Conducted EMS and EMI Measurements with R&S®EMC32

Application Note

Products:

- R&S®SMB100A
- R&S®BBA100
- R&S®NRP-Z91
- R&S®OSP120
- R&S®ENV216
- R&S®ESR
- R&S®ESRP
- R&S®ESU
- R&S®ESCI
- R&S®ESPI
- R&S®ESL

This application note shows how to configure, calibrate and perform conducted EMS (Electro Magnetic Susceptibility) measurements according to IEC / EN 61000-4-6 and EMI (Electro Magnetic Interference) measurements according to CISPR 16-2-1 with the R&S®EMC32 software tool.

Application Note

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ROHDE&SCHWARZ

Table of Contents

1 Introduction

The goal of this application note is to describe the hardware and software configuration for a typical conducted disturbance measurement setup, its calibration and an example for an EMS and EMI measurement.

The application note consists of two main parts:

EMS – **E**lectro**m**agnetic **S**usceptibility test standards for commercial equipment (IEC/EN 61000-4-6), hardware configuration for CDN (Coupling / Decoupling Network), EM-clamp and BCI (Bulk Current Injection), EMC32 Software installation and configuration for CDN calibration and example measurement. EMS measurements have the goal of determining whether the EUT (Equipment Under Test) is immune to electromagnetic interference signals or fields. This means that the functionality of the EUT is not disturbed or only disturbed to a permissible limit. The certification of the susceptibility is a precondition in the EC to get the CE label for an electronic device.

EMI – **E**lectro**m**agnetic **I**nterference test standards for commercial equipment (CISPR 16-2-1), hardware configuration with e.g. LISN (Line Impedance Stabilization Network) or current probe, EMC32 configuration and example measurement. EMI measurements have the goal of determining whether the electromagnetic interference produced by the EUT does not exceed a defined limit value. This ensures that the functionality of other electrical devices is not adversely affected. The certification that the interference radiation is below a certain limit is for example, a precondition in the European Community (EC) to obtain the CE label for an electronic device.

Without a CE label it is not allowed to place any electrical or electronic devices on the European Market.

The setups, especially the equipment are recommendations based on long term experience in design and implementation of EMC systems and have been optimized for best performance. The use of other components than the recommended ones may result in significant performance variations.

In addition the achievable system performance depends not only on the test equipment, but also on the environment e.g. the anechoic chamber performance. The configurations described in this application note can therefore not guarantee the fulfillment of the respective standards in any case.

The following abbreviations are used in the following text for R&S® test equipment:

- The R&S®SMB100A Signal Generator is referred to as SMB100A.
- The R&S®BBA100 Broadband Amplifier is referred to as BBA100.
- The R&S®NRP2 Power Meter is referred to as NRP2.
- The R&S®NRP-Z91 Power Sensor is referred to as NRP-Z91.
- The R&S®ENV216 Two-Line V-Network is referred to as ENV216.
- The R&S®OSP120 Switch Matrix is referred to as OSP120.
- The R&S®ESU EMI Test Receiver is referred to as ESU.
- The R&S®ESL EMI Test Receiver is referred to as ESL.
- The R&S®ESCI EMI Test Receiver is referred to as ESCI.
- The R&S®ESPI EMI Test Receiver is referred to as ESPI.
- The R&S®ESR EMI Test Receiver is referred to as ESR.
- The R&S®ESRP EMI Test Receiver is referred to as ESRP.
- R&S®EMC32 EMC Software is referred to as EMC32.
- R&S® refers to Rohde & Schwarz GmbH und Co KG

2 EMC32 Software Configuration

2.1 Overview

EMC32 offers various features allowing the experienced user to configure and perform a wide range of EMC tests. Many of the configurations are pre-configured and do not need to be changed for standard test described in this application note.

The following chapters guide through the configuration step by step. Please refer to the EMC32 Getting Started Tutorial or use the online help by pressing F1 for further information.

The EMC32 software must be installed and configured before first use. The main steps are:

- Software and driver installation. The drivers of the standard R&S devices in the selection lists are contained in EMC32.
- Configuration of hardware
- Calibration of signal paths
- Calibration of transducers
- Carrying out the first EMS or EMI test

2.2 Installation

After inserting the EMC32 CD-ROM the installer is either executed via auto-start, or needs to be started manually by double-clicking on **SHOWAUTOSTART.BAT**. The following screen appears.

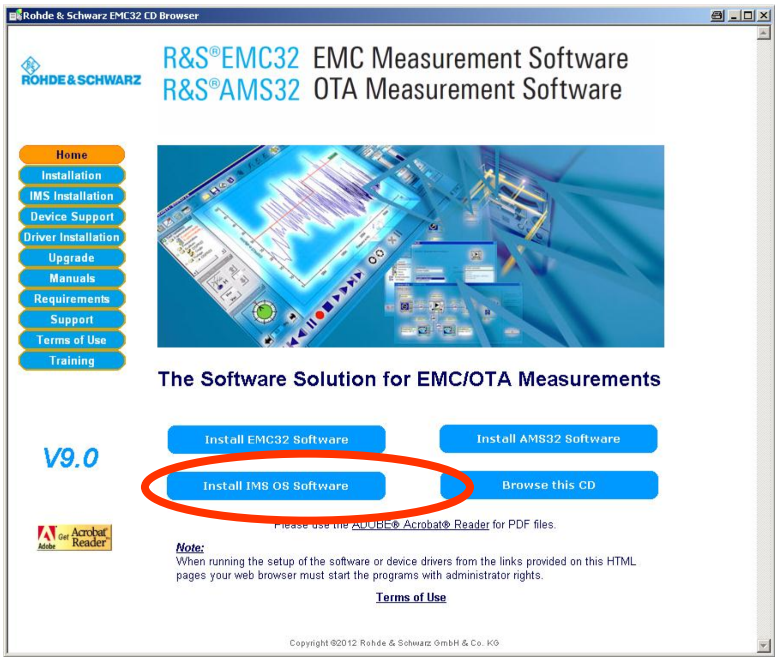


Fig. 2-1: EMC32 Start Screen

Note:

If you have a Windows 7 64 bit OS you must execute Setup_EMC32_AMS32.exe as administrator. This is done by right clicking on the file name and selecting "Execute as Administrator" in the Windows-Explorer.

Installing/Updating Drivers

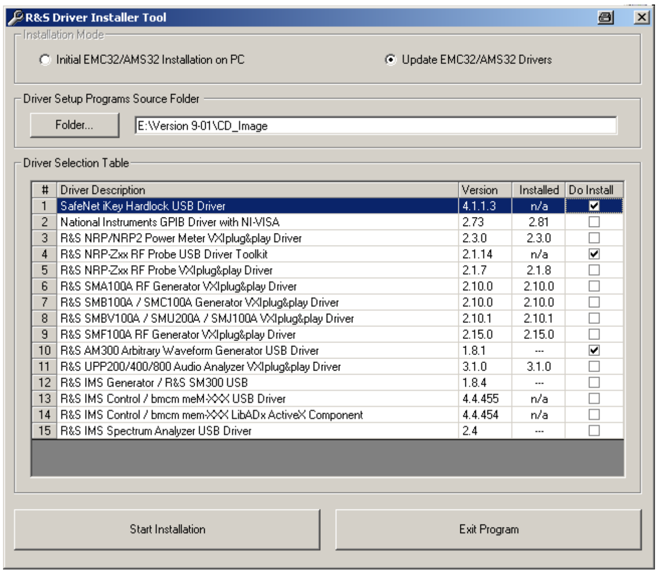


Fig. 2-2: Install Drivers

EMC32 has a driver installer tool that allows you to install / update the required drivers.

Configuring Hardware

- Start EMC32
- Choose Configuration Wizard in the start window.

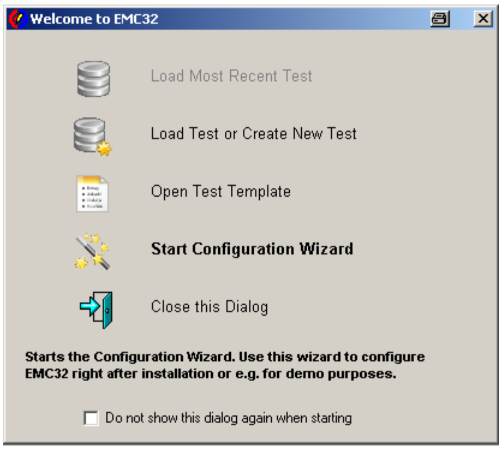


Fig. 2-3: Configuration Wizard

The Configuration Wizard can also be started in the menu **EXTRAS → WIZARDS → CONFIGURATION WIZARD.**

3 Conducted EMS

3.1 IEC / EN61000-4-6

IEC/EN 61000-4-6 describes conducted EMS-tests for commercial equipment. To carry out these tests detailed knowledge of the standard is necessary. The short overview shows the main parameters influencing a test system.

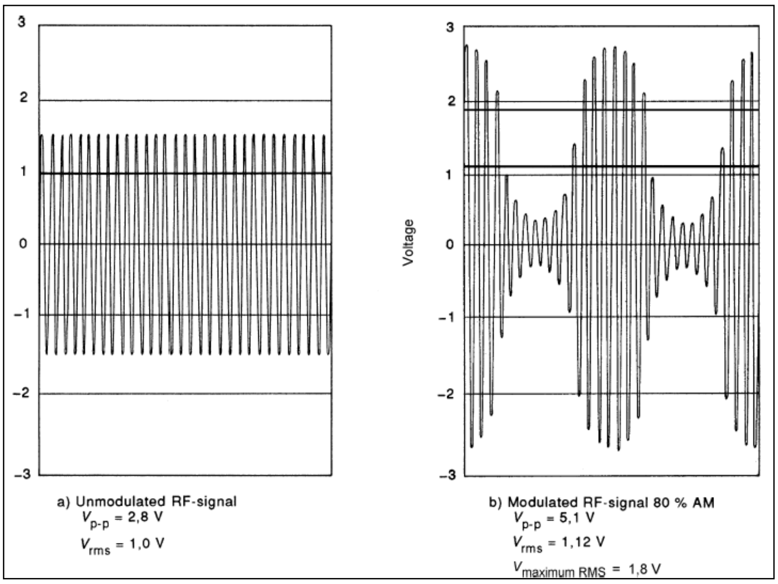
Frequency Range	150 kHz to 80 MHz
Modulation	80% Modulation with 1 kHz  Note: 1.8 times higher interference voltage (80% modulation) is necessary to achieve 3.24 times more amplifier power.
Harmonics	< 15 dBc
Coupling Methods	CDN (Coupling Decoupling Network, preferred method) EM-Clamp BCI (Bulk Current Injection, current clamp)
Impedance	150 Ω (at output of coupling network)
Test Environment	Shielded room
Test Setup	Test table with conducting surface and grounding connection Cable length EUT – coupling device: 0,1 to 0,3 m Cabling height: 0,1 m over conducting surface (with non-conducting supports) All coupling devices have to be grounded properly.
Frequency step	≤ 1 %, i.e. at least 100 steps. The measurement time per step depends on the EUT, but should not take longer as 66.7 seconds per decade.

Table 3-1: Influencing Parameters

3.2 Hardware Configuration

For conducted EMS measurements according to IEC/EN 61000-4-6 there are three possible methods of coupling into the EUT.

3.2.1 CDN (Coupling Decoupling Network)

The most common test method is coupling via CDN. It requires the least power and is always used when appropriate CDNs for the type of signal are available (AC power line, analog or digital input signal). The block diagram shows the basic configuration for measurements according IEC / EN 61000-4-6 with a CDN.

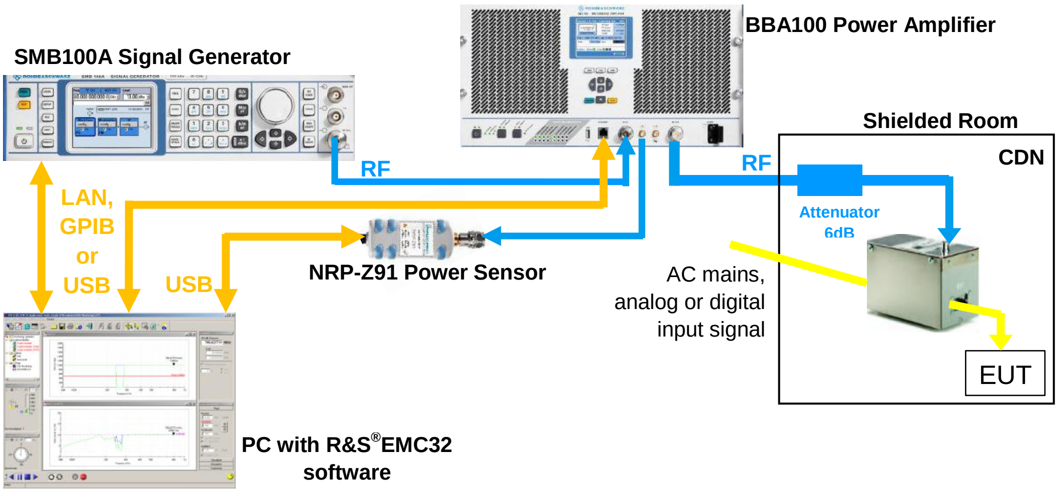


Fig. 3-1: Configuration for CDN

3.2.2 EM-Clamp

The EM-clamp is used when a CDN is not possible, e.g. for shielded or complex cables. The clamp and the separate decoupling clamp are placed around the cable.

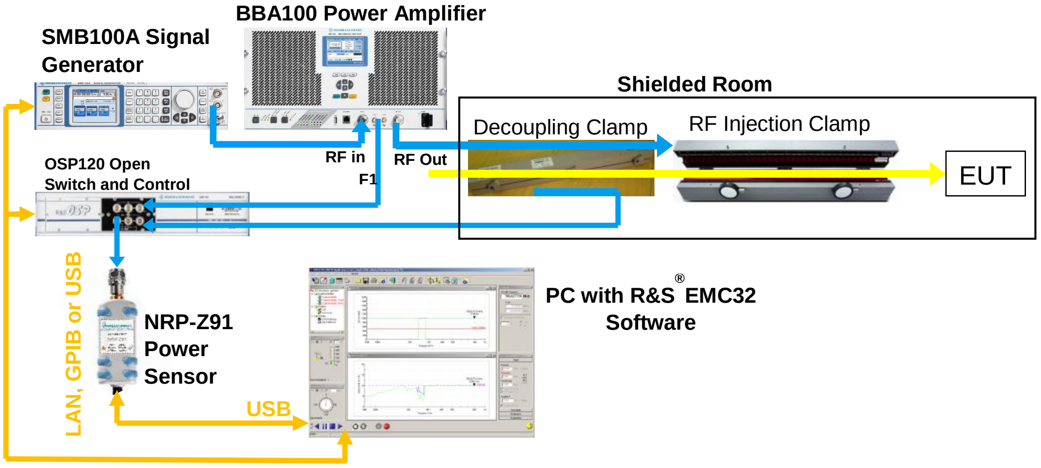


Fig. 3-2: Configuration for EM-Clamp

3.2.3 BCI (Bulk Current Injection)

Used similarly as EM-clamp. A monitoring of the injected current is strongly recommended. Alternatively, two NRP-Z91 power sensors can be used instead of the OSP120 + NRP-Z91 combination. In case the measurement equipment is located in remote location, it is convenient to use an NRP2 Power Meter with a LAN connector plus 2 NRP-Z91 power sensors. There are inexpensive solutions for converting electrical LAN cables to optical fibres which can be fed more easily into a break box of a shielded room.

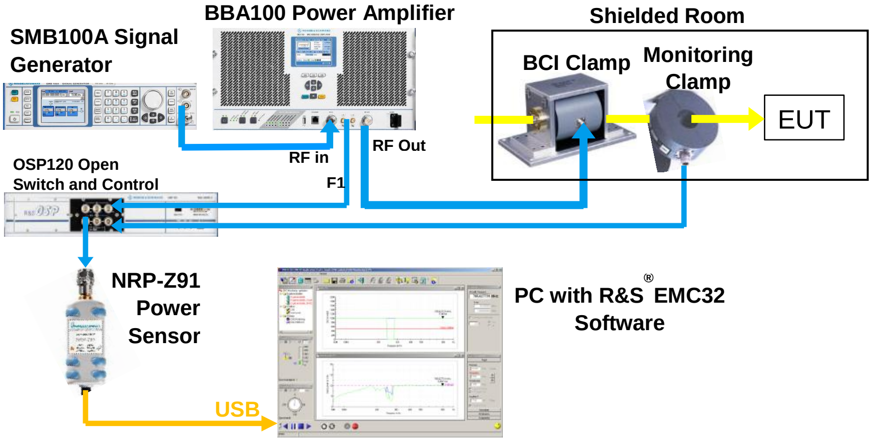
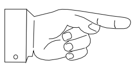


Fig. 3-3: BCI

3.2.4 Interlock Connection

The interlock is a safety feature, which ensures, that the RF power is only switched on, when the doors to the measurement site are closed. Contacts on the entrance doors of the anechoic room are required to implement the interlock.

Note:



The Interlock is a safety feature. It makes sure, that no person is exposed to hazardous fields or voltages. Therefore a proper installation of an interlock loop is strongly recommended.

Four interlock switches can be connected to the BBA100 Broadband Amplifier. The Device Interlock reduces the RF output to secure the amplifier or other connected devices. The three **GROUP INTERLOCKS** are used for the operators' safety, e.g. by turning the RF power off in case a door of the shielded room is open. Tests can only be carried out as long as this loop is closed.

3.3 EMS Configuration in EMC32

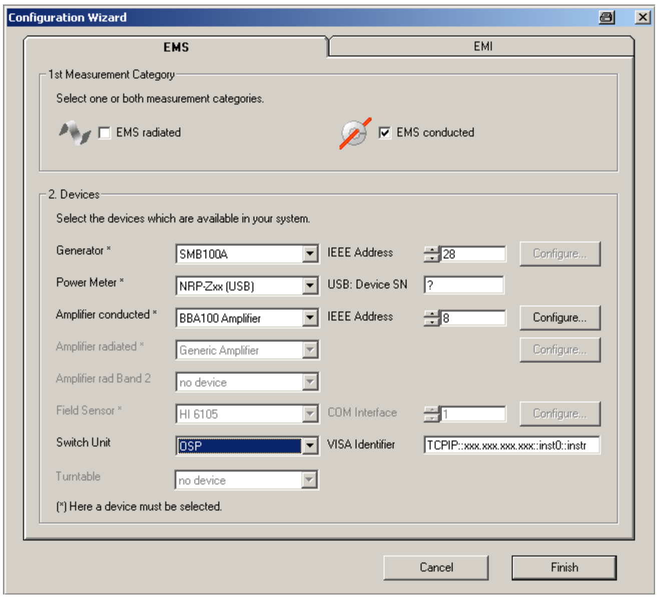


Fig. 3-4: EMS configuration window

Select the EMS conducted checkbox and choose the devices. You may either control the power sensors via USB like in this example or together with an NRP2 power meter.

3.4 EUT Monitoring

In order to classify the susceptibility of a DUT (Device Under Test) or EUT it is necessary to detect the effects that the disturbing frequencies have on the physical output signals (U, I, f, etc.), TTL I/O or signal monitored by a video camera. Usually the output signals are disturbed by certain frequencies so it is necessary to record the output signal synchronized with the current disturbing frequency. The following picture shows the possible monitoring routes that can be handled by EMC32.

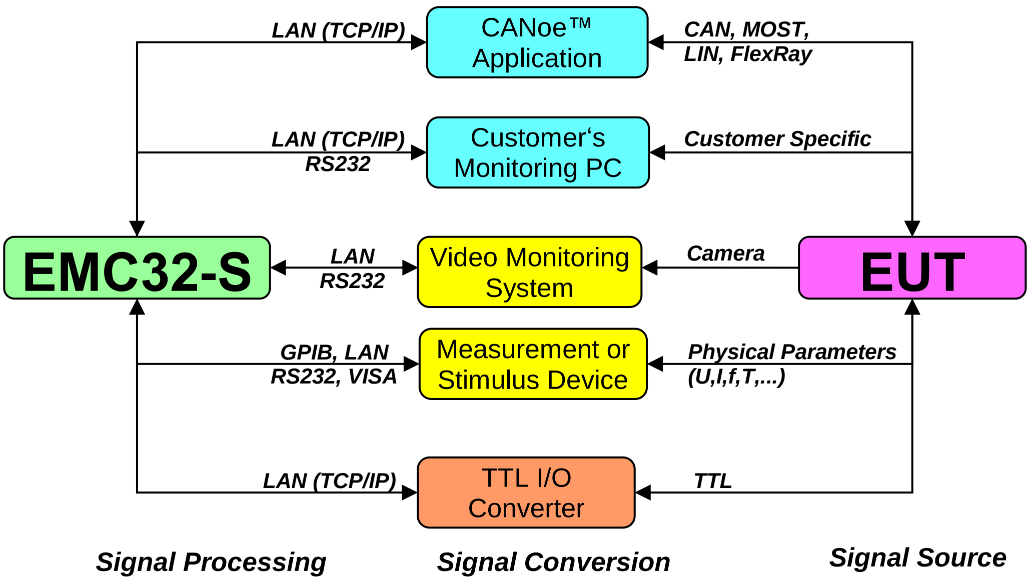


Fig. 3-5: EUT Monitoring Routes

The following figure shows the data flow of the monitoring process.

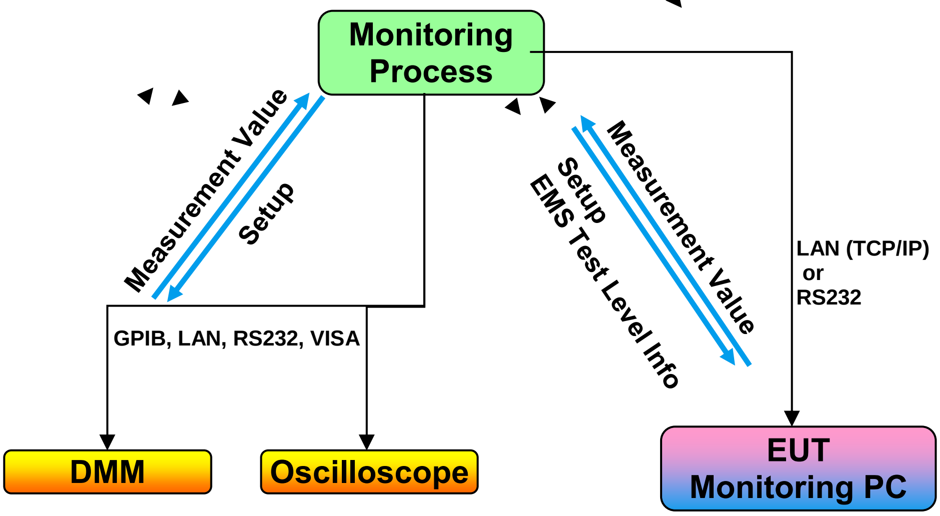


Fig. 3-6: EUT Monitoring data flow

EMC32 offers a generic monitoring device for adapting custom EUT monitoring devices such as oscilloscopes, digital voltmeters, video monitors etc.

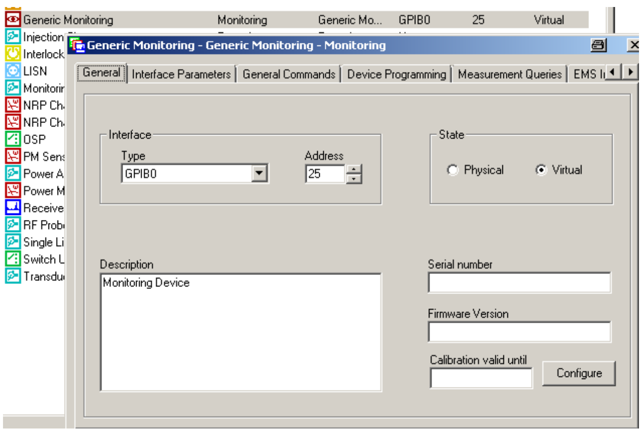


Fig. 3-7: Generic Monitoring

3.5 Example

This example shows how to configure, calibrate and measure EMS of a EUT with the CDN method shown in 3.2.1. The NRP-Z91 Power Sensors in this configuration are connected to the NRP2 Power Meter which is connected to the PC via GPIB or LAN. They could also be connected directly to the PC via USB depending on the location of your controller PC.

3.5.1 Calibrating Signal Paths for CDN with External Amplifier

One NRP-Z91 Power Sensor measures the forward power of the BBA100 Broadband Amplifier, while the second NRP-Z91 measures the voltage injected on the AC mains via Lüthi CDN L-801 M2/M3 with a Lüthi CR-100A Calibration Adapter.

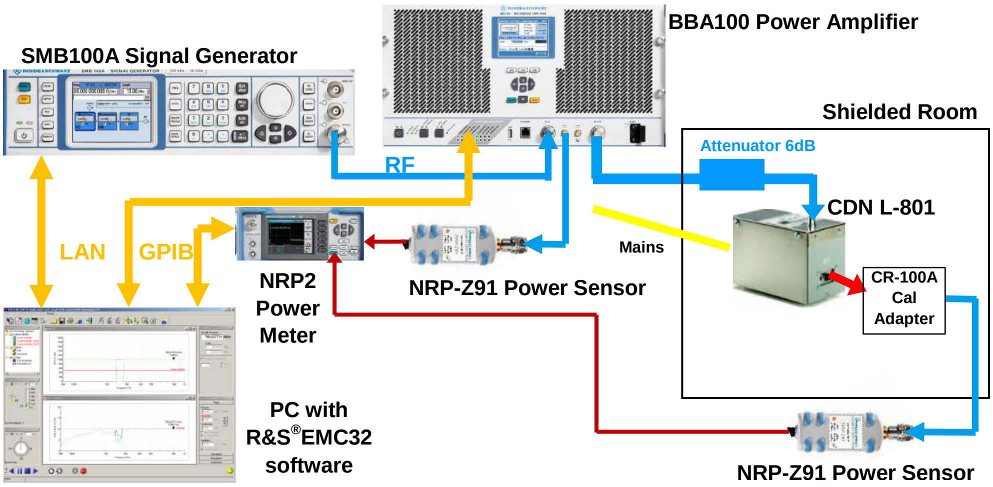


Fig. 3-8: Hardware configuration for CDN calibration

In the following example, the NRP-Z91 Power Sensors are connected to a NRP2 Power Meter which is remotely controlled via GPIB.

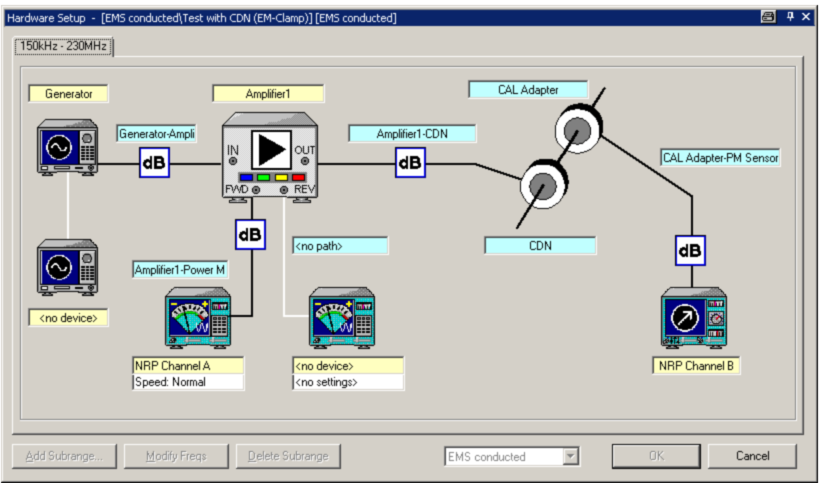


Fig. 3-9: Software configuration for CDN calibration

CDN impedance mismatch adjustment:

The BNC input of the CDN has 50 ohms while the CAL adapter output has 150 ohms. This results in 15.6 dB (U(CAL Adapter) = U(0) / 6) attenuation must be compensated with an offset in the CAL Adapter-PM Sensor control.

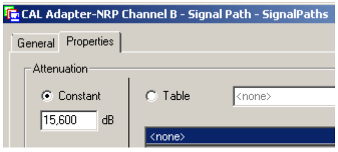


Fig. 3-10: 50 / 150 Ohm attenuation adjustment

EMC32 shows the measurement results in the Test Components window following window after the test has been performed.

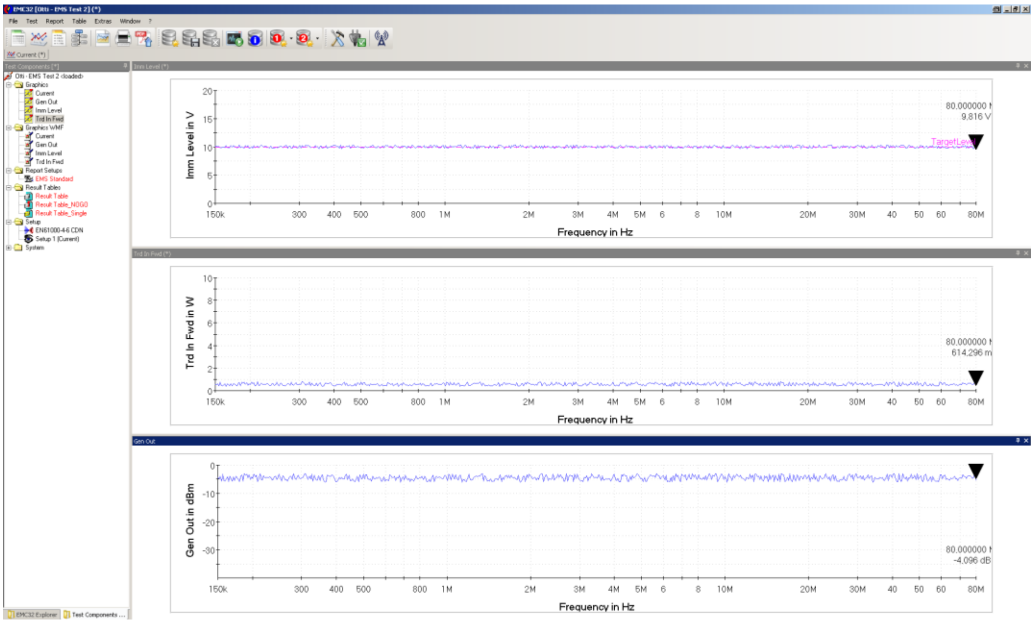
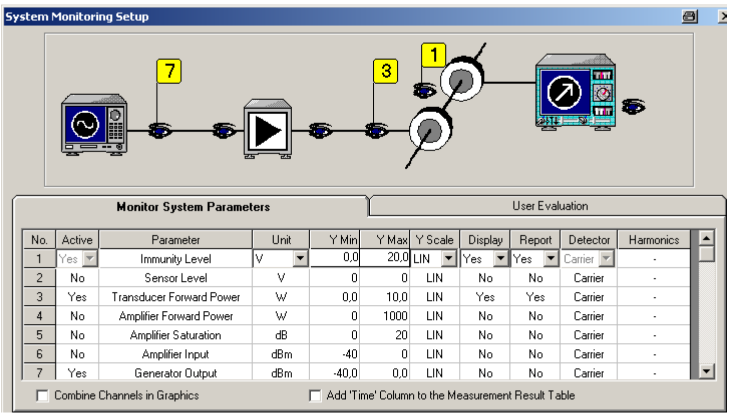


Fig. 3-11: Test Components

Following System Parameters are monitored



No.	Active	Parameter	Unit	Y Min	Y Max	Y Scale	Display	Report	Detector	Harmonics
1	Yes	Immunity Level	V	0,0	20,0	LIN	Yes	Yes	Carrier	-
2	No	Sensor Level	V	0	0	LIN	No	No	Carrier	-
3	Yes	Transducer Forward Power	W	0,0	10,0	LIN	Yes	Yes	Carrier	-
4	No	Amplifier Forward Power	W	0	1000	LIN	No	No	Carrier	-
5	No	Amplifier Saturation	dB	0	20	LIN	No	No	Carrier	-
6	No	Amplifier Input	dBm	-40	0	LIN	No	No	Carrier	-
7	Yes	Generator Output	dBm	-40,0	0,0	LIN	No	No	Carrier	-

Fig. 3-12: System Parameters

- Generator Output in dBm – Power fed from the generator to the amplifier.
- Transducer Forward Power in W – Power fed to the CDN.
- Immunity Level in V – Interfering voltage inducted by the CDN.

3.5.2 EMS Scan Template

The EMS Scan Template gives an overview on the hardware configuration and the used standards.

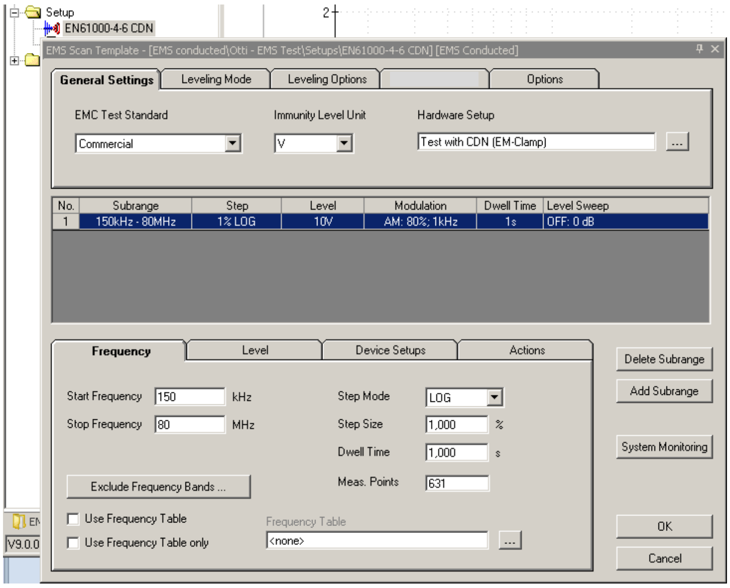


Fig. 3-13: EMS Scan Template

In the **LEVELING MODE** menu select the leveling method, the calibration table and the location of the power sensor.

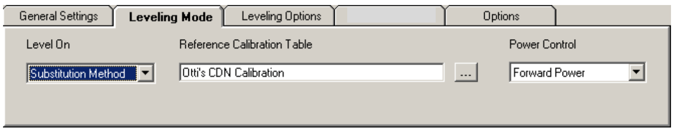


Fig. 3-14: Leveling Mode

In the Level menu select either a **CONSTANT IMMUNITY LEVEL**, e.g. 10.0 Volts or an **IMMUNITY SHAPE TABLE** and the **UPPER** and **LOWER LEVELING TOLERANCE**, e.g. 0.2 dB.

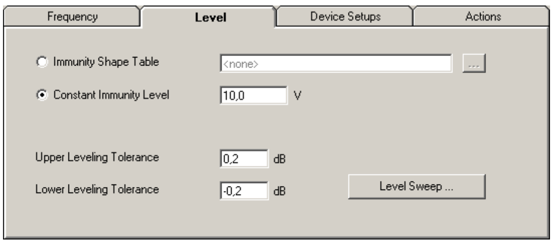


Fig. 3-15: Immunity Level and Tolerance

The **DEVICE SETUPS** menu shows the compressed view of the hardware setup in Fig. 3-6.

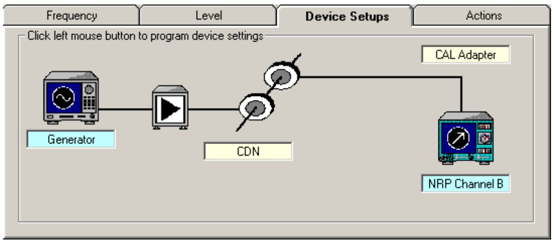


Fig. 3-16: Device Setup

The **ACTIONS** sub-menu allows you to add sub-ranges, custom steps etc.

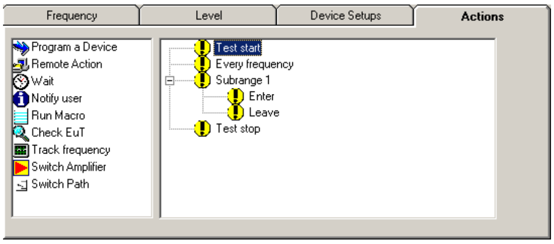


Fig. 3-17: Actions

The **MONITOR SYSTEM PARAMETERS** table gives a compressed overview of the location and function of the used power sensors.

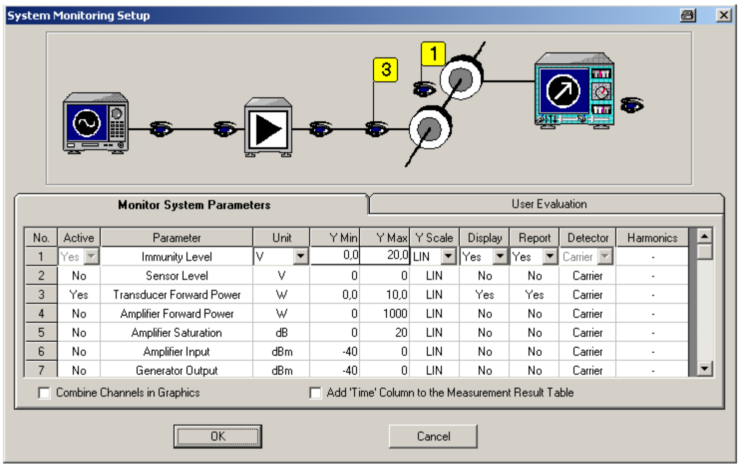


Fig. 3-18: System Monitoring

3.5.3 EUT Monitoring

EUT Monitoring allows monitoring the reaction of the EUT synchronized with the inducted EMS frequency scan in form of a voltage, current or digital result. The application PCMON Simulator included with this application note simulates a EUT monitoring program running a TCP server which communicates with the EMC32 Generic Monitoring driver. In the following example a simple TCP client console is used to demonstrate how the commands are sent to the PCMON Simulator and measurement values read back.

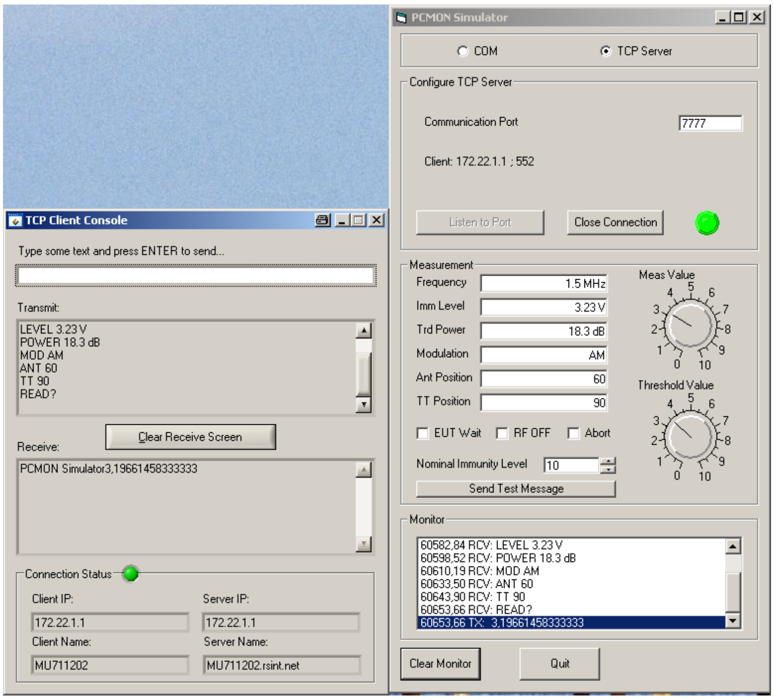


Fig. 3-19: TCP Communication with EUT Monitor

In EMC32 the commands for communication with an EUT monitor are defined in the Device List → Generic Monitoring device.

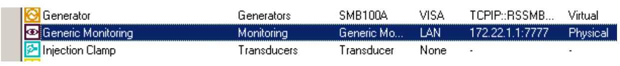


Fig. 3-20: Generic Monitoring device

1. In the General menu define **INTERFACE TYPE** = LAN and the IP address and Port of the TCP Server (PCMON Simulator) = e.g. 172.22.1.1:7777. Make sure the PCMON Simulator is in listening mode (LED turns green). Then set the Generic Monitoring **STATE** = **PHYSICAL**.

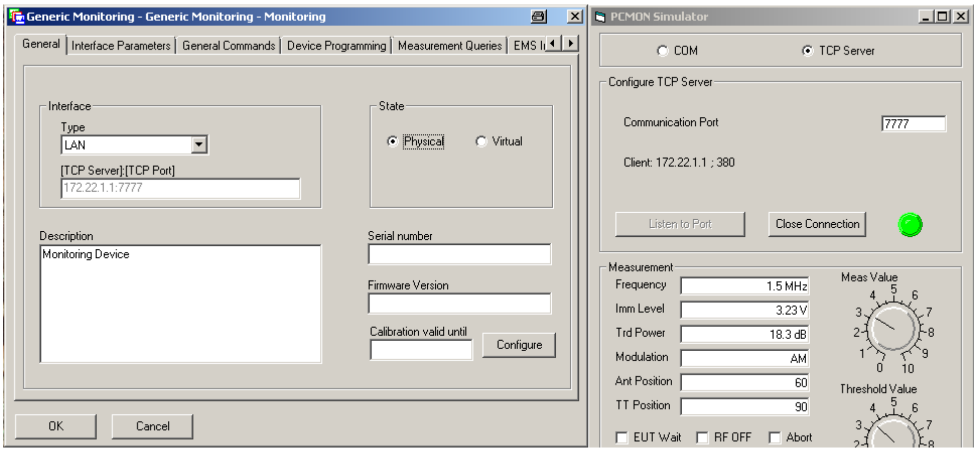


Fig. 3-21: General Settings

2. Select the **GENERAL COMMANDS** tab and set the commands as follows.

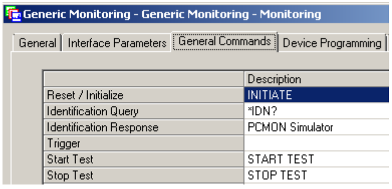


Fig. 3-22: General Commands

3. Select the **MEASUREMENT QUERIES** tab and set the command to read the measurement result (from PCMON Simulator) as shown below.

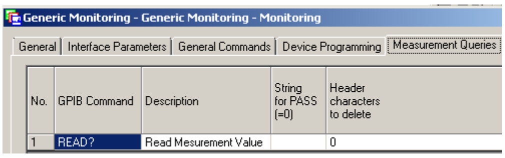


Fig. 3-23: Measurement Queries

4. Select the **EMS INFORMATION** tab and define the commands as follows. The **ANTENNA** and **TURNTABLE POSITION** parameters are only needed for radiated EMS.

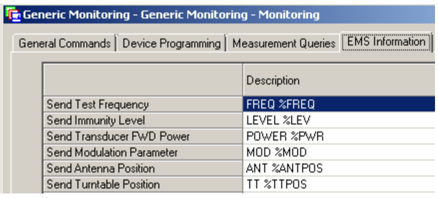


Fig. 3-24: EMS Information

The **DEVICE PROGRAMMING** tab allows custom commands for the EUT Monitoring device to be defined but is not necessary for the PCMON Simulator example. Press OK to close the **GENERIC MONITORING** window and OK again to leave the **DEVICE LIST** menu.

In the **CHANNEL** tab the detecting sensor, e.g. **VOLTAGE** is selected.

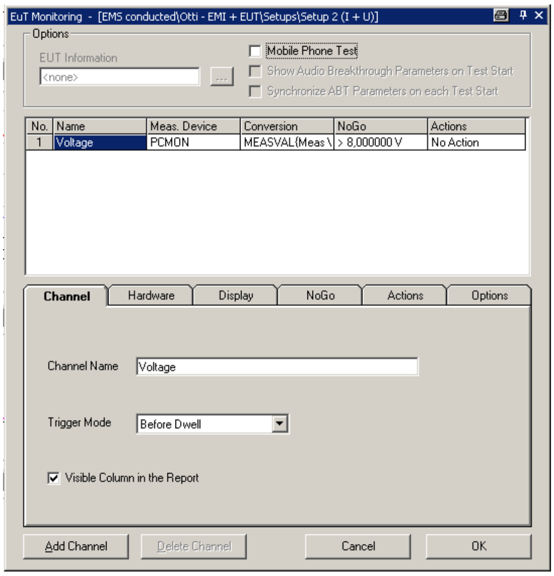


Fig. 3-25: EUT Monitor – Channel

In the **HARDWARE** tab select the PCMON device.

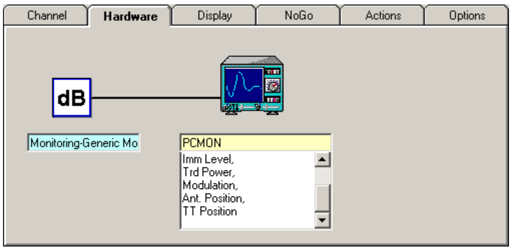


Fig. 3-26: EUT Monitor – Hardware

Click on the device icon to open the PCMON menu and select the **SETTINGS** tab. It displays all available commands which can be deactivated if not needed, for instance **ANT. POSITION** and **TT POSITION** (turntable) which are not necessary for conducted EMS.

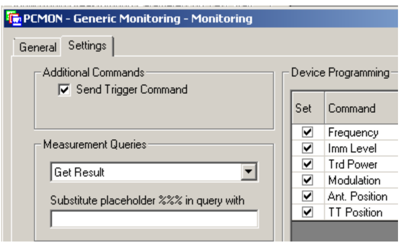


Fig. 3-27: PCMON - Generic Monitoring

Select the **NoGo** tab to define **NoGo Type**, **Limit Value** and **Value Range**. This means, that if the measured voltage returned by the EUT monitoring system (PCMON Simulator) invoked by the **READ?** command is above 8,000000 V or out of the 6,000000 V to 10,000000 V range will set a NoGo flag. The **Actions** tab (Figure 3-36) allows to define which actions will be taken in case of a NoGo flag.

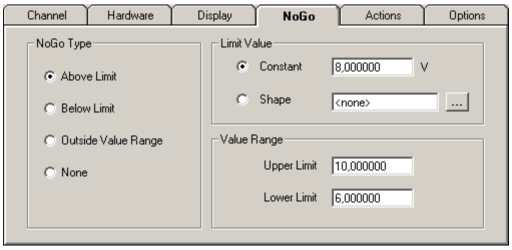


Fig. 3-28: EUT-Monitor – NoGo

The **Actions** tab defines the further actions to be taken in case of a Trigger, NoGo limits have been exceeded or the Go conditions have been met.

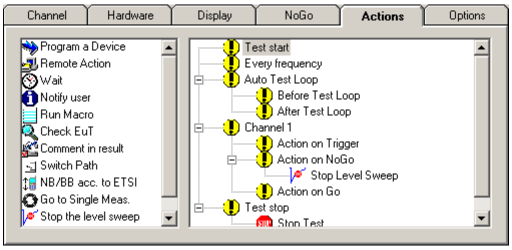


Fig. 3-29: EUT-Monitor Actions

4 Conducted EMI

4.1 CISPR 16-2-1

The CISPR 16-2-1 specification deals with conducted disturbance measurements concerning effects of cable bundling and specifies the methods of measurement of conducted disturbance phenomena in the frequency range 9 kHz to 30 MHz. Annex B of CISPR 16-2-1 to 16-2-3 contains a table of the minimum sweep times (fastest scan rates), from which the minimum sweep times for the CISPR band for conducted EMI measurement (Band B = 0.15 MHz to 30 MHz) for different detector types can be calculated. A peak detector scans this range in 2.985s (100 ms/MHz) while the quasi-peak detector would need 1:39 h (200 s/MHz). In order to reduce the measurement to a reasonable duration, a fast preview measurement with a peak detector is performed first, the critical frequencies, either exceeding an absolute limit, or a relative limit above the noise floor are stored for final, precise (re)measurement with a QP detector. This method is called data reduction (see 4.2.3 for further details).

4.2 EMI Auto Test Template

Open the **SYSTEM → TEST TEMPLATES → EMI AUTO TEST → VOLTAGE WITH 2-LINE-LISN**. The EMI Auto Test editor requires the **EMC32-K10** option to be installed. The automated sequence always consists of preview measurements, data reduction, maximization measurements, final measurements and reporting.

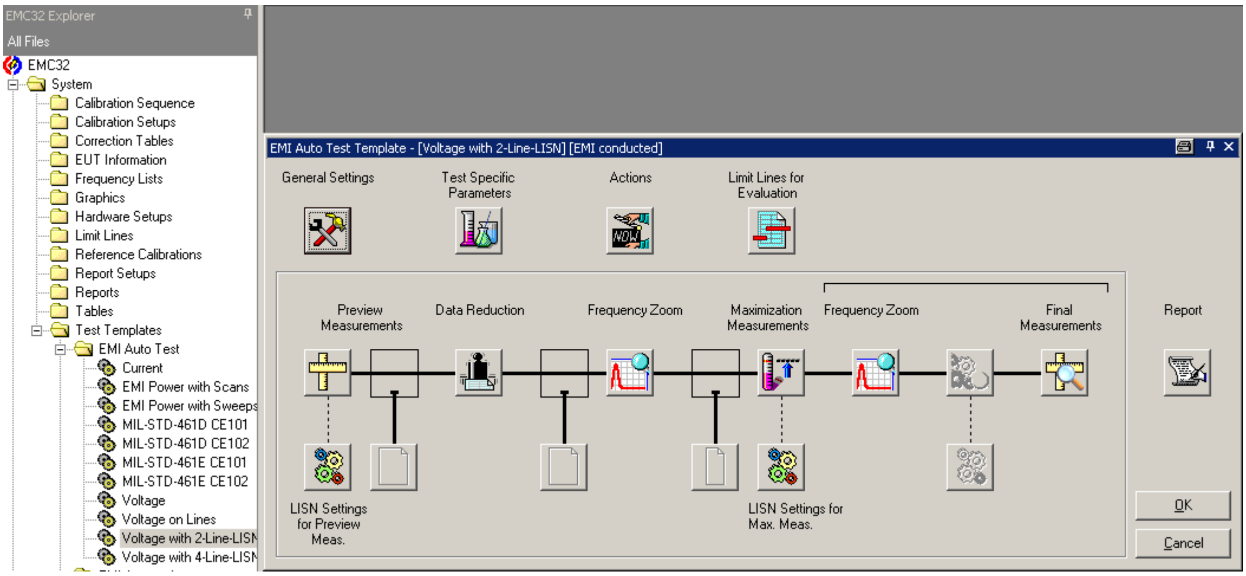


Fig. 4-1: Emi Auto Test Template

The EMI Auto Test of Voltage with 2-Line-LISN has following submenus:

- **GENERAL SETTINGS** – Defines according start and stop frequencies and the limit lines of a certain Hardware Setup (e.g. Voltage with 2-Line LISN).

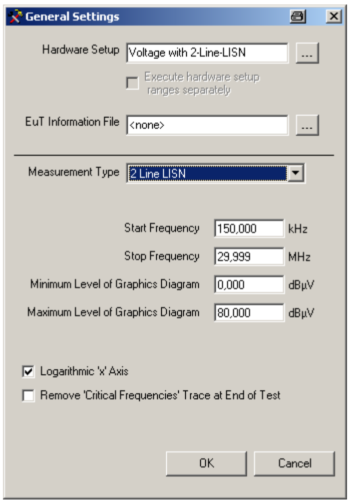


Fig. 4-2: General Settings

- **TEST SPECIFIC PARAMETERS** – Enables / disables the HP 150 kHz filter which not only suppresses frequencies under 150 kHz but more important, their associated harmonics that falsify the scan result.

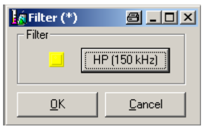


Fig. 4-3: HP Filter

- **ACTIONS** – Allows to add user defined actions (“Program a Device”, “Remote Action”, etc.) before and after each measurement step.

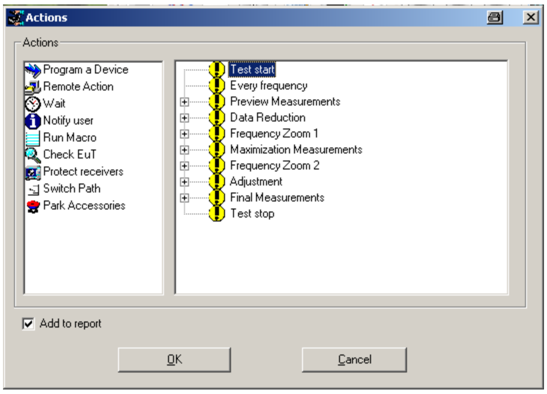


Fig. 4-4: Actions

- **LIMIT LINES FOR EVALUATION** – Defines which limit lines are used to determine the frequencies for the final measurement.

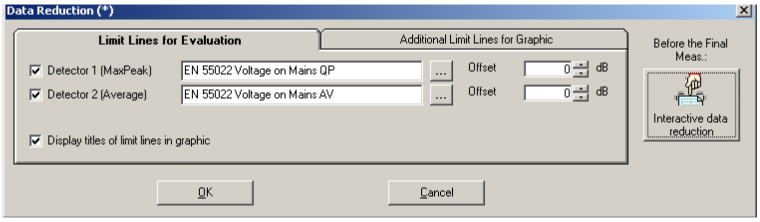


Fig. 4-5: Limit Lines

4.2.1 LISN Settings for Preview Measurement

Select which line should be measured, L1, N or both.

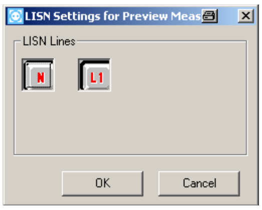


Fig. 4-6: LISN Settings for Preview Measurement

4.2.2 Preview Measurements

Quick, complete test over the whole frequency range repeated for all necessary accessory combinations (EMI conducted: 150 kHz to 30 MHz either for one or for both LISN lines). At each combination an EMI scan or sweep according to the test template is performed and the output of all scans/sweeps is merged into result tables with the information on relevant accessory settings for the larger of the measured values at all frequencies. The number of temporary generated tables for internal use and the resulting output tables is depending on the settings in the hardware setup (number of sub-ranges) and in the scan/sweep test template (number of detectors).

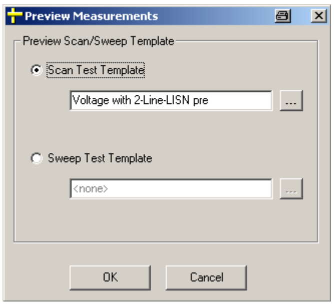


Fig. 4-7: Preview Scan / Sweep Template

4.2.3 Data Reduction

The CISPR 16-2-1 specification stipulates 9 kHz resolution bandwidth (RBW). The step size for the time-domain scan is ¼ RBW = 9 kHz / 4 = 2.25 kHz. The resulting number of frequency points is > 10000 and too large for final measurements with the quasi-peak detector. The data reduction sequence step avoids spending unnecessary measurement time for uninteresting frequencies during **ZOOM**, **MAXIMIZATION**, **ADJUSTMENT** and **FINAL MEASUREMENT**. The number of measured frequencies is reduced to a list of critical frequencies used as input at least for the Final Measurement.

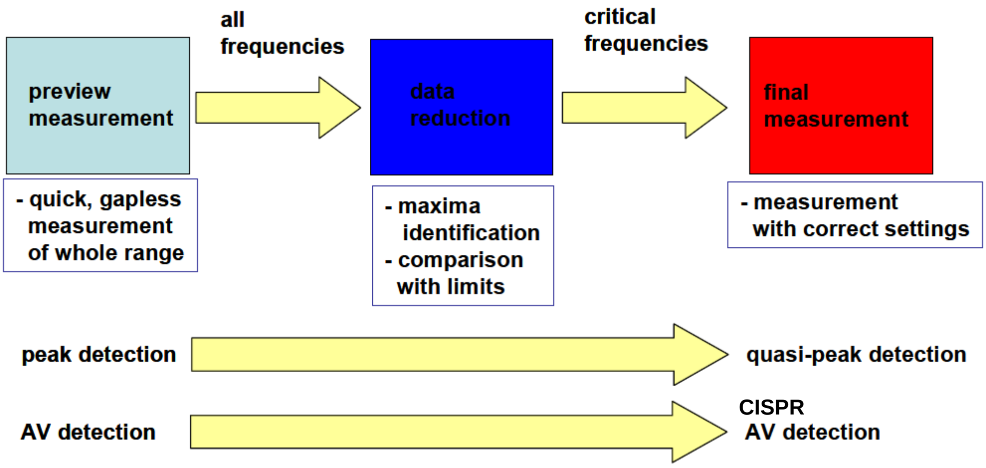


Fig. 4-8: Data Reduction Algorithm

The reduction of frequency points from the preview for final measurement is achieved in two paths (optionally 3 paths).

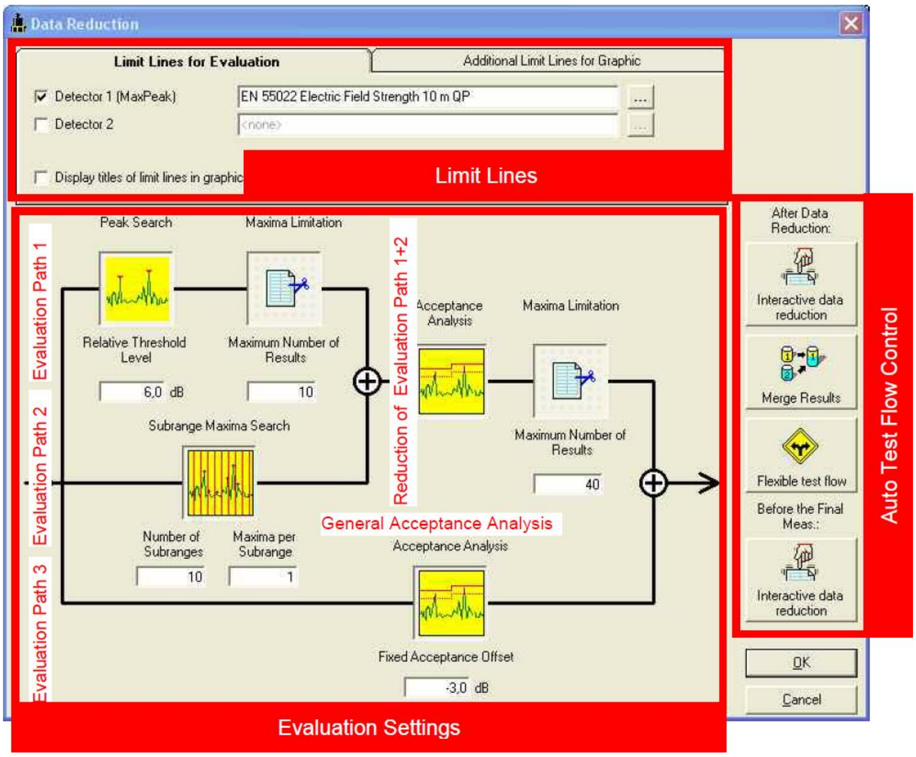


Fig. 4-9: Data Reduction in EMC32

Evaluation Path1:

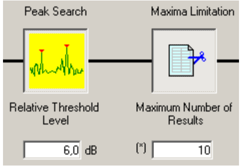


Fig. 4-10: Evaluation Path1

The 1st evaluation path contains a combination of **PEAK SEARCH** with relative threshold level and **MAXIMA LIMITATION.** This path helps to find the highest narrowband signals in the measured frequency range and reduce them to a reasonable number for further evaluation.

PEAK SEARCH is used to find all (preferably) narrowband interference peaks depending on a custom decision level. The decision level determines how far a local maximum must exceed the adjacent lower test points to be considered as a peak and to appear in the output file.

In case a limit line is additionally specified, not the absolute level characteristic of the trace is examined, but the distance between the test point and the respective limit value.

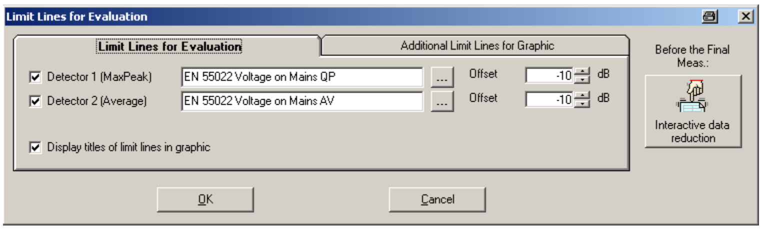


Fig. 4-11: Limit Lines for Evaluation

With 0 dB decision level, all local maxima are detected as peaks, with 20 dB for instance, only distinctive narrowband signals are detected. This function should only be used on non-intermittent curves, i.e. it should be the first one when combined with other data reduction functions.

MAXIMA LIMITATION is used to transfer a defined number (max. 1000) of maximum levels from the input to the output file. It is possible to focus e.g. on the 10 most critical points of a measurement result.

Evaluation Path 2:

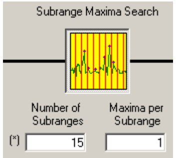


Fig. 4-12: Evaluation Path 2

In the 2nd evaluation path the **SUBRANGE MAXIMA** function is applied. Optionally determine n points per subrange (normally n=1). The highest local maxima will be collected from each subrange.

The **SUBRANGE MAXIMA** function is used to split the input file trace into a defined number of subranges (max. 1000). The maximum for each subrange is determined and transferred to the output file. If a limit line is specified, the distance between the test points and the according limit value is examined instead of the absolute level characteristic of the trace. The subrange limits are equidistant for linear or logarithmic scales. This function is suitable for detecting broadband and narrowband signals over the complete measured spectrum.

REDUCING THE NUMBER OF MAXIMA FROM PATH 1 AND PATH 2 EVALUATION:

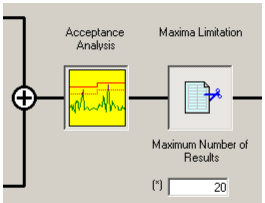


Fig. 4-13: Reduce Maxima

Path 1 and path 2 peak search results will be combined and the number of maxima reduced by following functions:

For the **ACCEPTANCE ANALYSIS** a limit line for each detector can optionally be selected which will also be used for the level evaluation in the final measurements. Each limit line may be optionally shifted by the defined offset value (thus EMC32 will add the offset value to the copy of the original limit line in the current test.

The **ADDITIONAL LIMIT LINES FOR GRAPHIC** are only displayed in the result graphic but are not used for data reduction or evaluation purpose.

Besides, the acceptance offset has to be defined (an offset of e.g. - 10 dB means that all level points which are higher than 10 dB below the limit will be accepted).

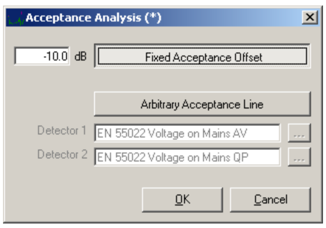


Fig. 4-14: Acceptance Analysis with Fixed Acceptance Offset

Alternatively to a fixed acceptance offset, you can directly let filter the data with an arbitrary acceptance line for each detector (the acceptance offset will then be ignored). This acceptance line is a user defined limit line (frequency range and level unit have to match the actual limit line) and is normally defined such that it runs closely above the noise floor. This is helpful in situations where the noise floor comes relatively close to the limit.

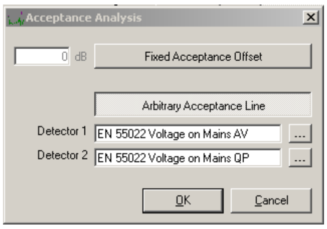


Fig. 4-15: Acceptance Analysis with Arbitrary Acceptance Line

The parameter 'Display titles of limit lines in graphic' allows enabling or disabling the display of the limit line name label. Optionally two 'additional limit lines' can be defined which will be shown in the measurement graphics.

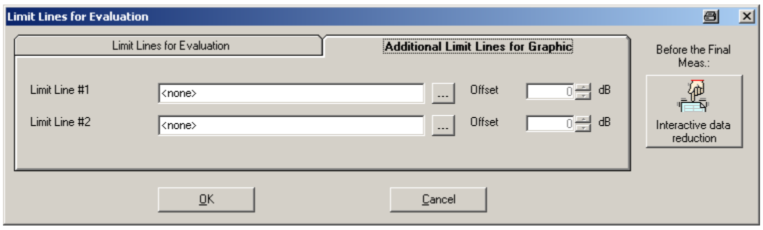


Fig. 4-16: Additional Limit Lines for Graphic

The number of measurement points that will remain after the data reduction can be limited through a further maxima setting.

Evaluation Path 3:

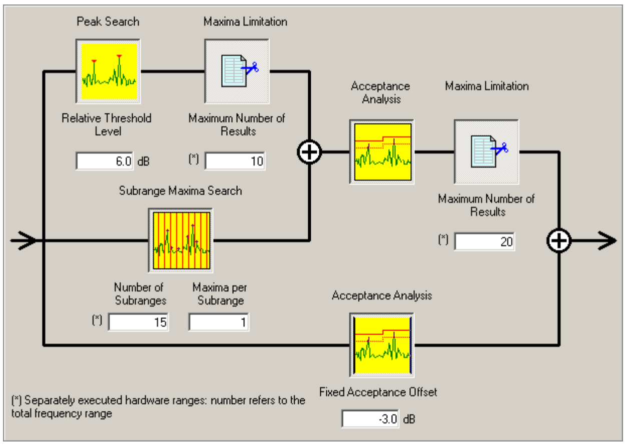


Fig. 4-17: Evaluation Path 3

Optionally a 3rd evaluation path (**ACCEPTANCE ANALYSIS**) can be used to ensure that any limit exceeding point will be kept. In rare cases a spike may dominate over a true interferer which therefore may not be kept (although exceeding the limit), depending on the parameters described above. An offset can be applied (e.g. - 3 dB means that all points which are higher than 3 dB below the limit will be added).

EVALUATION TRACEABILITY AFTER TEST

At the end of a test you will get the data reduction results, combined from all frequency ranges. This helps for the traceability of the results from the data reduction.

ADDITIONAL OPTIONS FOR THE TEST FLOW CONTROL:

The following buttons on the right side of this data reduction dialog provide additional user interaction and evaluation during the test flow:

- **AFTER DATA REDUCTION:**

  INTERACTIVE DATA REDUCTION – When enabled the results from the data reduction can optionally be revised (**interactive data reduction**). For this purpose the test will be interrupted after the data reduction has been completed so that the list of critical frequencies can be edited or expanded (this will be indicated by the PAUSE sign in the test control toolbar).

  MERGE RESULTS – When enabled the following additional evaluation after the data reduction is done:
  - If the preview results for **only the 1st detector** are generated, but the final measurements are defined with two detectors, then this preview result list will be copied to the 2nd detector and also be used for the final measurement with the 2nd detector.
  - If results for **two detectors** are generated, then both result lists can optionally be merged into a single list which will be used with the 1st detector only in the consecutive test phases. Especially with DC motors it may be interesting to extract maxima from a preview MaxPeak curve (broadband interferers) as well as maxima from a preview AV curve (NB interferers) and re-measure all these points with the same (Quasipeak) detector.

- **BEFORE FINAL MEAS:**

  INTERACTIVE DATA REDUCTION – When enabled the results from the latest test phase (typically from the maximization) can optionally be revised in another **interactive data reduction before the final measurements**. For this purpose the test will be interrupted so that the list of critical frequencies can be edited (normally removal of irrelevant points).

4.2.4 Frequency Zoom (I)

The accuracy of the remaining frequencies after data reduction can be increased by partial scans or sweeps. If the preview measurements are sampled / collected by means of a sweep template, then a template must be selected, because the frequency resolution might not be sufficient. When doing preview measurements with scans, then this feature is optional but may be necessary if the disturbance signals are drifting.

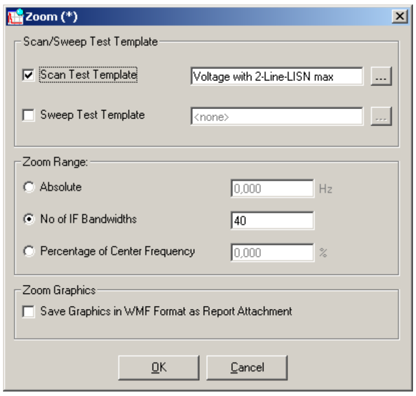


Fig. 4-18: Frequency Zoom (I)

4.2.5 Maximization Measurements

The (optional) maximization is performed with single measurements based on the selected scan template.

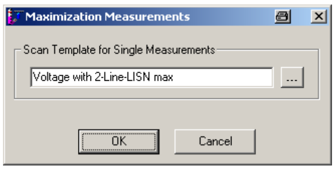


Fig. 4-19: Maximization Measurements

The maximization measurements will be performed on all LISN setups activated in this sub-dialog, and maximized in a way so that in the end for each frequency the maximum level and the corresponding LISN setup will be stored.

Note:

After the maximization phase, the test phases **FREQUENCY ZOOM (II)**, **ADJUSTMENT** and **FINAL MEASUREMENTS** will be performed sequentially (i.e. in one block) before tuning to the next critical frequency (see next chapter).

4.2.6 Frequency Zoom (II)

This additional test phase for increasing the frequency accuracy is optional (not available with all automatic test flows !), but may be helpful with interferers of which the frequency is drifting over time.

Note:

The "2nd zoom" measurements will not be performed in one block (like "1st zoom" measurements). Those measurements will be performed just before the corresponding adjustment / final measurement. As a consequence there is a short delay between the zoom and subsequent single measurements (all referring to the same interferer) helping with drifting interferers.

4.2.7 Final Measurements

The **FINAL MEASUREMENTS** are performed as single measurements based on the selected scan template. The scan template should fulfill all requirements of the EMC standard (detectors, IF bandwidth, measurement time). The results will be evaluated against the corresponding limit line (selected in the Data Reduction sub-dialog).

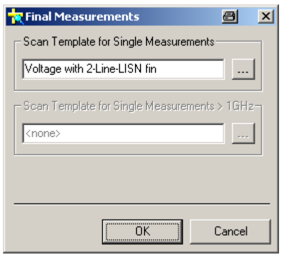


Fig. 4-20: Final Measurements

With conducted disturbance measurement, the LISN setup will be used and stored along with the result **before** each final measurement.

4.2.8 Report

The automatic report generation at the end of the test can be activated either as a printer hardcopy or a file (HTML: an HTML file plus one WMF file for each graphics diagram; RTF: a generic MS Word format; PDF: ADOBE Acrobat Reader). The file report will be stored in the sub-directory

<test directory>\Report\

with the name

Report1

(ascending numbers).

Note that a report setup can be defined with place holders so that certain results of an automatic test flow will be automatically included (typically the final results). The purpose of the Report Settings dialog is to reference a standard report template which is copied into a newly created test. This template can be modified in the **TEST NEW** dialog.

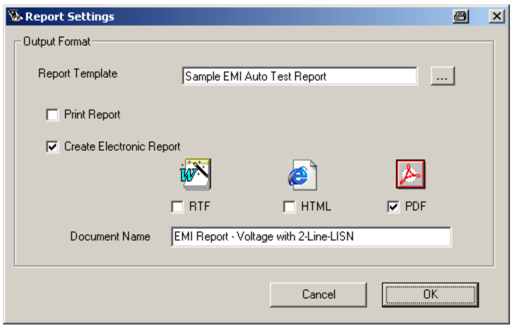


Fig. 4-21: Report Settings

4.3 Example

4.3.1 Hardware Configuration

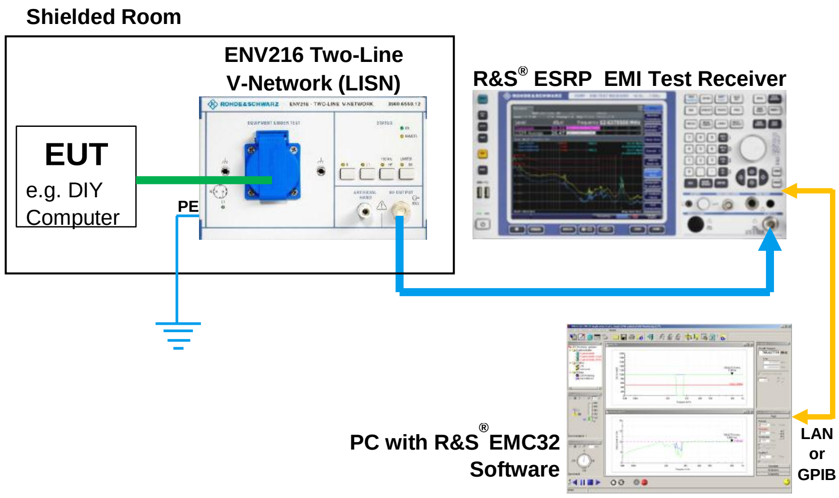


Fig. 4-22: Conducted EMI Hardware Configuration

Note:

Do not connect the power mains of the ENV216 Two-Line-V-Network to a plug secured by a leakage current circuit breaker. Due to the high error current, the circuit breaker will immediately trigger. Also be sure to connect a cable from the rear PE (Protective Earth) connecter to electrical earth before plugging in the mains.

4.3.2 Select Devices

- Open the **EXTRAS → DEVICE LIST** or press **F9** to define desired EMI Test Receiver, e.g. ESRP7.

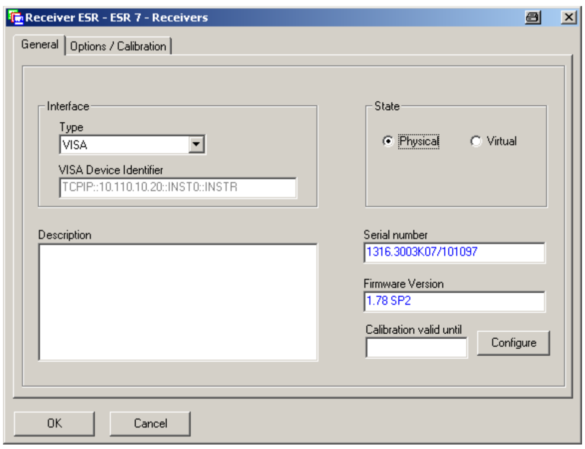


Fig. 4-23: ESRP7 Configuration

- and LISN.

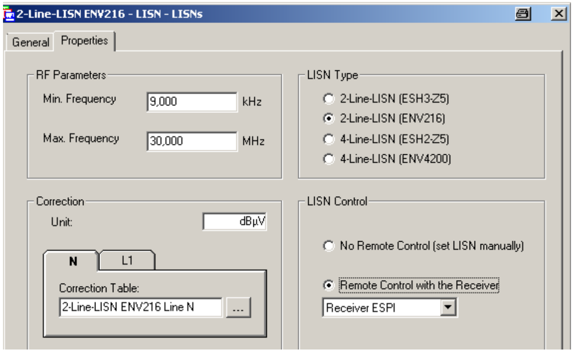


Fig. 4-24: LISN Parameters

Choose the appropriate **CORRECTION TABLE** for the N and L1 test. In case the test receiver has an according 25-pin Sub-D remote connected, select **LISN CONTROL → REMOTE CONTROL WITH THE RECEIVER** for an automated scan.

4.3.3 Start Measurement

Switch to Measurement Mode by clicking on the **SWITCH TO MEASUREMENT MODE (F4)** icon,

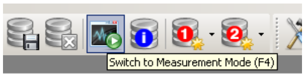


Fig. 4-25: Switch to Measurement Mode icon

selecting the **MEASUREMENT MODE (F4)** menu item

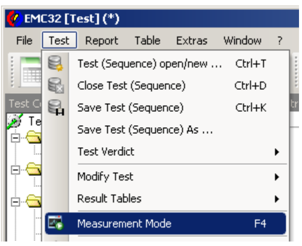


Fig. 4-26: Measurement Mode menu item

or pressing the **F4** button.

In order to start the measurement, press the Start button.

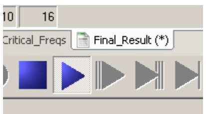


Fig. 4-27: Start button

A **Preview-Scan** of the complete frequency range (150 kHz to 30 MHz) will be performed first. Depending on the receiver type, this part can preferably be performed with the FFT-based time domain scan (ScanFast mode in EMC32), available on the ESRP, ESR and ESU, which only takes only a few seconds and is by magnitudes faster than the conventional stepped frequency scan (ScanLin mode) which is supported by default by all receiver types.

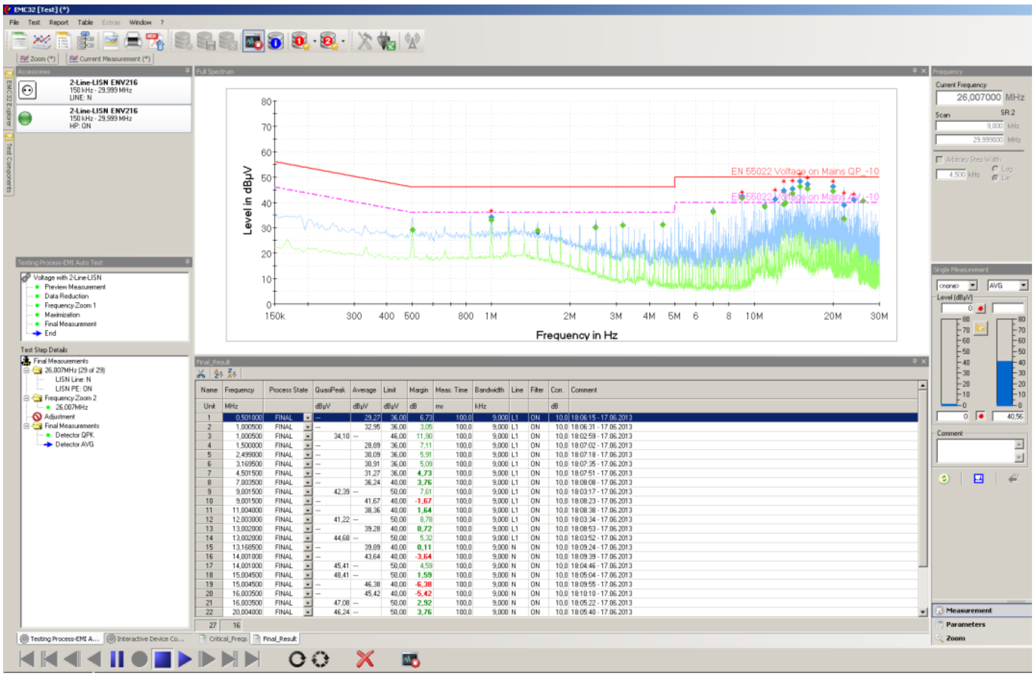


Fig. 4-28: Final Measurement Results

The **Final Test** result reveals that 29 test points were critical and needed to be re-measured according to the procedure described above. The green values passed after the final measurement, while the red ones (Margin < 0.0 dB) exceed the limit.

Critical_Freqs

Name	Frequency	Process State	MaxPeak	Average	Limit	Margin	Line	Filter	Corr.	Comment
Unit	MHz		dBµV	dBµV	dBµV	dB			dB	
1	0,501000	ZOOM2	---	29,31	36,00	6,69	L1	ON	10,0	18:06:11 - 17.06.2013
2	1,000500	ZOOM2	---	32,87	36,00	3,13	L1	ON	10,0	18:06:27 - 17.06.2013
3	1,000500	ZOOM2	36,70	---	46,00	9,30	L1	ON	10,0	18:02:54 - 17.06.2013
4	1,000500	ZOOM2	---	33,23	36,00	2,77	L1	ON	10,0	18:06:43 - 17.06.2013
5	1,500000	ZOOM2	---	27,98	36,00	8,02	L1	ON	10,0	18:06:58 - 17.06.2013
6	2,499000	ZOOM2	---	30,46	36,00	5,54	L1	ON	10,0	18:07:15 - 17.06.2013
7	3,169500	ZOOM2	---	30,76	36,00	5,24	L1	ON	10,0	18:07:31 - 17.06.2013
8	4,501500	ZOOM2	---	31,07	36,00	4,93	L1	ON	10,0	18:07:48 - 17.06.2013
9	7,003500	ZOOM2	---	36,82	40,00	3,18	L1	ON	10,0	18:08:04 - 17.06.2013
10	9,001500	ZOOM2	---	41,72	40,00	-1,72	L1	ON	10,0	18:08:20 - 17.06.2013
11	9,001500	ZOOM2	43,97	---	50,00	6,03	L1	ON	10,0	18:03:12 - 17.06.2013
12	11,004000	ZOOM2	---	39,04	40,00	0,96	L1	ON	10,0	18:08:35 - 17.06.2013
13	12,003000	ZOOM2	44,99	---	50,00	5,01	L1	ON	10,0	18:03:30 - 17.06.2013
14	13,002000	ZOOM2	48,34	---	50,00	1,66	L1	ON	10,0	18:03:48 - 17.06.2013
15	13,002000	ZOOM2	---	39,15	40,00	0,85	L1	ON	10,0	18:08:50 - 17.06.2013
16	20,004000	ZOOM2	---	44,13	40,00	-4,13	N	ON	10,0	18:09:05 - 17.06.2013
17	24,004500	ZOOM2	43,31	---	50,00	6,69	L1	ON	10,0	18:04:05 - 17.06.2013
18	13,168500	ZOOM2	---	39,37	40,00	0,63	N	ON	10,0	18:09:20 - 17.06.2013
19	13,002000	ZOOM2	44,00	---	50,00	6,00	N	ON	10,0	18:04:23 - 17.06.2013
20	14,001000	ZOOM2	---	43,53	40,00	-3,53	N	ON	10,0	18:09:36 - 17.06.2013
21	14,001000	ZOOM2	48,62	---	50,00	1,38	N	ON	10,0	18:04:41 - 17.06.2013
22	15,004500	ZOOM2	---	46,28	40,00	-6,28	N	ON	10,0	18:09:51 - 17.06.2013
23	15,004500	ZOOM2	51,31	---	50,00	-1,31	N	ON	10,0	18:05:00 - 17.06.2013
24	16,003500	ZOOM2	49,78	---	50,00	0,22	N	ON	10,0	18:05:18 - 17.06.2013
25	16,003500	ZOOM2	---	45,90	40,00	-5,90	N	ON	10,0	18:10:06 - 17.06.2013
26	20,004000	ZOOM2	48,26	---	50,00	1,74	N	ON	10,0	18:05:35 - 17.06.2013
27	22,002000	ZOOM2	43,76	---	50,00	6,24	N	ON	10,0	18:05:53 - 17.06.2013
28	22,006500	ZOOM2	---	33,99	40,00	6,01	N	ON	10,0	18:10:22 - 17.06.2013
29	26,007000	ZOOM2	---	40,70	40,00	-0,70	N	ON	10,0	18:10:37 - 17.06.2013
29	16									

Critical_Freqs | Final_Result

Fig. 4-29: Critical Frequencies

5 Ordering information

EMC32 Software		
EMC32		
EMC32-K10	**EMI Auto Test for EMC32-EB**	**1117.6840.02**
EMC32-K2	**Meas. Functions “audio break through”, “Spurious Emissions”**	**1147.5506.02**
EMS Measurements		
SMB100A	**Signal Generator**	**1406.6000.02**
SMB-B101	Frequency Range 9kHz to 1.1GHz	1407.2509.02
BBA100A	**Broadband Amplifier**	**5354.9000.50**
BBA9K250M	Single Band 9 kHz – 250 MHz	5354.2506.02
NRP2	**Power meter, control unit with color display, GPIB, USB, LAN**	**1144.1374.02**
NRP-Z91	**Power sensor 9 kHz – 6 GHz**	**1168.8004.02**
NRP-Z4	USB adapter for NRP-Z sensors	1146.8001.02
EMI Measurements		
ESR3	**EMI Test Receiver 9 kHz – 3.6 GHz**	**1316.3003.03**
ESR7	**EMI Test Receiver 9 kHz – 7 GHz**	**1316.3003.07**
ESRP3	**EMI Test Receiver 9 kHz – 3.6 GHz**	**1316.4500.03**
ESRP7	**EMI Test Receiver 9 kHz – 7 GHz**	**1316.4500.07**
ESU8	**EMI Test Receiver 20 Hz – 8 GHz**	**1302.6005.08**
ESU26	**EMI Test Receiver 20 Hz – 26 GHz**	**1302.6005.26**
ESU40	**EMI Test Receiver 20 Hz – 40 GHz**	**1302.6005.40**
ESCI	**EMI Test Receiver 9 kHz – 3 GHz**	**1166.5950.03**
ESCI7	**EMI Test Receiver 9 kHz – 7 GHz**	**1166.5950.07**
ESL3	**EMI Test Receiver 9 kHz – 3 GHz**	**1300.5001.03**
ESL6	**EMI Test Receiver 9 kHz – 6 GHz**	**1300.5001.06**
ESPI3	**EMI Test Receiver 9 kHz – 3 GHz**	**1164.6407.03**
ESPI7	**EMI Test Receiver 9 kHz – 7 GHz**	**1164.6407.07**

About Rohde & Schwarz

Rohde & Schwarz is an independent group of companies specializing in electronics. It is a leading supplier of solutions in the fields of test and measurement, broadcasting, radiomonitoring and radiolocation, as well as secure communications. Established more than 75 years ago, Rohde & Schwarz has a global presence and a dedicated service network in over 70 countries. Company headquarters are in Munich, Germany.

Environmental commitment

- Energy-efficient products
- Continuous improvement in environmental sustainability
- ISO 14001-certified environmental management system

Certified Quality System
ISO 9001

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