Shielding Effectiveness Measurement Application Note

Products:

R&S[®]EMC32-K48

This application note shows all necessary settings for measuring shielding effectiveness using the R&S[®]EMC32-K48 option via R&S[®]EMC32 Measurement Software.

Note:

Please find the most up-to-date document on our homepage http://www.rohde-schwarz.com/appnote/





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1 Overview

This document describes the functionalities for R&S[®]EMC32-K48 option in R&S[®]EMC32 platform which have to be done to support the shielding effectiveness test method.

The R&S[®]EMC32 software offers the following applications:

- Provide control for instruments (RF generator, amplifier, switch units, spectrum analyzer, network analyzer)
- Perform reference level testing of system and measurement protocol as recommended by test standard
- Perform EUT Test and Measurement automatically
- Evaluate and display real-time value of the measurement
- Generate report

The R&S[®]EMC32-K48 option requires R&S[®]EMC32-S Main Option (EMS Scan Template) and R&S[®]EMC32-K4 option (EMS Auto Test).

Multi-user licensee should purchase R&S®EMC32MK48 option.

The following abbreviation are used in the following text:

- R&S[®]EMC32 software is referred to as EMC32
- R&S[®]EMC32-S software option is referred to as EMC32-S
- R&S[®]EMC32-K4 software option is referred to as EMC32-K4
- R&S[®]EMC32-K48 software option is referred to as EMC32-K48
- R&S[®]EMC32MK48 software option is referred to as EMC32MK48
- Shielding Effectiveness is referred to as SE
- Equipment under test is referred to as EUT
- Radio frequency is referred to as RF
- Electromagnetic interference is referred to as EMI
- Electromagnetic susceptibility is referred to as EMS
- R&S[®] refers to Rohde & Schwarz GmbH & Co. KG

2 Introduction

Refer to the general block diagram below on the setup for SE system according to IEEE STD 299, EN 50147-1 and MIL-STD-188-125-1. EMC32 software is used.



Fig. 2-1: Typical SE system

The system above consists of the following:

- RF generator as RF signal source generation
- Amplifiers to magnify signal to increase system dynamic range
- Antenna sets for transmitting and receiving
- Spectrum analyzer measuring the received level at a given level of signal source generated
- Switching unit which can be used to switch to different amplifiers of different frequency range capabilities
- Network analyzer for SE measurement of an enclosure

3 EMC32 Setup

Follow the instructions below to setup EMC32. The steps are:

- Installation of software and drivers
- iKey requirements
- Online help

3.1 Installation of Software and Drivers

This test is programmed to work with EMC32 version 9.20 and above. Follow the installation procedures below:

- 1. Install National Instruments GPIB driver with NI-VISA.
- 2. Install EMC32 version 9.20 or higher. It is important to check all options for EMI and EMS.
- 3. Install iKey application
- Install VISA and drivers for relevant R&S device (e.g. SMC100A, SMF100A, NRP-USB, and FSP)

The software can now be launched.

3.1.1 EMC32 on the Web

Do check for the latest version of EMC32 via the help menu. In the main toolbar, select "?" and click on "EMC32 on the Web". Alternatively, you may also find the latest update info at www.emc32.rohde-schwarz.com.



Fig. 3-1: EMC32 on the web

3.1.2 Update Manager

The EMC32 integrated update manager will automatically prompt whenever there is a new service patch or version update. You can either enable or disable this update manager via the help menu by selecting "?" and clicking on "Update Manager" for its settings.



3.2 iKey Requirements

EMC32 uses a physical USB dongle referred to as iKey to run test simulations and control real equipment. Without the iKey, the EMC32 software can only run test simulations.

The required iKeys options for SE are EMC32-S (EMS Scan template), EMC32-K4 (EMS Auto-Test) and EMC32-K48 (Shielding Effectiveness Test). EMC32 allows merging of several options onto one iKey using EMC32 iKey Merge Tool from the EMC program group. You may refer to the EMC32 installation manual chapter 9 for more information on using the iKey Merge Tool.

3.3 Online Help

Online help is available on the CD and on the software after installation. Help can be accessed at any time via the main toolbar by selecting "?" or by pressing the **F1** key.

4 Test Configuration

Before performing SE measurements in EMC32, setup the test configuration as described in the following sections:

- Instrumentation
- Hardware Setup

4.1 Instrumentation

Refer to chapter 3.3 "Online Help" on page 6. In HTML Help, select the **Index** tab, search for "Device list" to show a detailed description on setting up the instruments.

To the sack Forward Print	
ontents Index Search Glossary	Device list
Device list	If some device is required for a measurement, it needs to be registered in EMC32. For this purpose a file EMC32.DeviceList is created in the folder \Execute\Configuration. This file is written in a text format and contains all information for the used devices. In each EMC32 installation this file exists only once. It describes all components of the system hardware.
OSP PSU RSU SCIU	In order to facilitate the generation of this device list, EMC32 is delivered with a Configuration Wizard assisting in the creation of a simple device list. As a second possibility, a device list editor is incorporated in EMC32 which allows modification of the device list.
TS-RSP Device Class Transducers Device Class Turntables	The device list editor is invoked through the main menu function Extras >> Device List
Adding a new device Defining the properties of a device	[Picture]
Displaying devices in the device list Find not referenced devices Modifying the layout of the device list Removing a device Search references to a device	The main elements of the device list editor is the device overview on the left side, containing the devices sorted by device classes, and the list of configured devices on the right side, containing all registered devices.
Signal path administration Special dependencies Why does it take so long to cancel the d	See also:
Device status How to set a device status to physical	Displaying devices in the device list
May I start a measurement with virtual de Why can I not set a device to physical?	 Modifying the layout of the device list
Devices Driver Installer Tool	<u>Registering a device</u>
Existing device drivers New device drivers	<u>Removing registered devices</u>
Properties and Settings	 Defining the properties of a device
Digital I/O Mem-PIO	Find and remove not referenced devices
NI-DIO NI-USB6009 USBDIO	Signal Path administration

Fig. 4-1: Online help for device list

The EMC32 software supports a wide range of spectrum analyzer models, antenna mast controller, amplifiers and their interlock, and OSP switch units.

evices:	Configured Devices:				 6-6- [] 	₩ º <u>0</u> ₩
- 🕨 Amplifiers	Name	Device	Туре	Interface	Addr/SN	State
🖅 🖬 Antennas	📧 TR Loop Antenna 9k - 30MHz	Antennas	Antenna	None		
🛛 📆 AntennaTowers	🗊 TR Dipole Antenna 100M - 1GHz	Antennas	Antenna	None		
🛛 🚫 AwgGenerators	📧 TR Broadband Horn Antenna 1G - 4	Antennas	Antenna	None		
⊡… <mark>sî</mark> FieldProbes	📧 TR Bicon Antenna 20M - 100MHz	Antennas	Antenna	None		
Generators	SMF100A	Generators	SMF100A	VISA	TCPIP::	Virtual
Interlock	SMC100A	Generators	SMC100A	VISA	TCPIP::	Virtual
I-O LISNs	TRCV Loop Antenna 9k - 30MHz	Antennas	Antenna	None		
	TRCV Dipole Antenna 100M - 1GHz	Antennas	Antenna	None		
	FRCV Broadband Horn Antenna 1G	Antennas	Antenna	None		
⊡ 💥 Oscilloscopes ⊡ 🔙 Positioners	TRCV Bicon Antenna 20M - 100MHz	Antennas	Antenna	None		
Positioners	C OSP	SwitchUnits	OSP	VISA	TCPIP::	Virtual
	Reverse (USB) Reverse	PowerMeters	NRP-Zxx (U	USB	?	Virtual
Slidebars	NRP-Z55 (USB) Forward	PowerMeters	NRP-Zxx (U	USB	?	Virtual
SwitchUnits	Unterlock OSP(1)	Interlock	Interlock OSP	VISA	TCPIP::	Virtual
SystemControls	FSV 40	Receivers	FSV 40	VISA	TCPIP:	Virtual
- 🚱 Transducers	FSP 40	Receivers	FSP 40	VISA	TCPIP::	Virtual
- 😳 TripleLoops	FSL 6	Receivers	FSL 6	VISA	TCPIP::	Virtual
🛛 💽 TurnTables	BSA 9k - 1GHz	Amplifiers	Generic Am	LAN	123.444	Virtual
	BLMA 1G - 40GHz	Amplifiers	Generic Am	LAN	123.44	Virtual

Fig. 4-2: Device list dialog box

4.2 Hardware Setup

Refer to chapter 3.3 "Online Help" on page 6. In HTML Help, select the **Index** tab, search for "Hardware Setup" to show a detailed description on setting up the hardware.

월 🗇 다 🞒 Hide Back Forward Print	
ontents Index Search Glossary	Hardware Setup
Hardware Setup	Once an EMC32 installation contains a complete <u>device list</u> , and before building test templates, it must be defined how the devices registered in the device list shall be combined to perform EMC measurements.
Hardware setup Hardware Setup Hardware setup editor EMI hardware setup EMS hardware setup NSA	For example, an EMS system designed to perform both radiated and conducted measurements may typically contain one signal generator, but at least two RF amplifiers. It must be defined which amplifier is to be used for which type of measurement. Moreover, if an RF switch unit is available which will automatically switch the generator's output to one of the amplifiers' input, it must also be defined which relays shall be set to which state for which type of measurement.
Reverberation Chamber System Check damonics Measurement F attenuation F bandwidth mport	All these informations can not be supplied in the Device List, as there only single devices are defined. In a Test Template such informations are also out of place, as this kind of file is meant to contain information about how to use a subsystem during a test, but not which devices make up this subsystem. As a general principle, there will be more than one Test Template referring to the same hardware, but using it with different set s of parameters.
mport of Calibration Data Field Probe Monitoring Clamp fromati	As a consequence, some intermediate setup information must exist between the pure listing of devices in the Device List and a Test Template. This intermediate link is provided by the Hardware Setup File.
put protection put selection iteractive measurement iterlock	Hardware Setups are defined in a special purpose editor and are always associated to one of the four main measurement categories (EMI radiated and conducted, EMS radiated and conducted). The appearance of the editor will change depending on the selected measurement category.
all devices meM-PIO OSP SCIU TS-RSP P address S011451 S011452	Note: Please note that one hardware setup may be referenced by several test templates. That has the consequence that modification in this hardware setup may influence other test templates and tests and may finally make the invalid. To avoid those side effects it might be a good way to duplicate a hardware setup, and give it a new name before doing modifications.
AN anguage ine Impedance and Stabilization Network	see also:
ve data reduction TE Camer Aggregation OTA Tests Macro Editor Macro Main Settings Public Variables Working with the Macro Editor +	Hardware setup editor

Fig. 4-3: Online help for hardware setup

Hardware setup can be configured for splitting into different frequency subranges to suit different antennas, amplifiers and generator models. It is recommended to conduct splitting according to the antenna subranges.

A typical SE system setup consist of a generator, power amplifier, power sensors, transmit antenna, receive antenna, switching unit and receiver (see chapter 2. "Introductions" on page 4). This is the same setup used in EMC32-S (Susceptibility) hardware setup for SE test.

5 Test Template Configurations

Before performing SE measurements in EMC32, setup the test template configuration as described in the following sections:

- Reference Level Test Template
- EUT Test Template
- EUT Monitoring Test Template
- EUT Auto Test Template

5.1 Reference Level Test Templates

Refer to chapter 3.3 "Online Help" on page 6. In HTML Help, select the **Index** tab, search for "EMS test new" to show a detailed description on setting up the reference level test template.

😵 HTML Help	
TI ← ← A Hide Back Forward Print	
Contents Index Search Glossary Creating a new EMS Test	
Type in the keyword to find: EMS test new There are several ways to create a new test:	
EMS test new	
Amplifier Test tab Frequency Range tab Report tab	
Susceptibility tab Test definition tab Test level tab <u>using the EMC32 explorer</u> (via the pop-up menu)	
ENS test save EN61000-4-3 EN61000-4-6 In both cases the definition dialog for a new test will be shown.	
ENV 216 ENV 4200 ENV 432 ENV 41 [New Test Dialog for an EMS Scan]	
Error handling ESAI ESBI ESCI	

Fig. 5-1: Online help for Reference level test template

Reference level test template, known as reference calibration test template in EMC32, is required to calibrate a known level at the output of the transmit cable, and to save the result to a reference calibration table.

The purpose of reference level test for SE is to set a reference for generator level to achieve SE maximum RF level which is known as reference calibration in EMC32.

This template is used for the first calibration without EUT. The test template is configured with several sub-ranges according to the different antennas and also the antenna sub-ranges.

In EMC32, reference level test is created in EMS scan test template in order to select the correct hardware setup and run as reference calibration test method to perform reference level testing.

5.1.1 Reference Level Test Template for SE

This chapter includes some of the parameters that is needed for the reference level test templates (known as reference calibration in EMC32) to perform the SE test.

For SE reference level measurement, SE test standard will be created in the EMC Test Standard dropdown box. EMC32-K48 option will be needed to activate the SE test standard

In Fig. 5-2, select **General Settings** tab. Under **EMC Test Standard**, select "SE REF CAL" from the dropdown list.

ΕN	IS Scan Template -	SE - Reference Test] [EMS Radiated] (*)			×
ſ	General Settings	Leveling Mode	WTD81 System	Options			
	EMC Test Standar SE REF CAL Commercial Automotive/MIL SE REF CAL	J	Immunity Level Uni	Hardware	s Setup		
	NO SE TEST		Level	Modulation	Dwell Time	Level Sweep	
	1 100kHz - 30M	Hz 1%LOG	-20dBm	Modulation Off	Os	OFF: 0 dB	
	2 30MHz - 100M		-20dBm	Modulation Off	Os	OFF: 0 dB	
	3 100MHz - 1GF	Hz 1%LOG	-20dBm	Modulation Off	Os	OFF: 0 dB	
ſ	Frequency	Lev	rel	Device Setups	Acti	ons	Delete Subrange
	Start Frequency 1	00 kHz	St	ep Mode	LOG 🔻		Add Subrange
	Stop Frequency 3	0 MHz	St	ep Size	1.000 %		
			Di	vell Time	0.000 s		System Monitoring
	Exclude Freque	ncy Bands	M	eas. Points 🛛 🗍	573		
	🔲 Use Frequency 1	able	Frequency Table				ОК
	🔲 Use Frequency 1	able only	<none></none>				Cancel

Fig. 5-2: Test standard selection for SE

In Fig. 5-3, select **Frequency** tab. In the area **Start Frequency** and **Stop Frequency**, enter the appropriate antenna frequency subranges.

Frequency	Level	Device Setu	abs 🔰	Actions	Delete Subrange
Start Frequency 100 Stop Frequency 30	kHz MHz	Step Mode Step Size Dwell Time	LOG • 50.000 % 1.000 s	1	Add Subrange System Monitoring
Exclude Frequency Band	s	Meas. Points	20		
🔲 Use Frequency Table	Frequenc	y Table		_	ок
Use Frequency Table only	<none></none>				Cancel

Fig. 5-3: Antenna frequency subranges setting

In Fig. 5-4, select **Leveling Mode** Tab. Under the section **Common Ref. Cal. File Name**, enter desired filename in the field below.

MS Scan Template - [SE - Refe						
	erence Test] [EN	/IS Radiated] (*))			>
General Settings Level	ing Mode	WTD81 System	Options			
Level On	Common Ref	. Cal. File Name			Power Mea:	surement
Sensor	SE_RefCal	\rightarrow			Generator I	Level 🔻
						_
No Subrange	Step	Level	Modulation	Dwell Time	Level Sweep	
1 100kHz - 30MHz	1% LOG	-20dBm	Modulation Off	0s	OFF: 0 dB	
2 30MHz - 100MHz	1% LOG	-20dBm	Modulation Off	Os	OFF: 0 dB	
3 100MHz - 1GHz	1% LOG	-20dBm	Modulation Off	Os	OFF: 0 dB	
Frequency	Level		Device Setups	Act	ions	Delete Subrance
Frequency	Level	Ţ	Device Setups	Act	ions	Delete Subrange
Frequency C Immunity Shape Table	Level	,	Device Setups		ions	Delete Subrange Add Subrange
	Knor	ne>	Device Setups			
C Immunity Shape Table	Knor	ne>	Device Setups			
C Immunity Shape Table	Knor	ne>	Device Setups			Add Subrange
C Immunity Shape Table	el [-20.1	0 dBm	,			Add Subrange

Fig. 5-4: Filename entry

From Fig. 5-5, select **Device Setups** tab. Click "Span" to bring up the dialog box as shown in Fig. 4-4. Set **Device Mode** to "Receiver" to activate zero span measurement and **Detector** to "Average".



Fig. 5-5: Span dialog box

5.2 EUT Test Template

Refer to chapter 3.3 "Online Help" on page 6. In HTML Help, select the **Index** tab, search for "EMS test new" to show a detailed description on setting up the EUT test template.



Fig. 5-6: Online help for creating a new EMS test

This template is used for measurement on the actual EUT. It sets the output transmit level according to previous reference level results and measure the difference in the output level from within the EUT. This difference is the shielding effectiveness.

The hardware setup should be preset accordingly (see chapter 4.2 "Hardware Setup on page 9) before the EUT test sequence can be created in the EMS scan test template. The EUT test carries out the antenna coupling test using the substitution method, based on the saved reference calibration table.

5.2.1 EUT Test Template for SE

For SE test configuration, SE test standard will be created in the EMC Test Standard dropdown box. EMC32-K48 option will be needed to activate the SE test standard

In Fig. 5-7, select **General Settings** tab. Under **EMC Test Standard**, select "SE TEST" from the dropdown list.

	Copy of SE - Refere	nce Test] [EMS Radia	ated] (*)			>
General Settings	Leveling Mode	WTD81 System	Options			
EMC Test Standard	Ú.	Immunity Level Unit	Hardware S	etup		
SE TEST	-	dBm 💌	SE			
Commercial Automotive/MIL SE REF CAL						
No SE TEST		Level	Modulation	Dwell Time	Level Sweep	
1 100kHz - 30MH	lz 1%LOG	by RefCal	Modulation Off	Os	OFF: 0 dB	
2 30MHz - 100MHz		by RefCal	Modulation Off	Os	OFF: 0 dB	
3 100MHz - 1GH	z 1% LOG	by RefCal	Modulation Off		OFF: 0 dB	
Frequency	Device S	Setups	Actions			Delete Subrange
Frequency Start Frequency 10			Actions)G 🔽		Delete Subrange Add Subrange
		Step	o Mode	0G 🔽		
Start Frequency 10	00 MHz	Ster Ster	p Mode LC			
Start Frequency 10	GHz	Ster Ster Dwe	p Mode LC	000 %		Add Subrange
Start Frequency 10 Stop Frequency 1	0 MHz GHz	Ster Ster Dwe	p Mode LC p Size 1.0 ell Time 0.0	000 %		Add Subrange

Fig. 5-7: SE test standard selection

For SE requirement, (nominal) immunity level in test measurement should follow its reference level table to maintain a nearly fixed generator level output for both horizontal and vertical polarization.

In Fig. 5-8, select **Leveling Mode** tab, input any reference calibration table created in SE REF CAL test template. Target level generator output will follow its reference calibration generator output hence the Power Control dropdown box will be greyed out.

Take note that SE tests are not run via a normal EMS Scan Test but in EMS Auto Test.

/IS Scan Template - [SE - EUT Test] [EMS Radiated] (*)								
Ge	eneral Settings	eling Mode	WTD81 System	Options				
Ъ	evel On	Reference	Calibration Table			Power Contr	ol	
9	Substitution Method	SE_RefCa	LSR01_POS01	>		Generator L	evel 💌	
No	Subrange	Step	Level	Modulation	Dwell Time	Level Sweep		
1	100kHz - 30MHz	50% LOG	by RefCal	Modulation Off	Os	OFF: 0 dB		
2	30MHz - 100MHz	50% LOG	by RefCal	Modulation Off	Os	OFF: 0 dB		
3	100MHz - 1GHz	50% LOG	by RefCal	Modulation Off	Os	OFF: 0 dB		
	Frequency	Device Set		Actions			Delete Subrange	
Sta	Frequency 100	Device Set		Actions) ep Mode / [DG 💌		Delete Subrange	
			St	ep Mode	0G 🔽			
	art Frequency 100	kHz	St	ep Mode LC ep Size 50				
	art Frequency 100	kHz MHz	St St Du	ep Mode LC ep Size 50	1.000 %		Add Subrange	
Sto	art Frequency 100	kHz MHz nds	St St Du	ep Mode LC ep Size 50 well Time 0.1	1.000 %		Add Subrange	

Fig. 5-8: Reference calibration table selection

5.3 EUT Monitoring Template

Refer to chapter 3.3 "Online Help" on page 6. In HTML Help, select the **Index** tab, search for "EUT Monitoring" to show a detailed description on setting up the EUT Monitoring template.



Fig. 5-9: Online help for EUT monitoring

The main purpose of a EUT measurement is to arrest unwanted failures during operation by stressing the EUT with a signal. For this purpose, the EUT monitoring template is necessary to ensure that certain parameters of the EUT are under stress still behaving as usual. It can also provide the EUT's worst-case results.

5.3.1 EUT Monitoring Template for SE

The settings of each EUT monitoring channel that use the spectrum analyzer are configured as follow:

In Fig. 5-10, select **Display** tab and set the **Units to be displayed** as "dB". Under the section **Value Conversion**, enter the evaluation formula as:

IMMLVL{Imm LvI dB}-107-MEASVAL{Meas Value}

This is to convert the measured value in dBm and tabulate the effective results in dB.

Channel	Hardware	Display	NoGo Y	Actions	Options
– Graphical Disp	-		Y Axis Maximum	120.000000	dB
Unit to be disp	layed dB		Y Axis Minimum		
Display Gr	aphics Diagram by D	efault		-5.000000	dB
🗖 Graphics N	lame (optional)				
Value Convers	ion				
Value Convers	ion	∫ AL{Meas Value}		E valuation B	uilder

Fig. 5-10: Evaluation formula for value conversion

In Fig. 5-11, select **Options** tab. Under **EMS Auto Test Evaluation**, select checkbox option "Worst Case Analysis. Under **Evaluation Mode**, select "Max. Peak".

Channel	Hardware	Display	NoGo	Actions	Options
	st Evaluation Case' Analysis ion Mode	Max Pea	k		
<u>A</u> dd Channel	Delete Cha	annel		Cancel	ОК

Fig. 5-11: EMS auto test evaluation options

5.3.2 Average Detector for EUT Monitoring

For SE testing, select "Average Detector" as shown in Fig. 5-12, instead of "Max Peak Detection". This option should be selected regardless of whether spectrum analyzer, or test receiver is used. This option is only available with EMC32-K48.

In Fig. 5-12, select **Hardware** tab. Under **Detector**, select from dropdown list "**Average**".

	o <mark>nitorin</mark> g ions	g - [SE]										
_	JT Inforn none>	nation										
No 1	Active	Name SE Gra	ph	Meas. Dev FSP 40	vice	Conversio MEAS -		Go I.5 dB			Actions No Action	
	Channel		Hardwar	e	Display	No	ào	Ŷ	Actions		Opti	ons
ſ		B-	ath	FSP 40					eep Para Track I enter Fre 00.00000	lmm. 9 quenc	Signal	
1	rie-al	npiner p	auri	"No. of "Measu	Repetitions'' = urement Mode' ndwidth'' = 120	" = Single	Â		etector verage		•	
				"Meas	Time" = 20 ms Bandwidth" =	2	-<		laxPeak verage MS			\triangleright

Fig. 5-12: Hardware tab in EUT monitoring window

5.3.3 Limit Line Input for EUT Monitoring

In EMC32, the NoGo in EUT monitoring defines the limit line for SE. The value of the limit line must be input in the NoGo tab as shown in Fig. 5-13. The value can either be a constant value (e.g. 120 dB), or a shape table which consists of different values at different frequencies.

_	ons IT Inform none>	nation					
No 1	Active V	Name Shielding	Meas. Device)	Conversion MEAS -	NoGo > -80 dB	Actions No Action
	Channel		are Dis	play	NoGo	Actions	Options
	-NoGo 1		are Dis		NoGo nit Value Constar(Options
	NoGo 1 R At	Dove Limit		Lin	nit Value C Constant C Shape		
	NoGo 1 R At	rype pove Limit elow Limit utside Value Ran		Lin	nit Value • Constar(<pre>(none)</pre>	dB

Fig. 5-13: NoGo tab in EUT Monitoring window

In the NoGo tab, the criteria for pass or fail are defined, with four NoGo types to choose from:

- Above Limit: The EUT has failed if the measured (and converted) value is bigger than a limit value or the value from a limit shape to be defined by the user. This type will be the preferred setting for SE measurement
- Below Limit: The EUT has failed if the measured (and converted) value is smaller than a limit value or the value from a limit shape to be defined by the user.
- **Outside Value Range**: The EUT has failed if the measured (and converted) value is outside of a window of values to be defined by the user.

None: The EUT will never be considered to have failed, the channel is only used for recording the EUT's parameter.

The limits defined here will be displayed in the graphics window associated to the channel.

5.4 EUT Auto Test Template

Refer to chapter 3.3 "Online Help" on page 6. In HTML Help, select the **Index** tab, search for "EMS Auto Test Template Editor" section to show a detailed description on setting up the EUT Auto Test template.



Fig. 5-14: Online help for EMS auto test template editor

EUT auto test (known as EMS auto test in EMC32), further enhances the automation capability of SE test. It allow users to repeat frequency sweeping of EUT measurement for multiple location, multiple subranges and different polarization when EMC32-K48 option is used. In addition, EUT monitoring template can be used together with EUT auto test to calculate SE for each location. Worst case analysis feature is also available to obtain the worst case result over all locations for every frequency point.

5.4.1 EUT Auto Test for SE

This section shows the configuration for EUT Auto Test for SE Test.

From Fig. 5-15, left-click on **Measurement Settings**. Enter the same setup as the EMS Scan template for EUT test.

	Heasurement Settings			x
EMS Auto Test Template	Test Loop Method			
EMS Auto Test Method	Test Method	EuT Qualification	_	
EUT Test	No Subrange	EMS Scan Template	Actions	_
	1 20MHz - 300MHz	SE - EUT test\SE - EUT test	Subrange 1	
	2 300MHz - 500MHz	SE - EUT test\SE - EUT test	Subrange 2	
	3 500MHz · 1GHz	SE - EUT test\SE - EUT test	Subrange 3	
Measurement Settings	EMS Scan Template EMS Scan Template Start Frequency Stop Frequency	Actions SE - EUT test 20 MHz 300 MHz	Sort Subrang Delete Subran Add Subrang OK Cancel	ige

Fig. 5-15: Measurement settings for EUT auto test

From Fig. 5-16 left-click on Loop Settings, add polarization and auto test subranges.

Under **User Definition Loop Settings**, enter the number of antenna positions. The step number corresponds to the antenna position number. For example, step 1 refers to antenna position 1.

Select checkbox **Visible Column in the Report** to display each loop column in the test report. Select checkbox **Show Trace for each Loop Result** to show loop result graphics in the test report.

EMS Auto Test Tem	훯 Loop Set	tings		X
EMS Auto Test Met	Priority	Loop Parameter	Range	Steps
EUT Test	2	Test Frequency Polarization	- H,V	· · ·
,	3	User Definition		2
	4	Auto Test Subrange		
Measurement Settings	Number of	ition Loop Settings Steps 2 am a Device te Action user facro	1 Notify: change to position 1	Delete Loop Add Loop OK Cancel

Fig. 5-16: Loop settings for EUT auto test

From Fig. 5-17, left-click on **Evaluation Settings** to show its dialog box. Under **EUT Worst Case Analysis**, select checkbox for "Do Worst Case Analysis for EUT Monitoring Channels".

Evaluation Settings	Fa All All 300 1			
EUT Failure Mode Evaluation-				
Create EUT Failure Mode Eva	luation Graphic	Г		
Result Graphic Name	My EUT Failures			
Limit Line #1	<none></none>			
Limit Line #2	<none></none>		eneral Settings	Actions
Limit Line #3	<none></none>		*	
- EUT Worst Case Analysis Do Worst Case Analysis for El	JT Monitoring Channels	A	valuation Settings	Report Settings
	OK Cancel			OK Cancel
				Laricel

Fig. 5-17: Evaluation settings for EUT auto test

From Fig. 5-18, left-click on **General Settings** to open its dialog box. Set the "EUT Monitoring" file to be used.

	3	Ceneral Settings	1450	x			
		EMC Standard					
		General		•			
_	_	EuT Monitoring			General Settings	Actions	
ζ	4	EuT Monitoring					
	*	Additional Options for the EUT Test				NOW	
					Evaluation Settings	Report Settings	
		OK	a 1				
	l	UK	Cancel				1
		Loop Settings	Measurement Loop Results		4	OK	
			Loop results			Cancel]

Fig. 5-18: General settings for EUT auto test

6 Running of Test

6.1 Reference Level Test for SE

The objective of a reference calibration is to set a **known calibrated level** at the **connection point** to the **transmitting antenna**. This calibrated level will then be used again with the EUT to get the SE of the shielded enclosure.

As shown in Fig. 6-1 below, the output cable is directly connected to the transmitting antenna; and the receiving antenna output cable is directly connected to the spectrum analyzer. The minimum respective distances between the transmitting antenna and receiving antenna are 0.6 m at 9 kHz to 20 MHz, 2 m at 20 MHz to 1 GHz and 1 m above 1 GHz.



Fig. 6-1: Reference level test for SE

Under **Test Template > EMS Scan > SE - Reference calibration**, right-click on the appropriate reference calibration template and select "New Test".

EMC32 Explorer	4
All Files	
All Files EMC32 Calibration Sequence Calibration Setups Calibration Setups Calibration Setups Correction Tables Frequency Lists Calibration Calibratio	New Test New Test Direct New File File Info Open Print Rename Duplicate Delete Add to Favorites Export
	(20MH2-300)
03. SE - Reference calibration	
EuT Monitoring	

Fig. 6-2: New test selection

In Fig. 6-3, select **Test Definition** tab. Under **Test method**, select "Reference Calibration" from the dropdown list and click OK.

New Test - [EMS Radiated]	×
Test Definition Test Level Report	
Test Control Parameter Test Name Test Test Method Reference Calibration	
Immunity Parameter	
© Reference Calibration	
EuT Monitoring Parameters	
<u>D</u> K Cancel	

Fig. 6-3: Test method selection



In Fig. 6-4, click play/start button to begin the reference calibration.

Fig. 6-4: Reference level test

A prompt window message will appear to announce completion of the reference calibration process. If multiple frequency subranges were inputted in the calibration, a prompt window as shown in Fig. 6-5 will appear. Choose the corresponding antenna position for the subrange that will be measured.

Save Reference	Calibration Data
	The measurement result will now be saved in a reference calibration table. Optionally enter here a file information text and specify the file name in the next dialog.
Description	
∣ ⊢Store Data v	with Antenna Polarization Information
 Horizor 	ntal O Vertical O None
- Shielding Eff	fectiveness RC File Name Builder
	ange No. 1 Antenna Position
Proposed F	File Name: <se_refcal_sr01_pos01></se_refcal_sr01_pos01>
s	Gave <u>C</u> ancel

Fig. 6-5: Reference calibration data

The naming convention for saving the reference calibration table will be SE_RC_Name_SR0x_POS0y; where SE_RC_Name is the reference calibration name, x is the subrange number and y is the antenna position.

Save Reference Calibration Data	ר ר
Save as	×
Path: C:\Users\goh_i\Desktop\SE1\System\Reference Calibrations Image: Set_RefCal_SR01_POS01 Image: Set_RefCal_SR01_POS02 Image: Set_RefCal_SR01_POS02 Image: Set_RefCal_SR01_POS03 Image: Set_RefCal_SR01_POS03 Image: Set_RefCal_SR01_POS03 Image: Set_RefCal_SR01_POS03 Image: Set_RefCal_SR01_POS03 Image: Set_RefCal_SR02_POS01 Image: Set_RefCal_SR02_POS01 Image: Set_RefCal_SR01_POS02 Image: Set_RefCal_SR01_POS02 Image: Set_RefCal_SR01_POS02 Image: Set_RefCal_SR02_POS01 Image: Set_RefCal_SR02_POS01 Image: Set_RefCal_SR02_POS02 Image: Set_RefCal_SR02_POS01 Image: Set_RefCal_SR02_POS02 Image: Set_RefCal_SR02_POS02 Image: Set_RefCal_SR02_POS02 Image: Set_RefCal_SR02_POS02 Image: Set_RefCal_SR02_POS02 Image: Set_RefCal_SR02_POS02 Image: Set_RefCal_SR02_POS02	Save Cancel <u>H</u> elp
File Name SE_RefCal_SR01_POS01	
	J

Fig. 6-6: Reference calibration filename convention

Save desired reference calibration for all subranges and antenna positions that are to be tested. Commence with the EUT testing. With the calibration results, the EUT test can now begin.

EMC32 Explorer									
Al Files	_	all_SR01_POS01						×	
Ø EMC32		🖹 🔏 🗎 🗎		· 🛐 (6) 1.000000	_ %				
Emeloz Emeloz	A, Z,	Frequency	💌 🖌 Frequ	ency 💌					
Calibration Sequence Calibration Setups	Name	Frequency	Generator Level/H	Transducer Level/H	Immunity Level/H	Generator Level/V	Transducer Level/V	Immunity Level/V	
Correction Tables	Unit	MHz	dBm	W	dBm	dBm	W	dBm	
EUT Information D Frequency Lists	Detector		Carrier	Carrier	Carrier	Carrier	Carrier	Carrier	
Graphics	SE RefC	all SR02 POS01						×	
Hardware Setups	-		n 🗟 🖳 署	3 (6) 1.000000	• %				
<mark>C</mark> Limit Lines ⊟ CN Reference Calibrations		E 🔊 Frequency			/0				
	Ź∜ Ā∜	Frequency	💌 🗸 Frequ	ency <u> </u>					
I SE_RefCal1_SR01_POS02	Name	Frequency	Generator Level/H	Transducer Level/H	Immunity Level/H	Generator Level/V	Transducer Level/V	Immunity Level/V 📫	
	Unit	MHz	dBm	W	dBm	dBm	W	dBm	
E_RefCall_SR03_P0S01	Detector		Carrier	Carrier	Carrier	Carrier	Carrier	Carrier	
Will SE_RefCal1_SR03_POS02	SE RefO	al1 SR01 POS0	2					×	
	-			- The state of the	%				
Tables	□ □ ↓ □ □ □ □ □ □ 0								
🖻 🔄 Test Templates	Z∜ A∜	Trequency	Y rieu	Jericy _					
Ci EMS AutoTest ⊟Can, EMS Scan	Name	Frequency	Generator Level/H	Transducer Level/H	Immunity Level/H	Generator Level/V	Transducer Level/V	Immunity Level/V	
Amplifier test	Unit	MHz	dBm	W	dBm	dBm	W	dBm	
	Detecto	r	Carrier	Carrier	Carrier	Carrier	Carrier	Carrier	
	SE_Re	Cal1_SR02_POS	02	·	·			×	
 (03, SE - Reference calibration (300MHz (04, SE - Reference calibration (500MHz) 			💼 📑 🚳 🗋	🖶 💽 🗍 (6) 1.00000	0 🔹 %				
EuT Monitoring	A Z	Frequency	▼ V Fre						
Tests		e Frequency		H Transducer Level/	La la munitu Louol/	H Gonarator Louel	C Transduger Louisl		
4					-			· ·	
· · · · · · · · · · · · · · · · · · ·	Unit	MHz	dBm	W	dBm	dBm	W	dBm	
🟫 🚺 😂 🖗 🗎 🗎 🔍 🚖 🤁	Detec		Carrier	Carrier	Carrier	Carrier	Carrier	Carrier	
	1	300.0000	-19	16 0	.0 -20	.0 -19	6 0.	0 -20.0	

Fig. 6-7: Reference calibration result parameters

6.2 EUT Auto Test for SE

The receiving antenna is placed inside the EUT to be measured. Using EMC32, run the Auto Test template as described in the actions that follows.



Fig. 6-8: EUT test for SE

Under **Test Template > EMS Auto Test**, right-click on the appropriate test template and select "New Test".



Fig. 6-9: New test selection

In Fig. 6-10, select **Test Definition** tab. Under **Test method**, select "EMS Auto Test" from the dropdown list. Under **EUT Monitoring Parameters**, select the appropriate EUT monitoring file and click OK.

New Test - [EMS Radiated]	×
Test Definition Report Frequency Range	
Test Control Parameter Test Name Test Test Method EMS Auto Test	
EMS Auto Test	
Test Loop Method EuT Qualification	
EuT Monitoring Parameters Template EUT Monitoring (20MHz-1GHz)	
Cancel	

Fig. 6-10: Test method selection

In Fig. 6-11, click play/start button to begin the EMS Auto Test for SE.



Fig. 6-11: EUT auto test

In the left window toolbox under **User Definition**, right-click the corresponding set position. Select **Set as next Loop Position** to move to the next frequency range or polarization.



Fig. 6-12: Next loop position

The worst case analysis will be reflected when EUT Monitoring Template is used with EMS Auto Test.



Fig. 6-13: Worst case analysis

The results are also made available in table format.

	Frequency	💽 🖌 Frequency	-			
Name	Frequency	Shielding Effectiveness	Polarization	User Definition	Modulation	
Unit	MHz	dB				
1	20.000000	111.019	Н	2: Set position 2	OFF	
2	25.000000	118.794	٧	1: Set position 1	OFF	
3	31.250000	98.606	٧	2: Set position 2	OFF	
4	39.062500	108.925	٧	1: Set position 1	OFF	
5	48.828125	106.519	٧	2: Set position 2	OFF	
6	61.035156	108.203	Н	1: Set position 1	OFF	
7	76.293945	110.824	V	2: Set position 2	OFF	
8	95.367432	117.056	Н	1: Set position 1	OFF	
9	119.209289	125.024	Н	2: Set position 2	OFF	
10	149.011612	128.381	Н	1: Set position 1	OFF	
11	186.264515	121.632	Н	1: Set position 1	OFF	
12	232.830644	110.696	Н	1: Set position 1	OFF	
13	291.038304	112.543	Н	1: Set position 1	OFF	
42	5					

Fig. 6-14: Worst case result in table format

7 Printing Report

Refer to chapter 3.3 "Online Help" on page 6. In HTML Help, select the **Index** tab, search for "Report" to show a detailed description on setting up the Report template and print it out.

B HTML Help T ← ↔ Hide Back Forward Print	
Contents Index Search Glossary Type in the keyword to find: report Report Adding a component	Next Lab As one of the most important functions EMC32 offers the possibility for creating measure
Arranging components Available Components Changing preview display Changing the component font Company logo Creating a new page	reports. Different test report templates can be created in the EMC32 "Report Setup". All the requirinformation can be added to the report when creating a new template. The Title, header of the test report can be added from the "General" column of the test report template.
Creating PDF reports Defining page setup Defining report tile, header and footer Defining the graphics presentation Defining the table presentation	A new report template can be created by selecting the either from the EMC32 Explorer of When creating via EMC32 explorer: >> Report Setup >> New [Picture] When creating via EMC32 menu: >> Report Setup, A "Report Setup Open" window will b

Fig. 7-1: Online help for report overview

7.1 Printing Report for SE

This section provides a guide to setting up and saving a report for SE.





Fig. 7-2: Measurement mode exit

From the "Test Components" tab, right-click on the folder "Report Setups" and select "Add Report Setup".



Fig. 7-3: Report setup

	o\SE2\System\Report Setups	
		Cano
₩Dynamic range ₩EUT test ₩ Reference calibration		Hel
Report Setup	1	

Select the appropriate report template and click OK

Fig. 7-4: Report template selection

The new setup will be shown in the folder "Report Setups" (see Fig. 7-5).



Fig. 7-5: Report setup creation

- General	1/4 ►H Q -	3	
Title			
EMC32 Report			
	EMS Auto Test With Some no con	nection	1/4
#Test# #Page# / #PageCount		EMC32 Report	
<u>F</u> ooter	Common Information	•	
#Date# #Version# #Time#	Test Description:	SE Test	
,	Test Site: Test Standard: Bhvironment Conditions:		
Available Components	Operator Name: Comment	R&S	
🔞 Information	Hardware Setup: EMS	radiated\SE - EUT test - [EMS radiated]	
🕖 EUT Information	Subrange 1 Frequency Range:	20 M Hz - 500 M Hz	
률 Hardware Setup	Generator:	SMEV100A (SMEV100A)	
🛅 Test Template		Ø MSA (AÖR TCRP::169.254.2.20::INST0:INSTR), SN 25 FW Rev 2.10.1, 01/2009, CV18.5	7668,
👁 EuT Monitoring	Signal Path:	RF_99_1+PA_1 FW1.0 Correction Table: RF_99_1+PA	
🚧 Graphics	Amplifier: Signal Path:	Generic Amplifer (Generic Amplifer) PA_1-Tx artenna	
New Page (Portrait)		FW1.0 Correction Table: PA_1-Tx anterna	
🗀 New Page (Landscape)	Antenna:	Tx antenna	
Table	Fwd PwrM tr: Signal Path:		
Text	RevPwrMtr: Sensor:	() RX_1 (ESU 29)	
💏 Image / Photo	2050.	 MSA (ADR TCRIP::192.168.48.20::INST0::INSTR), SN 100511/025. FW 4.73 	
🗒 Protocol	Signal Path:	Rx artenna to Rx_1 wo Pre-amp FW 1.0	
🗢 OTA Results	Sensor Robe	Correction Table: Rx artenna_Loop- RX_1 Rx artenna	
		Correction Table (vertical) : Dummy Factor	
	Subrange 2 Frequency Range:	500 MHz - 3 GHz	
Selected Components	Generator:	B/ B/100A(SMB/100A)	
F Information		Ø MSA (AÓR TCRP::169.254.2.20::INST0:INSTR), SN 25 FW Rev 2.10.1, 01/2009, CV18.5	7668,
Hardware Setup	Signal Path:	RF_50_1-PA_2_Band 1 FW1.0	
Test Template	Amplifier: Signal Path:	Correction Table: RF_SG_1 PA Generic Amplifier (Generic Amplifier) PA_2_Band 1-Tx anterna	
	agnarren:	FW1.0 Correction Table: FA_2 - Tx antenna	
W Graphics	Antenna	Tx antenna	
Mage / Photo	Fwd PwrM tr: Signal Path:	()	
	RevPwrMtr:	[]	
	2/32015	B/ 032 V9.20.0 1036	25 AU
<u>Cancel</u>			

From Fig. 7-6, double-click the designated report filename for more details.

Fig. 7-6: Report details

In the left window toolbar under **Selected Components** (Fig. 7-6), double-click on "Information" **Selected Components** (Fig. 7-6), double-click on

Test Site: 2LY2 Test Site: IEEE299 Environment Conditions: Dperator Name: Comment: EMC32 v9.20	Test Description	Shielding Effectiveness Test
Environment Conditions: Operator Name:	Test Site:	2LY2
Operator Name:		IEEE299
	Environment Conditions:	
Comment: EMC32 v9.20		
	Comment:	EMC32 v9.20

Fig. 7-7: Information details

In the left window toolbar under **Selected Components** (Fig. 7-6), double-click on "Hardware Setup" Hardware Setup to select the hardware setup required in the report.

Template Options	×
HW Setup	
 From the (current) 	test folder
C From the system f	older
<u>0</u> K	Cancel

Fig. 7-8: Hardware setup option

In the left window toolbar under **Selected Components** (Fig. 7-6), double-click on "Test Template" Test Template to select the test template required in the report.

Template Options	X
 Test Template From the (current) test folder 	
C From the system folder	
Template format EMI Auto Test (Test Templates) Preview Measurements Show Data Reduction Frequency Zoom Maximization Measurements Frequency Zoom Adjustment Final Measurements Show Actions Show Report Settings	
 Other Short format Show Actions 	
<u>D</u> K	

Fig. 7-9: Test template details

In the left window toolbar under **Selected Components** (Fig. 7-6), double-click on "Table" Table to select the type of tables required in the report.

Choose a Table	and the second se	×
Source	From active Test	_
Table Name	<none></none>	
<u> </u>	Ean Can	icel

Under **Table Name**, click on _____ to select table types.

Fig. 7-10: Table selection

In the left window toolbar under **Selected Components** (Fig. 7-6), double-click on "Graphics" Graphics to select the type of graphs required in the report.

More than one graph can be added to the report if the option is available.

From **Graphics Display**, under the field **Graphics Arrangement**, we recommend selecting "2 rows x 1 column" for optimum display.

From the Test		Selected Graphics
Test	• ;	>>> Shielding Effectiveness Shielding Effectiveness_WC
Graphics of this test: Imm Level-Pk		>
Shielding Effectiveness Sensor Level-Pk Ant In Fwd	-	
Amp In Gen Out	-	~
Add Graphic		
Graphics Display Graphics Arrangement 2 rows x 1 column	•	
 Shrink to fit onto page Show Graphics Name Show Graphics Title 		
Add Information for every graphic		
OK	1	Cancel

Fig. 7-11: Graphics details

In the left window toolbar under **Selected Components** (Fig. 7-6), double-click on "Image/Photo" Image / Photo to select any required image or photo for SE into the report.

Choose an Image	 ×
Image Name	
Image Properties	
Zoom factor	4 💌 %
Alignment	Left
🔲 With Legend	
<u></u> K	Cancel

Fig. 7-12: Image/photo selection

In the left window toolbar under Available Components (Fig. 7-6), click on "Export the

report" to export and save the final test report. Three types of file formats are available: PDF, RTF and HTML.

Select 'Save to the selected directory" and save the report to your desired file location.

Click OK to save the report.

Save Report as a File	emplate Bensor Positions
Output Format	Image: Second secon
C Save to Test Folder	Save As
Note: As long as this test is open test located in the <temptests> I</temptests>	
Document Name EMS Auto T	e 🖌 Favorites
Save to the selected directory	Desktop Downloads Outure Notes Data
<u>0</u> K	LOYANG GROUP LOYANG SERVER MLY01 GOH_J
	MLY01 GROUP
- <u> M</u> ilmage / Photo	MLY01
	PURA GROUP
	Recent Places V (III
<u>Cancel</u> <u>OK</u>	File name: EMS Auto Test With Some no connection.pdf
	Save as type: PDF File

Fig. 7-13: Saving of report

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The Rohde & Schwarz electronics group offers innovative solutions in the following business fields: test and measurement, broadcast and media, secure communications, cybersecurity, radiomonitoring and radiolocation. Founded more than 80 years ago, this independent company has an extensive sales and service network and is present in more than 70 countries.

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