Interactive EMI Measurements with R&S©EMC32-K24

EMC32

Application Note

Products:

- R&S®EMC32-EB
- R&S®EMC32-K10
- R&S®EMC32-K24

The option R&S®EMC32-K24 extends the emission measurement of the EMI Auto Test (R&S®EMC32-K10) with interactive measurement capabilities.

This extension is useful for test verification and measurement during product improvement.

Application Note
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5.2014 - 01.00

ROHDE&SCHWARZ

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1 Introduction

This application note gives an introduction to the interactive measurements supported with the extension R&S®EMC32-K24 for R&S®EMC32-EB EMI section with R&S®EMC32-K10 EMI Auto Test.

At the end of an automatic test routine during compliance testing it is recommended to verify the measurement results. When performing measurements during development, it may be helpful to repeat the measurement at some critical frequencies after modifying the device under test. The R&S®EMC32-K24 interactive measurement option simplifies this process for both cases indicated above. It provides excellent flexibility during automatic testing and allows the user to interactively control the test system. This option extends the R&S®EMC32-K10 EMI auto test software to include the following new functions:

Simple adaptation of the test routine without modifying the test template

Using the new "Testing Process" dialog window, the test routine defined by the test template can now be adapted without having to modify the template. For example, it is easy to deactivate individual test steps such as the zoom 1 measurement or individual accessory positions (e.g. for the turntable) during the preview measurement. Moreover, it is possible to select the test step where to begin or to continue the measurement.

Interactive final measurement at critical frequencies

Interactive final measurements are based on the "Process State" column in the table of critical frequencies, or on values that the user adds interactively. The interactive final measurement function provides a high degree of flexibility and saves time by focusing efforts on evaluating the critical frequencies. This function allows repetition of the automatic test routine at selected frequencies (e.g. redo the final measurement).

Interactive verification of measurement results

The R&S®EMC32-K24 function for interactive single measurements now makes it possible to verify individual frequencies from the "Final_Results" and "Critical_Freqs" tables on a fully interactive basis. Accessories such as the mast and turntable that are used in measuring the electric field strength are first moved to the position where the maximum value was found during the automatic test routine, and then a cyclical receiver measurement is launched. The user can now interactively adjust the position of the accessories and tune the receive frequency in order to determine the maximum radiation at this frequency. In addition, the current receive frequency can be saved with the current accessory positions as a new entry in the corresponding result table. Each frequency is provided with a timestamp to allow complete documentation of the test process. The critical frequency can also be determined more precisely using a partial scan around the frequency (interactive zoom measurement) in order to compensate for any drift in the interfering frequency vs. time.

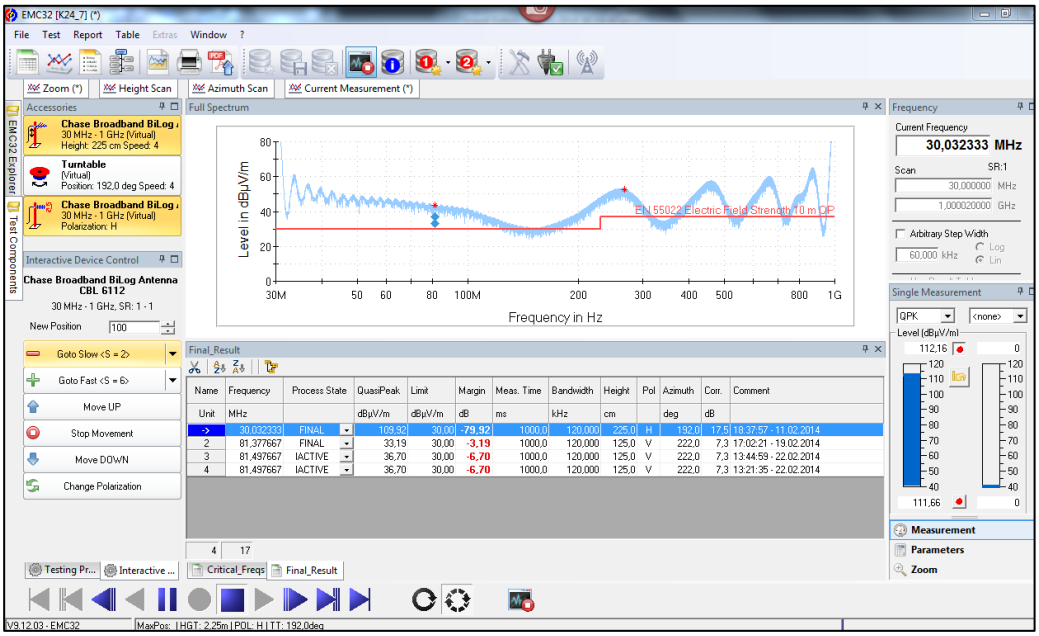


Fig. 1-1: EMI Auto Test in Interactive Measurement Mode

2 Auto Test Fundamentals

This chapter gives a short introduction to the most important EMI Auto Test contents and User Interface controls required for this application note.

2.1 Test Control Toolbar

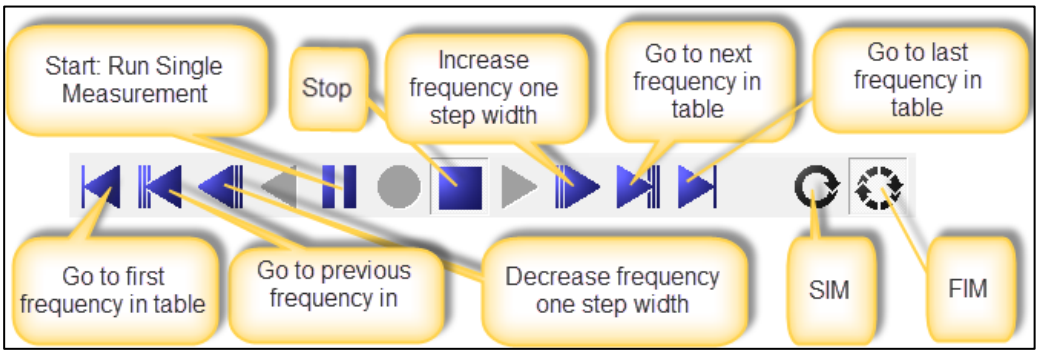


Fig. 2-1-1: Test Control Toolbar for FIM

Table here is either the Critical Frequency Table or Final Result Table.

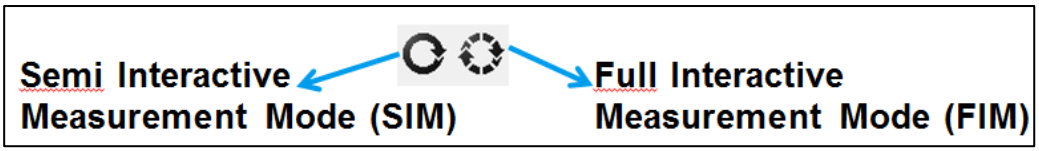


Fig. 2-1-2: Two Modes for Interactive Measurement

For better understanding we use the abbreviations SIM and FIM for Interactive Measurement. In SIM you can find and re-measure critical frequencies using the automated EMI measurement sequence; in FIM you can verify the final measurement results of the Auto Test with full interactive control of accessories and receiver.

2.2 Auto Test Control

Interactive variation of devices during EMI Auto Test is now supported with R&S®EMC32-K24 Single Measurement Mode. This option gives you the possibility for enabling or disabling test step details. The new functions can be selected for interactive measurements as seen in Fig.2-2-1. Each step position can be individually enabled or disabled.

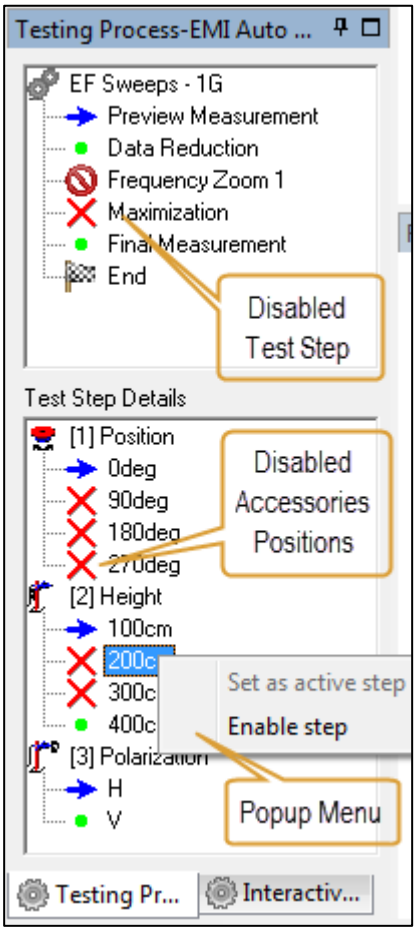


Fig. 2-2-1: EMI Auto Test Control with disabled accessories positions

2.3 Auto Test Result Tables and Their Usage

The EMI Auto Test mainly uses the following result tables which are also the central tables for the interactive measurements.

Critical Frequency Table

The Critical Frequency Table is the central table for processing critical frequencies which are determined by the

- Automated data reduction during this test step in the automated measurement flow
- Drag & Drop from Full Spectrum Graphics when the interactive data reduction is done or the measurement is stopped
- Import Results from other Tests or Frequency Lists when the interactive data reduction is done or the measurement is stopped

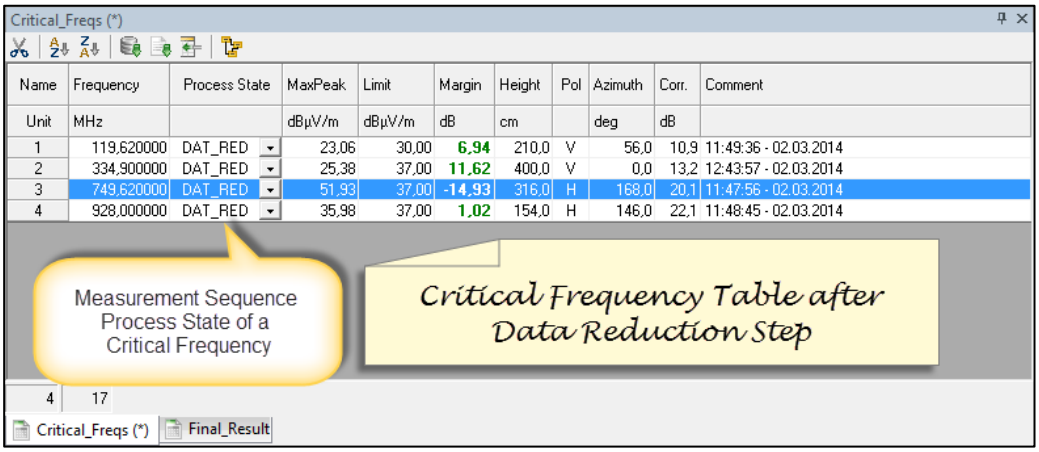


Fig. 2-3-1: Critical Frequencies Result Table

The Process State selection box can get the following states: Data Reduction, Zoom 1/2, Maximization, Adjustment or Final Measurement.

Final Result Table

The Final Result Table contains the final measurement results for the identified critical frequencies from the Critical Frequencies Table above. Each time a critical frequency has passed all selected steps of the automated EMI measurement flow (Zoom, Maximization, Adjustment) it is copied to the Final Result Table and the entry in both tables gets the Process State FINAL.

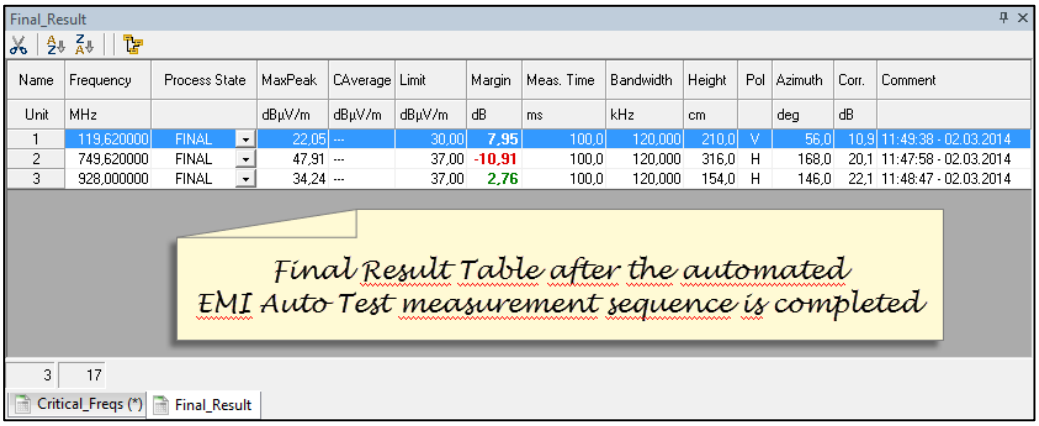


Fig. 2-3-2: Final Result Table

The Process State selection box can get the following states: FINAL or IACTIVE.

2.4 Table Editor in EMI Measurement Mode

Additional functions are available with R&S®EMC32-K24 option for table editor. For Final Result table the buttons cut, ascending and descending are self-explanatory. The button for Change Process State will help you to switch all listed frequencies from one state to a target state. This button  is useful if you do not want to click each frequency point to this state.

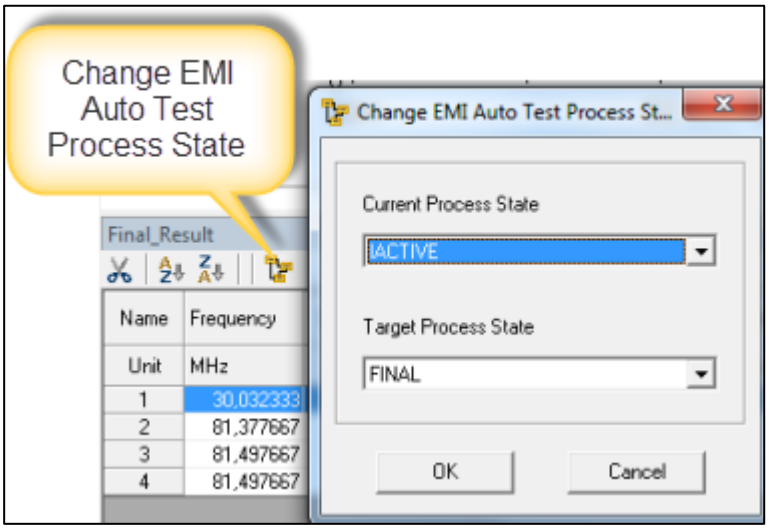


Fig. 2-4-1: Change Test Process State

For the Critical Freqs table there are also new functions available. This button  is used to import Critical or Final Result tables from other tests.

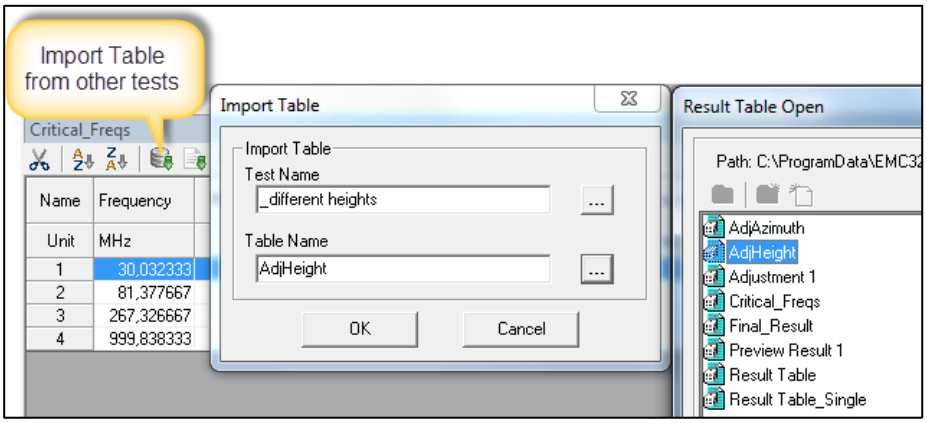


Fig. 2-4-2: Import of Tables from other tests

It is also supported to import a frequency list table with the button  shown in Fig.2-4-3. In this example an NSA frequencies table will be imported.

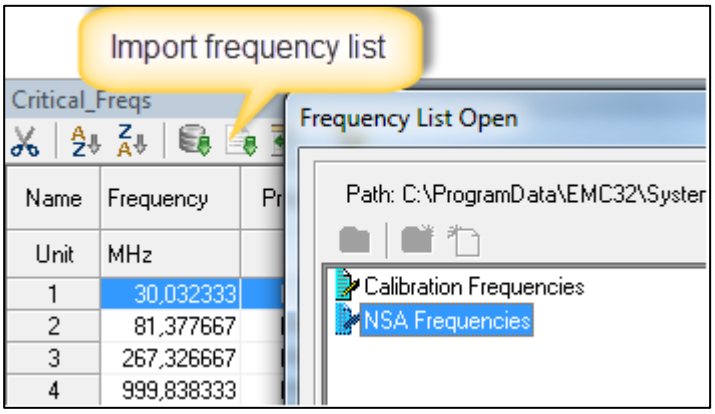


Fig. 2-4-3: Import of frequency list tables

To add any new frequency into the Critical Freqs table use button  as shown in Fig.2-4-4. It is supported to modify the frequency value via a double click on the frequency field when it is in the INITIAL process state.

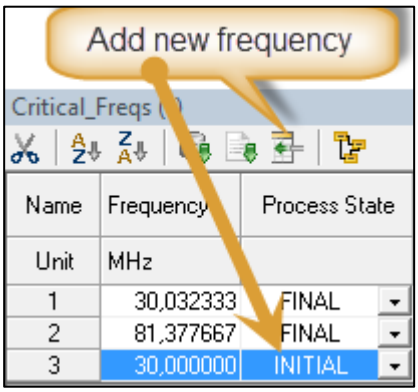


Fig. 2-4-4: Add new frequency to table and change manually with double click

2.5 Semi Interactive Measurement Mode (SIM)

The SIM is active when this button is pressed: 

This mode allows the operator to change the Process State of selected frequencies in the Critical Frequency Result Table to a previous measurement state (e.g. Final to Data Reduction) and then re-run the automated EMI measurement sequence. Thus these test steps (Zoom 1/2, Maximization, Adjustment or Final Measurement) will then be repeated for these frequencies and the measurement results in the Final Result Table will be overwritten. Only relevant sequence steps for the frequency will be measured.

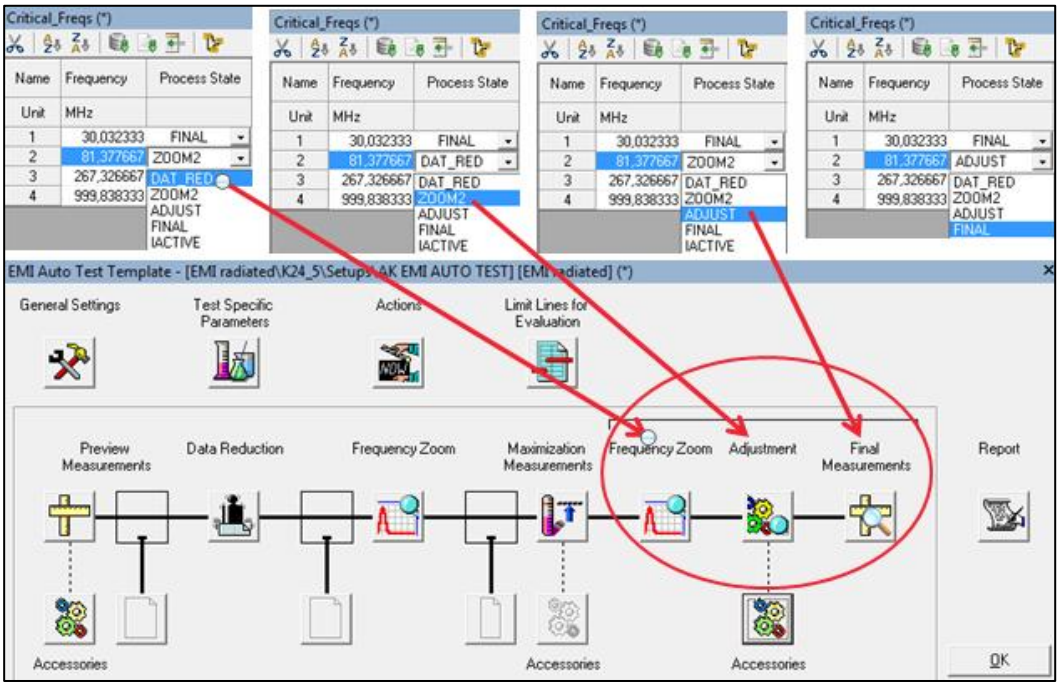


Fig. 2-5-1: SIM Algorithm

Now we apply in this example all possible variations for process state with Data Reduction, Zoom2, Adjustment or Final Measurement:

Critical_Freqs (*)

Name	Frequency	Process State	MaxPeak	Limit	Margin	Height	Pol	Azi
Unit	MHz		dBµV/m	dBµV/m	dB	cm		deg
1	30,032333	DAT_RED	119,52	30,00	-89,52	250,0	H	
2	81,377667	ZOOM2	43,57	30,00	-13,57	300,0	H	
3	267,326667	ADJUST	52,73	37,00	-15,73	200,0	H	
4	999,838333	FINAL	106,92	37,00	-69,92	225,0	H	

Fig. 2-5-2: Example of Critical Frequency List with different process states

For example we select the process state Data Reduction for 30 MHz. Then all relevant measurement steps will be executed beginning with Zoom2, Adjustment and Final Measurement for frequency 30 MHz. This means that all process steps after the Data Reduction step are executed for 30 MHz, the SIM algorithm begins with the next relevant step.

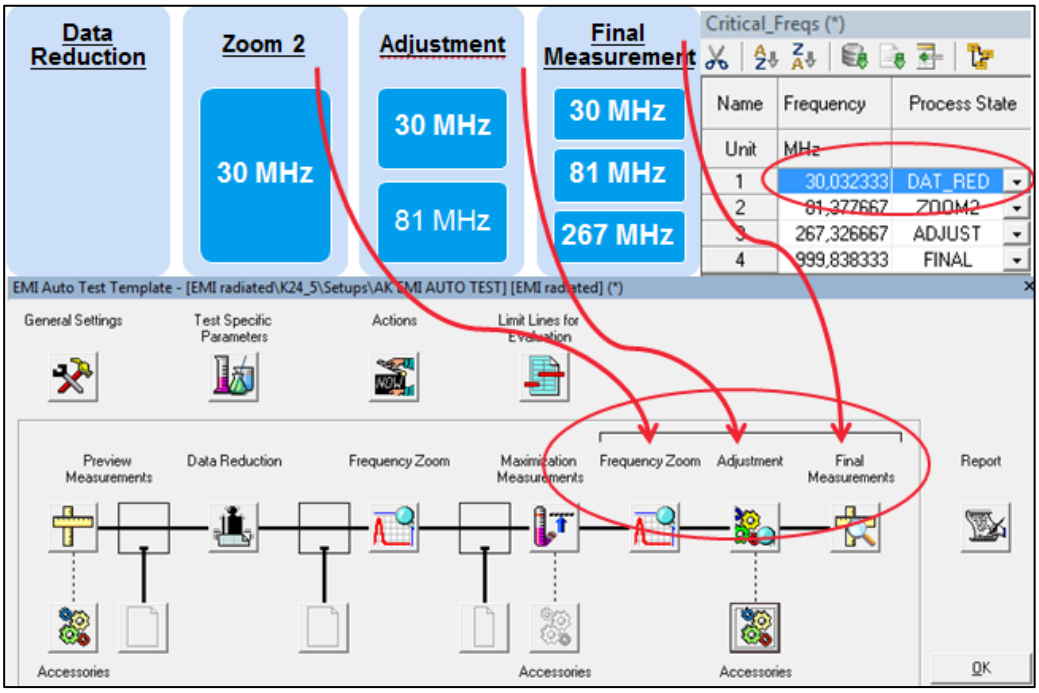


Fig. 2-5-3: SIM Algorithm

The measured frequencies will be stored in the Final Result Table with the process state FINAL:

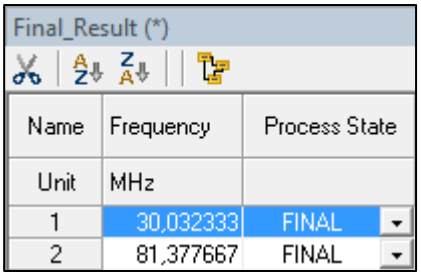


Fig. 2-5-4:Final Result table after running SIM

2.6 Full Interactive Measurement Mode (FIM)

The Full Interactive Measurement Mode is entered with the button  .

This mode allows controlling the system fully interactively and thus verifying the critical frequencies measured during the automated EMI measurement sequence. Optional additional critical frequencies can be identified and the maximum emission can be determined interactively. When selecting a new frequency in the Final or Critical Frequencies Result Table, EMC32 will automatically set the accessories to the position stored in the table (from automated measurement) which gives a quick and easy start for the interactive measurement.

The user can manually set accessory positions (antenna, turntable) or movements to measure and find the maximum emission of the EUT. With the Interactive Device Control the devices can be set to the desired positions easily:

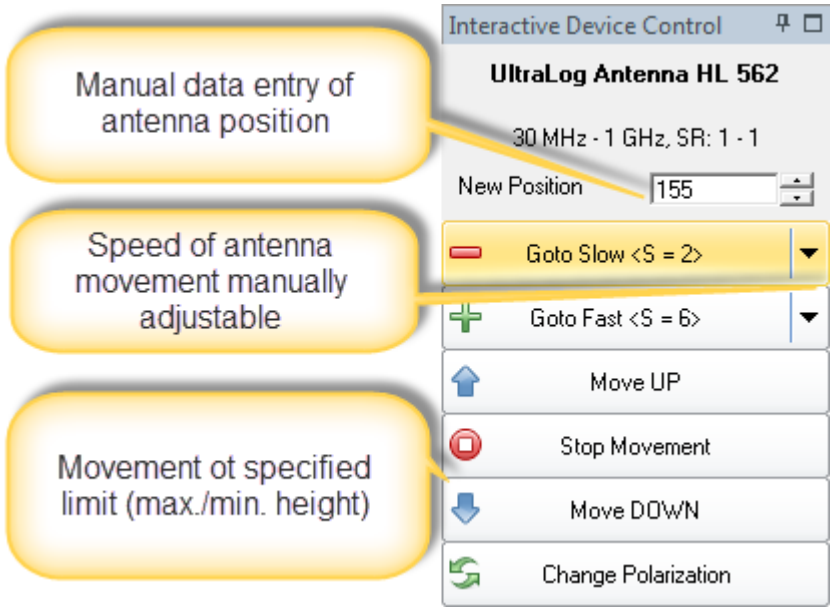


Fig. 2-6-1: Device Control Bar, Change capabilities during Interactive Measurement for antenna

You have also the possibility to move a device over the whole setting range. For example, you start interactive measurement, set the turntable to the minimum azimuth position and reset the Max Hold value. Then you move the turntable to the maximum position. In the Max Hold mode EMC32 will then store the position where the maximum emission was detected.

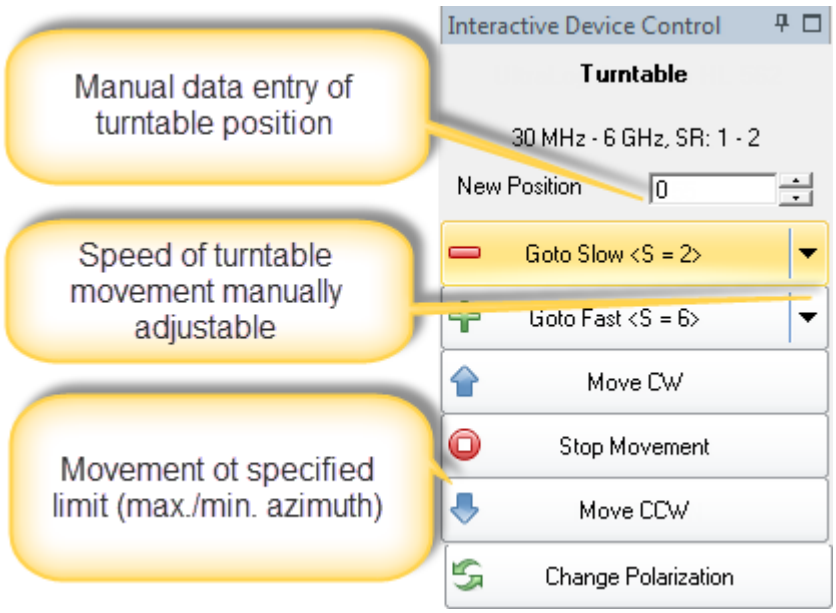


Fig. 2-6-2: Device Control Bar, Controlling capabilities during Interactive Measurement for turntable

3 A Straight Forward Example

This example shows in the first step the functionality of Semi Interactive Mode (SIM). In the second step the identified critical frequencies will be re-measured in Full Interactive Mode (FIM).

3.1 Example Semi Interactive Mode (SIM)

After the complete EMI Auto Test measurement sequence run has been completed you have now the possibility to verify the identified critical frequencies in SIM. Select the starting process wherever you want (Data Reduction, Zoom1/2, Adjustment or Final). You can add also individual frequency points to the Critical Frequency Table via drag and drop.

Add a frequency via drag and drop:

In this example we mark 81 MHz in the full emission spectrum (blue) graph. Via left mouse button pressed drag this point down to Critical Freqs Table and drop it there.

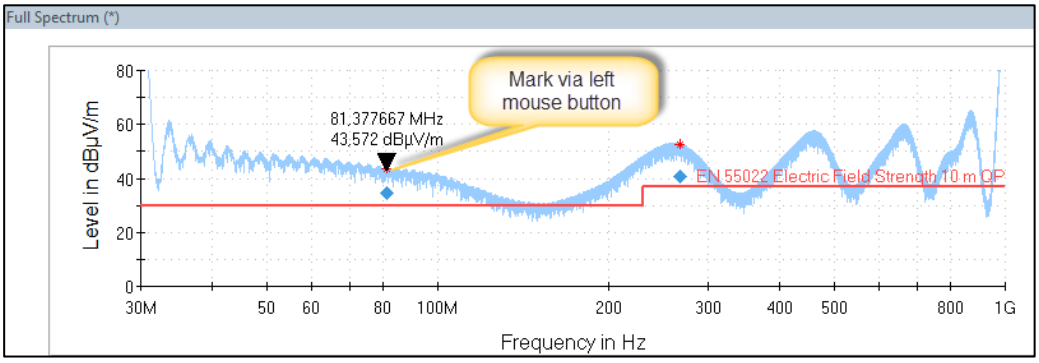


Fig. 3-1-1: drag and drop functionality

A new line with the frequency 81 MHz is added in the table. Additionally the information about the measurement value and accessories positions from this frequency are added with time and date information.

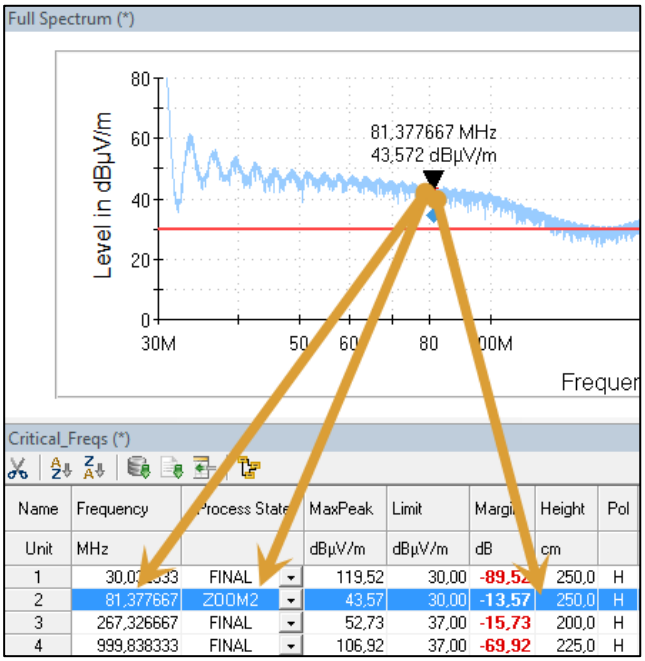


Fig. 3-1-2: new frequency added via drag and drop to Critical Freqs list

Now we select the process state Zoom2 as actual process state at 81 MHz and start the measurement. EMC32 will start to measure through the relevant test steps. The measurement steps Adjustment and Final measurement for frequency 81 MHz will be executed:

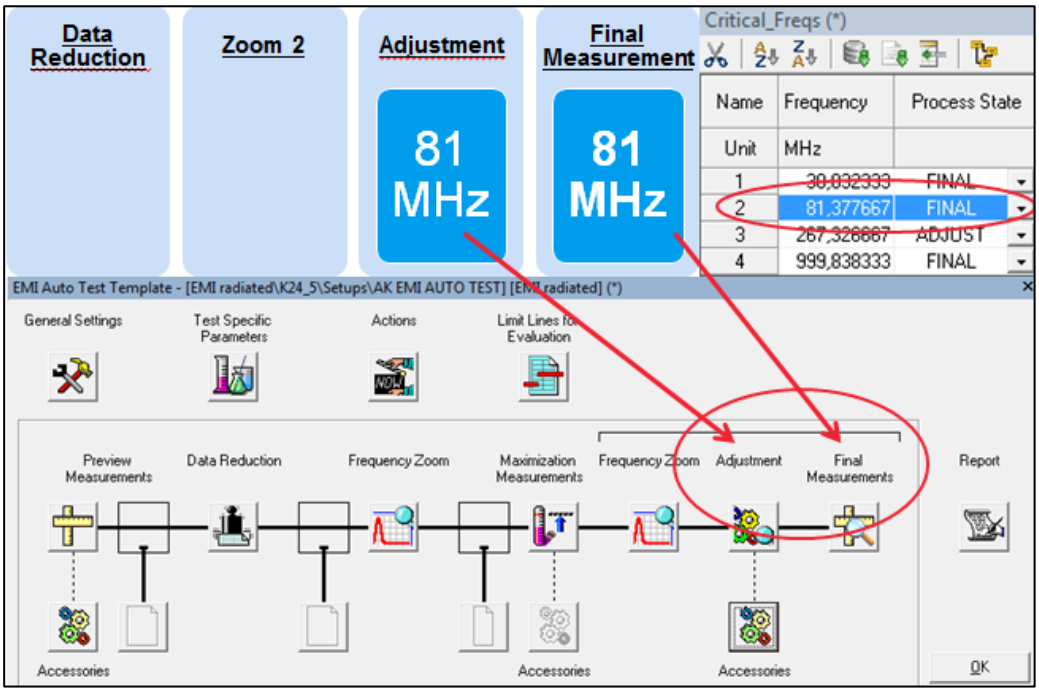
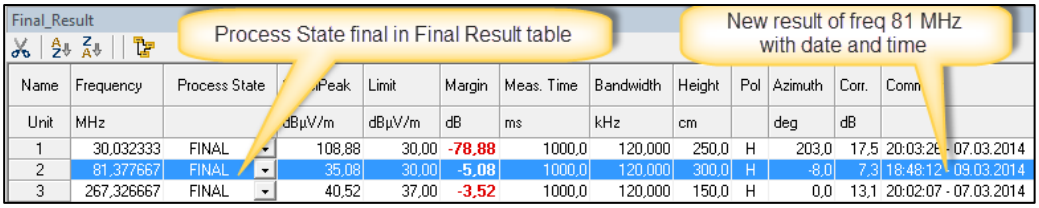


Fig. 3-1-3: SIM with Zoom2 process state for begin of test sequence

The positions of turntable and antenna together with the Quasi Peak value will be stored in Final Result Table:



Name	Frequency	Process State	Peak	Limit	Margin	Meas. Time	Bandwidth	Height	Pol	Azimuth	Corr.	Comm
Unit	MHz		dBµV/m	dBµV/m	dB	ms	kHz	cm		deg	dB	
1	30,032333	FINAL	108,88	30,00	-78,88	1000,0	120,000	250,0	H	203,0	17,5	20:03:26 - 07.03.2014
2	81,377667	FINAL	35,08	30,00	-5,08	1000,0	120,000	300,0	H	-8,0	7,3	18:48:12 - 09.03.2014
3	267,326667	FINAL	40,52	37,00	-3,52	1000,0	120,000	150,0	H	0,0	13,1	20:02:07 - 07.03.2014

Fig. 3-1-4: SIM Final result table

3.2 Example Full Interactive Measurement Mode (FIM)

Now we will verify the values of the measured frequencies in FIM. Click the button  to enter FIM. The following window will pop up:

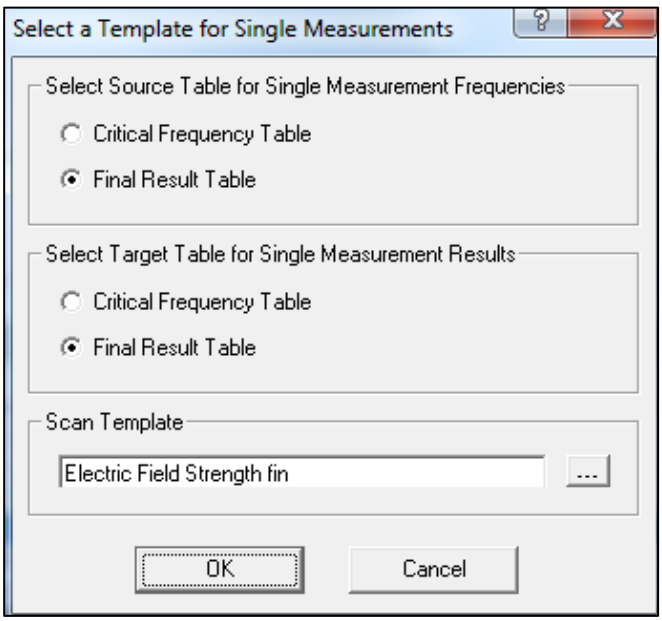


Fig. 3-2-1: Table for Single Measurements in FIM

We can select the source table (where the frequencies to be verified are listed) and target table (where the interactive measurement results shall be stored) for our evaluations, typically the Final Result Table is selected as standard. Optionally an alternative EMI Scan Template can also be selected. To verify the measurement result at frequency 81 MHz double-click the relevant column at Final Result Table and the cursor will jump to the relevant column as shown in Fig.3-2-2. Alternatively you can select it also via the Popup Menu.

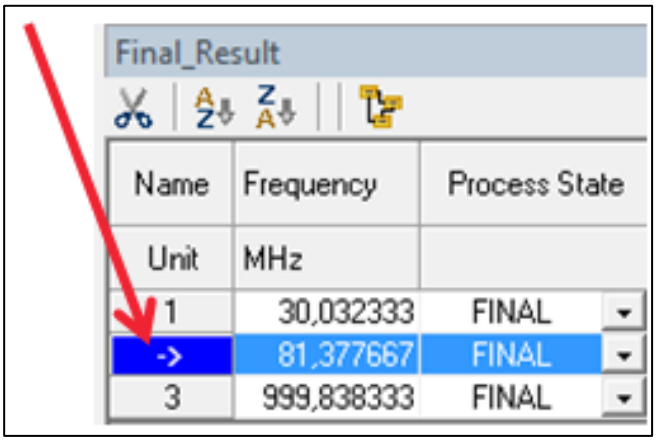


Fig. 3-2-2: Define Starting Position in Final Result Table

Either the measurement option Max Hold (find maximum emission over different accessory movements) or Clear Write (emission level for current accessories position) can be selected.

3.2.1 Clear Write Example in FIM

In this example we select Clear Write:

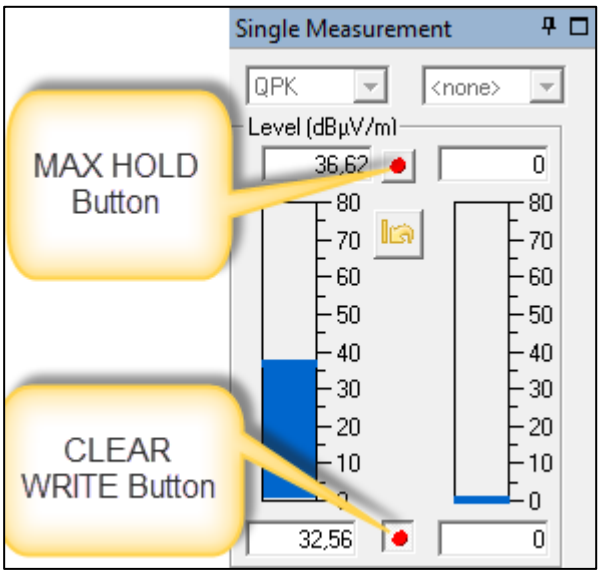


Fig. 3-2-3: Choose CLEAR WRITE or MAX HOLD Button

Start the measurement via the Pause button in the test tool bar, the accessories (antenna and turntable) can be moved individually via the Interactive Device Control Bar. The measurement data will be stored using the button Save Measurement in the Toolbar.

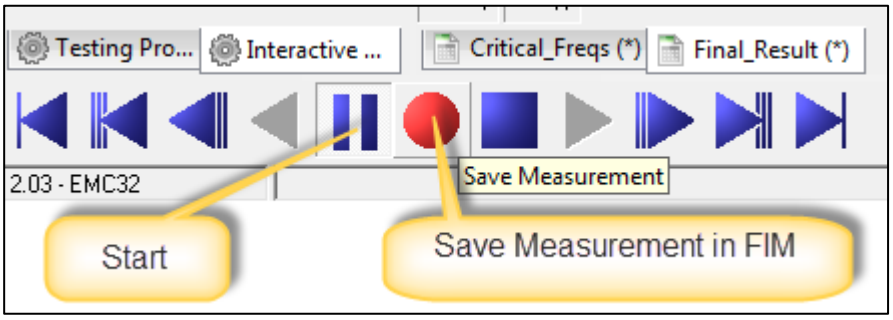


Fig. 3-2-4: Save Measurement in Toolbar

In this example we move the antenna to a height of 125 cm and vertical polarization, the turntable to azimuth position 222 deg. After changing the positions press the Save button and the measured frequency 81 MHz with the current accessories values will be stored in the Final Result Table (target table):

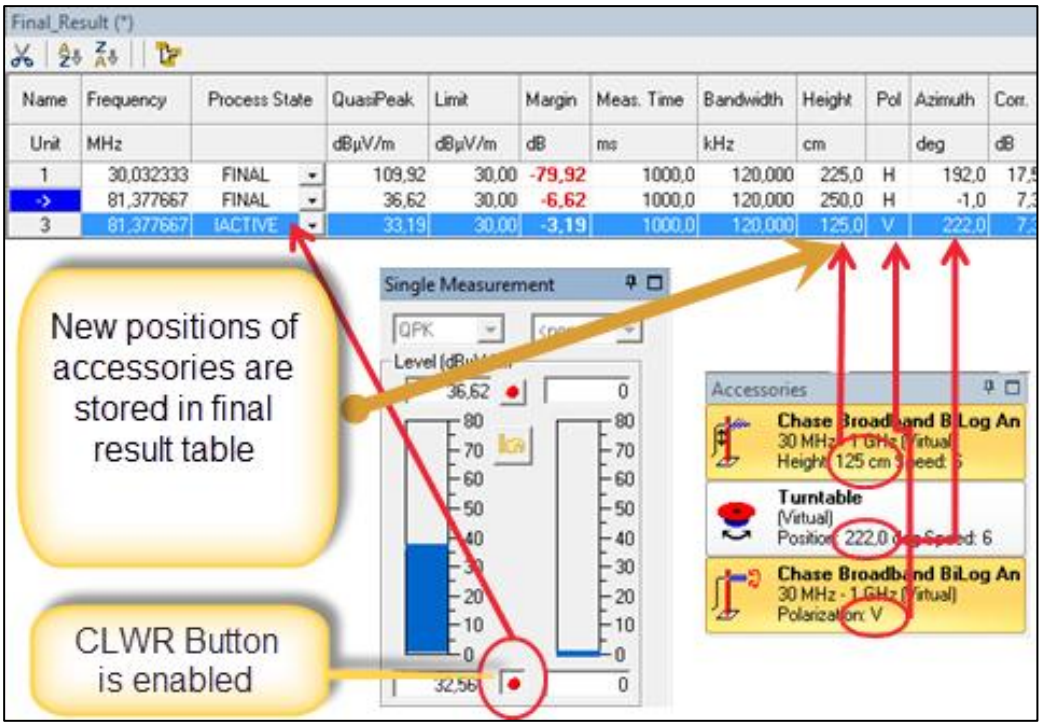


Fig. 3-2-5: Store of new accessories positions of devices

In the shown example the new measured values will be written into the Final Result table. The new accessory positions: antenna height (125 cm), turntable azimuth (222 deg.) and antenna polarization (vertical) will be stored in the new column as Interactive Measurement (Process State: IActive). You can change also the process state to Final for reporting if the frequency shall be handled as an automated measured frequency.

3.2.2 Max Hold example in FIM

To understand the difference between the Max Hold and Clear Write functions in FIM we press now the Max Hold button and start the measurement again. The

measurement will start setting the accessory positions from the Final Freqs Table for the current frequency.

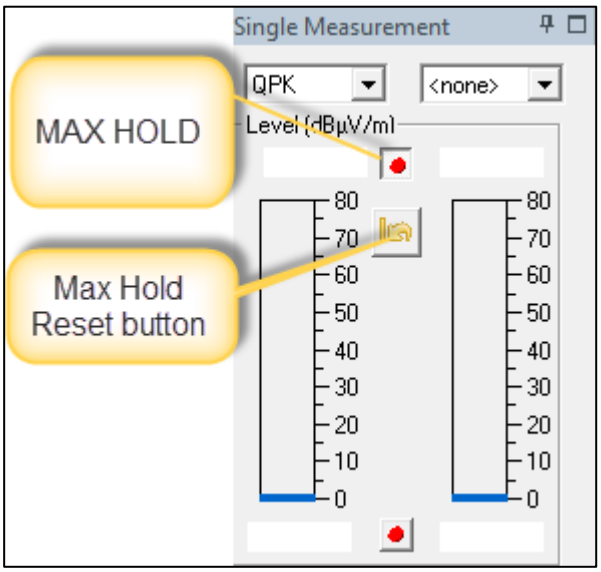


Fig. 3-2-6: Option Max Hold in FIM

Accessories will move to the defined position given in the Final Result Table: antenna height (300 cm), turntable azimuth (-8 deg) and horizontal polarization. Now we change via Device Control Bar the positions as follows: antenna height (410 cm), turntable azimuth (111 deg) and vertical polarization.

When we move now the turntable or antenna the FIM in the MAX HOLD mode will track not only the maximum level in the Single Measurement panel but also the position of the accessories where this maximum level was detected. The current values are shown in the EMC32 status line (see picture below).

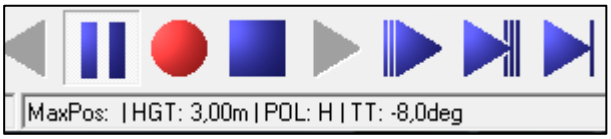
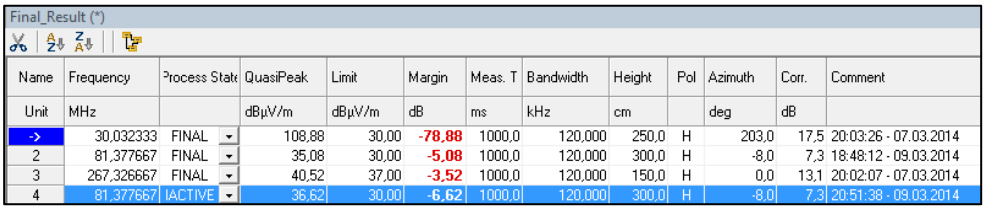


Fig. 3-2-7: MAX Peak accessories positions of devices with Max Hold

Now we save this measurement result to the Final Result Table by clicking on the Save button.


Final_Result (*)

Name	Frequency	Process State	QuasiPeak	Limit	Margin	Meas. T	Bandwidth	Height	Pol	Azimuth	Corr.	Comment
Unit	MHz		dBµV/m	dBµV/m	dB	ms	kHz	cm		deg	dB	
->	30,032333	FINAL	108,88	30,00	-78,88	1000,0	120,000	250,0	H	203,0	17,5	20:03:26 - 07.03.2014
2	81,377667	FINAL	35,08	30,00	-5,08	1000,0	120,000	300,0	H	-8,0	7,3	18:48:12 - 09.03.2014
3	267,326667	FINAL	40,52	37,00	-3,52	1000,0	120,000	150,0	H	0,0	13,1	20:02:07 - 07.03.2014
4	81,377667	IACTIVE	36,62	30,00	-6,62	1000,0	120,000	300,0	H	-8,0	7,3	20:51:38 - 09.03.2014

Fig. 3-2-8: Store of new accessories positions of devices

We see that the FIM now stores the Max HOLD value accessory positions from the status line: antenna height (300 cm), turntable azimuth (-8 deg.) and horizontal polarization:

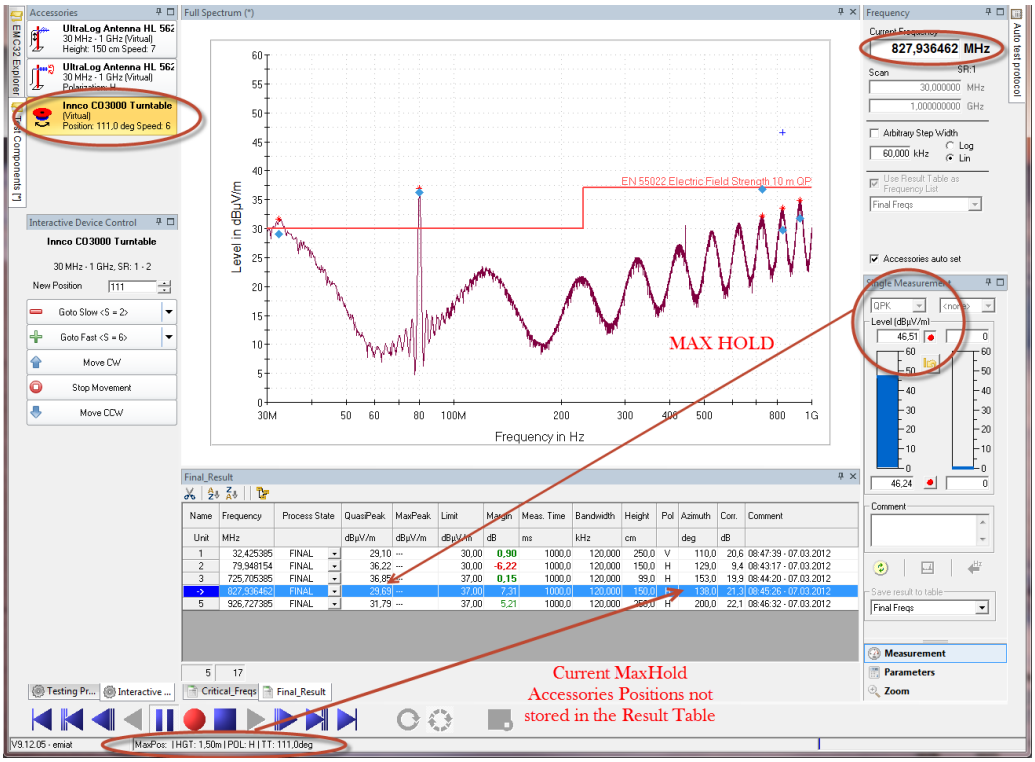


Fig. 3-2-9: Example store of new accessory positions of devices with Max Hold

The Max Hold value for the current frequency is either reset by changing the frequency value by selecting another line in the source table or by clicking on the Max Hold Reset button in the Single Measurement control panel.

4 Ordering Information

Designation	Type	Order No.
EMI measurement Software	R&S®EMC32-EB	1119.4638.02
EMI Auto Test	R&S®EMC32-K10	1117.6840.02
Interactive measurement for EMI Auto Test	R&S®EMC32-K24	1518.3202.02

About Rohde & Schwarz

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

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Environmental commitment

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

Certified Quality System
ISO 9001

PAD-T-M: 3573.7380.02/02.00/CI/1/EN/

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