LANGER
EMV-Technik

IC TEST SYSTEM

User manual
Probe set

P250

EFT/burst injection up to 6 kV

CE

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1 250 EFT/burst coupling network set

The ***P250*** probe is used to inject electrical fast transients into integrated circuits so as to determine their pulse immunity according to IEC 62215-3 and/or IEC 61000-4-4. The probe contains a coupling network which is supplied with pulses from an EFT/burst generator (according to IEC 61000-4-4).

Apart from its layout and housing design, the characteristics of the ICs which are used in a device are decisive for its EMC characteristics. The ICs' susceptibility to fast pulsed disturbances increases significantly if their structural dimensions, operating voltages and operating points are reduced. ICs with identical functions can thus show a very different EMC behaviour depending on the respective manufacturer, the package used or the corresponding series, among other things.

ATTENTION!

An EFT/burst generator supplies the devices with a high voltage. Please pay attention to the operating instructions of the respective EFT/burst generator used.

The high-voltage cable must be plugged into the *P250* probe before starting the measuring system.

The measuring system may not be started if the *P250* probe or high-voltage cable is defective or damaged.

	The tip of the ***P250*** probe is under high voltage during operation! Beware! Do not touch the tip!

2 Design and function of the P250 probe

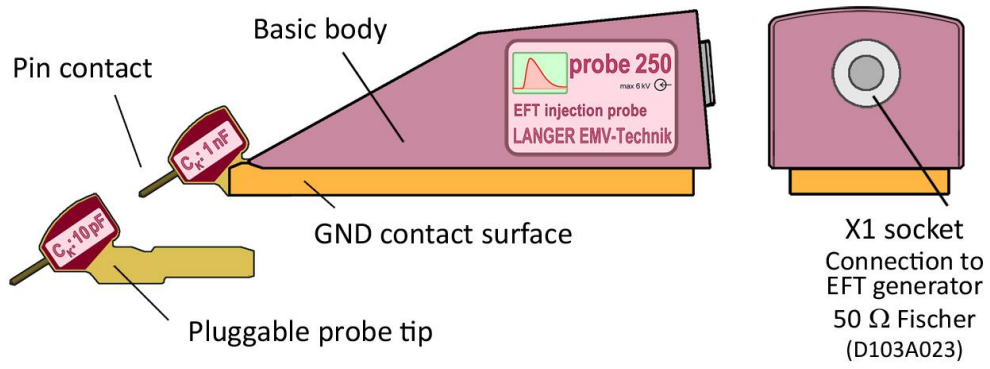


Figure 1: Description of the ***P250*** probe ports

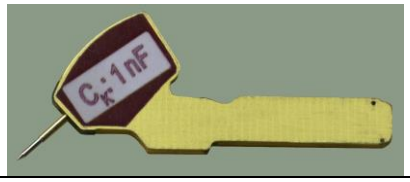
The basic body (**Figure 1**) holds the different probe tips which include the coupling network. The GND contact surface on the bottom of the probe is the return conductor.
The socket X1 is connected to the EFT/burst generator via the enclosed high-voltage cable ***HV FI SHV 1 m***.

Each of the five probe tips (**Figure 2**…**Figure 6**) includes a different coupling network that is used to inject disturbances into the different pins of the device under test.

	C_K = 2.2 pF R = 0 Ω max. 6 kV	Quartz crystal or oscillator input
Figure 2: ***TS 250-2.2p*** probe tip		

	C_K = 10 pF R = 0 Ω max. 6 kV	Inputs/outputs: reset, IRQ, analog inputs, amplifier inputs
Figure 3: ***TS 250-10p*** **probe tip**		

	C_K = 100 pF R = 0 Ω max. 6 kV	Automotive test, inputs/outputs
Figure 4: ***TS 250-100p*** **probe tip**		

	C_K = 1 nF R = 0 Ω max. 6 kV	Inputs/outputs: power supply
Figure 5: *TS 250-1n* probe tip		

	C_K = 100 nF R = 0 Ω max. 0.5 kV	Automotive test, power supply
Figure 6: *TS 250-100n* probe tip		

2.1 Characteristics

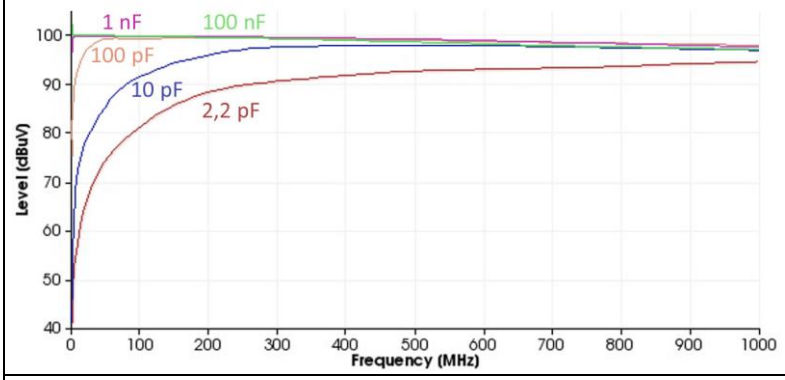


Figure 7: Frequency response of the ***P250*** probe with different probe tips

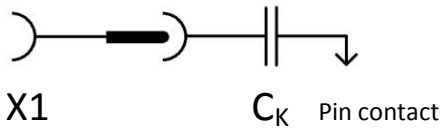


Figure 8: *P250* equivalent circuit diagram

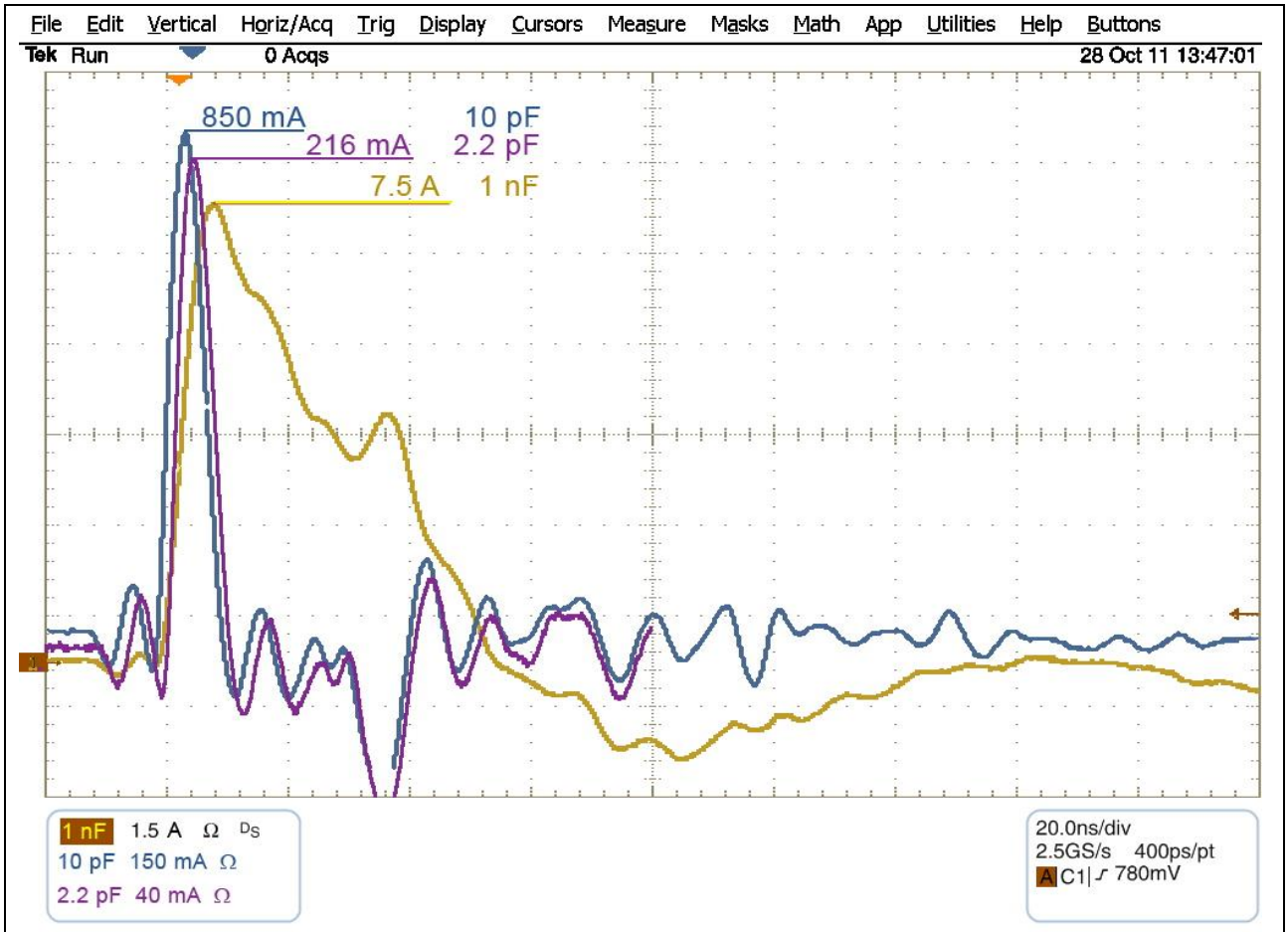


Figure 9: - EFT/burst disturbance pulses from the probe tips depending on the coupling capacitance C_K

- Supply voltage of the ***P250*** probe: 500 V, 5/50 ns
- The probe tip injects a voltage into a 200 mOhm shunt
- Measurement signal: current flow from the probe tip into the 200 mOhm shunt

The coupling capacitance of the probe tip converts the disturbance pulse of the EFT/burst-generator. The smaller the coupling capacitance C_K of the probe tip, the smaller the amplitude and pulse width of the emitted disturbance (**Figure 9)**.

2.2 System set-up

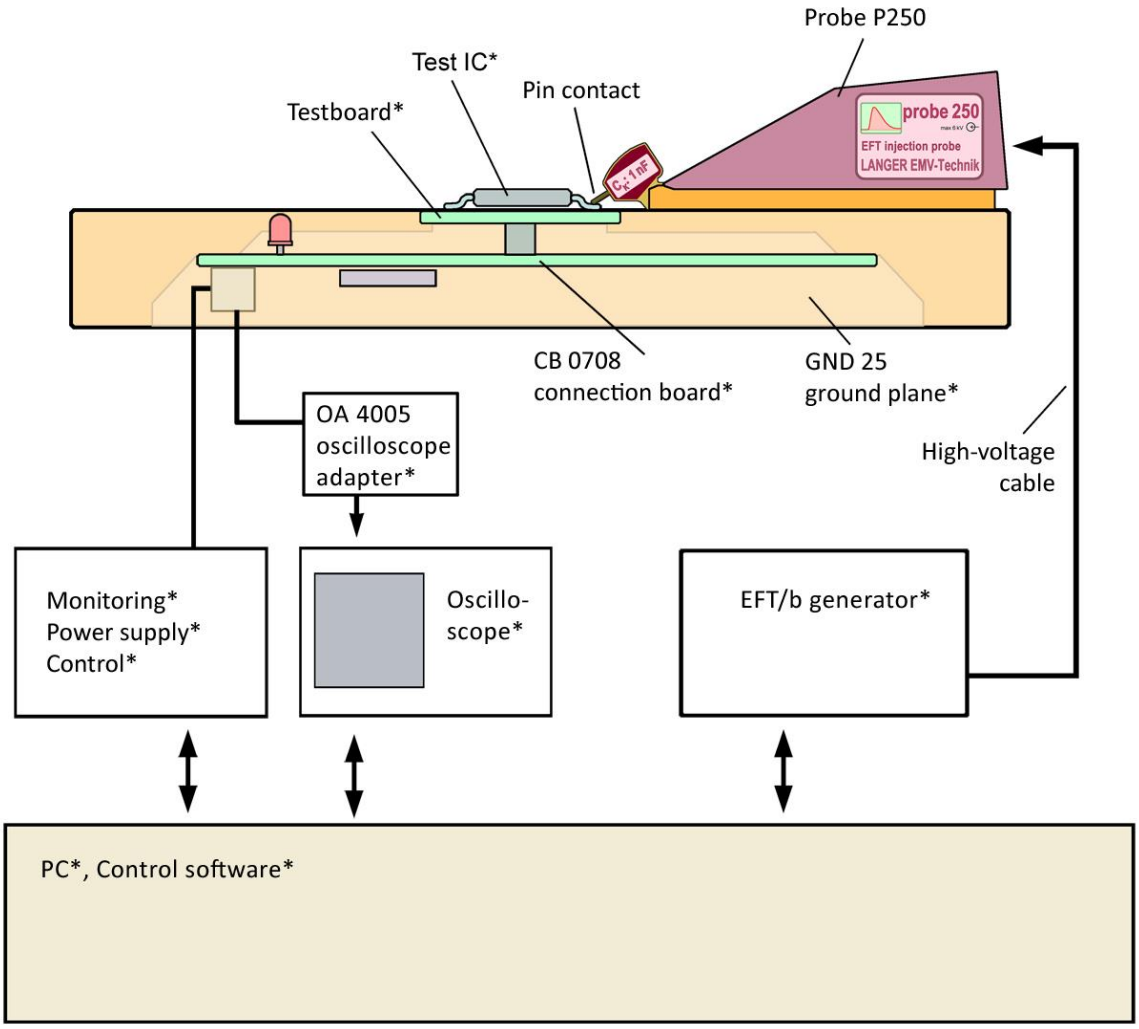


Figure 10: ***P250*** probe in the test environment

The components marked * are not included in the scope of delivery.

The components marked * are not included in the scope of delivery. **Figure 10** shows the set-up of the IC test system with the ***ICE1*** IC test environment set (**Table 1**) and the ***P250*** probe set.
The probe is used to contact the individual IC pins directly. Different coupling networks are available for the injection depending on the type of pin (I/O, Vdd),
(see **Figure 2**…**Figure 6**). The HV output of the EFT/burst generator is connected directly to the probe via the enclosed ***HV FI SHV 1 m*** high-voltage cable.

The ***P250*** probe is used to inject the disturbance pulse of the EFT/burst generator into the pin of the test IC through the coupling capacitance C_K.
The test IC is mounted on a test board[1]. The test board is inserted into the ***GND 25*** ground plane and connected to the ***CB 0708*** connection board via a plug connector.

[1] For manufacturing the test board: "IC-test instruction manual", Langer EMV-Technik GmbH

The ground plane and connection board are components of the ***ICE1*** IC test environment set. External devices such as an oscilloscope or special test hardware may be required to evaluate signals from the test IC (**Figure 11**).

Figure 11: Test set-up with the ***P250*** probe set and ***ICE1*** *IC* test environment set

The devices listed in the table are described in their respective instruction manuals:

Tasks and devices	**User manual**
• Instructions for the development of the test board • Test process	IC test instruction manual (Langer EMV-Technik GmbH)
• ***GND 25*** ground plane • ***CB 0708*** connection board • ***OA 4005*** oscilloscope adapter • ***TH 22*** probe head holder • Monitoring and controlling the test IC	***ICE1 set*** user manual

Table 1

2.3 Verifying the waveform

The ***SM 02-01*** shunt can be used to verify the waveform of the current pulse. The shunt has a bandwidth of 3 GHz and can be loaded with a maximum pulse current of 180 A in the single-pulse mode.

The shunt is inserted in the **GNDA 02** ground adapter (**Figure 12**). The SMB output is connected to the 50 R input of an oscilloscope. If the oscilloscope's attenuator is set to 26 dB (x20), the voltage value that is measured with the oscilloscope corresponds to the current flowing through the shunt. An oscilloscope with a bandwidth of 500 MHz or more should be used for the measurement. **Table 2** shows the probe parameters depending on the respective probe tip. The measurement was performed with an EFT/burst generator according to IEC 61000-4-4. The voltage was set to 1 kV on the EFT/burst generator, except for the 100 nF probe tip (500 V).

The waveform has to be verified prior to every major measuring job. Provided the waveform does not deviate from the given parameters, the ***P250*** probe only has to be calibrated every two years by **Langer EMV-Technik GmbH**.

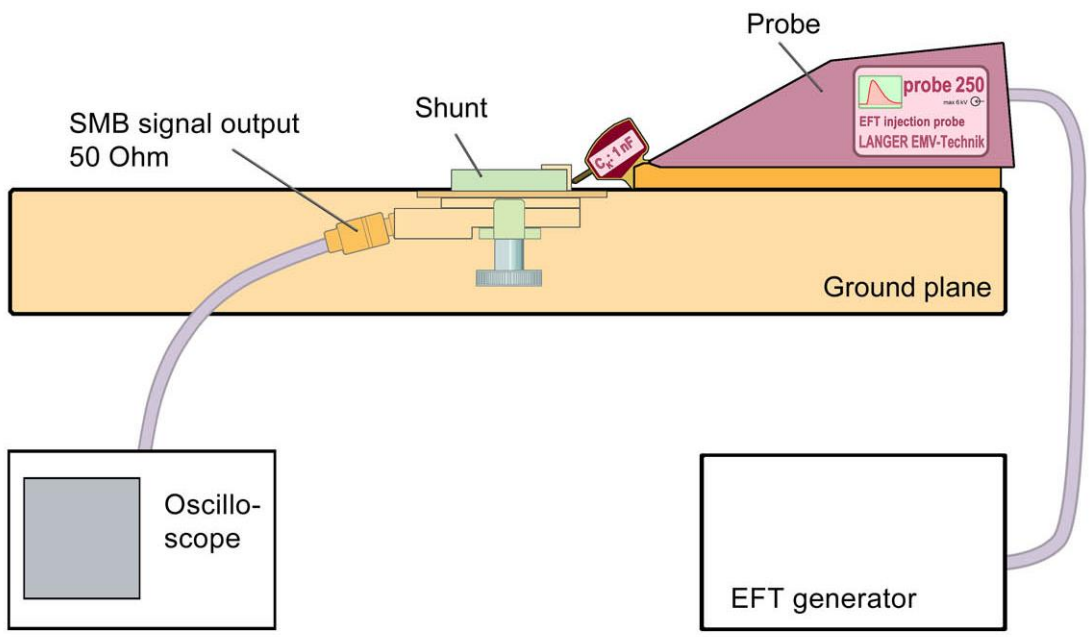


Figure 12: Measurement set-up to verify the waveform

Parameter	TS 250-2.2 p	TS 250-10 p	TS 250-100 p	TS 250-1 n	TS 250-100 n
I_{max}[A]	0.29…0.35	1.0…1.3	8.0…10.0	15.7…19.0	9.0…11.0
Rise [ns]	3.0…4.0	3.2…4.0	3.8…4.6	5.0…6.0	4.5…5.5
Width [ns]	5.0…6.0	5.0…6.0	6.0…7.4	21.0…27.0	42.0…52.0

Table 2: Waveform parameters

3 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.

- Observe the operating and safety instructions for all devices used in the set-up.
- 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 product from Langer EMV-Technik GmbH unattended whilst this is in operation.
- The Langer EMV-Technik GmbH product may only be used for its intended purpose. Any other use is forbidden.
- 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 the probe is operated. 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:
  - connecting a protective resistor in the IC's incoming power supply
  - 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 precautions if necessary:

- monitor the representative signals in the device under test,
- 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!

4 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.

5 Technical specifications

Parameter	P250
Max. pulse voltage acc. to IEC 61000-4-4	6 kV

Table 3: Limit values / load factor of the ***P250***

Parameter	TS 250-100 n	TS 250-1 n	TS 250-100 p	TS 250 – 10 p	TS 250 – 2.2 p
Coupling capacitance	100 nF	1 nF	100 pF	10 pF	2.2 pF
Max. pulse voltage	0.5 kV	6 kV	6 kV	6 kV	6 kV

Table 4: Limit values / load factor of the probe tips

6 Scope of delivery

Item	Designation	Type	Parameter	Qty.
01	EFT Coupling Network	***P250***	6 kV	1
02	Probe tip 2.2 pF	***TS 250-2.2p***	6 kV	1
03	Probe tip 10 pF	***TS 250-10p***	6 kV	1
04	Probe tip 100 pF	***TS 250-100p***	6 kV	1
05	Probe tip 1 nF	***TS 250-1n***	6 kV	1
06	Probe tip 100 nF	***TS 250-100n***	0.5 kV	1
07	High-voltage cable Fischer-SHV	***HV FI SHV 1 m***	1 m	1
08	Shunt	***SM 02-01***	0.1 Ω	1
09	Case with foam insert			1
10	User manual			1
11	Case insert / Quick guide			1

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