LANGER
EMV-Technik

User manual

Probes for measuring fast transient magnetic fields
S2 set

Magnetic Field Probes for E1 set

CE

Magnetic field probes for measuring the distribution, intensity and orientation of fast transient magnetic pulse fields and pulse currents.

Contents: **Page**

1 Brief description

1.1 Usage

For disturbance immunity problems (Burst/ESD), it was previously not possible to measure pulse current and magnetic pulse fields to assist fault identification. This was due to the extreme measuring conditions. During Burst or ESD events, measurement must be made with field strengths of 100 kV/m and pulse rise times of a few nanoseconds. Normal measuring technology, like oscilloscopes with 50 Ohm measuring leads, is not suitable for this. Extremely small and disturbance-immune probes without any electrical leads are necessary. HF and potential isolation via optical fibre is a prerequisite. With the magnetic field probes in the S2 probe set, fast transient magnetic pulse fields and pulse currents are measurable in electronic equipment and on electronic modules under extreme disturbance influence. The aim of the usage is the clarification of disturbance immunity phenomena resulting from Burst or ESD events. Targeted corrective measures can be identified from the distribution of the pulse current and magnetic pulse field measured on the module or in the equipment. The probes can only be used in conjunction with an optical fibre and optical evaluation.

1.2 Disturbance source burst generator

To make the measuring of magnetic field and current disturbance possible, these must be simulated in the unit under test.

1.2.1 Pulse rate procedure

The SGZ 21 burst generator contained in the E1 disturbance immunity development system makes this procedure possible. The unit under test is injected with pulses from the SGZ 21 burst generator so as to generate disturbance currents and magnetic field disturbance. The intensity of current and magnetic field can only be measured with the pulse rate procedure.

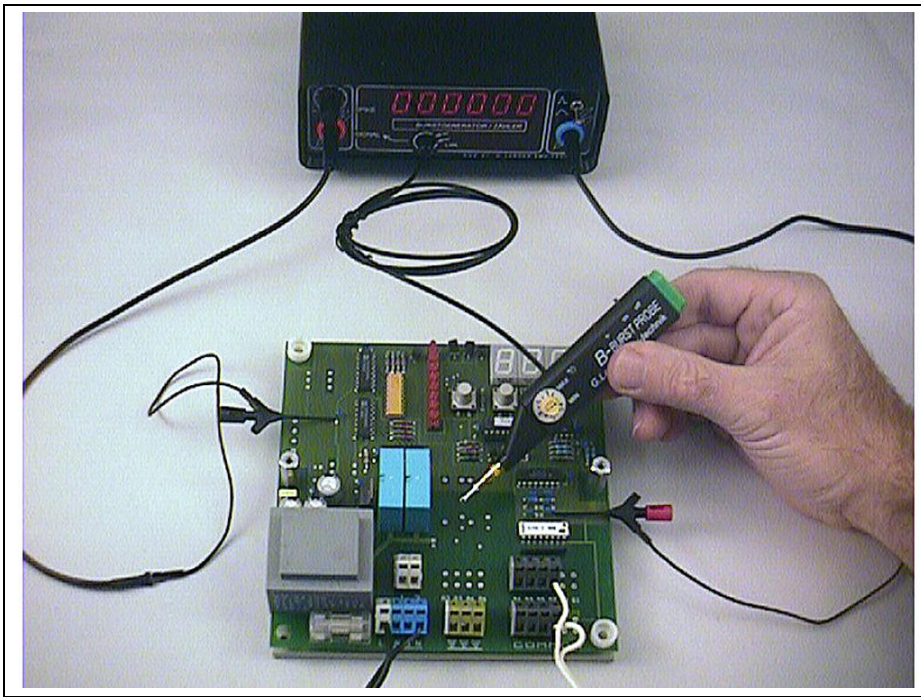


Figure 1 Pulse rate procedure with SGZ 21 burst generator and MSA 02

1.2.2 Threshold procedure

By using a burst generator according to EN 61000-4-4, a magnetic pulse field can be identified with a threshold value. Either the pulse rate counter of the SGZ 21 generator or the optical receiver OE 150 of the OSE optical signal acquisition, is to be used as indicating equipment.

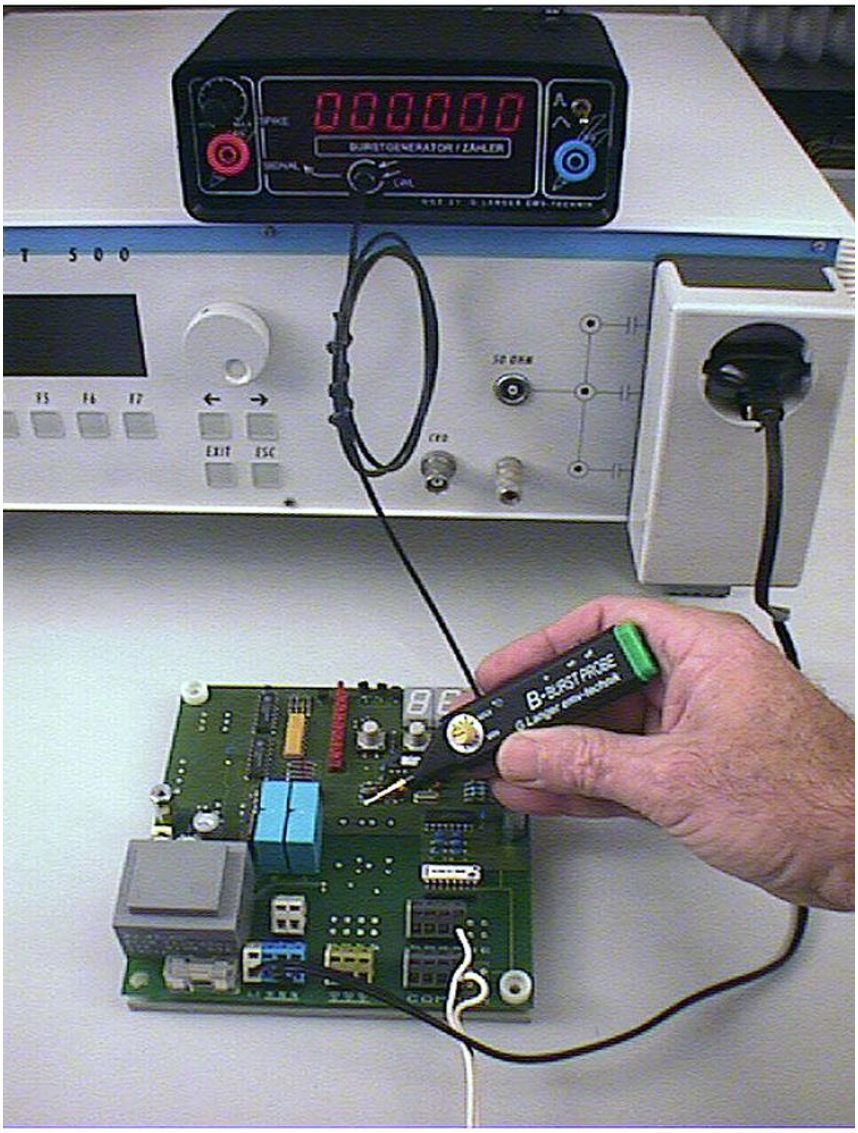


Figure 2 Threshold procedure with MSA 02, SGZ 21 and EFT burst generator according to EN 61000-4-4

2 Disturbance mechanisms

- Electronic modules have, depending on **layout** and **IC-sensitivity**, different levels of disturbance immunity.

- Precisely definable **weak spots** are the cause of Burst and ESD sensitivity. The formation of such weak spots depends mainly on the GND/Vcc/signal track geometry and the type/manufacturer of the IC utilized.

- Disturbance pulse current (I) infiltrates electronic modules via conductors or capacitance. Electric disturbance fields (electric field strength E) or magnetic disturbance fields (magnetic flux density B) caused by the disturbance current radiating the surface of the modules.

- **Magnetic pulse fields (B)** or **electric pulse fields (E)** are the major physical quantities which cause flat modules to be influenced.

- A weak spot is normally only magnetic sensitive or only electric-sensitive.

- In practice, both weak spot types are relevant. For example, in disturbance events, electric fields which influence electric-sensitive weak spots can occur. The currents driven by the electric field can themselves produce magnetic fields which influence magnetic sensitive weak spots (**Figure 3**).

- The disturbance effects of the two mechanisms overlap and are difficult to separate.

- Due to the different physical mechanisms each of the two weak-spot types requires different EMC measures.
- Usually, only a few disturbance immunity weak spots exist on one module and these are often confined to small surface areas.
- The module is immune to disturbance when these weak spots are located and corrected.

- The burst magnetic fields radiating on the module surface or within equipment spaces can be measured with special magnetic field probes without reverse reaction (S2 set).

- With the EMC sensors, reference disturbance thresholds can be modeled and influenced logical signals captured (E1, OSE 150).

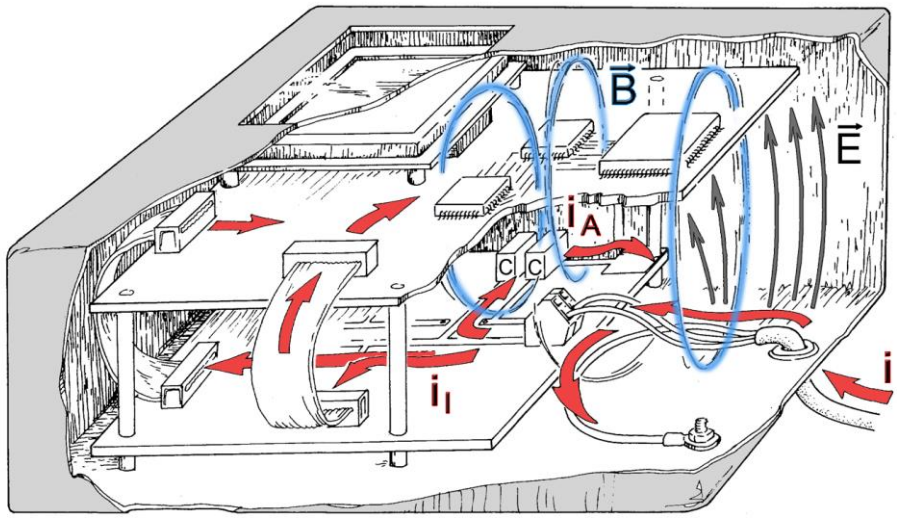


Figure 3 Field distributions

Disturbance current (i) infiltrates the unit via the input cable. The internal disturbance current (i_I) is reduced by the bypass current part (i_A) leaving the unit via the bypass capacitor (C) current paths. The magnetic fields B shown in the illustration Fehler! Verweisquelle konnte nicht gefunden werden. can influence electronic modules located within some decimetres. Not all B fields infiltrating the module surface have an influencing effect. Usually, only small areas are B-field sensitive. To be observed is that magnetic fields are not only produced by disturbance current (i) in the area of feed cables and PE connections. Participating to a large extent are also bypass capacitor (C) current paths and internal GND and Vcc connections.

Electric pulse fields (E) are radiated from the leads carrying the disturbance current and these mainly influence signal connections which have a high-impedance signal source.

3 Functioning

Disturbance current is injected into the unit under test over the generator leads from the SGZ 21 burst generator. The resulting magnetic pulse field induces a voltage pulse in the probe's induction coil. This is amplified and converted into an optical signal. The optical signal is fed to the optical receiver of the pulse rate counter via the optical fibre.
The indicated value is proportional to the magnetic flux density and the disturbance current. The counter indicates a higher pulse rate when the magnetic field probe is placed into an area with greater field strength. The count value provides a comparison measurement for development-accompanying measurements.

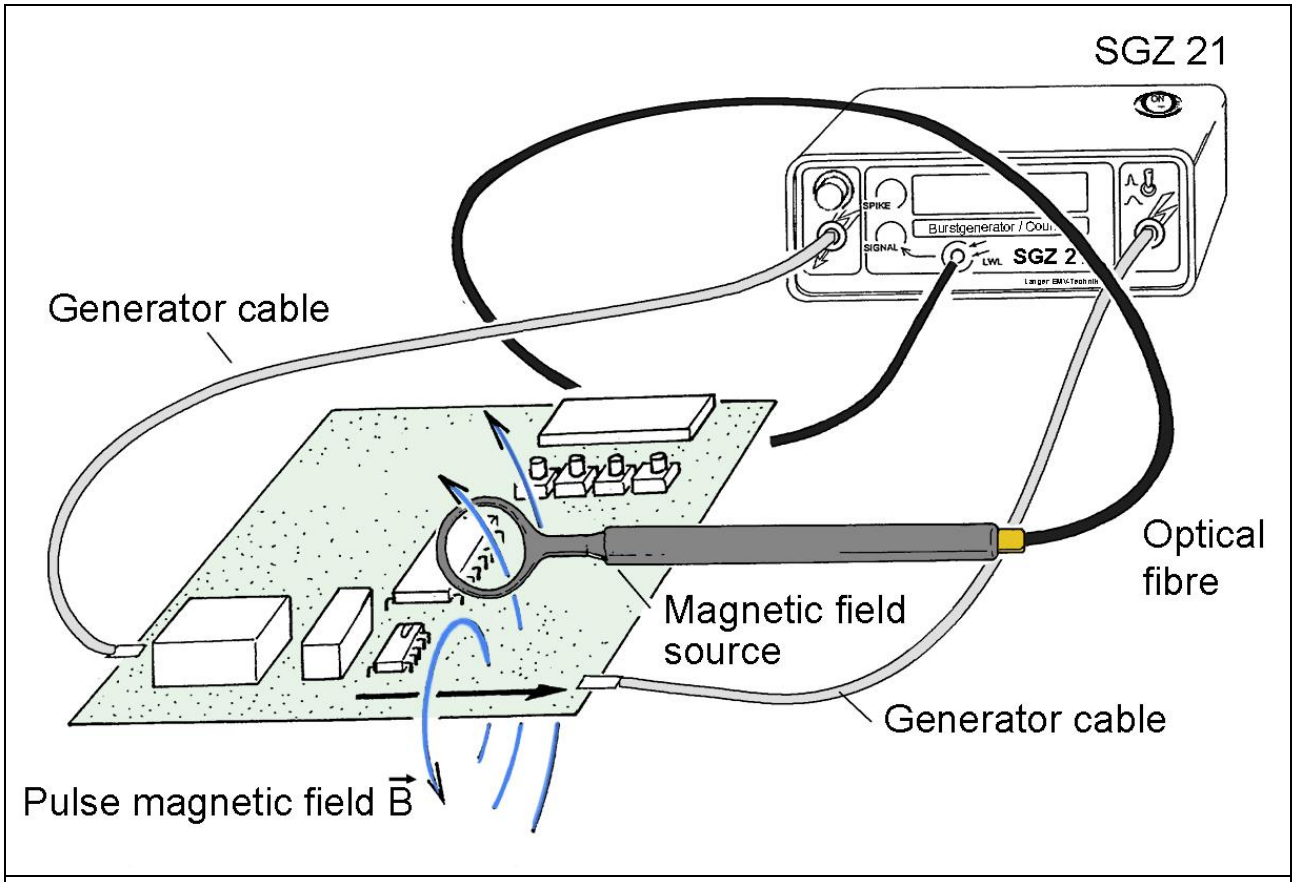
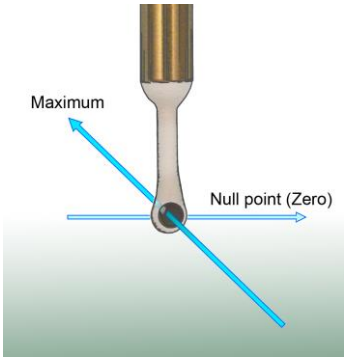
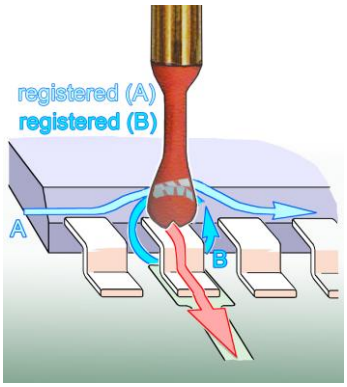
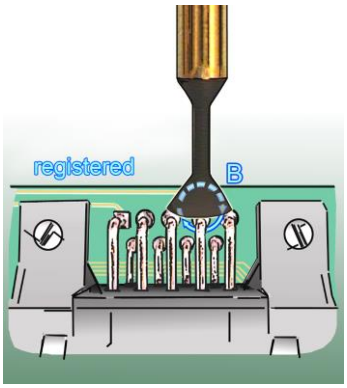
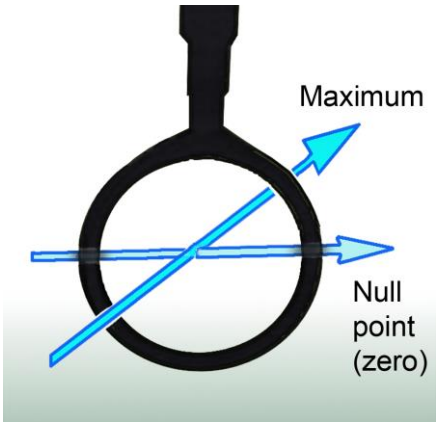
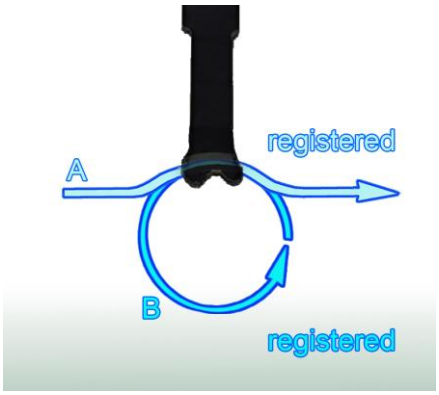


Figure 4 Pulse rate procedure

3.1 Probe heads

MSA 02 probe		
05R		- Measuring the spatial field destribution
05U		- Measurement of surface field A and conductor field / current B - Surface field ist he magnetic field on the surface of components like capacitors, metal parts, etc. - The measuring groove of the probe is placed onto the conductor / surface
05K		- Measurement of conductor field / current B - Surface fields or quasi homogenuous fields are not acquired by the probe head - A selective measurement of the conductor field (concentric field lines B) is possible

MS 101 probe		
		- Measuring the spatial field distribution

MS 102U probe	
	- Measuring of surface field A and conductor field / current B. - Surface field is the magnetic field on the surface of cables, capacitors, metal parts, etc. - The measuring groove of the probe is placed onto the conductor / surface. The measurement is proportional to the current.

3.2 Handling of the probes

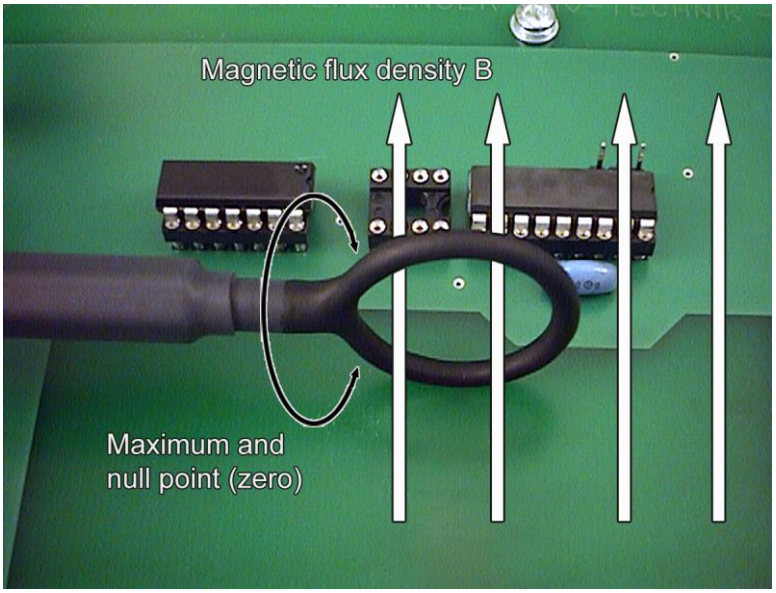


Figure 5 Handling of MS 101 magnetic field probe

The probes are manually guided over the unit under test. The MS 101 probe and the 05R probe head have a circle-shaped induction loop. The maximum and null-point intensity can be found by rotating the probe loop. The direction of the field lines is indicated by the plane of the loop at minimum and the perpendicular of the plane at maximum.

The value indicated by the pulse rate counter is proportional to the magnetic flux density penetrating the induction loop. This allows the spatial intensity and the orientation of the magnetic field to be defined.

3.3 Operating elements and connection of the probes

3.3.1 MSA 02 probe

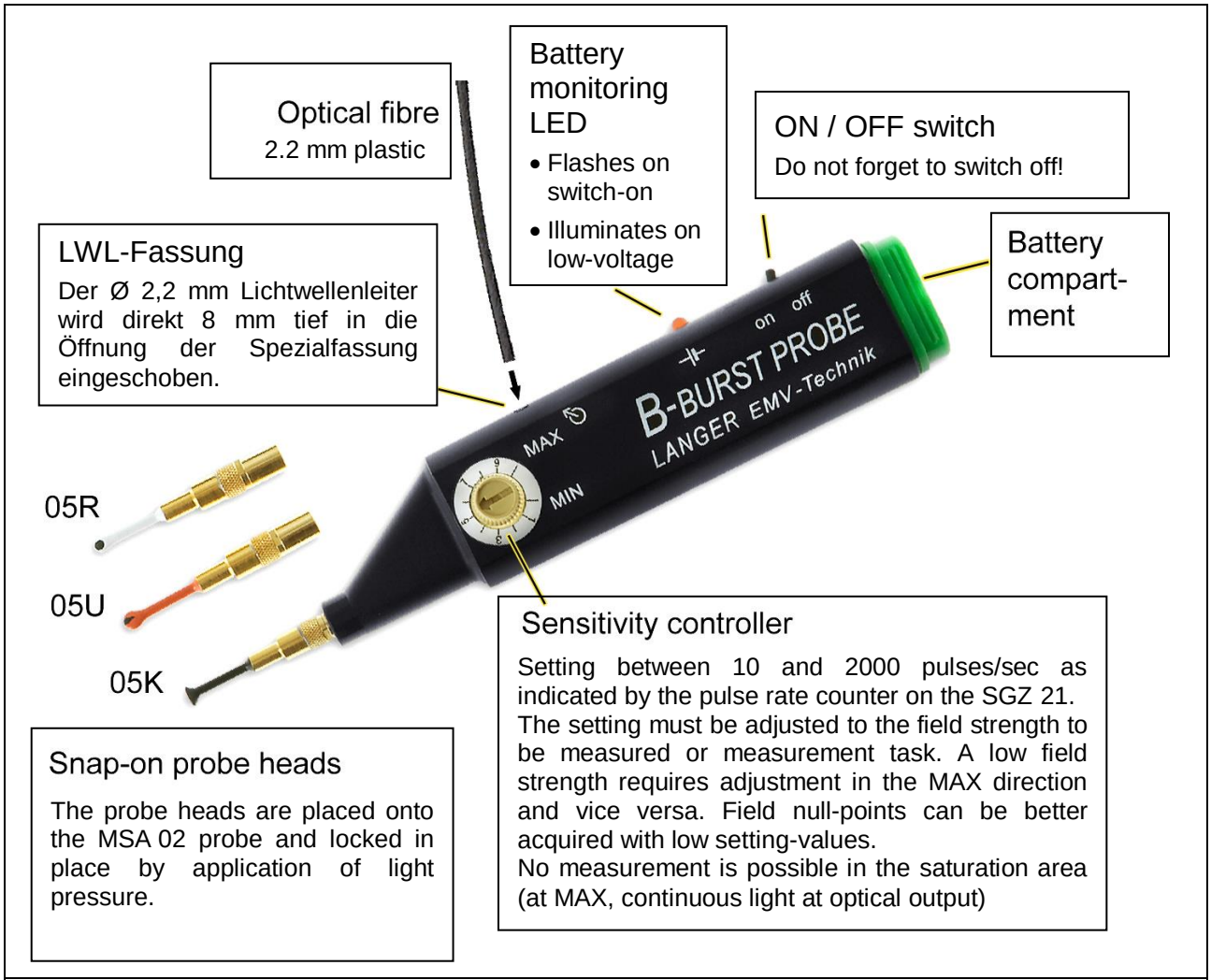
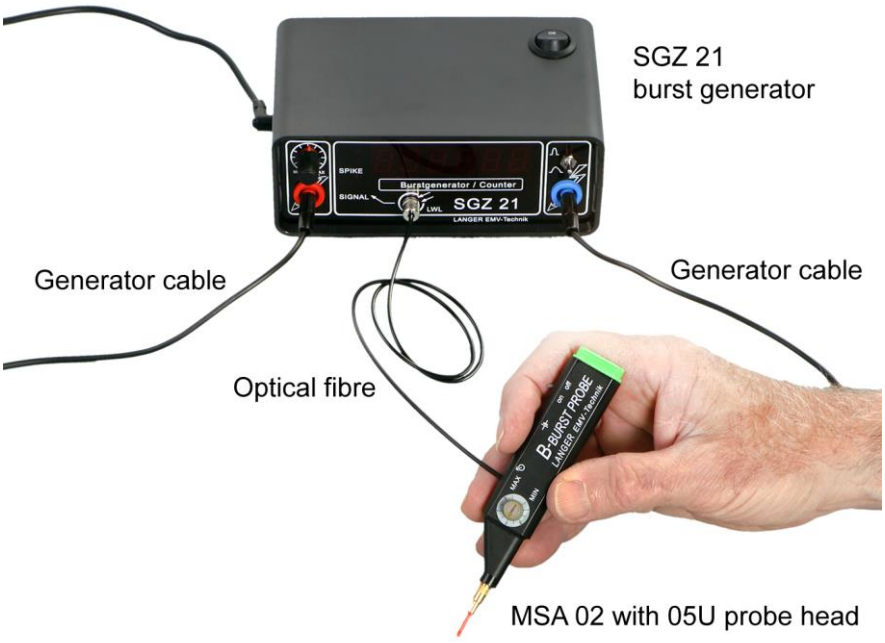


Figure 6 Operating elements and connections of MSA 02 probe

3.3.2 MS 101 / MS 102U probes

Figure 7 The optical fibre is pushed through the grip into the probe head.

3.3.3 Connection of cables



The connection of the probes to the optical input of the pulse rate counter and the connection of the generator cables to the unit under test is described in the user manual E1 set – cap. 5.4 Measurement of burst-related magnetic fields.

Figure 8 Example of the connection of cables to SGZ 21 and MSA 02

3.4 Battery replacement

- Positive terminal (+) on the panel side.
- Replace in reverse sequence.

Figure 9 Battery is changed by pulling the cap in the direction indicated by the arrow

4 Layout and function of the measuring place

4.1 Measuring place for pulse rate procedure

Disturbance must be injected with the pulse rate generator for measurement of the intensity distribution. The layout is in accordance with the user manual E1 set, cap. 3. The disturbance current injection is usually made directly into the GND system of the unit under test. The measuring layout should occur on a wooden or plastic table.

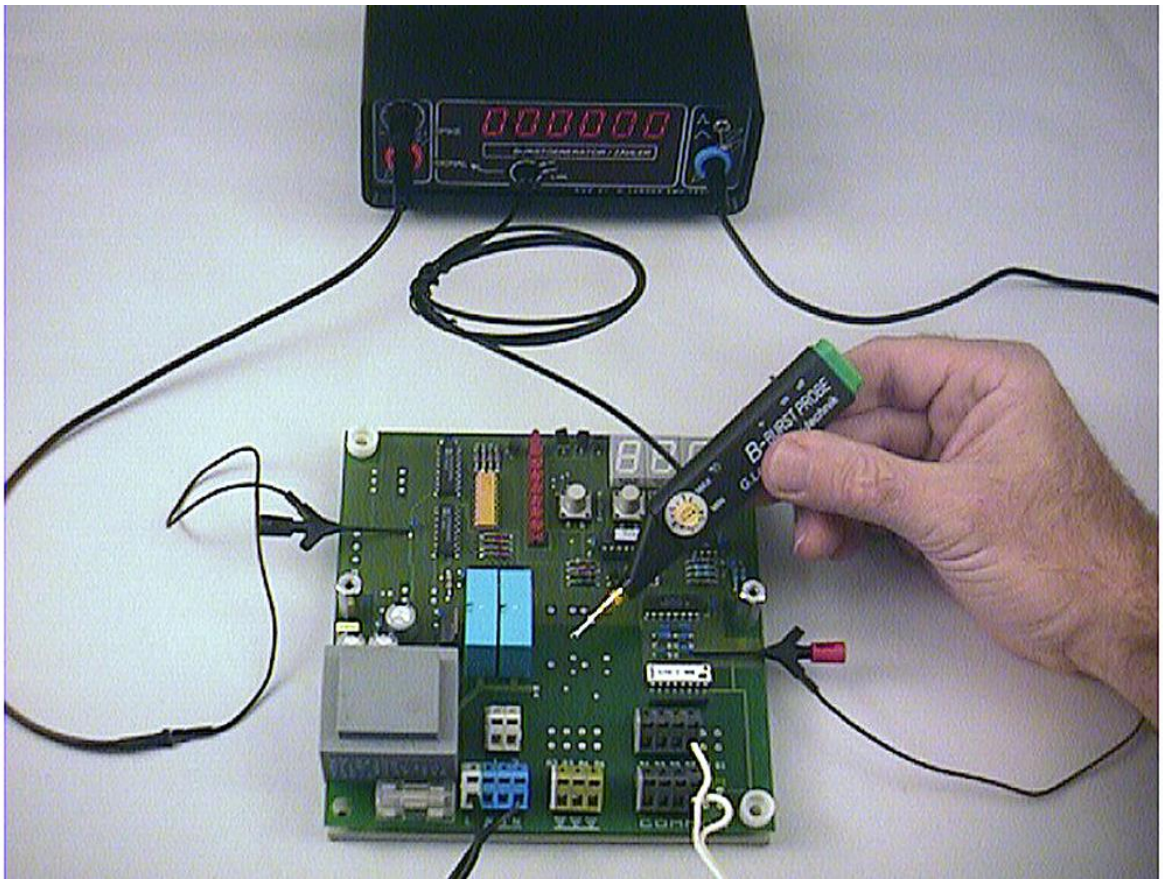


Figure 10 Measuring station for pulse rate procedure

4.2 Measuring place layout according to EN 61000-4-4

The standard layout according to EN 61000-4-4 must be used when the magnetic fields which arise during testing to standard are to be acquired.
Threshold values, but no intensity distribution, are measurable when injecting the unit under test with a generator in accordance with EN 61000-4-4. For measurement of the intensity distribution, injection can be made with the pulse rate generator. For this, the injection should not be made at the coupling clamp or the mains simulation of the standard generator but in the same disturbance current path direct at the unit under test.

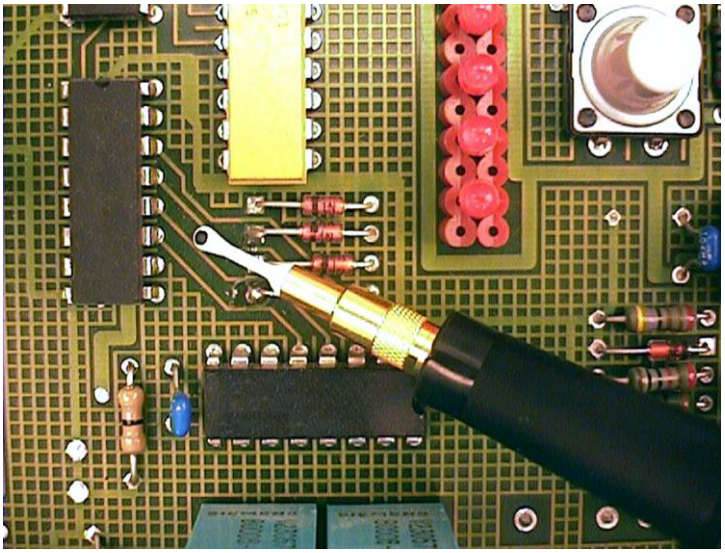
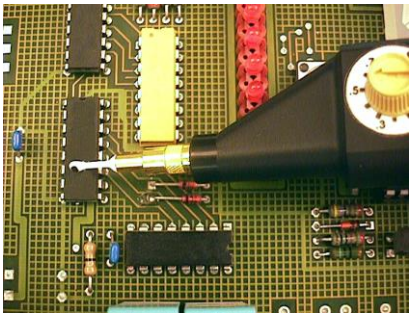
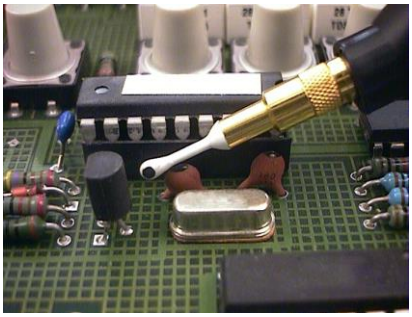
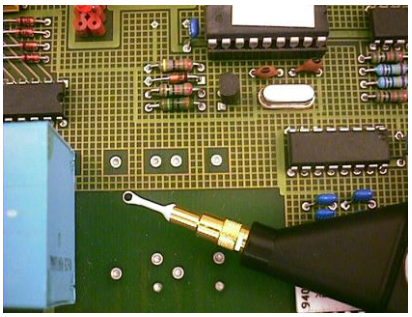
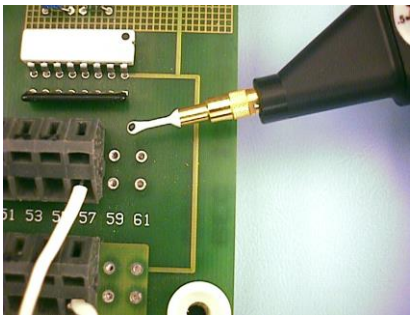
5 Usage

5.1 Analysis the disturbance current paths

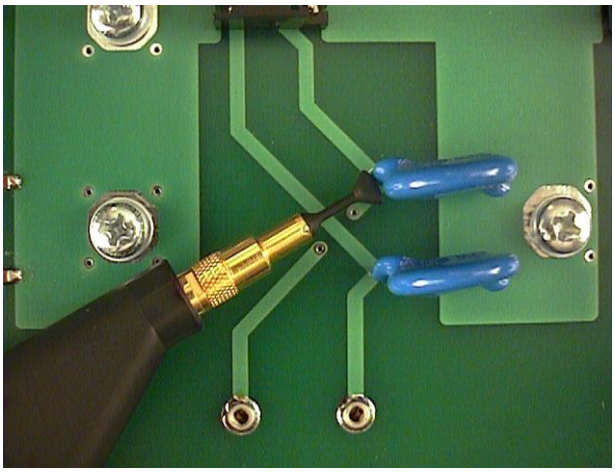
The analysis of the disturbance current paths should match the practical use of the equipment. Primarily, galvanic coupling is made into GND, screen, PE, earth or Vcc. Here, the current then enters, over the generator lead, crocodile clamps or clips, at a point in the module, flows through the module and generates a current and field distribution. The current is feed back to the generator over the second generator lead (user manual E1, cap. 5.1).

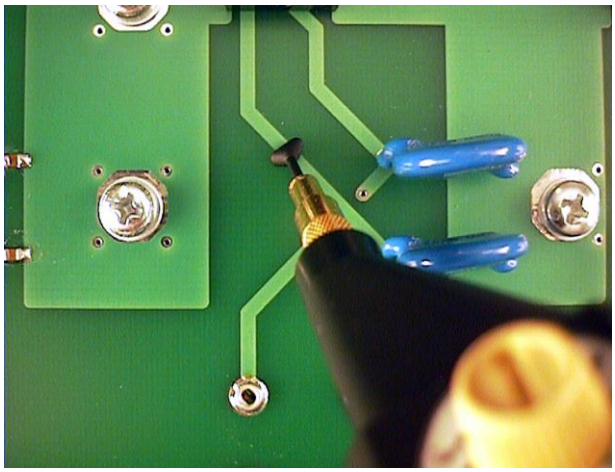
5.2 Modules

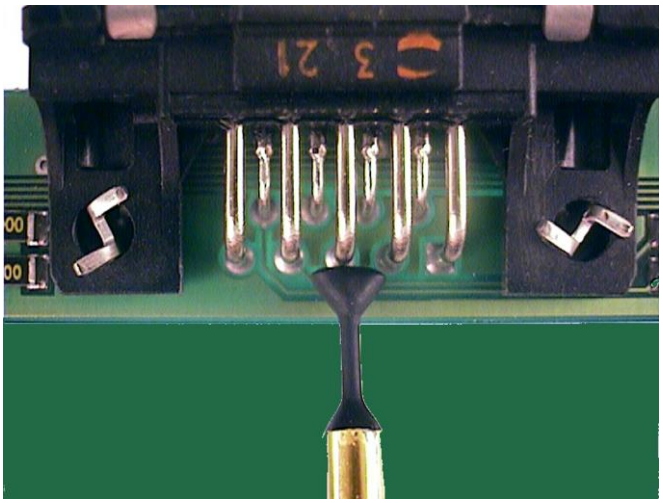
5.2.1 MSA 02 with probe head 05R

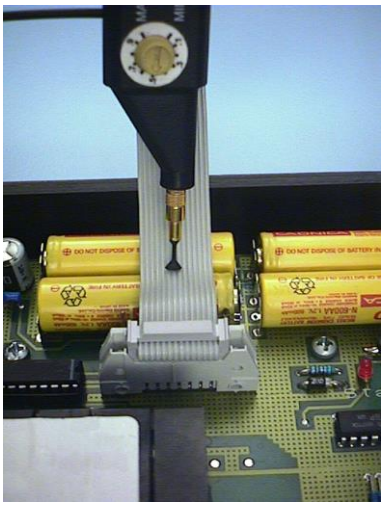
	At the locations where weak spots were identified with the field sources (Immunity development system E1), follow-up measurement can be made with the MSA 02/05R probe. The weak spot is critical when a field can be measured during realistic disturbance current injection.
 	Measuring the intensity and spatial orientation of a magnetic pulse field in IC proximity.
 	Spatial distribution of magnetic pulse field at the module surface.

5.2.2 MSA 02 with probe head 05K – Selective measuring on conductors



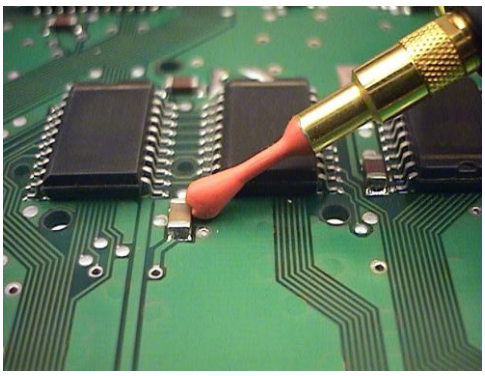
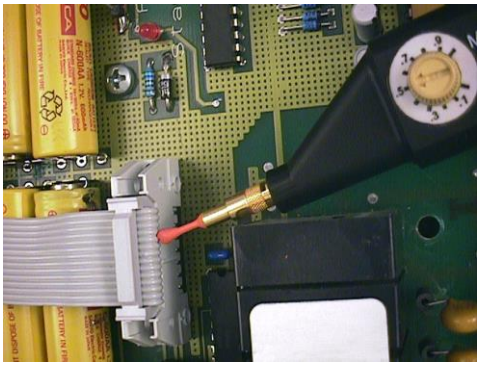
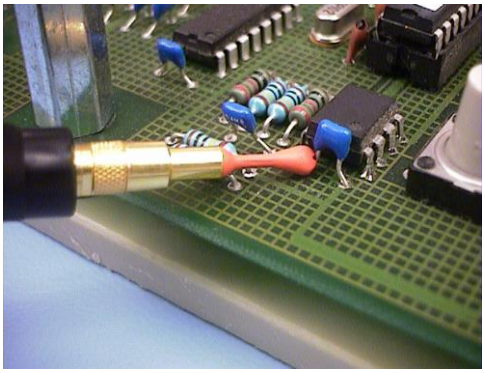
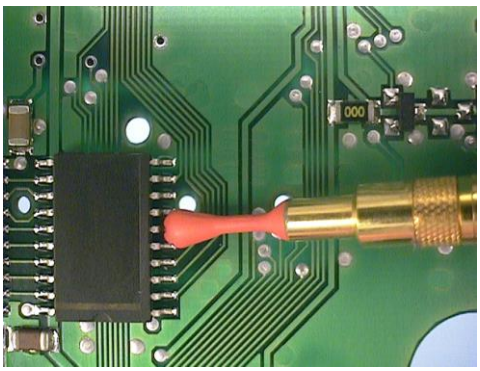






The circular magnetic field around conductors carrying pulse current can be selectively acquired with the 05K probe head. Homogeneous overlaid surface fields are not acquired by the probe.

5.2.3 MSA 02 with probe head 05U – Measuring on thin conductors and surface areas

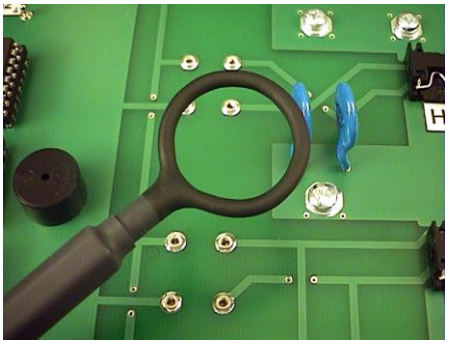
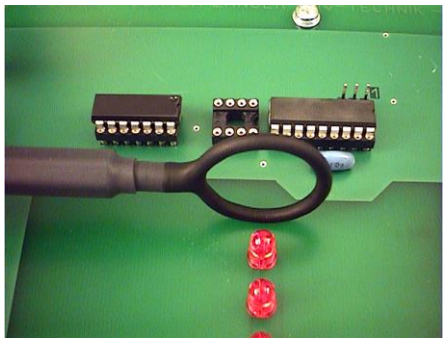
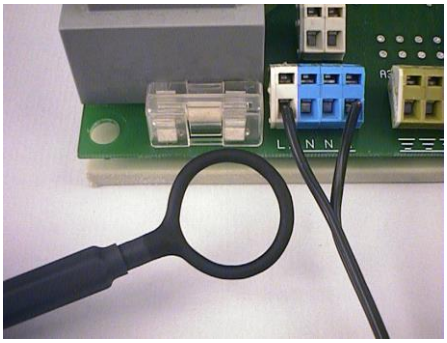
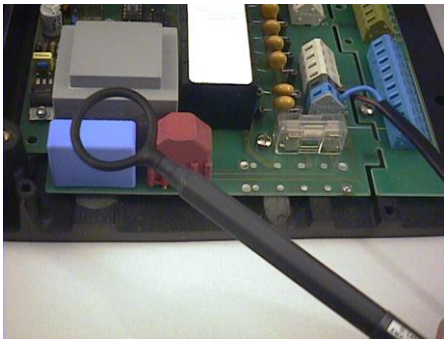
Placing the measuring groove onto surface / conductor.

Surface area magnetic fields, like those from SMD capacitors, can be acquired by the probe. The measuring groove located at the probe tip can be placed onto connecting wires or track runs for current-proportional measurement. In addition to the circular field from conductors, the probe measures the quasi homogeneous surrounding field.

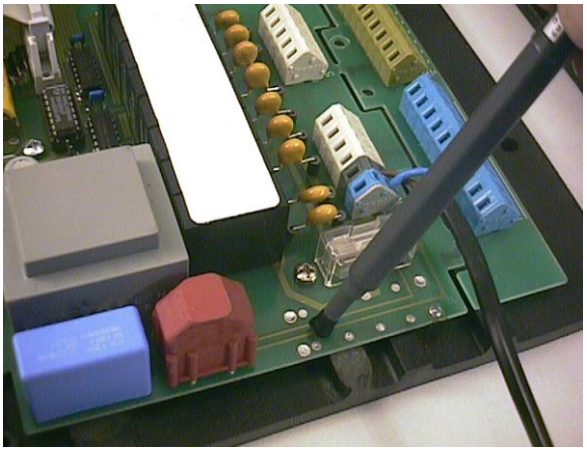
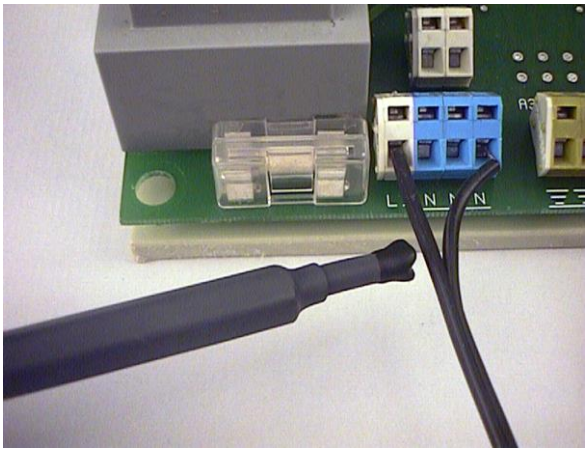
5.3 Equipment

5.3.1 MS 101 - Measuring in internal and external equipment areas

Acquiring the spatial field distribution

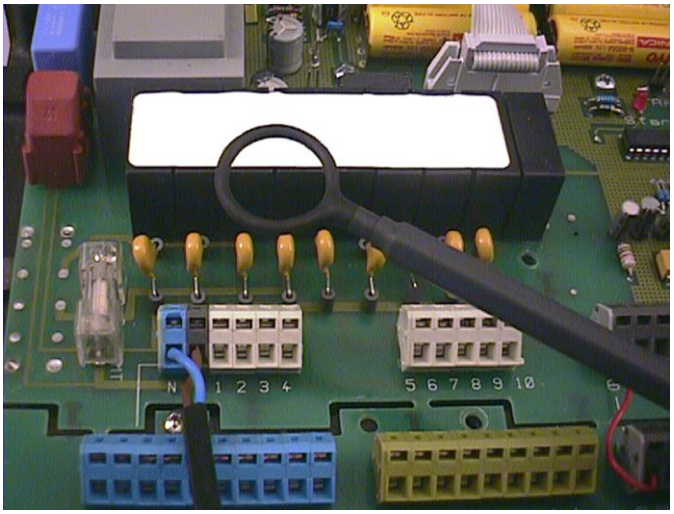
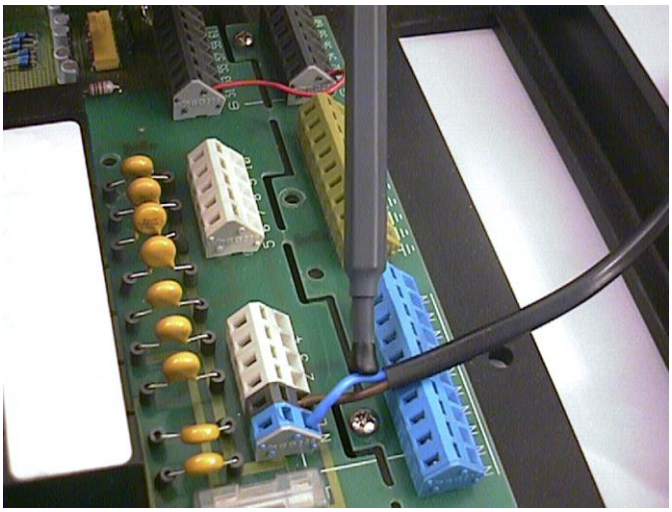
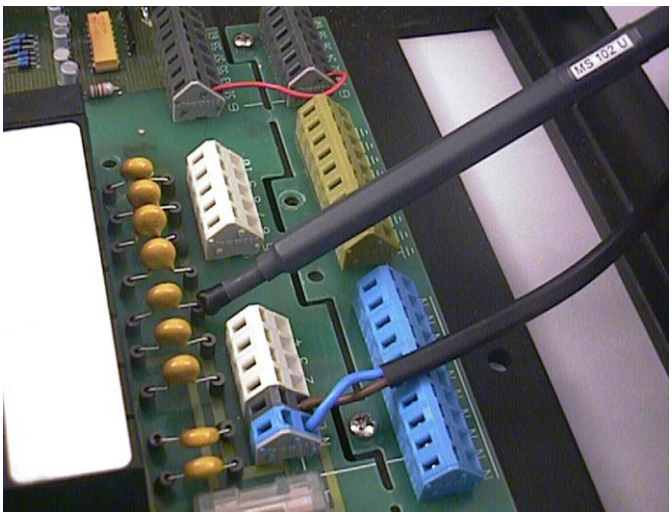
 	Disturbance current paths
 	Critical field strength in IC proximity

5.3.2 MS 102U – Disturbance current measurement on conductors

 
Placing the measuring groove onto surface/conductor

5.4 Natural disturbance sources

5.4.1 Measuring the disturbance field extending from relay disturbance sources

MS 101		Acquiring the spatial field distribution
MS 102U	 	Disturbance current paths
Relays generate magnetic pulse fields when they switch. The distribution of the magnetic fields and the current in leads, conductors and modules can be tracked with the probe. Advantageous for this is a cyclic relay switching.		

6 Requirements for the unit under test

6.1 Disturbance current injection

For the generation of magnetic fields in the areas to be measured within the unit under test, disturbance current must be injected in a practice-oriented manner. Appropriate adaptation points must be realized (user manual E1, cap. 5.1).

6.2 Accessibility

The areas to be measured must be accessible to the magnetic field probes:

a) When a module is to be measured, it can be subjected to disturbance current (bipolar) while it's separately placed and on a wooden table.

b) The module must be in an assembled state for measurement when the original disturbance current injection of the module surroundings is to be realized.

c) When under b) above, probe access to the equipment is not possible, measurement can, with acceptance of measurement inaccuracies, be made with the equipment disassembled. The coupling paths over conductors should be retained.

6.3 Functioning of the unit under test

The unit under test must be inoperative for magnetic field measurement.

A risk of unrecognized destruction as a result of disturbance current injection exists when electronic areas are supplied with auxiliary power (user manual E1, cap. 4).

The unit under test can be inoperative for magnetic field measurement. The supply voltage can be switched off to prevent destruction. In this condition, the disturbance current distribution may change as a result of unbiased protecting diodes.

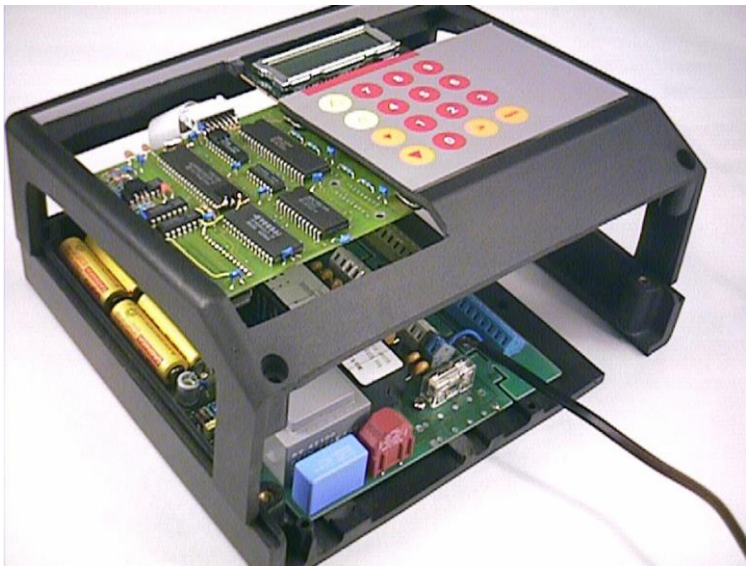


Figure 11 If necessary, special openings must be made in the equipment case so that the measurement areas can be accessed with the probe.

7 Safety instructions

This product meets the requirements of the following directives of the European Union: 2004/108/EC (EMC directive) and 2006/95/EC (low-voltage directive).

When using a product from LANGER EMV-Technik GmbH, please observe the following safety instructions to protect yourself from electric shock or the risk of injuries.

Read and follow the operating instructions and keep them in a safe place for later consultation. The device may only be used by personnel who are qualified in the field of EMC and who are fit to work under the influence of disturbance voltages and (electric and magnetic) burst fields.

- Never use any damaged or defective devices.
- Carry out a visual check before using a measurement set-up with a Langer EMV-Technik GmbH product. Replace any damaged connecting cables before starting the product.
- Never leave a Langer EMV-Technik GmbH product unattended whilst this is in operation.
- The Langer EMV-Technik GmbH product may only be used for its intended purpose. Any other use is prohibited.
- Observe the operating and safety instructions for all devices used in the set-up.
- People with a pace-maker are not allowed to work with this device.
- The test set-up should always be operated via a filtered power supply.
- **Attention! Functional near fields and interference emissions may occur when operating the SGZ 21 and especially when using the test set-ups described in this manual. The user is responsible for taking measures to prevent any interference to the correct function of products outside the operational EMC environment (in particular through interference emissions).**

  This can be achieved by:
  - observing an appropriate safety distance,
  - use of shielded or shielding rooms.
- The disturbances that are injected into the modules can destroy the device under test (latch-up) if their intensity is too high. Protect the device under test by:
  - increasing the disturbance gradually and stopping when a functional fault occurs,
  - interrupting the power supply to the device under test in the event of a latch-up.

Attention! Make sure that internal functional faults are visible from outside. The device under test may be destroyed due to an increase in the injection intensity if the faults are not visible from outside. Take the following measures as necessary:

- monitor representative signals in the device under test with optical sensors
- special test software
- visible reaction of the device under test to inputs (reaction test of the device under test).

We cannot assume any liability for the destruction of devices under test!

8 Warranty

Langer EMV-Technik GmbH will remedy any fault due to defective material or defective manufacture, either by repair or by delivery of replacement, 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.

9 Scope of delivery

Item	Designation	Type/Parameter	Qty.
01	Magnetic field probe (active)	MSA 02	1
02	Probe head	05R (white)	1
03	Probe head	05U (orange)	1
04	Probe head	05K (black)	1
05	Magnetic field probe (passive)	MS 101	1
06	Magnetic field probe (passive)	MS 102U	1
07	User manual	S2 m	1
08	Laminated quick guide	S2 qg	1
09	System case	S2 case	1

Figure 12 Case S2 set

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