Products: R&S IMS, R&S NRP-Z91, HL046E

R&S IMS
Hardware Setup according IEC / EN 61000-4-3 (radiated immunity)

Application Note

This application note describes the general setup and required equipment for EMC measurements according to the EMS standard IEC / EN 61000-4-3

ROHDE&SCHWARZ

1 Contents

2 General Remark

The aim of this application note is to describe the setup and putting into operation for a typical measurement setup.

The application note consists of two main parts:

- EMC Standards

  Background information on the range of EMC tests for commercial equipment and on details of IEC/EN61000-4-6

- Hardware Configuration

  Guide for the selection of appropriate hardware and accessories

There are four application notes covering the commercial sdtandards IEC / EN 61000-4—3 and -6:

- 1SP31 / R&S IMS - Hardware Setup according IEC / EN 61000-4-6 (conducted immunity)
- 1SP32 / R&S IMS -Hardware Setup according IEC / EN 61000-4-3 (radiated immunity)
- 1SP33 / R&S IMS - Software Configuration according IEC / EN 61000-4-6 (conducted immunity)
- 1SP34 / R&S IMS - Software Configuration according IEC / EN 61000-4-3 (radiated immunity)

Note:

To carry out measurements according to the EMC standards requires detailed knowledge of these standards and EMC practice, which can not be covered by this application note.

The setups, especially the equipment, are recommendations. They are based on many years of experience in the design and implementation of EMC systems and have been optimised for best system performance. The use of other components than the recommended ones may result in significant performance changes (e.g. use of other antennas).

In addition the achievable system performance depends not only on the test equipment, but also on the test environment e.g. the anechoic chamber performance. The configurations described in this application note can therefore not guarantee the fulfilment of the respective standards in any case.

3 EMC Standards

The aim of this chapter is to provide background information, for what type of equipment this application note applies. Because the EMC standardisation depends on the local legislation this overview is limited to the European market.

In addition it describes the main requirements of a test setup according IEC/EN 61000-4-6.

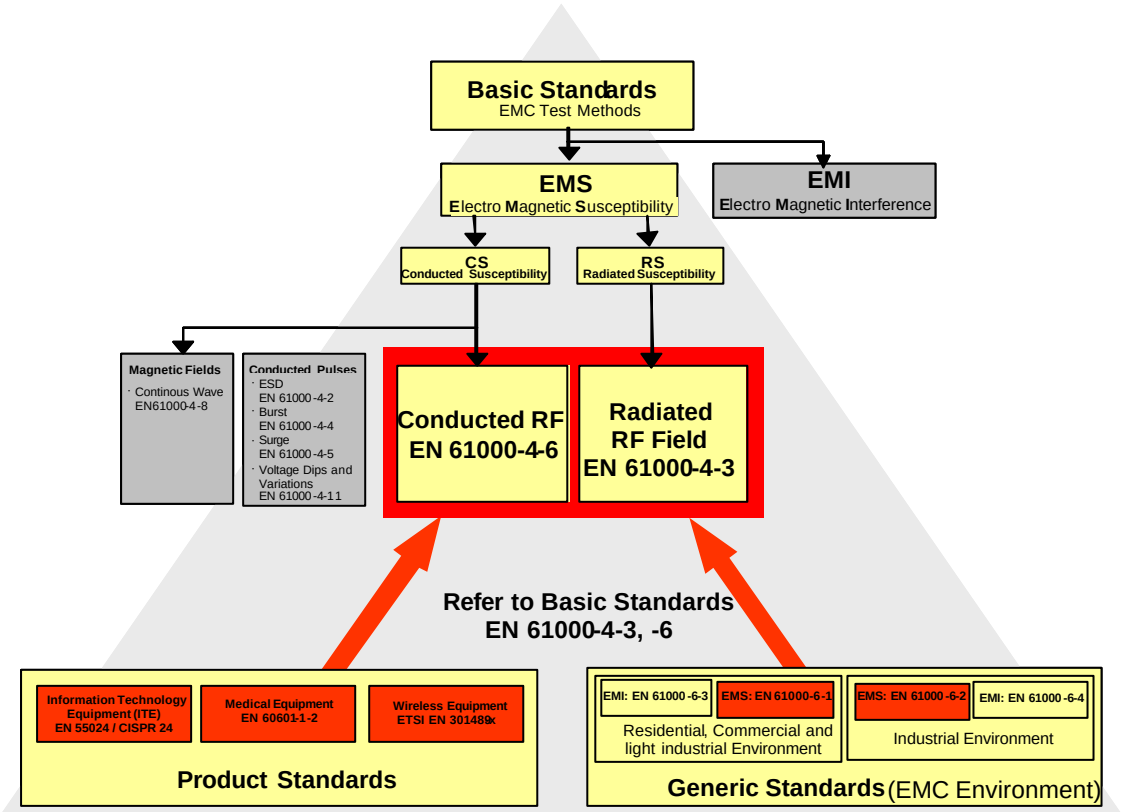
3.1 Applicable commercial EMC standards (EU)

Generally the EMC-Standards are divided into three groups:

- Basic Standard: Describes measurement techniques
- Generic Standard: Describes product environment, references to basic standard
- Product Standard: Describes measurements for type of product, references to basic standard

EN 61000-4-3, -6 are the Basic Standards for radiated and conducted immunity (EMS).

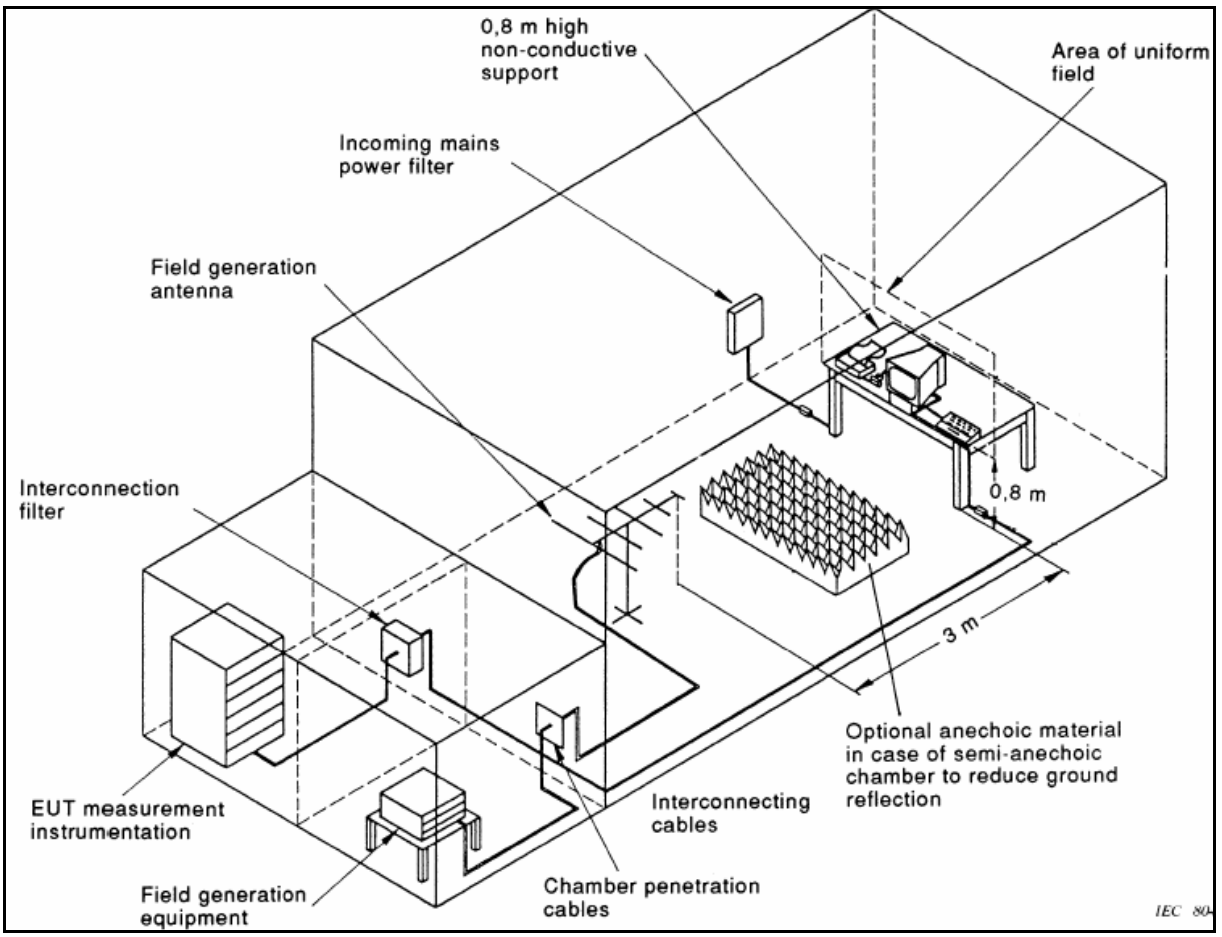
The following diagram gives an excerpt from the covered main standards:



Also other product standards may refer to EN 61000-4-3 and -6, because it is one of the most used basic standard in commercial EMS testing.

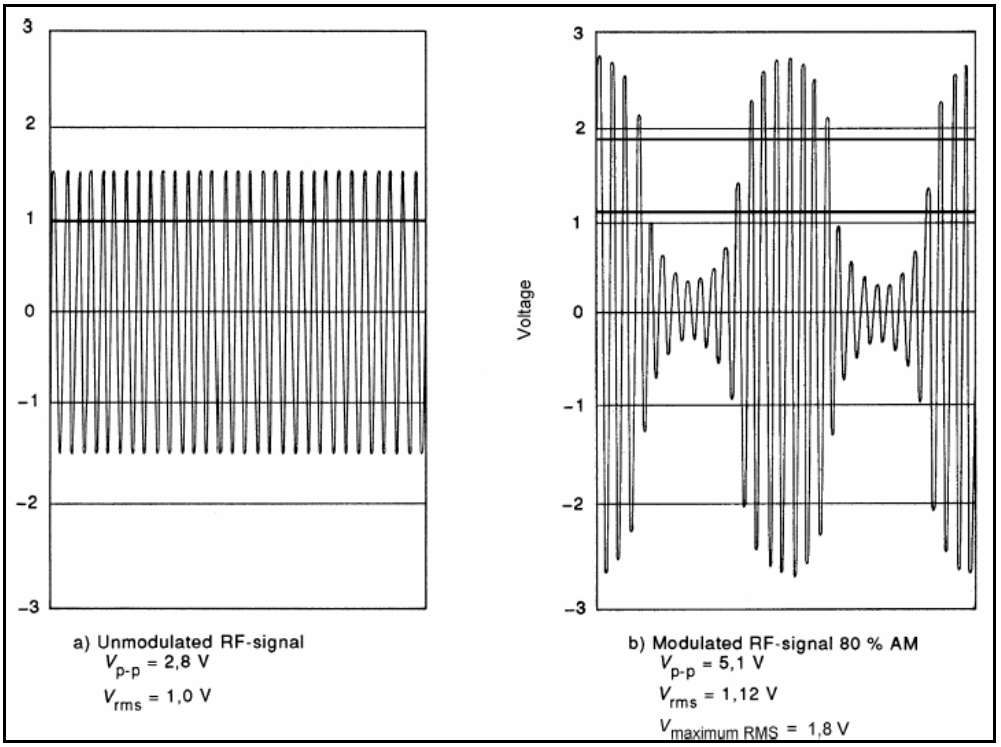
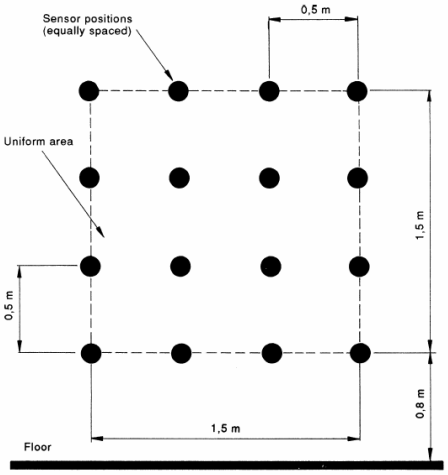
3.2 General Setup acc. IEC/EN61000-4-3

IEC/EN 61000-4-3 describes radiated EMS-tests for commercial equipment.



General Test Setup acc. EN61000-4-3

To carry out these tests detailed knowledge of the standard is necessary. The following is only a short overview of the main parameters, that influence the test system:

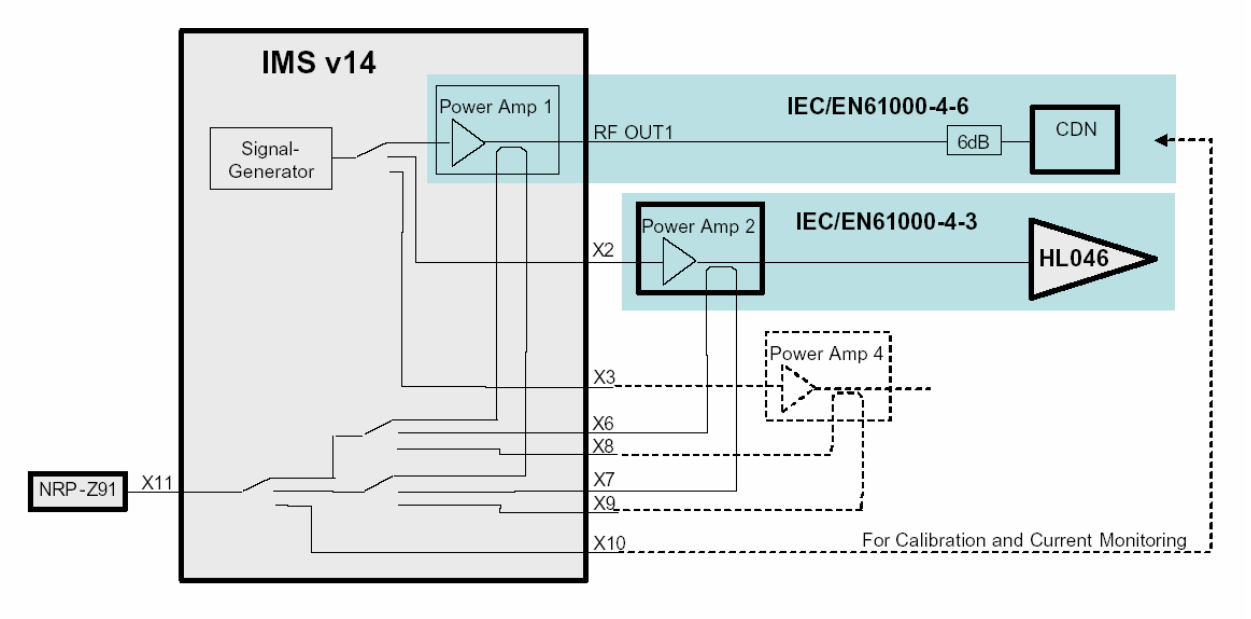
Frequency Range	80 MHz to 2 GHz
Modulation	80% Modulation with 1 kHz  Remark: To achieve 1,8 times higher field strength (80% modulation) 3,24 times more amplifier power is necessary.
Frequency step	≤1%, measurement time per step depends on the EUT, but must be ≥ 1,5 *10^{-3} decades/second
Harmonics	< 15 dBc
Coupling Method	Antenna
Field calibration	The field is measured without EUT in a homogenous area of 1,5 to 1,5 m represented by 16 points (see below). Out of these 16 field values the power required for the test configuration is evaluated. Remark: This evaluation routine according to the standard is implemented in the IMS operating system. 

Test Environment	Shielded room
Test distance	3 m from antenna tip to EUT (recommended)
EUT position	Table top equipment: 0,8 m table height Floor standing equipment: 0,1 m height on non-conducting support
EUT cabling	• Cable length > 3 m: Exposed to the field for a distance of 1 m • Decoupled by filters or ferrite tubes

4 Test System Hardware Configuration

4.1 General Configuration

The block diagram shows the basic system setup described in this application note:



Basic System Setup

Different alternatives are shown in the respective sections of this chapter.

4.2 Hardware for Radiated EMS (IEC / EN 61000-4-3)

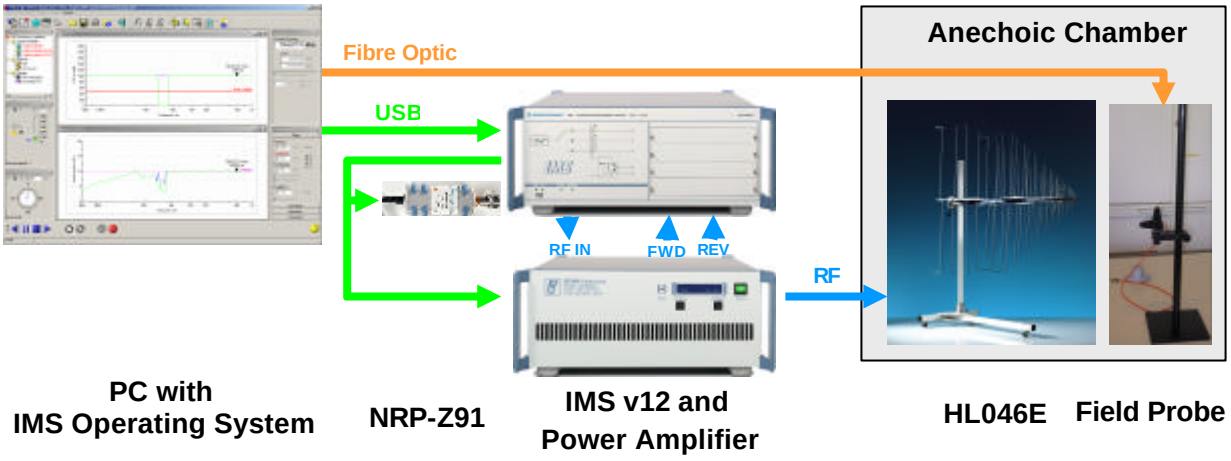
4.2.1 Site Requirements

For operation of the test system it is necessary to have

- Anechoic Chamber with 3 m test distance and floor absorbers
- Turntable (Supported controllers are inn-co, ETS, Frankonia, Siepel, HD Deisel)
- RF and fibre optic feedthrough into the shielded room
- Interlock circuit

Remark: This equipment is mostly delivered completely with the anechoic chamber.

4.2.2 Equipment (Standard Configuration 10 V/m)



The block diagram shows the general setup of a test system according IEC / EN 61000-4-3. It covers radiated fields in the frequency range 80 MHz to 2 GHz. The field strength in 3 m test distance and over an area of 1,5 x 1,5 m is 10 V/m. This configuration for 10 V/m is used by most customers.

Note:

Because 80% modulation is always added during the test, the test system must be capable of generating 1,8 higher field strength (e.g. for tests at 10 V/m plus 80% AM it must be capable of generating 18 V/m CW).

Equipment	Manu-facturer	Type	Field Strength	
			3 V/m	10 V/m
Integrated Measurement System R&S IMS	R&S	1502.0009.12	☺	☺
Documentation Calibration Values R&S IMS	R&S	0240.2193.14	✓✓	✓✓
Power Sensor R&S NRP-Z91	R&S	1168.8004.04	☺	☺
USB-Adaptor (passive) for R&S NRP-Z	R&S	1146.8001.04	☺	☺
Power Amplifier 80 MHz – 2 GHz, 160 / 100 / 60 W with USB-Interface [2) 3)]	Bonn	BLWA0820-160/100/60D	✓	☺
Antenna R&S HL046E with pedestal	R&S		☺	☺
Field Probe	Holaday [1)]	HI6005	☺	☺
Fibre Optic - RS232 Converter for Field Probe	Holaday [1)]		☺	☺
PC for System Control			☺	☺

☺: Mandatory equipment

✓: Equipment possible, but better alternative (☺) available

✓✓: Recommended equipment

[1)] Alternative: Narda EMC300 with probe

[2)] The power amplifier can be placed in the control room due to its low noise and waste heat. A special amplifier room is not necessary for this configuration. Please order stand-alone version, if it should not be rack mounted.

[3)] This power amplifier is a triple band amplifier, which represents the power amplifiers 2 to 4 in the software configuration

4.2.3 Cabling

The following cables are necessary:

Signal Path Name	From	To	Type	Con-nector	Length	Remark
Generator – Amplifier 2	IMS X2 RF OUT2	Amplifier2 Input	RG58 [3]	N	Typ. 0,5 m	
Amplifier2 – RFSensor1 (FWD)	Amplifier2 FWD	IMS X6 FWD2	RG58 [3]	N	Typ. 0,5 m	
Amplifier2 – RFSensor1 (REV)	Amplifier2 REV	IMS X7 REV	RG58 [3]	N	Typ. 0,5 m	
Amplifier2 – EMS Antenna	Amplifier2 OUT	HL046E	RTK81 [1]	N	max. 8 m [1]	Split at feedthrough into anechoic chamber [2], Manufacturer: Rosenberger
Fibre optic cable	Field probe	PC	50/120µm	FSMA	2 x 10 m	Split at feedthrough into anechoic chamber [2]
USB Connection Amplifier	IMS	Amplifier	USB Type B		Typ. 1 m	
Interlock Cable	IMS Interlock					See chapter 4.3

[1] The attenuation of the complete cabling between power amplifier and antenna has to be less than 2 dB at 2 GHz. Other cable types can be used, if this is achieved. Anyway this connection should be as short as possible.

[2] These cables are often placed in the double floor between chamber wall and connection panel.

[3] Cable type is uncritical for small distances (< 1,5 m)

4.2.4 Alternatives

4.2.4.1 Alternative 3 V/m

If only 3 V/m maximum field strength is necessary, the power amplifier can be replaced by the following combination:

Equipment	Manufacturer	Type	Remark
Power Amplifier 80 MHz – 1 GHz, 30 W	Bonn	BLWA0810-30	Dual-Band-Amplifier (represents Amplifier 2 + 3 in configuration)
Option Integrated Monitor and USB-Interface for Power Amplifier	Bonn		
Power Amplifier 1 – 2 GHz, 10 W	Bonn	BLMA1020-10	(Represents Amplifier 4 in configuration)
Option Integrated Monitor and USB-Interface for Power Amplifier	Bonn		
IMS-B2 Transfer Relay	R&S	1502.0838.02	
2 RF cables to power relay			IMS v02 required

Additional cables:

Signal Path Name	**From**	**To**	**Type**	**Connector**	**Length**	**Remark**
Generator – Amplifier 4	IMS X3 RF OUT3	Amplifier3 Input	RG58 [1)]	N	Typ. 0,8 m	
Amplifier4 – RFSensor1 (FWD)	Amplifier3 FWD	IMS X8 FWD3	RG58 [1)]	N	Typ. 0,8 m	
Amplifier4 – RFSensor1 (REV)	Amplifier3 REV	IMS X9 REV	RG58 [1)]	N	Typ. 0,8 m	
Amplifier2 – Transfer Relay	Amplifier2 OUT	IMS K5 (2)	RTK81	N	max. 0,5 m [2)]	
Amplifier4 – Transfer Relay	Amplifier3 OUT	IMS K5 (3)	RTK81	N	max. 0,5 m [2)]	
Transfer Relay – EMS Antenna	IMS K5 (1)	HL046E	RTK81 [1)]	N	max. 7,5 m [2)]	Replaces cable “Amplifier2 – EMS Antenna”

[1)] Cable type is uncritical for small distances (< 1,5 m)

[2)] The attenuation of the complete cabling between power amplifier and antenna has to be less than 2 dB at 2 GHz. Other cable types can be used, if this is achieved. Anyway this connection should be as short as possible.

4.2.4.2 Alternative 30 V/m 800 MHz to 2 GHz

If 30 V/m maximum field strength is required in the frequency range 800 MHz to 2 GHz in addition to the 10 V/m from 80 MHz to 1 GHz, the power amplifiers can be replaced by the following combination:

Equipment	Manufacturer	Type	Remark
Power Amplifier 80 MHz – 1 GHz, 160/100D, USB interface	Bonn	BLWA0810-160/100D	Dual-Band-Amplifier, represents Amplifier 2 + 3 in configuration
Power Amplifier 0,8 – 2,2 GHz, 350 W	Bonn	BLMA0822-350	(Represents Amplifier 4 in configuration)
Option Integrated Monitor and USB-Interface for Power Amplifier	Bonn		
IMS-B2 Transfer Relay	R&S	1502.0838.02	IMS v02 required

Additional cables:

Signal Path Name	**From**	**To**	**Type**	**Connector**	**Length**	**Remark**
Generator – Amplifier 4	IMS X3 RF OUT3	Amplifier3 Input	RG58 [1)]	N	Typ. 0,8 m	
Amplifier4 – RFSensor1 (FWD)	Amplifier3 FWD	IMS X8 FWD3	RG58 [1)]	N	Typ. 0,8 m	
Amplifier4 – RFSensor1 (REV)	Amplifier3 REV	IMS X9 REV	RG58 [1)]	N	Typ. 0,8 m	
Amplifier2 – Transfer Relay	Amplifier2 OUT	IMS K5 (2)	RTK81	N	max. 0,5 m [2)]	
Amplifier4 – Transfer Relay	Amplifier3 OUT	IMS K5 (3)	RTK81	N	max. 0,5 m [2)]	
Transfer Relay – EMS Antenna	IMS K5 (1)	HL046E	RTK81 [1)]	N	max. 7,5 m [2)]	Replaces cable “Amplifier2 – EMS Antenna”

[1)] Cable type is uncritical for small distances (< 1,5 m)

[2)] The attenuation of the complete cabling between power amplifier and antenna has to be less than 2 dB at 2 GHz. Other cable types can be used, if this is achieved. Anyway this connection should be as short as possible.

4.3 Interlock Connection

The interlock is a safety feature, which ensures, that the RF power is only switched on, when the doors to the measurement site are closed. For implementation of the interlock contacts on the entrance doors of the anechoic room are necessary.

Note:

The Interlock is a safety feature. It makes sure, that no person is exposed to hazardous fields or voltages. Therefore a proper installation of an interlock loop is strongly recommended.

The interlock has to be realised by a loop between pin 1 and pin 3 of the IMS interlock connector. The loop has to be equipped with potential free contacts e.g. at the chamber doors. Tests can only be carried out, as long as this loop is closed. Otherwise the test will stop and the signal generator is switched off. In addition with option IMS-B3, the input of the active power amplifier is disconnected from the signal generator output and terminated to 50 Ohm. If the power amplifiers are connected correctly, they are also switched inactive.

If no interlock shall be used due to low amplifier power or because the safety is realised in another way, pins 1 and 3 of the IMS interlock connector have to be bridged.

In addition the interlock connector provides status signals for the power amplifiers and a contact for a display “Test in Progress”.

The interlock cable is customer specific and therefore not delivered with the IMS.

The table shows the pin assignment for the cable, based on three power amplifiers:

Signal	**R&S IMS Interlock 25-pol. D-Sub**	**Bonn PA1 Remote Control 15-pol. D-Sub**	**Bonn PA2 Remote Control 15-pol. D-Sub**	**Bonn PA4 Remote Control 15-pol. D-Sub**	**Signal Type**
Interlock zu PA1	8, 15	8, 15	—	—	
Interlock zu PA2	7, 14	—	8, 15	—	
Interlock zu PA3	6, 13	—	—	8, 15	
Status RF ON PA1	5	2	—	—	
Status RF ON PA2	9	—	2	—	
Status RF ON PA3	17	—	—	2	
Error PA1	12	6	—	—	
Error PA2	4	—	6	—	
Error PA3	16	—	—	6	
Interlock signal to test room	1	—	—	—	+12 V, 0,2A to interlock loop (e.g. chamber door)
Interlock from test room	3	—	—	—	Input of interlock loop
Connection for signal lamp “Test in Progress“	10, 11	—	—	—	Potential-free relay contact, max. 100 V, 0,5 A
Ground	2, 24, 25	7, 14	7, 14	7, 14	

4.4 Combined Conducted and Radiated EMS Test System (IEC / EN 61000-4-3, -6)

Both test systems for radiated EMS (this application note) and conducted EMS (application note 1SP31) can be combined together using the same R&S IMS.

Remark: The only restriction is, that IMS-B2 for the radiated test system (version 3 V/m or 30 V/m with 2 amplifiers) requires IMS v12. In this case the conducted amplifier has to be external.