which is the default value, all analogue transponders are ignored.

The "Identify Satellite" checkbox allows the use of the recognized transponders to match the corresponding satellite, by comparing the transponder frequencies with a database of known satellite transponders. This database is contained within the "*transponder_lists*" folder included with the software. Inside are *.ini files, which can be downloaded from different websites dedicated to providing transponder lists in this exact format.
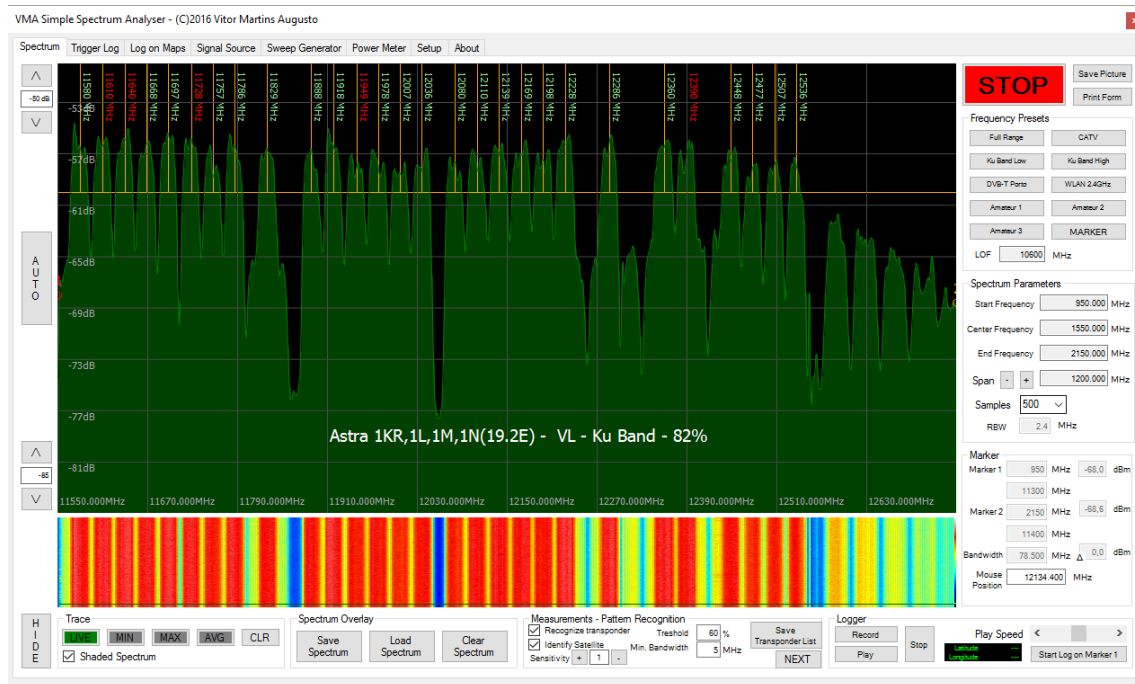
Fig. 9-22

Example 3: Automatic satellite identification

The "Sensitivity" field allows specification of how many MHz tolerance is given to each identified transponder for matching: 0 MHz, +/- 1MHz (default), +/- 2 MHz or +/- 3 MHz.

After satellite identification, the name of the satellite is shown, together with a percentage. This percentage states the quality of the match: 100% means that all found transponder have been successfully matched to the satellite transponder database.

A lower percentage means that some transponders could not be matched.

This happens for to the following reasons:

- The transponder is not included in the respective satellite *.ini file, because the *.ini file is outdated or wrong, because this transponder is new or because this transponder is due to a temporary feed.
- The satellite is received in poor conditions and the matching algorithm found a wrong satellite with better matches. This can occur when two satellites share the same frequencies on most transponders or when two satellites are received simultaneously due to small or bad aligned dish (i.e. Nilesat at 7.0W and Atlantic Bird at 8.0W).
- Amplitude, Treshold and Min. Bandwidth need better adjustment.

Matched transponders will be rendered in green colour, while unmatched transponders are rendered in red colour.

Press the "NEXT" button to return to the first measurements screen.

10. Trigger Log

The "Trigger Log" tab has two functions: it lists all trigger events in the main list box and it can be used to create the trigger template.
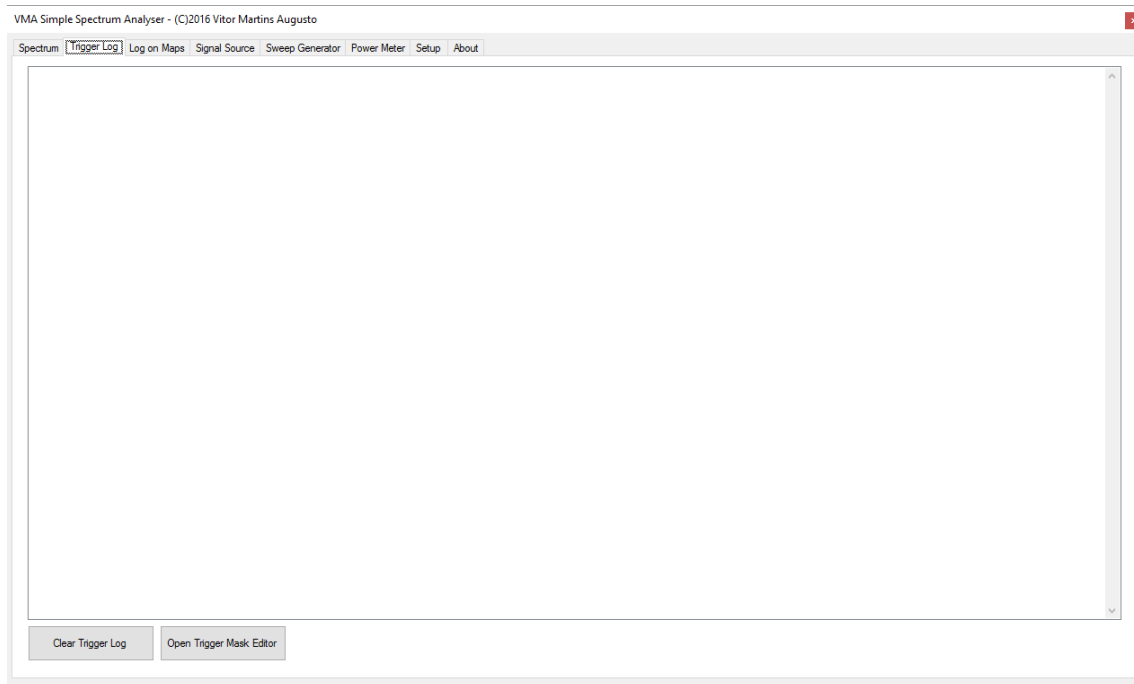

Fig. 10-1

By default, this tab only shows two buttons:

Press the "Clear Trigger Log" button to clear the list box. This will wipe all currently listed events.

Press the "Open Trigger Mask Editor" to change to the editor mode:
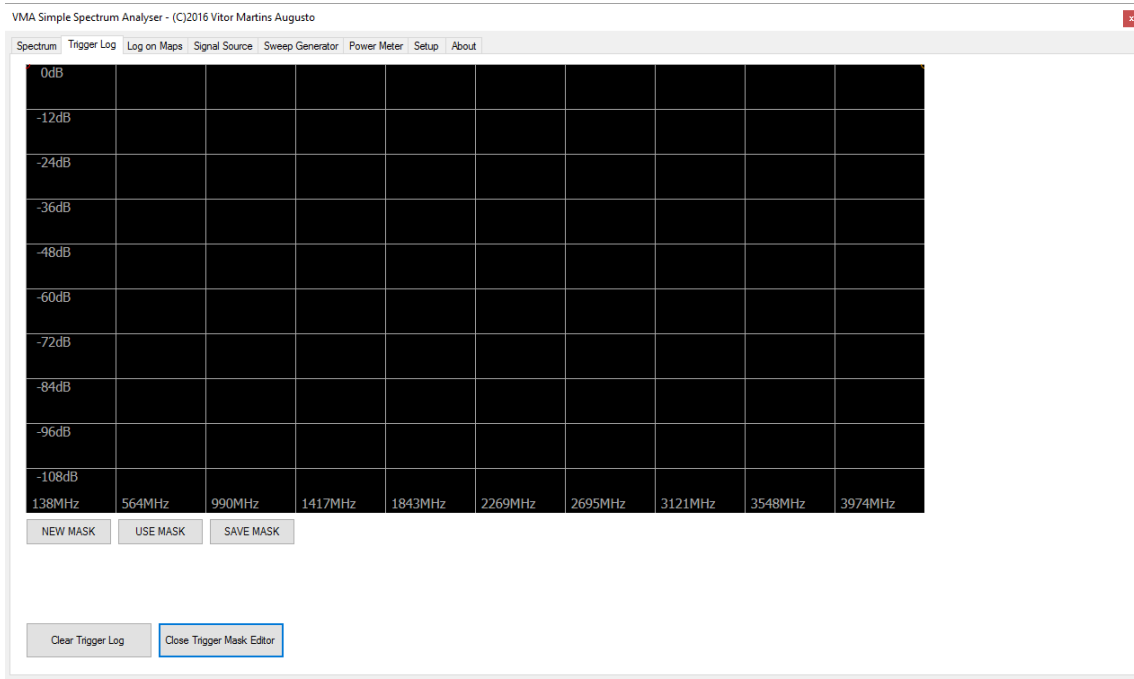
Fig. 10-2

Whenever you enter the editor mode or press the "NEW MASK" button, the current spectrum screen is copied to the trigger mask editor. It is recommended to have the live spectrum turned on, so that the current spectrum can be considered while drawing the trigger mask:
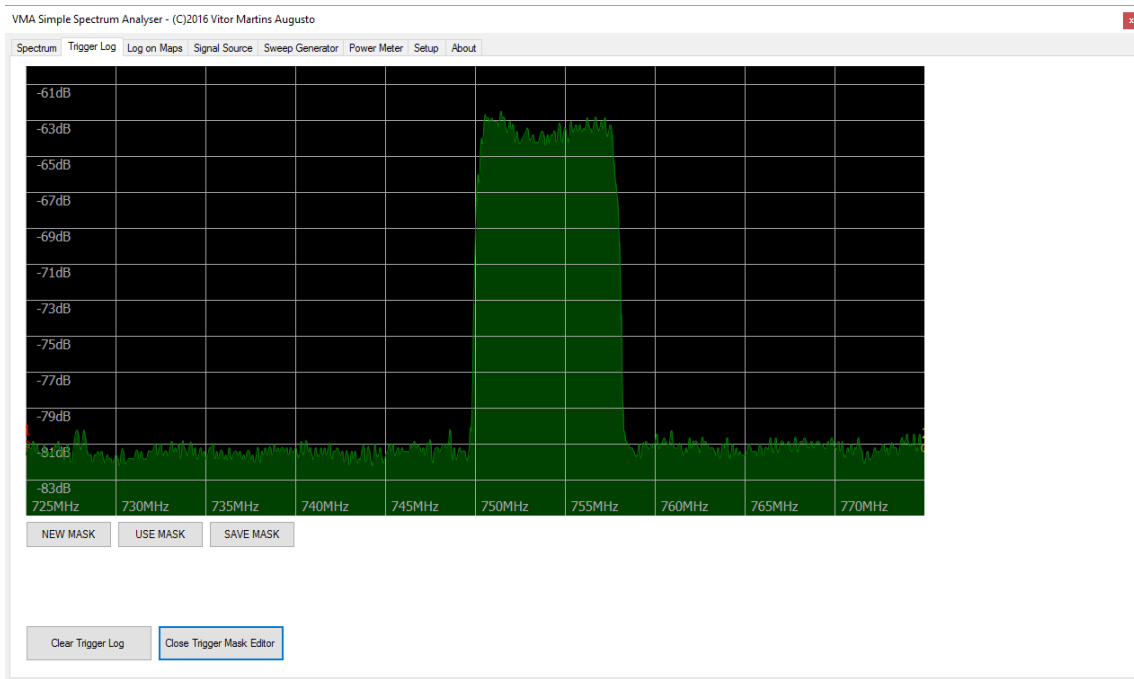
Fig. 10-3

Using the mouse with the left mouse button pressed, you can draw a blue line, which represents the upper MAX threshold for the trigger function.

Using the mouse with the right mouse button pressed, you can draw a red line, which represents the lower MIN threshold for the trigger function.

Because the mouse draws line segments using the last point as the start point of the next segment, you can use the middle mouse button to break this chain and start a new line segment.
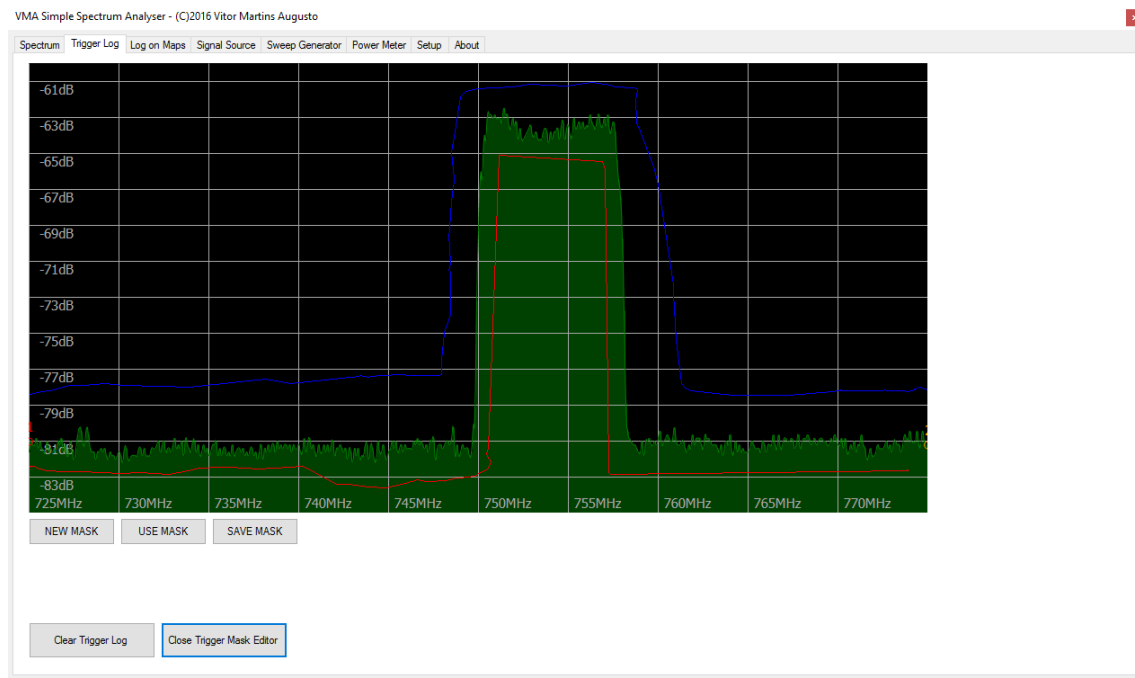
Fig. 10-4

You can press the "NEW MASK" button to start over at any time.

Press the "USE MASK" button to immediately use the trigger mask.

Press the "SAVE MASK" button to save the current trigger mask for future use, since you can load a stored trigger mask within the spectrum tab – see chapter 7.

NOTE	The use of the integrated trigger mask editor is not mandatory. Alternatively, you can save the current spectrum picture and edit it accordingly with any bitmap editor. You must, however, respect the following: • The MAX threshold has to be drawn with a blue colour, exactly matching RGB(0, 0, 250) • The MIN threshold has to be drawn with a red colour, exactly matching RGB(250, 0, 0) **Hint**: You use a trigger mask edited and saved with the VMA Simple Spectrum Analyser software. With the pipette tool (i.e. in Paint) you can then copy the blue and red colours. **Hint**: Paint allows setting customer colours and editing the RGB (Red, Green, Blue) values.

Once you finish editing the trigger mask, you can return to trigger log view by pressing the "Close Trigger Mask Editor" button. The currently open mask will not be lost.

11. Log on Maps

The "Log on Maps" tab allows visualization of the frequency logs recorded with the "Start Log on Marker 1" button.
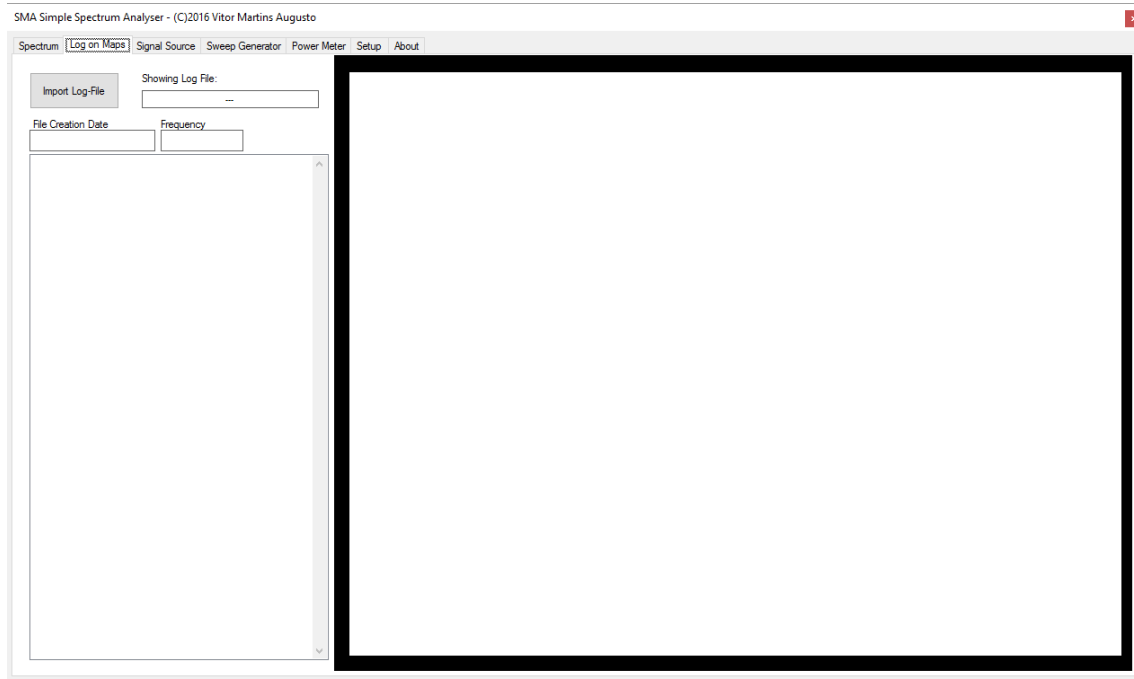

Fig. 11-1

Press the "Import Log-File" button and select a valid frequency log. This will show all captured measurements in a list box, displaying the latitude, longitude and signal level of each measurement. Also, the file creation date and frequency are displayed in text boxes.

The most interesting feature, however, is the Google Maps visualisation. It will show all measurements in colour codes as an overlay to Google Maps (map, satellite or street view).
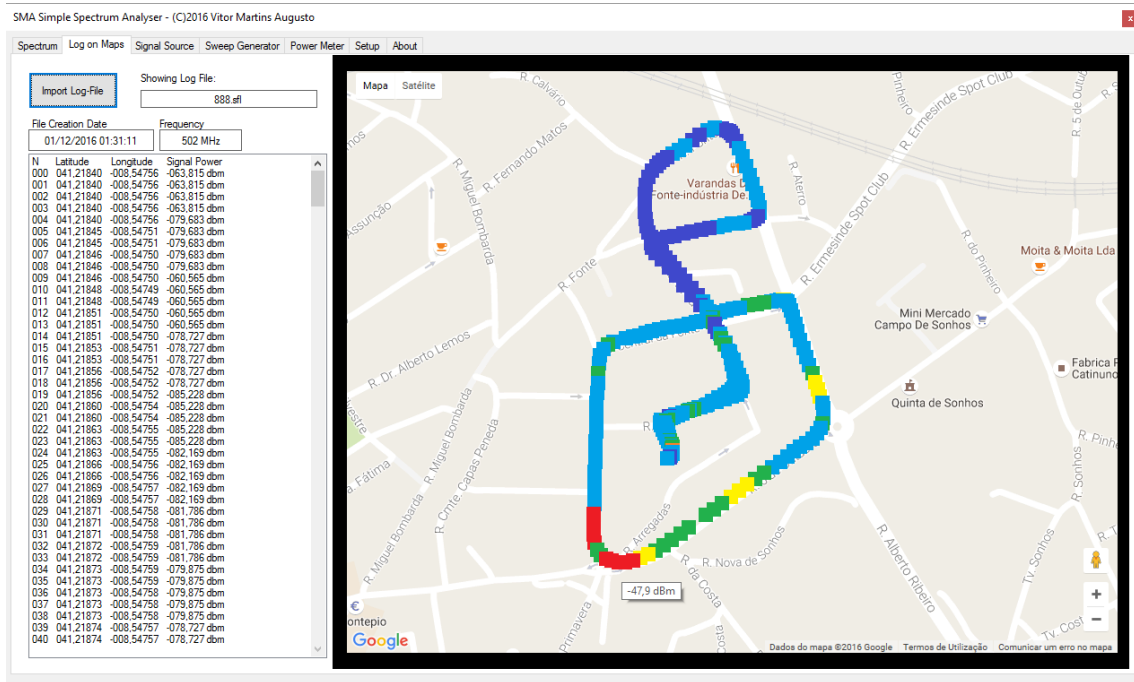
Fig. 11-2

Hovering with the mouse on any measurement point will show a tooltip with the relevant signal power. Alternatively, you can click a measurement and have the information shown in box.

12.   Signal Source

The signal source tab allows generation of a test signal at the specified frequency.

NOTE: The live spectrum must be stopped, before using this function!

Set the desired frequency using the up/down buttons:
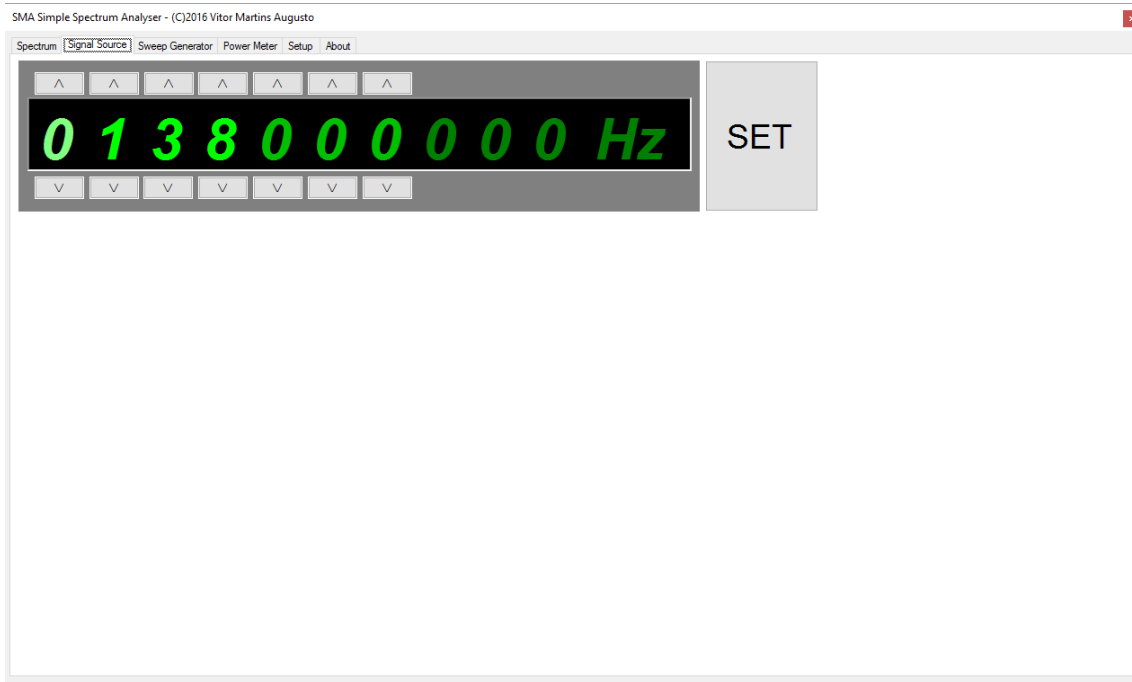
Fig. 12-1

Press SET to generate the output signal.

Press STOP to terminate this function.

13.   Sweep Generator

The sweep generator tab allows generation of a swept test signal.
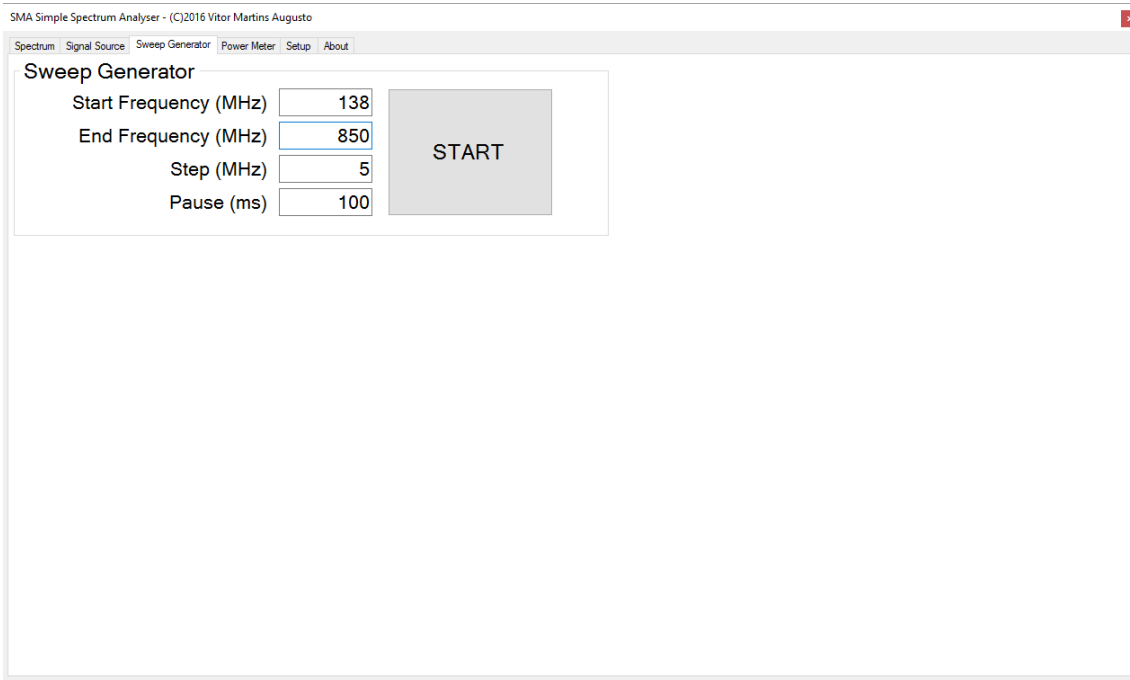
NOTE: The live spectrum must be stopped, before using this function!

Fig. 13-1

Input the required start and end frequencies, as well as, the increment and pause between steps. Once those parameters are set, press START to initiate the signal generation.

The device will sweep from start frequency to end frequency within the specified step size and waiting between each step the specified time interval. Once the end frequency is reached, the device starts again at the start frequency.

Press STOP to terminate this function.

⚠️ NOTE	The cheaper "SMA" devices only feature one ADF4350/ADF4351 IC and thus cannot simultaneously input and output a signal. The included SMA to SMA cables are useless on these devices and SWR measurements cannot be carried out using the WinNWT software.

14.   Power Meter

The Power Meter tab allows measurement of the selected channel power. The goal is to measure the total power within the bandwidth of a transponder.
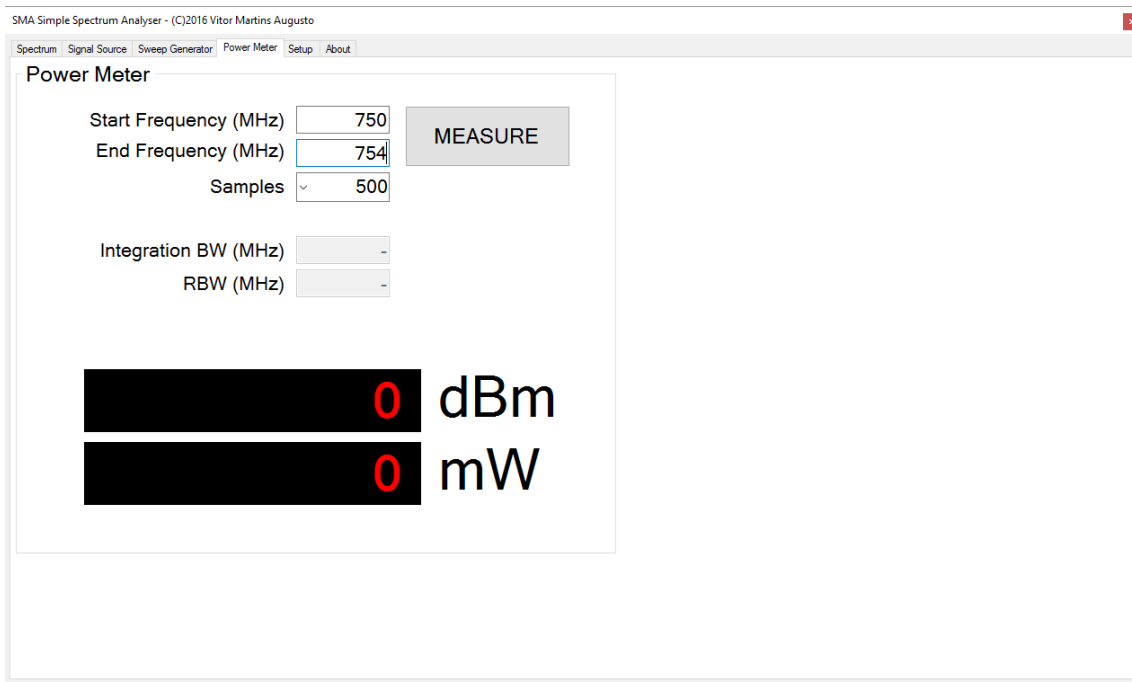
	The live spectrum must be stopped before using this function!
NOTE	

To carry out a measurement, in the spectrum tab, establish the required start and end frequencies.

Select the number of samples from the combo box and press MEASURE:

Fig. 14-1

The measurement takes a few seconds, depending on the amount of samples specified, and shows the resulting value in both dBm and mW:

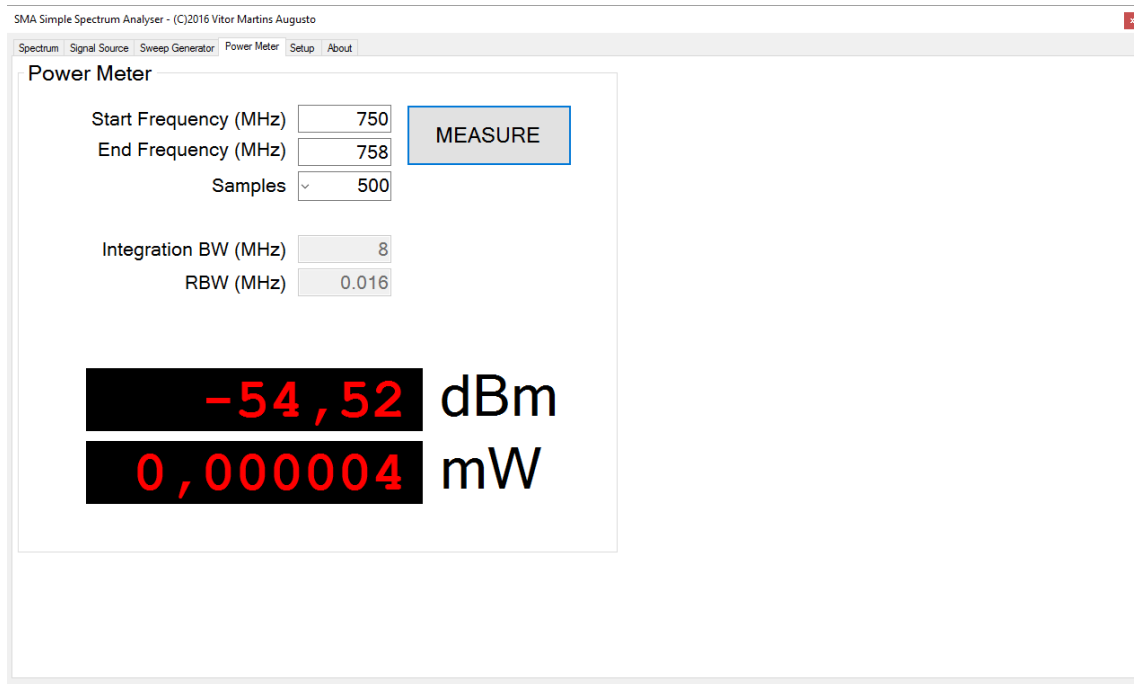
Fig. 14-2

This corresponds to the integration of the area under the transponder in spectrum view!

15. Acknowledgement

16.   About me

My name is Vitor Martins Augusto and I currently have a master's degree in metallurgical and materials science engineering.

I work as support director at a Portuguese CAD/CAM/CAE solutions provider, where I am responsible for customer training, pre- and post-sale support, as well as, sales and license management.

I am specialized in CNC programming through CAM software, post-processor development and automation through macro and Visual Studio programming.

Additionally, I am an assistant professor at FEUP (Faculty of Engineering of the University of Porto – www.fe.up.pt), where I am responsible for three courses of the "*Integrated Master in Metallurgical and Materials Engineering*" course:

- Computing and Programming
- Computer Aided Drawing
- Computer Aided Engineering

Apart from these two jobs, I have collaborated over a period of 5 years with TELE-audiovision as a writer, mainly reviewing professional broadcasting, measurement and distribution equipment.

Also, I have been doing professional translations for more than 30 years, due to the fact that I grew up bilingual (German/Portuguese).

I do translations of technical documents (with specialization on professional broadcasting, measurement and distribution equipment) within the following languages (in any combination):

- German
- Portuguese
- English
- Spanish

Last, but not least, I do consultancy on field meter and general TV distribution and reception equipment.

For this, I own a fully equipped laboratory/test-centre, including what is probably the world largest collection of TV/CATV/SAT field meters, signal generators, signal modulators, antennas (including 8 satellite dishes), receivers (including professional grade receivers), spectrum analyser, digital storage oscilloscope, etc.

I have an amateur radio license; my call sign is CT2JSA.

I am a black belt in Shotokan style karate.

Interested in my services? Please contact me: vma@norcam.pt