# Getting Started

# with

# EMC32

# COPYRIGHT

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# Content

# Preface

EMC32 is the Rohde & Schwarz System Software for EMC measurements on 32-bit operating systems from Microsoft (Windows XP, Windows NT, Windows 2000). It provides a common user interface for Emission Measurements (EMI) and Susceptibility Measurements (EMS) which is designed to operate like a virtual instrument. It combines the convenience of an intuitive graphical user interface according the actual Windows standards with the maximum flexibility both for support of measurement devices and for running EMC measurements.

This manual should guide and support the user during his first experience with EMC32 software. Therefore the manual provides step by step procedures from software installation and configuration to the first EMC measurement using figures and examples.

EMC32 software is available either as single package EMI/EMS or as complete suite. This allows the following installation combinations:

- **EMI**

- **EMS**

- **EMI + EMS**

In this manual examples for both types of measurements are described. Users which have only installed one of the two applications may jump over the sections describing the other application.

A detailed description of the installation procedure is provided in the manual "**Installation Guide**" which is available in printed form and in electronic form on the CD.

# 1  System Requirements

Before installing EMC32 you should check that your computer meets the following minimum system requirements:

- Operating System
    - Windows NT 4.0 with Service Pack 5.0 or higher
    - or Windows 2000 (recommended)
    - or Windows XP (recommended)
- Administrator Access Privileges
- Microsoft Internet Explorer 5.0 or higher
- PC with Pentium processor (at least 200 MHz)
- 64 MB RAM (Windows NT4.0), 128 MB RAM (Windows 2000), 256 MB RAM (Windows XP)
- 100 MB free hard disk space
- Super VGA monitor, screen resolution of at least 1024 x 768 Pixels, 65536 colors (higher resolution recommended)
- USB interface integrated on the motherboard (not required for the demo mode; USB interface plug in cards are not supported for Windows NT4.0).
- IEEE bus interface card from National Instruments with IEEE488 driver at least with version 1.60 for the corresponding operating system (not necessary for demo mode)

If your computer does not meet these requirements, the performance of the software may be impaired.

# 2 Getting Help for EMC32

Rohde & Schwarz would like to give you the best possible product support. For informing you continuously about news, updates and tips & tricks for EMC32 we recommend that you take the following information into account.

## 2.1 Registration of the Software

Before you start using EMC32 you should register your license at Rohde & Schwarz. You will benefit from the registration by receiving support from our hotline and information about news and updates of EMC32. You can send us this registration using one of the following possibilities:

- The registration of EMC32 may be started via the call of the entry
  *? ® EMC32 on the Web ® Register Now*
  *in* the help menu. It is required therefore that your computer provides a connection to the Internet.

- Alternatively the registration form may be opened using the Internet Explorer from the folder *\Registration* on EMC32 CD-ROM by double-clicking on the file *Rohde & Schwarz EMC32 Form.htm*. This formulary can then be filled out, printed and sent via fax to the following fax number:        +49 (0) 89 - 4129 - 11819.

You will find your **Product ID** either in the *Info to EMC32* dialog which you can opened via the help menu or in the welcome dialog which is shown during the start of EMC32. For the correct display of your Product ID it is required that you have started EMC32 with an iKey connected.

## 2.2 Online Help

The Online Help is available in form of Windows HTML Help both on the CD and after the installation on the hard disk. A shortcut for starting the help is available in the program group "EMC32".The help may be started any time via the **help** menu or by pressing the **F1** key (context sensitive) in EMC32.

## 2.3 Support Center

In case you need immediate help to continue your work please call our Support Center (please read the corresponding chapter in the online help before calling):

**Phone:**          **+49 1805 124 242**

**Fax:**             **+49 89 4129 13777**

## 2.4 e-mail

Send your request to the following e-mail address:

## CustomerSupport@rsd.rohde-schwarz.com

## 2.5  Send Feedback

We are always open to receive any feedback (criticism or suggestion) on EMC32 to improve permanently EMC32. Please use therefore our Send Feedback form.

This form you can open via the help menu *(? >> EMC32 on the Web >> Send Feedback*) under the precondition that your computer is linked to the Internet. Alternatively you can open the form from EMC32 CD-ROM (refer to the Installation Guide for more details on this item).

## 2.6  EMC32 on the Internet

The newest information concerning EMC32 you will find on the web home page of Rohde & Schwarz under www.emc32.rohde-schwarz.com. There you can find free updates to the newest version of EMC32.

## 2.7  Training

Our training center offers intensive training courses for the usage of EMC32 software. Course schedules are available on the Rohde & Schwarz home page.

# 3  EMI Measurements

The system software EMC32 allows the automation of interference measurements of high frequency radiated and conducted electromagnetic signals. **E**lectro**m**agnetic **I**nterference 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 EC to get the CE label for an electronic device. Without a CE label it's not allowed to sell any electrical or electronic devices on the European Market.

The definition of interference limits up to which an EUT may generate emissions, is under the responsibility of national and international standard committees for Electromagnetic Interference. The standards are grouped as follows: Generic Standard, Product Family Standard and Product Standard. If no product standard is defined for a product then the product family standard is applied (in the EMC Directive this is the standard EN50081). If no product family standard is available then the generic standard is used. For example,the standard EN55022 is applied for information technology equipment (ITE).

This section explains how such measurements are defined and executed with EMC32 by using examples. EMC32 not only provides the possibility to perform frequency scans according to the standards but also allows interactive examination of the EUT to optimize measurements.

The following examples require that EMC32 is installed with the EMI measurement part and configured with the demo configuration. The measurement sequence of these examples are applicable to any other configuration of an EMI Test System according to EN55011 or EN55022.

## 3.1  My first Test

**What is a Test?**

A Test is the central element in EMC32 when performing an EMI measurement. From the view of the file system it is a subdirectory containing several files in which both the settings for the execution of the measurement and the measurement itself -- in graphical and tabular form -- are stored. Information about the EUT and the setup of the measurement report are also stored here as well.

This Test (subdirectory) is then stored in a *directory structure* which is based on the name of the EUT. *Measurement Classes* are used in EMC32 to distinguish either with which subsystem (EMI or EMS) and with which measurement type (radiated or conducted) the measurement has been performed. Using this procedure allows all tests which have been made for a given EUT to be logically grouped together.
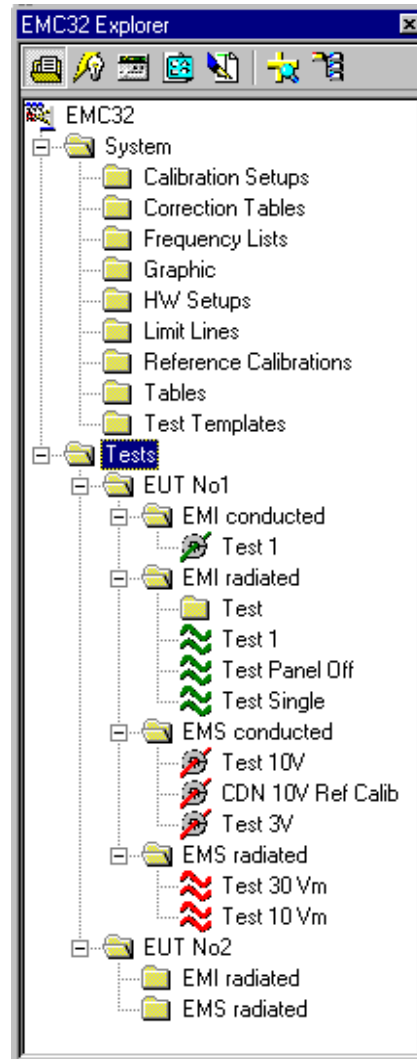
*Figure 3.1-1: Tree View of the EUT Oriented Test Directory Structure in EMC32 Explorer*


**What Components belong to a Test?**


A **Test** is stored in EMC32 file system by creating an new subdirectory on the same directory level as other Test subdirectories (or in a in an EUT oriented subdirectory under the root Tests) and contains the following files:

- A configuration file containing a reference to all files of the test (for internal use)

- Different result files depending on the measurement class of the test: EMI or EMS

- Test Templates in the subdirectory Setups

- Test Graphics in the subdirectory Graphics

- Possible HTML Reports in the subdirectory Reports

Since a test directory contains the used test templates which define how the result was measured as well as the measurement result, a clear reproducibility of the measurement and a traceability of the measurement result to the measurement setup is possible.

**What is a Test Template?**

For running an EMI measurement the software requires information about the frequency range in which the EUT interference should be measured. The settings of the receiver parameters to be used during the measurement run must also be defined.

These settings typically depend on the standard to which the EUT should be tested. They are stored together in a file called *Test Template for EMI Scan/Sweep*. Typically this file has the name of the referenced standard, for example "EMI Scan EN55022 Field". However, in our Getting Started example we will use a Test Template called "Generic Electric Field Strength". It contains typical settings for a field strength measurement but does not reference a particular EMI standard.

The configuration of the used measurement system is not stored in this Test Template but in an additional file called Hardware Setup (refer to the following definition).

This principle of using templates has the advantage that the complete measurement parameter definition does not have to be done every time before starting a measurement.

**What is a Hardware Setup?**

A Hardware Setup represents a block diagram of the used EMI Test System. Here the user defines which EMI receiver and which antenna or transducer (e.g. Current Clamp, LISN) should be used in each frequency range. The signal path for the signal connection between the devices is also defined and configured.

Running our first test can be divided into the following 5 steps:

- Start EMC32

- Create a new EMI Test

- Perform a measurement

- Store the test

- Create a measurement report

## 3.1.1  Starting EMC32

This step describes how to start EMC32 is started on your computer. After this step EMC32 is ready to run a new measurement test.

**Starting EMC32:**

1. Press the **Start** button on the Windows taskbar and select the Programs menu.

2. In EMC32 program group select EMC32 **icon** or perform a double-click on EMC32 icon on the desktop.

3. The start window of EMC32 opens and the current version and the registration information are displayed.

4. During the start process EMC32 main window is opened as well. When this process is finished the start window is closed and the start dialog appears:
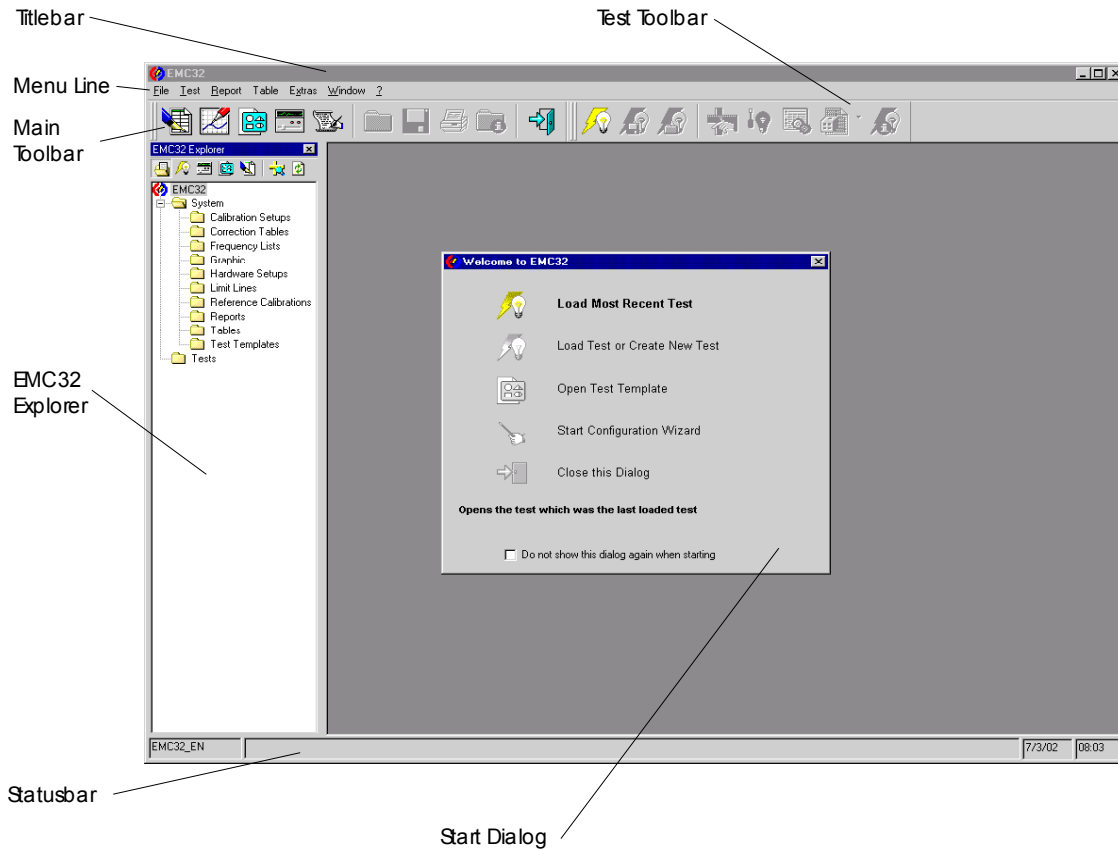
Titlebar

Test Toolbar

Menu Line

Main
Toolbar

EMC32
Explorer

Statusbar

Start Dialog

*Figure 3.1.1-1: EMC32 Main Window after the Start of the Software*

**Note:**
The window shown here may contain different elements due to modifications in the Options menu.

## EMC32 Main Window:

EMC32 Main Window contains the following elements:

*Head Line*: Here the name of the application EMC32 and possibly also the name of an opened Test is displayed. As long as the currently opened test has been modified but not stored (this applies to a new test too) a '*' symbol is also added to the test name.

*Menu Bar*: Contains the menu heads of EMC32.

*Main Toolbar*: Contains symbols which allow access to the most frequently used entries of the File menu.

*Test Toolbar*: Contains symbols which allow access to the most frequently used entries in the Test menu.

*EMC32 Explorer*: Allows the access to the file system of EMC32

*Start Dialog*: Is displayed at the start of EMC32 if this option is activated. The start dialog gives the first guidance to the user to quickly run a measurement.

*Statusbar*: Shows the Status of EMC32 during a measurement.

### Main Toolbar:

The following section gives a short introduction to the functionality of the symbols in the Main Toolbar.
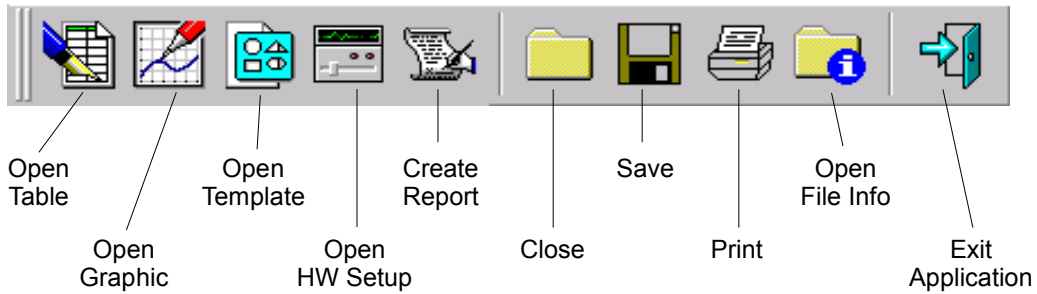


Open Table    Open Graphic    Open Template    Open HW Setup    Create Report    Close    Save    Print    Open File Info    Exit Application

*Figure 3.1.1-2: Main Toolbar*

### Test Toolbar:

The following section gives a short introduction to the functionality of the symbols in the Test Toolbar.



Open Test or Create New Test    Save Test    Close Test    Activate Measurement Mode    Modify Test Method    Modify Test Template    Open Result Table    Modify Test Info
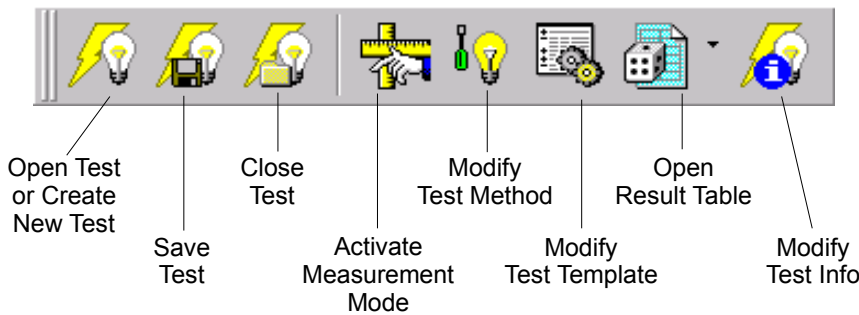
*Figure 3.1.1-3: Test Toolbar*

### EMC32 Explorer:

The following section gives a short introduction to the functionality of the symbols in EMC32 Explorer Window. EMC32 File Explorer provides an overview over the whole file system used by EMC32 and allows a quick direct access to these files.



Toolbar for Switching the View Mode of the Data Tree View

Start Point of the File Structure for the Calibrate and Configuration Data

View of the Directory and File Structure of the EMC32

Start Point of the EUT oriented Test Result Directory Structure

*Figure 3.1.1-4: EMC32 Explorer Window*

**Goal of this Step:**
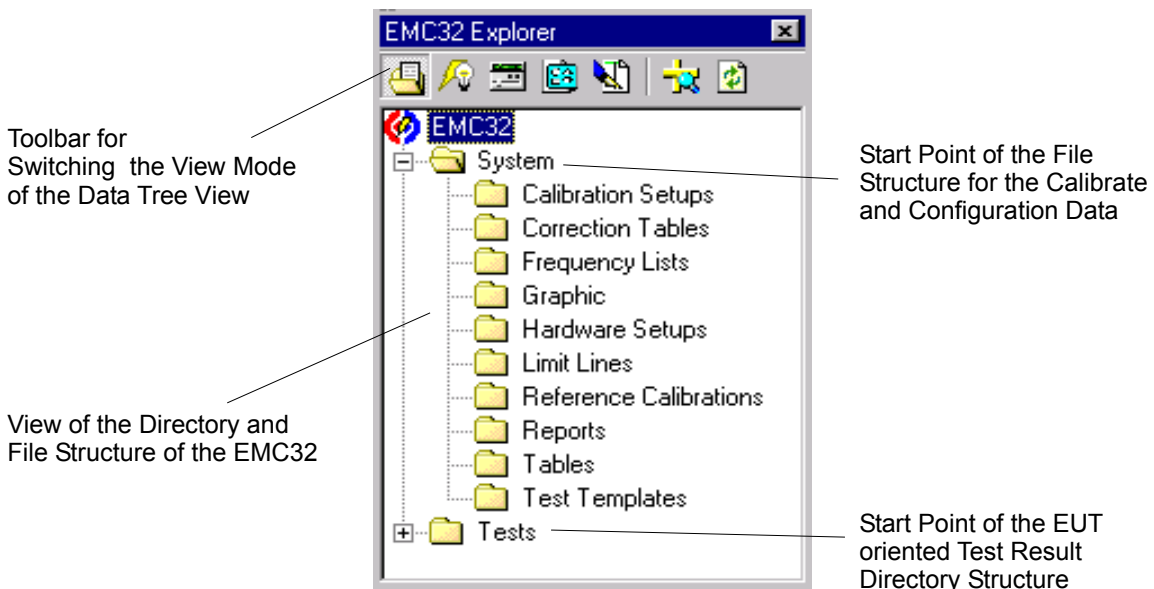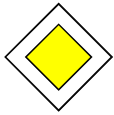EMC32 has been started and is now running. You should now be familiar with the main components of EMC32 Main Window. In the next step we want to create a new EMI test.

## 3.1.2 Create a new EMI Test

This step describes how a new EMI Test is created in EMC32. After this step the software is ready to run the measurement.

**Creation of a new EMI-Test in EMC32:**

1. Click in EMC32 menu on the **File** ® **Test** entry and the following Definition dialog for a new test will appear.



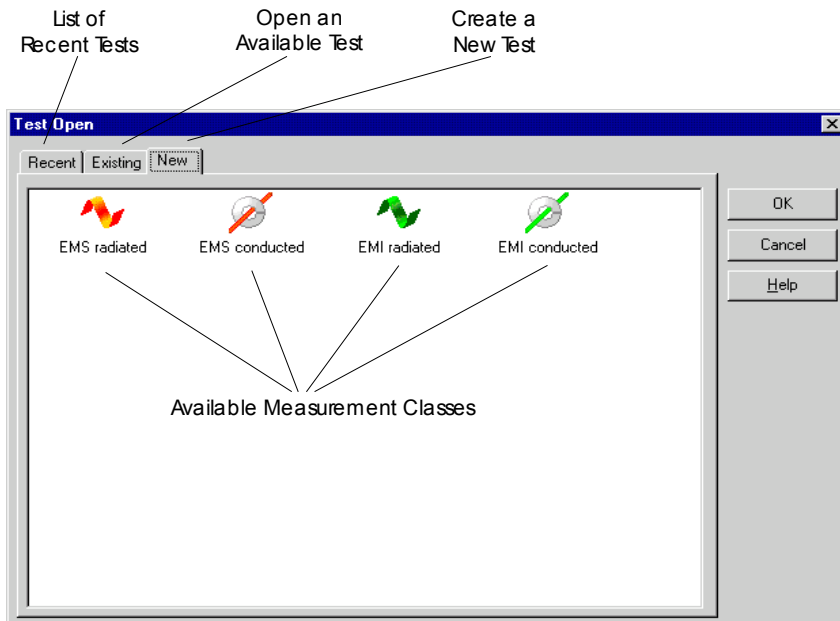*Figure 3.1.2-1: Open Test Dialog with selected Index-tab for a New Test*

2. Select the index-tab *New* and click on the symbol for the *measurement class* for which you want to run the measurement. For interference measurements *EMI radiated* and *EMI conducted* are available. Double-click in this example on the EMI radiated icon. The definition dialog for a new test appears.
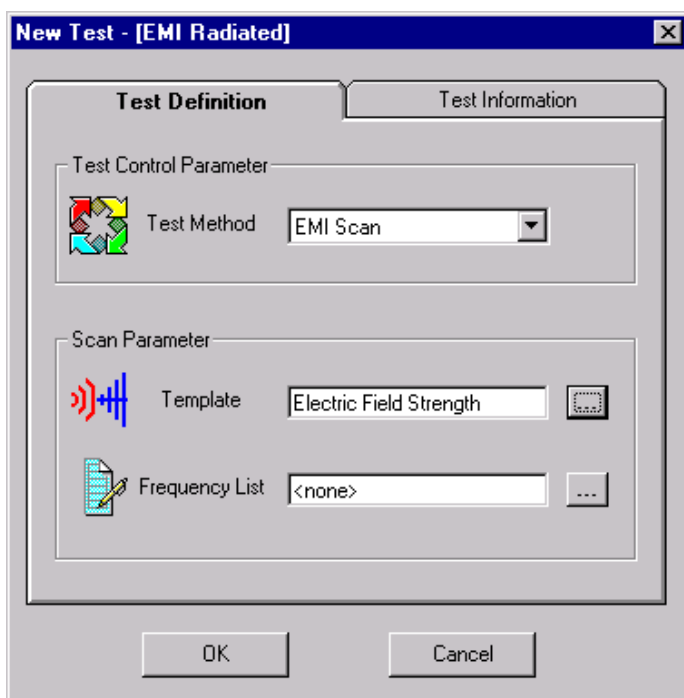
*Figure 3.1.2-2: New Test Dialog*

**Tip:**
You can also click with the right mouse button on the root directory **Tests** or on one of the EUT specific subdirectories below the **Tests** root. In the context menu which will appear you select the entry *New Test*. In the following dialog you select the measurement class for which you would like to run a measurement.

3. In this dialog you define which measurement you want to run. First you select the **Test Method**. In this example we want to run an *EMI Scan*. This is the default setting, so we have nothing to change.

4. After this we determine which scan parameter should be used. For the selection of a *Scan Template* (EMI Scan) we click on the button with the three points beside the text box field Template. In the following window only templates are available for selection which match the current measurement class (radiated).

5. The selection of the *scan parameter template* is **mandatory** but the selection of a frequency is list optional.

6. When required, the field *Test Information* maybe filled with any text which describes the EUT or the test procedure. Text may also be imported from a file. This text is stored in the test information for this test and can be used later on for the measurement documentation(report).

7. By clicking on the OK button the test creation is started. The test is then opened automatically. After that the measurement mode is activated and the control elements for the start of the measurement are displayed (refer to the following description). The EMC32 Main Window appears then as follows:
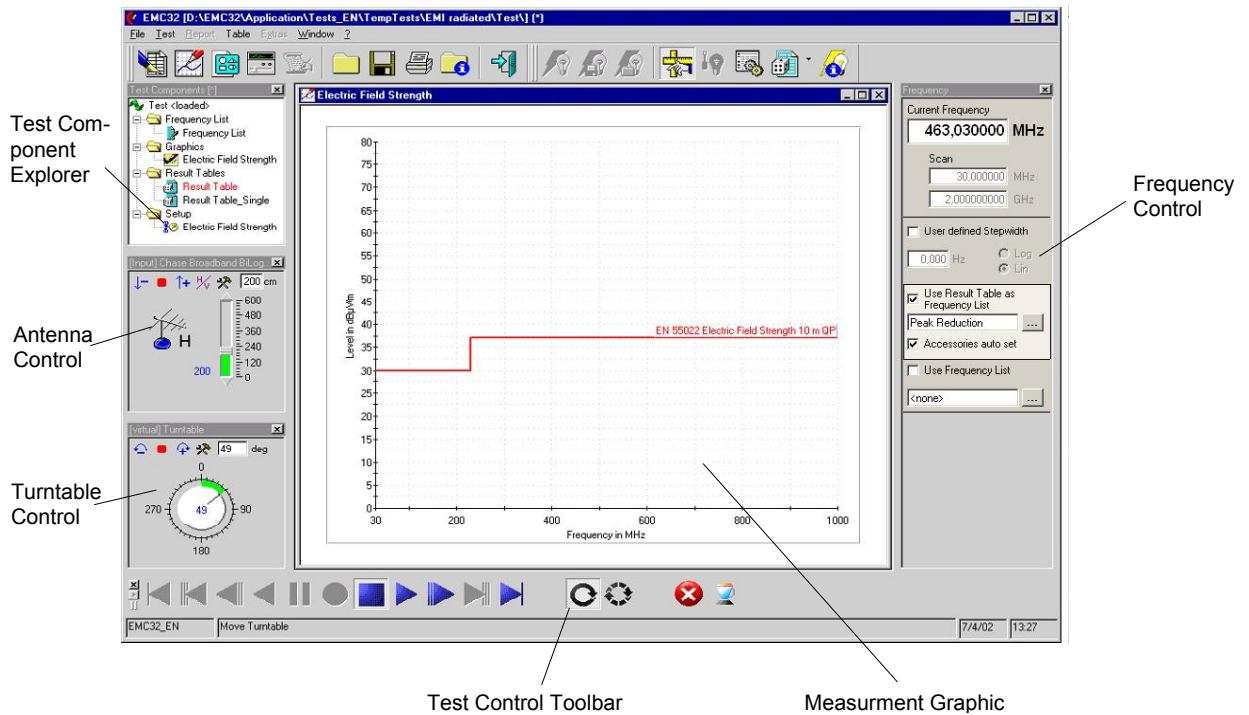
Figure 3.1.2-3: EMC32 Main Window after the Opening of a New Test

## New Elements in EMC32 Main Window:

After opening a new test the following additional elements appear in EMC32 Window:

*Test Component Explorer*: The Test Component Explorer window is docked on the left border of the main window. It contains a file tree structure representing all files which belong to the currently loaded test. The purpose of this window is to give the operator quick access to all data of a test, such as the result tables.

*Antenna Control*: This element is only available for tests of the measurement class radiated. It is used for both the display and the change of the antenna height and polarization. If there is no automatic antenna tower in the system, then the dialog serves for entering the position of a manually operated antenna.

*Turntable Control*: This element is only available for tests of the measurement class radiated and if a turntable device is available in the device list. It is used for both the display and the change of the turntable angle. If there is no automatic turntable in the system, then the dialog serves for entering the position of a manually operated turntable.

*Frequency Control*: This element is used for the control of the frequency scan and the setting of the current frequency.

*Test Control Toolbar*: The Test Control Toolbar is used to control the measurement. This is where the measurement run may be started and stopped. The operator may also use this to change from the automatic mode into the manual frequency scan.

**Test Component Explorer:**

The following section gives a short explanation of the functionality of the Test Component Explorer.
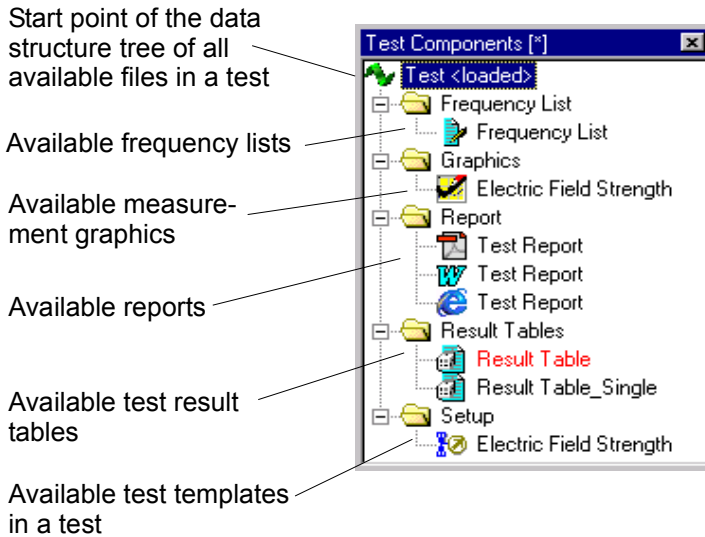
Start point of the data structure tree of all available files in a test

Available frequency lists

Available measurement graphics

Available reports

Available test result tables

Available test templates in a test

*Figure 3.1.2-4: Test Component Explorer*

**Frequency Control:**

The following section gives a short explanation of the functionality of the Frequency Control element. The operator may enter both the frequency where the measurement should be started and the frequency range in which the measurement should be performed (only limited by the frequency range defined by the EMI Scan Template).

Current Measurement Frequency

Scan Start Frequency

Scan Stop Frequency

Frequency Steps Coupled to Scan Template

Frequency Step Width

Frequency Step Mode

Automatic setup of e.g. antenna tower or EuT turntable as stored in the result table
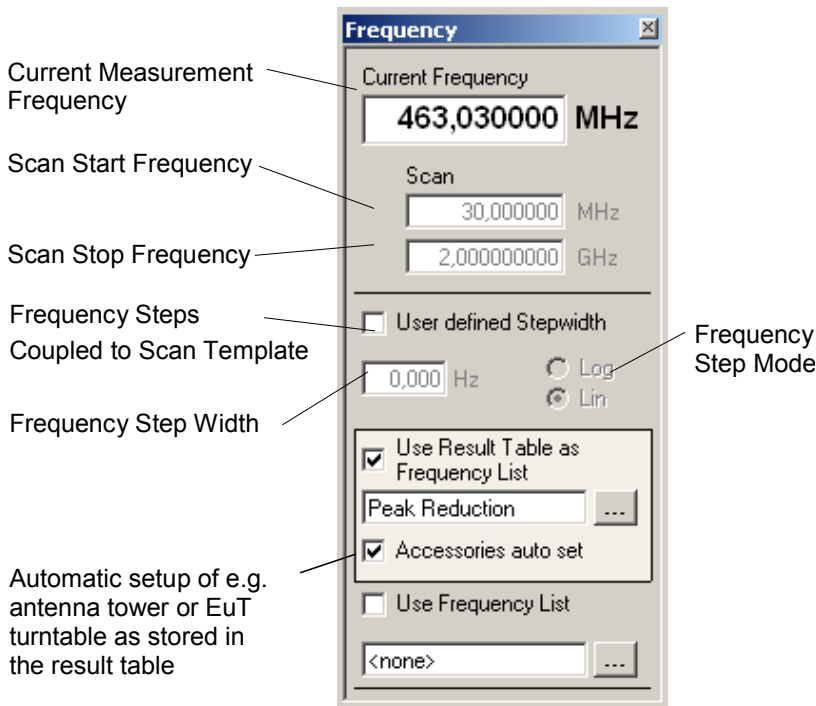
*Figure 3.1.2-5: Frequency Control*

**Test Control Toolbar:**

The following section gives a short introduction into the functionality of the Test Control Toolbar. It is used for the control of the measurement run and for switching of the measurement mode (automatic, single). During an automatic measurement only some of the symbols shown here are displayed.
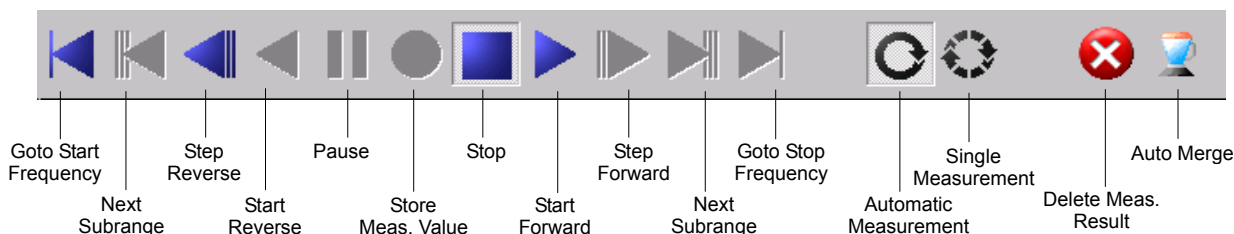


*Figure 3.1.2-6: Test Control Toolbar with View Single Measurement Mode*

**Which elements are only visible in the Single Measurement Mode ?**

The following symbols from figure 3.1.2-6 are only visible in the single measurement mode (refer to the following section) in the Test Control Toolbar:

- Start reverse

- Step reverse, forward (available for a Scan, not for a Sweep)

- Store Measurement Value

**What is the meaning of Measurement Mode?**

A test maybe loaded for two purposes: running a new measurement or doing additional analysis and to make a report printout of the measurement results.

EMC32 distinguishes between the **Measurement Mode**, used for running a measurement; and the **Analysis Mode**, where the symbols for running a measurement are not shown. The switching between both modes is done via the main menu entry Test → Meas. Mode, by pressing the **F4** key or by clicking on the corresponding symbol in the *Test Toolbar*.

When a new Test is created no result data are available for the analysis. Because of this the software immediately activates the measurement mode. If an existing test is loaded the software switches into the analysis mode. Here the measurement mode must be activated explicitly to repeat or continue the measurement.

In the measurement mode additional controls are added to the user interface of EMC32.
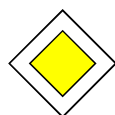
**Goal of this Step:**
You are now able to create a new EMI Test and are familiar with the basic functions of the controls for running a measurement.
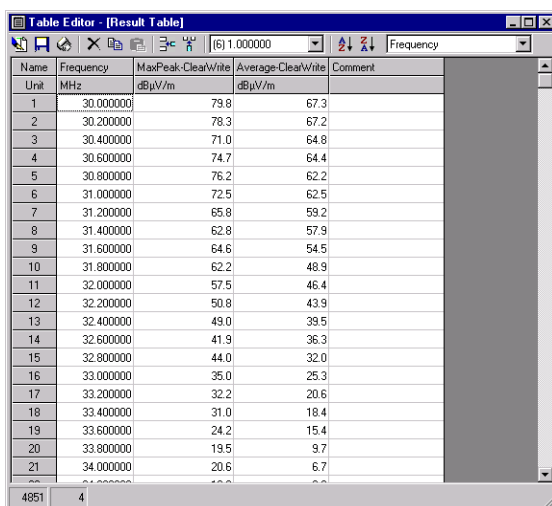
### 3.1.3  Running an EMI Measurement

This step describes how an EUT Measurement is performed. The EMC32 software mainly distinguishes between the automatic and the manual (interactive) measurement methods. In an automatic measurement the frequency is increasing automatically. The purpose of this measurement is mainly to determine whether the EUT shows interference within this frequency range. During a manual (single) measurement the operator may interactively modify both the frequency and the receiver settings (accessory optional). This measurement mode is used for the examination of an EUT at frequencies where there was a pronounced signal, in order to find the maximum value of the interference signal (depending for example, on the polarization for a radiated signal or from the current LISN line for a conducted signal) (refer also to chapter 3.2.2 for additional  details on Single Measurements).

After this step we will have measurement data available which we want to save and for which we want to generate a report printout.
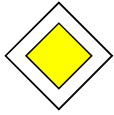
**Running an EMI Test in EMC32:**

1. Click on the **Start Forward** button in the *Test Control Toolbar*.

2. After checking whether all required measurement devices could be addressed the measurement is started. If at least one device is not accessible a dialog is opened which shows a list of all inaccessible devices. The operator has now the possibility to either stop the measurement or continue the measurement in the simulation mode.

3. During a measurement run EMC32 provides the possibility to stop the measurement run, enter a new measurement frequency and continue the measurement at this frequency.

4. For that purpose we now click on the **Pause** symbol in the test control toolbar, enter a new frequency which is within the current frequency range and click then on the **Start Forward** button.

5. This possibility is useful to stop the measurement run, for example to do some modifications of the EUT.

6. After we have performed a complete measurement we can see the measurement result in the graphics on the screen display. Now we want to see the measurement results in tabular form. We can see all available measurement result tables in the *Test Component Explorer*. For an automatic measurement run all results are stored in one result table. This table may either be opened via the file menu or by double-clicking on the corresponding table in the Test Component Explorer.



*Figure 3.1.3-1: Measurement Result Table of an Automatic Scan*

**Goal of this Step:**
You are now able to run an EMI Overview Measurement. You can stop and continue the measurement. You are now familiar with the functionality of opening the measurement result table for further analysis.

## 3.1.4 Saving a Test

This step describes how you can save your measurement data, which was generated in the previous steps, in the EUT-specific directory structure.

**Saving a Test in EMC32:**

1. First we exit the measurement mode since that it is not possible to save the test when this mode is active. Therefore we press the **F4** key or we click on the symbol **Activate Measurement Mode** in the Test Toolbar.

2. Select the menu entry **File** ® **Save Test** or click on the **Save** symbol button in the Test Toolbar. If the test was not saved before, like in our example, the following dialog will appear:
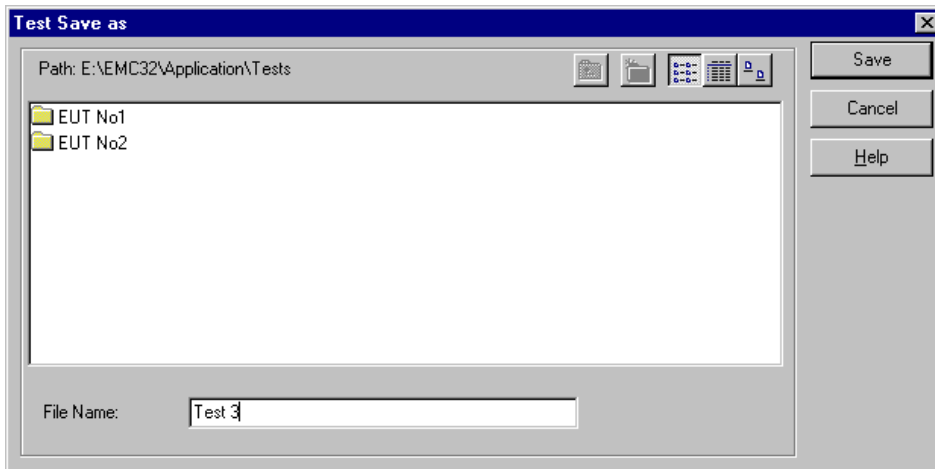


*Figure 3.1.4-1: Save Test Dialog*

Here the desired EUT subdirectory is selected, or a new EUT subdirectory is created and then selected.

**Advice:**
The EMC32 software creates a new subdirectory with the name of the measurement class if it doesn't exist (in our case EMI radiated) in the selected EUT subdirectory. It isn't necessary to select this subdirectory when the test is saved. If a test with the same name already exists, a message box appears asking if the existing test should be overwritten or not.

**Tip:**
If a new test has not been saved yet the Test Save as Dialog automatically appears when the test is closed.

3.  After we have entered a name for our test the following dialog appears before the Save procedure is finished. This dialog allows the user to input additional information about the EUT and the measurement. This dialog may be opened via the menu entry **Test ® Modify Test ® Test Info ...** as well or by clicking with the right mouse button on the Test entry in the Test Component Explorer and selecting the corresponding popup menu entry.
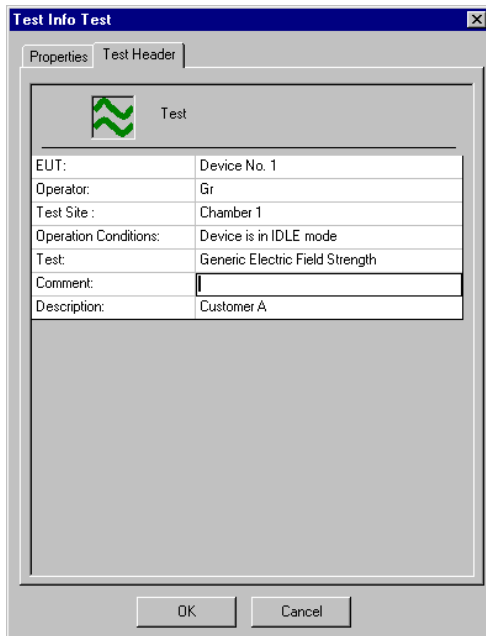


*Figure 3.1.4-2: Test Info Dialog*

4.  After closing the dialog with the **OK** button the Save Test procedure is finished.

5.  Now we may also make a copy of our test with a new name using  the **File ® Save Test As** function.

**Tip:**
If you would like to stop a test and continue it at a later time (for instance if the EUT is defective), you only need to open the test again, activate the measurement mode and then you may continue the measurement at the frequency where you stopped the measurement.
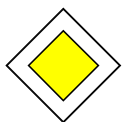
**Goal of this Step:**
You are now able to save your test in any location of the EUT specific test directory structure. You are also familiar with the functionality of entering additional information about the EUT and the measurement procedure into the Test Info Dialog.

### 3.1.5  Creating a Report

This step describes how you can create a report of your measurement results in EMC32 software.

**Creation of a Measurement Report in EMC32:**

1.   Select the menu entry **Report** ® **Report...** or click on the Create Report symbol in the Main Tool-bar. The Report Configuration Editor is started and EMC32 Main Window appears as follows:
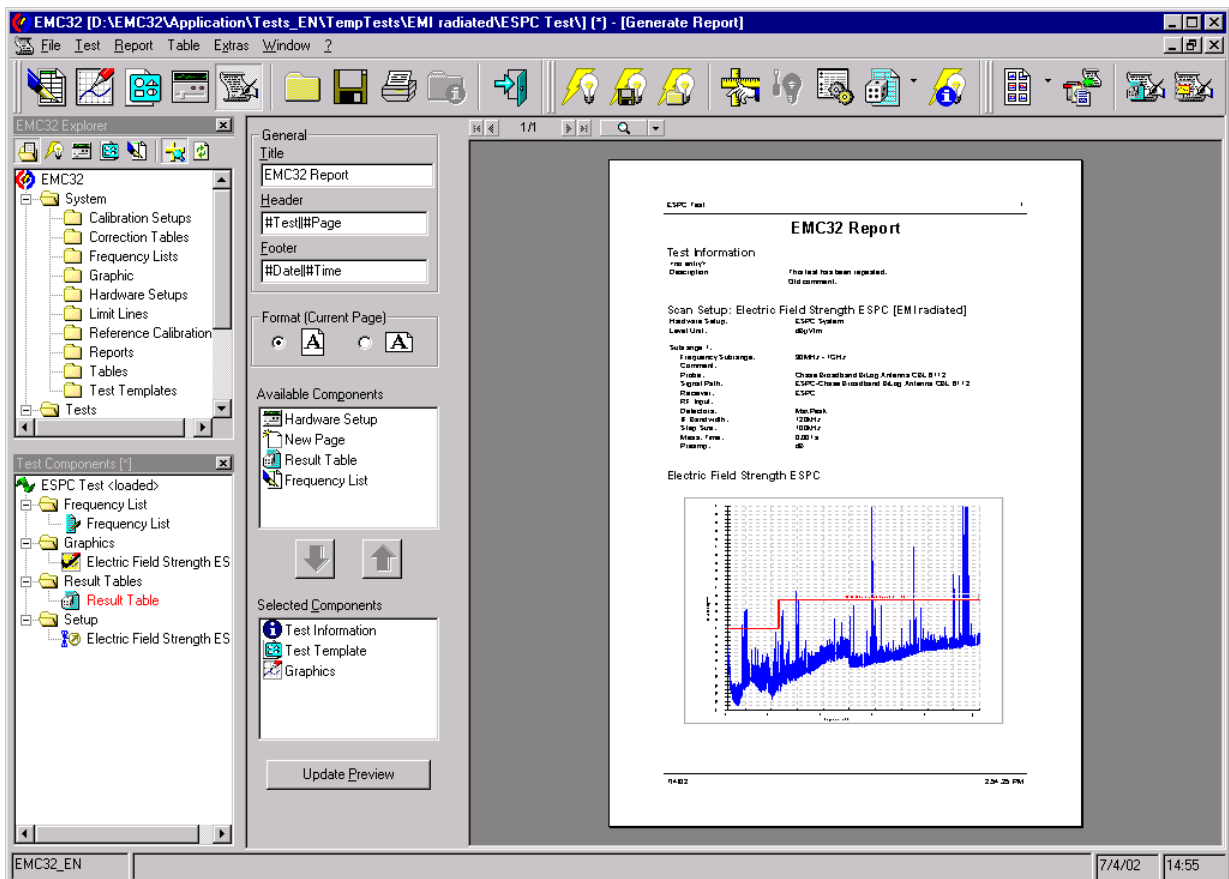


*Figure 3.1.5-1: EMC32 Software with opened Report Configuration Dialog*

## New Elements in EMC32 Main Window:

After starting the Report function the following additional elements appear in EMC32 Window:

*Report Toolbar*: The Report Toolbar provides fast access to the most important functions of the Report menu.

*Report Configuration Dialog*: In this dialog the report layout is configured. A Report consists of several components like Report Head, Graphics, Tables and Test Template Settings. These components may be configured and arranged in different positions of the report layout.

*Report Preview Window*: In this window a preview of the currently configured Report layout is shown. This preview corresponds to the printout which is done later.

**Report Toolbar:**

The following section gives a short introduction into the functionality of the Report Toolbar.



*Figure 3.1.5-2: Report Toolbar*

**Report Configuration Dialog:**

The following section gives a short introduction into the functionality of the Report Configuration Dialog.



*Figure 3.1.5-3: Report Configuration Dialog*

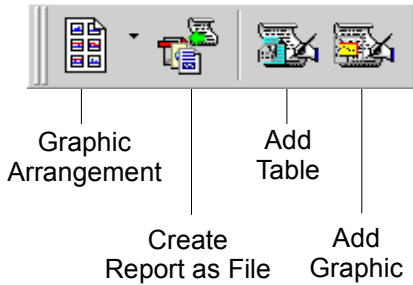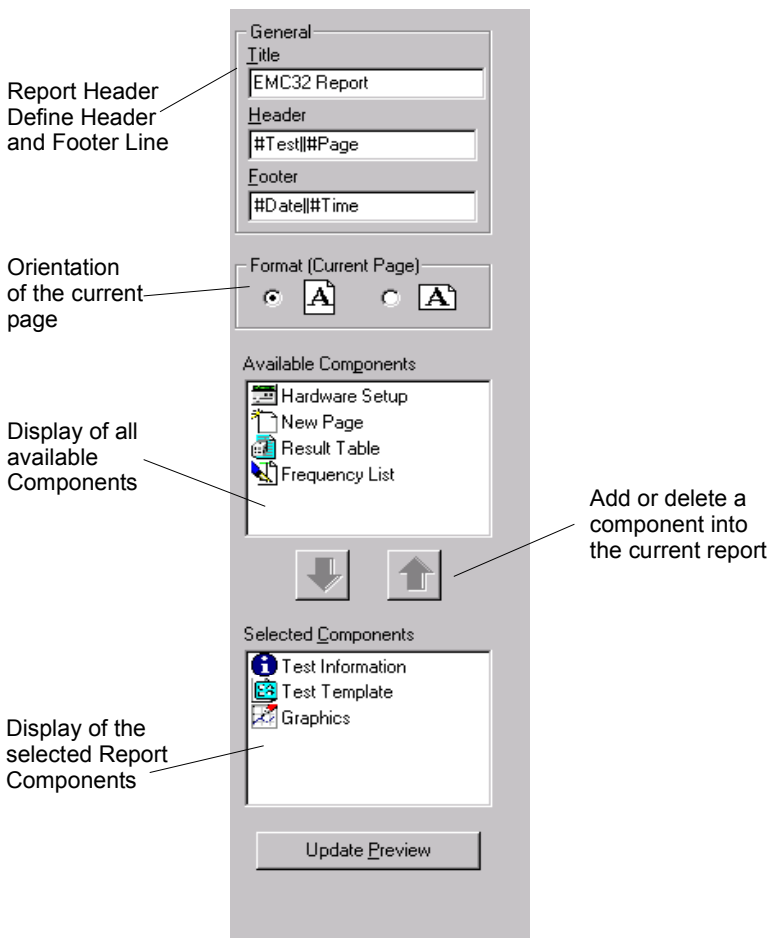2. The entries displayed in the dialog field Selected Components are defined by the template settings in the **Extras** ® **Options** (tab-index Report) dialog of EMC32. In our case the report contains the Test Info and graphics belonging to the current test (refer to the following tip as well).

   Now we also want to add a printout of the current EMI Scan Template to our report. Therefore we select in the list *Available Components* the entry Test Template and add this template to the list *Selected Components*, either through the selection of the menu function **Report** ® **Add Component** or by clicking on the **Add** button in the Report Configuration Dialog. After clicking on the button **Update Preview** in the Configuration Dialog, this component will appear in the report preview window.

3. In the last step we want to generate a printout of our report configured above. Therefore we select the menu entry **File** ® **Print** or we click on the symbol button **Print** in the Main Toolbar. A printout of our report is output on the current Windows standard printer.

4. Additionally an electronic report in PDF format should be generated. Therefore we select the menu entry **Report** ® **File Export** or we click on the **file Export** symbol in the Report Toolbar. The following dialog will appear:
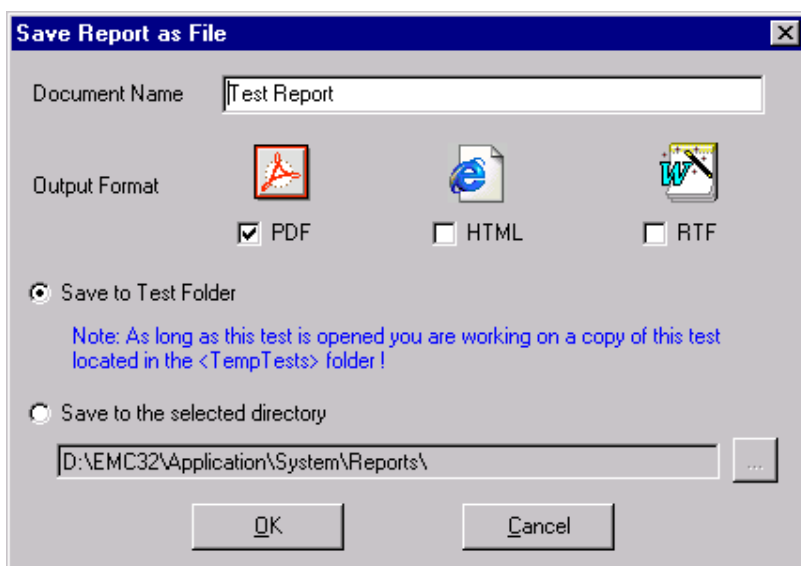


*Figure 3.1.5-4 Save Report as - Dialog*

In this dialog the operator has the possibility to define the name and the location for the report file as well as the output format. The report file may be stored either in the current test directory or in any selectable directory. The path and the name of the report file is displayed below the current selection in the dialog.

After clicking on the **OK** button the report file(s) is (are) created with the defined name in the selected folder. In PDF and RTF format one file will be generated. In HTML format for each graphics a file of the file type WMF (Windows Meta File) is created. Links to these graphics files are written into the HTML file.

5. The report configuration dialog is closed again by selection of the menu entry **Report** ® **Report**, clicking on the symbol **Close Report** in the Report Toolbar. The current report configuration is stored in the test and will be used as a template for the next call of the report function for **this** test.

6. Via the selection of the menu entry **File** ® **Close Test** or pressing the symbol **Close Test** the test currently open will be closed. All graphics and the Test Component Explorer will be closed.

**Tip for Graphics:**
All graphics in a report are handled as one single component. Due to this all graphics in a report may only be arranged and printed as a group. The determination of which graphic should be output is done via the configuration of the graphics component. If you open HTML reports containing WMF graphics with a Web Browser you should take into consideration whether your browser supports WMF graphics.

**Tip:**
The Report Configuration Dialog supports the Drag & Drop functionality, which means you can drag a test component from the list Available Components to the list Selected Components and drop it there. It's also possible to change the order of the components in the list *Available Components* by using this technique.
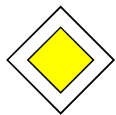
**Goal of this Step:**
You are now able to configure your measurement report according to your requirements and you can output the report on a printer or as a report file.

## 3.2 Further Steps with EMC32

During our first test in the previous section you have seen how a test is created, how a measurement is performed and how a measurement report is generated. In this section you will use examples to learn how:

• A Test Template is modified,

• A Single Measurement is done,

• An Automatic Conducted Test is performed.

These steps are useful when an EUT should be examined in detail after it has shown strong interference signals.

### 3.2.1 Modify an EMI Scan Template

This step describes how to modify the EMI Scan Test Template of an open test, for example to change the frequency step width or the measurement time.

Modify the Test Template in an EMI Scan Template of EMC32:

1. Select the menu entry **Test** ® **Modify Test** ® **EMI Scan** or click on the **EMI Scan** button in the Test Toolbar. The following dialog will appear:

Settings for
all Subranges
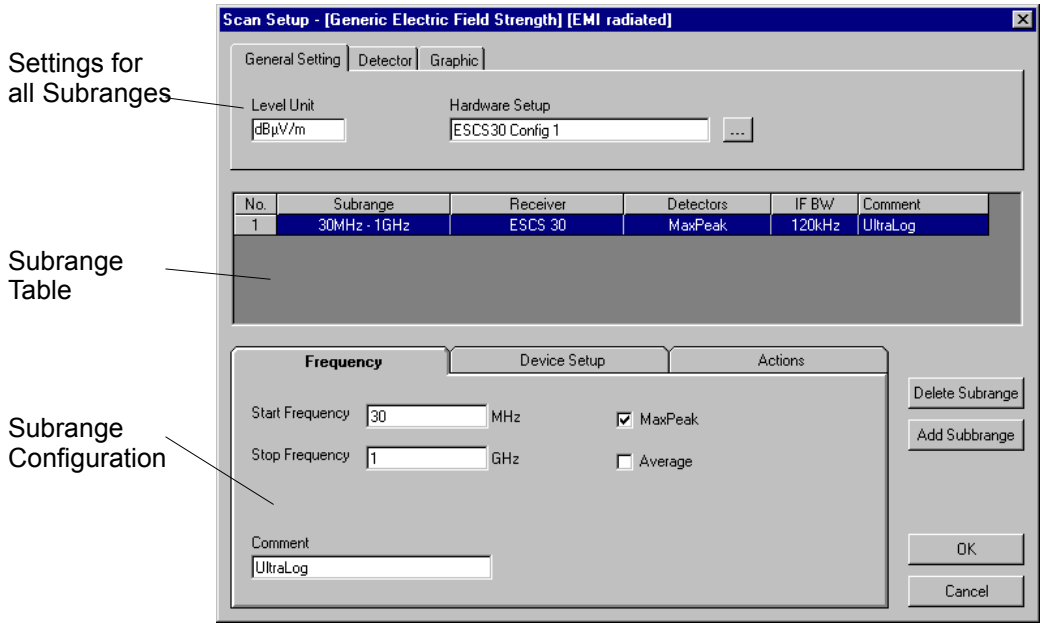
Subrange
Table

Subrange
Configuration

*Figure 3.2.1-1: EMI Scan Editor*

2. In this example the whole frequency range in which the measurement should be done is defined in one subrange. We now want to change the frequency step width of this example from 60 kHz to 40 kHz steps. Therefore we click first on the first subrange in the subrange list and then on the tab-index **Device Setup** in the *Subrange Configuration*. In this tab we click on the *receiver* symbol. The device dialog of the receiver appears.

   In the device dialog we select the tab-index Time/Bandwidth. Now we can enter the new value of 40 for the linear step width.

3. In our second example we want to change the measurement time. Therefore we click on the combo box *measurement time* and select the entry 2 ms.

4. Now we can close the editor by pressing the **OK** button.

5. After this all graphics in the EMC32 window are closed and a new test is created. The measurement mode is also activated to start the measurement run immediately.

**Note:**
Each modification in the EMI Scan Template will delete the existing measurement result. Before the test is initialized a request or is opened which allows the user to make a copy of the old measurement result.
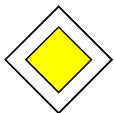
**Goal of this Step:**
You are now able to modify the most important parameters of an EMI Scan Template -- for example the frequency step width or the measurement time and to run a measurement with the modified parameters.

## 3.2.2  Running a Single Measurement

This step describes how you perform an EMI Single Measurement with EMC32. A Single Measurement is done in the same test in which the automatic preview measurement has been performed. The Single Measurement is based on a Scan Template of an automatic measurement, except that in this mode the following parameter settings of the template can be changed:

- Current Measurement Frequency

- Detectors

- Bandwidth, Measurement Time

- Demodulation

- Autorange, RF Attenuation, Minimum RF Attenuation

- Preamplifier, Reference Level

**Note:**
Some parameters are not available for each receiver type.

The measurement results of the Single Measurement are stored in a separate result table and also displayed in a separate curve in the graphics.

**Running a Single Measurement in EMC32:**

1. Create a new test or open an existing test and activate the measurement mode.
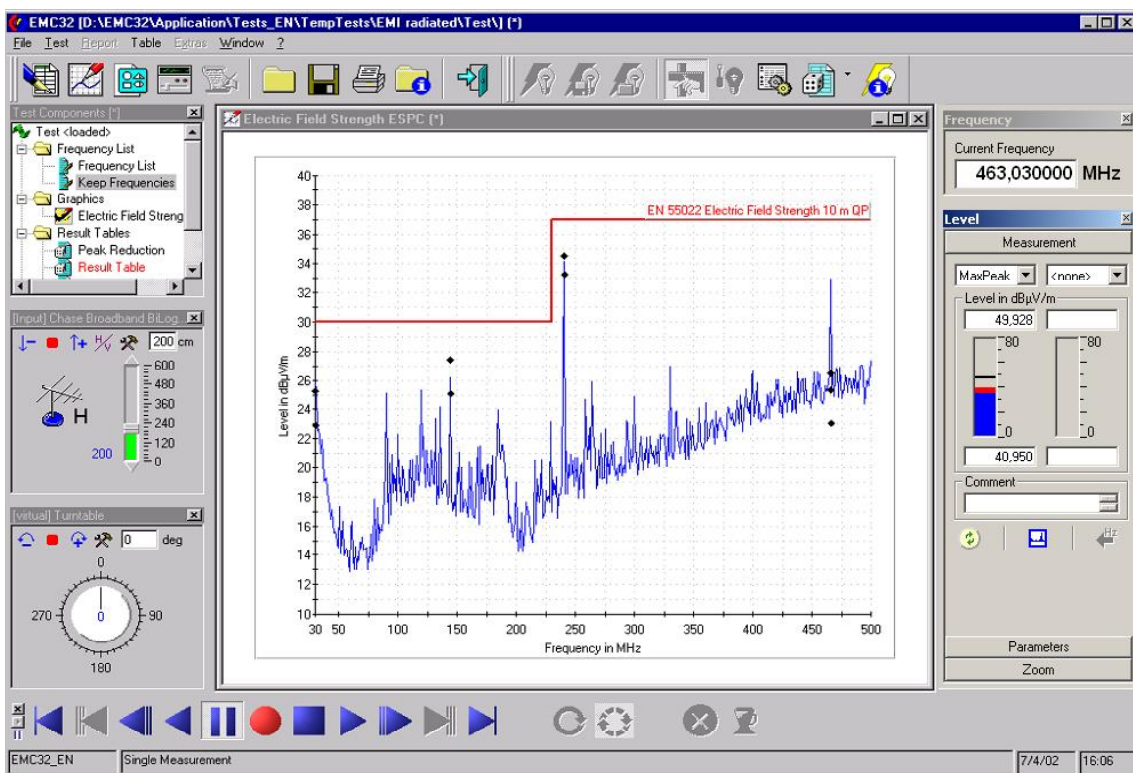


*Figure 3.2.2-1: Screen Shot of EMC32 in the Single Measurement Mode*

2. The Single Measurement Mode is activated by clicking on the **single measurement** symbol in the Test Control Toolbar. A dialog will appear for the selection of the Scan Template which will contain the measurement settings for the single measurement (in our example we will select the Test Scan Template from the automatic measurement).

   Now we want to examine the first peak from our Preview Measurement. Therefore we enter either the frequency of this peak into the frequency field of the frequency control or we use the Drag & Drop feature. We move the mouse pointer onto the peak until the **Set Marker** symbol appears, then press the left mouse button, hold it pressed and move the mouse pointer to the frequency input field of the Frequency Control until a '**+**' symbol appears. Now we release the mouse button and the frequency is displayed in the frequency field.

   By clicking on the Pause symbol our measurement system is activated at this frequency and the currently measured level is displayed both in the field Measurement of the Single Measurement Control and in the new graphics *Single*. The measurement is now repeated continuously for the current frequency until the user enters another frequency or performs another action
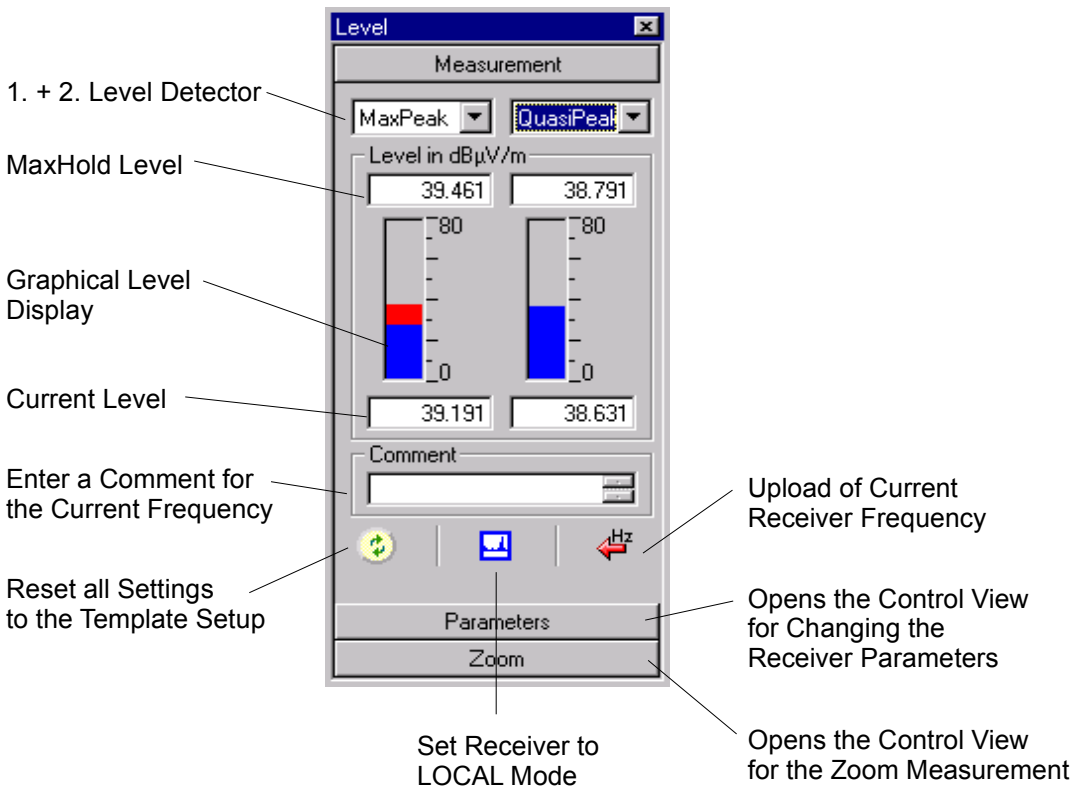


*Figure 3.2.2-2: Single Measurement Control in the View Measurement*

3. Now we want to activate the second detector to measure the interference signal level with the QuasiPeak detector according to the standard. Therefore we click on the corresponding combo box in the Single Measurement dialog and select the entry *QuasiPeak*.

4. For a detailed analysis it may be necessary to modify the receiver settings. For this purpose the Single Measurement Control can be switched into View Parameters.
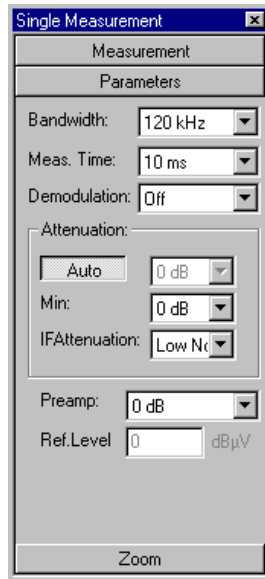
*Figure 3.2.2-3: Single Measurement Control in the View Parameter*

5.  Sometimes it can happen that the interference frequency is not stable over time (for example when the interference signal is not based on an oscillator). You can identify the problem when the interference level is lower in the single measurement than in the preview measurement. In this case it is necessary to first find the exact frequency for the maximum signal level before modification of the accessory equipment for the level maximization is performed.

    For this EMC32 provides the **Zoom** function: With this function it is possible to run a scan or sweep in a small frequency range around the interference frequency. To activate this function the *Single Measurement Control* is switched into the Zoom view. The following dialog view appears:

*Figure 3.2.2-4: Single Measurement Control in the View Zoom*

Before the *Zoom* Measurement is started a new scan or sweep template and the zoom range must be selected. After this the measurement can be started with the help of the **Start Forward** button. New graphics with the name **Zoom** containing several traces appear (see the figure below). With the help of the **Stop** button the measurement can be stopped again. Now the peak frequency of this graph 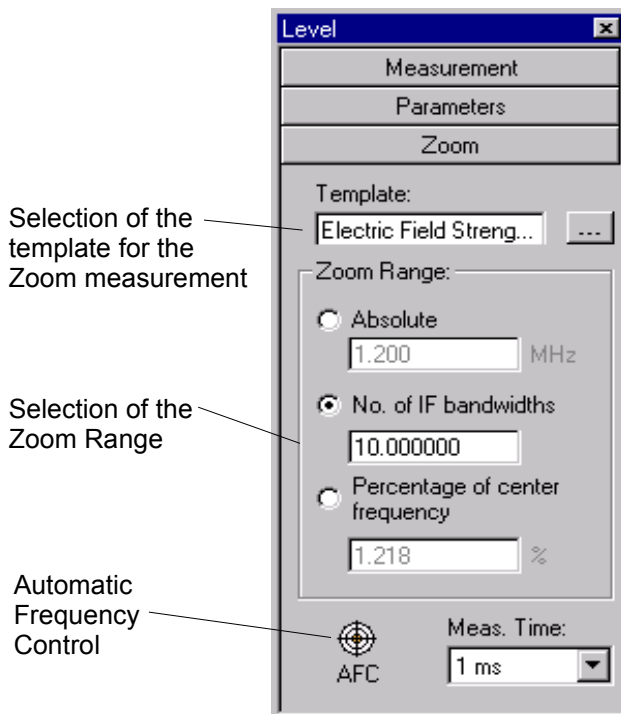may be copied into the frequency control using the Drag&Drop function (Note: The coupled frequency mode in the Frequency Control should be disabled before this action is done!). The Zoom Mode is exited by closing the Zoom View and the single measurement can be continued at this frequency.
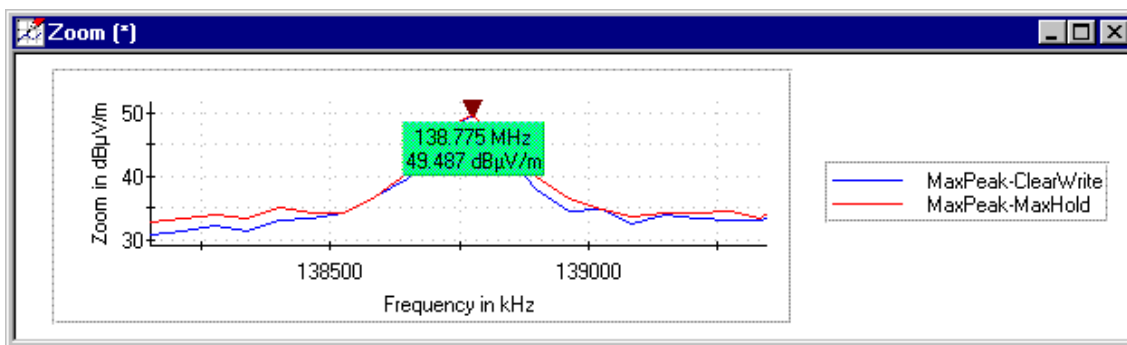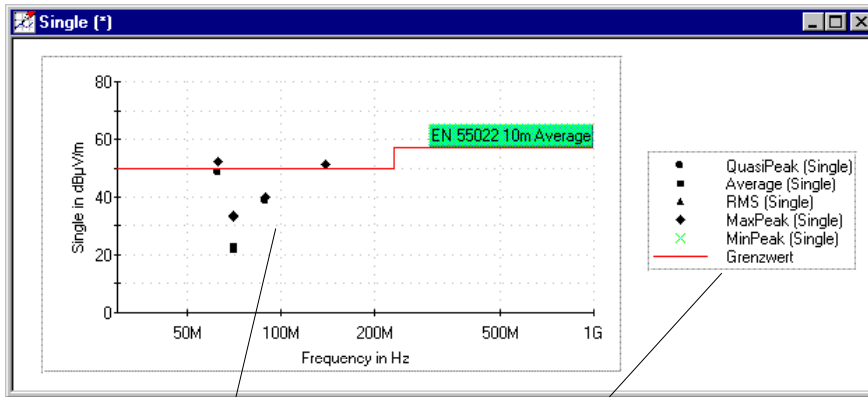


*Figure 3.2.2-5: Zoom Measurement Graphic*

6. If we want to save the current level and frequency we can do this by clicking on the **Store Measurement Value** button in the Test Control Toolbar. The current measurement values for the activated detectors will then be stored in the single measurement value table (we will have a look in this table in one of the next steps). This measurement point is also displayed in the measurement graphic. For better documentation, an additional comment may be stored for every measurement frequency (the input is done via the Single Measurement Control in the field Comment).

7. After detecting the interference frequency, the maximization through variation of the accessory (antenna tower and turntable for a radiated measurement) is performed. The variation of the accessory is done using the accessory controls (antenna tower and turntable control). The current settings of the accessory are added as special columns to the *Single Measurement Table*.

8. If the user also wants to analyze the frequency range around the current interference frequency he may modify the receiver frequency step by step. He can therefore click on one of the symbol buttons for **Step Forward** or **Step Reverse**. One click will change the current frequency by one step width value (as currently set in the Frequency Control).The accessory settings can then be modified until the maximum level value is found for this frequency. If we perform this procedure for several frequencies we will get graphics as shown in the following example.

For running the examination with smaller steps than during the automatic scan the Frequency Control provides the possibility to switch off this coupling and to set a smaller step width.

When the step width gets very small it is very inconvenient to permanently press the **Step Forward** or **Reverse** button. To avoid this EMC32 software provides the feature to run a frequency scan in the single measurement as well. This is done by clicking on one of both symbol buttons **Start Forward** or **Reverse**. The frequency is then automatically increased or decreased like during an automatic scan but only measurement values are stored where the operator clicks the **Store Measurement Value** button. This interactive scan can be stopped by clicking on the **Pause** symbol button.

Single measurement values          Trace graphic legend
for different detectors

*Figure 3.2.2-6: Level Graphic with Single Measurement Result Values*

9.  Finally we now want to open the result table of our single measurement. Therefore we do a double-click on the table in the Test Component Explorer which is shown in red letters and has the ending **'_Single'**. The following example shows such a result table:



| Name | Frequency | QuasiPeak | Average | MaxPeak | Meas. Time | Bandwidth | Turntable position | Antenna height | Polarity | Comment |
|------|-----------|-----------|---------|---------|------------|-----------|---------------------|----------------|----------|---------|
| Unit | MHz | dBµV/m | dBµV/m | dBµV/m | ms | Hz | deg | cm | | |
| 1 | 98.500000 | 38.9 | --- | 39.0 | 1 | 120000.000 | 99.0 | 200.00 | H | |
| 2 | 180.000000 | 19.7 | --- | 22.9 | 1 | 120000.000 | 99.0 | 200.00 | V | |
| 3 | 400.000000 | 22.7 | --- | 25.8 | 10 | 120000.000 | 42.0 | 372.00 | V | |

*Figure 3.2.2-7: Single Measurement Result Table*

This table may be added to a measurement report.

**Tip:**
The symbols representing the measurement values in the single measurement graphics may be changed in the Options dialog (Extras → Options). These settings are applied every time when a new test is created.

**Goal of this Step:**
You are now familiar with the functionality of the single measurement mode and you can run now an interactive EMI analysis of your EUT together with EMC32 software.

# 4  EMS Measurement

**E**lectro**m**agnetic **S**usceptibility measurements have the goal of determining whether the EUT 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. Without a CE label it's not allowed to sell any electrical or electronic devices on the European Market.

The definition of the stress limits which an EUT must be capable of tolerating without showing any faulty function is under the responsibility of national and international standard committees for Electromagnetic Susceptibility. The following standard groups are recognized: Generic Standard, Product Family Standard and Product Standard. If no product standard is defined for a product then the product family standard is applied. If no product family standard is available then the generic standard is used, which in the EC is the standard EN 61000-4.

The system software EMC32 allows the automation of measurements for testing EUTs against high frequency radiated electromagnetic fields (Generic Standard: EN 61000-4-3) and conducted electric signals (EN 61000-4-6).

This chapter will explain using an example how such measurements are defined and executed with EMC32. In this context the operation of EMC32 is explained. EMC32 not only provides the possibility to perform frequency scans according to the standards but also the interactive examination of the EUT, for example for the optimization of the device.

The following examples require that EMC32 be installed with the EMS measurement part and configured with the demo configuration. Of course the measurement sequence of these examples can be simply transferred to any other configuration of an EMS Test System according to EN 61000-4-3/6.

## 4.1  My first Test

**What is a Test?**

A Test is the central element in EMC32 when performing an EMS measurement. From the view of the file system it is a subdirectory containing several files in which both the settings for the execution of the measurement and the measurement itself in graphical and tabular form are stored. Information about the EUT and the setup of the measurement report are stored here as well.

This Test (subdirectories) are then stored in a directory structure which is oriented on the name of the EUT. *Measurement Classes* are used in EMC32 to distinguish with which subsystem (EMI or EMS) and with which measurement type (radiated or conducted) the measurement has been performed. Using this procedure allows all tests which have been made for a given EUT to be logically grouped together.
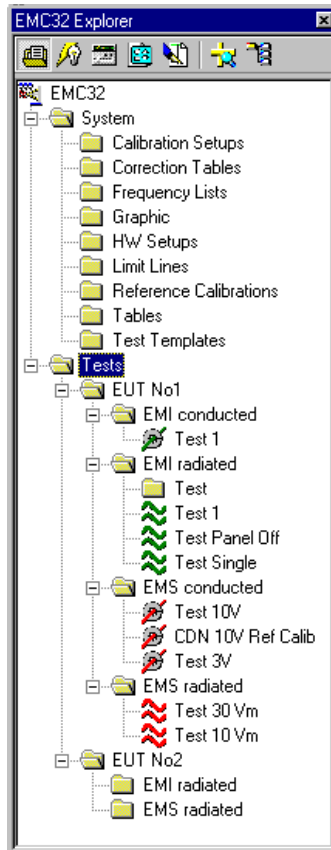
*Figure 4.1-1: Tree View of the EUT Oriented Test Directory Structure in EMC32 Explorer*

**What Components belong to a Test?**

A Test is stored in EMC32 file system by creating an new subdirectory parallel to other Test subdirectories (or in a in an EUT oriented subdirectory under the root Tests) and contains the following files:

- A configuration file containing a reference to all files of the test (for internal use)

- Different result files depending on the measurement class of the test: EMI or EMS measurement

- Test Templates in the subdirectory Setups

- Test Graphics in the subdirectory Graphics

- Possibly HTML Reports in the subdirectory Reports

Since a test directory not only contains the measurement result but also the used test templates, which define how the result was measured, a unique reproducibility of the measurement and a traceability of the measurement result to the measurement setup is possible.

**What is a Test Template?**

For running an EMS Measurement the software requires information about the frequency range and the stress level to which the EUT susceptibility should be tested.

For the generation of the stress level in EMC32 the following parameters must be defined:

- In which frequency range and with what frequency steps should the measurement scan run?

- What are the parameters of the stress signal (level)? Modulated or unmodulated ?

- With which procedure should the stress signal be generated? Leveling on a Sensor or Substitution Method?

- How is the system with which the stress signal is to be generated configured?

These settings typically depend on the standard according to which the EUT should be tested. They are stored together in a file which is called Test Template for EMS Scan. Typically this file has the name of the referenced standard, for example "EN 61000-4-3". The configuration of the used measurement system is not stored in this Test Template but in an additional file called Hardware Setup (refer to the following definition).

This principle of using templates has the advantage that the complete measurement parameter definition does not have to be done every time before starting a measurement.

The definition of the EUT Monitoring is done according to the same principle, only the parameters are different in this case. In the template for the EUT Monitoring *Monitoring Channels* are defined. Each Monitoring Channel references one measurement device and its settings. During the measurement run some measurement value is read from each monitoring device and then the EUT state is checked using predefined NOGO limits. The results of this EUT monitoring are then written to the result table of the test.

**What is a Hardware Setup?**

A Hardware Setup represents the block diagram of the used EMS Test System. Here the user defines which signal generator, which amplifier, which power meter, which antenna and which sensor in which frequency range should be used. The signal path for the signal connection between the devices is also defined and configured here.

Running our first test can be divided into the following 5 steps:

- Start EMC32

- Create a new EMS Test

- Perform a measurement

- Store the test

- Create a measurement report

### 4.1.1  Starting EMC32

This step describes how EMC32 is started on your computer. After this step EMC32 is ready to run a new measurement test.

**Starting EMC32:**

1.  Press the **Start** button on the Windows taskbar and select the Programs menu.

2.  In EMC32 program group select EMC32 icon or double-click on EMC32 icon on the desktop.

3.  The start window of EMC32 opens and the current version and the registration information are displayed.

4.  During the start process EMC32 main window is opened as well. When this process is finished the start window is closed and the start dialog appears:
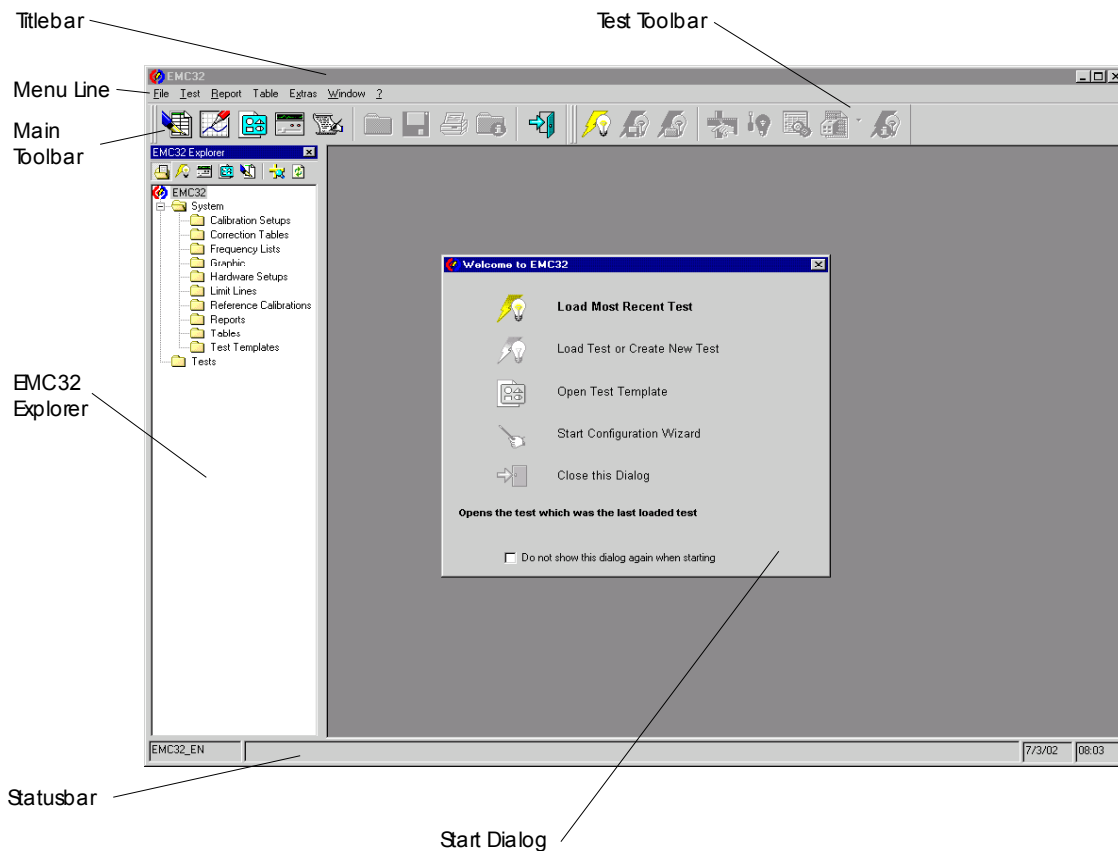


*Figure 4.1.1-1: EMC32 Main Window after the Start of the Software*

**Remark:**
The window shown here may contain different elements due to modifications in the Options menu.

# EMC32 Main Window:

The EMC32 Main Window contains the following elements:

*Head Line*: Here the name of the application EMC32 and possibly also the name of an opened Test is displayed. As long as the currently opened test has been modified but not stored (this applies to a new test too) a '*' symbol is also added to the test name.

*Menu Bar*: Contains the menu heads of EMC32.

*Main Toolbar*: Contains symbols which allow the access to the mostly used entries of the File menu.

*Test Toolbar*: Contains symbols which allow the access to the mostly used entries in the Test menu.

*EMC32 Explorer*: Allows the access to the file system of EMC32.

*Start Dialog*: Is displayed at the start of EMC32 if this option is activated. The start dialog gives the first guidance to the user to quickly run a measurement.

*Statusbar*: Shows the Status of EMC32 during a measurement.


## Main Toolbar:

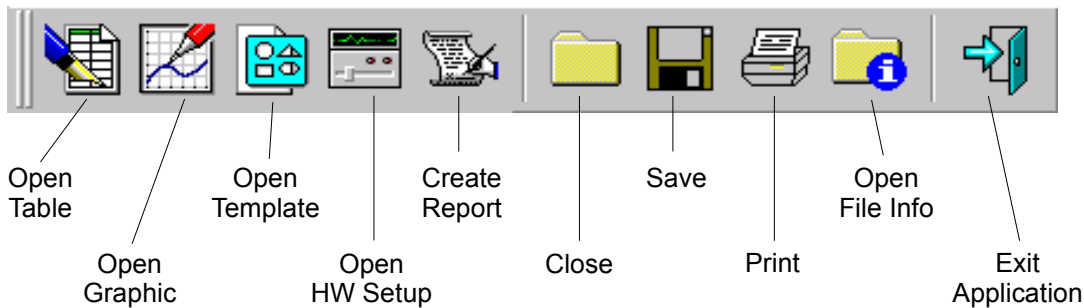The following section gives a short introduction to the functionality of the symbols in the Main Toolbar.



*Figure 4.1.1-2: Main Toolbar*


## Test Toolbar:

The following section gives a short introduction to the functionality of the symbols in the Test Toolbar.
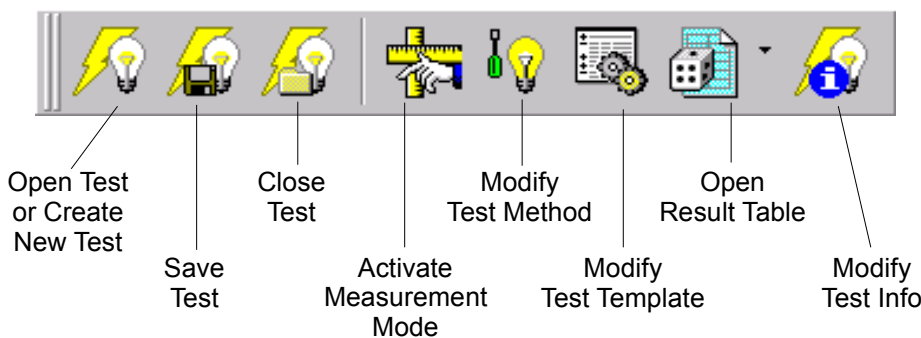


*Figure 4.1.1-3: Test Toolbar*

**EMC32 Explorer:**

The following section gives a short introduction to the functionality of the symbols in EMC32 Explorer Window. EMC32 File Explorer provides an overview over the whole file system used by EMC32 and allows a quick direct access to these files.
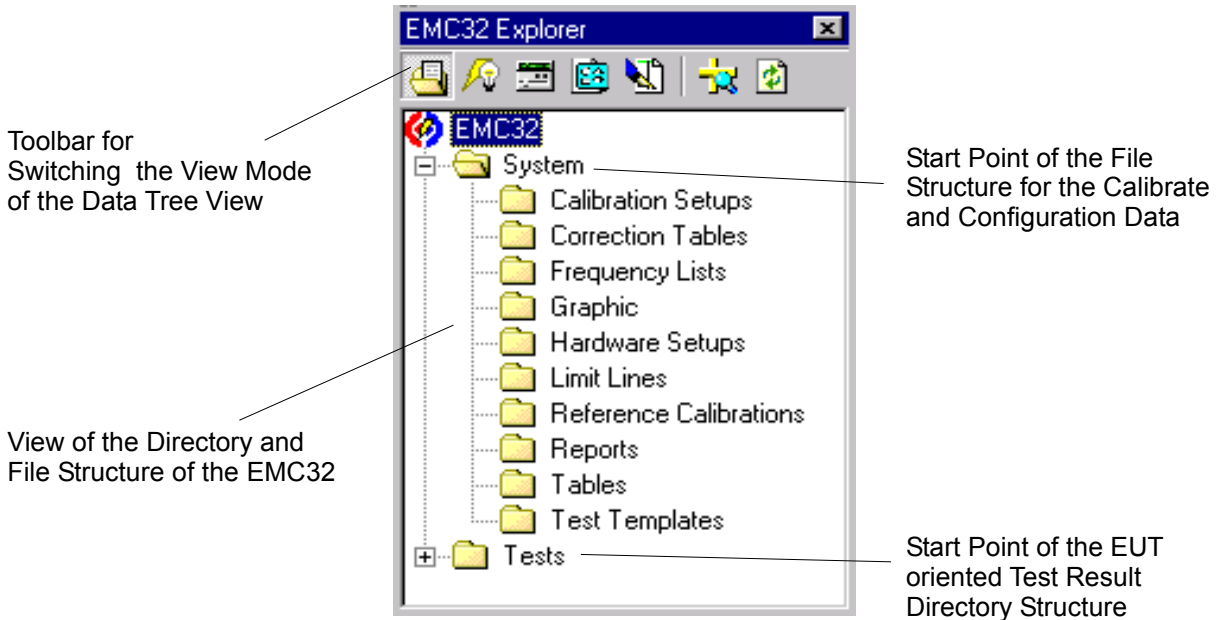


*Figure 4.1.1-4: EMC32 Explorer Window*

**Goal of this Step:**
EMC32 has been started and is now running. You should now be familiar with the main components of EMC32 Main Window. In the next step we want to create a new EMS test.

## 4.1.2  Create a new EMS Test

This step describes how a new EMSI Test is created in EMC32. After this step the software is ready to run the measurement.

**Creation of a new EMI-Test in EMC32:**

1.  Click in EMC32 menu on the **File** ® **Test** entry and the following Definition dialog for a new test will appear.
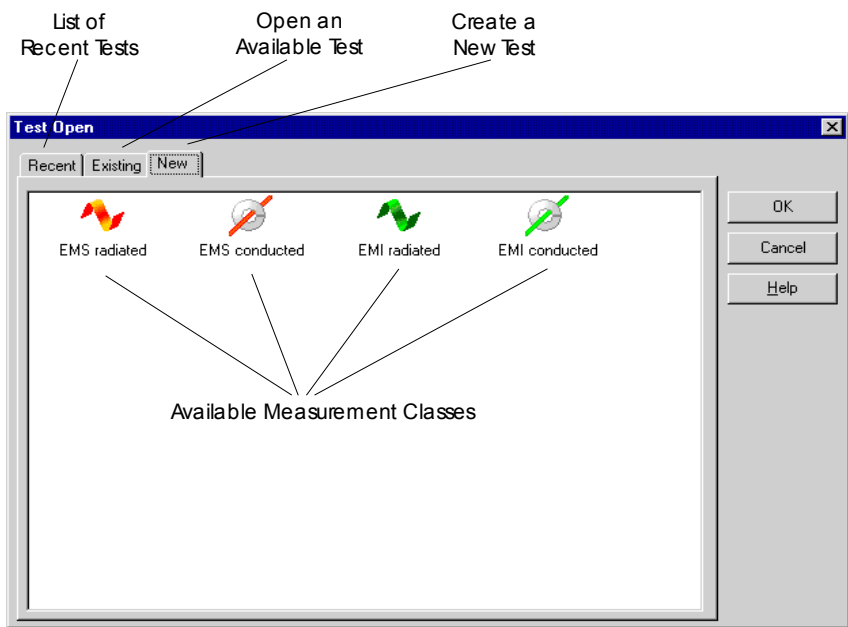


*Figure 4.1.2-1: Open Test Dialog with selected Index-tab for a New Test*

2.  Select the index-tab *New* and click on the symbol for the measurement class for which you want to run the measurement. For Susceptibility Measurements EMS radiated and EMS conducted are available. Double-click in this example on the *EMS radiated icon*. The definition dialog for a new test appears.
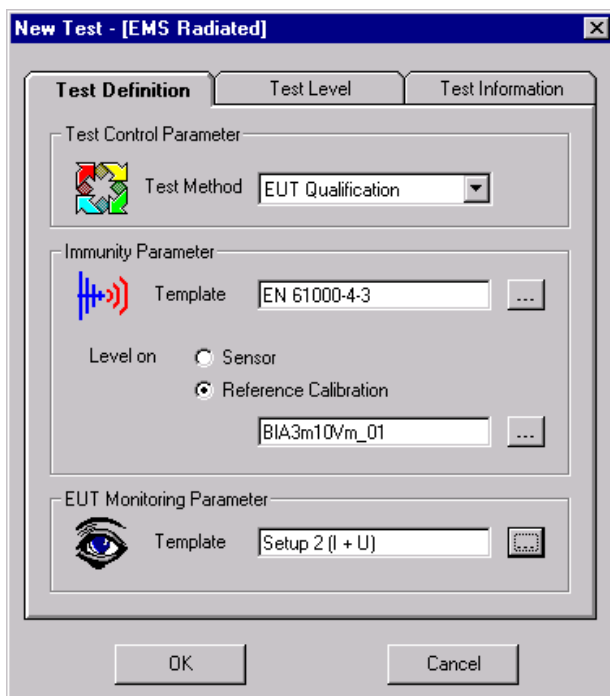
*Figure 4.1.2-2: New Test Dialog with the View Test Definition*

**Tip:**
Alternatively you can click with the right mouse button on the root directory **Tests** or on one of the EUT specific subdirectories below the **Tests** root. In the context menu which will appear you select the entry *New Test*. In the following dialog you select the measurement class for which you like to run a measurement.

3.  In this dialog you define which measurement you want to run. First you select the **Test Method**. In this example we want to run an EUT Test and therefore we select the measurement procedure *EUT Qualification*.

4.  After this we determine how the stress signal (in our case the field strength) should be created. For the selection of a Scan Template (EMS Scan) we click on the button with the three points beside the text box field Template. In the following window only templates which match the current measurement class (radiated) are available for selection.

5.  When the selection is finished all other fields in the tab-index *Test Definition* and *Test Level* are filled according to the settings stored in the selected template. Now we have the possibility to change the most important scan parameter settings here for our new test. These parameters are the definition of the leveling mode and the stress level. In our case the leveling should be based on a reference calibration file according to the standard EN 61000-4-3.

6.  Whereas the selection of an *Immunity Parameter Template* is mandatory, the selection of a template for the EUT Monitoring is optional. You should always choose such a template when you are able to perform an automatic EUT Monitoring with your measurement equipment (refer hereby to section 4.2.3 Monitor EUT Reactions).

7.  After this we click on the tab-index *Test Level* to do a check whether the test level stored in the selected EMS Scan template fulfils our requirements. Here we want to examine our EUT with a stress level of 10 V/m.
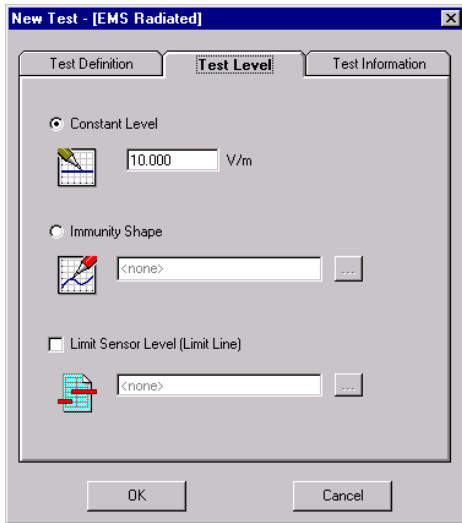
*Figure 4.1.2-3: New Test Dialog with View of the tab index Test Level*

8.  When required, the field *Test Information* may be filled with any text which describes the EUT or the test procedure. Text may also be imported from a file. This text is stored in the test information of this test and may be used later on for the documentation of the measurement (report).

9.  The creation of the test is started by clicking on the **OK** button. This test is then opened automatically. After that the measurement mode is activated and the control elements for the start of the measurement are displayed (refer to the following description). The EMC32 Main Window then appears as follows:
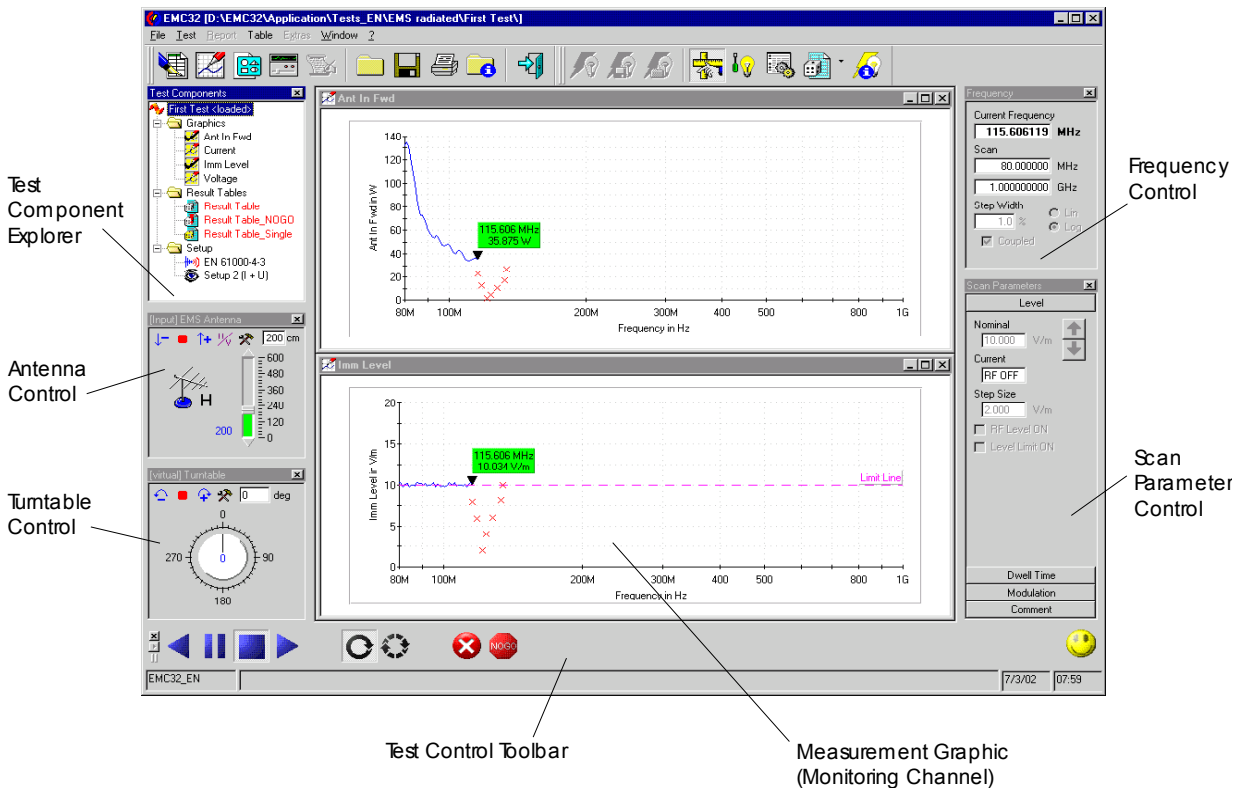


*Figure 4.1.2-4: EMC32 Main Window after the Opening of a New Test*

# New Elements in EMC32 Main Window:

After opening a new test the following additional elements appear in EMC32 Window:

*Test Component Explorer*: The Test Component Explorer window is docked on the left border of the main window. It contains a file tree structure representing all files which belong to the currently loaded test. The purpose of this window is to give the operator quick access to all data of a test, for example the result tables.

*Antenna Control*: This element is only available for tests of the measurement class radiated. It is used for both the display and the change of the antenna height and polarization. If there is no automatic antenna tower in the system, then the dialog serves for entering the position of a manually operated antenna.

*Turntable Control*: This element is only available for tests of the measurement class radiated and if a turntable device is available in the device list. It is used for both the display and the change of the turntable angle. If there is no automatic turntable in the system, then the dialog serves for entering the position of a manually operated turntable.

*Frequency Control*: This element is used for the control of the frequency scan and the setting of the current frequency.

*Scan Parameter Control*: This element is used for the control of the immunity level parameter. This includes both the amplitude and the modulation parameter of the stress signal.

*Test Control Toolbar*: The Test Control Toolbar is used for the control of the measurement. Here the measurement run can be started and stopped. The operator may also change from the automatic mode into the manual frequency scan here.

### Test Component Explorer:

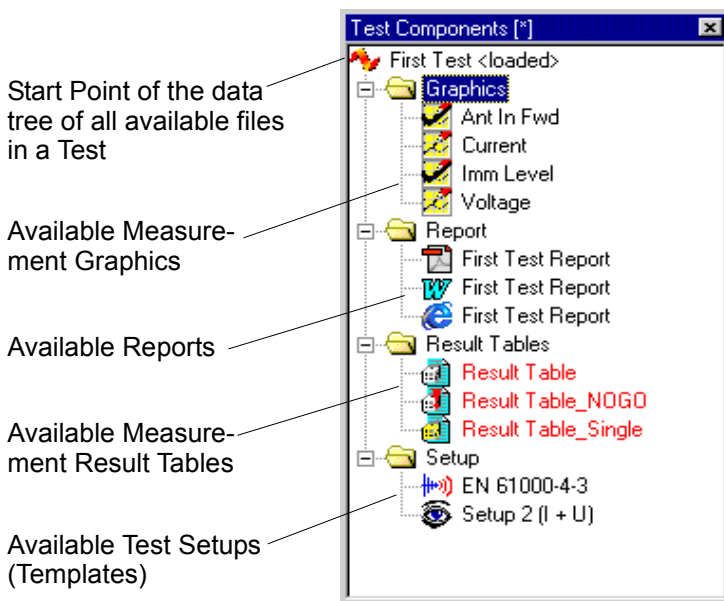The following section gives a short explanation of the functionality of the Test Component Explorer.



*Figure 4.1.2-5: Test Component Explorer*

## Frequency Control:

The following section gives a short explanation of the functionality of the Frequency Control element. The operator may enter both the frequency where the measurement should be started and the frequency range in which the measurement should be performed (only limited by the frequency range defined by the EMS Scan Template).
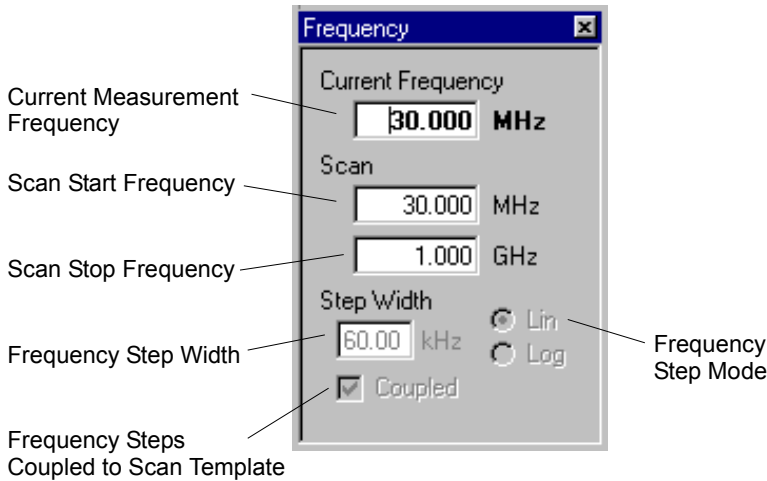


*Figure 4.1.2-6: Frequency Control*

## Scan Parameter Control:

The following section gives a short explanation of the functionality of the Scan Parameter Control element. During an automatic scan measurement it mainly displays the settings stored in the Scan Template. During a Single Measurement it may be used for the variation of the stress level parameters (refer to section 4.2.2. Running a Single Measurement).



*Figure 4.1.2-7: Scan Parameter Control with View Level*
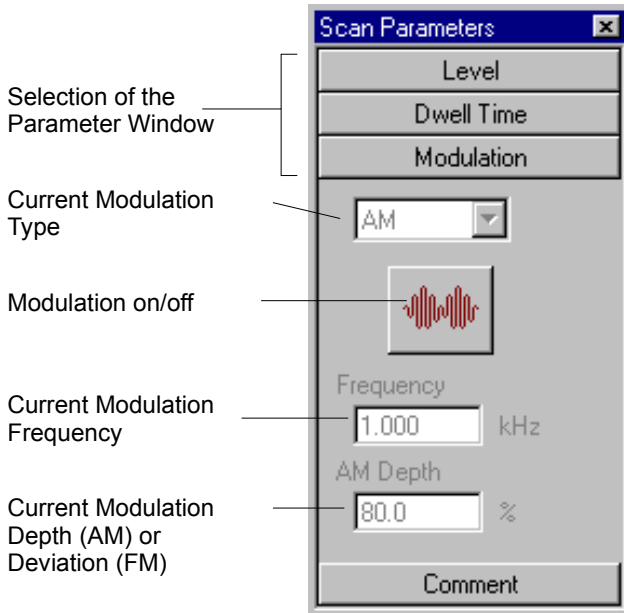
*Figure 4.1.2-8: Scan Parameter Control with View Modulation*

**Test Control Toolbar:**

The following section gives a short introduction into the functionality of the Test Control Toolbar. It is used for the control of the measurement run and the switching o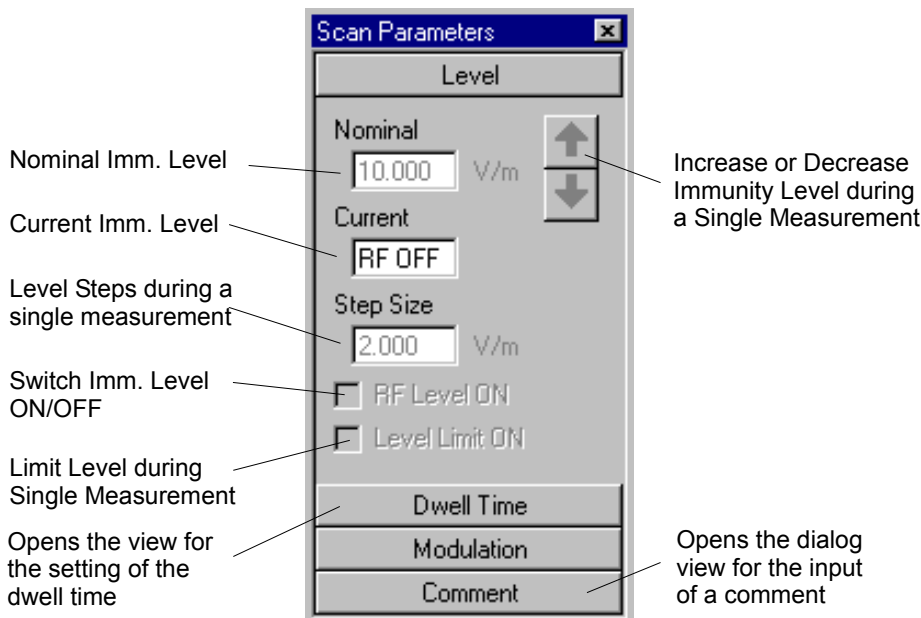f the measurement mode (automatic, single). During an automatic measurement only some of the symbols shown here are displayed.



*Figure 4.1.2-9: Test Control Toolbar with View Single Measurement Mode*

**Which elements are only visible in the Single Measurement Mode ?**

The following elements from figure 4.1.2-9 are only visible in the single measurement mode (refer to the following section) in the Test Control Toolbar:

- Jump to the start or stop frequency
- Next subrange
- Step reverse, forward
- Store measurement value

**What is the meaning of Measurement Channel?**

During an EMS Measurement, data from both the leveling algorithm which generates the stress level, and from the monitoring of the EUT are recorded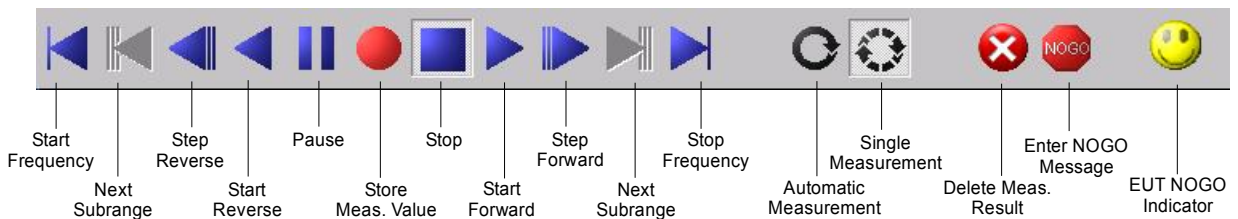. Each parameter monitored from one of both groups is handled in the software as a measurement channel (similar to the channels of an oscilloscope). One measurement value is stored per channel and frequency in a separate column of the measurement result table.

**What is the meaning of Measurement Mode?**

A test can be loaded for two purposes: running a new measurement or doing additional analysis with the goal of making a report printout of the measurement results.

For this, EMC32 distinguishes the **Measurement Mode**, used for running a measurement, and the **Analysis Mode**, where the elements for running a measurement are not shown. Switching between the two modes is done via the main menu entry Test → Meas. Mode, by pressing the **F4** key or by clicking on the corresponding symbol in the *Test Toolbar*.

When a new Test is created no result data are available for analysis. Because of that the software immediately activates the measurement mode.Otherwise an existing test is loaded and the software switches into the Analysis Mode. Here the measurement mode must be activated explicitly to repeat or continue the measurement.

In the Measurement Mode additional controls are added to the user interface of EMC32.
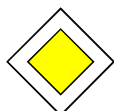
**Goal of this Step:**
You are now able to create a new EMS Test and are familiar with the basic functions of the controls for running a measurement.

## 4.1.3  Running an EMS Measurement

This step describes how an EUT Overview Measurement is performed. During a measurement EMC32 mainly distinguishes between the automatic and the manual (interactive) measurement run. In an automatic measurement the frequency is increasing automatically and the stress level is generated according to the settings in the template. The purpose of this measurement is mainly to determine whether the EUT shows faults within this frequency range. During a manual (single) measurement the operator may now interactively change both the frequency and the level parameters (and the accessory settings if available). This measurement mode is used for the examination of an EUT at frequencies where it has shown faults during the automatic scan. Now the stress level parameters may be changed until the fault disappears (level or modulation parameters) (refer also to chapter 4.2.2 for more details on Single Measurement).

After this step we will have measurement data available which we want to save and for which we want to generate a report printout.

**Running an EMS Test in EMC32:**

1. Click on the **Start Forward** button in the Test Control Toolbar.

2. After checking whether all required measurement devices can be addressed, the measurement is started. If at least one required device is not accessible a dialog is opened showing a list of all inaccessible devices. The operator now has the possibility to either stop the measurement or continue the measurement in the simulation mode.

3. During a measurement run EMC32 displays the current frequency in the Frequency Control and the current stress level in the Scan Parameter Control. A marker is displayed in each measurement graphics showing the measurement value of the last measured frequency. The test is done at all frequencies defined in the currently selected Scan Template until the stop frequency is reached. Finally the amplifier is switched to standby mode and the generator level is set to *RF off*.

4. In this test we don't use automatic EUT monitoring. Therefore in our first measurement we want to simulate an EUT fault by pressing the *space bar* of the keyboard or clicking on the **Enter NOGO Message** symbol in the Test Control Toolbar. This monitoring feature is available in every test.

   After pressing the space bar the following dialog is opened which allows the input of a comment describing the EUT fault.
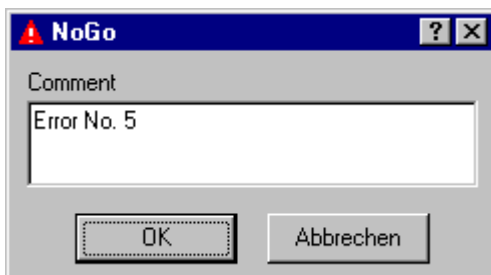
   

*Figure 4.1.3-1: Dialog for the Input of a NOGO Comment*

   After the input of the comment the dialog is closed with the **OK** button and the measurement is continued. The comment message is stored both in a special column of the result table and in the *NOGO table*. This NOGO table contains only frequencies where an EUT fault has been detected.

5. The EMC32 measurement run also provides the possibility to stop the scan, enter a new frequency and continue the frequency scan at this frequency. This feature is very helpful when you get a lot of EUT faults in the current frequency range. Using this feature you can jump to a new frequency where the EUT hopefully shows no further faults.
   Therefore we click on the **Pause** button in the Test Control Toolbar and enter a new frequency in the *Frequency Control*.

6. Now we want to enclose the frequency range where the faults appear. To do this we now start our measurement scan in the reverse direction by clicking on the **Start Reverse** symbol in the Test Control Toolbar. The frequency scan will then be continued and runs towards of the start frequency.

7. If we now want to do a modification of the EUT we can stop the frequency scan at any time by clicking on the **Stop** symbol. The test may be continued at any time.

8. After we have performed a complete measurement we can see the measurement result in the graphics on the screen display. Now we want to have a look on the measurement results in tabular form. We can see all available *measurement result tables* in the *Test Component Explorer*. For an automatic measurement run all results are stored in one result table. This table can either be opened via the file menu or via a double-click on the corresponding table in the Test Component Explorer.

*Figure 4.1.3-2: Measurement Result Table*

9. Another table with the name *Result Table_NOGO* was also created containing the frequencies where our EUT showed faults. This table can be either opened via the File menu or by a double-click on the corresponding table in the Test Component Explorer.



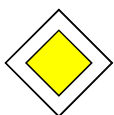*Figure 4.1.3-3: NOGO Result Table*

**Goal of this Step:**
You are now able to run an EMS Overview Measurement. You can stop and continue a measurement. You are also now familiar with the functionality to open the measurement result table for further analysis.

## 4.1.4  Saving a Test

This step describes how you can save your measurement data, generated in the previous steps, in the EUT specific directory structure.

**Saving a Test in EMC32:**

1. First we exit the measurement mode due to the reason that it is not possible to save the test when this mode is active. Therefore we press the **F4** key or we click on the symbol **Activate Measurement Mode** in the Test Toolbar.

2. Select the menu entry **File** ® **Save Test** or click on the **Save** symbol button in the *Test Toolbar*. If the test was not saved before like in our example the following dialog will appear:
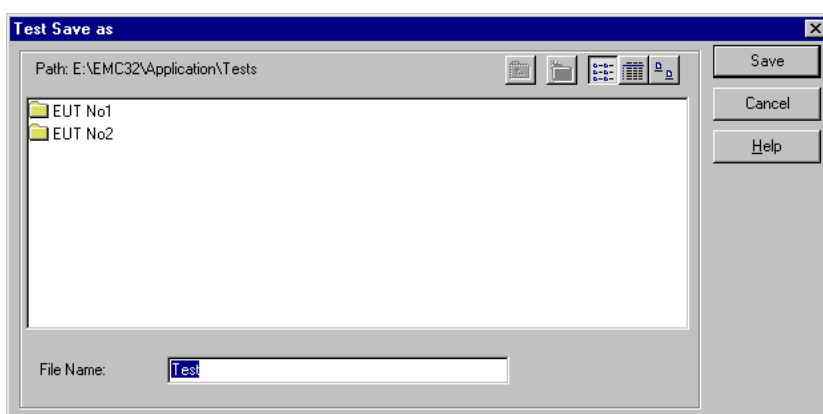


*Figure 4.1.4-1: Save Test Dialog*

Here the wanted EUT subdirectory is selected, or first a new EUT subdirectory is created and then selected.

**Advice:**
The EMC32 software creates in the selected EUT subdirectory a new additional subdirectory with the name of the measurement class if it doesn't exist yet (in our case EMS radiated). It is not necessary to select this subdirectory when the test is saved. If a test with the same name already exists, a message box appears asking whether the existing test should be overwritten or not.

**Tip:**
If a new test has not been saved yet the "Test Save as" Dialog automatically appears when the test is closed.

3. After we have entered a name for our test the following dialog appears before the Save procedure is finished. This dialog allows the user to input additional information about the EUT and the measurement. This dialog can be opened via the menu entry **Test** ® **Modify Test** ® **Test Info ...** as well or via clicking with the right mouse button on the *Test entry* in the Test Component Explorer and selecting the corresponding popup menu entry.
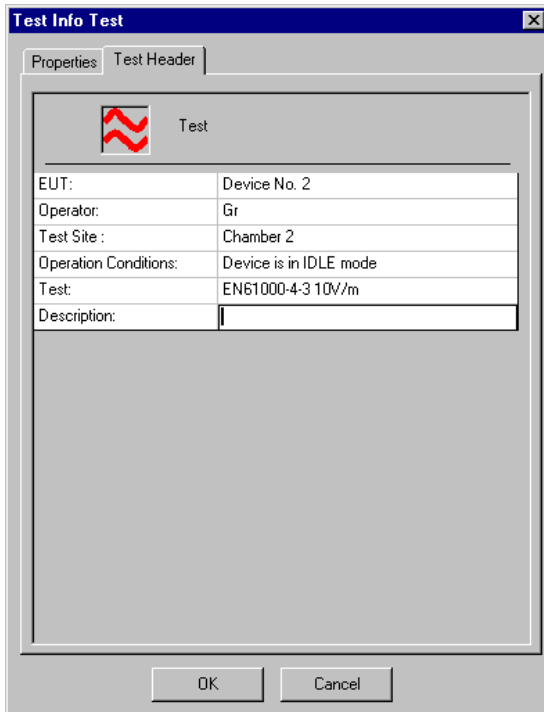
*Figure 4.1.4-2: Test Info Dialog*

4. After closing the dialog with the **OK** button the Save Test procedure is finished.

5. Now we may also make a copy of our test with a new name via the **File** ® **Save Test As** entry.

**Tip:**
If you would like to stop a test and continue it at a later time (for instance if the EUT is defective), you need only open the test again, activate the measurement mode and then you can continue the measurement at the frequency where you have stopped the measurement.
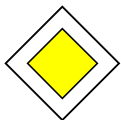
**Goal of this Step:**
You are now able to save your test at any location of the EUT specific test directory structure. You are also familiar with the functionality of entering additional information about the EUT and the measurement procedure into the Test Info Dialog.

## 4.1.5  Creating a Report

This step describes how you can create a report of your measurement results in EMC32 software.

**Creation of a Measurement Report in EMC32:**

1. Select the menu entry **Report** ® **Report...** or click on the **Create Report** symbol in the Main Tool-bar. The Report Configuration Editor is started and EMC32 Main Window appears as follows:
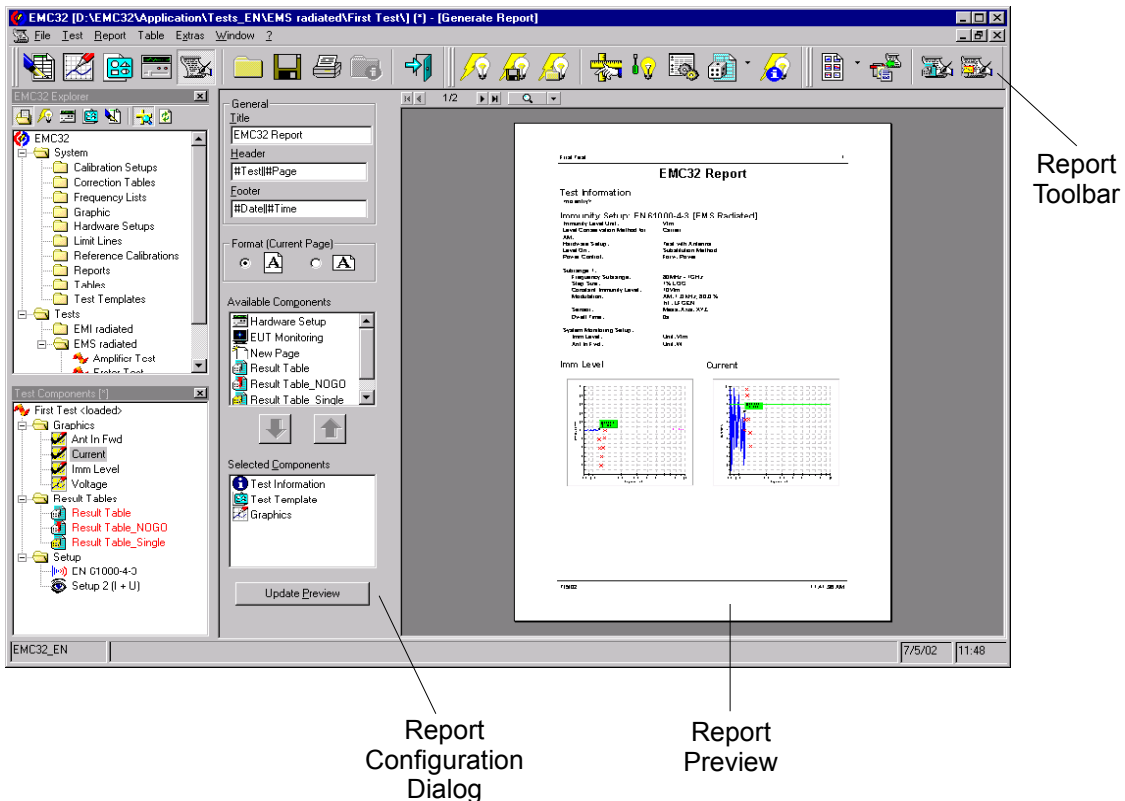


*Figure 4.1.5-1: EMC32 Software with opened Report Configuration Dialog*

## New Elements in EMC32 Main Window:

After starting the Report function the following additional elements appear in EMC32 Window:

*Report Toolbar*: The Report Toolbar provides fast access to the most important functions of the Report menu.

*Report Configuration Dialog*: In this dialog the configuration of the report layout is done. A Report consists out of several components like Report Head, Graphics, Tables and Test Template Settings. These components can be both arranged to different positions in the report layout and also configured.

*Report Preview Window*: In this window a preview of the currently configured Report layout is shown. This preview corresponds to the printout which is done later.

**Report Toolbar:**

The following section gives a short introduction into the functionality of the Report Toolbar.



Graphic Arrangement

Create Report as File

Add Table

Add Graphic
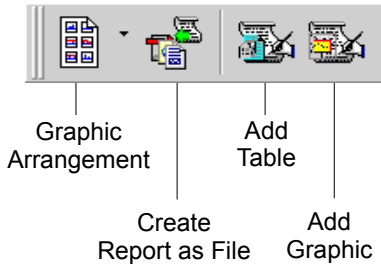
*Figure 4.1.5-2: Report Toolbar*

**Report Configuration Dialog:**

The following section gives a short introduction into the functionality of the Report Configuration Dialog.



Report Header Define Header and Footer Line

Orientation of the current page

Display of all available Components

Add or delete a component into the current report

Display of the selected Report Components

*Figure 4.1.5-3: Report Configuration Dialog*

2.  The entries displayed in the dialog field Selected Components are defined by the template settings in the **Extras** ® **Options** (tab-index Report) dialog of EMC32. In our case the report contains the Test Info and graphics belonging to the current test (refer to the following tip as well).

    Now we also want to add to our report a printout of the current EMS Scan Template. Therefore we select in the list Available Components the entry Test Template and add this template to the list Selected Components either through the selection of the menu function **Report** ® **Add C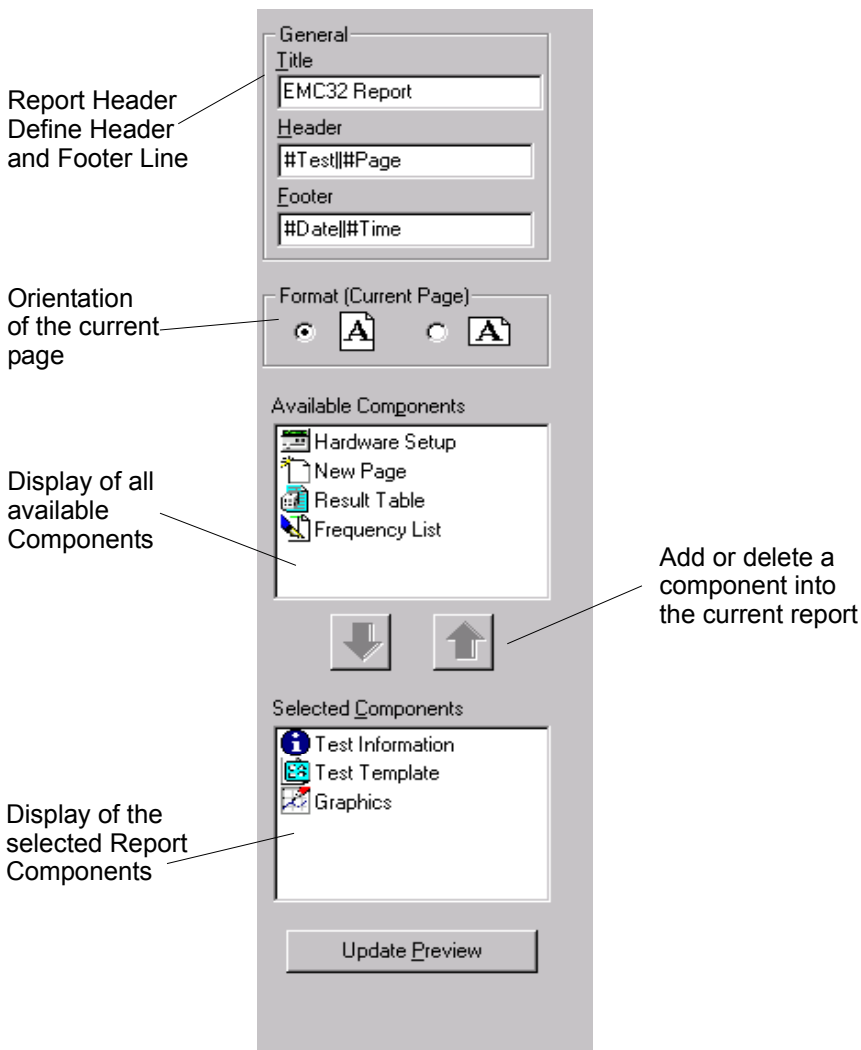omponent** or by clicking on the **Add** button in the *Report Configuration Dialog*. After clicking on the button Update Report in the Report Toolbar, this component will appear in the report preview window.

3.  In this chapter we want to define which measurement channel graphics our report should contain. Therefore we open the configuration dialog of the graphics component by clicking with the right mouse button on the component **graphics** in the list *Available Components* and select the entry Modify in the popup menu. A dialog as shown below appears in which all available graphics are listed. For our example we select two graphics and close the dialog after this with **OK**. After clicking on the button Update Report in the Report Toolbar both selected graphics will be displayed in the report preview.
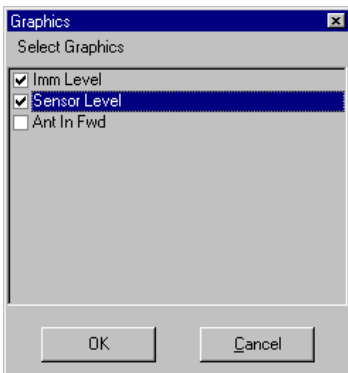


*Figure 4.1.5-4: Configuration Dialog of the Component Graphic*

4.  In the last step we want to generate a printout of our report configured above. Therefore we select the menu entry **File** ® **Print** or we click on the symbol button **Print** in the Main Toolbar. A printout of our report is output on the Windows standard printer.

5.  Additionally an electronic report in PDF format should be generated. Therefore we select the menu entry **Report** ® **File Export** or we click on the **file Export** symbol in the Report Toolbar. The following dialog will appear:
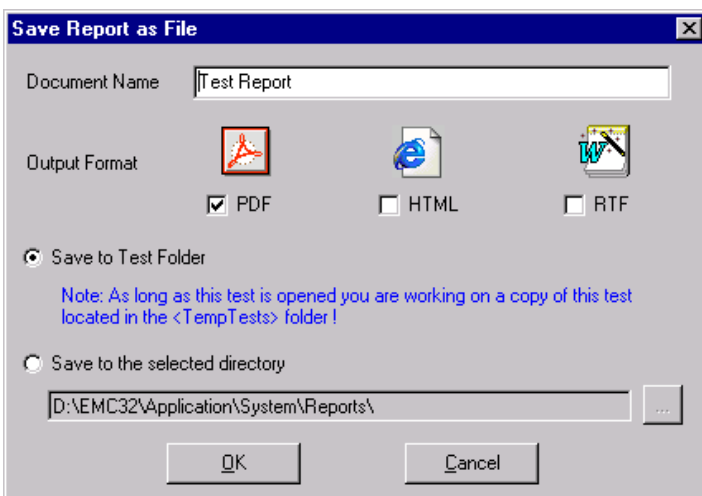
*Figure 4.1.5-5: HTML Report Save as - Dialog*

In this dialog the operator has the possibility to define the name and the location for the report file as well as the output format. The report file may be stored either in the current test directory or in any selectable directory. The path and the name of the report file is displayed below the current selection in the dialog.

After clicking on the **OK** button the report file(s) is (are) created with the defined name in the selected folder. In PDF and RTF format one file will be generated. In HTML format for each graphics a file of the file type WMF (Windows Meta File) is created. Links to these graphics files are written into the HTML file.

6.  The report configuration dialog is closed again by selection of the menu entry **Report** ® **Report**, clicking on the symbol **Close Report** in the Report Toolbar. The current report configuration is stored in the test and will be used as a template for the next call of the report function for **this** test.

7.  Via the selection of the menu entry **File** ® **Close Test** or pressing the symbol **Close Test** the test currently open will be closed. All graphics and the Test Component Explorer will be closed.

**Tip for Graphics:**
All graphics in a report are handled as one single component. Due to this all graphics in a report can only be arranged and printed together. The determination which graphic should be output is done via the configuration of the graphics component. If you open HTML reports containing WMF graphics with an Internet Browser you should take into consideration whether your browser supports WMF graphics.

**Tip:**
The Report Configuration Dialog supports the Drag & Drop functionality. This means you can drag a test component from the list Available Components to the list Selected Components and drop it there. It's also possible to change the order of the components in the list "Available Components" using this technique.
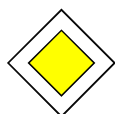
**Goal of this Step:**
You are now able to configure your measurement report according to your requirements and you can output the report on a printer or as a report file.

## 4.2  Further Steps with EMC32

During our first test in the previous section you have seen how a test is created, a measurement is performed and a measurement report is generated. In this section you will now use examples to learn how

*   A Test Template is modified,

*   A Single Measurement is done or

*   An EUT Monitoring is configured.

These steps are very useful when an EUT should be examined in detail after the EUT had shown faults during the measurement run (for example you can determine the level where the EUT fault disappears).

## 4.2.1  Modify an EMS Scan Template

This step describes how you can modify the EMS Scan Template of an open test to change, for e-xample, the frequency step width or the test level.

Modify the Test Template in an EMS Scan Template of EMC32:

1.  Select the menu entry **Test ® Modify Test ® EMS Scan** or click on the **EMS Scan** button in the Test Toolbar. The following dialog will appear:

Settings for all Subranges

Subrange Table

Subrange Configuration

Opens the Editor for the Definition of the System Monitoring Measurement Channels
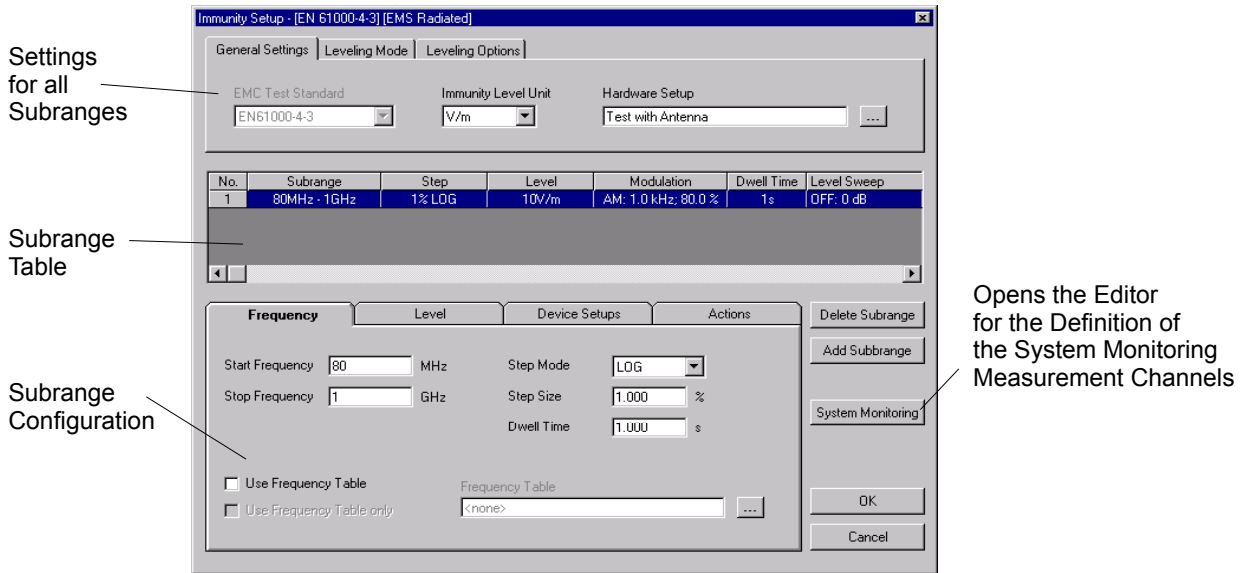
*Figure 4.2.1-1: EMS Scan Editor*

2.  In this example the whole frequency range in which the measurement should be done is defined in one subrange. We now want to change the frequency step width of this example from 1% LOG to 2.5 MHz LIN. Therefore we click on the first subrange in the subrange list and then on the tab-index *Frequency* in the Subrange Configuration. Here we modify both parameters.

3.  Now we also want to change the test level to 20 V/m. Therefore we click on the tab-index *Level* in the Subrange Configuration and change the field strength from 10 to 20 V/m.

4.  Now we can close the editor by clicking on the **OK** button.

5.  After this all graphics in EMC32 window are closed and a new test is created. The measurement mode is also activated to start the measurement run immediately.

> **Note:**
> Each modification in the EMS Scan Template will delete any existing measurement re-sult. Before the test is initialized a requesto or is opened which allows you to make a copy of the old measurement result.

**What is System Monitoring?**

*System Monitoring* means controlling documentation of parameters of the measurement system which is generating the stress level during the measurement run. Similar to the EUT Monitoring measurement channels can be defined here in which parameters of the EMS Test System are recorded and stored to the result file like, for example, current field strength, VSWR, antenna input power or amplifier output power.

For the definition which of the available parameters should be monitored EMC32 offers the System Monitoring Editor. This editor may be opened directly from the EMS Scan Template Editor by clicking on the button System Monitoring.
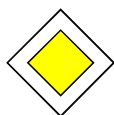
**Goal of this Step:**
You are now able to modify the most important parameters in an EMS Scan Template, for example start and stop frequency, frequency step width, dwell time or test level; and to start a new measurement run after this.

## 4.2.2  Running a Single Measurement

This step describes how you perform an EMS Single Measurement with EMC32. A Single Measurement is done in the same test in which the automatic preview measurement has been performed. The Single Measurement is based on the Scan Template of an automatic measurement but with the difference that in this mode setting parameters of the template can be changed like for instance:

- Current measurement frequency

- Frequency step width

- Test level

- Modulation

- Dwell Time

The measurement results of the Single Measurement are stored in a separate result table and displayed in a separate curve in the graphics as well.

**Running a Single Measurement in EMC32:**

1. Create a new test or open an existing test and activate the *measurement mode*.

2. The *Single Measurement Mode* can be activated during a running scan by clicking the following sequence. First click on the **Pause** symbol button of the Test Control Toolbar and then on the symbol Single Measurement. The *Single Measurement Mode* may also be activated directly when the measurement is stopped. In this case the measurement system must be activated again by clicking on one of the symbols **Pause**, **Start Forward** or **Reverse** in order to continue the measurement.

   In each graphics a symbol is displayed (under the marker symbol) at the current frequency which represents the current measurement value. The measurement run is now continued as during the automatic measurement but with the difference that the frequency is not changed.
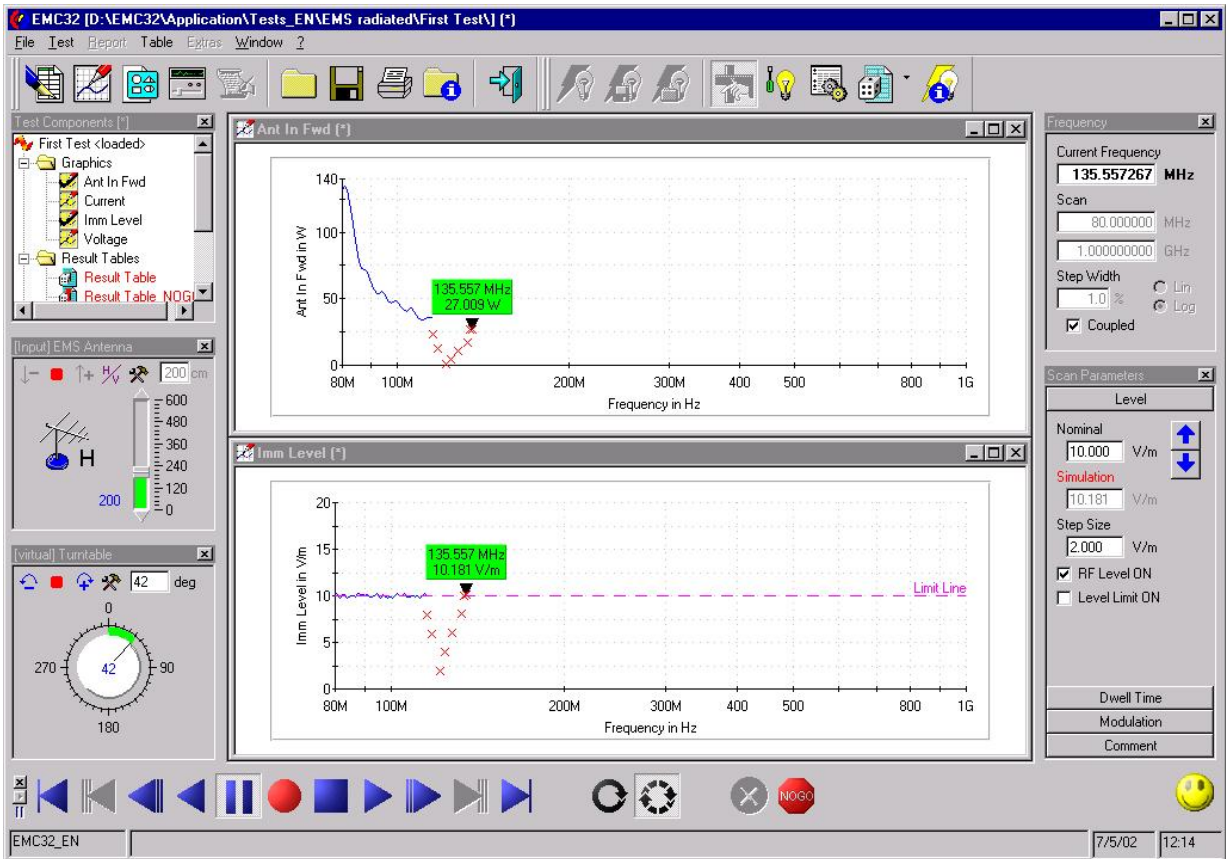
*Figure 4.2.2-1: Screen Shot of EMC32 in the Single Measurement Mode*

3. In this step we now want to change the Test Level to do an analysis of whether the EUT fault disappears when the field strength is reduced. Therefore we click on the symbol **Decrease Level** in the Scan Parameter Control. You can then watch in this control that the nominal value is decreased by the step width and after the end of the leveling cycle the value in the field Current Level shows the same value (except for the deviation caused by the leveling tolerance). The operator may also verify in the graphics of the current field strength that the field strength is decreased.

   Clicking with the right mouse button on the symbols Decrease or Increase Level allows the change of the level by three times the step width. The stress signal can be switched off completely with the help of the check box **RF Level ON**. This function is helpful for a check of whether the EUT is currently in an irreversible state.

4. If we now want to save the current level and frequency this can be done by clicking on the *Store Measurement Value* button in the Test Control Toolbar. The current measurement values will then be stored in the single measurement value table (we will have a look into this table in one of the next steps). This measurement point is also displayed in the measurement graphic. For a better documentation an additional comment can be stored with every stored single measurement frequency (the input is done via the Single Measurement Control in the field Comment).

5. If the user also wants to analyze the frequency range around the current test frequency he may modify the current frequency step by step. Therefore click on one of the symbol buttons for **Step Forward** or **Step Reverse**. One click will change the current frequency by one step width value (as currently set in the Frequency Control). Now the current stress level for this frequency can be modified until the EUT fault disappears. If we perform this procedure for several frequencies we will get graphics as shown in the following example.
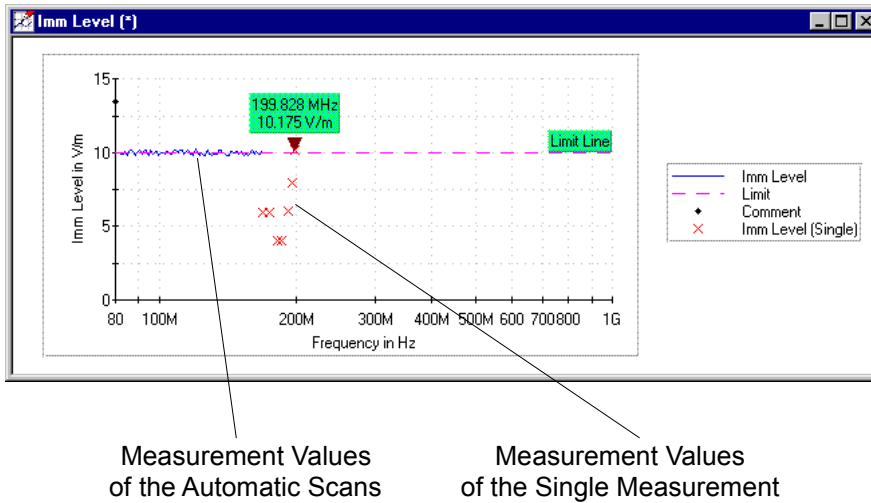
*Figure 4.2.2-2: Graphic of the Field Strength Channel with Single Measurement Result Values*

**Tip:**
Since the settings of the automatic measurement are used as default values at the start of a single measurement, the dwell time may be set at several seconds. This has the effect of a long delay time when leveling and doing frequency modifications because the leveling algorithm applies the dwell time currently set after each modification. The dwell time may be modified to reduce this delay in the Scan Parameter Control. After changing into the Overview Measurement Mode (Automatic Measurement) the dwell time value is reset to the value of the template.

6. For analyzing the EUT reaction depending on the modulation settings, EMC32 allows either to change the modulation parameters or to switch off the modulation completely. This functionality is provided in the tab-index view *Modulation* of the Scan Parameter Control. The current modulation settings are stored in an additional column of the single measurement result table for the documentation.

7. In the case of an EUT fault you want to analyze in detail in which frequency range this error is present. To run this examination with smaller step width than during the automatic scan, the *Frequency Control* provides the possibility to switch off this coupling and to set a smaller step width.

8. When the step width gets very small it is very inconvenient to permanently press the Step Forward or Reverse button. To avoid this EMC32 software provides the feature to run a frequency scan in the single measurement mode as well. This is done by clicking on one of both symbol buttons **Start Forward** or **Reverse**. The frequency is then automatically increased or decreased like during an automatic scan but only measurement values are stored where the operator clicks the Store Measurement Value button. This interactive scan can be stopped by clicking on the **Pause** symbol button.

9. Finally we want now open the result table of our single measurement. Therefore we perform a double click on the table in the *Test Component Explorer* which is shown in red letters and has the ending **'_Single'**. The following example shows such a result table:

*Figure 4.2.2-3: Single Measurement Result Table*

This table may be added to a measurement report.

**Tip:**
The symbols representing the measurement values in the single measurement graphic may be changed in the Options dialog (Extras → Options). These settings are applied every time a new test is created.
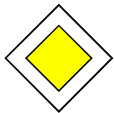
**Goal of this Step:**
You are now familiar with the functionality of the Single Measurement Mode and you can run now an interactive EMS analysis of your EUT together with EMC32 software.

## 4.2.3  Monitoring of EUT Faults

This step describes how you configure and perform an automatic EUT Monitoring with the help of additional measurement devices (like for instance voltmeters, frequency counters or oscilloscopes).

**Automatic EUT Monitoring in EMC32:**

This section requires that the necessary measurement devices are added to and configured in the device list of EMC32. Refer additionally to the section Generic EUT Monitoring Driver in the Online Help.

1.  Before we can integrate the *EUT Monitoring* during the creation of a new test we must create first a new EUT Monitoring Template. Therefore we open in the first step a new *EUT Monitoring Template* via the Open Test Template Dialog (*File ® Test Template ® New*). Then we choose the entry EUT Monitoring and by clicking on the OK button the following dialog appears:
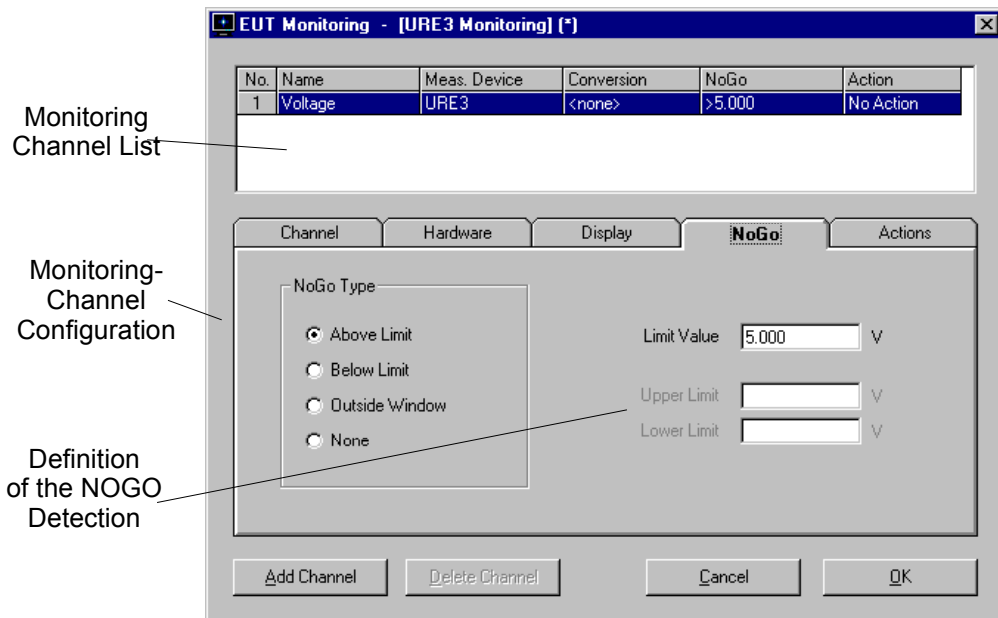
*Figure 4.2.3-1: EUT Monitoring Editor*

2.  Now our task is to define a Monitoring Channel. Therefore go step by step through all tab-indices of the *Monitoring Channel Configuration* in the lower area of the editor. With the exception of the following modification we can keep the default settings of the editor.

    First we enter a *name* for our Monitoring Channel. Then we select the tab-index *Devices* where we select and configure our measurement device by selecting the commands which are needed for the initialization and the measurement of our EUT parameter.

    By clicking on the tab-index *Display* we go into the dialog area for the definition of the unit and the graphics default settings for the Y axis of the EUT measurement graphics.

    Finally in the dialog area *NoGo* we define a threshold which is used by the software to decide whether the EUT shows a fault for the current parameter. In our example a fault of the EUT is detected when the measured current exceeds a value of 5 mA.

3.  After this input we can close the dialog by clicking on the button OK and entering a name for this *EUT Monitoring Template*

4.  Now we can create a new EMS Test using the EUT Monitoring Template configured before. Therefore we do the same procedure as described in section 4.1.2 Create New EMS Test, but with the difference that in the field *EUT Monitoring Parameter* we now select our EUT Monitoring Template created in the steps above.

5.  The new test is now created and we can start the measurement run. We will see additional graphics for our EUT parameter on the screen.
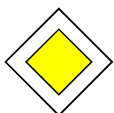
**Goal of this Step:**
You are now able to configure an EUT Monitoring Template for the observation of your EUT and use this template in your EMS Test.

# 5 Calibration of the System

An EMC Test System must be calibrated to get accurate measurement results. This requires a regular calibration of the single measurement devices, done by an authorized calibration lab. It also requires the calibration of all individual RF components of the measurement systems used during an EMC measurement.

EMC32 supports the second part of the calibration as follows:

The attenuation of the cables contained in the system can be measured with the integrated Signal Path Calibration function. The attenuation values are measured as a function of the frequency and stored in an *Attenuation Correction Table*. These attenuation correction files are accessed by the test via the signal paths defined in the Hardware Setup, where they are used during a measurement for the arithmetical correction of the current measurement values.

For example, the frequency dependent correction factors of transducer elements like antennas or current clamps must be considered during an emission measurement to calculate the actual interference generated from the EUT (the receiver only measures the interference signal at the output of the transducer). Typically these correction factors (antenna gain or transfer impedance) are provided by the manufacturer or a calibration lab. They can be entered into the table editor either manually or by using the import function. EMC32 also supports the measurement of these transducer factors in the signal path calibration utility.

For susceptibility measurements, two calibrations are the focus of attention. First is the *reference calibration*, which is the determination of the relation between the forward power and the immunity level necessary for generating the stress signal at the location of the EUT in the test setup. Second is that an analysis of the field uniformity in a defined area in the EUT plane must be done, which the standard EN 61000-4-3 requires for the anechoic chamber (where the radiated EUT test is performed). The deviation of the field strength in this area is not allowed to exceed the limits defined in the standard. This *field uniformity analysis* can be done in EMC32 using the integrated field uniformity algorithm.

## 5.1 Calibrate a Signal Path

This chapter describes how you can measure the frequency dependent attenuation of a signal path with your system during a path calibration and how you store the result in a file of the type Attenuation Correction Table.

**How is the Principle of a Signal Path Calibration?**

For the measurement of the attenuation a constant signal level is fed into the signal path by using a signal generator. The attenuation of this signal is then measured at the output of the path using a power meter. The usual connection is *signal generator à current signal path to be calibrated à power meter/RF probe*. Most times the direct connection signal *generator à signal path to be calibrated à power meter/RF probe* cannot be done because these components are located in different rooms. In this case the connection must be done using *reference cables*. These reference cables themselves have additional attenuation. For getting the net attenuation of our signal path the calibration is done in the two following steps:

**Normalization:**

In the first step the measurement of the signal generator level is done using the power meter (without the EUT signal path). To do this the signal generator is connected to the RF probe of the power meter. If necessary, additional reference cables are used.

**Calibration Measurement**

In the second step the signal path which shall be measured is inserted into the loop and the new signal level is measured. After this the result of the *Normalization* measurement is subtracted from this measurement result and we receive the "pure" attenuation of our signal path. This result is then stored in an Attenuation Correction Table.

It is also possible to measure the frequency response of a power meter via these two calibration steps. In this case the normalization is done by activating the frequency correction in the power meter, and the calibration measurement is done without the frequency correction

**Signal Path Calibration in EMC32:**

This section assumes that the required measurement devices (signal generator, power meter) are already added to the Device List and have been configured.

1. The settings used for the calibration of the signal path are stored in a file of the type Calibration Setup. For the definition of these settings a special dialog is implemented in EMC32. This dialog can be opened as follows:

    Via the File Explorer by a double-click on an existing Calibration Configuration or through a click with the right mouse button on the folder Calibration Setup and a click on the entry *New File* in the corresponding popup menu.

    Through a click on the button Calibrate in the Properties dialog of a signal path which has been opened via a Hardware Setup dialog. This call possibility has been implemented to configure and calibrate a new signal path at once via the Hardware Setup.

    When opening the Calibration Configuration editor a dialog appears as follows:
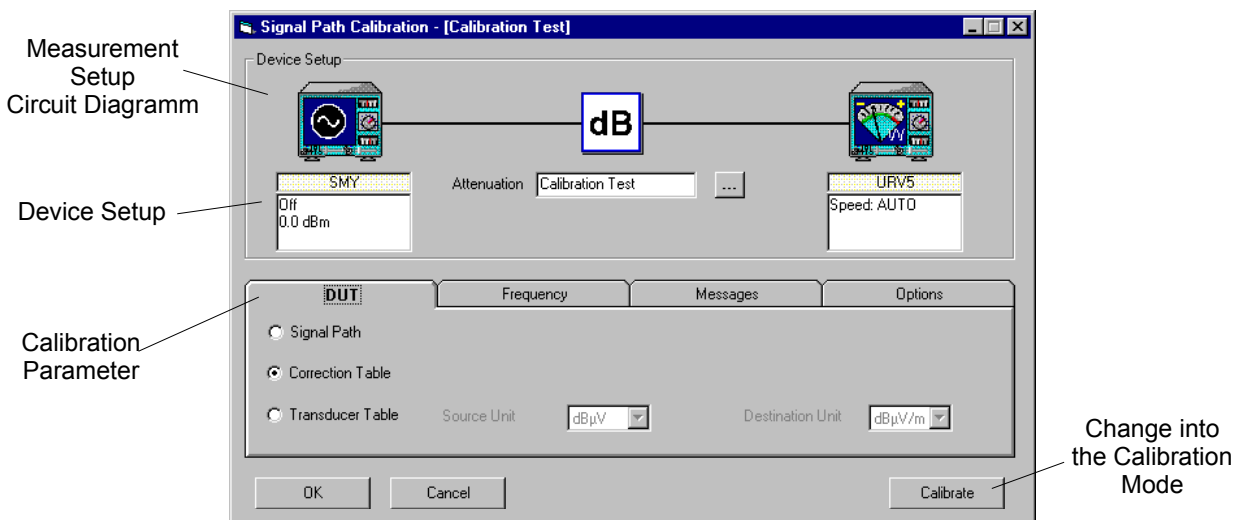


*Figure 5.1-1: Calibration Configuration Editor*

Like the Test Template Editors in EMC32 this dialog for the Calibration Setup contains a section for the definition of the used measurement devices and a section with a tab-index structure for the definition of the calibration parameter settings.

2.  The first time the *Calibration Configuration Editor* is opened for a signal path, the editor fills the dialog automatically with appropriate default values (takes the device names from the current Hardware Setup). Nevertheless the selected signal generator and the power meter should be checked and if necessary. another device may be selected. This is done through a click with the right mouse button on the *device icon* and selection of the corresponding device in the popup menu. After this the device settings for the generator and the power meter are done. Therefore we click with the left mouse button on the device icon. A device specific dialog appears with the device parameters (for additional info to the device parameter refer to the Online Help).

3.  After this step the calibration parameters will be checked and, if necessary, modified. In the register *DUT* the selection is fixed to Signal Path. In the register *Frequency* you should ensure that the start and stop frequency are suitable. A step size of 5 to 10% is normally adequate.

4.  For supporting the operator during the calibration phase appropriate messages can be entered in the tab-index *Messages* for the Normalization and the Calibration.

5.  For particular signal paths it is necessary to activate one of the calibration options as well. These are available in the tab-index Options. In our example we do not want to change anything here.

6.  After we have finished our configuration we will now activate the calibration mode by clicking on the button **Calibrate**. The Calibration Configuration Editor is faded out and two measurement graphics and the Calibration Control Dialog are opened.



*Figure 5.1-2: Screen View of EMC32 in the Signal Path Calibration Mode*

In the graphics *PathCalibrationMeasurement* two traces are displayed during the calibration run, one showing the measurement values of the *normalization*, and the other the values of the *calibration*, both in units dBm. The mathematical difference of both measurements is then displayed in the graphics *PathCalibrationResult* with the unit dB.

7.  The calibration process is controlled via the control dialog. You may choose whether only the normalization or the calibration should be done, or whether both measurements are performed automatically in a sequence. In our case we want to run both measurements and we therefore start the normalization measurement by a click on the Start button. After the message for the normalization -- defined in the tab-index Messages -- has been displayed, , the calibration run is started. The current  measured level is displayed in the lower graphics for surveillance. After the end of the measu-

rement run a message appears whether the normalization should be repeated or not. We answer this query with NO.

8.  Before the calibration measurement is started the message entered in the tab-index *Messages* for the calibration is displayed. For surveillance the currently measured level is displayed in the lower graphics in a second trace. The result of the calibration also appears in the upper graphics. After the end of the measurement scan a message appears asking if the calibration should be repeated or not. We answer this query with NO. Finally the measurement result is stored as an attenuation correction table using the name of the signal path.

9.  At the end of our calibration we want to generate a calibration report. Therefore we click on the button **Report** and the report configuration dialog appears with the report preview window. Usually the layout of the report should be already suitable. If necessary we can modify the report head (information) (Activate the popup menu by clicking with the right mouse button on the Information symbol in the list Selected Components of the Report Configuration Dialog and select the entry Modify). Now we start the printout by using the menu entry **File** ® **Print**. With a click on the **Close** button we leave the report function.

10. Finally, with a click on the Return button we leave the calibration mode and return back to the Configuration Mode. We finish the calibration and therefore close this dialog as well by clicking on the OK button.
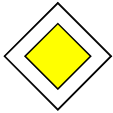
**Goal of this Section:**
You are now familiar with the functionality of the signal path calibration and you can run a signal path calibration independently.

## 5.2  Calibrate a Transducer

This chapter describes how you can measure the frequency dependent transfer function of a transducer with your system during a transducer calibration, and how you store the result in a file of the type *Transducer Correction Table*.

This procedure can be used, for example, to determine the transfer function of a monitoring current clamp or an EMI antenna.

**What is the Principle of a Transducer Calibration?**

For the measurement of the current clamp transfer function a constant signal level is fed into the current clamp calibration fixture by using a signal generator. Then the attenuation of this signal is measured at the output of the transducer using a power meter. Most times the direct connection signal generator à transducer to be calibrated à power meter/RF probe cannot be done because these components are located in different rooms. In this case the connection must be done using additional *reference cables*. These reference cables themselves have additional attenuation. For getting the net attenuation of our transducer the calibration is done in two steps:

**Normalization:**

In the first step the measurement of the signal generator level is done using the power meter (without the transducer). To do this the signal generator is connected to the RF probe of the power meter. If necessary additional reference cables are used.

**Calibration Measurement:**

In the second step the signal path to be measured is inserted into the loop and the new signal level is measured. After this the result of the Normalization measurement is subtracted from this measurement result and the result is the transfer function of the transducer. This result is then stored in a Transducer Correction Table.

**Signal Path Calibration in EMC32:**

This section assumes that the required measurement devices (signal generator, power meter, receiver) are already added to the Device List and have been configured. The following example shows the calibration of a monitoring clamp using a 50Ω calibration fixture (Calibration Jig).

1.  The settings used for the transducer calibration are stored in a file of the type **Calibration Setup**. For the definition of these settings a special dialog is implemented in EMC32. This dialog can be opened as follows:

    Via the File Explorer by a double-click on an existing *Calibration Setup* or through a click with the right mouse button on the folder *Calibration Setup* and selection of the entry New File in the corresponding popup menu.

    When opening the Calibration Configuration editor a dialog appears as follows:
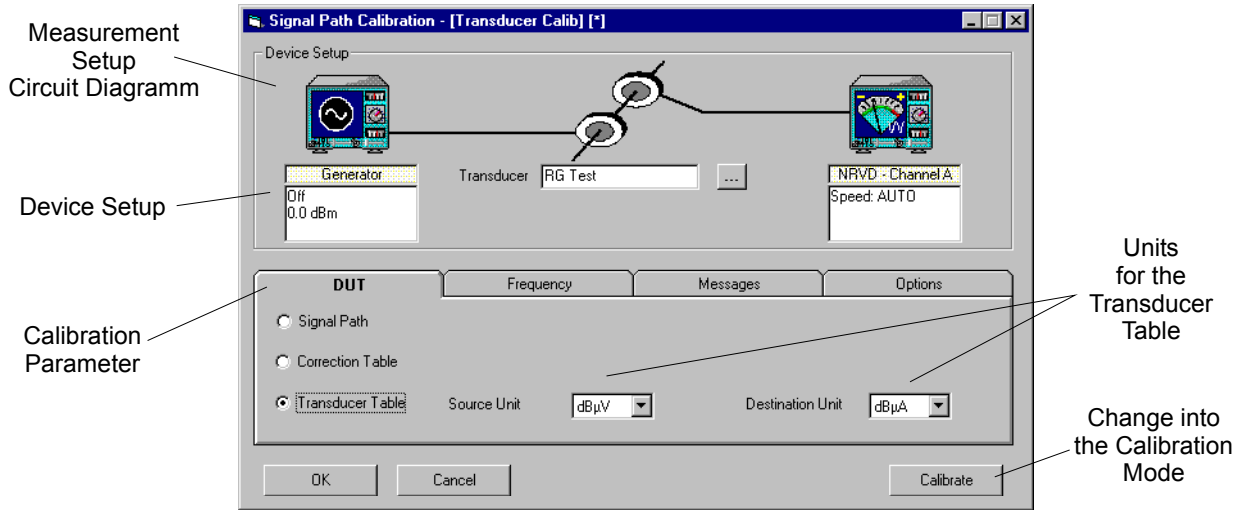
Measurement
Setup
Circuit Diagramm

Device Setup

Calibration
Parameter

Units
for the
Transducer
Table

Change into
the Calibration
Mode

*Figure 5.2-1: Calibration Configuration Editor*

Like the Test Template Editors in EMC32 this dialog for the Calibration Setup contains a section for the definition of the used measurement devices and a section with a tab-index structure for the definition of the calibration parameter settings.

2.  The desired signal generator and the power meter are selected. This is done via a click with the right mouse button on the device icon and selection of the corresponding device in the popup menu. After this the device settings for the generator and the power meter are done. Therefore we click with the left mouse button on the device icon. A device specific dialog appears with the device parameters (for additional info to the device parameter refer to the Online Help). An EMI receiver may be used instead of the power meter and the tracking generator of this receiver substituted for the signal generator.

3.  After this step the calibration parameters will be checked and, if necessary, modified. In the register *DUT* the selection is set to Transducer Table. The source and destination units in the result transducer table are also defined here (in our example the source unit shall be dBm because the measurement device returns the measurement value in dBm. The destination unit shall be dBµA because the current clamp should measure the current in the cable). In the register *Frequency* check whether the start and stop frequency and steps are suitable.

4.  For supporting the operator during the calibration phase appropriate messages shall be entered in the tab-index *Messages* for the Normalization and the Calibration.

5.  For particular transducers it is necessary to activate one of the calibration options as well. These are available in the tab-index *Options*. In our example we want to add to the measured transfer function a constant of 73 dB, representing the current injected in our calibration fixture (0 dBm at 50Ω corresponds to a current of 73 dBµA).

6.  After we have finished our configuration we will now activate the *calibration mode*. Therefore we click on the button **Calibrate**. The Calibration Configuration Editor is faded out and two measurement graphics and the Calibration Control Dialog are opened.

    Refer to the similar Figure 5.1-2: Screen View of EMC32 in the Signal Path Calibration Mode.

    In the graphics *PathCalibrationMeasurement* two traces are displayed during the calibration run, one showing the measurement values of the normalization and the other the values of the calibration, both in units dBm. The mathematical difference of both measurements is then displayed in the graphics *PathCalibrationResult* with the unit dB.

7.  The calibration process is controlled via the control dialog. You can choose whether only the normalization or the calibration should be done, or whether both measurements are performed automatically in a sequence. In our case we want to run both measurements and we therefore start the normalization measurement by a click on the Start button. After the message for the normalization -

- defined in the tab-index *Messages* -- has been displayed, , the calibration run is started. The current measured level is displayed in the lower graphics for surveillance. After the end of the measurement run a message appears asking if the normalization should be repeated or not. We answer this query with NO.

8.  Before the calibration measurement is started the message entered in the tab-index *Messages* for the calibration is displayed. For surveillance the currently measured level is displayed in the lower graphics in a second trace. The result of the calibration also appears in the upper graphics. After the end of the measurement scan a message appears asking if the calibration should be repeated or not. We answer this query with NO. Finally the measurement result is stored as a transducer correction table using the name from the calibration setup.

9.  At the end of our calibration we want to generate a calibration report. Therefore we click on the button **Report** and the report configuration dialog appears with the report preview window. Usually the layout of the report should already be suitable. If necessary we can modify the report head (information) (Activate the popup menu by clicking with the right mouse button on the Information symbol in the list Selected Components of the Report Configuration Dialog and select the entry Modify). Now we start the printout by using the menu entry **File** ® **Print**. With a click on the **Close** button we leave the report function.

10. With a click on the **Return** button we leave finally the calibration mode and return back to the Configuration Mode. We finish the calibration and close therefore this dialog as well by clicking on the OK button.
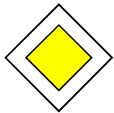

**Goal of this Section:**
You are now familiar with the functionality of the transducer calibration and you can run a transducer calibration independently.

## 5.3  EMS Reference Calibration and Field Uniformity

The recording of a Reference Calibration File in a defined test setup without an EUT is an essential part of many EMS standards which contain a procedure based on the substitution method. The procedure for running such measurements is an integral part of the EMS subsystem of EMC32. The reference calibration is performed like a standard EUT test with little modifications (refer also to the Online Help *EMS Measurements à Load EMS Test à Test Method*).

### *What is a Reference Calibration File?*

Most Susceptibility Measurements are performed using the **substitution method** (for example EN 61000-4). Here a calibration is run in the first step to determine which input power into the transducer is necessary to get the required stress level at the location of the EUT. The stress level is measured in this case with an appropriate measurement device (for example a field sensor in the case of a radiated measurement) (reference measurement). The received measurement results are stored in the Reference Calibration File. During the real EUT measurement the sensor is then replaced by the EUT. Now a forward power with a level stored in the reference calibration file is fed into the transducer to generate the required stress level.

Reference Calibration Tables are generated with the Test Method "Reference Calibration" during an EMS measurement run.

### 5.3.1  Reference Calibration

This step describes how you run a Reference Calibration and generate a **Reference Calibration** Table which is required for an EUT measurement according to EN 61000-4-3/6.

The following example assumes that the EMS measurement part of EMC32 is installed and configured with the demo configuration. The principle of this measurement example can be transferred easily to any other configuration of an EMS Test System for EN 61000-4-3/6.

**Running a Reference Calibration with EMC32:**

1.   In this example we want to perform a Reference Calibration for a radiated EMS Test. Therefore we open a new test via the menu entry **File ® Test ® New**. The New Test dialog appears which we will configure as follows:
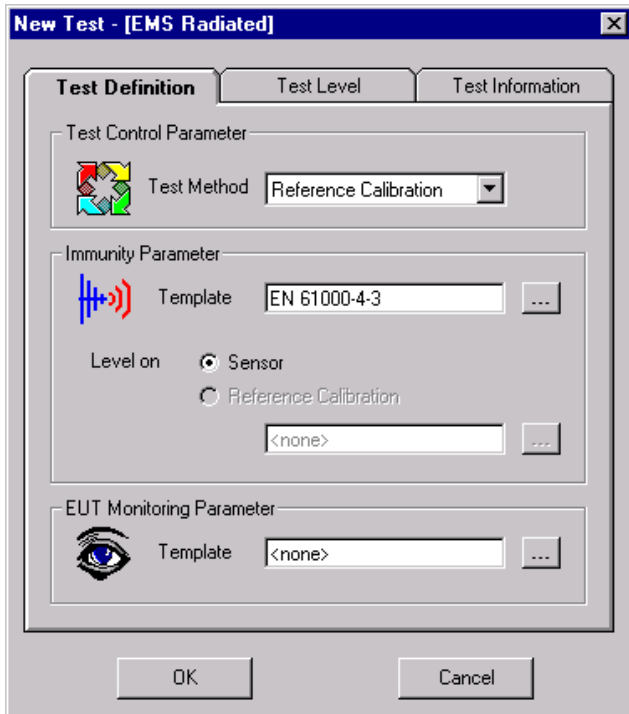
Figure 5.3.1-1: New Test Dialog for a Reference Calibration

In this case the leveling is done on a sensor defined in the *Hardware Setup* of the current test template. Of course here we select the *Test Method* **Reference Calibration**. After we have finished the input of these settings the generation of the new test is started by clicking the **OK** button.

2. When the test is opened we start the measurement by a click on the symbol **Start Forward** in the Test Control Toolbar.

3. After the measurement run over all frequencies is finished the following dialog for storing the reference calibration file appears:
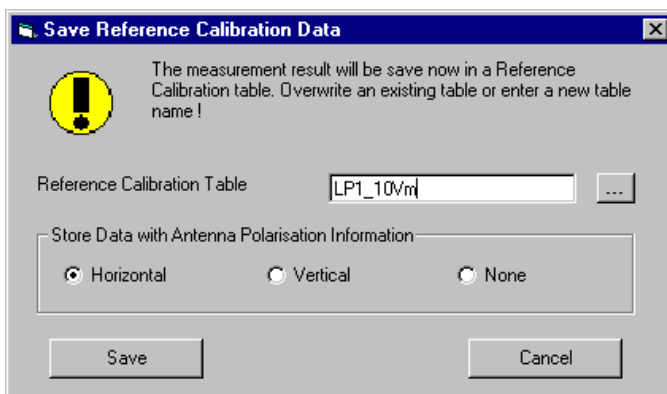


*Figure 5.3.1-2: Save Reference Calibration Data Dialog*

Here we first enter a name for the new reference calibration file or select an existing file (a click on the button **...** opens the File Explorer). Since we have done a radiated measurement, we can select whether we want to save the current polarization in the reference calibration file (the software already proposes the current polarization). After a click on the Save button the reference calibration file is generated.

4. In our example we want to calibrate the antenna for both polarizations. Therefore we click on the other polarization button in the Antenna Control element and repeat the measurement in the same test. When saving the result we choose the same file as in step 3 but with the difference that the polarization is now changed. EMC32 adds three additional columns to this table with the result of this polarization.

**Tip:**
The name of the reference calibration file should always give a reference to the name of the antenna and the immunity level (example: LP1_30Vm). If this reference calibration file shall be used for the field uniformity evaluation then the file name must correspond with the name conventions, described in the following chapter.

**Goal of this Step:**
You are now familiar with the theme Reference Calibration and you can perform and save a Reference Calibration by yourself.

### 5.3.2  Field Uniformity Evaluation

This chapter describes how you perform a field uniformity evaluation for your EMS Test System required by the standard EN 61000-4-3.

The standard EN 61000-4-3 and all product standards referencing this standard define a virtual uniform area in a plane which is located on the illuminated face of the EUT (typically in a 3 meter distance from the tip of the antenna and perpendicular to the field radiation direction). The area has dimensions of 1,5 x 1,5 meter; it starts in vertical direction 80 cm above the chamber floor; in horizontal direction it is positioned symmetrically on the center of the EUT. This area is covered with a pattern of 4 x 4 points having a distance of 50 cm from each other.

Now we want to run 16 reference calibrations for the same antenna polarization but with the difference that the field probe is set to each of the 16 predefined points. Finally the calibration result is checked whether the following condition can be met:

For each frequency points the following conditions are checked: If we assume a constant power into the antenna input for all 16 points then at least 12 of the 16 points have to be inside a window 0 to +6 dB. This 12 points of the 16 points have to be taken whose field strength in V/m is closest to the mean value of all points. Furthermore it must be fulfilled that the remaining 12 points are inside a limit of +-3dB to the mean value. The point with the lowest field strength will get the reference point. It is permissible for up to 3% of the frequency points that they are in the tolerance window of 0 to +10 dB. (The procedure may be changed in new issues of the standard.)

If this requirement is met for both antenna polarization then the field generated in the chamber is indicated to be uniform for running susceptibility tests according to EN 61000-4-3. If the required homogeneity criterion is not met, one needs to modify the set-up: re-position the antenna with respect to the chamber axis, place floor absorbers between antenna and homogeneous area, maybe change antenna model.

The following example assumes that the required 32 reference calibrations have been performed (16 points per antenna polarization) and stored into 16 reference calibration files.

**Running a Field Uniformity Evaluation with EMC32:**

1.  For running the evaluation with EMC32 the field uniformity evaluation dialog is opened via the main menu entry **Test** ® **Uniformity**. The following dialog will appear:
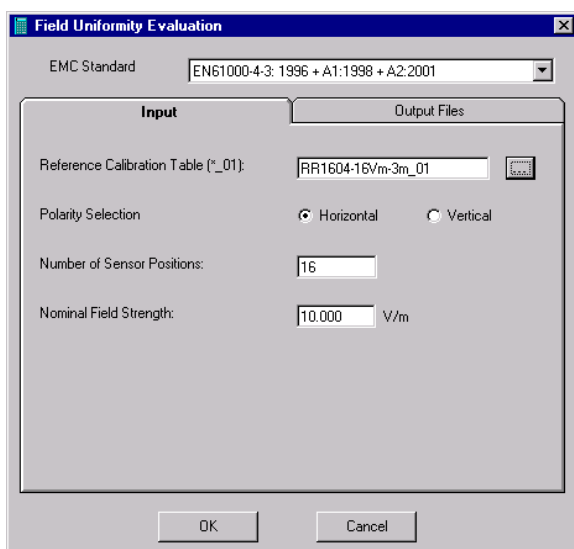


*Figure 5.3.2-1: Field Uniformity Evaluation Dialog with Tab-index View Input*

2. In this dialog we first select the *EMC Standard* according to which the evaluation has to be performed, in our case EN 61000-4-3:1996 + A1:1998 +A2:2001. After this we click on the button ... of the parameter *Reference Calibration Table* and select the first of our 16 reference calibration files which ends with **_01**. After closing this file selection dialog the fields *Number of Sensor Positions* and *Nominal Field Strength* are automatically filled. We also select that we want to run the evaluation for horizontal antenna polarization.

3. Now we define which output files the algorithm should create. Therefore we click on the tab-index Output Files to activate this dialog view. Up to four files and five graphics can be created as a result of the evaluation. All outputs are optional. You can choose the file name <none> for all files and deactivate all graphics outputs; nevertheless the evaluation is performed.
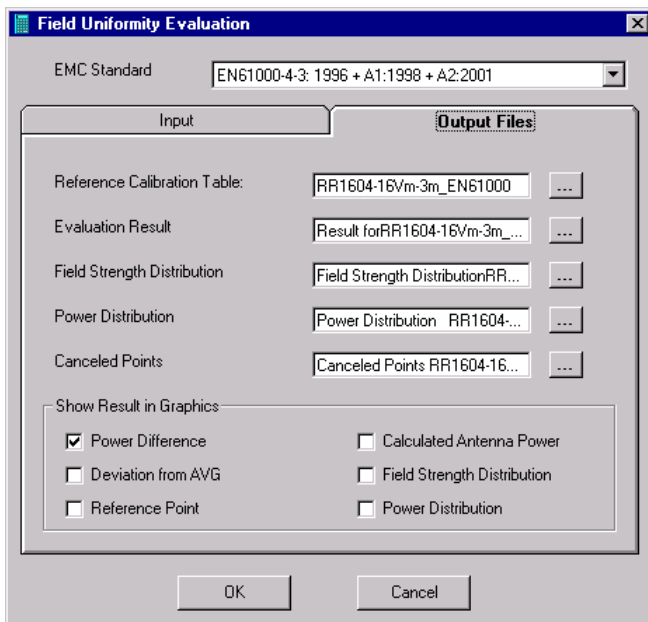


*Figure 5.3.2-2: Field Uniformity Evaluation Dialog with Tab-index View Output Files*

After the selection of a reference calibration file in the Input tab-index the names of the four possible output files are automatically created. In our example we want to use these file names. The most important result of the evaluation is the new reference calibration file used later for the EUT test. Further additional files are created containing different evaluation parameters which allow a more detailed analysis of the chamber field uniformity (for more details about these output files refer to the Online Help).

Up to six graphics may also be created by the evaluation algorithm showing the evaluation result in a graphical form. In our example we want to output graphics for the power difference between the measurement points.

4. After a click on the button **OK** the evaluation is performed. The progress of the evaluation is displayed in the progress bar of the EMC32. When the evaluation has been finished the *Field Uniformity Analyzer* dialog is opened. With the help of the field uniformity analyzer you can visualize in detail the evaluation result for each test frequency point:
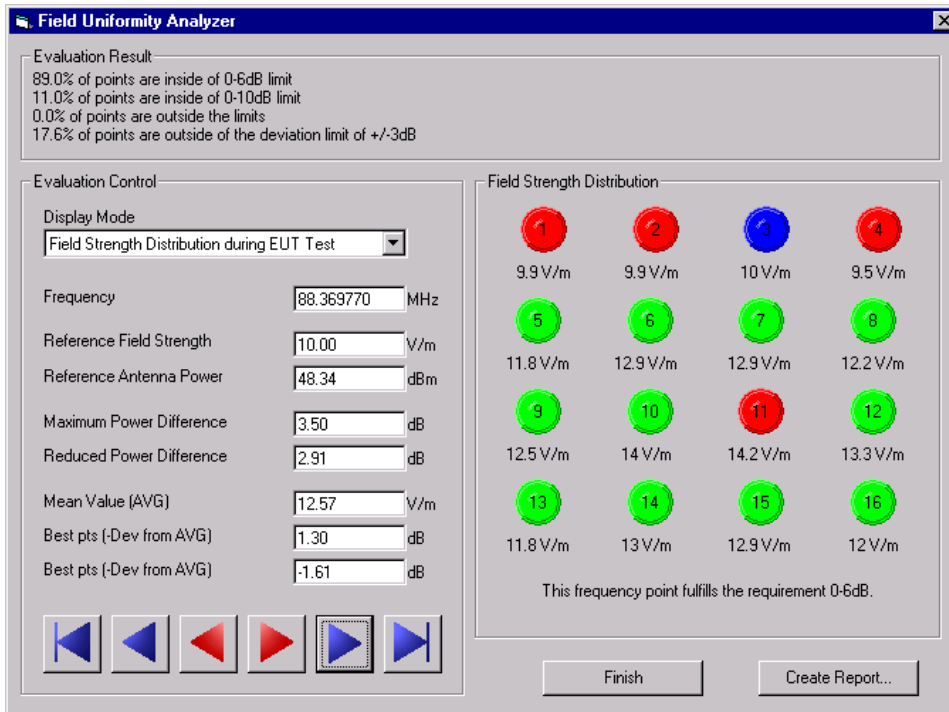
*Figure 5.3.2-3: Field Uniformity Analyzer dialog*

4.   Finally we want to create a report printout of the evaluation result. Therefore we click on the button **Create Report...** in the evaluation summary dialog. The analyzer dialog is closed and the report configuration dialog will appear with the report preview window. Usually the shown report preview should already have the right layout and we can modify the report head (information) if necessary (open the context menu by right-clicking on the Information symbol in the list Selected Components of the report configuration dialog and selecting the entry Modify). Via the menu entry **File ® Print** we now start a printout on the printer and then leave the report dialog by a click on the Close button.

5.   The evaluation above was performed for the horizontal antenna polarization. Now we must repeat the steps 1 to 5 for the vertical polarization. It's important that we select the same reference calibration file for the result so the algorithm can add additional columns for the vertical polarization.

**Tip:**
You must run the evaluation two times for a complete evaluation of your chamber, once for each antenna polarization.
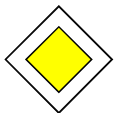
**Goal of this Step:**
You are now familiar with the functionality of the field uniformity evaluation and you can perform an evaluation of the uniformity of your measurement chamber.

# 6 Glossary

### *Calibration Setup*

A Calibration Setup is a configuration file that contains all settings (device configuration and frequency parameter) to run a signal path calibration —that is, measure the attenuation of a device -- and store it into an appropriate table (Attenuation Correction Table).

### *Configuration Wizard*

After the installation and before a measurement with EMC32 may be performed, the software must be adapted to the system. That means you tell EMC32 which devices are available in your system, via which interfaces and interface addresses they should be addressed, how the devices are connected with each other and how the measurements.

Therefore the configuration wizard is available in EMC32 which asks the required measurement categories (radiated/conducted) and the measurement devices from the user. Using this information the wizard creates a standard configuration for your system. Additionally predefined correction tables and test templates are copied into the corresponding folders. After this step EMC32 is ready for running the first demo measurement.

Before the first real DUT measurement is started the appropriate calibration data for the antennas and the transducer as well as for the signal path attenuation have to be entered or calibrated (refer to the chapter System Calibration). Otherwise the measurement accuracy can not be guaranteed.

### *EMI*

**E**lectro**m**agnetic **I**nterference: Ability of an electrical appliance to not disturb its environment by emitting an interfering signal.

### *EMS*

**E**lectro**m**agnetic **S**usceptibility: Property of an electrical appliance to tolerate a disturbance of a particular level without showing any faults.

### *EUT Monitoring*

Monitoring of different EUT parameters during an EMS measurement by using several measurement instruments with the goal of detecting EUT failures.

### *Explorer*

Representation of EMC32 file structure in a clear tree view diagram allowing a direct access to all files of the file system.

### *Field Uniformity Evaluation*

Check of the field strength distribution in a plane (position of the EUT) with a defined distance from the antenna tip. The field strength value at the predefined points in the plane is not allowed to differ more than a predefined limit from the other points. This limit depends on the applied EMC standard (for example in the standard EN 61000-4-3: 0 to +6 dB).

## *Hardware Setup*

The Hardware Setup represents the system configuration of the EMS/EMI Test System. In the EMC32 software it defines which signal generator, which amplifier, which power meter, which antenna and which sensor in what frequency range should be used by the leveling algorithm. The signal paths for the signal flow between the devices are also defined and configured.

## *iKey*

An i-Key is a little key which is connected to a free USB Port. It is used for the protection of the software against illegal copy and therefore EMC32 periodically checks whether the i-Key is still connected.

## *Limit Line*

In all EMI standards maximum permissible level values for the interference signal generated by the EUT are defined depending on the EUT class. A table containing these limit values over the frequency for an EUT class is called Limit Line in EMC32.

## *Measurement Class*

In EMC32 four Measurement Classes are distinguished. First the separation is done whether an EMI or EMS measurement is performed and second, whether it is a conducted or a radiated measurement. As a result of this principle the following combinations are available:

- EMI conducted

- EMI radiated

- EMS conducted

- EMS radiated

The Measurement Classes are used to generate and provide an additional subdirectory structure both for the calibration and configuration files and also for the measurement results. Using this principle the EUT Tests are sorted into the test directory structure first by the EUT name and then by the measurement class.

## *Monitoring Channel*

A Monitoring Channel is an element in a Test of EMC32 used both for monitoring of an EUT parameter (e.g. output voltage) and also for checking the EMS Test System (e.g. current test level). It is represented in a test by graphics and an appropriate column in the measurement result table.

## *Receiver*

In EMC32 an EMI receiver could be represented by one of the following three devices:

- Spectrum Analyzer (supports only Sweep Measurements)

- EMI Measurement Receiver (supports only Scan Measurements)

- EMI Combination Receiver (supports both Sweep and Scan Measurements)

Depending on the device type not all measurement modes may be used.

## Reference Calibration

Typically susceptibility measurements are performed using the reference calibration method (e.g. in EN 61000-4). Here a calibration is done in the first step which has the task of determining what input power into the transducer is necessary to generate the stress level at the location of the EUT. The immunity level is measured with an appropriate measurement device (for example a field sensor for radiated measurements). The received measurement values are stored in a reference calibration file. During the EUT measurement the sensor is replaced by the EUT. Then the transducer power stored in the reference calibration file is fed into the transducer input.

## Scan

A Scan is a measurement run during which the receiver or the signal generator is tuned step by step over the whole frequency range. In the definition file of a scan the following parameters are available: the step width (absolute or in percent from the current frequency), the dwell time at each frequency and the start and stop frequency.

## Signal Path

A Signal Path in EMC32 is a logical object which is used for connecting of two devices in the Hardware Setup. It contains an Attenuation Correction Table (attenuation of the signal path) and a list of switch paths which have to be set when this signal path is activated in the Test System. The attenuation table and the switch path are optional in a Signal Path. Instead of an attenuation table a constant value can be used.

## Single Measurement

A Single Measurement is a final measurement at particular frequencies determined during the automatic Pre-scan Measurement (for example interference frequencies in EMI or frequencies where the EUT shows faults in EMS). The Single Measurement is typically performed interactively by the user.

## Sweep

A Sweep is a measurement run during which the analyzer is tuned (quasi) continuously over the whole frequency range. The definition parameter for a sweep are as follows: Start and stop frequency and the sweep time which the analyzer needs to cover the frequency range.

## System Monitoring

The System Monitoring is comparable to the EUT Monitoring but with the difference that here, instead of the EUT, an EMS Test System parameter may be monitored. Such parameters include the current stress level, the amplifier output power, the transducer input power or the VSWR. In a test, these parameters are treated like monitoring channels. These monitoring channels are defined in the EMS Scan Template.

## *Test*

In EMC32 a Test is the central element for running EMI and EMS measurements. It represents a subdirectory in the file area containing several files in which both the settings for running the measurement and the measurement results themselves are stored in graphical and tabular form. Additional information about the EUT is stored for the measurement documentation (report).

All Tests (subdirectories) are filed in a directory structure which is defined by the operator (typically using the name of the EUT). *Measurement classes* are also distinguished in EMC32. These classes are combinations of the subsystem name (EMI/EMS) and the type of the measurement (radiated, conducted). This principle allows the generation of clear and logical structures for storing the EUT test results.

A Test is created as a new subdirectory in the **Tests** root directory (alternatively in a EUT specific subdirectory in the **Tests** root directory) and contains the following data:

- A configuration file containing the main setting parameters of the test

- Result files: the number and name of the files depend whether the test is an EMS Measurement or an EMI Measurement

- Test Templates in the subdirectory Setups

- Test Graphics in the subdirectory Graphics

- HTML reports in the subdirectory Reports

Due to the fact that a test subdirectory not only contains all measurement results but also the currently used Test Templates, which define how the measurement was done, a clear traceability of the measurement results to used scan parameter is guaranteed. This principle makes a test reproducible as well.

## *Test Information*

Test Information means a text table where the operator can store information about the EUT and the measurement run. This test information may be added to the report.

## *Test Component*

Test Component means all files which belong to a Test. A Test Component could be a Test Template, a Measurement Graphic, a Result Table or the Test Information.

## *Test Method*

A Test Method represents a sequence of actions which are performed by the software during a test run.

For an EMS Measurement the followings actions are performed cyclically: generate test level, wait dwell time, do EUT Monitoring, store measurement results.

### Test Template

For running an EMI or an EMS Measurement the software needs needs to know how and in which frequency range the interference of the EUT is to be measured; and how the stress level in which frequency range should be applied at the EUT to check its functionality.

**For Testing the Interference of an EUT the following Parameters must be defined in EMC32:**

- In which frequency range and with which frequency step width should the scan run?

- What are the settings of the receiver or analyzer?

- Which limit line should be applied?

- What is the setup of the test system used for the measurement of the interference signal?

**For the Generation of the Stress Signal the following Parameter must be defined in EMC32:**

- In which frequency range and with which frequency step width should the scan run?

- What are the parameters of the stress signal (level)? Modulated or unmodulated?

- What method should be applied for the generation of the stress signal? Leveling on a Sensor or Substitution Method?

- What is the setup of the test system used for the generation of the stress signal?

### Transducer

Transducers are converters which convert the input signal into an output signal. Theoretically they can be operated in both directions, but this is not always possible due to technical reasons.

A Transducer for conducted measurements is, for example, a current clamp.In an EMI Measurement It converts the current in a conductor through the monitoring clamp into a voltage at the output of the clamp. During an EMS Measurement the current clamp is operated vice versa that means the amplifier power fed into the input inducts a current into the conductor through the clamp.

An antenna is a transducer for radiated measurements. It converts the power at the input of the antenna into a field strength at the EUT location, or vice versa.

An important term in the case of transducers is the conversion factor. This is the difference between the level at the output and the level at the input of the transducer (a logarithmic representation of both levels in the unit dB is used). This conversion factor is stored in EMC32 in a special table type called Transducer Table. This table is assigned in the device configuration to the appropriate device.

### USB

**U**niversal **S**erial **B**us. New industry standard for a serial interface with high transmission rate. The USB is a bus system to which up to 128 devices may be connected. Usually new motherboards are equipped at least with 2 USB ports. If more USB devices should be connected then the interface can be extended by using a HUB.

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