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.

가 HTML Help	
Hide Back Forward Print	
Contents Index Search Glossary	Device list
Generic	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]
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.
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	<u>Removing registered devices</u>
Properties and Settings	 Defining the properties of a device
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.

Device List							×
Devices:		Configured Devices:			1	×	<u>■</u> 1 8
		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		
E FieldProbes		📧 TR Bicon Antenna 20M - 100MHz	Antennas	Antenna	None		
		🔁 SMF100A	Generators	SMF100A	VISA	TCPIP::	Virtual
		SMC100A	Generators	SMC100A	VISA	TCPIP::	Virtual
		📧 RCV Loop Antenna 9k - 30MHz	Antennas	Antenna	None		
H Multicideraboa		📧 RCV Dipole Antenna 100M - 1GHz	Antennas	Antenna	None		
		TRCV Broadband Horn Antenna 1G	Antennas	Antenna	None		
E Positioners		TRCV Bicon Antenna 20M - 100MHz	Antennas	Antenna	None		
		C OSP	SwitchUnits	OSP	VISA	TCPIP::	Virtual
		🔀 NRP-Z55 (USB) Reverse	PowerMeters	NRP-Zxx (U	USB	?	Virtual
+		RP-Z55 (USB) Forward	PowerMeters	NRP-Zxx (U	USB	?	Virtual
		🙄 Interlock OSP(1)	Interlock	Interlock OSP	VISA	TCPIP::	Virtual
		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
±		🕨 BSA 9k - 1GHz	Amplifiers	Generic Am	LAN	123.444	Virtual
		BLMA 1G - 40GHz	Amplifiers	Generic Am	LAN	123.44	Virtual
OK Cancel							
	1						

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.

PHTML Help		x
Hide Back Forward Print		
Contents Index Search Glossary	Hardware Setup	Â
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 etcor 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 Harmonics Measurement IF attenuation IF bandwidth Import	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.	
Import of Calibration Data Field Probe Monitoring Clamp informati	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.	
input protection input selection Interactive measurement Interlock	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.	Ш
al devices meM-PIO OSP SCIU TS-RSP IP address ISO11451	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.	
ISO11452 LAN Language	see also:	
Line Impedance and Stabilization Network live data reduction LTE Carrier 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: 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 Test level tab	
ENG test save ENG1000-4-3 ENG1000-4-6 In both cases the definition dialog for a new test will be shown.	
ENV 216 ENV 4200 ENV 432 ENV 41	
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 DEC CAL	J 	Immunity Level Uni	Hardware	e 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	Hz 1% LOG	-20dBm	Modulation Off	Os	OFF: 0 dB	
	3 100MHz - 1GH	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	aps 👔	Actions	Delete Subrange
Start Frequency 100 Stop Frequency 30	kHz MHz	Step Mode Step Size Dwell Time	LOG 50.000 1.000	* % \$	Add Subrange System Monitoring
Exclude Frequency Bands		Meas. Foints	120		
Use Frequency Table	Frequency	Table			ОК
Use Frequency Lable only	Tenones				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.

VIS Scan Template - [SE - Refer	rence Test1 (EM					
	ence readjient	S Radiated] (*))			:
General Settings Levelir	ng Mode	wTD81 System	Options			
Level On	Common Ref.	Cal. File Name			Power Meas	surement
Sensor	SE_RefCal	$\overline{}$			Generator I	evel
						_
No Subrange	Step	Level	Modulation	Dwell Time	Level Sweep	
1 100kHz - 30MHz	1%LOG	-20dBm	Modulation Off	Os	OFF: 0 dB	
2 30MHz - 100MHz	1% LOG	-20dBm	Modulation Off	Os	OFF: 0 dB	
3 100MHz - 1GHz	1%LOG	-20dBm	Modulation Uff	Us	OFF: 0 dB	
Frequency	Level		Device Setups	Act	ions	Delete Subrance
Frequency	Level		Device Setups	Act	ions	Delete Subrange Add Subrange
Frequency C Immunity Shape Table C Constant Immunity Level	Level	re> dBm	Device Setups	Act	ions	Delete Subrange Add Subrange System Monitoring
Frequency C Immunity Shape Table C Constant Immunity Level Upper Leveling Tolerance	Level	e> dBm	Device Setups	Act	ions	Delete Subrange Add Subrange System Monitoring
Frequency C Immunity Shape Table Constant Immunity Level Upper Leveling Tolerance Lower Leveling Tolerance	Level	le> dBm dB dB	Device Setups	Act	ions	Delete Subrange Add Subrange System Monitoring OK

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.

General Settings	Leveling Mode	WTD81 System	Options			
EMC Test Standard		Immunity Level Unit	Hardware S	etup		
SE TEST	-	dBm 💌	SE			
Commercial Automotive/MIL SE REF CAL						
No SE TEST	D ONOP	Level	Modulation	Dwell Time	Level Sweep	
1 100kHz - 30MH	iz 1% LOG	by RefCal	Modulation Off	Os	OFF: 0 dB	
2 30MHz - 100MH	Hz 1%LOG	by RefCal	Modulation Off	Os	OFF: 0 dB	
3 100MHz - 1GH	z 1%LOG	by RefCal	Modulation Off	Os	OFF: 0 dB	
Frequency	Device S	Setups	Actions			Delete Subrange
Frequency Start Frequency 10	Device S	Setups Ste	Actions	IG 💌		Delete Subrange Add Subrange
Frequency Start Frequency 10 Stop Frequency 1	Device S 00 MHz GHz	Setups Ste Ste	Actions	IG 🔻		Delete Subrange Add Subrange
Frequency Start Frequency 10 Stop Frequency 1	Device S 00 MHz GHz	Setups Ste Ste Dw	Actions pp Mode [L0 pp Size [1.] vell Time [0.]	IG - 1000 %		Delete Subrange Add Subrange System Monitoring
Frequency 10 Start Frequency 10 Stop Frequency 1 Exclude Frequen	Device S 0 MHz GHz 1cy Bands	Setups Ste Ste Dw Me	Actions p Mode [L(p Size]1. vell Time [0.1 pas. Points]23	IG 100 % 100 s 1		Delete Subrange Add Subrange System Monitoring
Frequency 10 Start Frequency 10 Stop Frequency 1 Exclude Frequency 1 Use Frequency T 1	Device S)0 MHz GHz 1cy Bands	Setups Ste Ste Dw Me	Actions LC ep Mode LC ep Size 1. vell Time 0. eas. Points 23	IG • 1000 % 1000 s		Delete Subrange Add Subrange System Monitoring OK

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.

//S Scan Template - [SE - EUT Test] [EMS Radiated] (*)							
Ge	neral Settings	eling Mode	WTD81 System	Options			
L	evel On	Reference	Calibration Table		-	Power Contr	ol
5	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	
	Frequency	Device Set	ups	Actions			Delete Subrange
Sta	Frequency	Device Set	ups) Sti	Actions	0G 💌		Delete Subrange Add Subrange
Sta	Frequency 100 pp Frequency 30	Device Set	ups Str Str	Actions ep Mode Li ep Size 50	0G 🔹		Delete Subrange Add Subrange
Sta	Frequency 100	Device Set	ups St St	Actions ep Mode Lu ep Size 55 vell Time 0.	0G 🔹		Delete Subrange Add Subrange System Monitoring
Sta Sto	Frequency 100 Int Frequency 30 PFrequency 30 Exclude Frequency Bar	Device Set kHz MHz nds	ups Sti Dv Mi	Actions ep Mode Lu ep Size 50 vell Time 0. eas. Points 12	DG ▼ 0.000 % 000 s		Delete Subrange Add Subrange System Monitoring
Sta Sto	Frequency 100 art Frequency 30 Exclude Frequency Bar Use Frequency Table	Device Set kHz MHz nds	ups St. St. Dv Mo	Actions Lt ep Mode Lt ep Size 56 vell Time 0. eas. Points 12	06 - 0000 % 0000 s		Delete Subrange Add Subrange System Monitorin OK

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	lay		Y Avis Mavimum	120,000000	-n-
Unit to be disp	layed dB			120.00000	06
🔽 Displau Gr	aphies Diagram bu D	efault	t axis minimum	-5.000000	dB
🔲 Graphics N	lame (optional)				
☐ Graphics N Value Convers Evaluation For	lame (optional) ion				
Graphics N Value Convers Evaluation For IMMLVL{Imm	lame (optional) ion mula LvI dB}-107-MEASV.	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
EMS Auto Tes	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**".

F Mo Opti EL	nitoring ions JT Inform	g - [SE]				
<r< th=""><th>none></th><th></th><th></th><th></th><th></th><th></th></r<>	none>					
No 1	Active V	Name SE Graph	Meas. Device FSP 40	Conversion MEAS -	NoGo < 0.5 dB	Actions No Action
	Channel	Hardw	are Display	NoGo	Actions	Options
					Sweep Parame	eters
г	d	B molifier path	ESP 40		Center Freque	m. Signal ency MHz
Г	d Pre-ar	B mplifier path	FSP 40 "No. of Repetitions" "Measurement Mode "IF Bandwidth" = 120 m "Video Bandwidth" = 120 m	= 1 s" = Single 0 kHz 10 MHz	Center Frequ 100.000000 Detector Average MaxPeak Average RMS	n. Signal ency MHz

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.

Dpti EU <r< th=""><th>ons IT Inform none></th><th>nation</th><th></th><th></th><th></th><th></th><th></th></r<>	ons IT Inform none>	nation					
۷o 1	Active	Name Shielding	Meas. Device)	Conversion	NoGo	Actions
	Channel	Hardw	are Dis	play	NoGo	Actions	Options
	Channel - NoGo 1 & At	Hardw Type Dove Limit	are Dis	splay	NoGo nit Value Constar(Actions	Options
	Channel -NoGo 1 / At C Be	Hardw Type Dove Limit elow Limit	are Dis	splay	NoGo nit Value C Constar(C Shape	Actions (none)	Options dB
	Channel NoGo 1 At C Be	Hardw Type Dove Limit elow Limit utside Value Ran	are Dis	play	NoGo nit Value C Constant C Shape lue Range Upper I	Actions	Options 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	e ge

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
FUT Test	1	Test Frequency Relation	·	
EOTTES	3	User Definition	Π,Υ	2
	4	Auto Test Subrange		
Measurement Settings	User Defin Number of Progra Remol Wait Notify Run M Switch	Increase Priority	Decrease Priority Visible Co Show Tra Show Tra Notify: change to position 1 2 Notify: change to position 2	Iumn in the Report ice for each Loop Result 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 185 184 323 1	×		
EUT Failure Mode Evaluation				
Create EUT Failure Mode Eva	luation Graphic	-		
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	4	valuation Settings	Report Settings
	OK Cancel			ок
				Lancel

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	Report Settings	
		f	a 1				
	l	UK	Cancel				1
		Loop Settings	Measurement		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 System Calibration Sequence Calibration Sequence Calibration Setups Correction Tables Correction Tables Calibrations Calibration	New Test New Test Direct New File File Info Open Print Rename Duplicate Delete Add to Favorites Export
02. SE - Reference calibration	(20MH2-300) (300MHz-500
04. SE - Reference calibration	(500MHz-1G

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 Template 02. SE - Reference calibrat	
Reference Calibration Image: Context in the	
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	
L ⊢Store Data v	with Antenna Polarization Information
 Horizor 	ntal C Vertical C None
- Shielding Eff	fectiveness BC File Name Builder
EMS Subra	ange No. 1 Antenna Position
Proposed I	File Name: <se_refcal_sr01_pos01></se_refcal_sr01_pos01>
S	ave <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	7
Save as	×
Path: C:\Users\goh_i\Desktop\SE1\System\Reference Calibrations Path: C:\Users\goh_i\Desktop\SE1\System\Reference Calibrations SE_RefCal_SR01_POS01 SE_RefCal_SR01_POS02 SE_RefCal_SR01_POS02 SE_RefCal_SR01_POS03 SE_RefCal_SR01_POS03 SE_RefCal_SR02_POS01 SE_RefCal_SR02_POS02 SES_RefCal_SR01_POS02 SES_RefCal_SR01_POS02 SES_RefCal_SR01_POS02 SEST_RefCal_SR01_POS02 SEST_RefCal_SR01_POS02 SEST_RefCal_SR01_POS02 SEST_RefCal_SR01_POS02 SEST_RefCal_SR02_POS02 SEST_RefCal_SR02_POS02 SEST_RefCal_SR02_POS02 SEST_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 7	SE_RefCi	al1_SR01_POS01						X
All Files	B 🖶	a 🗶 🖻	ñ 👔 🔹 🔻	3 (6) 1.000000	- %			
Ø EMC32	AL ZI	Frequency	 Frequencies 	encu 🔻	_ **			
Erro System	ZV KV							
	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	Detector		Carrier	Corrior	Carrier	Carrier	Corrier	Carrier
	Detector		Califer	Califer	Calife	Califer	Califer	Janici
	SE_RefCa	al1_SR02_POS01						x
	1	🛢 🗶 🖻 (🖻 👔 😫 📝	6) 1.000000	- %			
Generations	AL ZL	Frequency	▼ Frequ	ency 🔻				
E_BefCal1_SR01_POS01	ZV RV							
- Marcal SE_RefCall_SR01_POS02	Name	Frequency	Generator Level/H	Transducer Level/H	Immunity Level/H	Generator Level/V	Transducer Level/V	immunity Level/V
SE_RefCal1_SR02_POS01	Unit	MHz	dBm	W	dBm	dBm	W	dBm
SE BefCall SB03 PDS01	Detector		Carrier	Carrier	Carrier	Carrier	Carrier	Carrier
SE_RefCal1_SR03_POS02	Detector		Caller	Califer	Califo	Califei	Califor	Janici
🛄 Report Setups	SE_Ref0	al1_SR01_POS0	2					×
Carl Reports		🔒 🔏 🖻	💼 📦 🚳 💈	6) 1.00000) 🔹 %			
🛄 Tables	AL ZI	Frequency	▼ Fren	uencu 🔻				
I est l'emplates DIC Auto Tout								
EMS Adult Test	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
🗀 SE - EUT test	Detecto	r	Carrier	Carrier	Carrier	Carrier	Carrier	Carrier
⊡ · · · · · · · · · · · · · · · · · · ·		·	Cantor	ound	Califor	Califor	Gunor	
12. SE - Reference calibration (20MH2-3	- SE_Re	Cal1_SR02_POS	02					×
4 04 SE · Reference calibration (SODM12	î 🗎 🖥	8 🕺 🕯) 💼 📦 🗳 .	🛃 📑 (6) 1.0000	00 🛃 %			
- 🗋 EuT Monitoring	A, Z	J. Frequency	💌 🗸 Fre	quency 💌				
- 🛅 Tests	New		Constant and		11 Internet		V. T	A language language
	i Nam	riequency	Generator Level	m Harisudcer Level/	n minurity Level/	n Generator Level/	v Hansuucer Level/	/ minurity Level/v
< III >>	Unit	MHz	dBm	W	dBm	dBm	W	dBm
	Detec	tor	Carrier	Carrier	Carrier	Carrier	Carrier	Carrier
	1	300.0000	-19	1.6 C	.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	
Template SE - EUT Test	
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.

Shieldin	g Effectiveness_	WC				×
 □ □ ↓ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ 						
Name	Frequency	Shielding Effectiveness	Polarization	User Definition	Modulation	1
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	V	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.

👔 HTML Help	
Hide Back Forward Print	
Contents Index Search Glossary Type in the keyword to find:	Report Overview
Report Adding a component Aranging components Available Components Changing preview display Changing the component font Company logo Creating a new page	As one of the most important functions EMC32 offers the possibility for creating measure reports. Different test report templates can be created in the EMC32 "Report Setup". All the requinformation 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 (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

· · · · · · · · · · · · · · · · · · ·	top/SE2/System/Report Setups	
		Cance
124 Dynamic range 124 EUT test 124 Reference calibration		Help
Report Setup	>	

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 III II	1/4 нн Q, -	3	
Title			
EMC32 Beport			
Header			
	EMS Auto Test With Some no con-	rection	1/4
#Test# #Page# 7 #PageLount		EMC32 Report	
<u>Footer</u>	Common Information	-	
#Date# #Version# #Time#	Test Description: Test Site:	SE Test	
	Test Standard: Environment Conditions:		
Available Components	Operator Name: Comment	R&S	
😈 Information	Hardware Setup: EMS	radiated\SE - EUT test - [EMS radiated]	
0 EUT Information	Bubrange 1 Frequency Range:	20 M Hz - 500 MHz	
Fardware Setup	Generator:	SH EV100A (SMEV100A) © VISA (ADR TORR-169, 254, 2, 20::INSTR: INSTR: SN 257	1668 .
:= Test Template	Signal Path:	FW Rev 2.10.1, 01/2009, CVI 8.5 RF_83_1-RA_1	
EuT Monitoring		FW 1.0 Correction Table: RF_SG_1-PA	
Graphics	Ampine: Signal Path:	Generic Amplifer (Generic Amplifer) PA_1+Tx artenna SW 1 0	
New Page (Portrait)	Antenna	Correction Table: PA_1-Tx anterna Tx anterna	
New Page (Landscape)	Fwd/PwrM tr:	H	
	Signal Path: RevPwrMtr:	H	
We have a state of the state of	Sensor:	RX_1(ESU 25) ANASA (ADB TORIE-192 168 48 20-INSTO-INSTE) SN	
	Signal Path:	100511/025, FW 4.73 Rx antenna to Rx_1 wo Pre-amp	
		FW 1.0 Correction Table: Rx artenna_Loop - RX_1	
	Sensor Probe	Rx artenna Correction Table (vertical): Dummy Factor	
- 문 🗙 🖷 🔄 🖌	Subrance 2		
	Frequency Range:	500 MHz - 3 GHz	
	Generator:	9/I B/100A [SMB/100A] © VISA (ADR TCRP: 169.254.2.20::INST0: INSTR), SN 257 DM DW 24 04 04 04 04 04 04 04 05	668 ,
1 Information	Signal Path:	RF_83_1PA_2_Band 1 FW1.0	
Nordware Setup	Amplifie:	Correction Table: RF_SG_1-PA Generic Amplifier (Generic Amplifier)	
I est l'emplate	Signal Path:	PA_2_Band 1-Tx anterna FW 1.0	
	Antenna	Correction Fable: PA_2 - 1x antenna Tx antenna	
w uraphics	Fixel PwrM tr: Signal Path:	H	
mage / Photo	RevPwrMtr:	H	
	2/32015	B/C32 V9.20.0 1036:3	25 AU
<u> </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
Test Standard: IEEE299 Environment Conditions: Diperator Name: Comment: EMC32 v9.20	Test Site:	2LY2
Environment Conditions: Dperator Name: Comment: EMC32 v9.20	Test Standard:	IEEE299
Dperator Name: Comment: EMC32 v9.20	Environment Conditions:	
Comment: EMC32 v9.20	Operator Name:	
	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.

■ 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 Final Measurements Show Actions Show Report Settings	
Other Short format Show Actions	

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>C</u> an	cel

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 Sensor Positions
Output Format	Image: Second secon
C Save to Test Folder	Save As
Note: As long as this test is opened	
test located in the <1 emp1 ests> to	Organize 👻 New folder
Document Name EMS Auto Te	Favorites Name
Save to the selected directory	
<u>o</u> ĸ	LOYANG GROUP LOYANG SERVER MLY01 GOH_J
	MLY01 GROUP
- Milmage / Photo	MLY01
	PURA GOH J
	PURA GROUP
-	🖫 Recent Places 🔻 🖌 💷
<u>C</u> ancel <u>O</u> K	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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PAD-T-M: 3573.7380.02/02.04/EN/

1.00

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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Regional contact

Europe, Africa, Middle East +49 89 4129 12345 customersupport@rohde-schwarz.com

North America 1 888 TEST RSA (1 888 837 87 72) customer.support@rsa.rohde-schwarz.com

Latin America +1 410 910 79 88 customersupport.la@rohde-schwarz.com

Asia Pacific +65 65 13 04 88 customersupport.asia@rohde-schwarz.com

China +86 800 810 82 28 |+86 400 650 58 96 customersupport.china@rohde-schwarz.com

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Rohde & Schwarz GmbH & Co. KG Mühldorfstraße 15 | 81671 Munich, Germany Phone + 49 89 4129 - 0 | Fax + 49 89 4129 - 13777

www.rohde-schwarz.com