LANGER
EMV-Technik

User manual

Demonstration Boards Near-Field Probes
EMC-Basic 2 set

Table of contents: **Page**

1 Declaration of Conformity

Manufacturer:
Langer EMV-Technik GmbH

Nöthnitzer Hang 31
01728 Bannewitz
Germany

Langer EMV-Technik GmbH herewith declares that the

EMC-Basic 2 set, Emission Development System

conforms with the following relevant regulations:

- EMC Directive 2014/30/EU
- Low-Voltage Directive 2014/35/EU
- Restriction of certain Hazardous Substances 2011/65/EU

The following applicable standards were used to implement the requirements specified by the aforementioned directives:

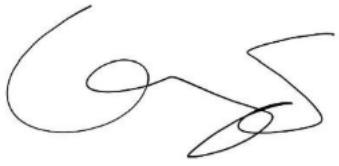
- DIN EN IEC 61000-6-1:2019-11 (EMC immunity)
- DIN EN IEC 61000-6-3:2022-06 (EMC emission)
- DIN EN 61010-1:2020-03 (Safety)
- DIN EN IEC 63000:2019-05 (Restriction of hazardous substances)

Name of the person authorized to compile the technical documentation:

Katja Langer

Bannewitz, 2026-01-14

Signature:



K. Langer, Managing Director

2 General Information

2.1 Storage of the User Manual

This user manual enables the safe and efficient use of the EMC-Basic 2 set. It must be kept close at hand and accessible to the use.

2.2 Reading and Understanding the User Manual

Read the user manual carefully, observe the safety information (Chapter 3) and follow the instructions given in this manual before putting the device into service.

2.3 Local Safety and Accident Prevention Regulations

The local accident prevention and general safety regulations also apply to ensure that the EMC-Basic 2 set is used for its intended purpose.

2.4 Images

Figures and images have been included in this user manual to assist the reader's understanding but may differ from the device's actual version.

2.5 Limitation of Liability

In the following cases, Langer EMV-Technik GmbH can assume no liability for damage to property and personal injury if:

- The information given in this user manual has not been observed.
- EMC-Basic 2 set was operated by staff not qualified in the field of EMC.
- EMC-Basic 2 set was subjected to unauthorized modifications or technical changes.
- EMC-Basic 2 set was not used according to its intended purpose.
- Spare parts or accessories were used that had not been approved by Langer EMV-Technik GmbH.

The actual scope of delivery may deviate from the illustrations and texts in this user manual due to the customization of orders or due to technical changes and innovations.

2.6 Errors and Omissions

The information in this manual has been carefully checked and is believed to be accurate; however, the Langer EMV-Technik GmbH assumes no responsibility for any clerical, typographical, or proofreading errors, or omissions.

2.7 Copyright

3 Safety

3.1 Labels and Signs

		
General warning sign	Warning; Electricity	Prohibition sign; No access for people with active implanted cardiac devices.
Table 1: Safety signs		

Safety instructions in this user manual are marked by symbols (**Table** 1). Observe the safety precautions and act cautiously to avoid accidents as well as personal and material damages.

3.2 Intended Use

The EMC-Basic 2 set with the SA 11 and SA 21 demonstration boards is an assembly for demonstrating emission phenomena.
These boards allow demonstrations of various EMC measurement devices such as spectrum analyzers and near-field probes from all manufacturers. Similarly, emission measurements with antennas are possible. With the demonstration boards, magnetic (SA 11) and electric (SA 21) emission effects can be shown on one board each with the help of suitable near-field probes (B-field: RF-R 50-1 and E-field: RF-E 05).

3.3 Reasonably foreseeable Misuse

	**Danger resulting from misuse!** **Misuse of the EMC-Basic 2 set can lead to dangerous situations!**
Warning!	

Incorrect applications of the sets include:

- Use of the product outside of the given specifications.
- Modification or changes to the product without the consent of Langer EMV Technik GmbH.
- Operation of the product with a technical defect.

3.4 Staff Requisition

Only qualified staff with training, knowledge, and experience in the field of EMC is allowed to operate the EMC-Basic 2 set.

Persons whose ability to perform is influenced or impaired by alcohol, drugs, or pharmaceuticals, are not allowed to operate the EMC-Basic 2 set.

3.5 Safety Instructions

 Warning; Electricity!	**Danger resulting from electricity!** **Risk of injury by electrocution!**

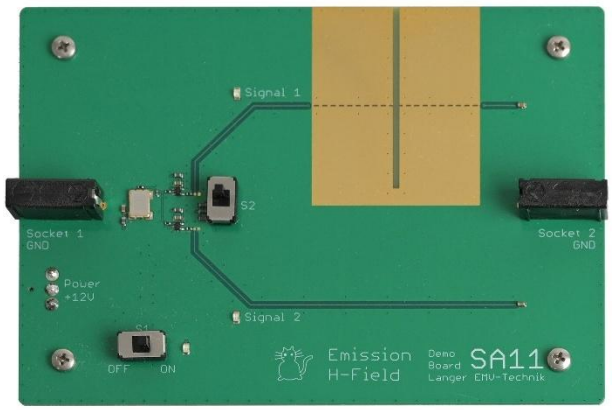
4 Scope of delivery

SA 11 – Demo Board Emission B-Field

Short Description
The Demo Board SA 11 is an assembly on which demonstration tests for magnetic field for interference emission are carried out.
A spectrum analyzer is used to display the measurement results. On the Demo Board SA 11, e.g. antennas, near-field probes, the development system ESA1 of Langer EMV-Technik GmbH or other measuring devices for emitted interference can be demonstrated.

Technical Parameters

Supply voltage	12 V
Current input	ca. 20 mA
Sizes (L x W x H)	(140 x 100 x 23) mm

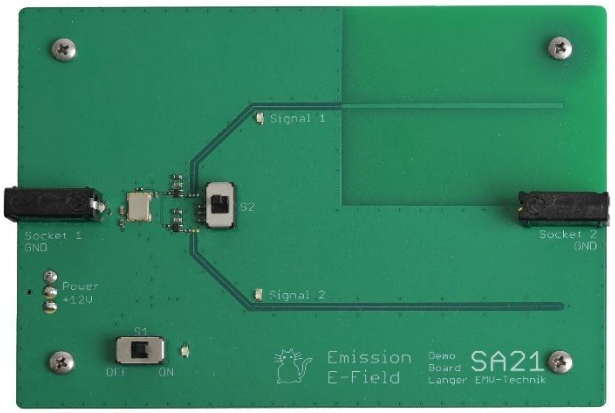


SA 21 – Demo Board Emission E-Field

Short Description
The Demo Board SA 21 is an assembly on which electric field demonstration tests for interference emission are carried out.
A spectrum analyzer is used to display the measurement results. At the Demo Board SA 21 e.g. antennas, near field probes, the development system emitted interference ESA1 of Langer EMV-Technik GmbH or other measuring devices for emitted interference can be demonstrated.

Technical Parameters

Supply voltage	12 V
Current input	ca. 20 mA
Sizes (L x W x H)	(140 x 100 x 23) mm



NT FRI EU – Power Supply Unit

Technical Parameters

Output voltage	12 V

RF-R 50-1 – Near-Field Probe (B-field)

Short Description
The RF-R 50-1 magnetic field probe is suitable for measurement on assemblies at a distance of up to approx. 3 cm. The near field probe is connected to a spectrum analyzer or an oscilloscope with 50 Ω input.
The RF-R 50-1 is a passive near-field probe and has no 50 Ω terminating resistor internally.

Technical Parameters

Frequency range	30 MHz ... 3 GHz
Connector	SMB
Weight	16,5 g
Dimensions probe head	Ø ≈ 10 mm
Sizes (L x W x H)	(150 x 12 x 9) mm

RF-E 05 – Near-Field Probe (E-field)

Short Description
The electrode at the bottom of the probe head of the RF-E 05 is approx. 0.5 mm wide. This allows E-fields from clocked lines, IC pins or smaller components to be localized very precisely. The near-field probe is connected to a spectrum analyzer or an oscilloscope with 50 Ω input.
The RF-R 50-1 is a passive near-field probe and has no internal 50 Ω terminating resistor.

Technical Parameters

Frequency range	30 MHz ... 3 GHz
Connector	SMB
Weight	15,5 g
Dimensions probe head	≈ (1 x 8) mm
Sizes (L x W x H)	(150 x 9 x 9) mm

SMB - BNC – Probe Connection Cable

Technical Parameters

Length	1 m
Connection	SMB BNC

5 Demo Board

5.1 Structure and Function

5.1.1 General Structure

With two different demo boards, emission mechanisms can be displayed. The demo boards are printed circuit boards with the same basic structure (Figure 1):

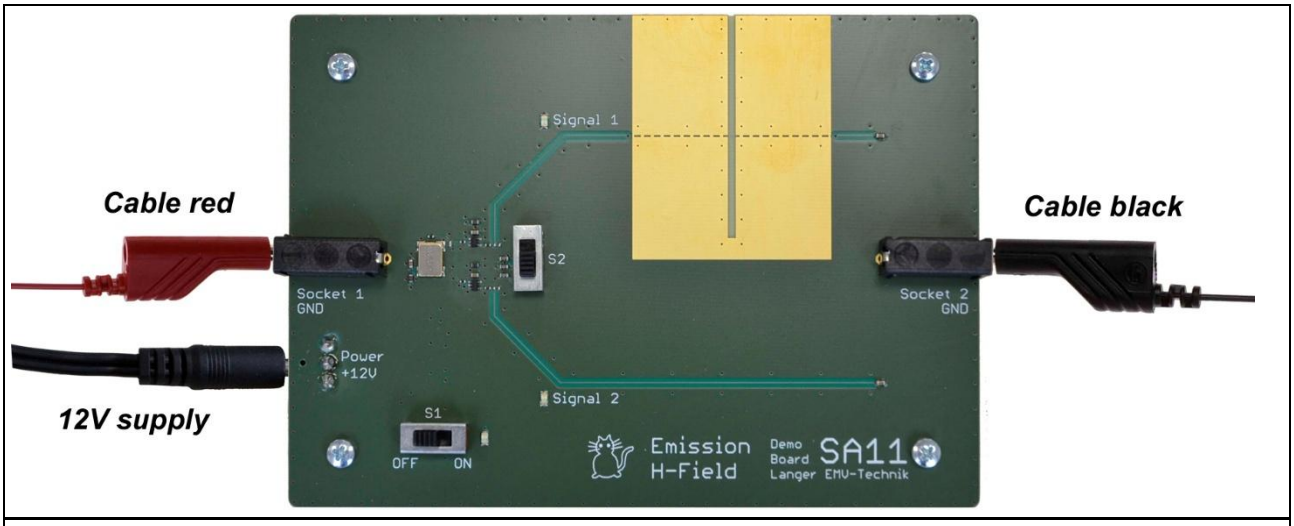


Figure 1: Demo board with connected cables

- Power is supplied by the included power supply unit and the socket labeled "Power +12 V" on the left side of the demo boards.
- The demo boards are switched on with the switch labeled “S1”. For control purposes a red LED lights up directly to the right of the switch.
- All demo boards have two signal lines labeled “Signal 1” and “Signal 2” on the upper side, which can be switched by the switch labeled “S2”. The currently active signal line is indicated by a red LED directly at the lettering "Signal 1" or "Signal 2". On all demo boards, the signal line Signal 1 is installed without EMC protection. In contrast, the signal line Signal 2 is embedded in GND. All demo boards have four layers.
- On the left and right side of the demo boards there is a 4 mm socket labeled "Socket 1 GND" and "Socket 2 GND" respectively. Depending on the test set-up, the supplied laboratory cables or possibly existing laboratory cables of other lengths can be connected there.
- Four rubber feet allow the Demo Boards to stand safely on both insulating and conductive surfaces.

5.1.2 Demo Boards for Demonstration of Emission

Together with a spectrum analyzer, the SA demo boards (Figure 2) are suitable for demonstration experiments on interference emission. They can be used in conjunction with antennas, near-field probes and the ESA1 development system of the Langer EMV-Technik GmbH.

Figure 2: Demo boards for interference emission SA 11 and SA 21

5.1.3 SA 11 Demo Board

The oscillator of the SA 11 generates a digital signal at 10 MHz, which is fed from the output of an IC via the line Signal 1 or Signal 2 to a capacitor. This capacitor simulates the capacitive load that would be present in a real assembly by the input capacitance of a connected IC input or by the gate capacitance of a transistor. This results in a current which generates a magnetic field B.
In Figure 3, Signal 1 is active. The conductor loop Signal 1 - Capacitor - GND runs across the gap in the GND system, the resulting magnetic field is shown in green. The component $B_1(t)$ of the magnetic field orbits the GND system and induces a voltage U_{ind}, which leads to interference emission.

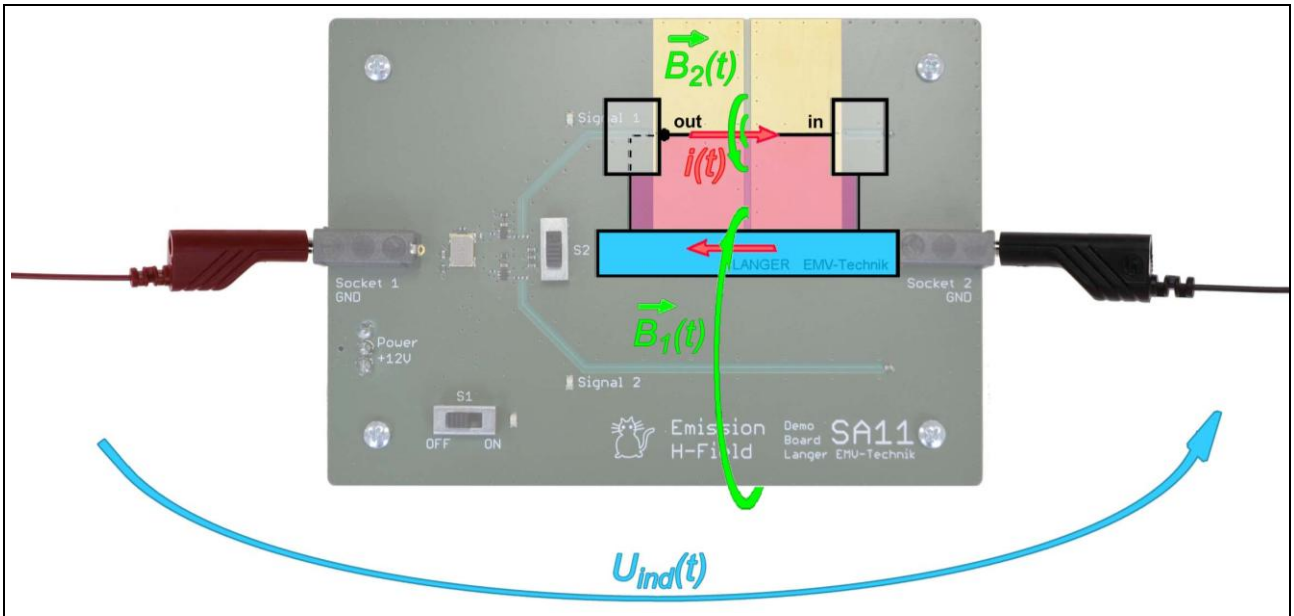


Figure 3: Emission by magnetic field at SA 11

If Signal 2 is used as the source, the emission is significantly lower, since the conductor loop Signal 2 - capacitor - GND is completely backed with GND and therefore cannot form the magnetic field.

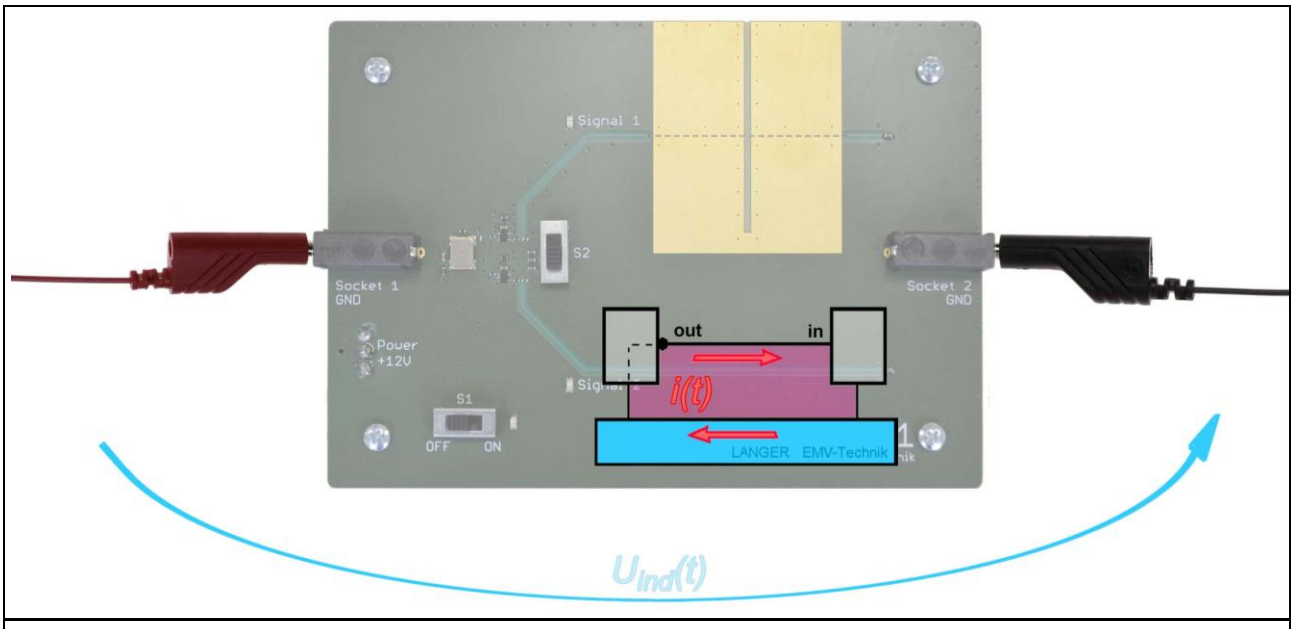


Figure 4: Signal 2 of the SA11 generates almost no magnetic field

By measuring the cable with the aid of a near-field probe and a spectrum analyzer, a qualitative evaluation of the interference emission can first be made. This depends on the demo board and the length and position of the connected cables.

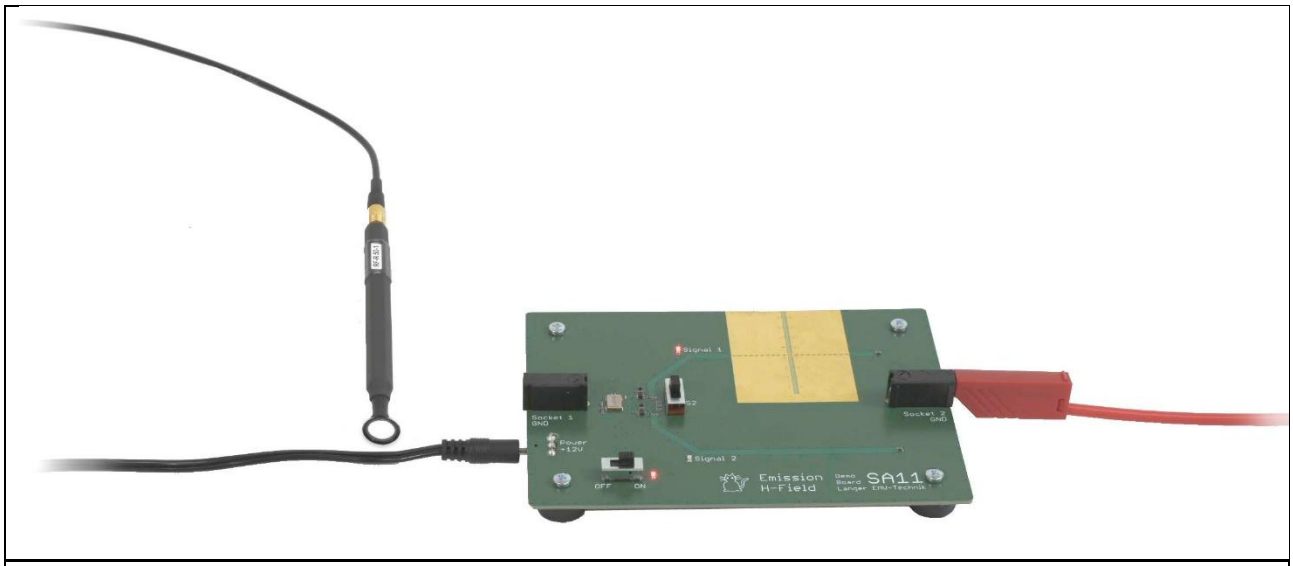


Figure 5: Measurement of the interference emission with the RF-R 50-1 near-field probe on the cable

The generation of magnetic fields on the SA 11 demonstration board can be reproduced with the aid of the RF-R 50 magnetic field probe. A square wave signal with 10 MHz is generated on the board. This is output on signal 1 or 2 depending on the switch position. When signal 1 is active, a strong magnetic field is generated in the gap. If signal 2 is active, the fi eld is significantly lower.

To measure the magnetic field, the probe is passed over the assembly by hand at a distance of approx. 1 cm (Figure 6)

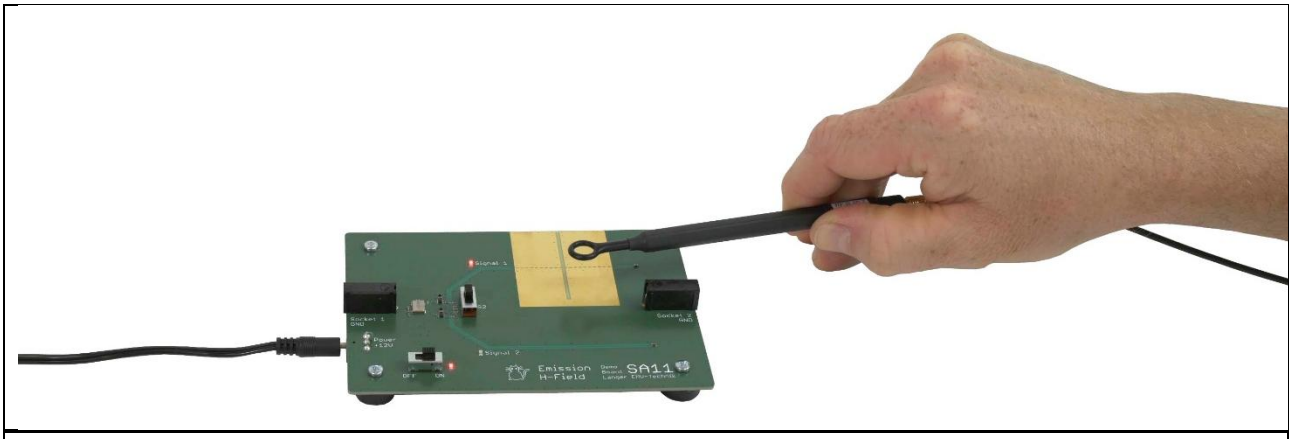


Figure 6: RF-R 50-1 near-field probe is routed via the SA11 demo board for signal 1

When signal 1 is active (selected at switch S 2), magnetic field is deliberately enabled through a gap in the GND surface. It penetrates between the signal line 1 and GND through the gap in the GND surface through the module - interference emission occurs.
When signal 2 is active, the magnetic field is significantly smaller, since the signal line is completely backed by GND.

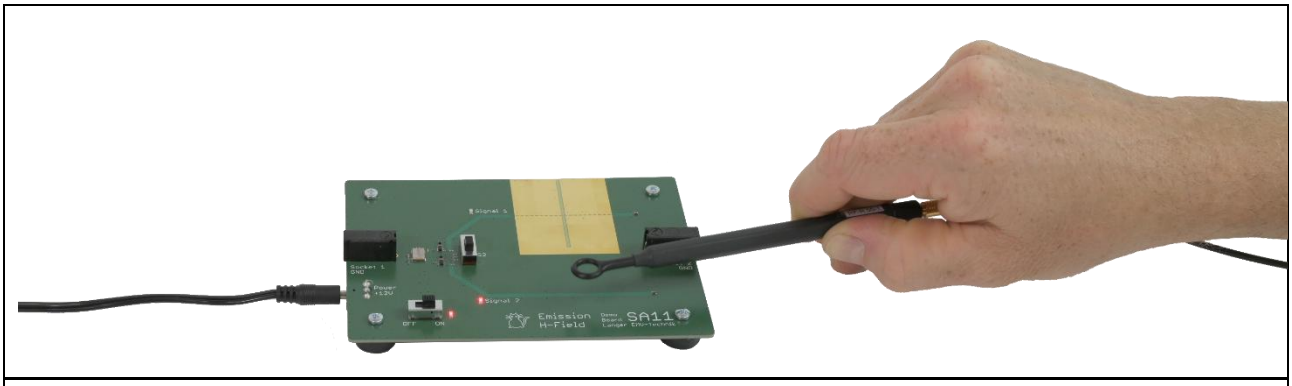


Figure 7: Above the signal line 2, the magnetic field is significantly lower

For comparison, Figure 8 and Figure 9Figure 9 show the magnetic fields emerging vertically from the assemblies at 60 MHz. The measurements were performed with the RF-B 3-2 magnetic field probe and a Langer Scanner.

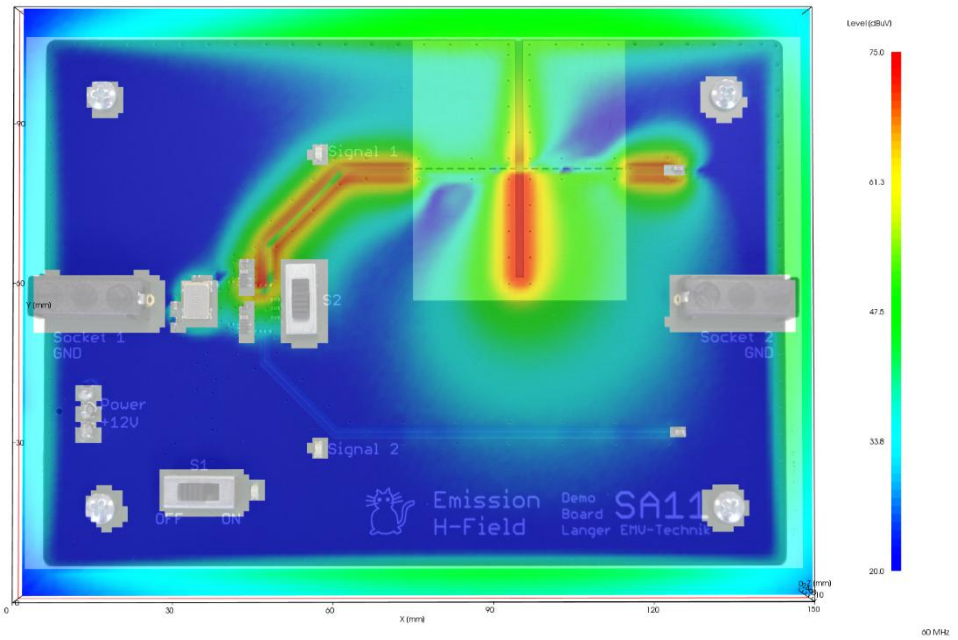


Figure 8: Vertical component of the magnetic field at 60 MHz; SA 11; Signal 1 active

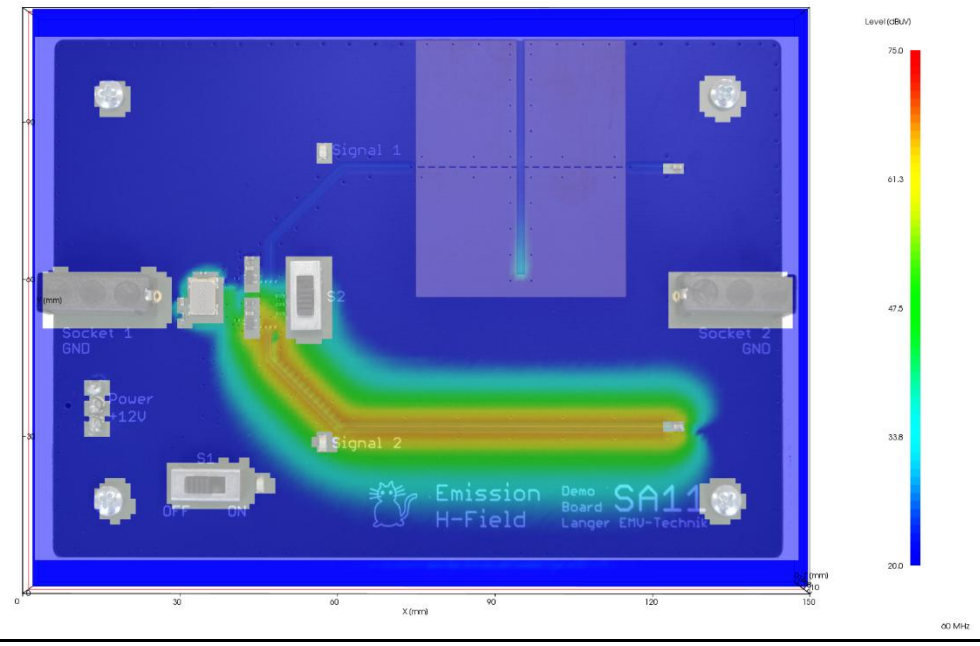


Figure 9: Vertical component of the magnetic field at 60 MHz; SA 11; Signal 2 active

If Signal 2 is active, almost no magnetic field can be detected outside the GND area of the demo board. This result corresponds to the measurements with antenna (see Section 5.2.1) and RF current transformer (see Section 5.2.2).

Modification:

The magnetic field generated when signal 1 is active can be greatly reduced by bridging the GND gap with copper tape.

To evaluate the improvement, a measurement with the RF-R 50-1 magnetic field probe on the cable analogous to the measurement shown in Figure 10 is recommended.

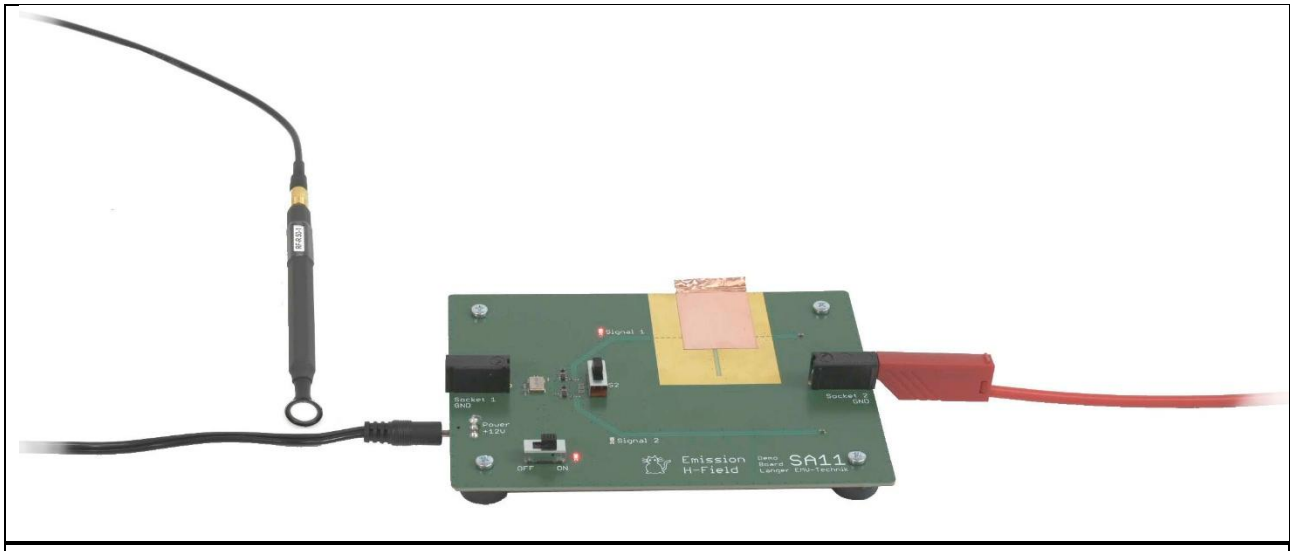


Figure 10: Reduction of interference emission by a piece of adhesive copper tape

5.1.4 SA 21 Demo Board

Unlike the SA 11, no components are connected to Signal 1 and Signal 2 of the SA 21. The capacitive coupling to GND is limited to the parasitic capacitances caused by the layout. This results in a much larger electric field (Figure 11).

In real circuits this corresponds to signals that drive inputs with very small input capacitance or that are used for programming (pull-up resistors of several kOhm have almost no significance for HF).

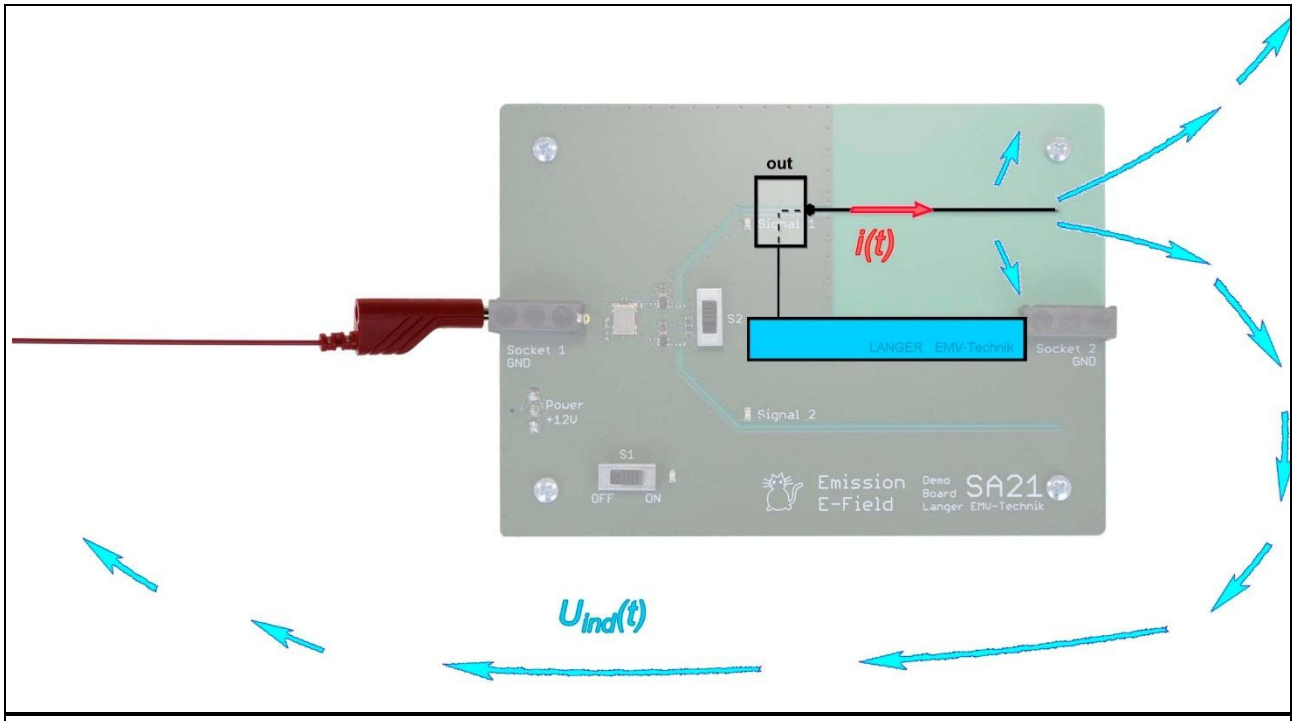


Figure 11: Signal 1 of SA 21 generates E-field

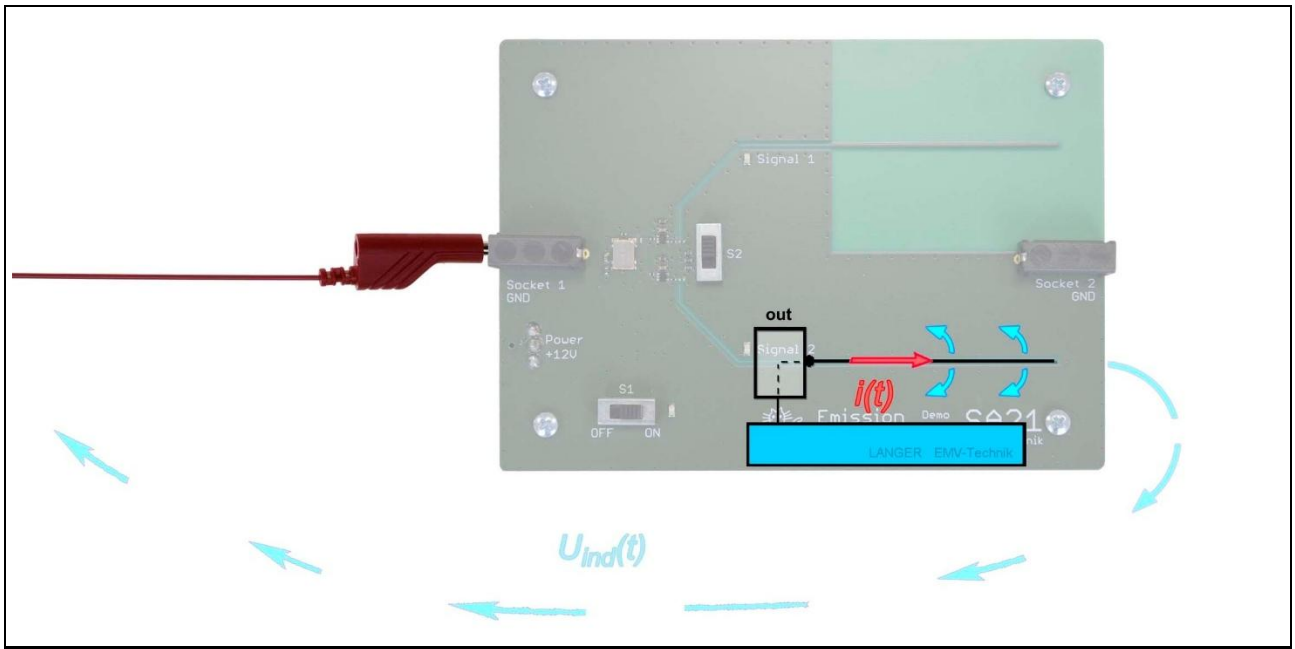


Figure 12: The E-field of Signal 2 couples back to GND

Part of the electric field couples out of the signal line 1 into the environment and generates interference emission. When signal line 2 is active, the E-field is shielded by the GND tarpaulin. A measurement with a magnetic field probe on the cable shows how strongly the assembly causes interference emission.

Figure 13: Measurement of the interference emission with the RF-R 50-1 near-field probe on the cable

An E-field probe, e.g. the RF-E 05, is required to investigate the actual field sources.
The E-field probe is passed over the module at a distance of approx. 1 cm to determine and compare the fields of signal 1 and signal 2.
It can be seen that the electrical field is effectively reduced by placing GND behind signal line 2 compared to the completely exposed line on signal 1.

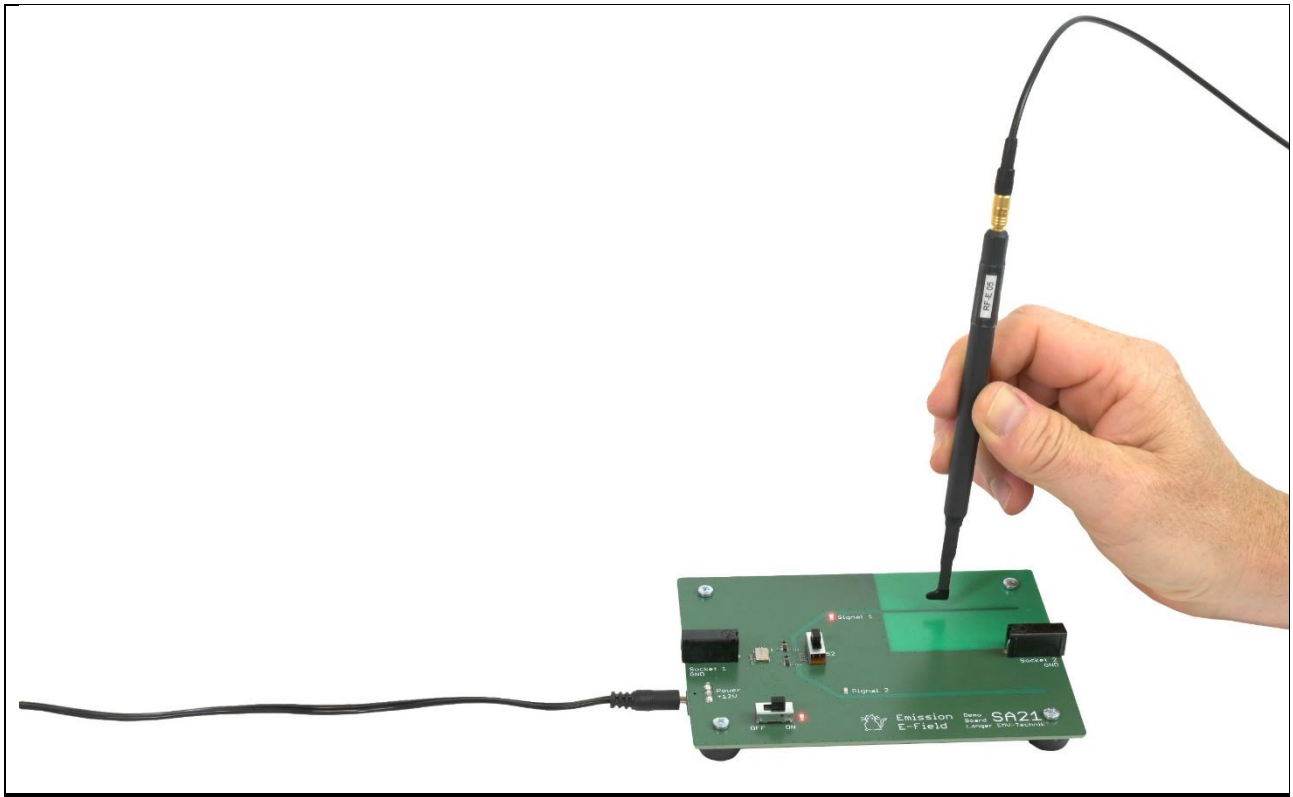


Figure 14: E-field measurement with the RF-E 05 E-field probe over the active signal line 1

5.2 Demonstration Tests for Emission

5.2.1 Tests with an Antenna

Laboratory cables can be connected to one or both GND sockets of the SA 11 and SA 21 demo boards. Together with the demo boards, these cables act as an antenna and generate an interference emission which can be measured with a receiving antenna, e.g. in an anechoic chamber.
However, during demonstrations at events, unfavorable environmental conditions usually prevail. Laptops, beamers, audio systems and similar equipment generate a high level of interference, so that the emission of the demo boards can only be measured to a very limited extent. The curves shown in Figure 15 were generated under favorable environmental conditions and with the antenna placed close to the test set-up. If demonstrations with an antenna are planned, it is essential to make preliminary measurements and select suitable tests based on the results.

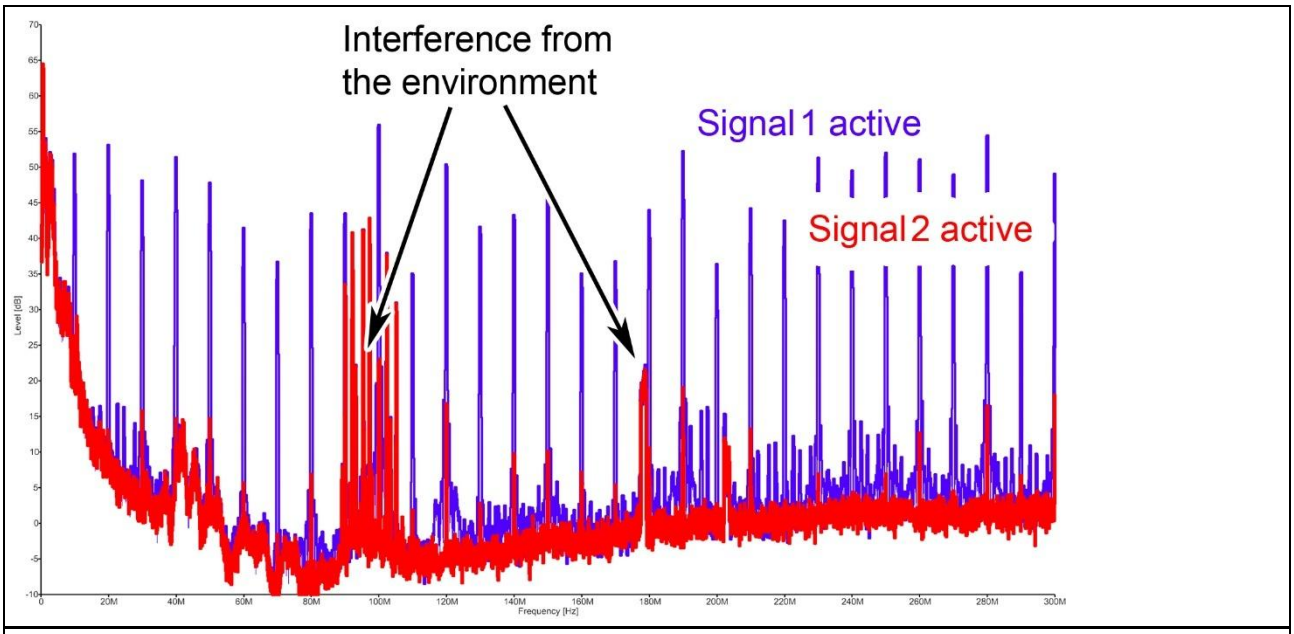


Figure 15: Measured emission of a demo board with two cables connected

5.2.2 Tests with ESA1 Emission Development System

For comparative measurements with different DUTs or for the evaluation of modifications to DUTs during development, measurement procedures such as those possible with the ESA1 emission development system are suitable.
Figure 16 shows a typical set-up: The SA 11 (or SA 21 respectively) demo board is connected with its supply line to the HFW 21 RF current transformer on one side. The supply voltage coming from the power supply unit is fed through filters in the metallic GP 23 base plate and through the current transformer.
Since the interference emission of the demo board is via the connected line (typically for most electronic boards), the RF current in this line can be used as a measure for the interference emission of the demo board.

For a better overview, Figure 16 was photographed without the associated shielding tent.

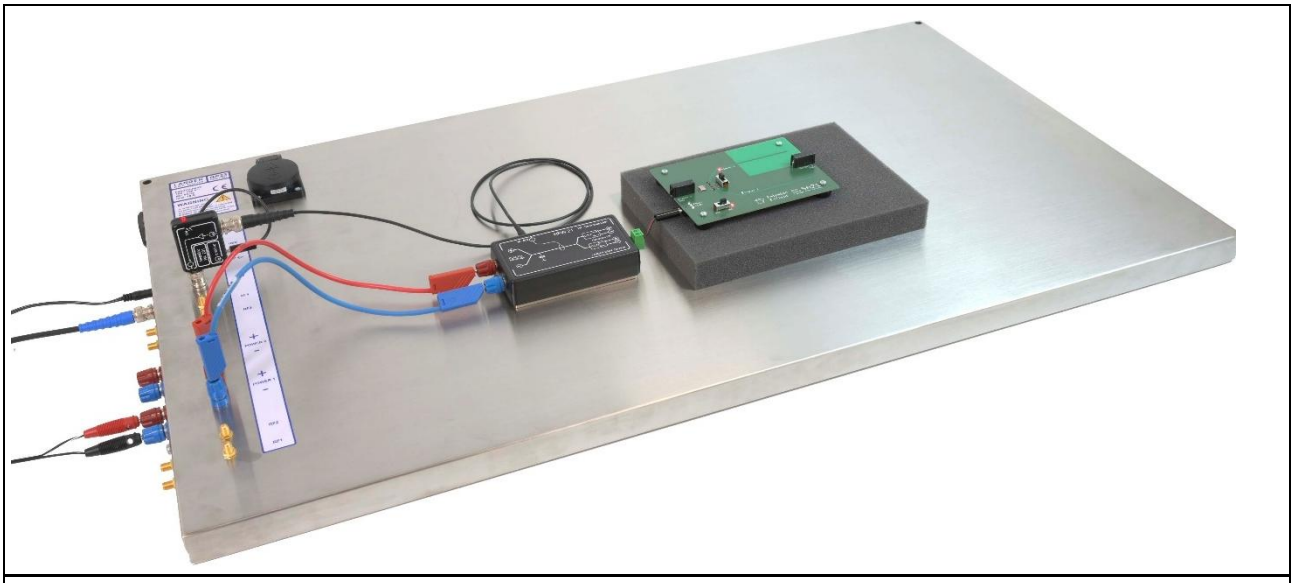


Figure 16: RF current measurement with SA 11 demo board and HFW 21 RF current transformer

It is recommended to measure and store the RF current with a spectrum analyzer to show the different effects of Signal 1 and Signal 2 or changes in the test set-up. In conjunction with a spectrum analyzer, we recommend using the ChipScan-ESA software (from Langer EMV-Technik GmbH) with which the following measurement results were also recorded.

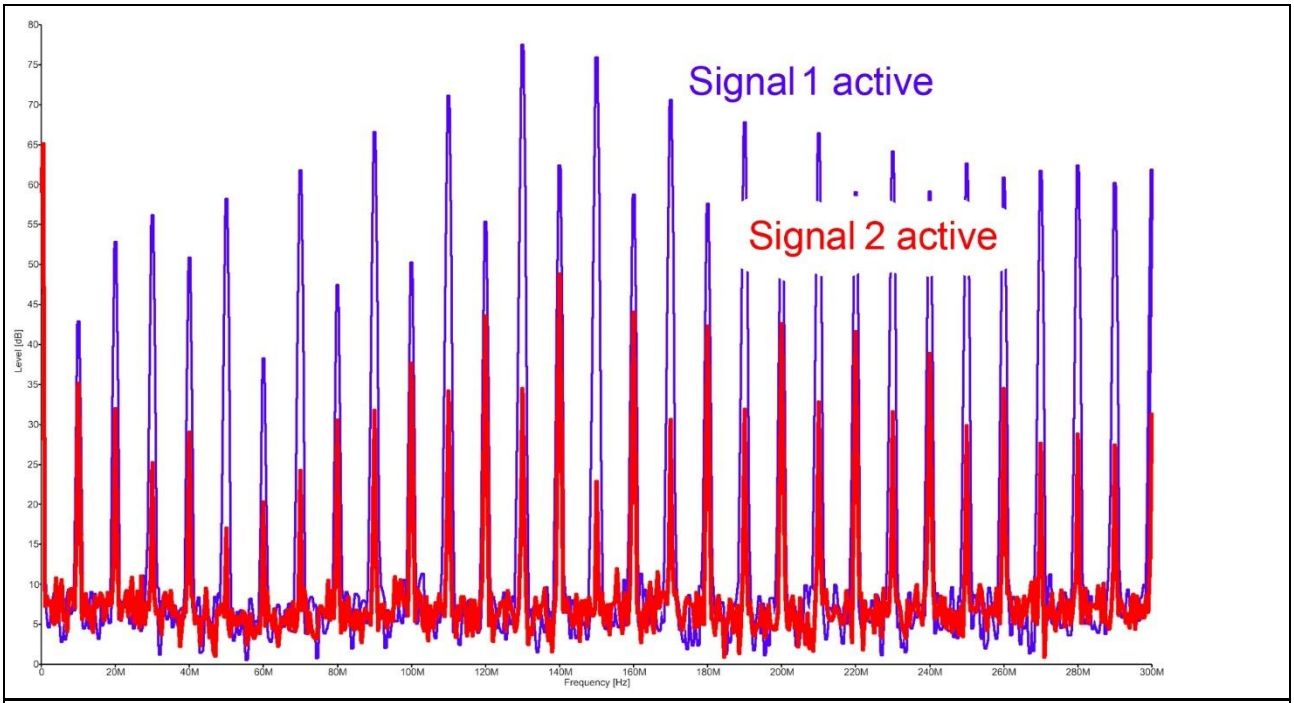


Figure 17: RF current measured at SA 11 with HFW 21

Figure 17 shows the measurement results with SA 11 single-pole connection. The oscillator frequency of SA 11 and SA 21 is 10 MHz, the harmonics are clearly visible as needles in the spectrum. For practical demonstrations, the frequency range below 300 MHz is suitable, since at higher frequencies, depending on the ambient conditions, additional effects can occur and the measurement results become less clear.

5.2.3 Tests with Near-Field Probes

As a simplified variant for comparative measurements or for the evaluation of modifications, the RF current on the supply line can be measured with a near-field probe as shown in Figure 18. In addition to the RF current generated by the DUT, the RF current coupled in from the environment (radio transmitter, etc.) is also measured. The length and position of the supply line also influence the measurement result.

The SA 11 demo board is particularly suitable because the decoupling of electric field is particularly effective when only one cable is connected. This cable - the power supply line - is measured with the near-field probe (Figure 18).

Depending on the DUT it may be useful to increase the sensitivity of the measurement set-up by using a ferrite collapsible core (Figure 19). The core increases the transformer coupling between the supply line and the near-field probe. Under unfavorable ambient conditions, however, interference from the environment can cause the spectrum analyzer input to be overloaded, so that this test set-up is not generally recommended.

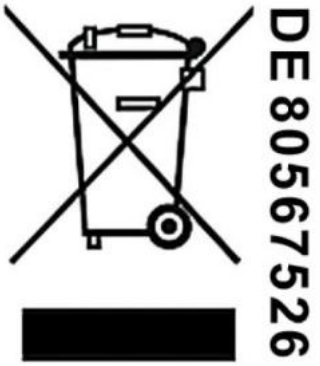
Figure 18: RF current measurement on the supply line connected to the SA 11 demo board

Figure 19: Using a ferrite core for the RF current measurement

6 Information on Recycling and Disposal

In accordance with the WEEE Directive 2012/19/EU (Waste of Electrical and Electronic Equipment), the following must be observed:

At the end of its service life, this product should be taken to a suitable disposal facility for recycling and disposal. Do not dispose of with household waste.



7 Customer service

Please contact us if you have any questions, comments or suggestions.

You can contact us:

Monday – Friday
8:00 Uhr bis 15 Uhr (CET)

Contact us at:

Address: Langer EMV-Technik GmbH
Nöthnitzer Hang 31
01728 Bannewitz
Germany

Internet: https://www.langer-emv.com/
E-mail: sales@langer-emv.de
Phone: +49 (0) 351-430093-0
Fax: +49 (0) 351-430093-22

Calibration

We recommend having the product calibrated every two years by the manufacturer Langer EMV-Technik GmbH or by a certified distributor.

8 Warranty

Langer EMV-Technik GmbH shall remedy all defects attributable to material or manufacturing faults within the statutory warranty period by repairing the product or supplying replacement parts.

This guarantee is only granted on condition that:

- the information and instructions in the operating instructions are observed.

The guarantee expires if:

- an unauthorized repair is carried out on the product
- the product is modified
- the product is not used as intended

LANGER
EMV-Technik GmbH
Noethnitzer Hang 31
DE-01728 Bannewitz
www.langer-emv.de
Tel.: +49 351/430093-0
Fax: +49 351/430093-22
sales@langer-emv.de