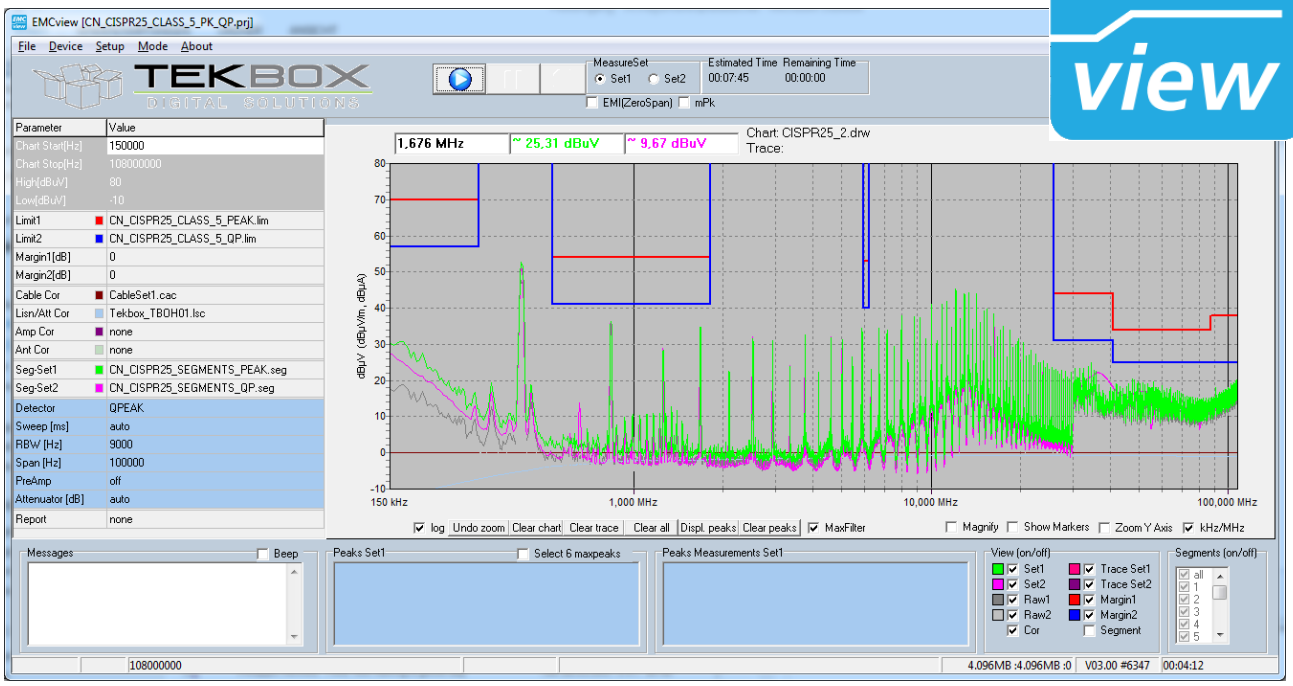
Tekbox EMCview Manual



Contents

1. Introduction

The EMCview software carries out automated conducted or radiated noise measurements. It currently supports Rigol and Siglent spectrum analyzers. All relevant CISPR (= EN550xx) conducted and radiated noise measurement settings are pre-configured in the current version.

2. Installation

Download and install the VISA driver package from the National Instruments website.
Create a directory into which you copy *EMCview.exe*. Execute *EMCview.exe* to install the software. Copy the license file into the same directory as EMCview.exe. Click EMCview.exe within your program directory to run the program.
Important: in case of the DSA815, the firmware version must be V00.01.16 or higher.
In case of the Siglent SSA30xx, the firmware version must be V1.2.8.2 or higher. If the firmware is older, update the Spectrum Analyzer firmware first.
PC-requirements: Windows 7, 8, 10; min 4MB RAM

The window may be too large for laptops with a tiny display. In order to use EMCview on such computers, start EMCview.exe with parameter **s**. This parameter will add scrolling bars to the window.
Limitation without license: The upper frequency of measurements is limited at 10MHz

3. Warning – spectrum analyzer input rating

Always consider the maximum input ratings of any spectrum analyzer. Be aware that powerful surges and harmonics of a DUT may have the potential to damage the spectrum analyzer input stage.

Be aware, that EMCview project files are set up to utilize the maximum sensitivity of the spectrum analyzer. The requirements of certain standards are tough, especially those of CISPR 25 class 5 and manufacturer specific automotive conducted noise standards. Consequently, the internal attenuator is set to OFF and the internal preamplifier is set to ON in order to avoid crossing the limit lines with the noise level of the analyzer. Furthermore, all conductive noise measurement projects use the LISN correction file for disabled attenuator/limiter.

Take following precautions to protect the spectrum analyzer input before testing an unknown DUT:

Check the attenuator and preamplifier settings of the segment file upfront to any measurement

Be especially careful when testing conducted emissions of inductive loads such as motors or switched inductive loads.

Whenever measuring an unknown source or DUT, protect the spectrum analyzer input with the internal limiter an external attenuator of 20dB or 30dB and check the spectrum for any high amplitude signals.

Protect the spectrum analyzer input from harmful ESD events.

In case of conducted noise measurements with the 50µH LISN (TBLC08) follow the procedure in the LISN manual. With the LISN power switch OFF, the line selection switch OFF and the LISN attenuator/limiter on, first power the isolation transformer and thereafter turn ON the LISN power switch. Next, connect the powered spectrum analyzer via BNC cable to the LISN. The internal spectrum analyzer attenuator shall be ON and the internal preamplifier shall be OFF. It is a good practice to keep the spectrum analyzer RF input disconnected or at least the line switch in OFF position when powering ON/OFF the DUT in order to protect the analyzer from potentially harmful switching transients.

In case of the 5µH LISN (TBOH01) use an external 20dB attenuator or consider using an external limiter such as the TBFL1 for a first check.

Before running a test with EMCview, monitor especially the frequency range 9 kHz to 2 MHz for potential high amplitude harmonics and check for spectrum analyzer messages “IF overload”. Operate the spectrum analyzer with Max Hold for this purpose. In case of strong signals, increase the attenuator and reference Level of the analyzer or even add an external attenuator at the input.

Modify the segment file with respect to attenuator and preamplifier settings accordingly. When doing a fast scan, consider the attenuator and preamplifier settings in the control box.

Hint: attenuator and preamplifier settings in the segment files can easily be modified using a text editor with “find and replace all” capability.

4. Projects

In EMCview, any EMC standard is represented by one or more projects. A project summarizes all configurations necessary to carry out measurements. It consists of limit files, segment files, a cable file, a LISN file, an antenna file, an amplifier file and various settings such as graph boundaries, trace colors, and settings for peak measurements.

Limit files: configuration containing the frequency dependent limit values given in the corresponding standard.

Segment files: spectrum analyzer settings such as start and stop frequency, sweep time, resolution bandwidth, detector, attenuator and preamplifier settings. Refer to the CISPR16 standard or to the Tekbox document *Pre Compliance Conducted Emission Measurements V1_1.pdf* for more detailed information. Radiated noise measurements often cover a wide frequency span and require different antennas for different frequency ranges. Consequently, it makes sense to split segment files. Segment files for radiated noise typically cover 150kHz -30MHz, 30MHz-300MHz, 300MHz-1GHz, 1GHz – 1,5GHz (DSA815 frequency range), etc.

LISN files: insertion loss/calibration data of the LISN over frequency, entered in dB with negative sign. Use LISN files also to implement conversion from dBµV to dBµA for conducted noise measurements with RF current probes. The default 50µH LISN file is using the correction data for the attenuator/limiter in OFF position. If you measure with attenuator/limiter engaged, select the corresponding LISN file.

Antenna files: antenna factor of the antennas used for radiated noise measurement; converts the dBµV measured by the spectrum analyzer into dBµV/m

Cable files: insertion loss of cables between DUT and spectrum analyzer

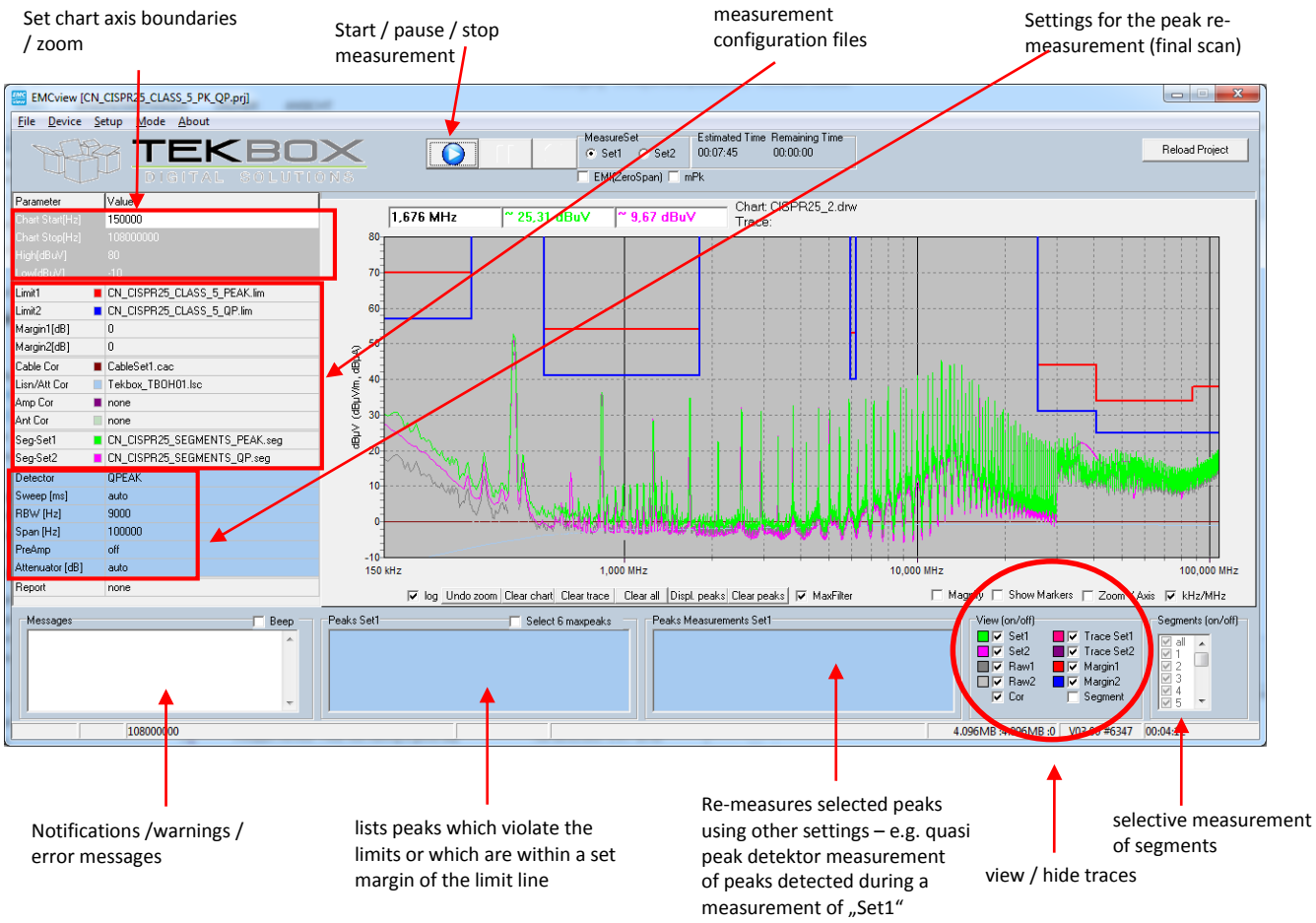
Gain files: amplifier gain or attenuator loss in the signal path, if any

These files can be created or edited either with a built in editor in the **Setup Menu** or with any text editor. The files are located in the **src** subdirectory. Press the **Tab** key after loading any configuration file.

Project files for conducted noise measurements have file names starting with CN_*.prj. Project files for radiated noise measurements with antennas start with RN_*.prj. Project files for radiated noise measurements with TEM cells start with TC_*.prj.
Refer to the applicable standards for more details and insight. Standards and corresponding limits may change over time. Tekbox does not take any liability for the validity of the limits and other settings in the preconfigured projects.

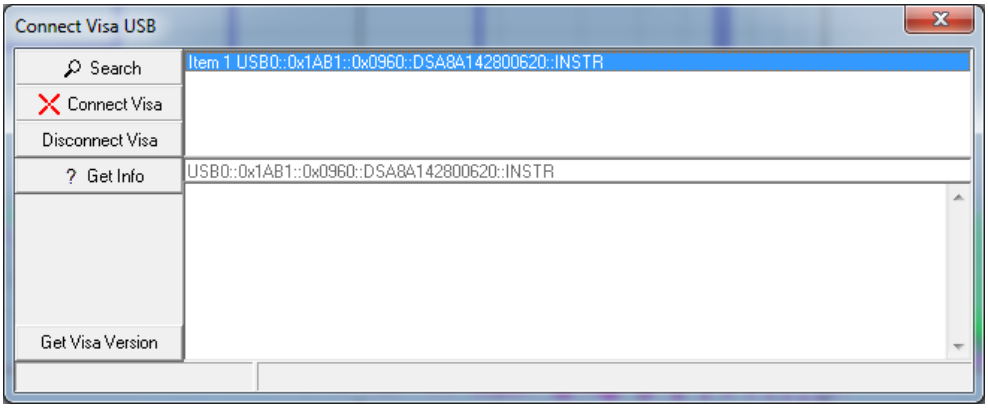
Consider that most segment files have the default attenuator settings at 0dB and in some cases such as CISPR 25 the preamplifier of the spectrum analyzer is set to ON in order to achieve maximum sensitivity. When testing any device with switched mode power supplies, consider to change the attenuator setting to 10dB for the first run.
Also in case of an “IF Overload” message of the analyzer, stop the measurement and disconnect the analyzer and increase the attenuator setting before proceeding with the measurement.

5. Workspace

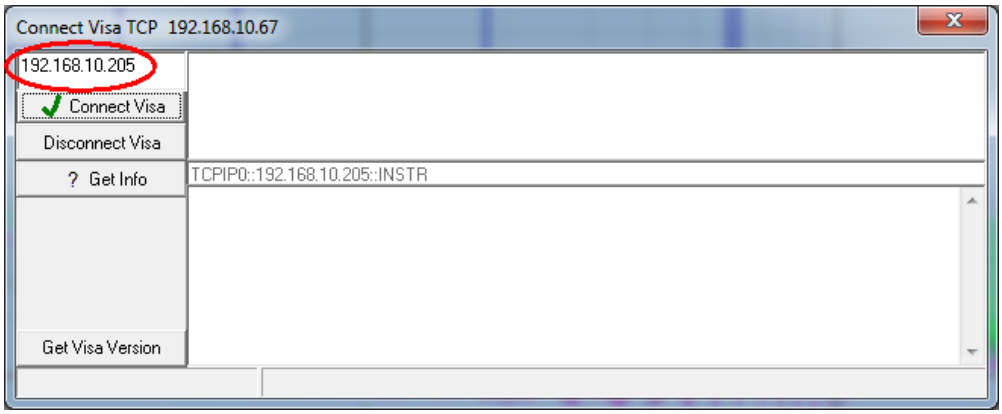


6. Connecting to the spectrum analyzer

Via USB: Launch EMCview and connect the spectrum analyzer to the PC via USB.
In the menu line, click **DEVICE**, then **DSA USB** and **SEARCH**. You should then see the Rigol analyzer listed in the search window. Click at the line with the Rigol Analyzer and then click the **CONNECT VISA** button. You can validate the connection by clicking the **GET INFO** button. Furthermore, you should see a “licensed” status message in the very left lower corner of EMCview. Close the window with the **x** button. Do not close it with the **Disconnect Visa** button, as it would disconnect the spectrum analyzer.

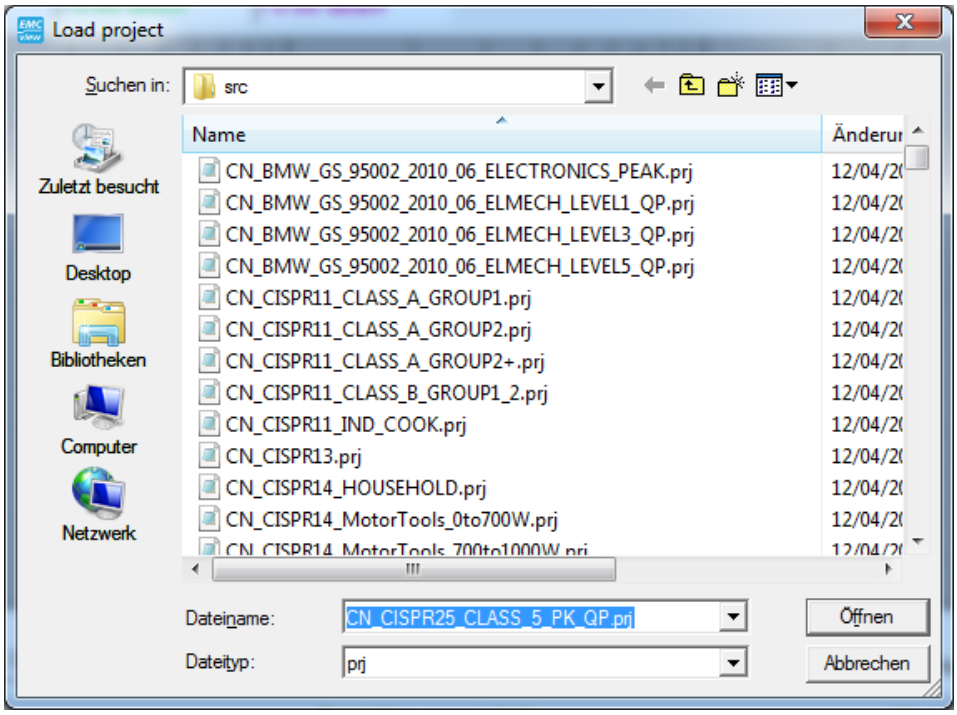


Via Ethernet: Launch EMCview and connect the spectrum analyzer to the PC via an Ethernet cable. On the analyzer LAN settings, change to manual IP and enter an IP address, e.g. 192.168.10.205
In the menu line, click **DEVICE**, then **DSA TCP**. Enter the IP address of the spectrum analyzer into the box at the upper right corner. Click the **CONNECT VISA** button. You can validate the connection by clicking the **GET INFO** button. Furthermore, you should see a "licensed" status message in the very left lower corner of EMCview. Close the window with the **x** button. Do not close it with the **Disconnect Visa** button, as it would disconnect the spectrum analyzer.



7. Prepare measurements

Click **File**, **Load Project** and select an appropriate standard for your DUT.
The predefined limit lines and segment files for the selected standard will pop up in the box at the left side of the window. The limit lines will appear in the graph chart.
If you miss any standard, you can create new limit lines, segment files and correction files in the menu **Setup**. Alternatively and most likely the faster approach, you can copy, rename and modify one of the existing files using a text editor.

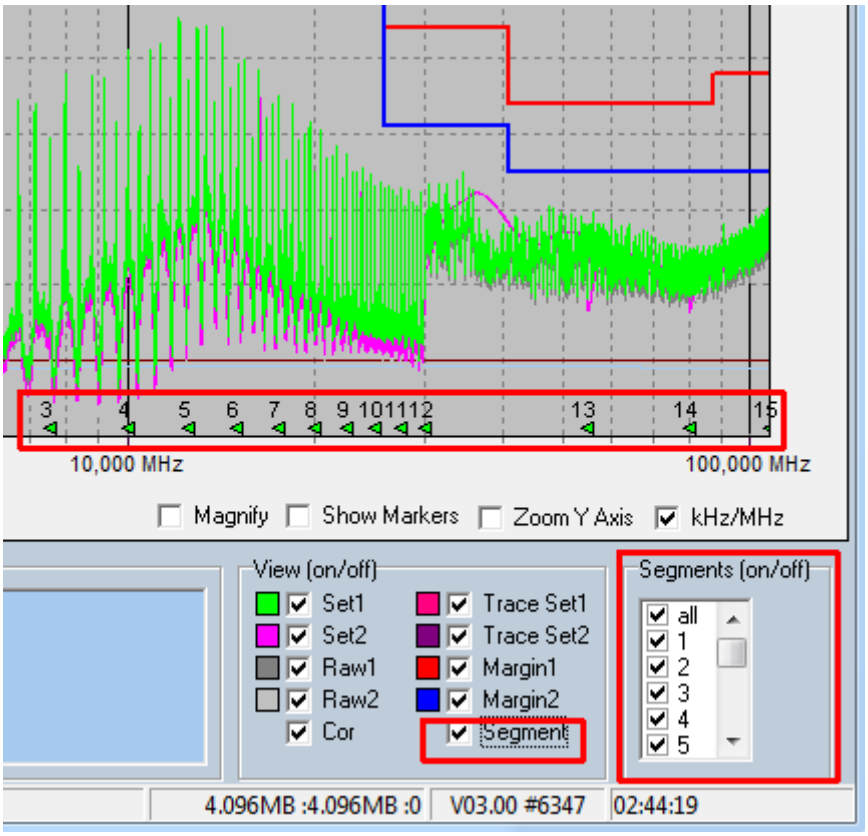


If you change to any other configuration file during an ongoing session with EMCview, press the **Reload Project files** button in the right upper corner.

8. Measurement

After correct set up and configuration, just press the **Play** button at the top of the window. The analyzer will start carrying out the measurement defined in *Segment-Set 1*. The associated limit line is *Limit1*. After the measurement is completed, click the *Set2* button at the top of the window. Press the **Play** button. The analyzer will start carrying out the measurement defined in *Segment-Set 2*. The associated limit line is *Limit2.*

Most project files define Peak or Average measurements as Set1 and Quasi-Peak measurements as Set2.
By default, all segments are measured and displayed consecutively.
If you want to focus on a certain frequency range when carrying out EMC related improvements of a DUT, you can shorten time by selectively measure the segments of interest:
Activate displaying the segments by clicking the corresponding box in **View (on/off) / Segment**. You will then get the frequency segments displayed at the bottom of the graph. Select the segments that you want to measure in the **Segments (on/off)** box. Upon starting a measurement, only the selected segments will be measured and other segments will be skipped.

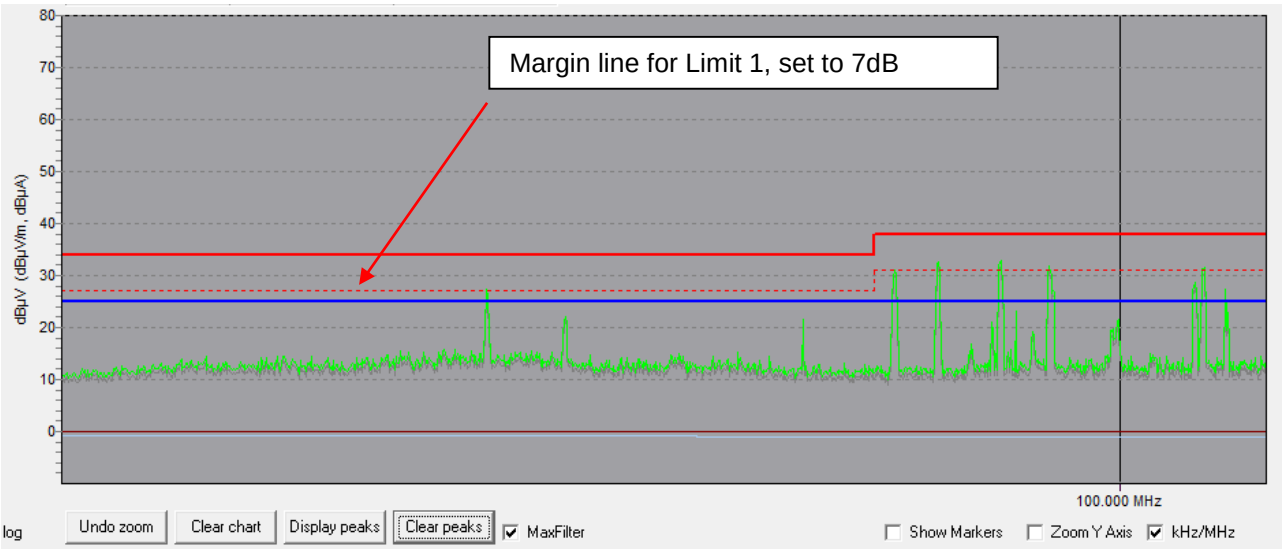


As Quasi-Peak measurements take much time, an alternative measurement method is available. A peak-scan would only look at frequencies, which come close to the limit or which exceed the limit in Peak or Average mode.
Pressing the **Pause** button interrupts ongoing measurements. The current segment will however be completed, before the measurement pauses. To continue the measurement, press the **Play** button.

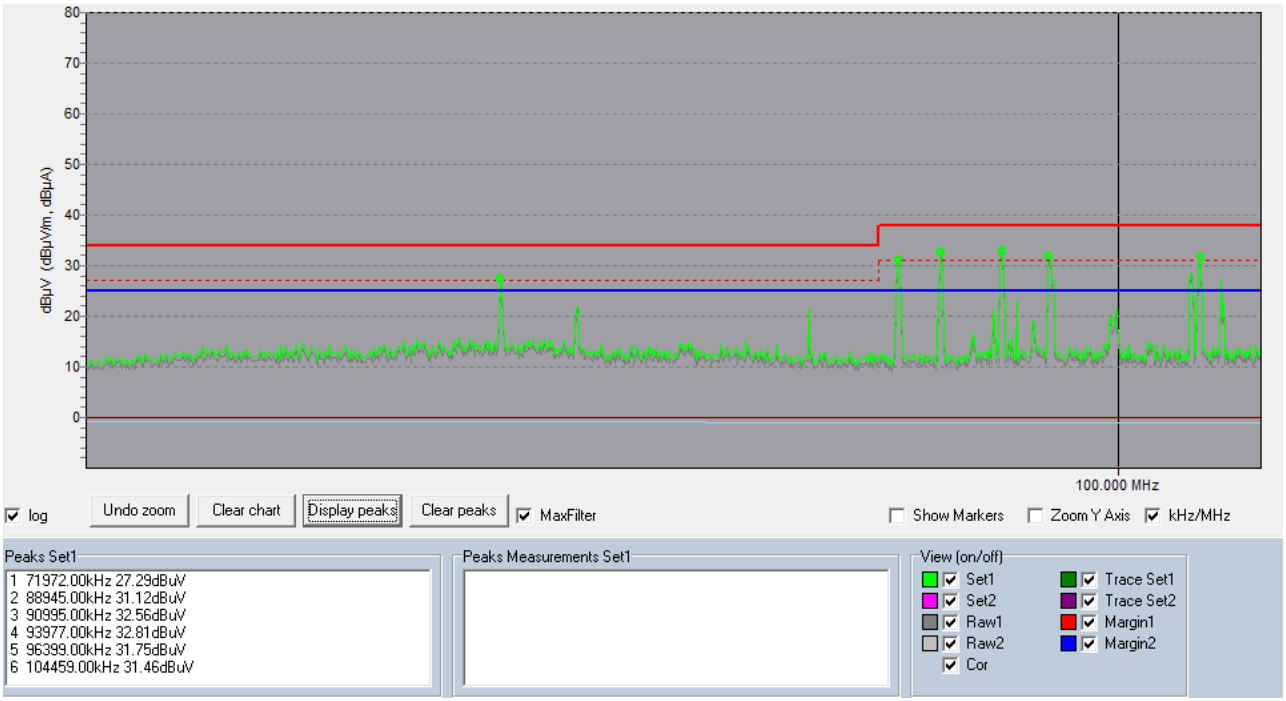
9. Peak scan

Any measurement value of the Set1 run that violates the limit line is indicated with a small bubble on top of the peak. Activating the **MaxFilter** box at the bottom of the graph will only mark the highest peaks, if several consecutive measurement values violate the limit lines.

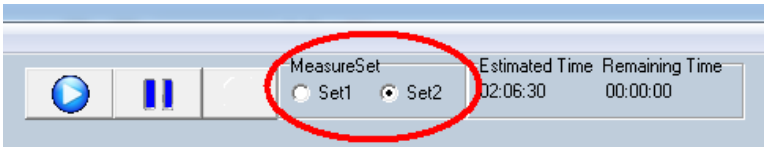
You can define **Margins** with respect to the limit lines of each measurement set. The SW would then indicate peaks, which cross the margin lines.
Enter the margin with positive sign to create a dashed line offset below the limit line. Margins with negative sign can be created as well.



By default, the margins are set to 0, so any peak crossing the limit line would be indicated. Setting margin1 to e.g. 7dB would select all peaks coming within 7 dB close to the limit line of the graph measured with Settings1. Peaks crossing the margin line or limit line can be listed in the in the **Peaks window** by pressing the **Display peaks** button.

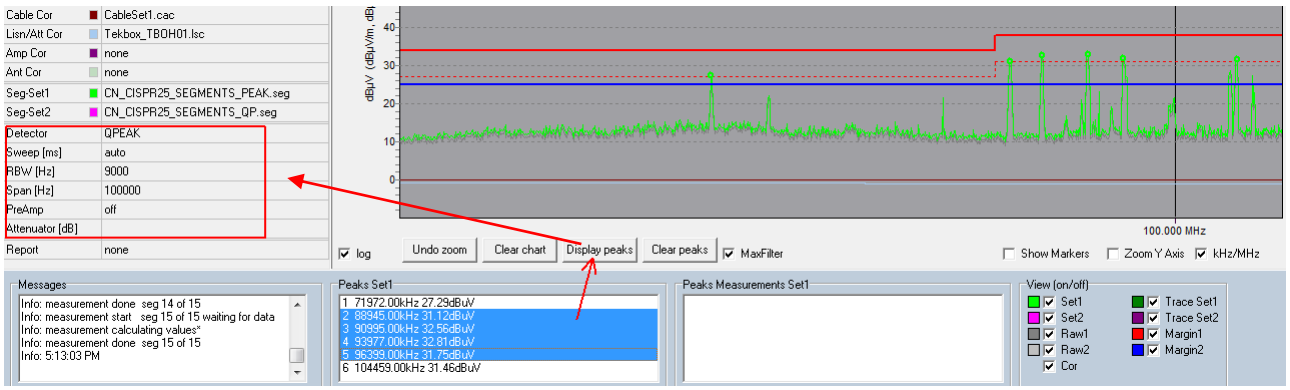


In order to display peaks for the second graph, change **MeasureSet** to set 2

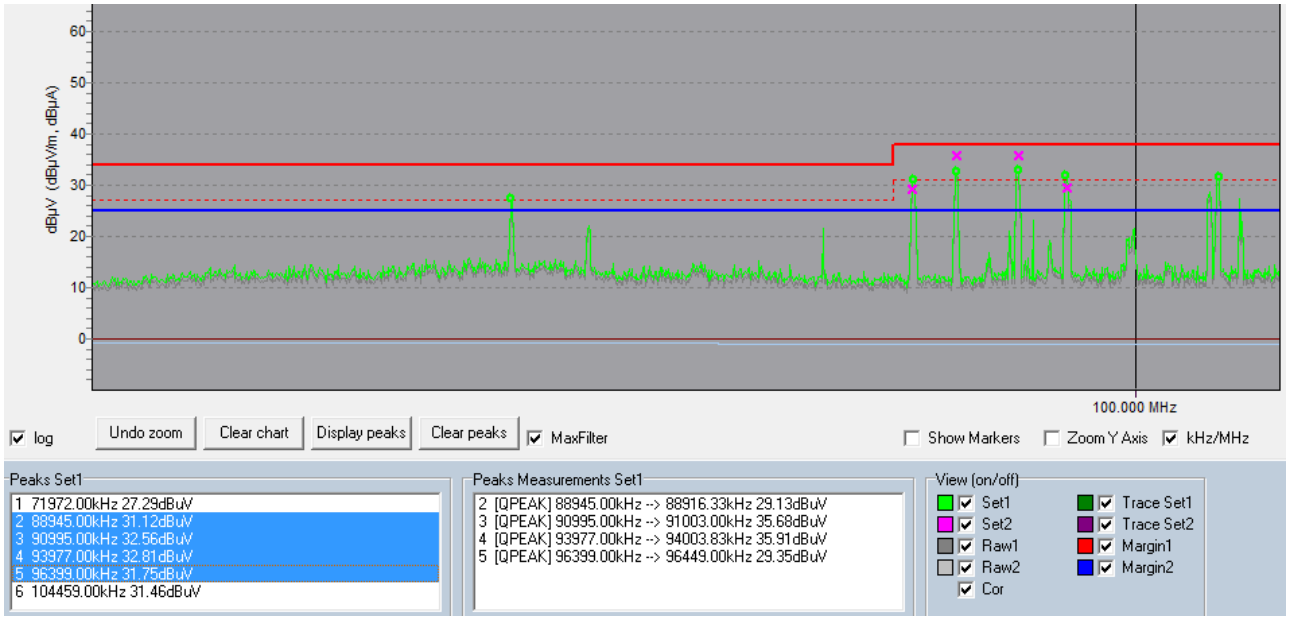


10. Final scan / peak re-measurement

Select any peaks from the list by pressing the **Ctrl** button and select it with the left mouse button. Then click the right mouse button and click **Measure.** There are two measurement options. The recommended choice is **Measure (consider drift)**.

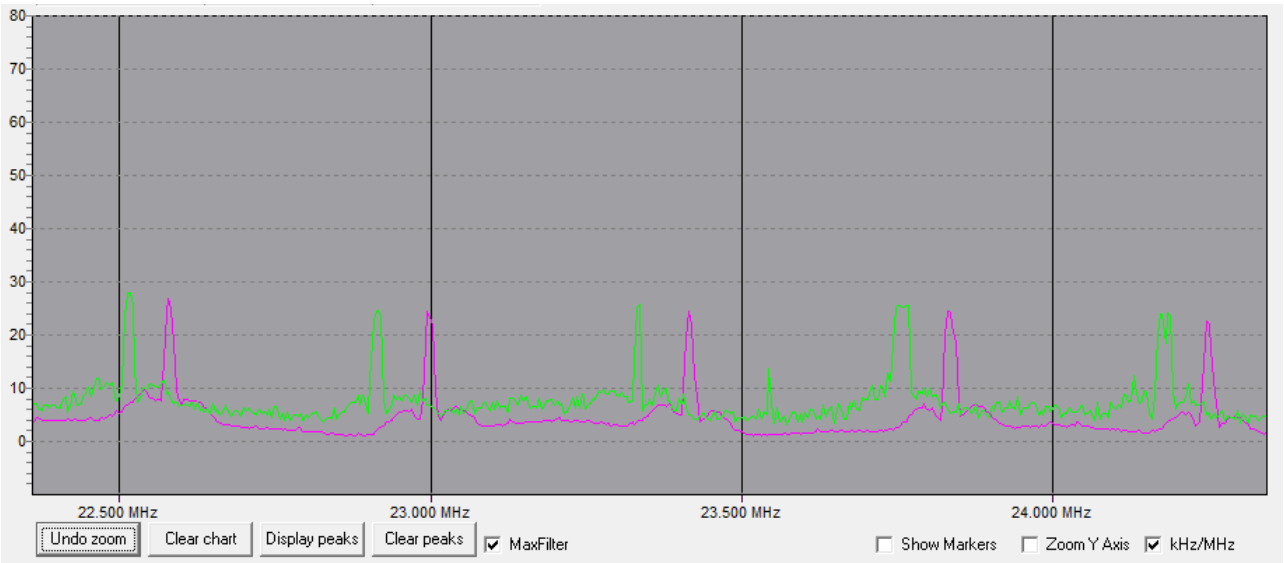


The software will then re-measure, using the selected peaks as center frequency and using the detector, sweep time, RBW, Span and PreAmp settings defined in the control box. This feature is a short cut to make a fast Quasi Peak measurement for selected peaks, instead of making a time consuming full span QP measurement.



The Peaks Measurements box then displays the results of the fast quasi peak measurement.
In addition, the graph shows a cross at the respective frequency and level.

Consider the span setting of the peak re-measurement, with respect to a potential drift of the peaks. The higher the drift over time (e.g. drift of the frequency of a switched mode regulator), the wider make the span. The software will scan the measurement values of the entire span for the highest peak. Consequently, the frequency of the re-measured peak may deviate from the initial peak frequency. The capability of setting a Span for a peak re-measurement is an essential feature of EMCview, often missed by similar tools.

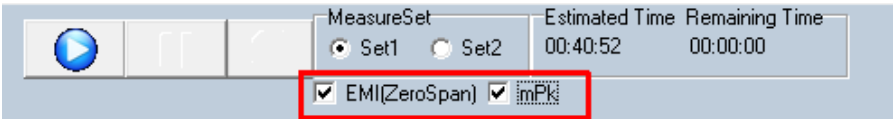


Above an example to illustrate the purpose of the span setting. Harmonics of a switched mode regulator, which drifted over the time that passed between carrying out the peak measurement (green graph) and the quasi peak measurement (purple graph). If measured at exactly the peak frequencies of the green graph using the option **Measure (ignore drift)**, it would completely miss the signals when re-measuring with quasi peak detector. However, by setting a span of 200 kHz, the quasi peak signal is measured correctly. Use the option **Measure (ignore drift)** only if the spurious are harmonics of a crystal clock.

Comment: Siglent Analyzers may sometimes return wrong peak values at lower frequencies. This is subject to bug fixing and will be corrected in an upcoming analyzer FW revision. Currently, use slower sweep settings, which will significantly reduce this issue.

11. Pseudo measurement receiver mode

This feature is still in an experimental state and not fully elaborated. You can activate it by clicking **EMI (zero span)** and optionally **mPk** (maximum peak).



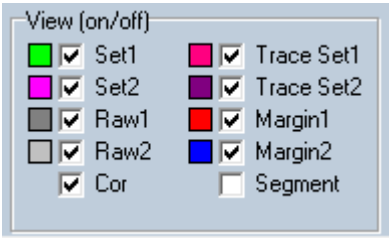
Instead of sweeping the analyzer will step discrete frequency points and make measurements in zero span. All other settings are currently derived from the segment files.
The number of frequency steps per segment is corresponding with the default number of display points of the spectrum analyzer (e.g. 601 points for the Rigol DSA815). The dwelling time is corresponding with the sweep time of the segment divided by the number of display points.
By default, the analyzer returns the value measured at the center of the display. Clicking **mPk** will read the maximum value of the displayed line instead.

12. View / hide graphs

The graph window can display several traces:

Set 1	corrected graph of the measurement defined by Seg-Set1 and Limit1
Set 2	corrected graph of the measurement defined by Seg-Set1 and Limit1
Raw 1	raw data of Set1 – no LISN, cable, etc. correction
Raw 2	raw data of Set2 – no LISN, cable, etc. correction
Cor	correction data of LISN, cable, etc.
Trace Set1	imported data from previous measurement to overlay for comparison purpose
Trace Set2	imported data from previous measurement to overlay for comparison purpose
Margin1	margin with respect to Limit1
Margin2	margin with respect to Limit2
Segment	displays the frequency segments, which are defined in the segment file click Segment to enable measurement of selected segments only

Hide or view traces using the tick boxes in the lower right corner of the window.
Configure colors of traces, limit lines and the background of the graph window in the **Setup** menu, **edit colors**.



13. Zoom graphs

You can zoom or set the boundaries of the graph by entering frequency and amplitude values into the boxes **Chart Start[Hz]**, **Chart Stop[Hz]**, **High[dBµV]**, **Low[dBµV]**. Press the TAB button or click another box to confirm the entered values. During an ongoing measurement, access to the control box is disabled. Alternatively, you can use the mouse and pull a rectangle in the graph section. When zooming with the mouse, you can **Undo Zoom** with a button under the graph window. You can also switch between **lin**ear and **log**arithmic frequency axis. When zooming in very deeply, the display may be changed automatically to linear frequency display in order to get a useful grid. Switching to logarithmic frequency axis is not possible then, unless you **Undo Zoom**.

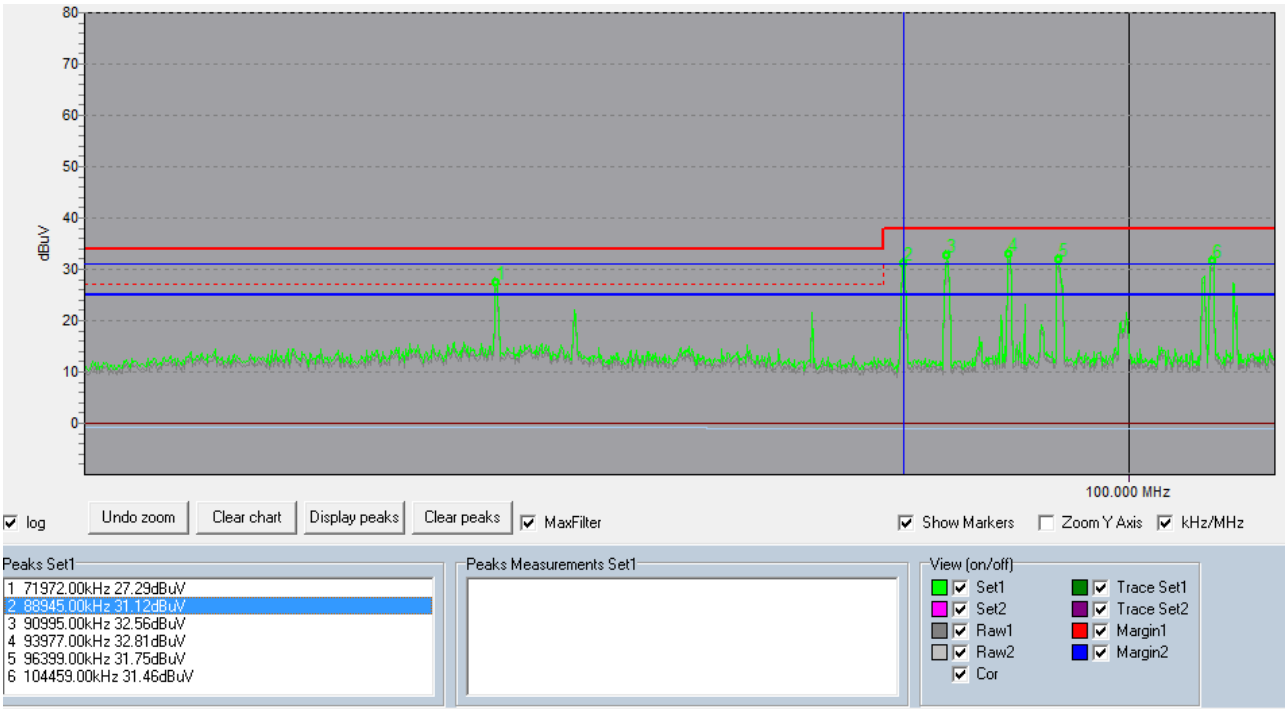
Parameter	Value
Chart Start[Hz]	9000
Chart Stop[Hz]	30000000
High[dBuV]	120
Low[dBuV]	-11
Limit1	none
Limit2	none
Margin1[dB]	0
Margin2[dB]	0
Cable Cor	none
Lisn/Att Cor	none
Amp Cor	none
Ant Cor	none
Seg-Set1	none
Seg-Set2	none
Detector	QPEAK
Sweep [ms]	auto
RBW [Hz]	9000
Span [Hz]	200000
PreAmp	off
Attenuator [dB]	10
Report	none

To restrict zooming to the y-axis, click the Y-axis check box.

In order to use the magnifying glass to check the graph, click **Magnify**.

14. Markers

Clicking **Show Markers** adds the corresponding peak number of the peak list to the graph.
Double clicking any marker in the list will place a cross hair.



15. Saving graphs and measurement results

Save data in **File** menu, **Utilities, Save Chart.** The chart (graph) of any measurement can be reloaded into EMCview clicking **Load Chart**. Clicking Load Chart overwrites any graph present on the screen.
Reload and overlay older measurements to a fresh measurement for comparison purpose by clicking **Load Reference Trace** in the same menu. This feature adds (overlays) one or two more graphs to the existing measurement or chart. Restarting a measurement will clear the graph of the previous measurement, but not affect the **Reference Trace**.
Click **Save as WMF File** to save chart screen shots.
Click **Save as CSV File** to save the measurement result as table.

16. Create Reports

Click **Setup**, **Edit Report**. Click **Clear** and then enter the report details. Click **Save** and enter a file name.
In order to print the report, click **File**, **Utilities**, **Print Report**. If you want to keep the report as a file, print using a pdf writer.

17. RF coverage measurement mode

In RF coverage measurement mode, the field strength of up to 3 transmitters can be monitored in parallel. GPS coordinates are assigned to every measurement sample. EMCview currently supports Opus / Eride chipset based GPS receivers with NMEA output via USB. A suitable GPS receiver is also available from Tekbox.

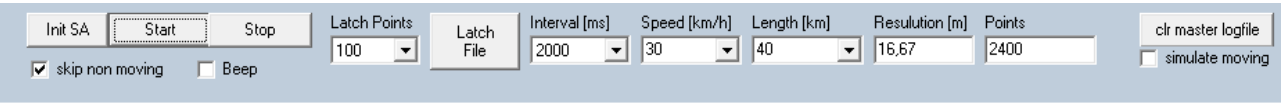
In order to make RF coverage measurements, connect to the spectrum analyzer and GPS receiver in the **Device** menu.
Click **Mode**, **RF Coverage** to enter RF coverage measurement mode.

17.1 Configuration

Enter the frequencies that you want to observe along with the spectrum analyzer settings:

Parameter	Value
Freq A[Hz]	173575000
Freq B[Hz]	88500000
Freq C[Hz]	146725000
High[dBm]	-10
Low[dBm]	-110
Cable Cor	none
Amp Cor	none
Ant Cor	none
Detector	VAV
Sweep [ms]	auto
RBW [Hz]	10000
Span [Hz]	25000
PreAmp	off
Attenuator [dB]	0

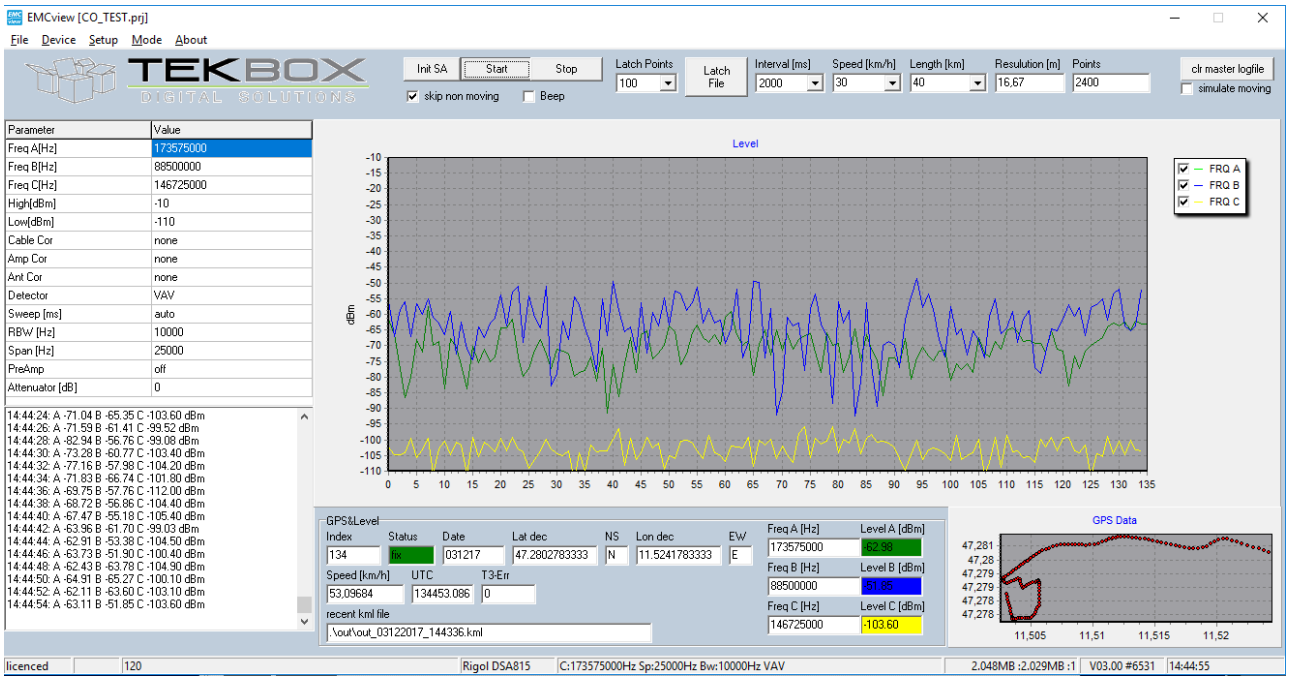
If Freq(B) and or Freq(C) are not required for the measurement, simply delete the contents of the corresponding box.
High[dBm], Low[dBm] values specify the y-axis display range of the graph. The values on the X-axis correspond to the index of the consecutive measurement samples.



Init SA: transfers the measurement settings to the spectrum analyzer and initialize the SW for a new measurement
Start: start measurement or continue interrupted measurement; requires a GPS fix and established connection to the spectrum analyzer.
Stop: stop measurement
Latch Points: select the number of measurement points, after which a KML file will be created automatically. If the total number of measurement points exceeds the settings in **Latch Points**, additional KML files will be created.
Latch File: creates a KML file upon pressing the button
Interval [ms]: time in between two consecutive measurements (measurement interval). Minimum time largely depends on number of observed frequencies, sweep time and measurement response time of the analyzer. With the analyzer settings in the example above, 3 frequencies can be monitored every 2 seconds. If the set interval time is too low, a timing error will be occur and increment the T3-Err counter at the bottom of the graph.
Speed [km/h]: enter the estimated average speed of your measurement drive here to calculate the resolution of your measurement
Length [km]: enter the estimated length of your measurement drive here to calculate the resulting number of measurement points
Resolution[m]: average distance between two measurement points based on the entered value of Speed and the settings for the measurement interval.
Points: resulting number of measurement points based on the estimation of the length of the measurement drive and the settings for the measurement interval.

Clr master logfile: the data of every measurement point is logged into a text file with file name **coverage.txt**. Any additional measurement will be appended to existing data in the log file. Press this button to delete the contents of the log file. The log file is located in the sub directory **\out**.
Skip non moving: Don´t log any measurement points if the speed reported by the GPS receiver is zero
Simulate moving: only to validate the measurement setup; don´t click for an actual measurement. The SW generates a random offset to the coordinates measured by the GPS receiver to simulate a test drive.

17.2 Status and measurement results



The main graph displays the measured field strength of the observed transmitters on the y- Axis and the index number of the corresponding measurement on the X-axis.
The GPS data window displays the coordinates of consecutive measurement points.

Index: index counter; number of current measurement sample
Status: displays GPS fix
Date: current date
Lat dec: current latitude in decimal format
NS: latitude north/south
Long dec: current longitude in decimal format
EW: latitude east/west
Speed: current speed
UTC: current time
T3-Err: error counter, counts timer errors caused by insufficient length of measurement interval
Freq A: observed frequency A
Level A: field strength/ amplitude of transmitter A
Freq B: observed frequency B
Level B: field strength/ amplitude of transmitter B
Freq C: observed frequency C
Level C: field strength/ amplitude of transmitter C
Recent kml file: shows the path and file name of the latest generated kml file: default directory is **\out**. The kml file is created automatically and consists of the string **out_date_time.kml**.

17.3 Log file

The index file is a text file containing an index for each sample, date, time, longitude, latitude, speed, observed frequencies and corresponding field strength.
Example:

Index;Fix;Date;UTC;Lat;NS;Long;EW;Speed[km/h];FreqA[Hz];LevA[dBm];FreqB[Hz];LevB[dBm];FreqC[Hz];LevC[dBm]
0;fix;031217;133951.086;47.2786633333;N;11.5031383333;E;19,8164;173575000;-61.62;88500000;-55.71;146725000;-102.30
1;fix;031217;133953.086;47.2785533333;N;11.5031883333;E;23,46484;173575000;-66.53;88500000;-67.06;146725000;-104.70
2;fix;031217;133955.086;47.2784366667;N;11.5032450000;E;24,20564;173575000;-77.26;88500000;-58.54;146725000;-104.80
3;fix;031217;133957.086;47.2783266667;N;11.5033033333;E;22,35364;173575000;-86.61;88500000;-56.00;146725000;-104.00
4;fix;031217;133959.086;47.2782150000;N;11.5033666667;E;22,24252;173575000;-80.06;88500000;-67.07;146725000;-99.37
5;fix;031217;134001.086;47.2781033333;N;11.5034316667;E;21,87212;173575000;-67.92;88500000;-56.49;146725000;-105.80
6;fix;031217;134003.086;47.2780050000;N;11.5034866667;E;19,446;173575000;-72.14;88500000;-59.98;146725000;-103.10
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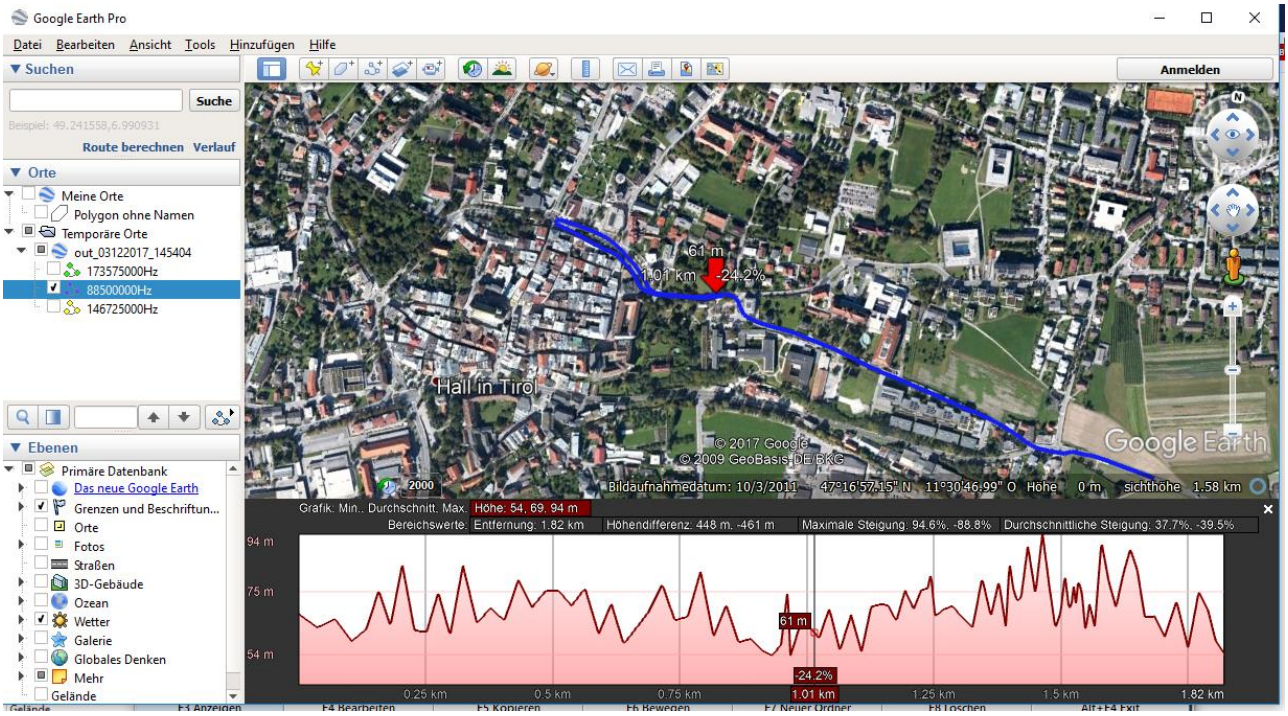
17.4 KML file

The KML file can be used to project the measurement drive into Google Earth Professional.
The altitude-profile graph feature of Google Earth Professional is utilized to display a field strength profile. The [m] unit displayed by Google Earth is equivalent to the measured amplitude in [-dBm]. Consequently, peaks in the graph represent lower field strength values, means the graph is mirrored on the x-axis.
In Google Earth menu **View**, **reset tilt**. If you don´t see the track, in **Layers**, activate **More**. In order to see the field strength profile, click the **Edit** menu and then show **elevation profile**.



18. History

Version	Date	Author	Changes
V 1.0	20.04.2017	Mayerhofer	Creation of the document
V 1.1	26.04.2017	Mayerhofer	Chapter 2 (warnings) added
V 1.2	21.06.2017	Mayerhofer	Siglent support added
V 1.3	16.12.2017	Mayerhofer	Updates - SW REV 3.0