Description

Integrated Measurement System

R&S® IMS

1502.0009.02/04

Printed in Germany

ROHDE&SCHWARZ
Test and Measurement Division

Dear Customer,

When referring to your Integrated Measurement System R&S® IMS the abbreviation R&S IMS is used throughout this operating manual.

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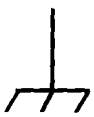
Safety Instructions

This unit has been designed and tested in accordance with the EC Certificate of Conformity and has left the manufacturer's plant in a condition fully complying with safety standards.

To maintain this condition and to ensure safe operation, the user must observe all instructions and warnings given in this operating manual.

Safety-related symbols used on equipment and documentation from R&S:

							
Observe operating instructions	Weight indication for units >18 kg	PE terminal	Ground terminal	Danger! Shock hazard	Warning! Hot surfaces	Ground	Attention! Electrostatic sensitive devices require special care

1. The unit may be used only in the operating conditions and positions specified by the manufacturer. Unless otherwise agreed, the following applies to R&S products:

   IP degree of protection 2X, pollution severity 2 overvoltage category 2, only for indoor use, altitude max. 2000 m.

   The unit may be operated only from supply networks fused with max. 16 A.

   Unless specified otherwise in the data sheet, a tolerance of ±10% shall apply to the nominal voltage and of ±5% to the nominal frequency.

2. For measurements in circuits with voltages V_{rms} > 30 V, suitable measures should be taken to avoid any hazards.

   (using, for example, appropriate measuring equipment, fusing, current limiting, electrical separation, insulation).

3. If the unit is to be permanently wired, the PE terminal of the unit must first be connected to the PE conductor on site before any other connections are made. Installation and cabling of the unit to be performed only by qualified technical personnel.

4. For permanently installed units without built-in fuses, circuit breakers or similar protective devices, the supply circuit must be fused such as to provide suitable protection for the users and equipment.

5. Prior to switching on the unit, it must be ensured that the nominal voltage set on the unit matches the nominal voltage of the AC supply network.

   If a different voltage is to be set, the power fuse of the unit may have to be changed accordingly.

6. Units of protection class I with disconnectible AC supply cable and appliance connector may be operated only from a power socket with earthing contact and with the PE conductor connected.

7. It is not permissible to interrupt the PE conductor intentionally, neither in the incoming cable nor on the unit itself as this may cause the unit to become electrically hazardous.

   Any extension lines or multiple socket outlets used must be checked for compliance with relevant safety standards at regular intervals.

8. If the unit has no power switch for disconnection from the AC supply, the plug of the connecting cable is regarded as the disconnecting device. In such cases it must be ensured that the power plug is easily reachable and accessible at all times (length of connecting cable approx. 2 m). Functional or electronic switches are not suitable for providing disconnection from the AC supply.

   If units without power switches are integrated in racks or systems, a disconnecting device must be provided at system level.

9. Applicable local or national safety regulations and rules for the prevention of accidents must be observed in all work performed.

   Prior to performing any work on the unit or opening the unit, the latter must be disconnected from the supply network.

   Any adjustments, replacements of parts, maintenance or repair may be carried out only by authorized R&S technical personnel.

   Only original parts may be used for replacing parts relevant to safety (eg power switches, power transformers, fuses). A safety test must be performed after each replacement of parts relevant to safety.

   (visual inspection, PE conductor test, insulation-resistance, leakage-current measurement, functional test).

continued overleaf

Safety Instructions

10. Ensure that the connections with information technology equipment comply with IEC950 / EN60950.
11. Lithium batteries must not be exposed to high temperatures or fire.

    Keep batteries away from children.

    If the battery is replaced improperly, there is danger of explosion. Only replace the battery by R&S type (see spare part list).

    Lithium batteries are suitable for environmentally-friendly disposal or specialized recycling. Dispose them into appropriate containers, only.

    Do not short-circuit the battery.
12. Equipment returned or sent in for repair must be packed in the original packing or in packing with electrostatic and mechanical protection.
13. Electrostatics via the connectors may damage the equipment. For the safe handling and operation of the equipment, appropriate measures against electrostatics should be implemented.
14. The outside of the instrument is suitably cleaned using a soft, lint-free dustcloth. Never use solvents such as thinners, acetone and similar things, as they may damage the front panel labeling or plastic parts.
15. Any additional safety instructions given in this manual are also to be observed.

Certified Quality System

DIN EN ISO 9001 : 2000
DIN EN 9100 : 2003
DIN EN ISO 14001 : 1996

DQS REG. NO 001954 QM/ST UM

QUALITÄTSZERTIFIKAT

Sehr geehrter Kunde,
Sie haben sich für den Kauf eines Rohde & Schwarz-Produktes entschieden. Hiermit erhalten Sie ein nach modernsten Fertigungsmethoden hergestelltes Produkt. Es wurde nach den Regeln unseres Managementsystems entwickelt, gefertigt und geprüft.
Das Rohde & Schwarz Managementsystem ist zertifiziert nach:

DIN EN ISO 9001:2000
DIN EN 9100:2003
DIN EN ISO 14001:1996

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Dear Customer,
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The Rohde & Schwarz quality management system is certified according to:

DIN EN ISO 9001:2000
DIN EN 9100:2003
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Cher Client,
vous avez choisi d'acheter un produit Rohde & Schwarz. Vous disposez donc d'un produit fabriqué d'après les méthodes les plus avancées. Le développement, la fabrication et les tests respectent nos normes de gestion qualité.
Le système de gestion qualité de Rohde & Schwarz a été homologué conformément aux normes:

DIN EN ISO 9001:2000
DIN EN 9100:2003
DIN EN ISO 14001:1996

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EC Certificate of Conformity

CE

Certificate No.: 2005-02

This is to certify that:

Equipment type	Stock No.	Designation
IMS	1502.0009.02/.04	Integrated Measurement System
IMS-B2	1502.0838.02	Transfer Relay
IMS-B3	1502.0873.02	Gen. Intlk. Relay
IMS-B4	1502.0915.02	Upgrade to EMC32-A+
IMS-B7	1502.0721.02	Hardware Extension Power Sensor

complies with the provisions of the Directive of the Council of the European Union on the approximation of the laws of the Member States

- relating to electrical equipment for use within defined voltage limits (73/23/EEC revised by 93/68/EEC)
- relating to electromagnetic compatibility (89/336/EEC revised by 91/263/EEC, 92/31/EEC, 93/68/EEC)

Conformity is proven by compliance with the following standards:

EN61010-1 : 2001-12
EN55011 : 1998 + A1 : 1999, Klasse B
EN61326 : 1997 + A1 : 1998 + A2 : 2001

For the assessment of electromagnetic compatibility, the limits of radio interference for Class B equipment as well as the immunity to interference for operation in industry have been used as a basis.

Affixing the EC conformity mark as from 2005

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Munich, 2005-02-02

Central Quality Management MF-QZ / Radde

Customer Support

Technical support – where and when you need it

For quick, expert help with any Rohde & Schwarz equipment, contact one of our Customer Support Centers. A team of highly qualified engineers provides telephone support and will work with you to find a solution to your query on any aspect of the operation, programming or applications of Rohde & Schwarz equipment.

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or request the desired information and upgrades via email from your Customer Support Center (addresses see below).

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Contents of the Manual

Operating Manual

Introduction

This operating manual provides information about:

- Technical characteristics of the instrument
- Putting into operation
- Basic operating procedures and control elements
- Operating via the remote control

The operating manual is divided into the following chapters:

First the data sheet in the General part gives an overview of the technical parameters of the R&S IMS. Chapter 1 then contains instructions on putting the system into operation with descriptions on

the controls, displays and connectors on the front and rear panels,
putting the R&S IMS and the connectors to external instruments into operation,
installing the operating system, loading drivers and configuring the R&S EMC32.

Chapter 2 gives an overview of manual operation.

Chapter 3 gives a description of the R&S IMS functions.

Chapter 4 contains an overview of some possible examples of R&S IMS applications, listed according to various standards.

Chapter 5 describes the use of the R&S IMS for measuring immunity to electromagnetic interference according to different EMC standards.

Chapter 6 contains an interface description for the R&S IMS together with notes on maintenance and error messages.

Chapter 7 contains the relevant parts of the description of the integrated amplifier. It only applies to R&S IMS variant 04.

1 Putting into Operation

Chapter 1, "Putting into Operation", explains the control elements, displays and connectors of the Integrated Measurement System IMS with the aid of the front and rear views and describes how to put the instrument into operation. It describes the connection of external devices such as power sensors and amplifiers as well as how to install the operating system on the PC. Technical data concerning the interfaces can be found in chapter 6, Interface Description.

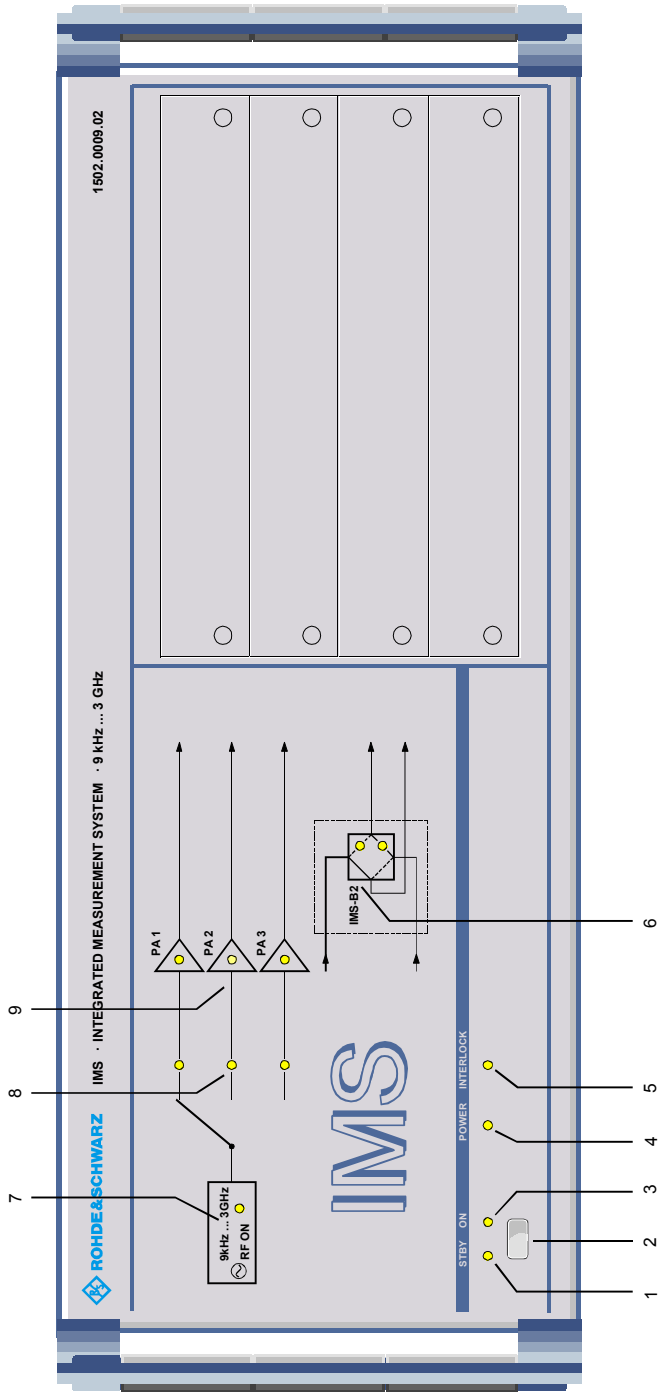
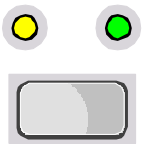


Fig. 1-1 Front view

1.1 Front Panel

This section gives an overview of the control elements and displays on the front panel of the R&S IMS. Each element is briefly described together with a cross-reference to the chapter or chapters where detailed information can be found.

1 STBY LED

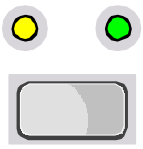


The yellow LED on the left above the button shows that the instrument is in STBY mode (standby).

Only power supply unit 2 is active. It powers the USB hub with +5 V and +12 V for the displays and fans.

See chapter 1.3.5

2 Button



The on/off button switches the instrument from the STBY mode to the ON operating status, provided the power switch on the rear panel is switched on.

The yellow LED (left) is on in the standby mode; the green LED (right) is on when the instrument is ready for operation.

***Warning*!**

The AC supply is still connected to the instrument in STBY mode.

See chapter 1.3.5

3 ON LED

The green LED on the right above the button shows that the instrument is in POWER ON mode.

The power is now on and all modules are fully operational.

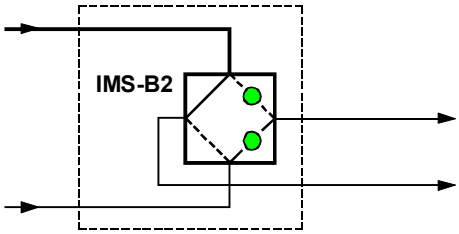
4 POWER LED

When this two-color LED (green, red) is green, it means that all operating voltages are at their correct value. When it shows red it indicates that one or more operating voltages are out of tolerance.

5 INTERLOCK LED

When this two-color LED (green, red) is green, it means that the interlock is closed and the R&S IMS is ready for operation. When it shows red it indicates that the door to the test room is open and it is not possible to start a test at this time.

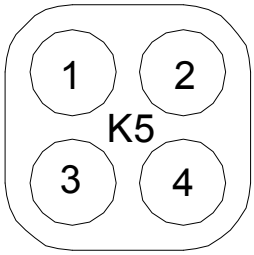
6 Transfer Relay Option R&S IMS-B2



Provides the option to switch RF from one or two amplifier outputs on two RF paths.

Caution

Do not overload the RF connections. The maximum permitted RF loading on the relay is 360 W at 3 GHz.



View of the N connectors of the relay

Upper LED lights up

The relay is at rest (NC) and connections are as follows:

RF output
1 to 2, 3 to 4

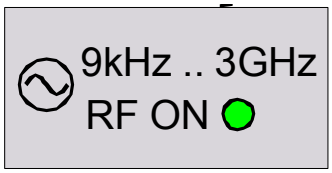
Lower LED lights up

The relay is on (NC) and connections are as follows:

RF output
1 to 3, 2 to 4

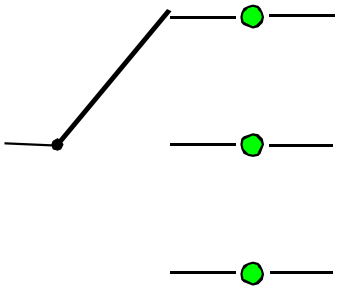
The appropriate R&S IMS OS device driver for switching this relay can be found in the equipment list under the name "Switch Unit" and is the IMS RSU type. Double-click on the entry to open a dialog box. The "Test" selection box contains switch commands which are listed when you click on the "Switch" button.
The command for switching the RF output 1 to 2, 3 to 4 (upper LED) is "K5_1"
The command for switching the RF output 1 to 3, 2 to 4 (lower LED) is "K5_2"

7 RF ON LED in the Generator Icon



The green LED indicates that the generator module is in RF ON status.

8 Signal Path LED

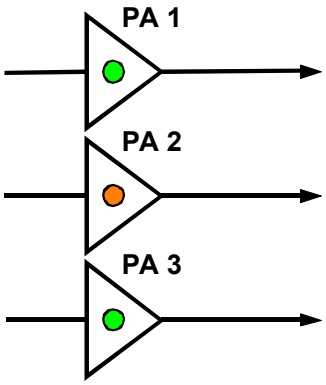


The green LEDs indicate the RF path selected for the generator signal to the amplifiers PA1, PA2, PA3 respectively.

At the same time the appropriate FWD and REV directional coupler signal is switched to the power sensor(s).

The appropriate R&S IMS OS device driver for switching these relays can be found in the equipment list under the name "Switch Unit" and is the IMS RSU type. Double-click on the entry to open a dialog box. The "Test" selection box contains switch commands which are listed when you click on the "Switch" button.
The command for switching the upper path is "PA 1" (upper LED)
The command for switching the middle path is "PA 2" (middle LED)
The command for switching the lower path is "PA 3" (lower LED)

9 PA x LED



When these two-color LEDs (green, red) show green, they indicate that amplifier PA1, PA2, PA3 respectively is in "OPERATE" status.

Red LEDs indicate a "GENERAL FAULT" status in amplifier PA1, PA2, PA3 respectively, also indicating interference due to the open INTERLOCK on the amplifier.

The LED PAx displays described above are provided only by amplifiers from the Bonn company with the standard configuration for the I/O USB board in the R&S IMS. In the case of amplifiers from other manufacturers it is possible that a software-driven "Operate (PowerON) Display" may be generated in the amplifier due to changing the jumper positions on the I/O USB board.

The I/O USB board is located at the rear and to the left in the instrument when viewed from the front. To remove this board proceed as follows:

Undo the four feet on the R&S IMS and remove the cover from the instrument. Undo four fastening screws and pull the I/O USB board half out of the instrument (paying careful attention to the cable connections).

The jumpers can then be repositioned according to the following table (see component location plan for I/O USB board):

Display	Bonn amp.	Other amp.
Status PA1 Fault	X20 1-2	X20 2-3
Status PA1 RF ON	X21 1-2	X21 2-3
Status PA2 Fault	X22 1-2	X22 2-3
Status PA2 RF ON	X23 1-2	X23 2-3
Status PA3 Fault	X24 1-2	X24 2-3
Status PA3 RF ON	X25 1-2	X25 2-3

Table 1-1 Jumper assignment on the I/O board

The rest of the jumpers (X26 through X31) should not be moved, since their functionality is not under consideration at this time.

Reassemble the board in the reverse order.

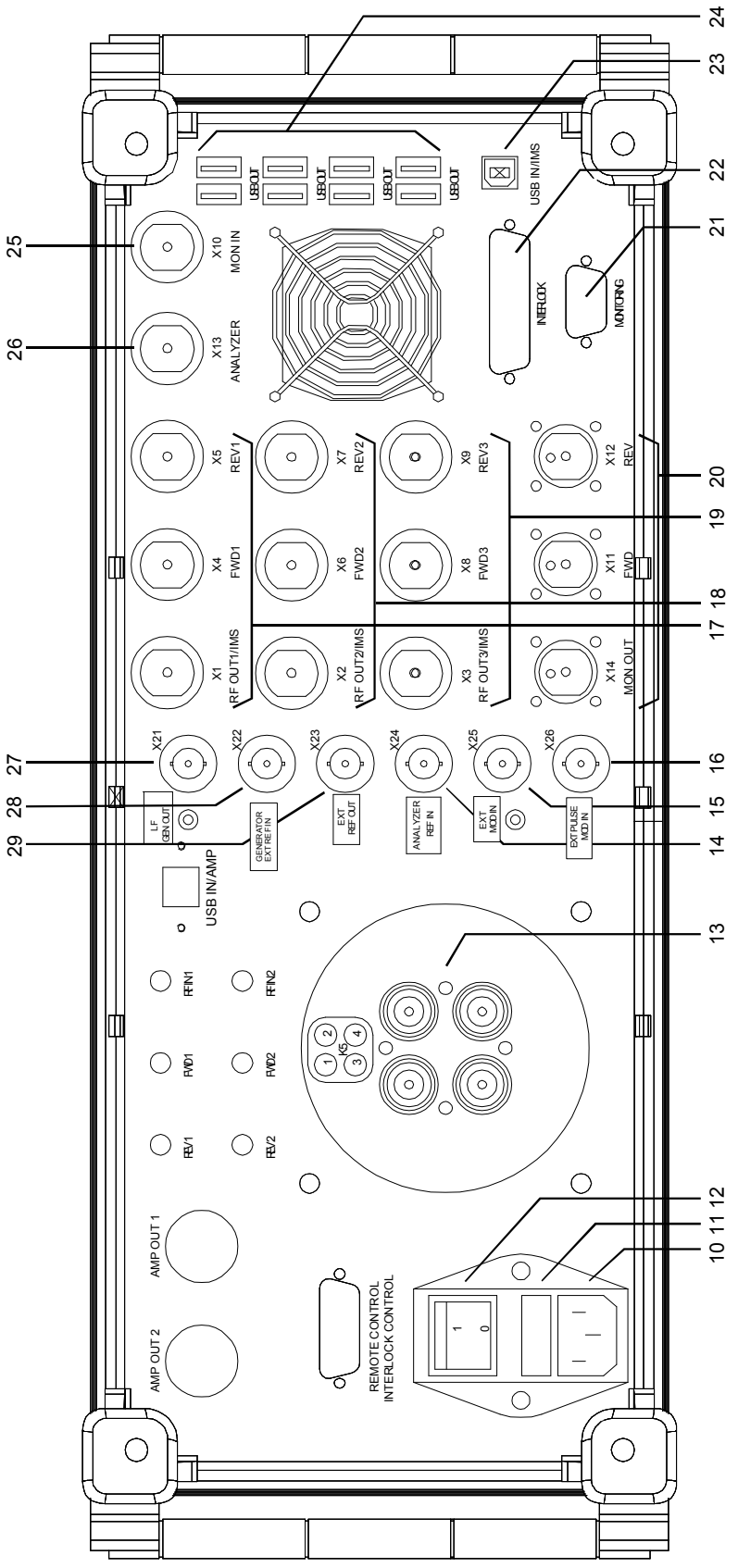


Fig. 1-2 Rear view of model 02 with option R&S IMS-B2

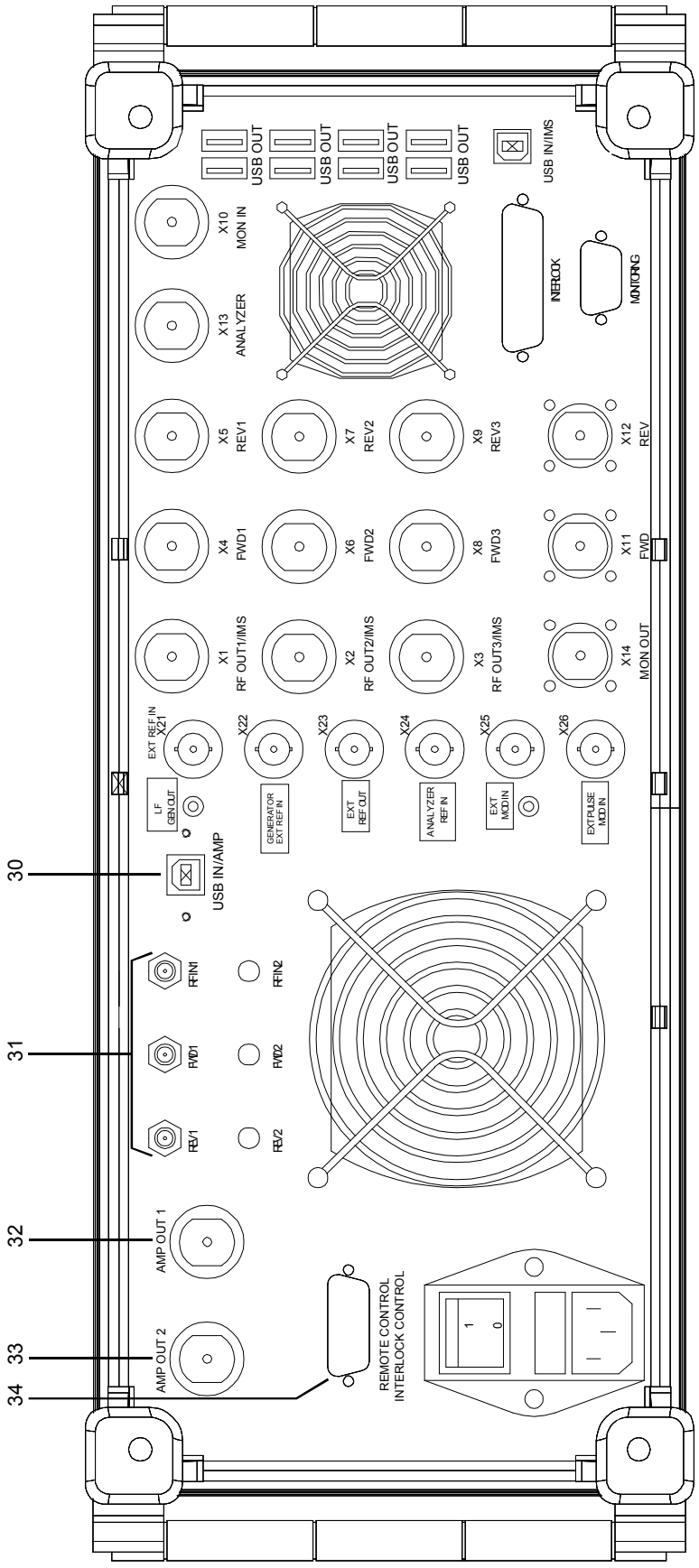
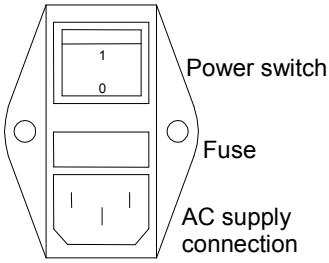


Fig. 1-3 Rear view of model 04

1.2 Rear Panel

This section gives an overview of the connectors on the rear panel of the R&S IMS. Each connector is briefly described and a reference is given to the chapters containing detailed information. For technical data of the connectors refer to the data sheet.

10, 11, 12 AC Supply



AC supply connector

When the R&S IMS is connected to the AC supply, it automatically sets itself to the correct range for the applied voltage (range: 100V – 230V). There is no need to set the voltage manually or change fuses.

Fuse

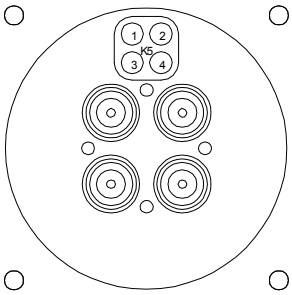
The fuse value can be read from the type label. The identifying code of the fuse is F3,15T-H

Power switch

A double-pole power switch is used to disconnect the R&S IMS from the AC supply.

See data sheet

13 Transfer Relay Option R&S IMS-B2



Transfer relay

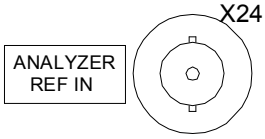
A relay on the rear panel of model 02 or integrated into model 04 switches the RF output from one or two amplifiers on two different paths to the test sets.

In the case of an integrated amplifier the RF output of the amplifier is connected to connector 1 of the transfer relay. Connectors 2 and 3 connect outputs AMP OUT1 and AMP OUT2

See data sheet or element description 6 of the front panel

The appropriate R&S IMS OS device driver for switching this relay can be found in the equipment list under the name "Switch Unit" and is the IMS RSU type. Double-click on the entry to open a dialog box. The "Test" selection box contains switch commands which are listed when you click on the "Switch" button.
The command for switching the RF output 1 to 2, 3 to 4 (upper LED) is "K5_1"
The command for switching the RF output 1 to 3, 2 to 4 (lower LED) is "K5_2"

14 Reference Signal Input for Analyzer

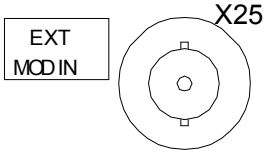


ANALYZER REF IN X24

Input for external reference signal 10 MHz

See data sheet

15 Input for External Modulation Signal - AM / FM

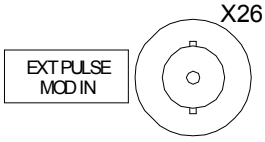


EXT. MODULATION IN X25

Input for external analog modulation signals (amplitude modulation and pulse modulation).

See data sheet

16 Input for External Modulation Signal - Pulse

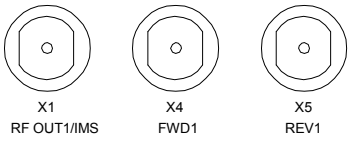


EXT. PULSE MOD IN X26

Input for external pulse modulation signals.

See data sheet

17 RF I/O for Amplifier 1

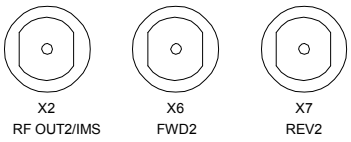


RF OUT1/IMS X1
FWD1 X4
REV1 X5

Generator signal to amp. 1, directional coupler output FWD and REV from amp. 1 to the power sensor.

See data sheet

18 RF I/O for Amplifier 2

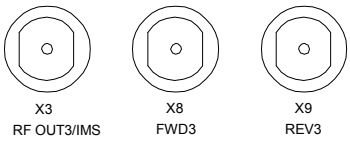


RF OUT2/IMS X2
FWD2 X6
REV2 X7

Generator signal to amp. 2, directional coupler output FWD and REV from amp. 2 to the power sensor.

See data sheet

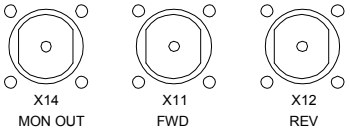
19 RF I/O for Amplifier 3



RF OUT3/IMS X3
FWD3 X8
REV3 X9
Generator signal to amp. 3, directional coupler output FWD and REV from amp. 3 to the power sensor.

See data sheet

20 Outputs for Power Sensor R&S NRP-Z91



MON OUT X14
FWD X11
REV X12
The standard connector is **one** sensor on X11 (REV and MON IN are polled via pin switches). With option R&S IMS-B7 (two sensors) only FWD is applied to X11, whilst REV and MON OUT are on X12. Socket X14 is not used for the time being.

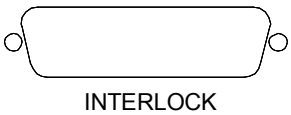
See data sheet

21 MONITORING

MONITORING interface 9 pin D-SUB
I/O to the communication with the EUT, level TTL +5 V. Pin assignment described in chapter 6.

See chapter 6 for interface description

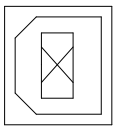
22 INTERLOCK



INTERLOCK interface 25 pin D-SUB
Control contact to interlock switch.
Relay contact for test lamp.
Status input from amplifiers.
Interlock contact to amplifier.
Pin assignment described chapter 6.

See chapter 6 for interface description

23 USB Connector - Type B

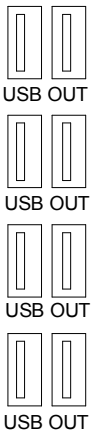


USB IN/IMS

USB (universal serial bus) interface of type B (device USB).
Remote control input of the R&S IMS.

See data sheet

24 USB Connectors - Type A



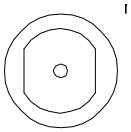
USB (universal serial bus) interfaces of type A (host USB).

– Connection of peripherals such as amplifiers and power sensor.

– Connection of the iKey for option R&S IMS-B4, upgrade to R&S EMC32-A+ incl. GPIB interface for USB.

See data sheet

25 MON IN

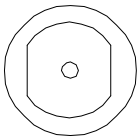


X10
MON IN

MON IN X10
Input of a monitor signal, e.g. from a test clamp.

See data sheet

26 ANALYZER

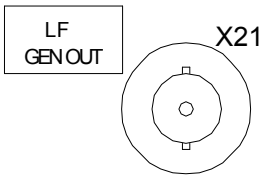


X13
ANALYZER

ANALYZER IN X13
Input connector of the optional Analyzer module

See data sheet

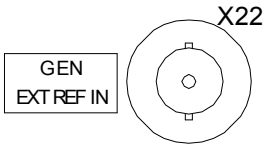
27 LF Output



LF GEN OUT X21
LF output signal from the internal LF generator in the RF generator

See data sheet

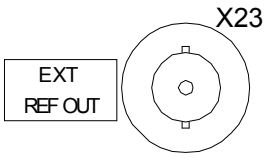
28 Reference Signal Input for Generator



GEN EXT.REF IN X22
Input for external reference signal 10 MHz

See data sheet

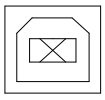
29 Reference Signal Output from Generator



EXT. REF OUT X23
Output of the internal reference signal from the generator

See data sheet

30 USB Connector - Type B



USB IN/AMP

USB (universal serial bus) interface of type B (device USB).
Remote control of the amplifier in the R&S IMS.

See data sheet

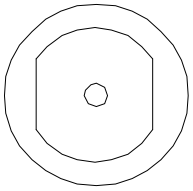
31 RF I/O from Amplifier 1

RF IN1
FWD1
REV1
Generator signal input for amp.1 in Model 04
Directional coupler output FWD and REV from amp. 1

See chapter 6 and data sheet

32 AMP OUT 1

AMP OUT 1



RF output 1

Output from the internal amplifier in model 04.
Standard RF output without option R&S IMS-B2.

With option R&S IMS-B2, RF output 1 is connected to connector 2 of the transfer relay.

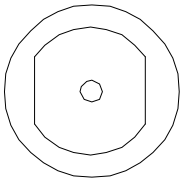
See chapter 6 and data sheet

AMP OUT 1 is connected directly to the RF output of the internal amplifier.

With option R&S IMS-B2 AMP OUT 1 is connected to the RF output of the amplifier when the upper LED on the front panel is lit in the R&S IMS-B2 icon.

33 AMP OUT 2

AMP OUT 2



RF output 2

Output from the internal amplifier in model 04.

Only in combination with option R&S IMS-B2; RF output 2 is then connected to connector 3 of the transfer relay.

See chapter 6 and data sheet

With option R&S IMS-B2 AMP OUT 2 is connected to the RF output of the amplifier when the lower LED on the front panel is lit in the R&S IMS-B2 icon.

The appropriate R&S IMS OS device driver for switching this relay can be found in the equipment list under the name "Switch Unit" and is the IMS RSU type. Double-click on the entry to open a dialog box. The "Test" selection box contains switch commands which are listed when you click on the "Switch" button.
The command for switching the RF output 1 to 2, 3 to 4 (upper LED) is "K5_1"
The command for switching the RF output 1 to 3, 2 to 4 (lower LED) is "K5_2"

34 REMOTE CONTROL / INTERLOCK CONTROL

REMOTE CONTROL 15 pin D-SUB
Parallel I/O for data signals and status messages together with interlock control.
The pin assignment is described in chapter 6.

See chapter 6 for interface description

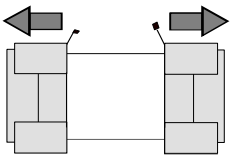
1.3 Putting into Operation

The following section describes the procedure for putting the instrument into operation and the connection of peripherals such as amplifiers and power sensors. It contains general safety instructions for operating the instrument.

This chapter also describes how to install software updates.

The next section describes how to install the R&S IMS operating system. **The R&S IMS operating system is based on the R&S EMC32 software platform. The iKey dongle required for operating the software needs to be plugged into a USB port on the instrument.**

1.3.1 Unpacking the R&S IMS



Remove protective covers

- Remove the R&S FS300 from its packaging and check that the delivery is complete using the delivery note and the accessory lists for the various items.
- Remove the two protective covers from the front and rear panel of the Integrated Measurement System and carefully check the instrument for damage.
- If there is damage, immediately contact the carrier who delivered the instrument. In this case, make sure not to discard the box and packing material.
- The original packaging is also useful for transporting or dispatching the Integrated Measurement System later on. Keep at least the two protective covers to prevent control elements and connectors from being damaged.

1.3.2 Setting up the Instrument or Installing it in a 19" Rack

The instrument is designed for indoor use. It can either be set up independently or mounted in a 19" rack.
A rack adapter (see data sheet for Order No.) is required for installation in a 19" rack. The mounting instructions are supplied with the adapters.

1.3.3 Safety Instructions

Caution

Caution
Before putting the instrument into operation, make sure that:

- *The covers of the housing are in place and screwed on*
- *Vents are not obstructed. Make sure that the air can escape freely through the vents at the rear and at the sides. The minimum distance to the wall should therefore be at least 10 cm.*
- *No signal voltage levels above the permissible limits are applied to the inputs*
- *The outputs of the instrument are not overloaded or wrongly connected*
- *The instrument should only be operated in horizontal position on an even surface*
- *The ambient temperature must not exceed the range specified in the data sheet*

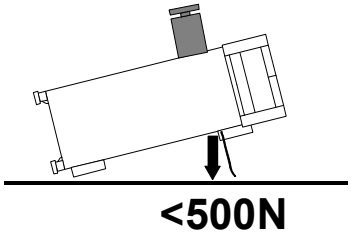
Any non-compliance with these precautions may cause the instrument to be damaged.

1.3.3.1 Safety Precautions against Electrostatic Discharge

To avoid damaging the electronic components of the EUT due to electrostatics produced by contact, the use of appropriate protective measures is recommended.

1.3.3.2 Installing the Instrument

Warning!
The feet must be fully folded in or fully folded out. Only then can a stable position of the instrument and reliable operation be ensured. The uniform pressure on the folded-out feet must not exceed 500 N (weight of instrument and of equipment stacked on top). Stacked instrumets must be secured against slipping (e.g. by locking the feet to the top of the front-panel frame).



When the instrument is shifted with the feet out, the feet might fold in. To avoid injuries, do not shift the instrument when the feet are out.

1.3.3.3 EMC Safety Precautions

To avoid electromagnetic interference, use only well-shielded signal cables and control cables. Any supplementary USB cables used must be type USB 2.0 with continuous shielding (like the USB cables supplied).

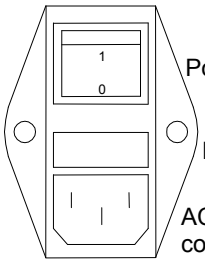
1.3.4 Connecting the R&S IMS to the AC Supply

The R&S IMS is automatically matched to the applied AC voltage (see rear panel). There is no need to set the voltage manually or change fuses. The AC supply connector is at the rear of the unit (see below).

Note:

Before connecting the PC to the R&S IMS via the USB interface, it is essential to make sure that all USB drivers for the R&S IMS application have been installed.

1.3.5 Switching On the R&S IMS

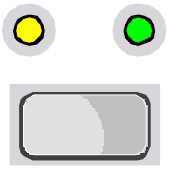


- Connect the Integrated Measurement System to the AC supply by means of the supplied power cable.

  Since the instrument is in compliance with safety class EN61010-1, it should only be connected to a socket with a protective ground contact.

- Press the main power switch on the rear panel of the instrument to position I.

  After power-up the instrument is either ready for operation (STBY) or in operating mode, depending on the position of the ON/STBY switch on the instrument front panel (see below).



- If the R&S IMS is on STBY after power-up, the yellow LED lights up.

The USB hub and the INTERLOCK are active.

Note: ***All USB devices can be addressed from the PC during STBY mode except the generator, the option R&S IMS-B1 analyzer and the switch unit.***

- Press the ON/STBY switch on the front panel; the green LED must be light up.

  The instrument is ready for operation. All modules in the instrument are supplied with power.

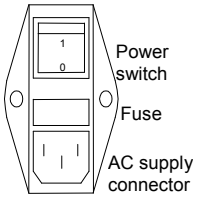
1.3.6 Power-up Actions of the R&S IMS

Since there is no built-in controller in the R&S IMS, there is no boot**. The instrument can only be operated with the aid of a PC having a USB remote control interface and R&S IMS software. The iKey for this software is plugged into the instrument and is detected by the R&S IMS software when there is a USB connection between the R&S IMS and the PC.**
If a powered up R&S IMS is connected to a booted PC via the USB interface, the USB hubs in the R&S IMS are activated and this is indicated by an audible signal on the PC.
The active USB interfaces can be checked from the PC with the aid of the menu sequence Start\Settings\Control Panel\System\Device Manager\USB Controllers.

Note: ***Before starting the R&S EMC32 software the R&S IMS should be switched to the ON mode and then connected to the booted PC via USB cable so that Windows can activate the USB drivers. The R&S EMC32 software should not be started until then.***

1.3.7 Switching Off

Note: ***Before switching off the R&S IMS the R&S EMC32 application should be closed and the USB cable should be disconnected from the PC. Only when this has been done, the R&S IMS should be switched to STBY mode or entirely disconnected from the AC supply by means of the main power switch.***



➢ Press the ON/STBY switch on the front panel for at least 2 seconds.

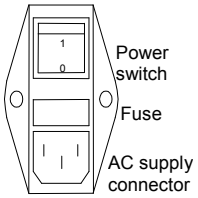
The AC supply switches to the STBY mode.
The USB hub and the INTERLOCK circuit are supplied with operating voltage via power supply unit 2 only.

The yellow LED 1 must be on.

Warning:

The AC supply is still connected to the instrument in STBY mode.

To disconnect the instrument completely from the AC supply:



➢ Press the main power switch at the rear of the instrument to position 0. None of the front-panel LEDs should be on.

1.4 Function Checks

The Integrated Measurement System R&S IMS automatically monitors the operating voltages in the instrument and indicates an undershoot or overshoot of the voltage tolerance thresholds by switching POWER LED 4 to red.

Moreover in the event of an error when starting the software and/or starting a test, the software displays an error message.

No further function checks or error displays are available.

1.5 Connecting the Power Sensor

Up to three R&S NRP-Z91 power sensors with USB interface can be connected to the R&S IMS.
The sensors are connected to a USB interface, type A, on the rear panel of the instrument.

Note: ***Before connecting an instrument to the PC via the USB interface, it is essential to make sure that the corresponding USB drivers have been installed.***

The sensors are detected automatically once they are connected. The sensor(s) then need only be physically enabled in the instrument configuration of the R&S EMC32 software by means of their serial numbers.

1.6 Connecting Amplifiers

Up to three amplifiers with USB interface, supplied by the Bonn company, can be connected to the R&S IMS. One of these amplifiers can be built into the R&S IMS in the case of model 04.

The amplifiers are connected to a USB interface on the rear panel of the instrument.

Note: ***Before connecting an instrument to the PC via the USB interface, it is essential to make sure that the corresponding USB drivers have been installed.***

The amplifiers are detected automatically once they are connected. The amplifiers then need only be physically enabled in the instrument configuration of the R&S EMC32 software by means of their serial numbers.

The RF cabling needs to be installed according to the block diagram and the caption on the back panel (see also chapter 6).

A connection from the "Interlock" 25 pin D-SUB connector on the R&S IMS to the respective 15 pin D-SUB connectors (Remote Control) on the amplifiers is also needed (see also chapter 6). The pin assignment is shown in the table below:

Name	**R&S IMS Interlock 25 pin D-Sub**	**Bonn PA1 Remote Control 15 pin D-Sub**	**Bonn PA2 Remote Control 15 pin D-Sub**	**Bonn PA3 Remote Control 15 pin D-Sub**
Interlock to PA1	8, 15	8, 15	—	—
Interlock to PA2	7, 14	—	8, 15	—
Interlock to PA3	6, 13	—	—	8, 15
Status RF IN PA1	5	2	—	—
Status RF IN PA2	9	—	2	—
Status RF IN PA3	17	—	—	2
General fault PA1	12	6	—	—
General fault PA2	4	—	6	—
General fault PA3	16	—	—	6
Interlock to test room door	1, 3	—	—	—
Test In Progress lamp	10, 11	—	—	—
Ground	2, 24, 25	7, 14	7, 14	7, 14

Table 1-2 Pin assignment on the connecting cable for external amplifiers from the Bonn company

1.7 Connecting EUT Monitoring

Caution:
The level on this interface must not exceed 0V / +5 V or the interface and the R&S IMS could be damaged.

An external monitor with a TTL interface can be connected to the MONITORING connector on the rear panel of the R&S IMS.

The connector interface is described in Chapter 6.2.

With four TTL inputs and four TTL outputs, the R&S IMS provides you with the ability to use the R&S EMC32 application to monitor an EUT during a test by observing the level on this interface.
In the event of an EUT NOGO, commands can be given to the item under test (e.g. Stimulus : Reset).

The "instrument" in the R&S EMC32 application for interacting with the EUT is called "DIO Monitoring" (see also chapter 5.3.5, Equipment Test with Coupling/Decoupling Network and EUT Monitoring).

1.8 Installing the Operating System

This section contains instructions for installing, updating and starting the R&S IMS operating system, which is based on the EMC32 software platform. It tells you about installation, software configuration, starting the program and troubleshooting.

If however you encounter any problems during installation, please contact the Rohde & Schwarz support line as follows:

Telephone: **+49 1805 124242**
Fax: **+49 1805 13777**
E-mail: **CustomerSupport@rsd.rohde-schwarz.com**

1.9 Registering the License

Before starting to use the EMC32 software, you should register with Rohde & Schwarz. By doing this you will be sure to receive support via our support line and regular information about the latest updates.

You can start registration from within EMC32 by calling the Help menu with the following sequence: ? → EMC32 on the Internet → Register now. To do this you must have connected your PC to the Internet.

Alternatively you can also open the registration form by using the Autostart program on the EMC32 CD and clicking on the Registration menu item.

To find your product ID go to the About EMC32 dialog which you can open via the Help menu. This information also appears in the opening dialog when you start EMC32. For your product ID to be displayed you must start the EMC32 software with the iKey supplied.

1.10 Installing the EMC32 Software

1.10.1 System Requirements

Before installing EMC32 you should make sure that your PC satisfies the following minimum system requirements:

- Windows XP operating system, SP2 or Microsoft Patch KB822603 installed
- Administrator rights
- PC with Pentium processor (2.4 GHz) or comparable
- 256 MB RAM (512 MB RAM recommended)
- 200 MB of available hard disk space
- Super VGA monitor, minimum screen resolution 1024 x 768 pixels, 65536 colors, higher resolution recommended
- Free USB port

There is no guarantee that the product will operate correctly unless all the above minimum system requirements are met.

1.10.2 Data Security and User Administration

For the sake of software data security the protective functions of the operating system listed in the system requirements must be used. The user administration built into EMC32 is not provided for the purpose of data security, but to ensure that "standard users" cannot change important settings within EMC32.

Note:

*System Administrators are strongly recommended to read the PDF document "**Data Security and User Administration"** in the* Documentation *folder on the CD before starting installation.*

1.10.3 Simplified User Administration

If the EMC system is to be operated by only a few users with a comparable level of knowledge, it may not be necessary to implement the security functions available in the operating system. In such a case it is up to the system owner to decide whether a logon and user list are necessary and whether the test data for the various users need be stored in different folders.

Details of the necessary settings can be found in the online help, chapter "**Data Security and User Administration"**.

1.11 Installing the Software

Note:

If a version of EMC32 is already installed, it must be uninstalled first. Please also comply with the explanations in the chapters "Update der EMC32" and "Deinstallation der EMC32".

1.11.1 Installing the R&S IMS Operating System

The information needed to carry out the installation and related procedures for EMC32 is provided via the **Autostart program** on the EMC32 CD-ROM. By the time you have completed the following steps the software will have been installed on your PC and will be ready to run.

Starting installation:

1. Shut down any other programs you are running.
2. Put the **EMC32 CD** into your CD-ROM drive. If the Autostart function on your system is enabled, the installation program starts automatically and you can skip steps 3 and 4.
3. Select **Run** from the **Start** menu.
4. Enter **D:\HTMLVIEW.EXE** (replace **D:** with the letter appropriate to your CD-ROM drive if different).
5. Click on the **Install IMS OS Software** button and follow the instructions on the screen.
6. When asked to choose the product, select **IMS OS Software**.

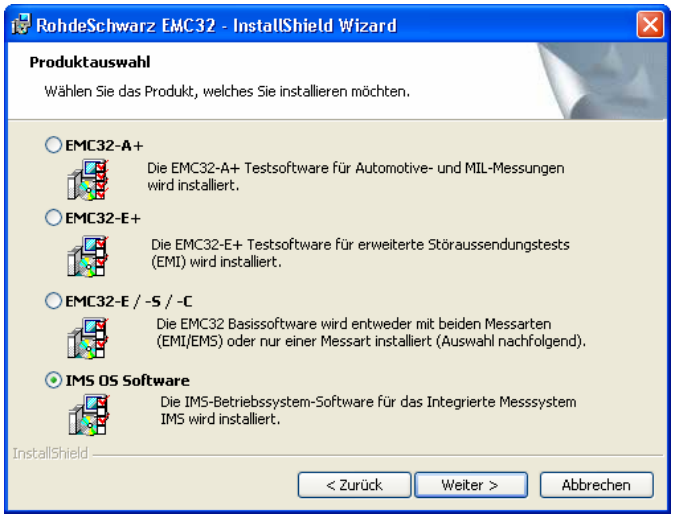


Fig. 1-4 Choosing the product in the installation program

7. In the next dialog the option R&S IMS Operating System Software is active. You can change the installation folder if you wish.

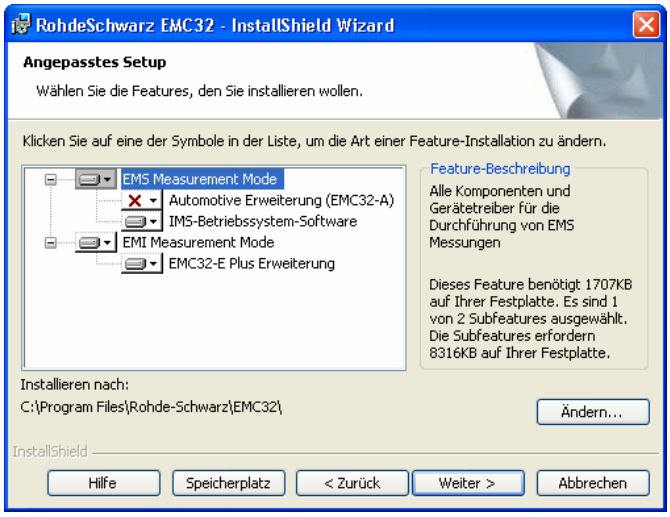


Fig. 1-5 Choosing the installation path in the installation program

8. Alternatively you can start the installation process by entering **D:\SETUP.EXE** (replace **D:** with the letter appropriate to your CD-ROM drive if different).

Note:

It is not possible to install more than one instance of EMC32 on a PC.

1.11.2 Installing USB Device Drivers

The next step is used for installing all the necessary USB Windows device drivers. This step is not necessary when installing a demo version without hardware.

Note:

Do not plug in the R&S IMS before you have installed the USB Windows device drivers and when requested to do so in the subsequent instructions.

The installation procedure can be run either via the **Autostart program** on the EMC32 CD-ROM or manually via the steps listed below.

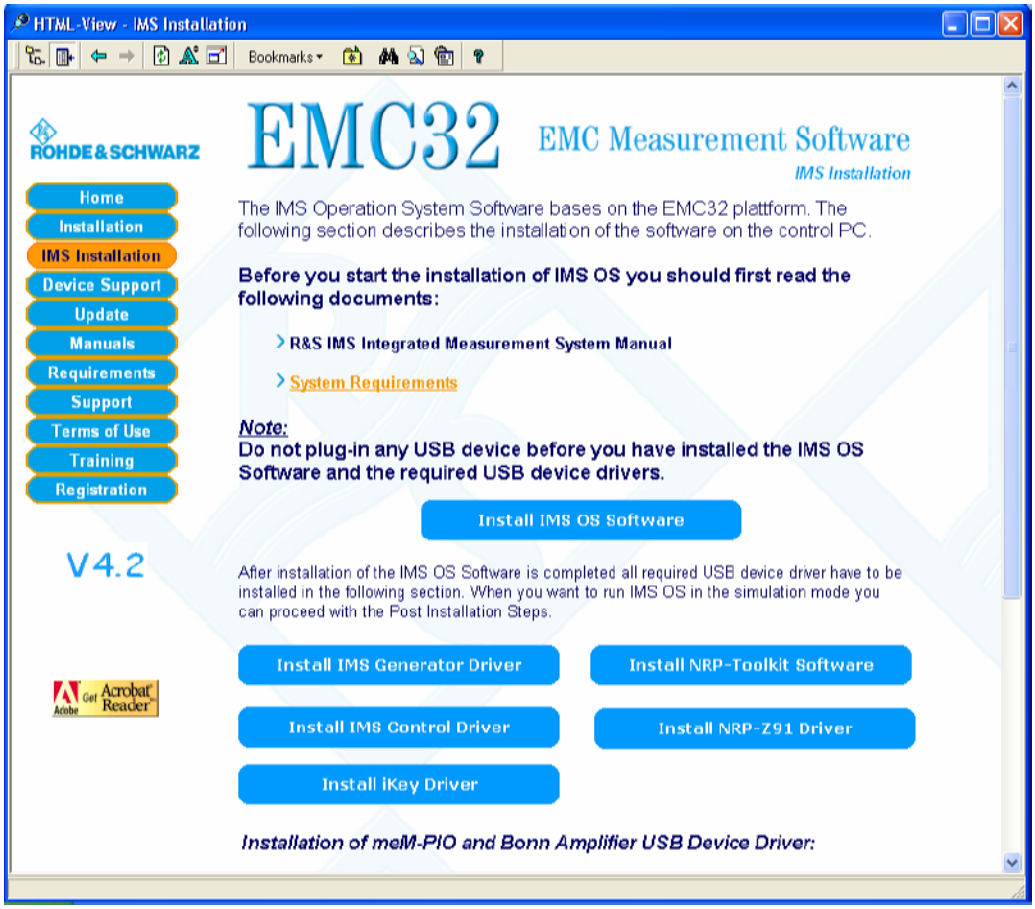


Fig. 1-6 Instructions for installing the USB drivers via the Autostart program

The following steps show you how to install the device drivers required for the R&S IMS. All such drivers are on the EMC32 CD-ROM.

Driver for R&S IMS generator module:

1. Start the program "*D:\SystemDrivers\SM300\rssism_vxipnp_1_4.exe*", replacing "D:" with the letter appropriate to your CD-ROM drive if different.
2. Follow the instructions of the installation routine.

Driver for NRP-Z91 RF sensor:

The installation for the NRP-Z91 RF sensor consists of two installation procedures:

1. Start the program "*D:\SystemDrivers\NRP-Zxx\Toolkit\Setup.exe*", replacing "D:" with the letter appropriate to your CD-ROM drive if different.
2. Follow the instructions of the installation routine.
3. Start the program "*D:\SystemDrivers\NRP-Zxx\ rsnrpz_vxipnp_1_18.exe*", replacing "D:" with the letter appropriate to your CD-ROM drive if different.
4. Follow the instructions of the installation routine.

Driver for the meM-PIO I/O module:

1. Start the program "*D:\SystemDrivers\MemPio\mem-actx-3.4.148.exe*", replacing "D:" with the letter appropriate to your CD-ROM drive if different.
2. Follow the instructions of the installation routine.
3. Now plug the R&S IMS into the system process controller and switch on the instrument at the mains switch on the rear panel.
4. The Windows utility for detecting new USB devices should now start automatically and report that it has found a new device of the "meM-PIO (USB Interface)" type.
5. At this point select Installation from a known source.
6. In the dialog that opens next, either select Find CD-ROM or choose the following path as the folder: "*D:\SystemDrivers\MemPio*", replacing "D:" with the letter appropriate to your CD-ROM drive if different.
7. If you continue the driver will be installed and you should receive a Windows message telling you that the driver has been successfully installed.

Driver for the Bonn USB amplifier remote control (for R&S IMS with integrated amplifier module or external Bonn amplifier only):

1. Now plug the R&S IMS into the system process controller and switch on the instrument at the mains switch on the rear panel if you have not already done so in the previous step.
2. The Windows utility for detecting new USB devices should now start automatically and report that it has found a new device of the "Bonn BSA 0125-25I" type.
3. At this point select Installation from a known source.
4. In the dialog that opens next, either select Find CD-ROM or choose the following path as the folder: "*D:\SystemDrivers\BonnUsb*", replacing "D:" with the letter appropriate to your CD-ROM drive if different.
5. If you continue the driver will be installed and you should receive a Windows message telling you that the driver has been successfully installed.

Driver for iKey software protection

The EMC32 software is protected by a hardware key called **iKey**. This is integrated into the R&S IMS and contains the software license information. In order for EMC32 to work with the R&S IMS, the USB driver must previously have been installed.

1. Start the program "*D:\i_Key\IKeyall.exe*", replacing "D:" with the letter appropriate to your CD-ROM drive if different.
2. Follow the instructions of the installation routine (when the installation program prompts you to connect the iKey, acknowledge the message. Restart the PC after quitting the installation).

To check that the software is working correctly proceed as follows:

After restarting, a utility program "**iKey Token Utility**" appears in the task bar and can be used to test whether the iKey has been recognized. Double-clicking on this icon starts the program and the dialog shown below appears. If the *serial number* of the iKey is displayed, it has been correctly recognized.

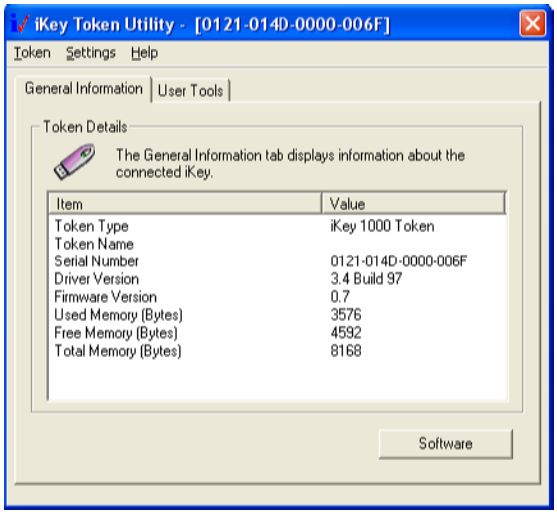


Fig. 1-7 Dialog for the iKey Token Utility program

1.12 Starting the Program

Following program installation you will find an EMC32 icon on your desktop. Double-click on this icon to start the software. You can of course also start the program via the Start button on the Windows desktop.

Starting the program via the Start button:

1. Click the **Start** button on your desktop.
2. Select **Programs – Rohde & Schwarz – EMC32 – EMC32**.

Changing the language in EMC32:

The language for the EMC32 software can be changed during runtime, but the change only takes effect when the application is restarted. You can change the current language in the dialog for that purpose by choosing ***Extras → Language...*** menu.

1.13 EMC32 - IMS Configuration

Before you carry out a measurement with the R&S IMS, you have to adapt the software to your system. This means you must tell the EMC32 software which instruments are present in your system, which interfaces are used to address them, how the instruments are interconnected and how it is intended that the measurements obtained via these instruments shall be carried out.

For this purpose the EMC32 software includes a wizard (**Configuration wizard**), which prompts you for the required measurement modes (radiated/conducted) and the measuring instruments in your system, and then uses this information to create a standard configuration for the system. Correction tables and test templates are also copied to the appropriate folders, so that after this step the EMC32 software is ready for the start of the first **demo measurement**.

Before you start your first real test equipment measurement, the corresponding calibration data for the antennas or transducers and for the signal paths must be entered or calibrated (for more details see also the chapter on system calibration in the online help).

For more detailed notes on operating the configuration wizard please refer to chapter 6 "Messbeispiele".

1.14 Updating the EMC32 Software

Please follow the advice in the notes below when updating the software:
When you update, the EMC32 system data and test results stay intact – the update affects only the program files (it is not necessary to uninstall). All the same, for safety's sake we recommend that you take a copy of all the test and calibration data that you have saved to the EMC32 folder. Use the Backup function in the File menu to create a copy of the **SYSTEM, TESTS** and **CONFIGURATION** folders in another location on your hard disk (such as in your ***My Documents*** folder), before carrying out the EMC32 update.

To update the EMC32 software proceed as follows (unless you receive different instructions with the update):

1. Shut down any other programs that are running.
2. Put the **EMC32 CD** into your CD-ROM drive. If the Autostart function on your system is enabled, the installation program starts automatically and you can skip steps 3 and 4.
3. Select **Run** from the **Start** menu.
4. Enter **D:\HTMLVIEW.EXE** (replace **D:** with the letter appropriate to your CD-ROM drive if different).
5. Click on the **Update EMC32 Software** button and follow the instructions on the screen. If you wish to install a measurement mode that you have not installed before at the same time as the update, enable it in the installation program dialog (see chapter Installing the EMC32 software).
6. Do **not** start the configuration wizard after successfully updating.
7. It is not necessary to uninstall and reinstall the iKey software.

1.15 Uninstalling the EMC32 Software

To uninstall the EMC32 software proceed as follows:

1. From the **Start** menu select **Settings – Control Panel**.
2. Double-click on the **Software** icon**.**
3. Click on **Add/Remove Programs**.
4. From the list of programs which you can uninstall, select **Rohde & Schwarz EMC32**.
5. Click on **Remove**.
6. The Windows Installer dialog now opens. Select **Remove** and confirm that you want to remove the EMC32 application (insert the EMC32 CD if the PC prompts you for it or click the **Cancel** button).

   The uninstall program then deletes all program entries, folders and Registration database entries created during installation.
7. Once the files are deleted, you receive a message saying that the installation process is complete. Click **OK**.
8. Use Windows Explorer to delete the Rohde-Schwarz folder from the Program Files folder.

To uninstall the USB Windows drivers proceed as follows:

1. First close the **iKey Token Utility** program if it is active in the taskbar. 
2. From the **Start** menu select **Settings – Control Panel**.
3. Double-click on the **Software** icon**.**
4. Click on **Add/Remove Programs**.
5. If necessary remove the iKey and the R&S IMS from the USB port.
6. From the list of programs which you can uninstall, select **Rainbow iKey Components**. Click on **Remove**.
7. From the list of programs which you can uninstall, select **Rainbow iKey Driver**. Click on **Remove**.
8. From the list of programs which you can uninstall, select **Bonn USB Drivers**. Click on **Remove**.
9. From the list of programs which you can uninstall, select **NRP Toolkit**. Click on **Remove**.
10. From the list of programs which you can uninstall, select **Rohde & Schwarz, NRP-Z Driver**. Click on **Remove**.
11. From the list of programs which you can uninstall, select **Rohde & Schwarz, RSSISM Driver**. Click on **Remove**.

1.16 Network Installation Tips

The EMC32 application should normally be held in the Program Files folder on the Local Disk in Windows. However, system data such as measurement results, configuration and correction tables may be stored on a network server. If this is the case, make sure that a suitable network speed is installed, otherwise performance problems may occur when operating the EMC32 application.

First install the EMC32 software on the local disk as normal (you must have administrator rights). You can then change the paths for the EMC32 folder structure. For more detailed information please refer to the chapter **OPTIONS – File locations** in the **EMC32 online help**.

As a precondition you must have the necessary read/write access rights for the corresponding network drive.
If you are uncertain about any of the possible settings involved, please contact your network administrator for help with installing the EMC32 application.

1.17 Data Backup Instructions

It is recommended that measurement data and the system configuration should be backed up at regular intervals. When this is done, all selected EMC32 files are written to a compressed file in ZIP format.

Use **File >> Backup/Restore ...** to open the dialog for carrying out a backup or for restoring your files. The following functions can be selected:

- Select mode: Backup / Restore
- Select the EMC32 objects you want to back up or restore:
  System folder
  Tests folder
  Configuration files
- Select the output ZIP file
- Select a temporary folder for the backup / restore procedure.

For more detailed information please refer to the chapter "Backing up or restoring data and configuration" in the EMC32 online help.

Caution:
The target folder for the ZIP file and the temporary folder must both have enough available disk space.

Caution:

You can of course also archive (or move) individual files or complete tests from these folders. You should be aware, however, that the EMC32 application will then no longer be able to access these files or tests. Moving important calibration data or configuration files can also make it impossible to open or run a test. For further information on the EMC32 file structure please refer to the appropriate section of the online help.

1.18 Troubleshooting

Problems may occasionally occur during installation. Here are some troubleshooting tips to help you solve the commonest situations. If you have any further questions, please contact Rohde & Schwarz Support or look through the Readme file.

- Before starting to install the application you should close all programs, particularly virus protection programs. Virus protection programs normally have little or no effect on the installation process. However, if such software is running and you experience problems when installing the EMC32 application, you should close the virus protection program and run the installation again.
- If in the course of installation you receive a message telling you that a Windows DLL is in use and therefore cannot be updated, press OK to confirm so that the installation will continue. Normally this does not cause any problems.
- Delete all files from your temporary folder. (This folder is defined by the environment variable TEMP, which normally has the value C:\TEMP or C:\WINDOWS\TEMP.)
- Run a disk checking program on your hard drive. Hard drive faults can cause problems during the installation process. (Some Microsoft Windows systems include a utility program called ScanDisk. If you have any queries about disk checking programs, please contact your system administrator.)
- Copy the EMC32 installation CD to your hard disk and start SETUP.EXE from there.
- Check that you have enough free space available on your hard disk. (The installation process will tell you if there is not enough available disk space when you start of the installation procedure.)
- In the Regional Options under the Numbers and Currency tabs always use "." rather than "," as the decimal separator. Do not use the symbol "," in groups of numbers (use a blank character instead).

2 Manual Operation

2.1 Manual Operation

The Integrated Measurement System R&S IMS has no means of entering settings on the front panel. All settings must be entered by means of the operating system software, since there is no built-in intelligence.
However, the software can be used to operate the individual modules "manually".

1. Connect the PC and the R&S IMS by means of USB cable
2. Start the R&S EMC32 software on the PC
3. Call *Selftest* from the EXTRAS menu
4. Click the *Test All* button → All the instruments in the system are physically enabled
5. Double click on the required instrument
6. Select the Test tab
7. The predefined settings or switch commands can now be selected. Then click on the fields labeled
   Button
   Setting
   Run
   Analyze
   to run them.

Note: *Only one instrument dialog can be opened at a time. To open another dialog the first dialog must be closed.*

3 Instrument Functions

3.1 Introduction

This chapter describes the individual function blocks of the R&S IMS, using the names given in block diagram 1502.0009.01 S BI 1+2 or circuit diagram.

3.2 Instrument Functions

The Integrated Measurement System R&S IMS is a complete EMS test system for acceptance tests to civil, military and automotive standards from 9 kHz to 3 GHz.

It offers the following functions in a 4 HU 19" instrument:

- Signal source
- Signal change
- Power measurement
- Controlling and switching up to three amplifiers including interlock
- R&S IMS operating system: Fully compliant test software for EMS and EMI measurements
- Integrated amplifier
- Spectrum analyzer

In addition the R&S ESCI and R&S ESPI receivers are both supported for EMI measurements.

Furthermore the following modules are housed in the R&S IMS for the purpose of internal communication between these function blocks:

a USB hub with 13 USB outputs (8 external, 5 internal)
an I^2C control module for switching the relay
a voltage monitoring module on the front panel for nine operating voltages
a USB/TTL interface chip (memPIO) for three 8-bit TTL IN/OUT ports

The eight external USB outputs are provided for: 3 x amplifiers, 3 x R&S R&S NRP-Z91, iKey dongle, reserve
The five internal USB outputs are provided for: generator, analyzer, power supply unit, iKey dongle, memPIO.

R&S IMS

Signal generation

The generator is built into the R&S IMS as an A4 module. There is also a matched A5 power supply unit. Both modules are remotely controlled by means of an internal USB interface. Analog modulation types AM, FM, PH and pulse are available from the generator module. A built-in LF generator provides the modulation frequencies, but can also deliver its signal externally.
With the R&S IMS-B3 option (generator interlock relay) a 50 Ohm termination can be applied in the RF line to the RF switching unit in place of the generator signal in the event of an open interlock circuit.

Power measurement

The R&S NRP-Z91 power sensor is used for measuring forward power and reflected power as well as for monitoring the injected current (BCI) for example. The system can be switched between forward power, reflected power and monitoring via a fast and wear-free K4 PIN diode switch.
As an option, additional power sensors can be used (option R&S IMS-B7 required).
The power sensor(s) are connected externally to the USB outputs via the R&S NRP-Z4 adapter cable.

Spectrum analyzer

Frequency-selective power measurement is available with the optional R&S IMS-B1 spectrum analyzer. For example the harmonic components of the amplifier can be observed at the 1 dB compression point. A further application is current monitoring for the BCI method in the automotive area (checking the first five harmonics). Remote control of the analyzer module uses an internal USB port. The generator power supply unit also provides the analyzer module with the necessary voltages.

RF switching unit

The RF switching unit together with relays K1 to K3 switches all R&S IMS RF paths over for up to three amplifiers. The remote control uses the generator power supply unit and the I^2 bus. All three relays are switched simultaneously with one command, so that only one amplifier with RF input, forward power and reflected power is ever connected to the R&S IMS.
The transfer relay (option R&S IMS-B2) can be used to switch two amplifier outputs to two different transducers (e.g. antennas, current clamps) or connection points (e.g. in anechoic chambers and shielded enclosures).

Internal amplifier module (R&S IMS, model 04)

An internal amplifier module (R&S IMS model 04) with a frequency range of 9 kHz to 250 MHz is available for conducted measurements. The amplifier power of 25 W (CW lin) enables measurements to be taken with coupling/decoupling networks (CDN) at 10 V test voltage to EN 61000-4-6.
The amplifier operates independently, has its own power supply unit and is remotely controlled via an external USB port.

External amplifiers

Amplifiers with authorized USB control (e.g. from Bonn Elektronik GmbH) can be integrated into the system with the aid of exactly the same connections as the internal amplifier. Other amplifiers can be controlled by using the GPIB upgrade (option R&S IMS-B4). A total of three amplifiers can be controlled and switched.

Interlock
The R&S IMS operating system supports the monitoring of an interlock circuit for checking safety functions during EMS measurement, such as door contacts and amplifier status. A K6 relay in the R&S IMS is set by means of a short-circuit-proof +12V supply via a door contact. This relay in turn activates the R&S IMS-B3 option (generator interlock relay), releases the amplifier and issues a message to the R&S EMC32 operating system.

Test-in-progress relay
At the start of a test a K7 test-in-progress relay closes a floating relay contact which can be made to switch on say an illuminated sign on the test room door.

EUT monitoring
The R&S IMS has four digital inputs (D8 memPIO) for monitoring the EUT during an EMC test. These inputs can be polled individually or as a group. Four digital outputs are provided for EUT stimulus (static values or pulse signal).

USB hub
The USB hub is provided by means of the 4 port USB hub modules D9, D11, D12, D13 and the current monitoring modules D14, D15, D16. The current monitoring modules limit the current on the USB interface to < 1 A. The USB ports are only activated when a connection exists to a USB host (PC).

Voltage monitoring
Voltage monitoring for the nine operating voltages used in the system is built into the LED board on the front panel. A +/- tolerance threshold for each voltage is provided via OPs. This tolerance is used in continuous monitoring and if the voltage value goes above or below this value the "POWER" LED on the front panel turns red. At the same time a status message is sent to the operating system via D8 (memPIO) and is output during initialization and at the start of a test.

Upgrade for EMI measurements
Rohde & Schwarz test receivers R&S ESCI and R&S ESPI are supported for EMI measurements. A GPIB interface is required for this purpose (R&S TS-PIEC2). Other test receivers and spectrum analyzers can be integrated with the aid of the R&S IMS-B4 option (which upgrades the R&S IMS operating system to R&S EMC32-A+).

4 Applications

4.1 Introduction

The following chapter contains an overview of some possible examples of R&S IMS applications, listed according to various standards.
Starting from a basic configuration with R&S IMS model 02, hardware setups are shown and the additional components needed in order to operate them are listed.

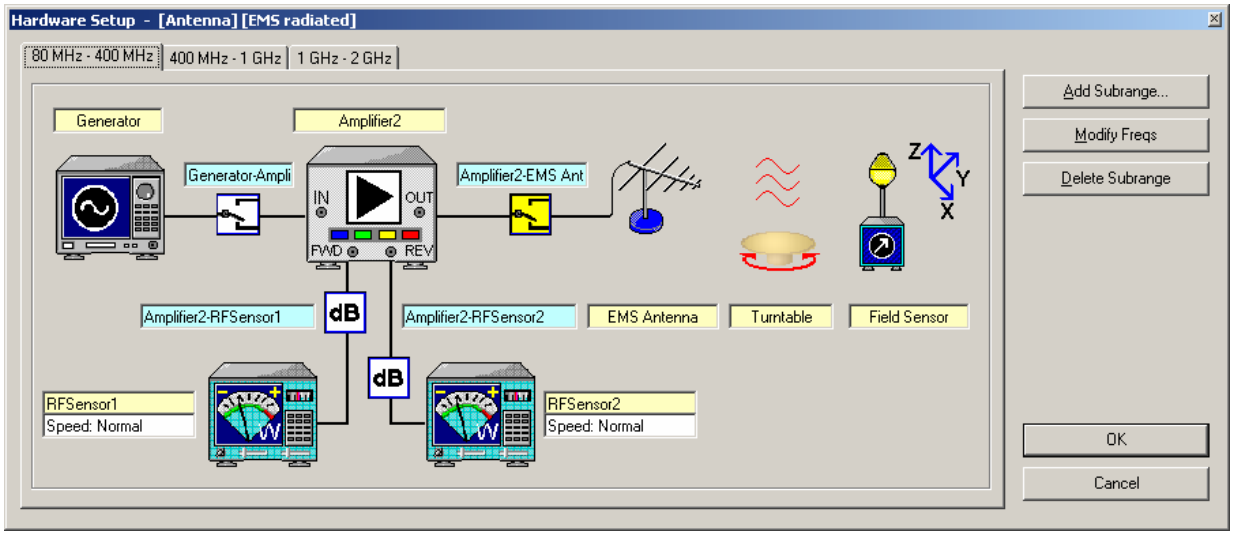
The R&S IMS model 02 without an internal amplifier has space in the empty amplifier compartment on the right for further expansion modules such as EUT monitoring.

4.2 Applications

R&S IMS basic configuration

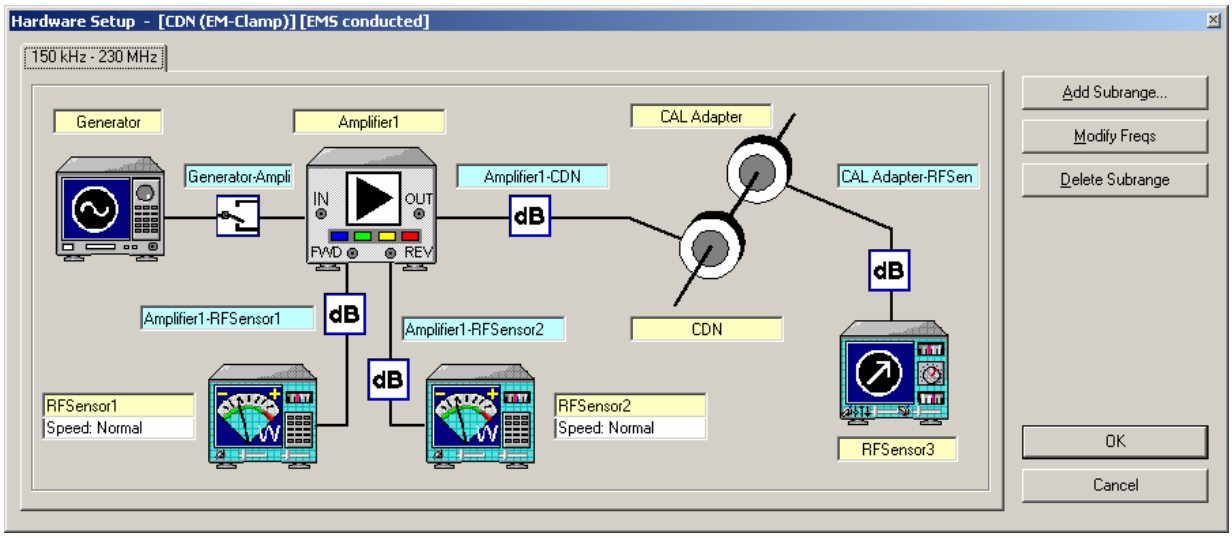
- Integrated EMC Measurement System R&S IMS model 02
- Power sensor R&S R&S NRP-Z91
- USB adapter R&S R&S NRP-Z4
- Process controller (PC)
- Cable set (USB and RF cables)

4.2.1 Commercial Standards



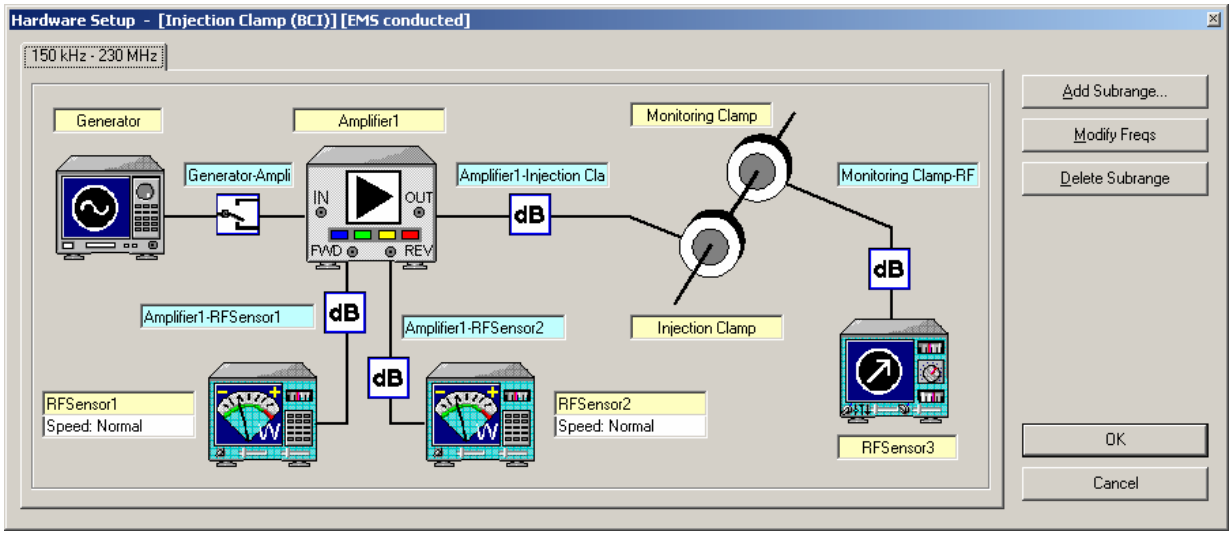
EN 61000-4-3: Radiated susceptibility in anechoic chamber, 80 MHz to 2 GHz, 10 V/m at 80 % AM

- R&S IMS basic configuration
- Antenna R&S HL046E
- Suitable amplifier
- Field-strength measurement system



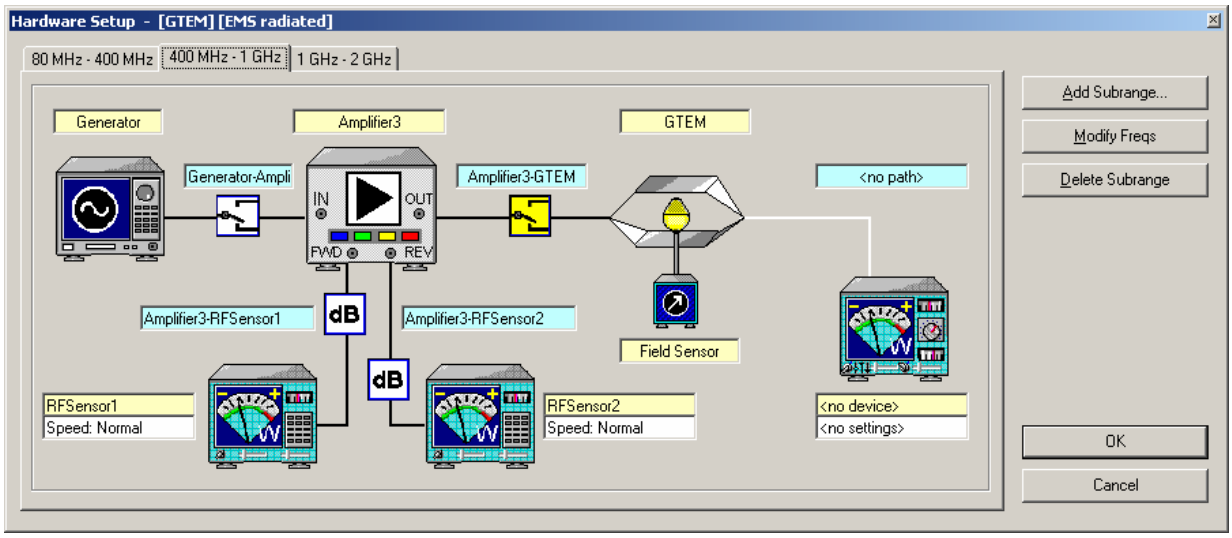
EN 61000-4-6: Conducted susceptibility with CDN, 150 kHz to 230 MHz, 10 V

- R&S IMS basic configuration with R&S IMS model 04 with internal amplifier 9 kHz to 250 MHz, 25 W
- CDN suited to the EUT



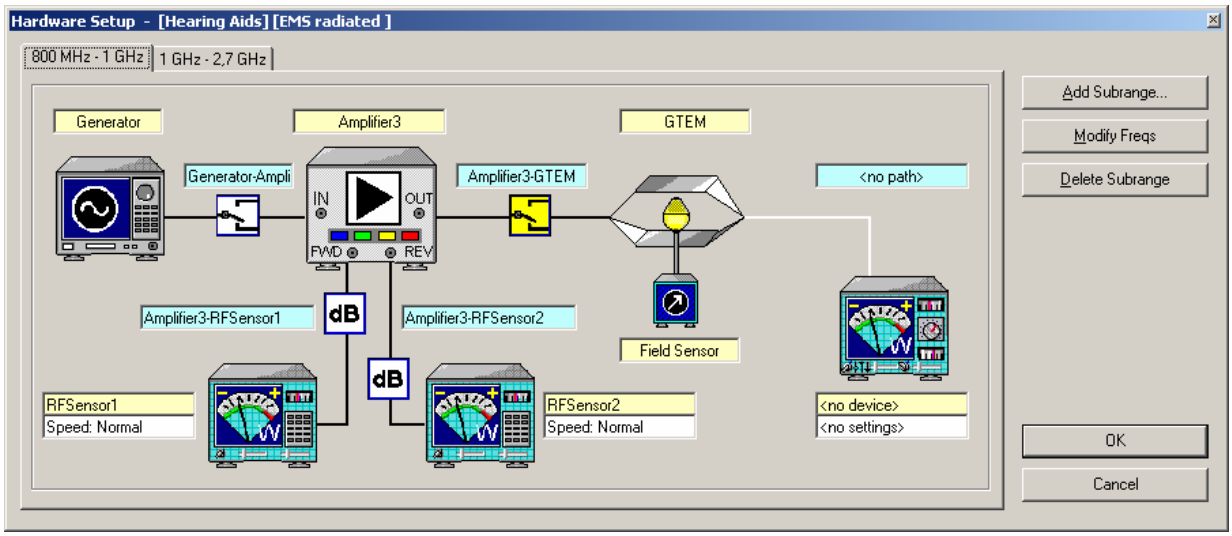
EN 61000-4-6: Conducted susceptibility with EM clamp, 150 kHz to 230 MHz, 10 V

- R&S IMS basic configuration
- EM clamp
- Suitable amplifier



EN 61000-4-20: Radiated susceptibility with GTEM cell, 80 MHz to 2 GHz, 10 V/m at 80 % AM

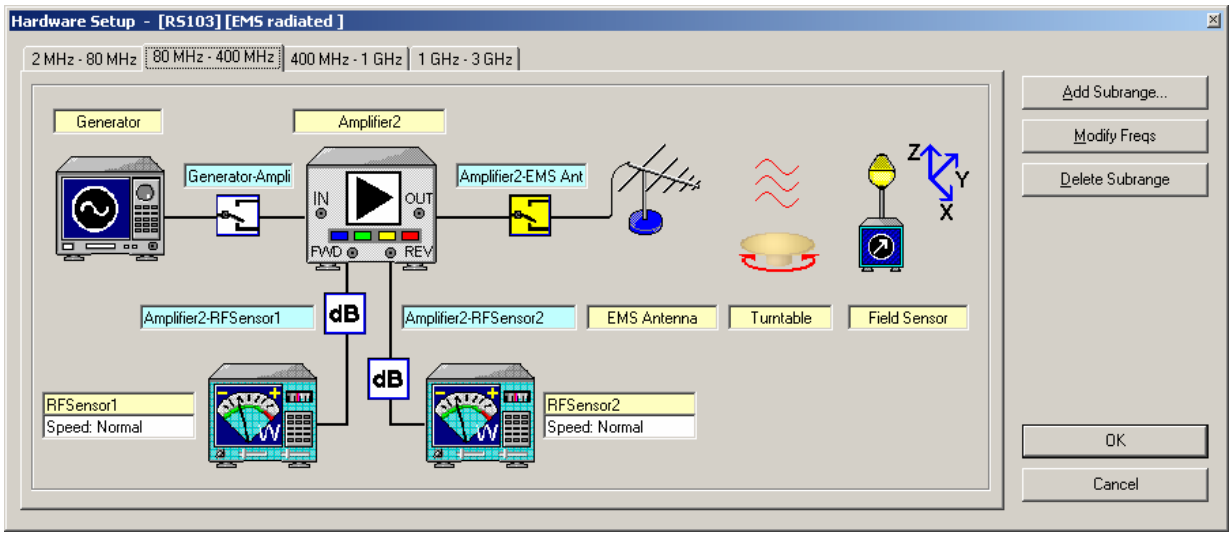
- R&S IMS basic configuration
- GTEM cell
- Suitable amplifier
- Field-strength measurement system



EN 60118-13: Susceptibility of hearing aids, frequency range 800 MHz to 2.7 GHz

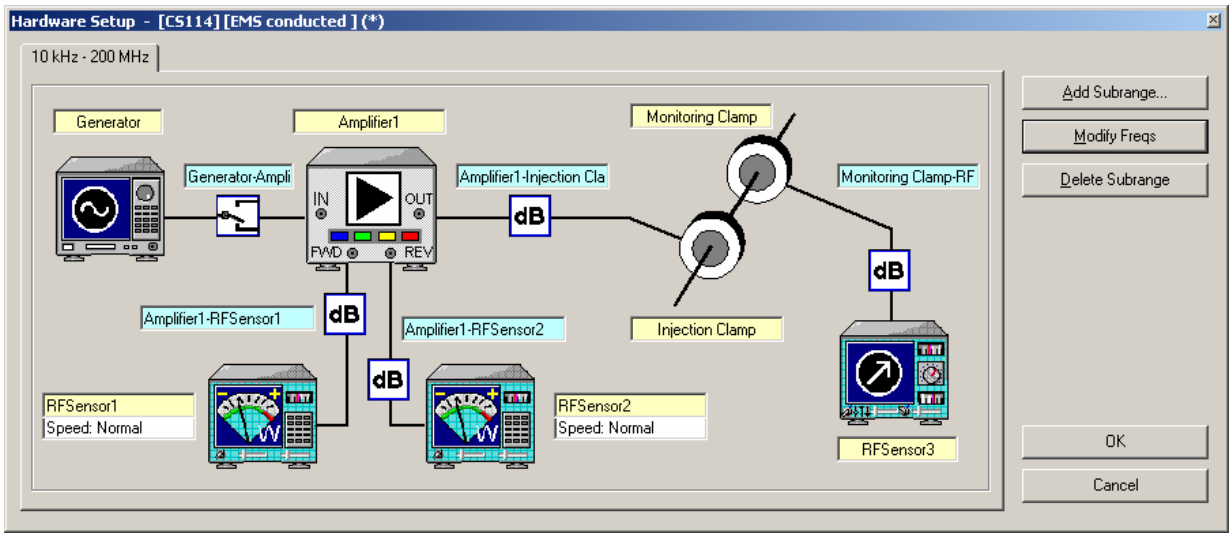
- R&S IMS basic configuration
- GTEM cell with EUT positioning device
- Suitable amplifier
- Audio analyzer R&S UPL
- R&S IMS-B4 upgrade to
  R&S EMC32-A+ incl. GPIB interface for USB
- Adapter
- Microphone

4.2.2 Military Standards



MIL 461E: Radiated susceptibility RS103, 2 MHz to 3 GHz

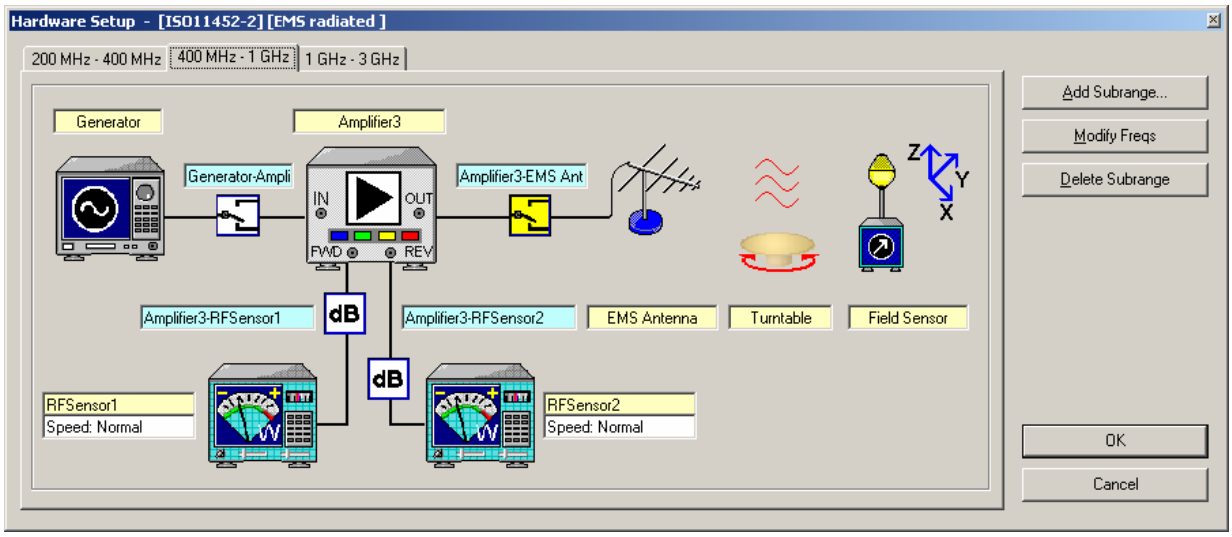
- R&S IMS basic configuration
- Suitable amplifier
- Antenna
- Field-strength measurement system



MIL 461E: Conducted susceptibility CS114 (bulk cable injection), 10 kHz to 200 MHz

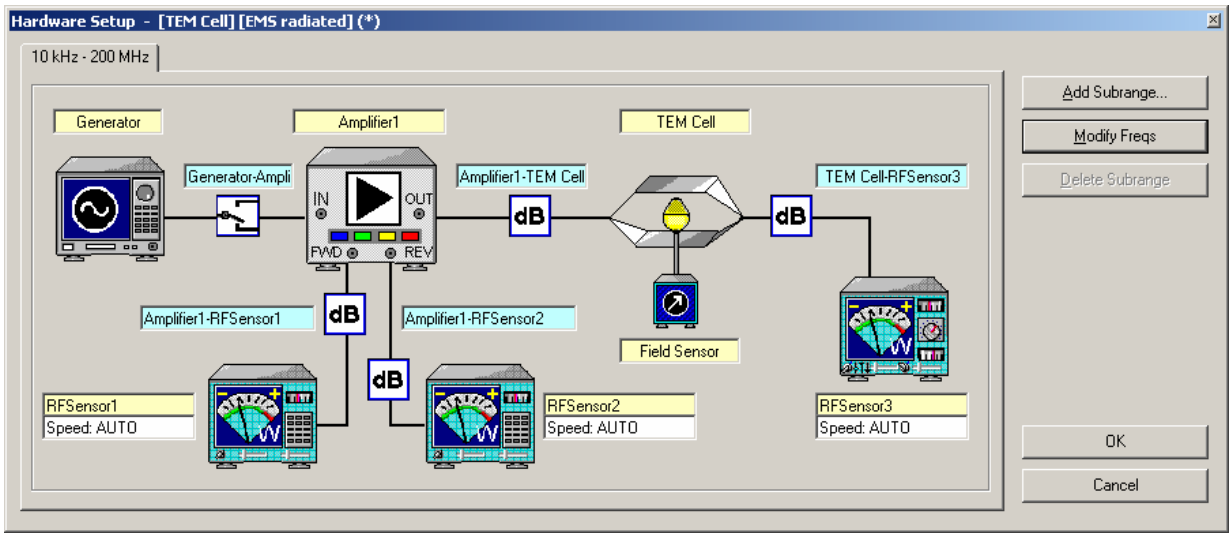
- R&S IMS basic configuration
- Suitable amplifier
- Coupling and monitoring current clamps

4.2.3 Automotive Standards



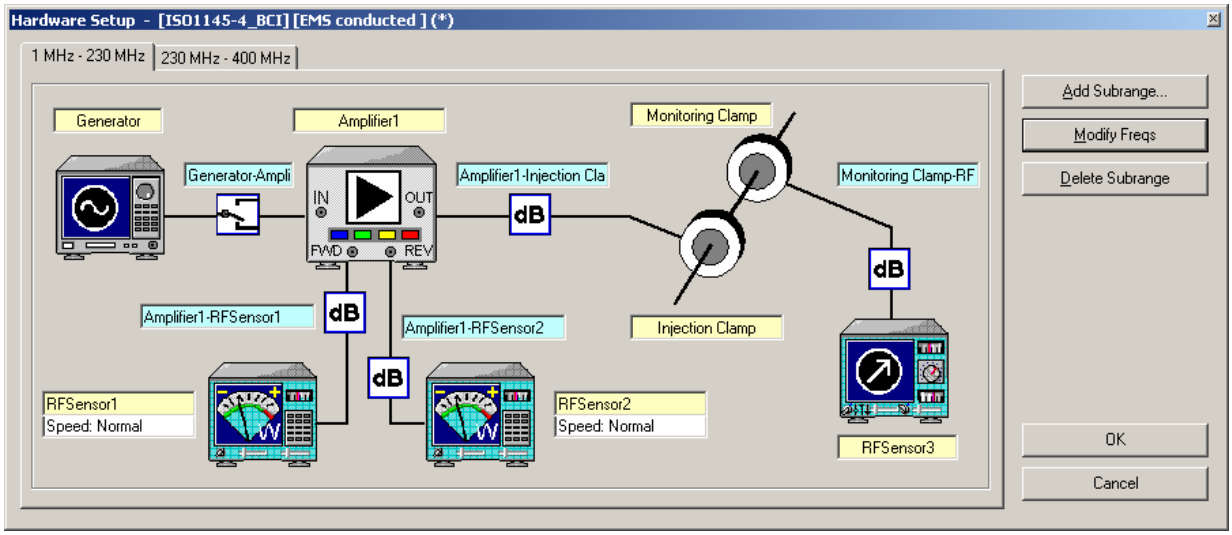
ISO 11452-2: Radiated susceptibility in anechoic chamber, 200 MHz to 3 GHz, 100 V/m

- R&S IMS basic configuration
- Antenna
- Suitable amplifier
- Field-strength measurement system



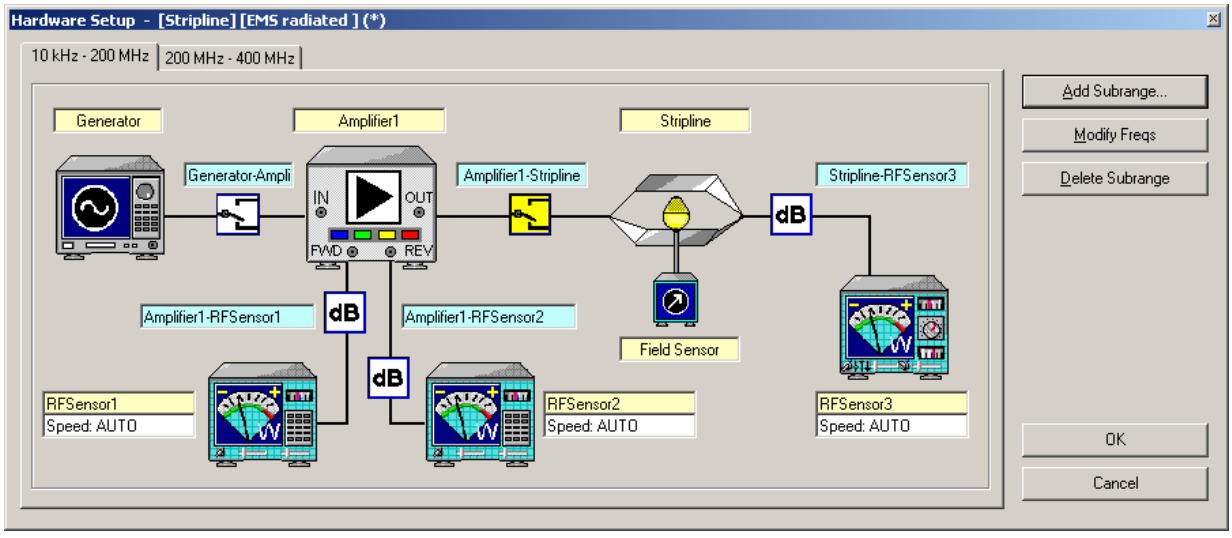
ISO 11452-3: Conducted susceptibility with TEM cell, 10 kHz to 200 MHz, 200 V/m

- R&S IMS basic configuration
- TEM cell
- Suitable amplifier
- Field-strength measurement system



ISO 11452-4: Conducted susceptibility with BCI method, 1 kHz to 400 MHz, 300 mA

- R&S IMS basic configuration
- Suitable amplifier
- Coupling and monitoring current clamps



ISO 11452-5: Radiated susceptibility with stripline, 10 kHz to 400 MHz, 200 V/m

- R&S IMS basic configuration
- Stripline
- Suitable amplifier
- Field-strength measurement system

5 Examples of Measurements

5.1 Introduction

This chapter describes the use of the R&S IMS for measuring immunity to electromagnetic interference according to different EMC standards. The following points are dealt with in respect of each standard:

- Test setup in the system
- Software configuration
- Calibrating signal paths
- Reference calibration procedure
- Performing equipment tests

Further details on configuration and on operating the EMC32 software (operating the editors and test control elements) can also be found in the EMC32 online help which you can open by clicking **?** on the Help menu. You will also find a reference to the EMC32 application note for the described standards together with additional detailed instructions.

5.2 Measurement to EN 61000-4-3 (Radiated)

This section describes the use of the R&S IMS for measurements to generic standard EN 61000-4-3.

5.2.1 Test Setup for External Dual Band Amplifiers

This application uses the R&S IMS with an external dual band amplifier covering a frequency range of 80 MHz to 1 GHz. The amplifier power is sufficient, when the log-periodic antenna is used, to carry out tests with a test level of 10 V/m at a distance of 3 m.
The illustration below shows how the system can be configured using few additional components:

- R&S NRP-Z91 RF sensor with NRP-Z4 USB adapter
- Dual band amplifier with internal input and output switching matrix
- Log-periodic antenna in the frequency range 80 MHz to 1 GHz
- Field probe with fiber-optic transmission and RS-232-C PC interface
- RF and USB cable set

System process controller with R&S IMS operating system (EMC32)

-

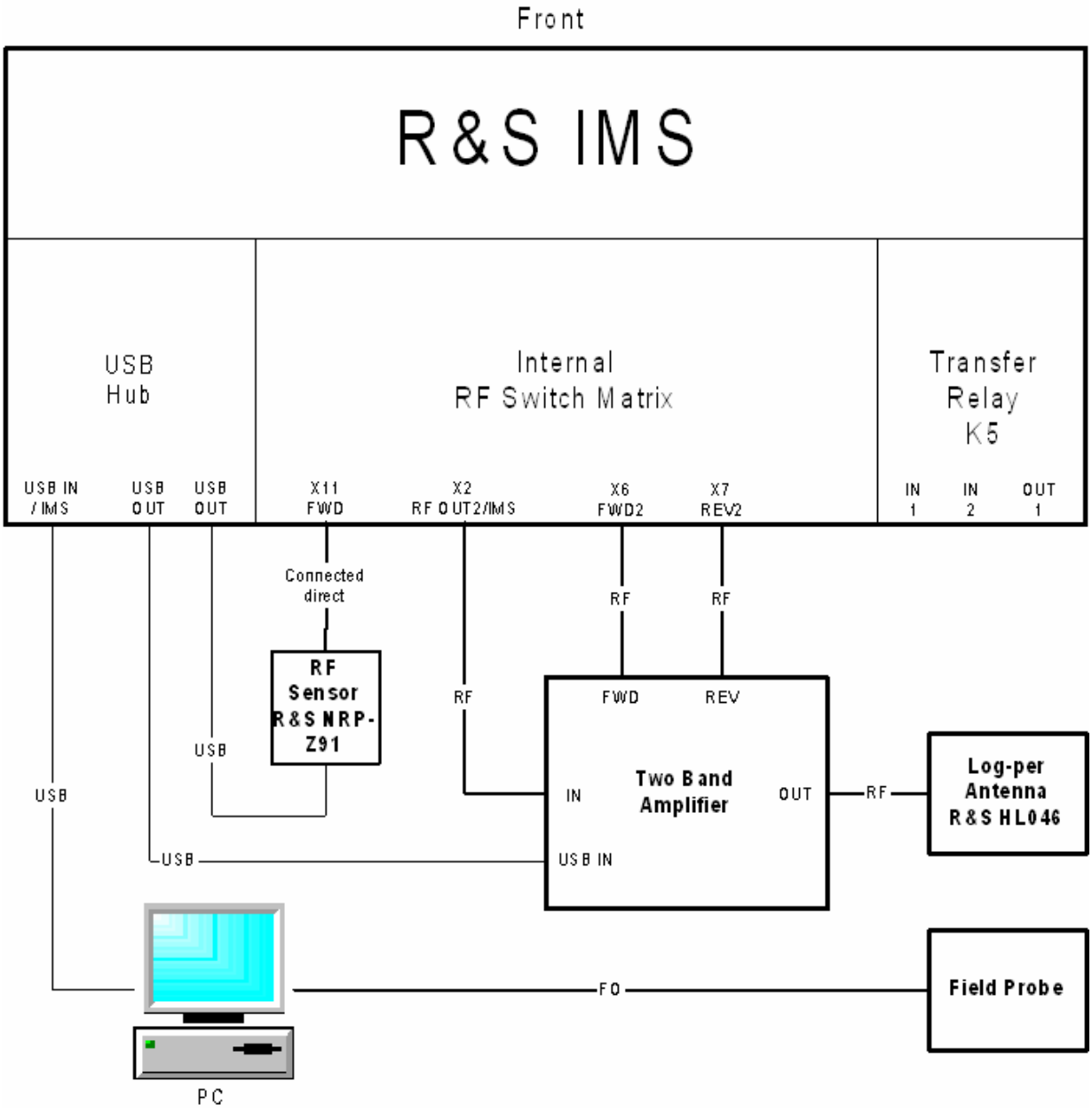


Fig. 5-1 Test setup to EN 61000-4-3 with a dual band amplifier in a single RF sensor configuration

The above figure shows the system setup for carrying out calibration and the subsequent test equipment measurement. The field probe is not needed for this, since the substitution method is used. Because of the PIN diode switch integrated in the R&S IMS, the system can be operated using **one** RF sensor. This switches the input for the forward RF power and the input for the reflected RF power to the RF sensor as appropriate.

5.2.2 Configuring the Software for Dual Band Amplifiers

In the first step after installing the EMC32 operating system software for the R&S IMS, you have to adapt the software to your system. This means you must tell the EMC32 software which instruments are present in your system, which interfaces are used to address them, how the instruments are interconnected and how it is intended that the measurements obtained via these instruments shall be carried out.
For this purpose the EMC32 software includes the **R&S IMS configuration wizard**, which prompts you for the instruments present in the system and then creates a standard configuration for the system. Correction tables and test templates are also copied to the appropriate folders.

To start the R&S IMS configuration wizard proceed as follows:

1. Start the EMC32 application.
2. If the opening dialog is enabled, you will see that it contains an icon that will open the wizard.

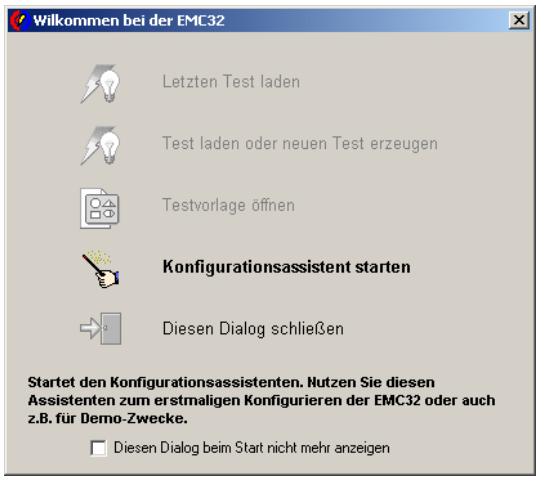


Fig. 5-2 Opening dialog for the EMC32 software

3. Otherwise open the wizard via the menu: **Extras – Wizard – IMS Configuration.**
4. The following dialog opens. Measurement class *EMS radiated* will be selected for EN 61000-4-3.

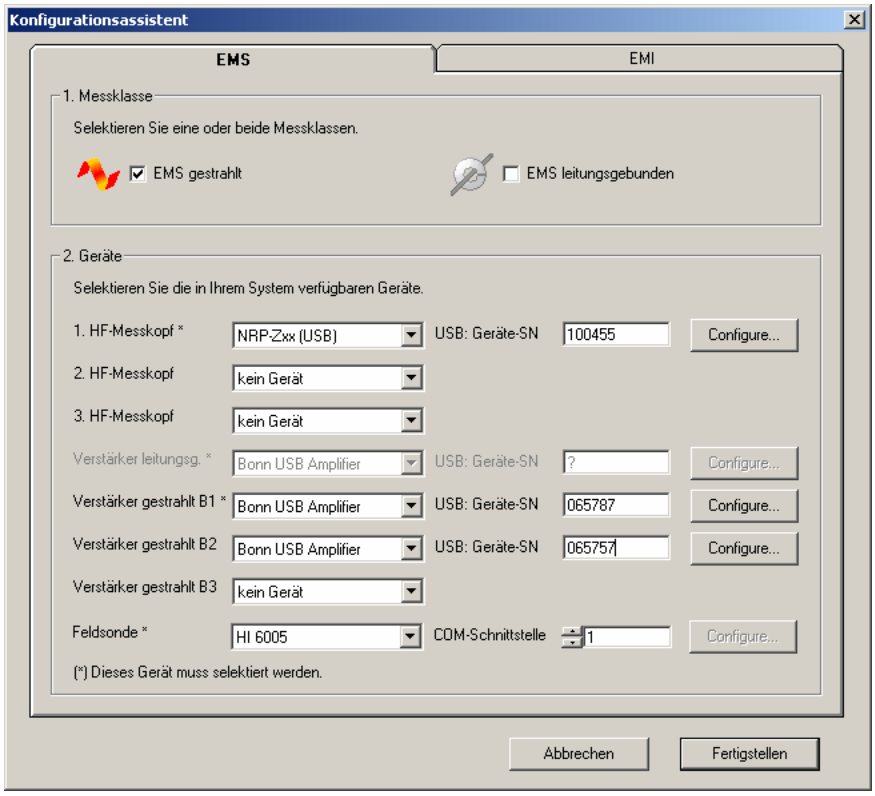


Fig. 5-3 Dialog in the R&S IMS configuration wizard (EMS radiated)

5. In this example the chosen configuration is One RF Sensor. Sensors 2 and 3 are therefore not selected. The serial number of the R&S NRP-Z91 sensor that will be used can be entered in the *USB instrument SN* field. If this number is not known, a '?' can be entered. When using a different sensor from the NRP-Zxx product family, this can be changed in the *Configure...* dialog.

6. Each band in the dual band amplifier is treated as a separate amplifier.
   Lastly enter the serial number of the external Bonn amplifier that will be controlled via the USB port. To use a different type of amplifier, select *Generic Amplifier* as the device driver in place of the *Bonn USB Amplifier* type. The amplifier parameters can be adapted in the *Configure...* dialog.

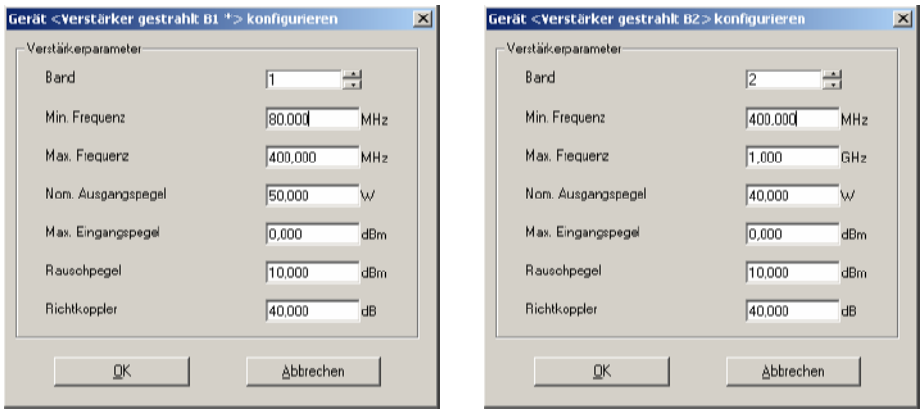


Fig. 5-4 Dialog for configuring both bands in the Bonn dual band amplifier

7. Having completed all the entries, click on the **Finish** button to run the configuration procedure.

8. When the configuration wizard has closed, the EMC32 application must be restarted.

Note:

The EMC32 software is now ready to begin the first demo measurement. Before you can carry out the first test equipment measurement, it is necessary to calibrate the signal paths and measure the field uniformity with the log-periodic antenna.

9. As well as the configuration for measuring with the aid of an EMS antenna, the wizard also creates a configuration for an amplifier test on the dual band amplifier. For more details on these configurations please refer to the Application Notes for *EN 61000-4-3* in the EMC32 online help.

10. The wizard creates an EMC32 list of equipment containing the following instruments:

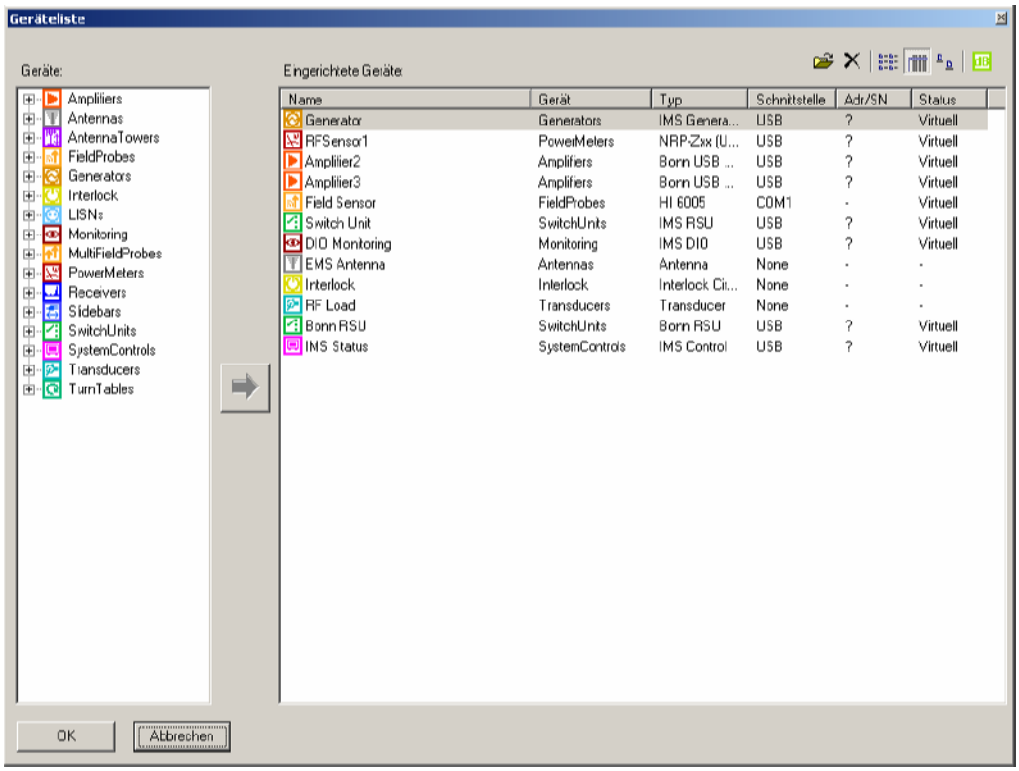


Fig. 5-5 Equipment list created by the configuration wizard for EMS radiated

The following table contains short descriptions of the device driver functions:

Instrument name	Description
Generator	For controlling the internal R&S IMS generator module
RFSensor1	For controlling RF sensor NRP-Z91
Amplifier2	For controlling band 1 of the external Bonn amplifier (1st amplifier for radiated measurements)
Amplifier3	For controlling band 2 of the external Bonn amplifier (2nd amplifier for radiated measurements)
Field Sensor	For controlling the field strength sensor used
Switch Unit	For controlling the internal RF switching matrix
DIO Monitoring	For controlling the R&S IMS EUT Monitoring interface for test equipment monitoring and stimulation
EMS Antenna	For defining the physical limit values of the log-periodic antenna used
Interlock	For monitoring the interlock input

Instrument name	Description
RF Load	For defining the physical limit values of the RF terminating impedance for the amplifier test
Bonn RSU	For controlling the internal RF switching matrix of the dual band amplifier
IMS Status	For controlling the R&S IMS status display on the front panel

Table 5-1 List of the instruments entered in the equipment list by the configuration wizard

5.2.3 Signal Path Calibration for Dual Band Amplifiers

In the second step the supplementary RF cable must be calibrated in order to increase measurement accuracy. This is done with the aid of the signal path calibration tools incorporated in the EMC32 software.

During signal path calibration the frequency-dependent damping behavior of a signal path in the test system is determined and saved to a file of the *damping correction table* type. The settings used when measuring a signal path are held in a file of the *calibration configuration* type. A dedicated dialog box has been provided for defining these settings.

There are two possible ways of opening this dialog:

- From the Explorer by double-clicking on an existing calibration configuration or by clicking once with your right mouse button on the Calibration Configurations folder and clicking once on **New File** in the context menu.
- By clicking on the **Calibration** button in the Properties dialog of a signal path that has been called out from an instrument configuration. This call has been provided so that an instrument configuration can be fully and consistently created in a single process. If a number of correction tables are specified, a selection dialog opens first so that you can select the table requiring calibration.

The following signal paths require calibration for this measurement application:

Path name	From	To	Remarks
Generator-Amplifier2	Output X2 RF OUT2/IMS of the R&S IMS	Input of the external dual band amplifier	
Amplifier2-RFSensor1(FWD)	Output FWD of the dual band amplifier	Output X11 FWD via input X6 FWD 2	
Amplifier2-RFSensor1(REV)	Output REV of the dual band amplifier	Output X11 FWD via input X7 REV 2	
Amplifier2-EMS Antenna	Output cable of the dual band amplifier	Input of the log-periodic antenna	
Directional Coupler Factor Amplifier2			The manufacturer's calibration values are used
Generator-Amplifier3	Output X2 RF OUT2/IMS of the R&S IMS	Input of the external dual band amplifier	
Amplifier3-RFSensor1(FWD)	Output FWD of the dual band amplifier	Output X11 FWD via input X6 FWD 2	

Path name	From	To	Remarks
Amplifier3-RFSensor1(REV)	Output REV of the dual band amplifier	Output X11 FWD via input X7 REV 2	
Amplifier3-EMS Antenna	Output cable of the dual band amplifier	Input of the log-periodic antenna	
Directional Coupler Factor Amplifier3			The manufacturer's calibration values are used

Table 5-2 List of signal paths

To calibrate the signal paths shown in the above table, proceed as follows:

1. From the EMS radiated instrument configuration open the "IMS radiated" file.
2. Left click on the icon for the signal path "Generator-Amplifier2" in order to open the Properties dialog of that signal path.
3. Start signal path calibration by clicking on the Calibration radio button in the dialog. All settings for calibration in the signal path calibration editor are already preconfigured. Start calibration by pressing the *Calibration* button.
4. For normalization connect the RF sensor to output X2 RF OUT2/IMS.
5. For signal path measurement insert the cable between output X2 RF OUT2/IMS and the amplifier input between output X2 RF OUT2/IMS and the RF sensor. For more detailed information on using the signal path calibration tools in EMC32, please refer to the chapter System Calibration – Signal Path Calibration in the EMC32 online help.
6. Calibrate the other signal paths in the same way.

To enter the calibration values for the directional coupler factor proceed as follows (assuming it is measurable):

1. Create a new damping correction table via File → New Table.
2. Enter the correction values or import them from a file.
3. Save the file.
4. From the EMS radiated instrument configuration open the "IMS radiated" file.
5. Left click on the icon for the amplifier titled "Amplifier2" in order to open the Properties dialog of that amplifier.
6. In the Directional Coupler field change the fixed value damping correction in the file.
7. Carry out steps 1 – 6 for amplifier 3.

5.2.4 Test Setup for Two External Amplifiers

This application uses the R&S IMS with built-in transfer relay together with two external amplifiers which together cover a frequency range of 80 MHz to 1 GHz. The amplifier power should be sufficient, when the log-periodic antenna is used, to create tests in respect of field uniformity using a test level of 10 V/m at a distance of 3 m.
The illustration below shows how the system can be configured using few additional components:

- 2 x R&S NRP-Z91 RF sensor with NRP-Z4 USB adapter
- External amplifier with a frequency range of 80 MHz to 400 MHz
- External amplifier with a frequency range of 400 MHz to 1 MHz
- Log-periodic antenna in the frequency range 80 MHz to 1 GHz
- Field probe with fiber-optic transmission and RS-232-C PC interface
- RF and USB cable set
- System process controller with R&S IMS operating system (EMC32)

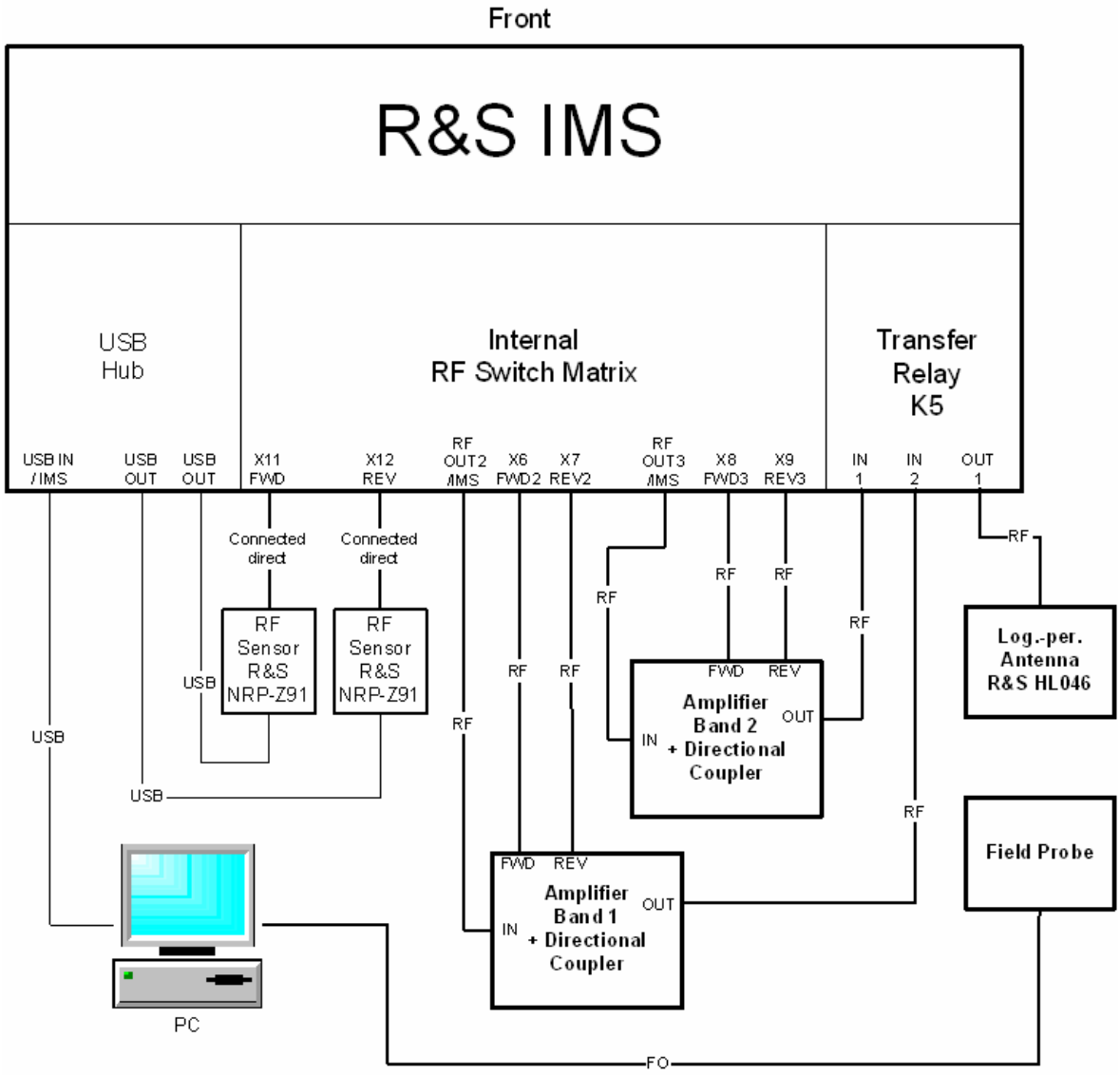


Fig. 5-6 Test setup to EN 61000-4-3 with two external amplifiers in a two RF sensor configuration

The above figure shows the system setup for carrying out calibration and the subsequent test equipment measurement. The field probe is not needed for this, since the substitution method is used.
In the R&S IMS in Two Sensor configuration, the nominal forward power inputs are hard wired into the X11 FWD output by means of a relay. The integral PIN diode switch is used for signal conversion between the reflected power and the monitoring input for conducted measurements. In our application example however, it is hard wired into the reflected power.

5.2.5 Configuring the Software for Two External Amplifiers

In the first step after installing the EMC32 operating system software for the R&S IMS, you have to adapt the software to your system. This means you must tell the EMC32 software which instruments are present in your system, which interfaces are used to address them, how the instruments are interconnected and how it is intended that the measurements obtained via these instruments shall be carried out.
For this purpose the EMC32 software includes the **R&S IMS configuration wizard**, which prompts you for the instruments present in the system and then creates a standard configuration for the system. Correction tables and test templates are also copied to the appropriate folders.

To start the R&S IMS configuration wizard proceed as follows:

1. Start the EMC32 application.

If the opening dialog is enabled, you will see that it contains an icon that will open the wizard.

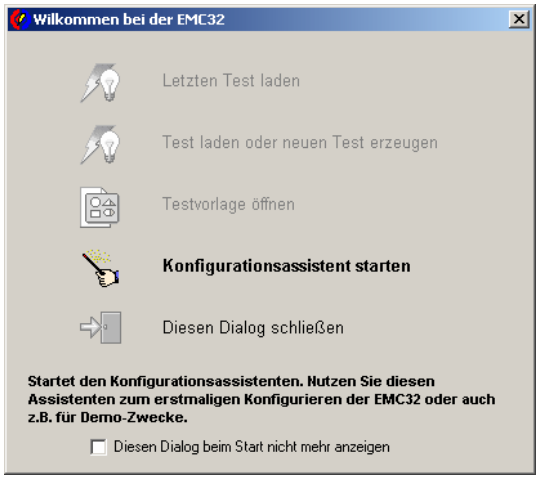


Fig. 5-7 Opening dialog for the EMC32 software

2. Otherwise open the wizard via the menu: **Extras – Wizard – IMS Configuration.**
3. The following dialog opens. Measurement class *EMS radiated* will be selected for EN 61000-4-3.

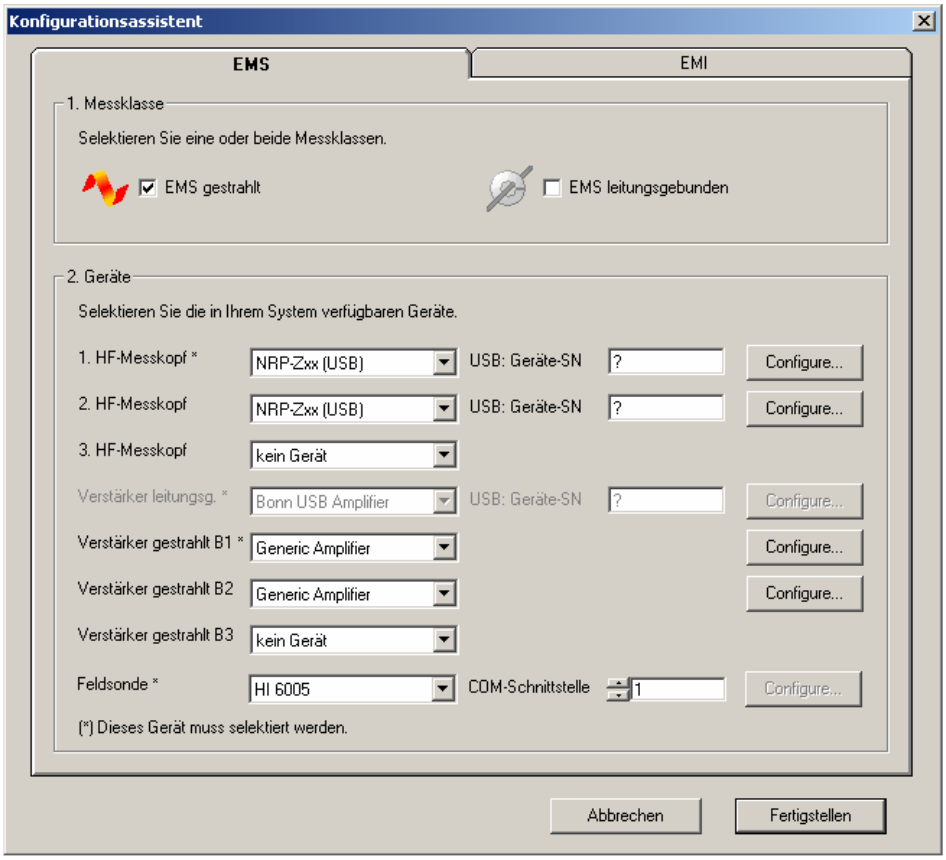


Fig. 5-8 Dialog in the R&S IMS configuration wizard (EMS radiated)

4. In this example the chosen configuration is Two RF Sensor. Sensors 1 and 2 are therefore selected. Enter the serial numbers of the R&S NRP-Z91 sensors that will be used in the *USB instrument SN* field. When using a different sensor from the NRP-Zxx product family, this can be changed in the *Configure...* dialog.

5. Select "Generic Amplifier" as the device driver for both external amplifiers. The amplifier parameters can be adapted in the *Configure...* dialog.

Fig. 5-9 Amplifier configuration dialog for radiated measurement

6. Having completed all the entries, click on the **Finish** button to run the configuration procedure.

7. When the configuration wizard has closed, the EMC32 application must be restarted.

Note:

The EMC32 software is now ready to begin the first demo measurement. Before you can carry out the first test equipment measurement, it is necessary to calibrate the signal paths and measure the field uniformity with the log-periodic antenna.

8. As well as the configuration for measuring with the aid of an EMS antenna, the wizard also creates a configuration for an amplifier test on the two amplifiers. For more details on these configurations please refer to the Application Notes for EN 61000-4-3 in the EMC32 online help.
9. The wizard creates an EMC32 list of equipment containing the following instruments:

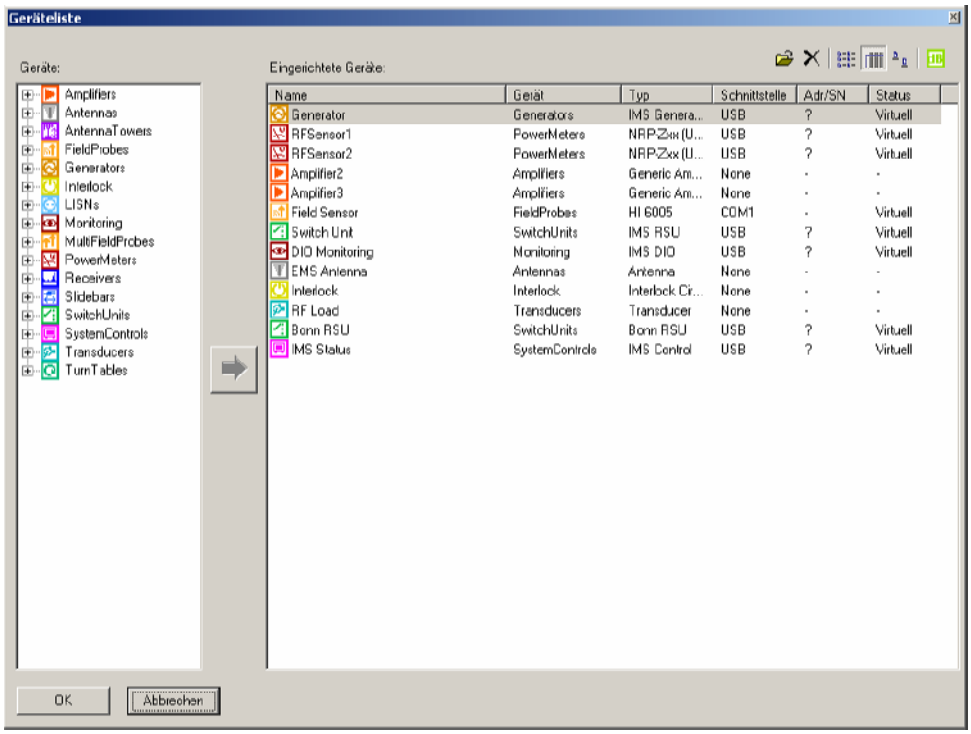


Fig. 5-10 Equipment list created by the configuration wizard for EMS radiated

The following table contains short descriptions of the device driver functions:

Instrument name	Description
Generator	For controlling the internal R&S IMS generator module
RFSensor1	For controlling the RF sensor NRP-Z91 for forward power
RFSensor2	For controlling the RF sensor NRP-Z91 for reflected power
Amplifier2	For controlling band 1 of the external amplifier (1st amplifier for radiated measurements)
Amplifier3	For controlling band 2 of the external amplifier (2nd amplifier for radiated measurements)
Field Sensor	For controlling the field strength sensor used
Switch Unit	For controlling the internal RF switching matrix

Instrument name	Description
DIO Monitoring	For controlling the R&S IMS EUT Monitoring interface for test equipment monitoring and stimulation
EMS Antenna	For defining the physical limit values of the log-periodic antenna used
Interlock	For monitoring the interlock input
RF Load	For defining the physical limit values of the RF terminating impedance for the amplifier test
IMS Status	For controlling the R&S IMS status display on the front panel

Table 5-3 List of the instruments entered in the equipment list by the configuration wizard

5.2.6 Signal Path Calibration for Two External Amplifiers

In the second step the supplementary RF cable must be calibrated in order to increase measurement accuracy. This is done with the aid of the signal path calibration tools incorporated in the EMC32 software.

During signal path calibration the frequency-dependent damping behavior of a signal path in the test system is determined and saved to a file of the *damping correction table* type. The settings used when measuring a signal path are held in a file of the *calibration configuration* type. A dedicated dialog box has been provided for defining these settings.

There are two possible ways of opening this dialog:

- From the Explorer by double-clicking on an existing calibration configuration or by clicking once with your right mouse button on the Calibration Configurations folder and clicking once on **New File** in the context menu.
- By clicking on the **Calibration** button in the Properties dialog of a signal path that has been called out from an instrument configuration. This call has been provided so that an instrument configuration can be fully and consistently created in a single process. If a number of correction tables are specified, a selection dialog opens first so that you can select the table requiring calibration.

The following signal paths require calibration for this measurement application:

Path name	From	To	Remarks
Generator-Amplifier2	Output X2 RF OUT2/IMS of the R&S IMS	Input of the external amplifier band 1	
Amplifier2-RFSensor1(FWD)	Output FWD of the external amplifier band 1	Output X11 FWD via input X6 FWD 2	
Amplifier2-RFSensor1(REV)	Output REV of the external amplifier band 1	Output X12 REV via input X7 REV 2	
Amplifier2-EMS Antenna	Output cable of the external amplifier band 1	Input of the log-periodic antenna	Via the transfer relay
Directional Coupler Factor Amplifier2			Enter manufacturer data or calibrate using the calibration function of the EMC32 software

Path name	From	To	Remarks
Generator-Amplifier3	Output X3 RF OUT3/IMS of the R&S IMS	Input of the external amplifier band 1	
Amplifier3-RFSensor1(FWD)	Output FWD of the external amplifier band 2	Output X11 FWD via input X8 FWD 3	
Amplifier3-RFSensor1(REV)	Output REV of the external amplifier band 2	Output X12 REV via input X9 REV 3	
Amplifier3-EMS Antenna	Output cable of the external amplifier band 2	Input of the log-periodic antenna	Via the transfer relay
Directional Coupler Factor Amplifier3			Enter manufacturer data or calibrate using the calibration function of the EMC32 software

Table 5-4 List of signal paths

To calibrate the signal paths shown in the above table, proceed as follows:

1. From the EMS radiated instrument configuration open the "IMS radiated" file.
2. Left click on the icon for the signal path "Generator-Amplifier2" in order to open the Properties dialog of that signal path.
3. Start signal path calibration by clicking on the *Calibration* radio button in the dialog. All settings for calibration in the *signal path calibration* editor are already preconfigured. Start calibration by pressing the *Calibration* button.
4. For normalization connect the RF sensor to output X2 RF OUT2/IMS.
5. For signal path measurement insert the cable between output X2 RF OUT2/IMS and the amplifier input between output X2 RF OUT2/IMS and the RF sensor. For more detailed information on using the signal path calibration tools in EMC32, please refer to the chapter System Calibration – Signal Path Calibration in the EMC32 online help.
6. Calibrate the other signal paths in the same way.

To enter the calibration values for the directional coupler factor proceed as follows (assuming it is measurable):

1. From the EMS radiated instrument configuration open the "IMS radiated" file.
2. Left click on the icon for the amplifier titled "Amplifier2" in order to open the Properties dialog of that amplifier.
3. Enter a name for the directional coupler and in the *Directional Coupler* field change the fixed value damping correction in the file.
4. Close the Properties dialog.
5. Left click on the icon for the amplifier titled "Amplifier2" and then select the "Calibrate Directional Coupler" function.
6. The calibration configuration editor opens. You can carry out the calibration just as you would for a signal path. Be sure to use a high enough signal generator level (> 10 dBm) so as to operate outside the noise level of the RF sensor. Also all ports on the directional coupler must be terminated with 50 Ohm.
7. Carry out steps 1 – 6 for amplifier 3.

5.2.7 Reference Calibration with Field Uniformity Evaluation of the Log-Periodic Antenna

Part of the reference calibration procedure establishes the antenna input power and generator level needed for producing the required field strength at the field sensor for each frequency point. This result is then saved to a Reference Calibration Table type of file.

To measure field uniformity, place the field sensor at 16 different predefined positions in a level space measuring 1.5m x 1.5m located at a distance of 3m in front of the tip of the antenna. Carry out a reference calibration sequence for each individual sensor position. You also need to take this measurement for each polarization of the antenna.
Detailed instructions for carrying out reference calibration can be found in the online help, "*Application Notes → EN 61000-4-3 → Field Uniformity Calibration"*.

As a result of this field uniformity evaluation you obtain a reference calibration file containing the antenna input power needed to give the desired S/N ratio. This file is subsequently used in the equipment test.

5.2.8 Equipment Test with EUT Monitoring

Before carrying out the equipment test, place the EUT in the middle of the field uniformity area and remove the field sensor.
Detailed instructions for carrying out an equipment test can be found in the "Getting Started" manual for the EMC32 application or in the online help in the chapter on *EMS Measurement* or in the online help, "*Application Notes → EN 61000-4-3 → Equipment Test"*.

The reference calibration (field uniformity evaluation result) generated in the previous step is to be used during the test equipment measurement. If you also wish the EUT to be monitored during the test via the EUT monitoring TTL interface built into the R&S IMS, you can use for this purpose the EUT monitoring configuration "DIO Monitoring" generated by the R&S IMS configuration wizard.
In this case a 10 ms pulse is generated on line 1 (pin 1) of the output port (port 4 in the EMC32 IMS DIO driver) at each test frequency. The status of line 3 (pin 8) of the input port (port 3 in the EMC32 IMS DIO driver) is also monitored. The pin assignment for the EUT monitoring interface can be found in chapter 6.2 Geräteschnittstellen.

Further details on the EUT Monitoring topic can be found in the chapter "*Fundamentals – Test Template Editors – EUT Monitoring*" in the EMC32 online help.

5.3 Measurement to EN 61000-4-6 (Conducted) with CDN

This chapter describes the use of the R&S IMS for measurements to generic standard EN 61000-4-6. Depending on the EUT used, the standard requires the S/N ratio level to be coupled to one of the transducer instruments in the following list:

- Coupling/decoupling network (CDN)
- EM coupling clamp
- Bulk-current injection clamp (BCI)

For further information on the rules for selecting the suitable coupler please refer to the appropriate chapter in the published standard.
The test using coupling/decoupling networks is described below. The coupling/decoupling network types used in this case are determined by the interfaces on the test equipment (e.g. M2, M3, AF). However, the same configuration is used for the software and test setup regardless of type.
EMS tests using the EM coupling clamp or the bulk-current injection clamp require an external amplifier, since the power of the internal 25 W amplifier is not adequate for an S/N ratio of 10 V.

5.3.1 Test Setup

This measurement uses the R&S IMS instrument with the built-in 25 W amplifier covering a frequency range of 9 kHz to 250 MHz. The amplifier has enough power for tests to be carried out at a test level of 10 V.
The illustration below shows how the system can be configured using few additional components:

- R&S NRP-Z91 RF sensor with NRP-Z4 USB adapter
- 6 dB RF attenuator with minimum 25 W power drain
- CDN with appropriate calibration adapter (other types are also possible)
- RF and USB cable set
- System process controller with R&S IMS operating system (EMC32)

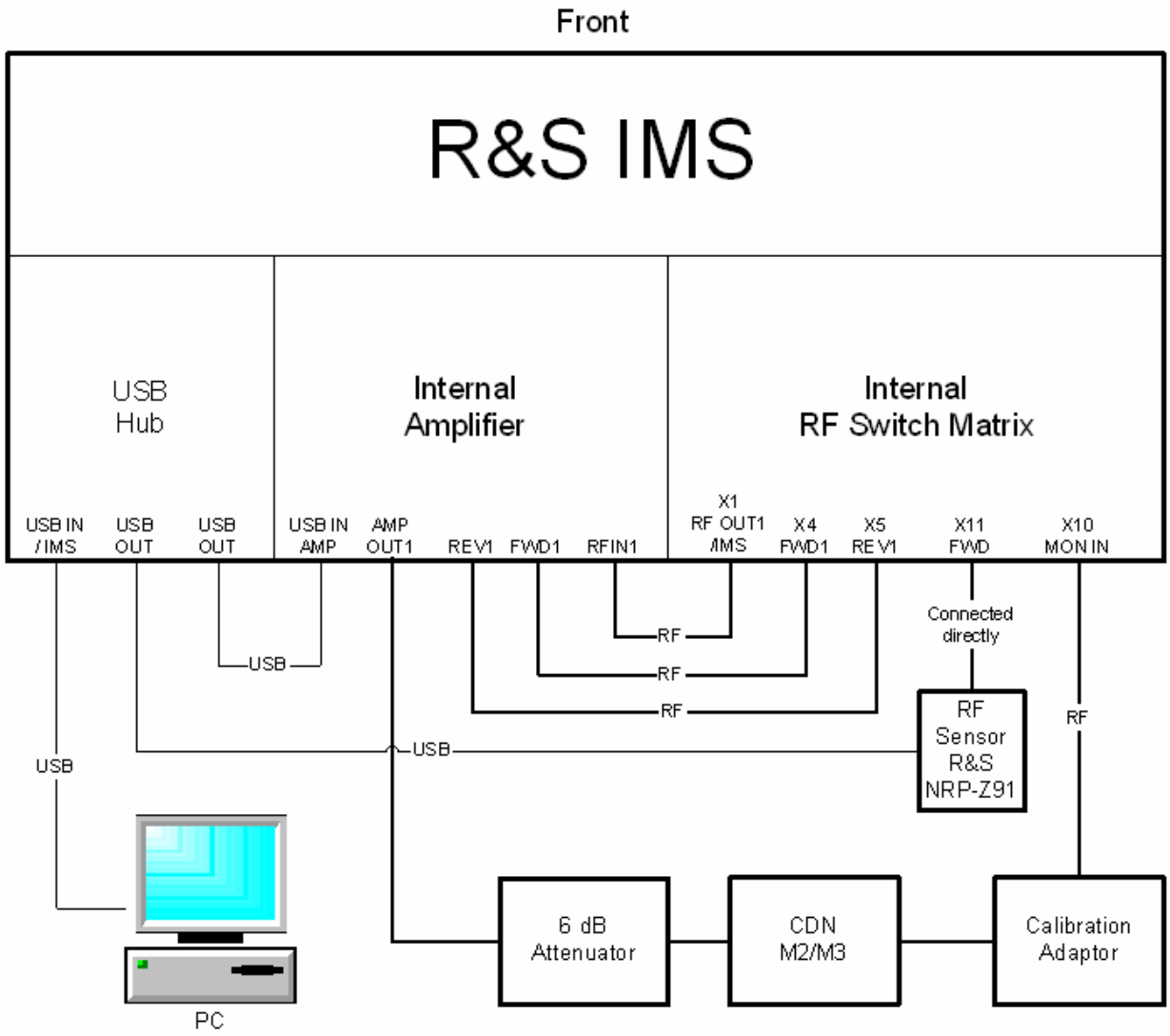


Fig. 8 Test setup to EN 61000-4-6 with a coupling/decoupling network in a one RF sensor configuration

The above figure shows the system setup for calibrating the coupling/decoupling network CDN. During subsequent test equipment measurement the calibration adapter is replaced by the EUT itself.
Because of the PIN diode switch integrated in the R&S IMS, the system can be operated using one RF sensor. This switches the input for the forward RF power, the input for the reflected RF power and the input for the monitor input RF signal to the RF sensor as appropriate.

5.3.2 Software Configuration

In the first step after installing the EMC32 operating system software for the R&S IMS, you have to adapt the software to your system. This means you must tell the EMC32 software which instruments are present in your system, which interfaces are used to address them, how the instruments are interconnected and how it is intended that the measurements obtained via these instruments shall be carried out.
For this purpose the EMC32 software includes the **R&S IMS configuration wizard**, which prompts you for the instruments present in the system and then creates a standard configuration for the system. Correction tables and test templates are also copied to the appropriate folders.

To start the R&S IMS configuration wizard proceed as follows:

1. Start the EMC32 application.
2. If the opening dialog is enabled, you will see that it contains an icon that will open the wizard.

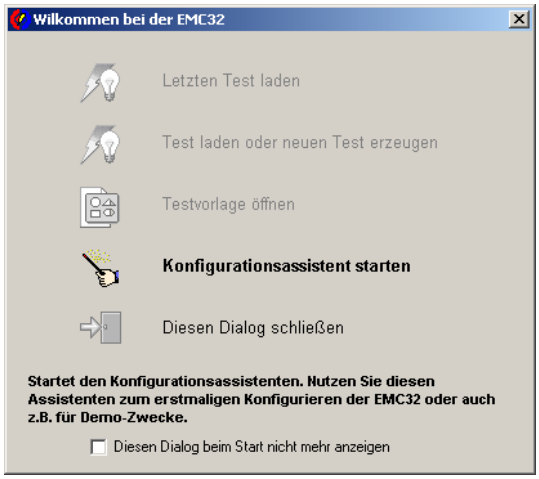


Fig. 9 Opening dialog for the EMC32 software

3. Otherwise open the wizard via the menu: **Extras – Wizard – IMS Configuration.**
4. The following dialog opens. Measurement class *EMS conducted* will be selected for EN 61000-4-6.

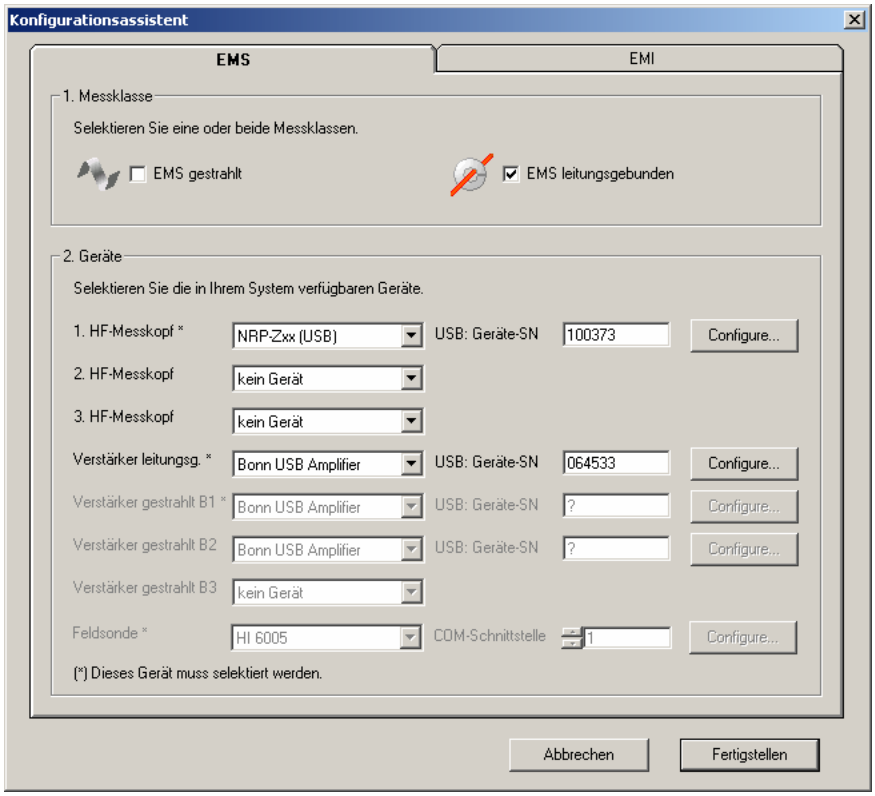


Fig. 5-11 Dialog in the R&S IMS configuration wizard (EMS conducted)

5. In this example the chosen configuration is One RF Sensor. Sensors 2 and 3 are therefore not selected. The serial number of the R&S NRP-Z91 sensor that will be used can be entered in the

USB Instrument SN field. If this number is not known, a '?' can be entered. When using a different sensor from the NRP-Zxx product family, this can be changed in the *Configure...* dialog.

6. Lastly enter the serial number of the internal amplifier that will be controlled via the USB port. To use an external amplifier, select Generic Amplifier as the amplifier type in place of the Bonn USB amplifier type. The amplifier parameters can be adapted in the *Configure...* dialog.

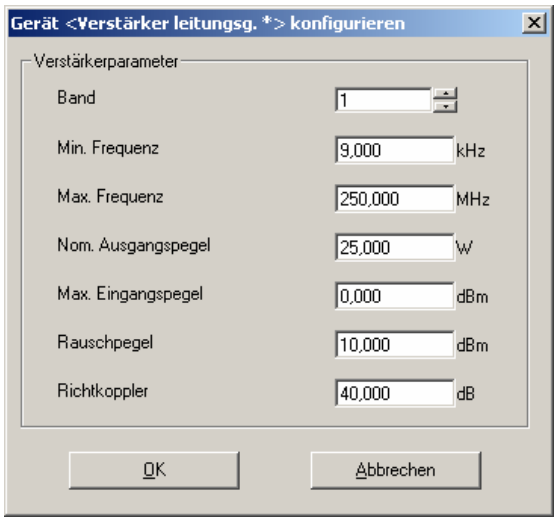


Fig. 5-12 Configuration dialog for the conducted amplifier

7. Having completed all the entries, click on the **Finish** button to run the configuration procedure.

8. When the configuration wizard has closed, the EMC32 application must be restarted.

Note:

The EMC32 software is now ready to begin the first demo measurement. Before you can carry out the first test equipment measurement, it is necessary to calibrate the signal paths and the coupling/decoupling network.

9. As well as the configuration for measuring with the aid of coupling/decoupling networks, the wizard also creates a configuration for calibrating the bulk-current injection clamp, for measuring with the current clamp and for an amplifier test on the conducted amplifier. For more details on these configurations please refer to the Application Notes for EN 61000-4-6 in the EMC32 online help.

10. The wizard creates an EMC32 list of equipment containing the following instruments:

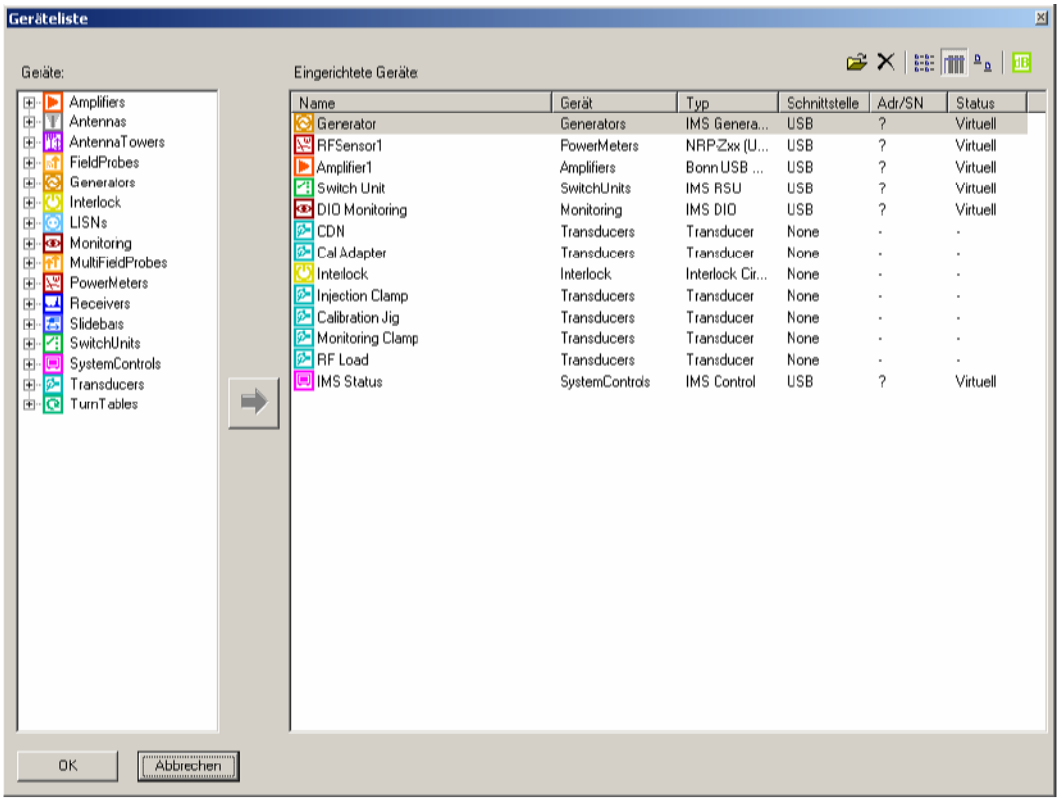


Fig. 5-13 Equipment list created by the configuration wizard for EMS conducted

The following list contains short descriptions of the device driver functions:

Instrument name	Description
Generator	For controlling the internal R&S IMS generator module
RFSensor1	For controlling RF sensor NRP-Z91
Amplifier1	For remote control of the internal amplifier module
Switch Unit	For controlling the internal RF switching matrix
DIO Monitoring	For controlling the R&S IMS EUT Monitoring interface for test equipment monitoring and stimulation
CDN	For defining the physical limit values of the coupling/decoupling networks. In this case the 6 dB attenuator is defined as the fixed value.
Cal Adapter	For defining the physical parameters of the calibration adapter. The value of 1/6 required for measuring U_0 is defined here as a constant attenuation of 15.56 dB.
Interlock	For monitoring the interlock input
Injection Clamp	For defining the physical limit values of the bulk-current injection clamp for BCI measurements
6	For defining the physical parameters of the calibration adapter referenced to the bulk-current injection clamp and required for calibration. The value of 1/2 required for

Instrument name	Description
	measuring U_0 is defined here as a constant attenuation of 6 dB.
Monitoring Clamp	For defining the physical parameters of the monitoring clamp for BCI measurements. The transmission characteristic of the clamp must be either calibrated or entered in a transducer table. For details please refer to the Application Note EN 61000-4 in the EMC32 online help.
RF Load	For defining the physical limit values of the RF terminating impedance for the amplifier test
IMS Status	For controlling the R&S IMS status display on the front panel

Table 5-5 List of the instruments entered in the equipment list by the configuration wizard

5.3.3 Signal Path Calibration

In the second step the supplementary RF cable must be calibrated in order to increase measurement accuracy. This is done with the aid of the signal path calibration tools incorporated in the EMC32 software.

During signal path calibration the frequency-dependent damping behavior of a signal path in the test system is determined and saved to a file of the *damping correction table* type. The settings used when measuring a signal path are held in a file of the *calibration configuration* type. A dedicated dialog box has been provided for defining these settings.

There are two possible ways of opening this dialog:

- From the Explorer by double-clicking on an existing calibration configuration or by clicking once with your right mouse button on the Calibration Configurations folder and clicking once on **New File** in the context menu.
- By clicking on the **Calibration** button in the Properties dialog of a signal path that has been called out from an instrument configuration. This call has been provided so that an instrument configuration can be fully and consistently created in a single process. If a number of correction tables are specified, a selection dialog opens first so that you can select the table requiring calibration.

The following signal paths require calibration for this measurement application:

Path name	From	To	Remarks
Generator-Amplifier1	Output of the internal generator module	Input of the internal amplifier module	Correction table on accompanying CD-ROM
Amplifier1-RFSensor1(FWD)	Output of the internal amplifier module FWD1	Output X11 FWD via internal directional coupler	Correction table on accompanying CD-ROM
Amplifier1-RFSensor1(REV)	Output of the internal amplifier module FWD1	Output X11 FWD via internal directional coupler	Correction table on accompanying CD-ROM
Amplifier1-CDN	Cable at AMP OUT1 output	Cable at CDN input	Calibration without 6 dB attenuator
CAL Adapter-RFSensor1	Cable at calibration adapter output	Cable at X10 MON IN input	

Table 5-6 List of signal paths

The first three signal paths in the above table cannot be calibrated without opening the R&S IMS. The attenuation correction tables are therefore included in the CD-ROM as files. To import these tables proceed as follows:

1. In the EMC32 Explorer expand the tree system for Correction Tables and look for the Attenuation entry.
2. Right click on the Attenuation entry and select the Import From entry from the popup menu.
3. A file selection dialog opens. Select the required table and import it by clicking the Open button.
4. Carry out steps 2 and 3 for all three of the above mentioned tables.

To calibrate the last two signal paths from the above table (including the external RF cable), proceed as follows:

5. From the EMS conducted instrument configuration open the "CDN (EM-Clamp)" file.

1. Left click on the icon for the signal path "Amplfiier1-CDN" in order to open the Properties dialog of that signal path.
2. Start signal path calibration by clicking on the Calibration radio button in the dialog. All settings for calibration in the signal path calibration editor are already preconfigured. Start calibration by pressing the *Calibration* button.
3. For normalization connect the RF sensor to output X1 RF OUT/IMS.
4. For signal path measurement insert the cable between output AMP OUT 1 and CDN between output X1 RF OUT/IMS and the RF sensor. For more detailed information on using the signal path calibration tools in EMC32, please refer to the chapter *System Calibration – Signal Path Calibration* in the EMC32 online help.
5. Proceed in much the same way to calibrate the "CAL Adapter-RFSensor1" signal path.
6. Normalization is carried out as in step 4.
7. Calibration must include measuring the cable between the output X10 MON IN and the calibration adapter.

5.3.4 Reference Calibration of Coupling/Decoupling Networks

Part of the reference calibration procedure establishes the CDN input power and generator level needed for producing the required voltage at the CDN output for each frequency point. This result is then saved to a Reference Calibration Table type of file.
The reference calibration must be carried out separately for each RF coupling/decoupling network type in use and saved to a separate reference calibration table. The test template "EN61000-4-6 CDN" prepared by the configuration wizard is to be used for calibration.
Detailed instructions for carrying out the reference calibration can be found in the "*Getting Started*" manual for the EMC32 application or in the online help in the chapter "*System Calibration – Reference Calibration"*.

5.3.5 Equipment Test with Coupling/Decoupling Network and EUT Monitoring

Before carrying out a test equipment measurement you must first connect the EUT to the output of the coupling/decoupling network CDN. The calibration adapter is no longer needed and can be removed along with the RF cable.
Detailed instructions for carrying out the equipment test can be found in the "*Getting Started*" manual for the EMC32 application or in the online help in the chapter "*EMS Measurement*".

The reference calibration generated in the previous step is to be used for the respective coupling/decoupling network during the test equipment measurement. If you also wish the EUT to be monitored during the test via the EUT monitoring TTL interface built into the R&S IMS, you can use for this purpose the EUT monitoring configuration "DIO Monitoring" generated by the R&S IMS configuration wizard.
In this case a 10 ms pulse is generated on line 1 (pin 1 of the MONITORING socket) of the output port (port 4 in the EMC32 IMS DIO driver) at each test frequency. The status of line 3 (pin 8 of the MONITORING socket) of the input port (port 3 in the EMC32 IMS DIO driver) is also monitored. The pin assignment for the EUT monitoring interface can be found in chapter 6.2 Geräteschnittstellen.

Further details on the EUT Monitoring topic can be found in the chapter "*Fundamentals – Test Template Editors – EUT Monitoring*" in the EMC32 online help
.

6 Instrument Interfaces, Maintenance, Errors

6.1 Introduction

This section deals with the instrument interface and gives an overview of the error displays which appear on the R&S IMS.

6.2 Instrument Interfaces:

Entry in column D (direction): O **= output** I **= input** B **= bidirectional**
Entry in column T (type): A **= analog** D **= digital** P **= power**
Entry in column TT P **= test value** **T = trimming value**
(test & trimming instructions) D **= design value** E **= setting value**

	D	T	Value range	TT		Connector	Comment
RF output 1	O	A	9kHz to 3 GHz -127 dBm - +13 dBm	P	-	X1 RF OUT1/IMS	Generator output via relay K1
RF output 2	O	A	9kHz to 3 GHz -127 dBm - +13 dBm	P	-	X2 RF OUT2/IMS	Generator output via relay K1
RF output 3	O	A	9kHz to 3 GHz -127 dBm - +13 dBm	P	-	X3 RF OUT3/IMS	Generator output via relay K1
Measurement input of the forward power, amp. 1	I	A	9kHz to 3 GHz -70 dBm - +13 dBm	P	-	X4 FWD1	from directional coupler of amp. 40dB decoupl.
Measurement input of the forward power, amp. 2	I	A	9kHz to 3 GHz -70 dBm - +13 dBm	P	-	X6 FWD2	from directional coupler of amp. 40dB decoupl.
Measurement input of the forward power, amp. 3	I	A	9kHz to 3 GHz -70 dBm - +13 dBm	P	-	X8 FWD3	from directional coupler of amp. 40dB decoupl.
Measurement input of the reflected power, amp. 1	I	A	9kHz to 3 GHz -70 dBm - +13 dBm	P	-	X5 REV1	from directional coupler of amp. 40dB decoupl.
Measurement input of the reflected power, amp. 2	I	A	9kHz to 3 GHz -70 dBm - +13 dBm	P	-	X7 REV2	from directional coupler of amp. 40dB decoupl.
Measurement input of the reflected power, amp. 3	I	A	9kHz to 3 GHz -70 dBm - +13 dBm	P	-	X9 REV3	from directional coupler of amp. 40dB decoupl.

	D	T	Value range	TT		Connector	Comment
Monitor input	I	A	9kHz to 3 GHz -70 dBm - +13 dBm	P	-	X10 MON IN	Monitor signal from test clamp or sensor
Measurement output for first R&S NRP-Z91 power sensor	O	A	9kHz to 3 GHz -70 dBm - +13 dBm	P	-	X11 FWD	all measurement signals are applied via switch K4 (FWD, REV, MON IN); with option R&S IMS-B7 FWD only
Measurement output for second R&S NRP-Z91 power sensor R&S IMS-B7	O	A	9kHz to 3 GHz -70 dBm - +13 dBm	P	-	X12 REV	measurement signals (REV, MON IN) are applied via switch K4
Signal input for optional analyzer R&S IMS-B1	!	A	9kHz to 3 GHz -70 dBm - +20 dBm	P	-	X13 ANALYZER	
Reserve						X14 MON OUT	Reserve
LF generator output	O	A	20 Hz to 20 kHz 1mV -2V rms	P	-	X21	
Ext. REF input of generator	I	A	10 MHz, 0.5 V to 2 V on 50 Ω	P	-	X22	
Ext. REF output of generator	O	A	10 MHz, >0.5 V on 50 Ω	P	-	X23	
Ext. REF input of optional analyzer	I	A	10 MHz, 0.5 V - 2 V on 50 Ω	P	-	X24	
Ext. modulation input of generator	I	A	20 Hz to 20 kHz for AM 20 Hz to 80 kHz for FM	P	-	X25	also DC also DC
Ext. pulse modulation input of generator	I	A	100 µs to 1 s pulse width 200µs to 2s pulse period	P	-	X26	external AC/DC
RF input of int. amplifier 1	I	A	9kHz to 3 GHz -127 dBm to +13 dBm	P	-	RF IN1	model 04 only
Measurement output of the forward power, amp. 1	O	A	9kHz to 3 GHz -70 dBm to +10 dBm	P	-	FWD1	from directional coupler of amp. 40dB decoupl.
Measurement output of the reflected power, amp. 1	O	A	9kHz to 3 GHz -70 dBm to +10 dBm	P	-	REV1	from directional coupler of amp. 40dB decoupl.
RF output 1 of int. amplifier 1	O	A	9kHz to 3 GHz -16 dBm to +44 dBm	P	-	AMP OUT1	in model 04 / with opt. R&S IMS-B2
RF output 2 of int. amplifier 1	O	A	9kHz to 3 GHz -16 dBm to +44 dBm	P	-	AMP OUT2	in model 04 with opt. R&S IMS-B2
RF input of int. amplifier 2	I	A		P	-	RF IN2	not assigned at present

	D	T	Value range	TT		Connector	Comment
Measurement output of the forward power, amp. 2	I	A		P	-	FWD2	not assigned at present
Measurement output of the reflected power, amp. 2	I	A		P	-	REV2	not assigned at present
Remote control input of the R&S IMS from the host computer	B	D	USB connection, version 2.0	D	-	USB IN / IMS	Type "B" connector
Remote control input of the R&S IMS for sensor, amplifier, iKey	B	D	USB connection, version 2.0	D	-	USB OUT	8 pcs type "A" connector
Remote control input of the amplifier	B	D	USB connection, version 2.0	D	-	USB IN / AMP	Type "B" connector model 04 only
Monitor connection to EUT	I	D	TTL IN, +5 V	P	-	Monitoring Pin 1, 2, 3, 4	Input
Monitor connection to EUT	B	A	Ground	D	-	Monitoring Pin 5	Ground
Monitor connection to EUT	O	D	TTL OUT, +5 V	P	-	Monitoring Pin 6, 7, 8, 9	Output
						Remote Control Interlock Control	**Amplifier side 15 pin D-Sub**
Interlock	I	A	floating contact	P	-	Pin 8	
Interlock	I	A	floating contact	P	-	Pin 15	
Ground	B	A	Ground	D	-	Pin 7, 14	
Status RF IN	O	A	CMOS, approx. 12V	P	-	Pin 2	
Status Sum Alarm	O	A	CMOS, approx. 12V	P	-	Pin 6	
						Interlock	**R&S IMS side 25 pin D-Sub**
Interlock to test room door	O	A	+12V, 0.2 A	P	-	Pin 1	Contact to interlock switch on test room door
Interlock from test room door	I	A	Relay contact + LED	P	-	Pin 3	Contact to interlock switch on test room door
Interlock to amplifier 1	O	A	floating contact	P	-	Pin 8	Contact for interlock message to amplifier 1

	D	T	Value range	TT		Connector	Comment
Interlock to amplifier 1	O	A	floating contact	P	-	Pin 15	Contact for interlock message to amplifier 1
Interlock to amplifier 2	O	A	floating contact	P	-	Pin 7	Contact for interlock message to amplifier 2
Interlock to amplifier 2	O	A	floating contact	P	-	Pin 14	Contact for interlock message to amplifier 2
Interlock to amplifier 3	O	A	floating contact	P	-	Pin 6	Contact for interlock message to amplifier 3
Interlock to amplifier 3	O	A	floating contact	P	-	Pin 13	Contact for interlock message to amplifier 3
Test in Progress	O	A	floating contact	P	-	Pin 10	Contact to the indicator light
Test in Progress	O	A	floating contact	P	-	Pin 11	Contact to the indicator light
Message from amplifier 1 "RF IN"	I	A	approx. +12 V, CMOS	P	-	Pin 5	Message goes to front LED of R&S IMS
Message from amplifier 1 "General interference"	I	A	approx. +12 V, CMOS	P	-	Pin 12	Message goes to front LED of R&S IMS
Message from amplifier 2 "RF IN"	I	A	approx. +12 V, CMOS	P	-	Pin 9	Message goes to front LED of R&S IMS
Message from amplifier 2 "General interference"	I	A	approx. +12 V, CMOS	P	-	Pin 4	Message goes to front LED of R&S IMS
Message from amplifier 3 "RF IN"	I	A	approx. +12 V, CMOS	P	-	Pin 17	Message goes to front LED of R&S IMS
Message from amplifier 3 "General interference"	I	A	approx. +12 V, CMOS	P	-	Pin 16	Message goes to front LED of R&S IMS
Ground	B	A	Ground	D	-	Pin 2, 24, 25	
Amp. 1 "RESET"	O	D	TTL OUT, 5V,	P	-	Pin 18	Command to external amplifier 1 with parallel interface
Amp. 1 "OPERATE"	O	D	TTL OUT, 5V,	P		Pin 19	Command to external amplifier 1 with parallel interface

	D	T	Value range	TT		Connector	Comment
Amp. 1 "REMOTE"	O	D	TTL OUT, 5V,	P		Pin 20	Command to external amplifier 1 with parallel interface
Amp. 2 "RESET"	O	D	TTL OUT, 5V,	P	-	Pin 21	Command to external amplifier 2 with parallel interface
Amp. 2 "OPERATE"	O	D	TTL OUT, 5V,	P		Pin 22	Command to external amplifier 2 with parallel interface
Amp. 2 "REMOTE"	O	D	TTL OUT, 5V,	P	-	Pin 23	Command to external amplifier 2 with parallel interface
AC supply	I	P	100 V to 240 V, 50 Hz to 60 Hz, max. 110 VA model 02 max. 280 VA model 04	D	-	Power plug	

6.3 Maintenance

No special maintenance action is necessary for the R&S IMS.

Mechanically care should be taken to ensure that the fans can deliver the cooling air unhindered. The air intake aperture at the front of the side panel on the left of the housing, viewed from the front, should therefore be checked occasionally for accumulation of dust and cleared if necessary.
Similarly any accumulation of dust in the air outlet apertures should also be cleaned.

The air duct on the integral amplifier should simply be checked as a whole and brushed out if necessary.
Filter mats are not used in the R&S IMS.

Electrically just check that all connecting cables are in their proper control side and RF side places and make any necessary correction.

6.4 Error Displays

The error displays which appear on the R&S IMS are hardware controlled and have the following meanings (see Fig. 1-1):

POWER LED 4
green when all operating voltages are within tolerance.
red when one or more operating voltages are out of tolerance.

INTERLOCK LED 5
green when the interlock circuit is closed; all connected amplifiers are ready to operate.
Built-in option R&S IMS-B3 is activated, i.e. the amplifier input is connected to the generator output.

red when the interlock circuit is open; none of the connected amplifiers can be switched to Operate.
Built-in option R&S IMS-B3 is deactivated, i.e. the amplifier input receives a 50 Ohm termination.

The PAx LED also shows red when an amplifier is connected in the event of an open interlock.

PAx LED 9 (with amplifiers supplied by the Bonn company only)
green when the amplifier has received the RF IN command and also switches to Operate.
red when there is a sum error in the amplifier (also including an open interlock).

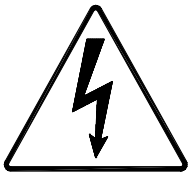
7 Amplifier Manual

This section only applies to R&S IMS Var. 04 where there is an integrated amplifier.

7.1 Preparation for Use

Pay Attention to the Operating Instructions!

During operation there may be a hazard due to electromagnetic fields. (According to Part 2 of VDE 0848)!



Dangerous Electric Voltages!

During open-circuit operation, the voltage at the centre conductor of the output connector may exceed 50 V AC.

Caution! *This device generates RF power, which can be emitted unintentionally if the operating instructions and the general safety regulations are not observed!*

This amplifier corresponds to rating class 1A according to VDE 0800. The AC voltage at the output is ≤60 Vrms.

According to annex 1 of the Amtsblattverfügung Nr. 243/1991 (operating regulations gazette of German PTT) of 11th December 1991, Allgemeingenehmigung nach dem Gesetz über den Betrieb von Hochfrequenzgeräten (general permit according to the law on use of high-frequency devices) the following must be considered:

Signal or test generators with an RF power supplied via connectors and exceeding 4 W (PEP - Peak Envelope Power) must be operated inside RF-shielded rooms!

7.1.1 Setting up the amplifier

When setting up the amplifier, make sure that the cooling airflow is impeded neither at the air inlet at the front nor at the outlet at the rear. The permissible operating temperature ranges from +5°C to +45°C with an air humidity of max. 95%. The outlet air temperature exceeds the inlet temperature by max. 20°C.

Caution! *The temperature of the inlet cooling air must not exceed +45 °C. The outlet air temperature should be maximum 20 °C higher than the inlet air temperature.*

7.1.2 Rack mounting

To ensure sufficient ventilation, make sure to provide enough space between the casing and the air inlet at the front panel and the air outlet at the rear. Make sure that there is sufficient air supply inside the rack (forced ventilation) and that no overheating can occur due to other instruments placed under or over the amplifier.

Caution! *The temperature of the inlet cooling air must not exceed +45 °C.*

7.1.3 Mains connection

The amplifier is equipped with a power supply which can be operated at a voltage of 100 ... 240 V AC.

Note: *When connecting the amplifier to the AC mains network, make sure to provide a proper protective earth connection according to the regulations.*

7.1.4 RF connectors

The amplifier is equipped with N- or SMA-type female connectors at all RF connectors. The mating connectors must be tightened manually!

7.1.5 Interlock safety loop

This amplifier permits an interlock safety loop to be connected, which must be always closed for activating the amplifier. The interlock function protects the user against unintentional emission of RF power.

It is necessary to wire the attached mating connector for the Remote Control and Interlock connector at the rear panel of the instrument as shown below. Pin 8 and pin 15 should be connected to the safety loop of the measuring room.

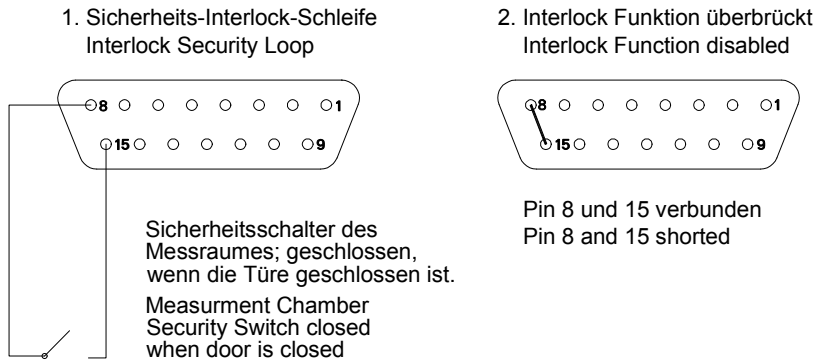


Fig. 7-1 Pin assignment of remote control and interlock connector

This ensures that the amplifier can only be switched on when the safety switch, and thus the door of the measuring room, is closed.

The EXTERNAL INTERLOCK and EXTERNAL INTERLOCK RETURN contacts are designed as floating ones. In this way more than one amplifier can be interconnected in an interlock system with a common switch or a common loop.

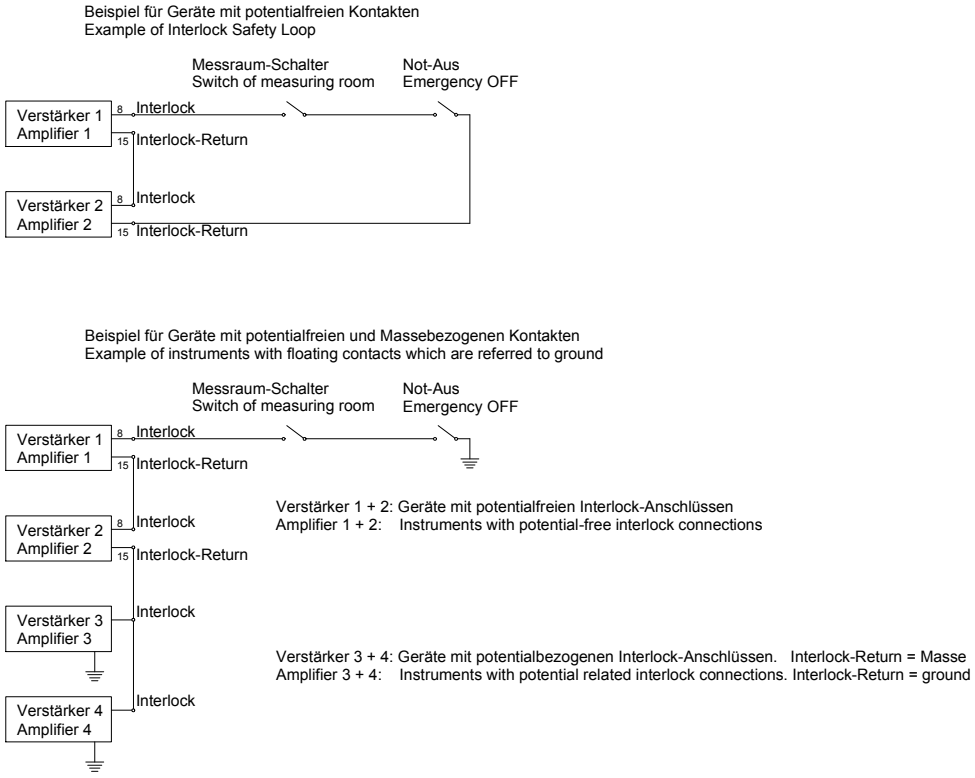


Fig. 7-2 Example of interlock safety loop

If this safety function is not used after thorough examination, the interlock contact can be bridged in the Remote Control and Interlock connector. This is done using a jumper from EXTERNAL INTERLOCK pin 8 to EXTERNAL INTERLOCK RETURN pin 15.

Note: *If the interlock connection is missing, the amplifier cannot be operated!*

Finally check that there is no message indicating an interlock error status on the display. Now the amplifier is ready for use and can be operated either manually via the front panel or via one of the remote control interfaces.

7.2 Functional Description

7.2.1 RF amplifier

See Fig. 25: Block diagram of complete amplifier (in appendix)
See Fig. 26: Block diagram of RF amplifier module (in appendix)

The power amplifier BSA 0125-25I can deliver an output power of 25 W over the frequency range of 9 kHz to 250 MHz.

The five-stage solid-state amplifier is integrated into one module.

The preamplifier is implemented with MIC components (microwave integrated circuits). They ensure high overload immunity and a low VSWR at the input of the amplifier. Three MIC components will amplify the input signal with a flat overall frequency response. The signal of the input stage is split up with 180° phase offset between the two MIC components of the driver stage.

The input stage is decoupled from the input DC voltage via a coupling capacitor. Due to the high linearity over the wide frequency range of the MIC component used, a frequency-dependent negative feedback is not required. The following stages, on the other hand, all feature an individually adjusted negative feedback, resulting in a flat overall frequency response.

The fourth (driver) stage is implemented using FET technology; working in class-A mode, driving the push-pull final stage using bipolar transistors working in class A mode to reduce distortion over the wide frequency range. Following the final stage the signal is recombined again by broadband combiners.

In order to achieve a stable output power, the bias of the FET and bipolar stages are controlled by low-drift voltage regulators.

The maximum input power for achieving the nominal output power is 0 dBm corresponding to 1 mW or 0.224 V into 50 Ω. Due to its gain reserve, the amplifier usually achieves full output power with an input power of -5 dBm.

The final stage is separately protected against overload by current limitation. The amplifier is protected against open circuit and short circuit at the output. By using suitable transistors and a special circuit design in the final stage, even a total mismatch at the output will not cause any damage. For a VSWR ≤ 2:1 the maximum power can be obtained, all specifications being met.

The amplifier housing is designed to ensure minimum RF leakage and high RF immunity. The module is supplied with DC voltage via RF feed through filters.

In order to protect the amplifier against thermal overload in case the blower fails or the ambient temperature is too high, a temperature sensor is mounted on the heat sink in the vicinity of the final stage.

7.2.2 Power supply

See Fig. 27: Block diagram of power supply (in appendix)

The power supply consists of a main power supply module with line filtering and auxiliary power supply modules.

Line filtering

Mains phase and neutral are routed to the line filter via mains fuse and mains switch.

Radiated emissions are avoided by shielding and a special design of the wire connections. Conducted emissions are suppressed by a two stage filtering in the main power supply and the line filter at the mains input.

The radio interference suppression of the complete power supply meets the requirements of class B according to VDE 0871.

Power supply

The main power supply is designed such as to work from an operating voltage range of 100 to 240 V. The front-end module filters the distortions caused by the power factor correction and the switched-mode controller.

The power supply is designed as a switched mode DC-DC converter using resonance converter technology and has an efficiency of >95%. In the front-end of the switched-mode power supply, the required correction of the power factor is integrated. The front-end module also limits the inrush current and provides a transient and over voltage protection.

After switching the instrument on with the mains switch the auxiliary power supply will be operating. It feeds the control circuitry of the amplifier and the power supply even if the outputs of the main power supply are disabled.

The communication between the main control board and the micro controllers on the power supply boards is made via the internal control bus system. All operating conditions or fault status messages are continuously polled and processed.

The power supply control is surveying the status of all DC-DC converter outputs in the power supply. An error status will be indicated by the respective fault message on the front panel display.
As voltage and current of all outputs are continuously monitored a detailed problem diagnosis can be issued.

All DC-DC converter outputs have their own voltage regulation (over voltage protection) as well as an own current limitation circuit.

For optimum adaptation to the final stage transistors the current limitation for each individual transistor can be set directly by the micro controller.

Wherever possible and practicable power supply lines, control lines and RF modules are separated totally. This ensures a minimum of intersignal interference. Radiated emission is limited by the technique used for the RF modules. The conducted emission is limited by two stage filtering. The first filtering is done directly on the power supply modules where the final filtering is done at the AC input.

7.2.3 Monitor output (Option A)

The monitor output is implemented with an internal dual directional broadband coupler for forward and reflected power at the connectors FORWARD and REFLECTED (as a standard at the rear panel).

7.2.4 USB remote control interface (Option U)

The USB interface is integrated on a separate control board which directly communicates to the main control board.

7.2.5 Control

The system control consists of a Bus-system with differential transmission. All boards of the system are connected to the control bus. The main control board will handle all status and fault messages and will control all other control and power supply boards.

7.3 Maintenance and Troubleshooting

7.3.1 Maintenance

In general, the amplifier does not require any maintenance due to its solid-state amplifier design and overrating of all components under thermal stress.

The fan has a lifetime ≥40,000 h; this results in a lifetime of 5 years even with permanent operation.

Cleaning and care of the RF connectors are to be performed according to the regulations valid for N- or SMA- series connectors. All mechanical and electrical specifications are guaranteed for at least 500 plug-in cycles.

For cleaning the front panel, it is best to use a moist, soft cloth and, if necessary, a mild detergent. Solvents must not be used.

7.3.2 Troubleshooting

If the instrument does not react at all please check the following.

- No response after switching the mains on: — Check the mains voltage at the line input of the amplifier.

If a fault message will be indicated, the following should be checked:

- Indication: **Interlock External** — Check the connection to the external interlock switch or jumper in the interlock connector (see Fig. 7-1).
- Indication: **Temperature X** — Check whether the airflow is obstructed.
  Check if the internal blower works.
  Check if the ambient temperature is more than 45 °C
  Allow the instrument to cool down and try to start again.
  Check if the Fault message persists.
- Indication: **PowerSupply X** — Fault of one or more output voltages of the indicated power supply X.
  Switch off the amplifier and try to start again.
  Check if the Fault message persists.
- Indication: **Control fault** — An internal control fault occurred.
  Switch off the amplifier and try to start again.
  Check if the Fault message persists.

If a non-permanent error message is being indicated it has to be confirmed by sending the RESET command before the fault status will be unlatched.

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