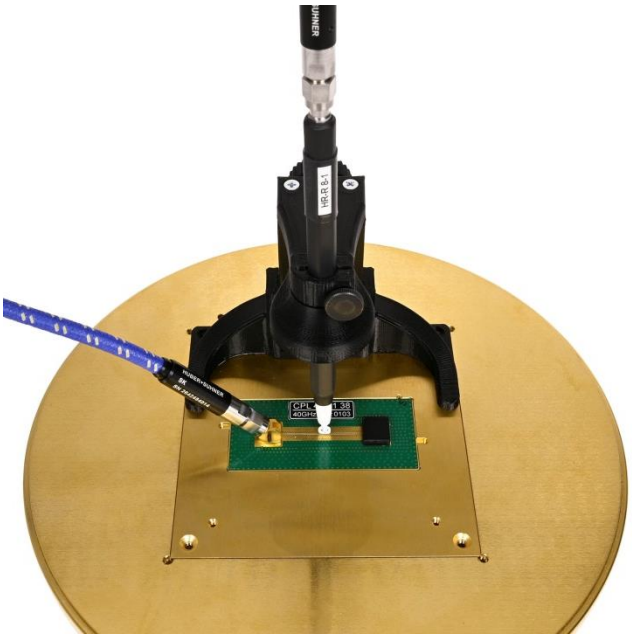
LANGER
EMV-Technik

User manual

HR-R 8-1 set

Near-field probe set up to 40 GHz

B-field



- Translation -

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1 Declaration of Conformity

Manufacturer:

Langer EMV-Technik GmbH
Nöthnitzer Hang 31
01728 Bannewitz
Germany

Langer EMV-Technik GmbH herewith declares that the

HR-R 8-1 set, Near-field probe set up to 40 GHz; B-field
with near-field probe HR-R 8-1

conforms with the following relevant regulations:

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

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

- EN 61000-6-3:2011-09 (EMC)
- DIN EN 61000-6-1:2007-10 (EMC)
- DIN EN 50581:2013-02 (Restriction of hazardous substances)

Name of the person authorized to compile the technical file:

Bannewitz, 2023-05-11

(Signature)
G. Langer, Managing Director

2 General Information

2.1 Storage of the User Manual

This user manual enables the safe and efficient use of the HR-R 8-1 set. It must be kept close at hand and accessible to the user.

2.2 Reading and Understanding the User Manual

Before using the product, the user must have read and understood the operating instructions. If you have any questions or comments, please contact Langer EMV-Technik GmbH.

2.3 Local Safety and Accident Prevention Regulations

The applicable local general safety and accident prevention regulations must be adhered to.

2.4 Figures and graphics

Figures and graphics 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.
- the product has been used by persons who are not qualified in the field of EMC and are not suitable to work under the influence of interference voltage and electromagnetic ESD fields.
- the product was not used according to its intended purpose.
- the product was subjected to unauthorized modifications or technical changes.
- Spare parts or accessories were used that had not been approved by Langer EMV-Technik GmbH.

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

2.8 Description of Symbols

Warning signs	
 General warning sign	 Warning against dangerous electrical voltage hazard

3 Scope of delivery

Item	Designation	Type	Quantity
01	Magnetic field probe up to 40 GHz; B-field	**HR-R 8-1**	1
02	Software ChipScan-ESA Viewer	CS-ESA Viewer	1
03	HR-R 8-1 characteristic curves	HR-R char	1
04	System case	Case 4	1
05	Quick guide	HR-R 8-1 qg	1
06	User manual	HR-R 8-1 m	1

Important:
The scope of delivery may deviate depending on the respective order.

Figure 1: system case HR-R 8-1 set

4 Technical Parameters

4.1 HR-R 8-1 B-field probe

Weight	15 g
Housing dimensions (L x B x H)	(147 x 9 x 9) mm
Upper frequency limit	40 GHz
Lower frequency limit	Depending on the measuring device
Output resistance	50 Ω
Connection - output	2,92 mm (K), female, jack
Probe head dimensions	5x5x2 mm

Table 1: technical Parameters HR-R 8-1 B-field probe

5 Safety

5.1 General safety instructions

The operating and safety instructions for all devices used must be observed.

Damaged or defective devices must not be used.

The use of the near-field probes on DUTs with voltages greater than safety extra-low voltage is only permitted by trained personnel. Additional protective measures (e.g. isolating transformer, additional insulation) must be provided to protect against electric shock and to minimize the risk of injury.

Depending on the measured field strength, voltages may occur at the output of the probes which are higher than the max. permissible input voltage of the connected device. This may also occur in the case of short-time events such as short circuits, high inrush currents, etc. If necessary, appropriate protective measures such as attenuators, transient limiters or similar must be used.

The probe tip is sensitive to mechanical stress and does not provide guaranteed isolation. To protect the DUT and the connected measuring instrument, the user must provide appropriate isolation, if necessary.

5.2 Intended Use

The HR-R 8-1 near field probe is a passive probe which converts high-frequency magnetic near fields into current or voltage. It may only be used by personnel with expertise in the field of EMC to measure these near fields. The probe is designed for connection to spectrum analyzers, oscilloscopes and similar devices.

5.3 Reasonably foreseeable Misuse

Reasonably foreseeable misuses of the HR-R 8-1 set include:

- Use of the product outside of the given specifications.
- Modification or changing of the product without consent of Langer EMV-Technik GmbH.
- Operating the product with a technical fault.

No liability is accepted for damage caused by improper use.

5.4 Staff Requisition

Only qualified staff with training, knowledge, and experience in the field of EMC is allowed to operate the HR-R 8-1 set.
Only persons who are qualified to work under the influence of interference voltages and burst fields (electrical and magnetic) may operate the HR-R 8-1 set.
Persons whose ability to perform is influenced or impaired by alcohol, drugs, or pharmaceuticals, are not allowed to operate the HR-R 8-1 set.

6 Magnetic field probe HR-R 8-1

The HR-R 8-1 is a passive field probe for measuring magnetic fields up to 40 GHz.
Network analyzers, spectrum analyzers or oscilloscopes can be used for signal evaluation. The probe can be used to measure on lines, IC pins, IC packages, surfaces and other objects.

The measuring cable[1] must be suitable for this frequency range.

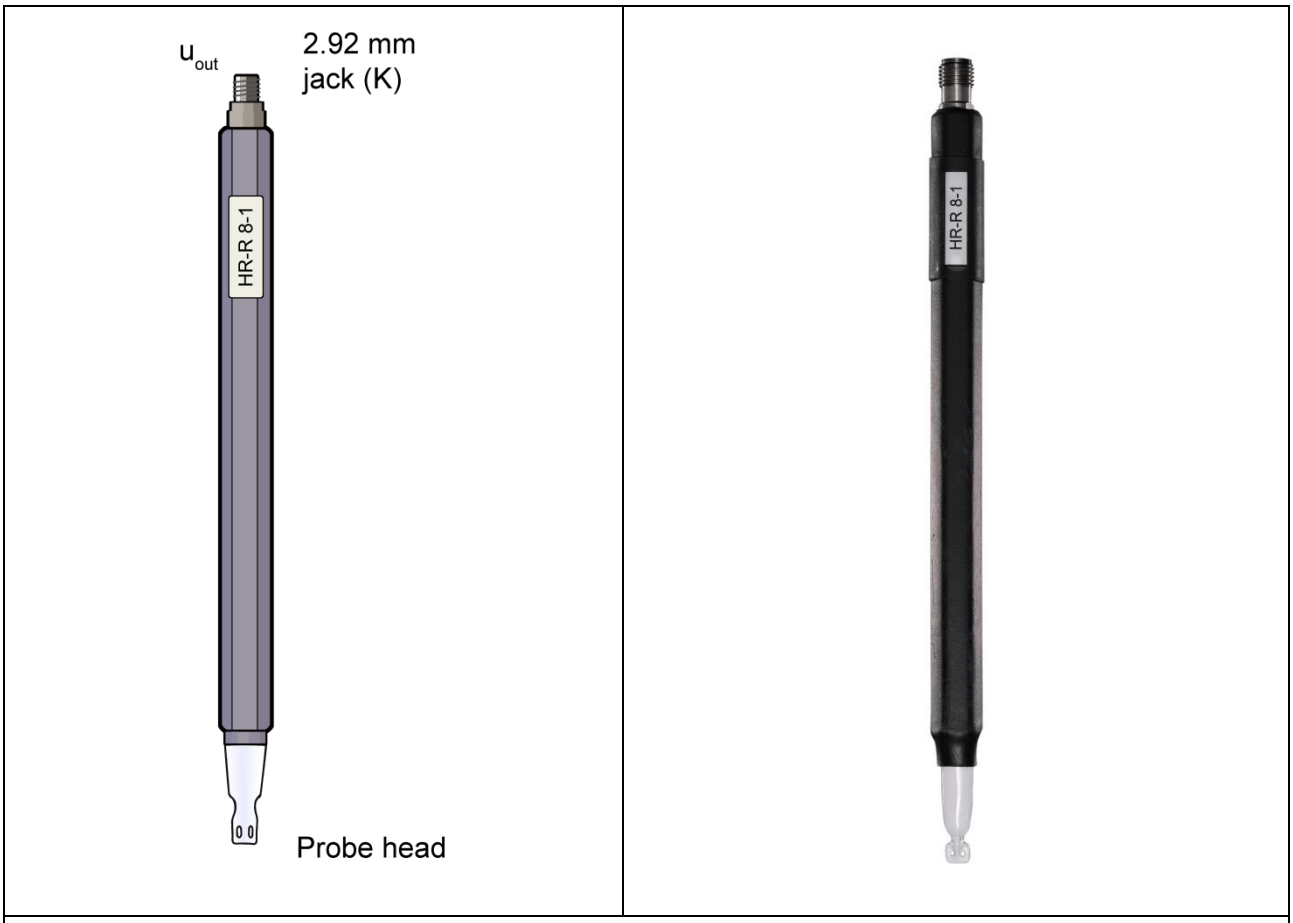


Figure 2: HR-R 8-1 Magnetic field probe

[1] The measuring cable is available on request.

7 Measurement Set-Up

For measurement, the probe is connected to a measuring device by means of the measuring cable. It can then be freely moved over the surface of the test object.

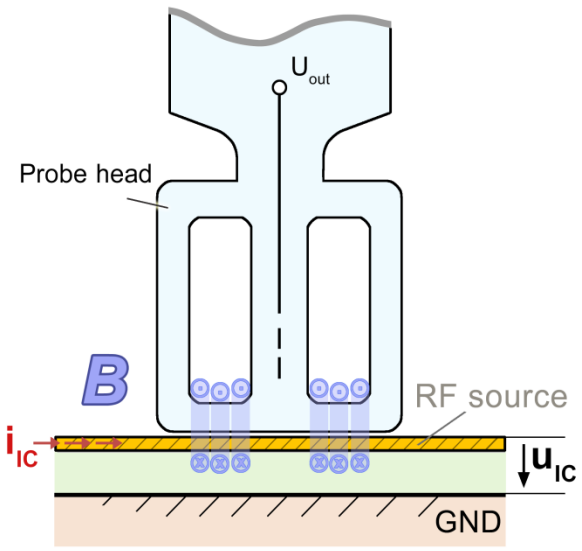


Figure 3: Principle application of the HR-R 8-1 probe / Schematic representation of the HR-R 8-1 directly above an RF line

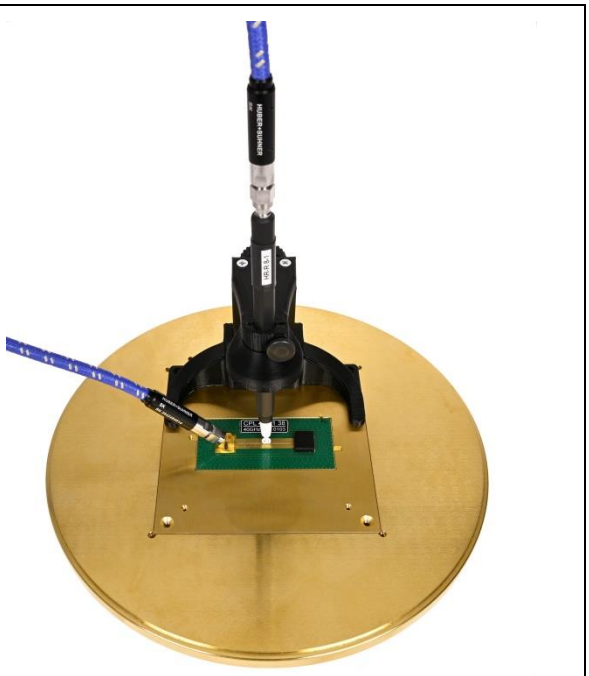


Figure 4: HR-R 8-1 test setup with SH 02 probe holder on coplanar line CPL 40-01 38

Reproducible and reliable conditions are obtained when the probe head is placed vertically, parallel and centrally on an RF line. Resonance processes (Figure 5) can be excited if the probe is placed asymmetrically and if the width of the PCBs is in the range of one centimeter.
Note: The ground plane of conductor cards which are too small can be increased by gluing them onto a larger ground plane.

Under the described measuring conditions the frequency response (chapter 9) and the correction functions (chapter 11) are valid.

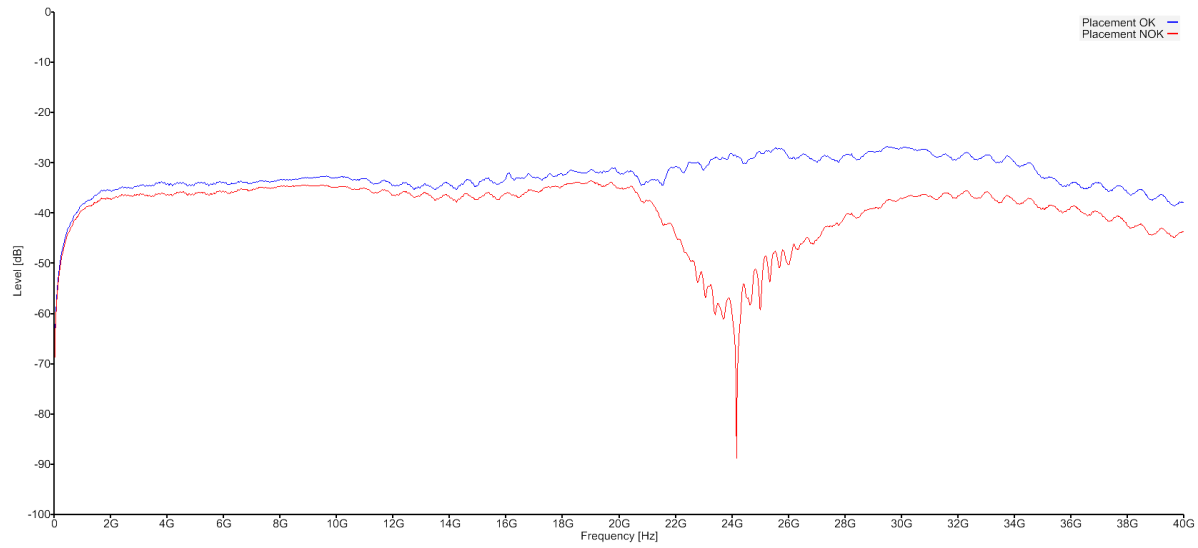


Figure 5: Resonance process with asymmetrical placement of the probe on the RF line

7.1 Connecting the HR probe

7.1.1 Connecting an HF cable to the HR probe

Required tools:

- Torque wrench 8 mm (5/16 inch) / 0.9 Nm
- Open-end wrench with wrench size ¼ inch

Please inspect the connectors. All connectors must be undamaged, clean, and within mechanical specification.

1. Push the connector straight together so that they can engage smoothly (do not tilt).

2. Turn the connector nut alone until it is hand-tight and make sure that the threads do not cross over.

Figure 6: Connecting an RF cable to the HR probe

3. Use the torque wrench to make the final connection. Tighten the connection until the torque wrench releases. User the open-end wrench to prevent the probe from rotating with it.

7.1.2 Disconnecting an HF cable from the HR probe

Required tools:
- Open-end wrench with width across flats 5.5 mm (1/4 in.)
- Open-end wrench 8 mm (5/16 inch)

Do not use the torque wrench to loosen the connection!

1. Use the 5.5 mm open-end wrench to prevent the probe from rotating.
2. Use the 8 mm open-end wrench to loosen the connection.
3. Complete the process by hand, turning only the connector nut with your fingers.
4. Pull the connector apart carefully (do not lift them).

8 Application

The probe is placed directly on the RF line or near the field source for measurement. The sheathing of the probe prevents the DUT from being short-circuited by the shielded probe head.

Attention! Mechanical stress on the probes can cause damage to the sheathing of the probe, which can lead to short circuits of the probe with the DUT.

Touching the probe near the probe tip may interfere with probe operation.

The probe head has a size of 5x5x2 mm (LxWxH). The sensing coil is frequency matched to 50 ohms. The probe behaves like a short-circuited line at low frequencies. (ripple). Frequency dependent the virtual input impedance rises to 50 Ohm.

The probe can also be used at a distance from measurement objects. The greater the distance, the weaker the measurement signal.

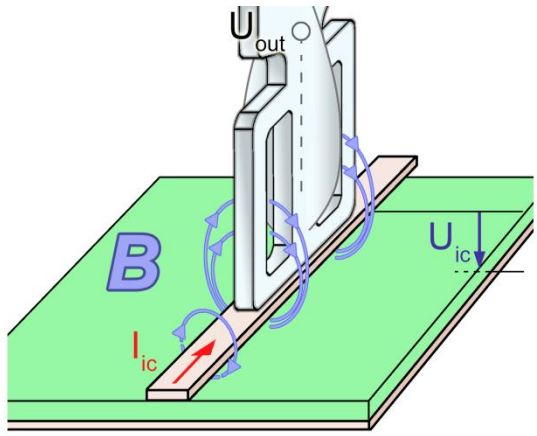


Figure 7: Attaching the HR-R 8-1 probe to the HF line

9 Frequency response

The voltage u_{out} of the probe does not directly represent the RF property of the RF line (Figure 7). It is useful to specify electrical quantities that describe the electrical processes of the RF line (Figure 7).

1. voltage u_{ic} of the RF line
2. mean magnetic flux B in the probe head starting from the RF line
3. current flow i_{ic} in the RF line (source current of the magnetic field)

The voltage u_{out} to the voltage of the RF line u_{ic} is called the frequency response of the probe u_{out}/u_{ic} (Figure 8). Furthermore, Figure 10 shows the frequency responses B/u_{ic}, i_{ic}/u_{ic} and u_{ic}/u_{ic}.

The technically interesting quantities u_{ic}, B and i_{ic} can be calculated with correction functions from the output voltage u_{out} of the probe (chapter 11).

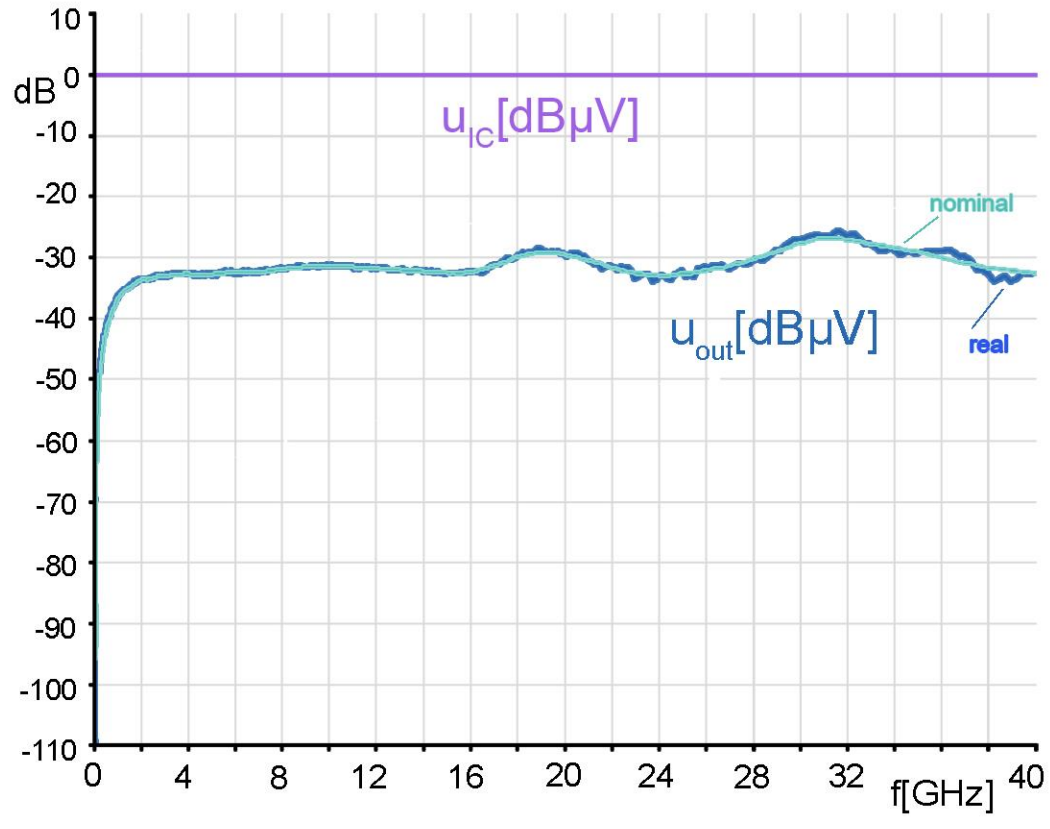


Figure 8: Frequency response at the coplanar strip line

The frequency response was determined on the test setup of a coplanar strip line (Figure 9).

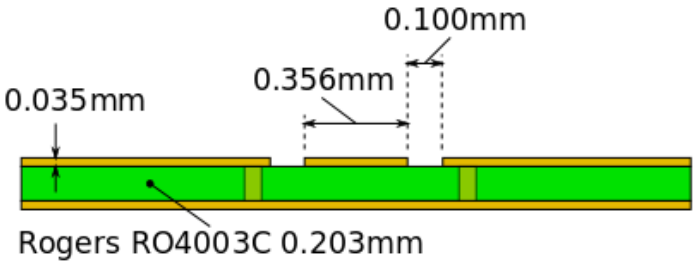


Figure 9: Structure of the coplanar strip line

The frequency response B/u_{ic} , H/u_{ic} and U_{out}/u_{ic} was calculated section by section.

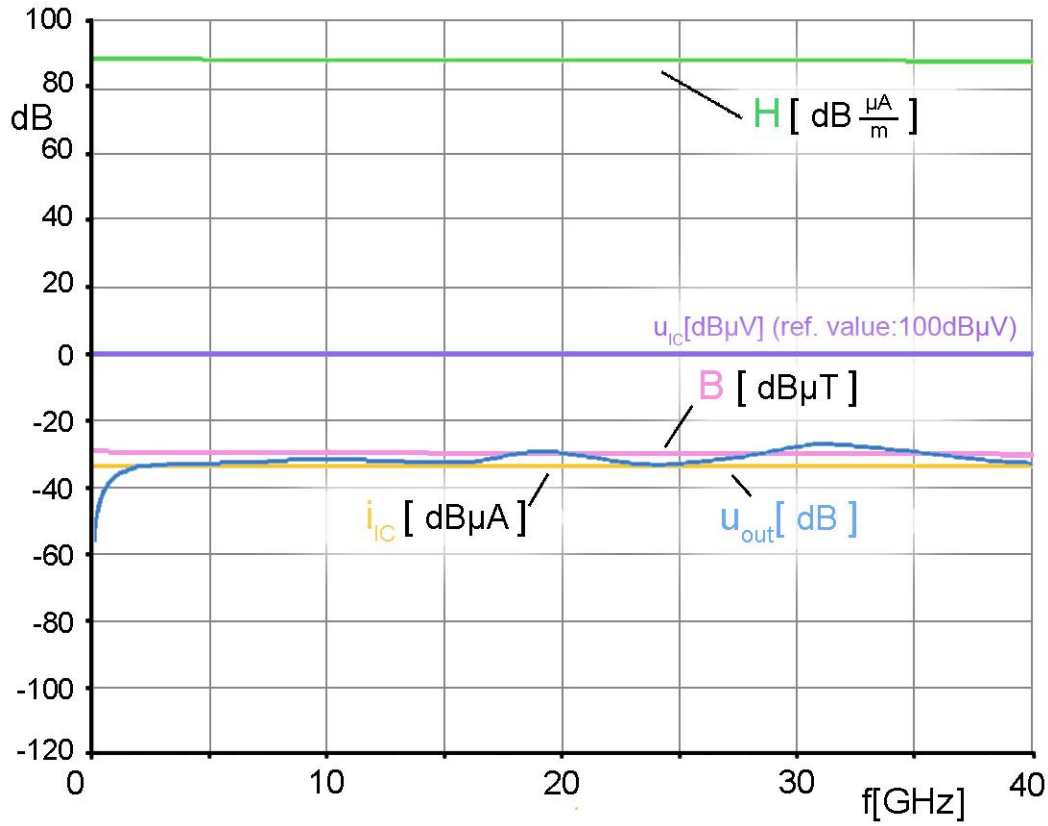


Figure 10: Frequency response of the fields and reference quantities at the coplanar strip line

10 Function

The real curve of the output voltage u_{out} has a functional ripple of 2 dB. A nominal curve was derived from the real curve in which the ripple was eliminated.

The probe can be used up to an upper frequency limit of 40 GHz. Due to its function, it does not have a lower frequency limit. The lower frequency limit depends on the displayed noise level of the measuring instrument used.
Example:
If the measuring instrument displays a noise level of -100 dBµV, the probe can be used in the range >1 MHz if it achieves an output signal of > -100 dBµV at > one MHz in the application case.

The probe has two operating ranges in the frequency response u_{out}/u_{ic}

1. lower range (<1 GHz) the increase of the frequency response u_{out}/u_{ic} 20 dB/ dec. u_{out}/u_{ic} is approximately proportional to the frequency.
2. upper range (>1 GHz) the output voltage is almost constant u_{out}/u_{ic} is approximately proportional to the voltage u_{ic}/u_{ic}.

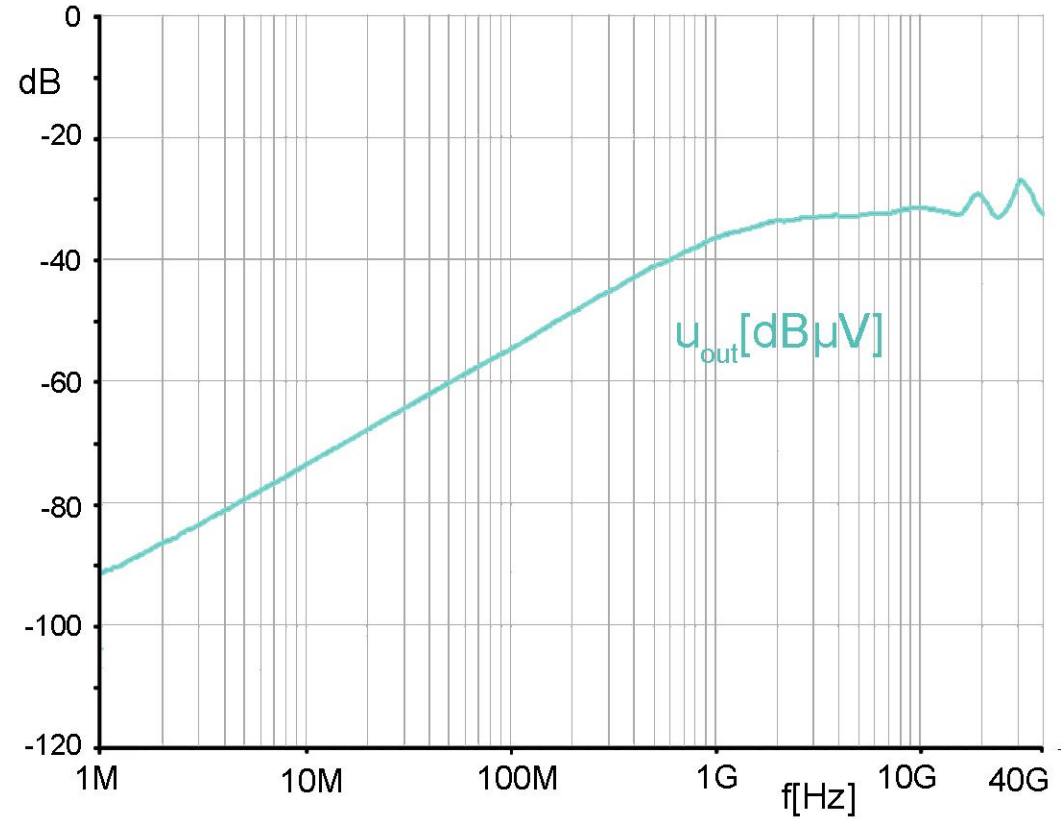


Figure 11: Frequency response u_{out}/u_{ic} in double logarithmic representation to clarify the frequency range 20 dB / decade up to approx. 1 GHz

11 Correction functions

The output voltage u_{out} of the probe can be converted with correction functions k (Figure 12) into the following electrical quantities of the RF line (ChipScan-ESA):

1. mean magnetic flux B starting from the RF line whirling through the probe head
2. Mean magnetic field strength H starting from the RF line swirling through the probe head
3. current flow i_{ic} in the RF line

The correction functions k are logarithmic functions [dB]. To perform the correction, the correction functions are added to the probe output voltage u_{out} [dB] mesasured by the spectrum analyzer. The addition can be done automatically with the software ChipScan-ESA from Langer EMV-Technik GmbH.

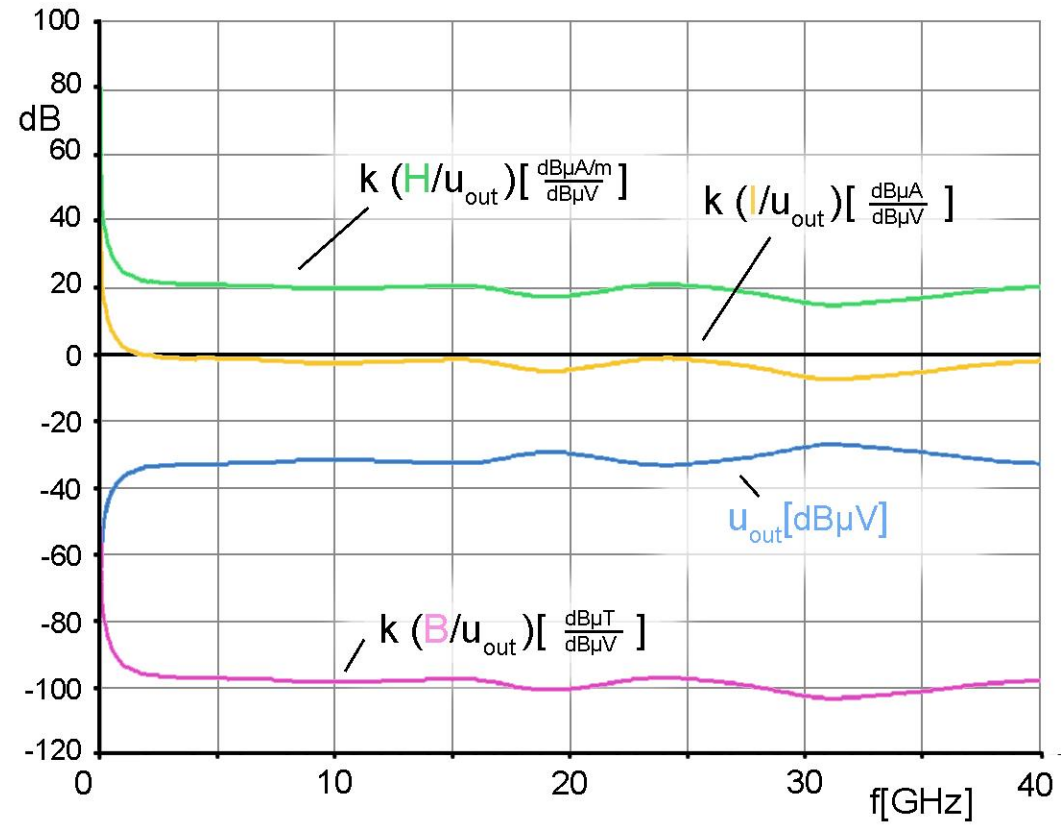


Figure 12: Correction functions k determined on a coplanar strip line (CPL 40G-38)

The correction functions are nominal curves. The real curves have a ripple of 2 dB (see frequency response u_{out} real curve). The period of the ripple depends on the length of the cable used when measuring with spectrum analyzers. Correction curves with ripple could increase the measurement error caused by ripple when used. Therefore the correction curves are nominal curves where the ripple has been removed afterwards.
The correction curves was determined on one special measurement setup:

1. coplanar strip line

If the design of a measurement object deviates from the design of the coplanar or micro strip line, deviations may occur in the measurement result.

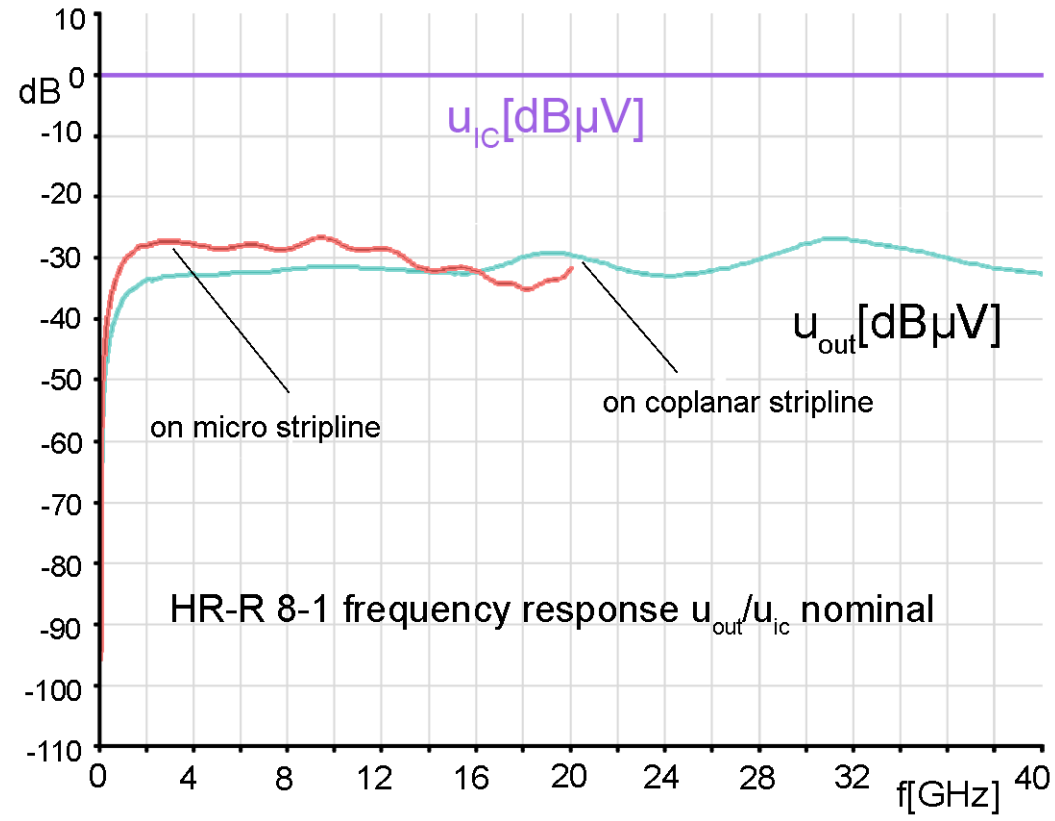


Figure 13: Comparison of the frequency response u_{out}/u_{ic} of the B-field probe HR-R 8-1 measured on a microstrip line and on a coplanar strip line

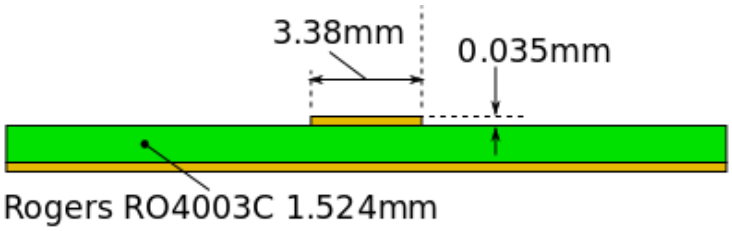
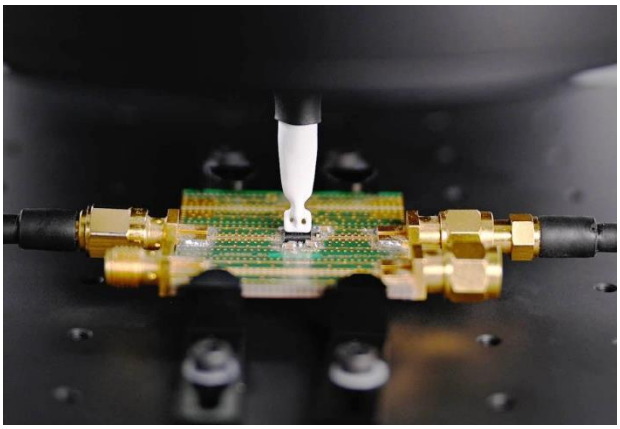


Figure 14: Structure of the microstrip line

12 Spatially reproducible measurements

The field probe can be used in conjunction with an e.g. IC scanner ICS 105 for spatially reproducible measurements. For mounting the HR probe, the probe holder for long scanner is provided.



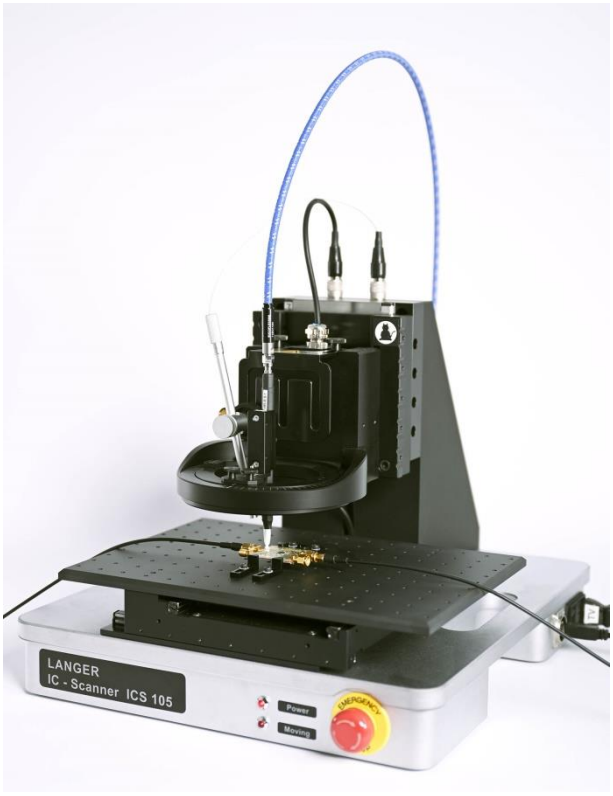


Figure 15: Measurement setup with Langer IC scanner ICS 105

13 Measuring software ChipScan-ESA (Viewer)

The software ChipScan-ESA, from Langer EMV-Technik GmbH, incorporates the experience gained from over 20 years of component interference suppression. It is an ideal tool for the EMC engineer.
With ChipScan-ESA RF measurements can be logged, which are performed with the spectrum analyzer. The correction functions k can be applied automatically. The correction functions are stored on the USB stick in the file "HR-R 8-1 Frequency Response, Correction Curves.csc". The file must be imported via the "Import" button (Figure 16, bottom right).
Figure 16 shows how the frequency responses F and the correction functions k (list note) can be displayed with the ChipScan-ESA Viewer included in the scope of delivery. The functions can be compared with each other.
Figure 17 shows how the automatic correction for spectrum analyzer measurements is activated. Several corrections k can be applied simultaneously. For example, the charge quantity Q can be calculated from a current i by integration (with the correction - 20 Log Omega). Corrections can also be applied subsequently, e.g. the correction function of a preamplifier (with function: add, subtract,...).

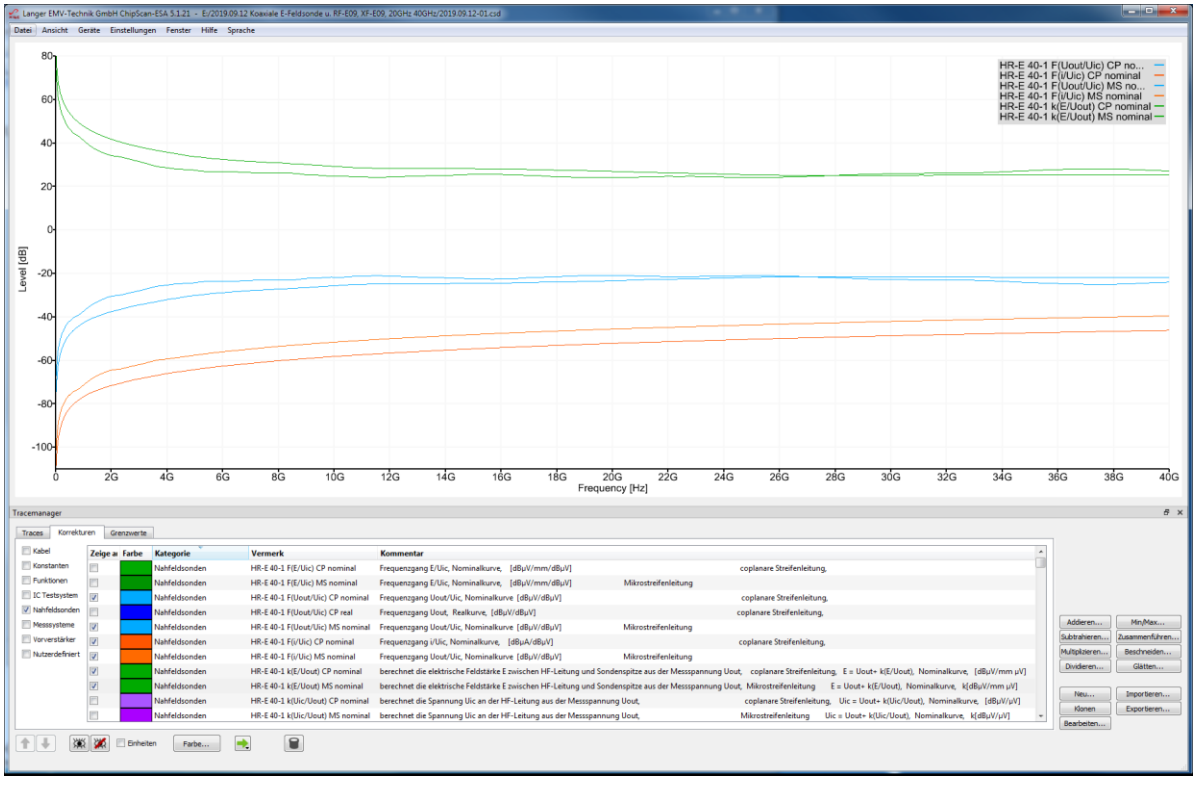


Figure 16: ChipScan-ESA Viewer with list and display of selected frequency responses and correction functions

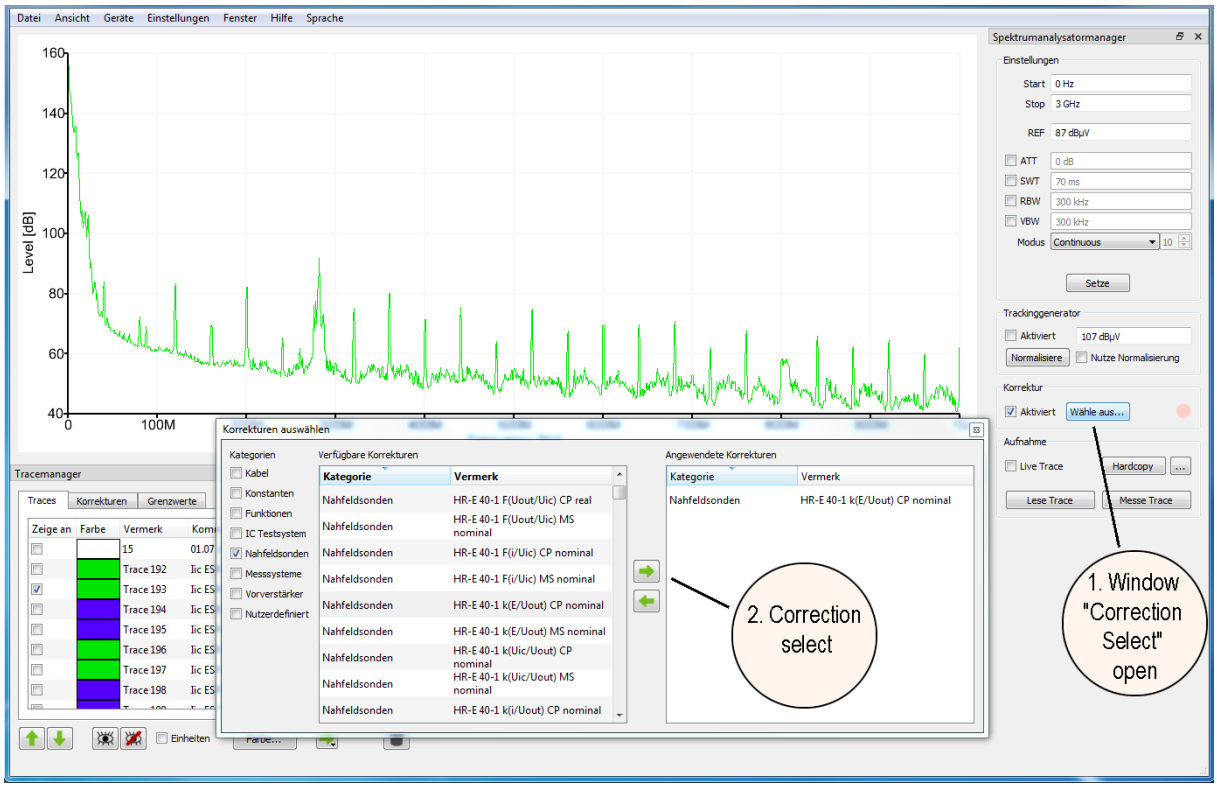


Figure 17: Aktiveren der Korrekturfunktionen im ChipScan-ESA (Vollversion, mit Dongle)

14 Warranty

Langer EMV-Technik GmbH will remedy any fault due to defective material or defective manufacture, either by repair or by delivery of spare parts, during the statutory warranty period.

This warranty is only granted on condition that:

- the information and instructions in the user manual have been observed.

The warranty will be forfeited if:

- an unauthorized repair is performed on the product,
- the product is modified,
- the product is not used according to its intended purpose,
- the product is opened.

Documentations:

Task	Instruction
• Instructions for the development of the test board • Test procedure	Instruction IC Pulse Test (Langer EMV-Technik GmbH)
• Groundplane GND 25 • Groundadapter GNDA 02 • Monitoring and control of the test IC	User manual ICE1 set (Langer EMV-Technik GmbH)
• Probe positioning	User manual ICS 105 set (Langer EMV-Technik GmbH)
• Oszilloskop • Spectrum analyzer • Network analyzer • PC	User manuals of the manufacturer

15 Information on recycling and disposal

Waste Electrical and Electronic Equipment (WEEE) Directive (European Union):

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

16 Customer service

If you have any questions, comments or suggestions, please feel free to contact us.

You can reach us: Mon. - Fri. 8.00 a.m. - 4.00 p.m., (CET / GMT+1)

Please contact us at:

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