E1 set

Immunity Development System

Technical parameters:

Pulse parameter	• rise time approx. 2 ns • tail time approx. 10 ns • peak values approx. 0 V bis 1500 V
Optical input	• max. frequency 5 MHz • min. pulse width 100 ns • optical fiber Ø 2,2 mm

Area of application:

» for EMI suppression in printed circuit boards

» for detecting burst and ESD faults

» checking the effect of EMC measures

Additional product:

S2 set *Magnetic Field Probes for E1*

- for non-reactive and fast measurement of pulse magnetic fields
- analysis of burst or ESD processes
- operation only possible with burst generator SGZ 21 (in E1 set).

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Achieve interference immunity by identifying and eliminating EMC weak points :

Strategy with field sources - H2 set and H3 set Field Sources from Langer EMV-Technik GmbH and E1 set Immunity Development System.

Introduction

Field sources are essential tools for EMC immunity testing during development. They enable developers to pulse various surface areas of electronic assemblies with electric or magnetic fields in a targeted manner.

Normally, this type of pulsing is started with low-resolution field sources in order to influence larger areas of the assembly with widely distributed field bundles. This makes it possible to narrow down fault areas, but not to determine the exact causes of the faults. For this reason, higher resolution field sources are then used. These emit narrow and concentrated field beams, which can be used to clearly identify weak points within the fault areas.

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Using the Field Sources for Troubleshooting

A prerequisite is that the module is pulsed with a standard generator (ESD or burst) in accordance to the standard. The resulting fault patterns must be precisely recorded and must subsequently be found again during localization with field sources.

Note: During the analysis with field sources, new fault patterns are sometimes detected. These often occur below the interference threshold of the standard test and are therefore less critical. Later, these additional fault patterns can also be eliminated and thus contribute to the hardening of the assembly.

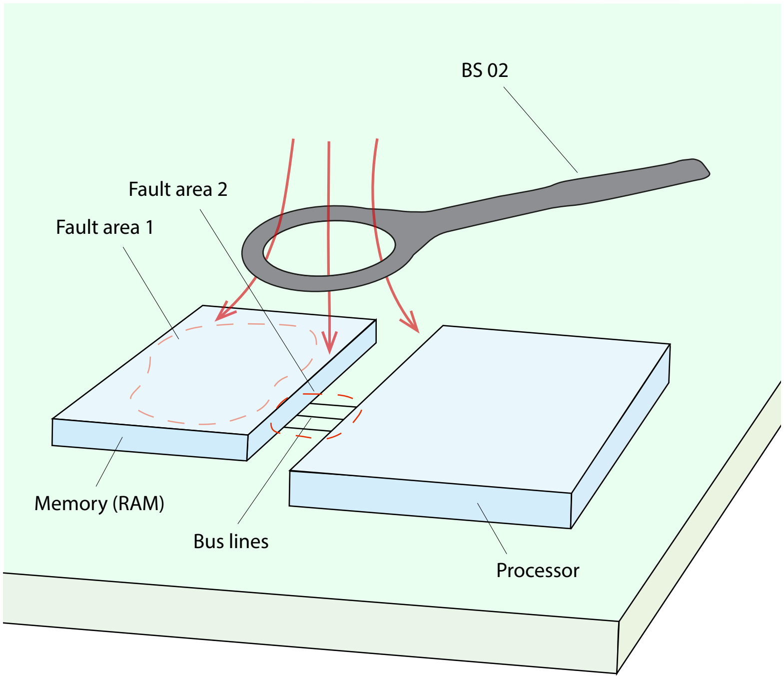

Figure 1 – Pulsing with BS 02 magnetic field source

Practical Example

Figures 1 to 3 show an electronic circuit in which a processor controls a screen via HDMI. The processor is connected to a memory circuit (RAM) via bus lines (Figure 1-3) and continuously retrieves its program code from this circuit.

The pulsing with a standard generator leads to the error pattern that the image content on the HDMI monitor freezes. The error can only be rectified by interrupting the power supply to the processor.

The first task is to reproduce the screen freezing error when the module is pulsed with field sources. The HDMI system (HDMI connector, cable, and monitor) is the first possible source of error to be considered.

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Troubleshooting begins with the BS 02 magnetic field source, the largest magnetic field source in the E1 set immunity development system.

Alternatively, the BS 02-h from the H2/H3 field source set can be used in conjunction with a burst generator or the BS 02-h from the TS 23 set TroubleStar Development System for ESD / Burst.

The BS 02 is guided over the module at a maximum distance of two centimeters (Figure 1). The possible confinement of the weak point corresponds approximately to the size of the field source head.

When the HDMI system is pulsed with the field source, image interference or a black screen occurs, but this does not correspond to the error pattern being searched for. The entire module is then exposed to the BS 02 field source section by section. In the area of the processor and RAM, the fault being searched for can actually be reproduced.

With the higher resolution field source BS 04 DB (E1 set), the fault can be narrowed down further (Figure 2). Alternatively, BS 04DB-h from the field source sets H2 and H3 set can also be used in conjunction with a burst generator.

It is initially unclear whether the cause lies in the RAM, in the conductor lines or in the processor. The pulsing of the surface of the memory circuit generates new error images on the monitor (similar to a checkerboard pattern), which are not relevant for the time being (see above).

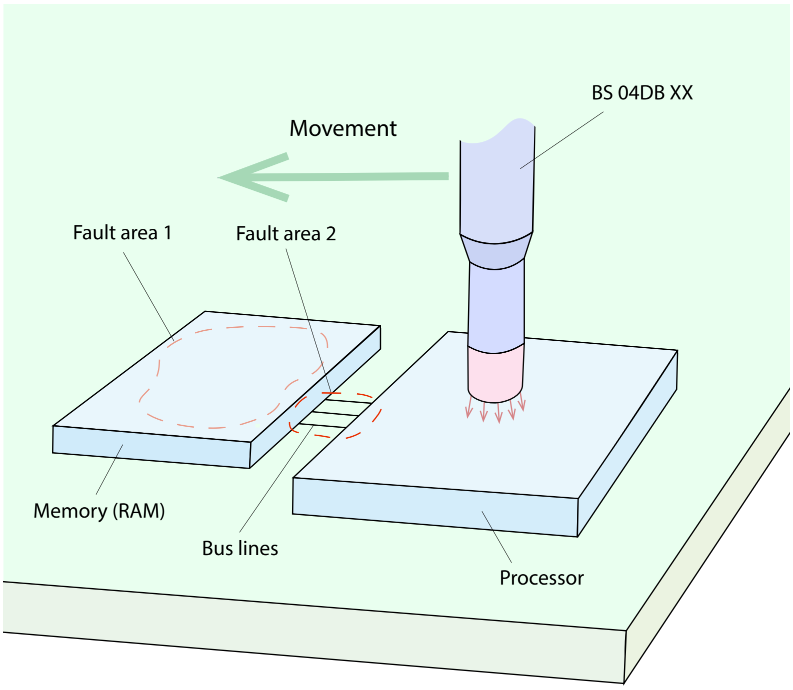

Figure 2 - Narrowing down the fault areas with BS 04 DB XX

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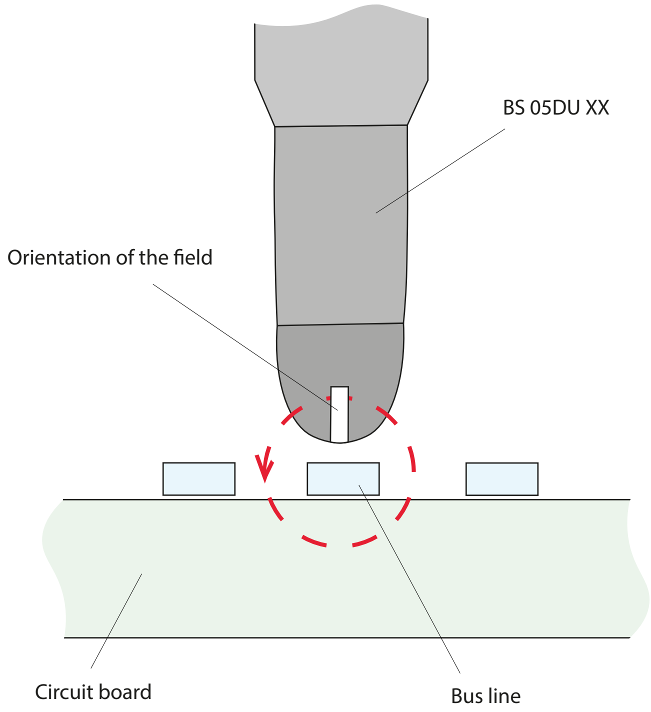

Figure 3 Pulsing of a bus line with BS 05DU XX

For further analysis, the area of the bus lines between the two ICs is examined with the BS 05 DU field source (Figure 3). Here the fault pattern can be reproduced directly on these lines.

With this knowledge, suitable countermeasures can now be tested.

To prevent interference on the bus lines, they must be shielded. As a test, the bus lines are therefore covered with copper foil and the module is pulsed with the standard generator again. The result is that the shielding prevents the corresponding error pattern.

The successful shielding can now be put into practice with appropriate layout measures. For example, the bus lines could be laid in an inner layer and shielded with a ground layer.

Note: This interference immunity test should be carried out as early as possible in the development phase (first prototype) in order to avoid unnecessary layout changes.

The targeted, strategic use of field sources provides developers with effective tools for identifying weak points in the design and then taking targeted countermeasures.

Use the following Langer EMV products for this purpose:

- E1 set Immunity Development System
- TS 23 set TroubleStar Development System for ESD / Burst
- H2 set and H3 set Field Sources

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Mini Burst Field Generators

in pocket size

The P1 set with the three mini burst field generators is used to quickly test the immunity of assemblies. They are a quick alternative to EMC test stations, where larger generators have to be set up and put into operation at a laboratory workstation, which is time-consuming.

The pocket-sized mini burst field generators can be put into operation immediately without any additional measures. This enables fast, flexible testing of electronic systems.

At their tip, they generate burst or ESD-like interference fields with an interference pulse of 2/8 ns.

The mini burst field generators are guided by hand with their field-emitting tips close to the test object (e.g. printed circuit board). They are most effective when they are placed directly on the surface of the device under test.

The weak points react to the pulse field and functional faults can be triggered. In the device under test, weak points can be found specifically on individual sections of the PCB design (faults in the ground system, individual conductor tracks or IC pins). The separation of magnetic (P11 and P12) and electrical (P21) coupling enables optimum adaptation of the EMC countermeasures to a weak point.

Figure 1 shows the three generators (from the P1 set). Each of the generators fulfils a specific task.

1

Figure 1 P1 set

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P11 Mini burst field generator generates a magnetic field that emerges axially from the tip. The magnetic field can be used to test current and signal loops in the module for interference immunity. It can also be coupled into the surface of ICs in order to hit the die of the IC.

P12 mini burst field generator generates a magnetic field that emerges in a circle from the tip. The magnetic field of this mini burst field generator can selectively detect IC pins and conductors and induce an interference voltage in them. The (sensitivity tester) P12 can be used to test the sensitivity of IC inputs and conductors.

The P21 mini burst field generator generates an axial electric field at its tip. The tip is shaped in such a way that the field electrode can be placed longitudinally on conductor runs for coupling. This enables intensive direct coupling. Active inputs of ICs (reset, clock) react particularly sensitively if they have high-impedance drivers (pull-up or pull-down resistors).

B-Pulser P11 (red) **B-Pulser P12 (yellow)** **E-Pulser P21 (blue)**

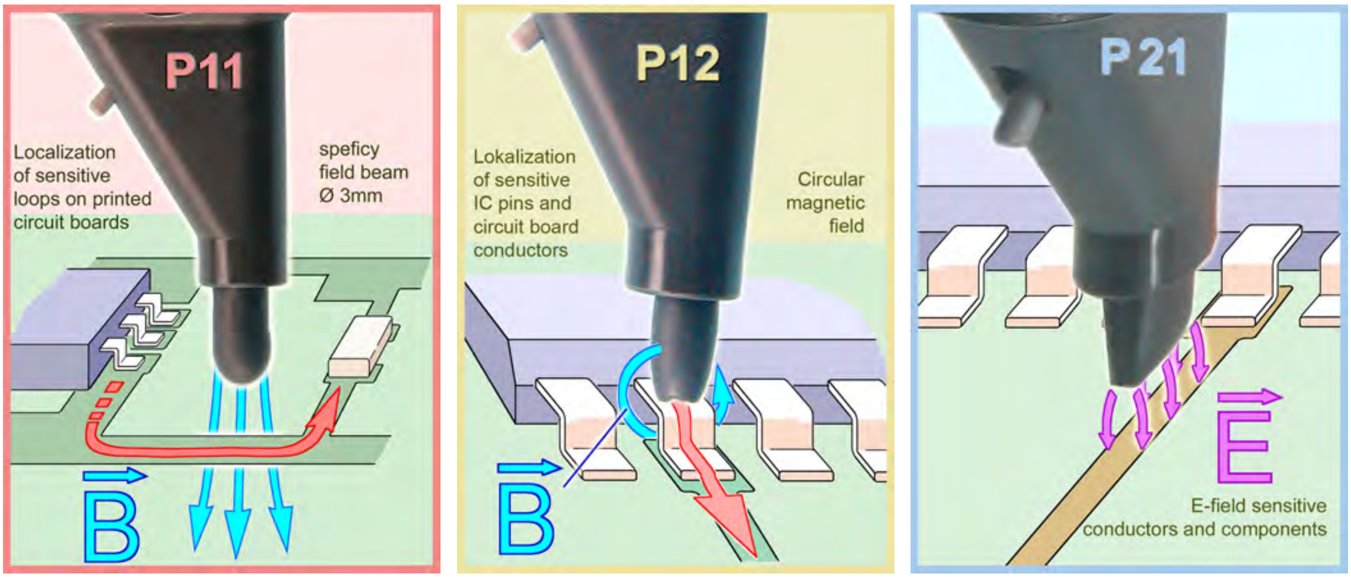

Figure 2 Applications of the mini burst field generators from P1 set

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Figure 3 Magnetic field coupling into the VDD systems of an IC

Figure 3 shows the use of the P12 pulser when interference current is coupled into a VDD/VSS capacitor of the microcontroller. The interference current can briefly reduce the supply voltage in the IC and switch off the IC for a few nanosecond

Figure 4 shows the application of the mini burst field generator P21 on a quartz oscillator. This demonstrates that the module can be disturbed via the quartz oscillator when exposed to an electric field.

The mini burst field generators are used to analyze flat assemblies during development. The generator's field source generates ESD/ burst-like pulsed fields limited to a few square millimetres.

The adjustable intensity of the disturbance variable means that weak points can be compared with each other and the effectiveness of EMC measures can be checked. The separation of magnetic coupling (B-pulser P11, red) and electrical coupling (E-pulser P21, blue) enables magnetic and electrical weak points to be differentiated and the countermeasure corresponding to the cause-effect relationship (E/H) to be determined.

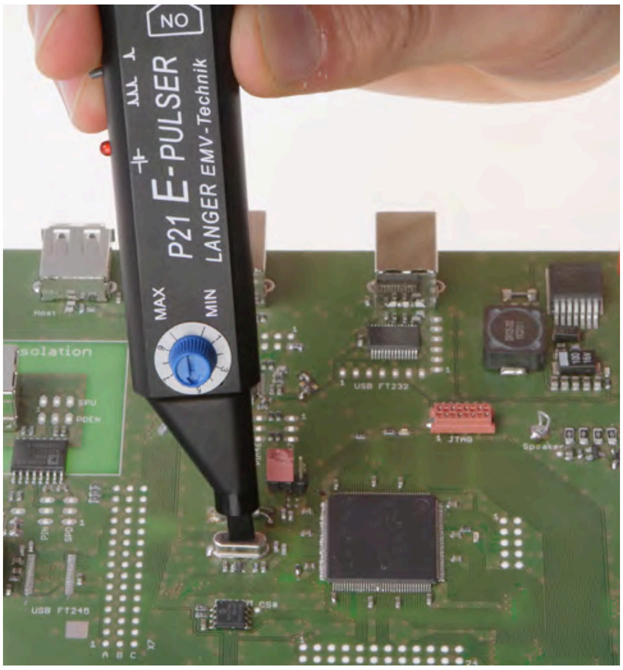

Figure 4 Coupling of electric field into a quartz oscillator

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Information

since 2024

P512 set

IC DPI- and RF-Measurements

Area of application

» DPI Measurements on each IC pin with the same coupling network up to 12 GHz

» RF measurements on each IC Pin

IC Test system for IC immunity testing

- High power injection of 2 W at 12 GHz
- Reliable coupling network
- RF-Measurements up to 12 GHz
- Low attenuation less than 3 dB up to 12 GHz
- SWR lower than 2

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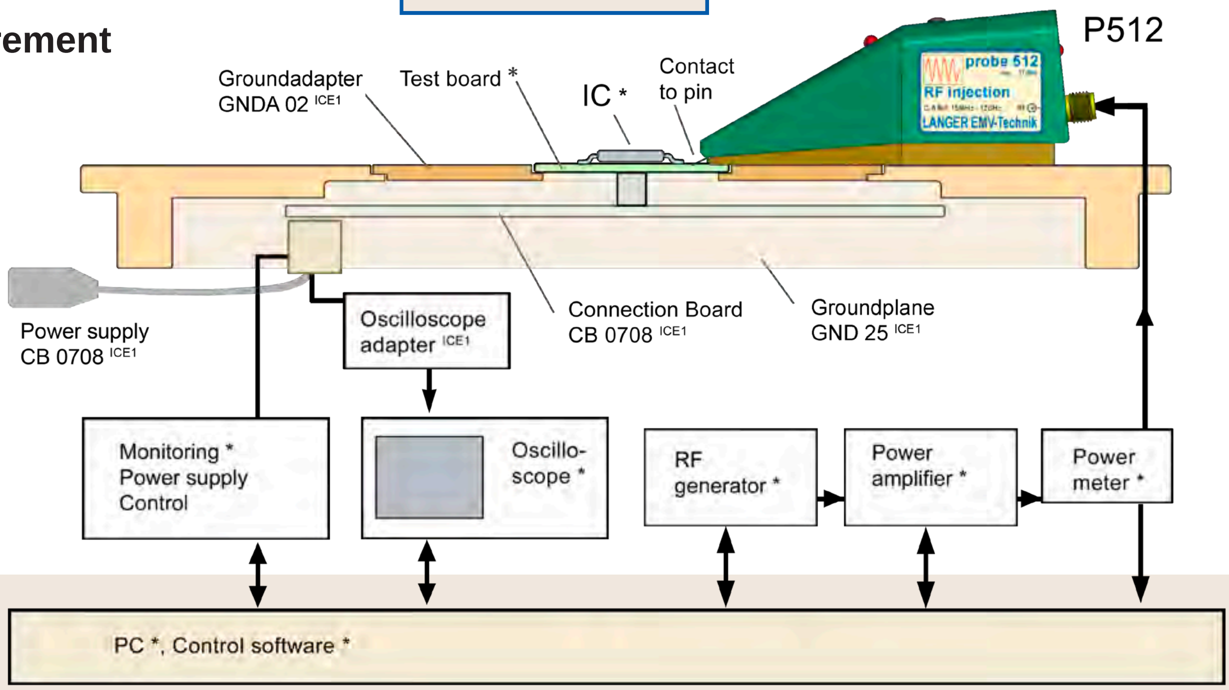
Measurement setup



IC DPI- Measurement **P512 set**

Related products

IC Probe for RF-immunity testing on IC

- DPI According to IEC 62132-4
- Up to 3 GHz
- Measurement of current, voltage and phase information at the probe tip

P501 / P503 set

ICE1 Test Environment

- Elements for supplying test ICs
- Devices for the evaluation of influencing events on ICs
- Setup of the test environment for IC tests

ICE1 set

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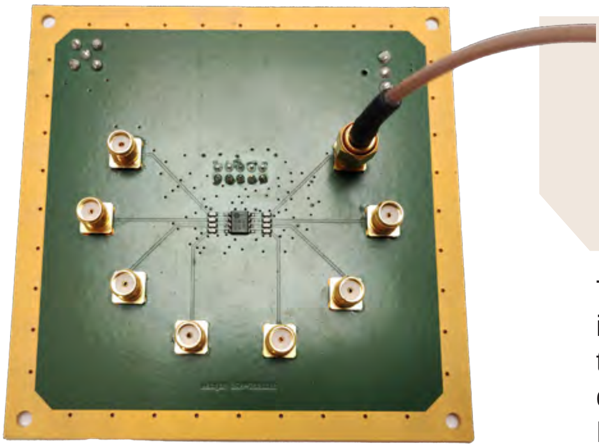

Figure 1: Test PCB for DPI according to IEC 62132-4

P512 and DPI

The weak points for the susceptibility to interference in modern electronics often lie in the circuits (ICs) of the assemblies. However, the increasing integration density and smaller semiconductor structures in the ICs also change their interference behavior. Fast and high-frequency interference, which was compensated for in ICs of older generations by the larger structures or did not become effective due to the high inductance of the longer interference current paths, is becoming increasingly relevant for new types of ICs. To test an IC for its susceptibility to interference from high-frequency signals, RF power can be fed directly into the pins in a conducted manner.
This method of directly feeding RF power (DPI) into IC pins is generally carried out using a test PCB in accordance with the standard (IEC 62132-4). According to the standard board, each pin to be tested is provided with a coupling capacitance of 6.8 nF and a subsequent RF-compatible connector (e.g. SMA). By connecting a power amplifier to the connectors, RF power can be fed directly into the pin. The upper limit frequency up to which such a DPI test is carried out is 1 GHz. In the automotive sector, tests are carried out up to 3 GHz.

For DPI tests for ICs with more than 100 pins, the design of the test PCB quickly becomes complex and confusing. In this case, either only a small number of pins that are considered relevant are tested or several test PCBs are designed, on each of which different pin groups can be tested.

The new development from Langer EMV-Technik, the P512 probe, is capable of coupling RF power of up to 12 GHz into IC pins. A special contact system with a large-area ground connection is used for this purpose. The probe's cut-off frequency of 12 GHz was measured using an IC stripline within the ground system.

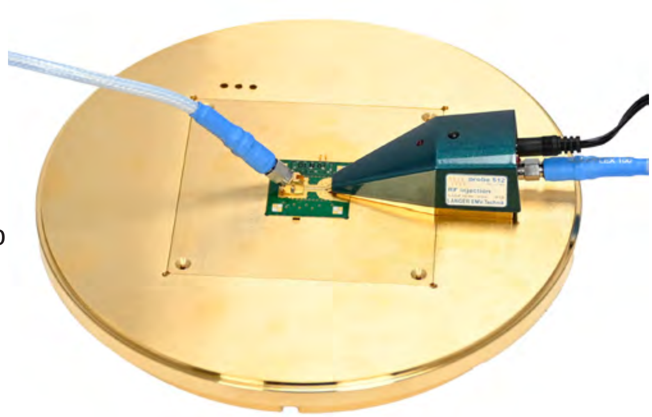

Figure 2: Measurement of the cut-off frequency of the P512 on a stripline

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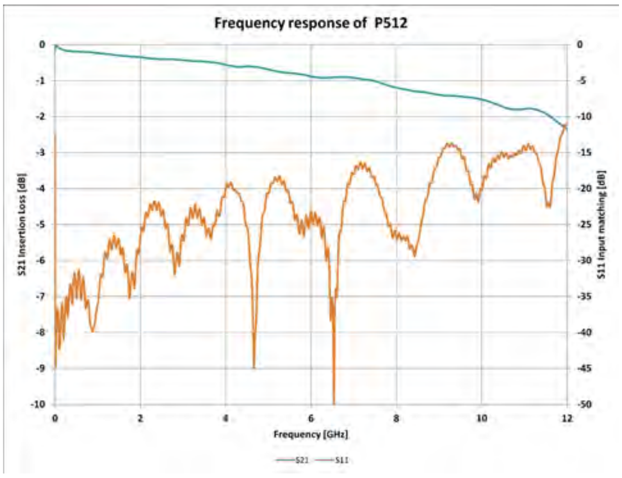
The main advantage of using the P512 is the reliable frequency extension to 12 GHz for the coupling of RF power. ICs manufactured using flip-chip technology and housed in a BGA package are particularly susceptible in this higher frequency range. Further advantages result from the design of the sample in combination with the ground system included in the set. The IC pins no longer have to be contacted separately via the SMA connector of the respective pin in order to couple in RF power; instead, the probe itself is connected to the power amplifier with the SMA connector on the back of the probe. The pins are then contacted using the tip of the probe, which can be flexibly positioned on each pin of the IC. This eliminates the need to switch between



testing two pins and makes it possible in principle to automate the measurement. The 6.8 nF coupling capacitance is located inside the probe and no longer needs to be taken into account when designing the test PCB.

Use as HF probe head

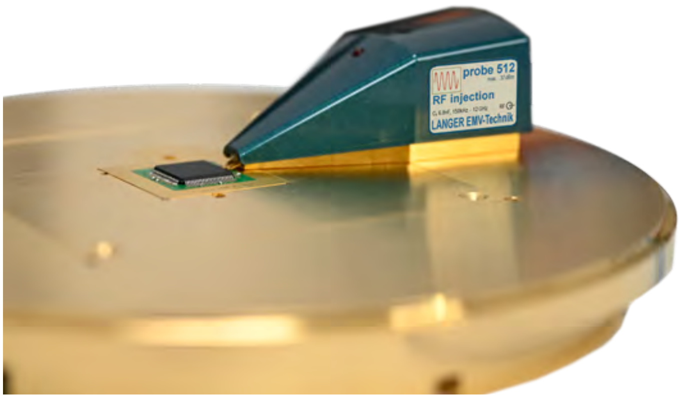


Figure 3: Measurement of RF useful signals

The P512 can also be used as an RF probe for measuring high-frequency signals up to 12 GHz. The measurement takes place in the same ground system as the coupling. The advantage of flexible contacting of any pins, as already mentioned for coupling, is therefore retained. Due to the ground contact of the sample directly next to the measuring tip, potential coupling loops remain minimal, which leads to increased freedom from feedback in the measurement. When measuring high-frequency useful signals, the signal may be capacitively loaded and distorted by the 6.8 nF. In such cases, the internal coupling capacitance of the probe can be flexibly adjusted to any value in the pF range.

Service

For further information, please contact sales@langer-emv.de.

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