LANGER
EMV-Technik

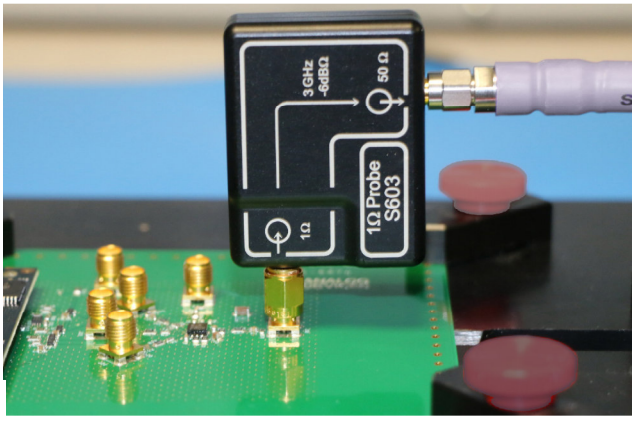
IC TEST SYSTEM

User manual

S603/ S750 Set

Measurement of Conducted Emissions
1 Ohm/150 Ohm
Direct Coupling Method

IEC 61967-4:2002 + A1:2006



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1 S603 / S750 Set 1 Ohm / 150 Ohm IC Measurement

The probes S603 / S750 are used to measure the conducted emission with direct 1 Ohm (S603) / 150 Ohm (S750) coupling, according to the standard EN 61967-4: 2002 + A1: 2006.
The coupling networks for direct 1 Ohm / 150 Ohm coupling according to standard IEC 61967-4 are included in the probes S603 and S750.

To evaluate the EMC properties of integrated circuits (ICs), the measurement method with direct 1 Ohm /150 Ohm coupling, measurement of the conducted emission of IC, was developed. The measured variables for the S603 / S705 set transmitted by IC pins are the HF current (S603) or the HF voltage (S750).

To measure the emission characteristics of the IC according to the standard, special test PCBs are required. These test PCBs are equipped with IC under test and the coupling networks, as well as connectors for the probes / probes. The space requirement for the coupling network on the test PCB increases with the number of IC pins to be measured. This limits the number of practically measurable pins.
The frequency response of the switching networks depends on the layout and component design of the networks. This affects in particular the components of the 1 Ohm Shunts.

The 1 Ohm coupling network consists of a 1 Ohm shunt for measuring the single or the sum of the current at the ground pins of the ICs. The 150 Ohm coupling network consists of a 150 Ohm voltage divider for measuring the interference voltage on IC pins.

The S603 and S750 probes have been designed to improve accuracy and adjunct the reproducibility and comparability of measurements. This has the positive affect to reduce space requirements on the test board. The S603 and S750 probes contain the corresponding coupling network for 1 Ohm / 150 Ohm internally up to a frequency of 3 GHz. The coupling network is no longer needed on the test circuit board. The probes S603 and S750 are contacted by means of a coaxial SMA connector on the test PCB.

2 Setup and Function of the Probes

2.1 S603 1 Ohm

2.1.1 Setup S603 Probe

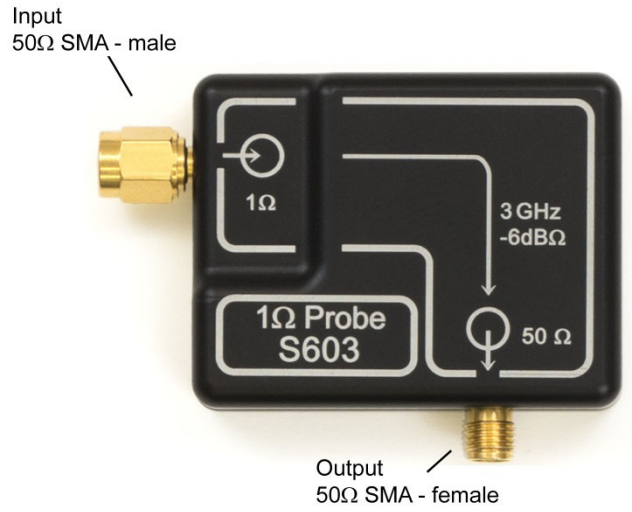

Fig. 1 Connectors of the S603 Probe, 1 Ohm Probe

The closed aluminum housing houses the 1 Ohm coupling network according to IEC 61967-4. The two coaxial SMA connectors are used to connect the probe to the test PCB and to a measuring instrument (spectrum analyzer / test receiver).

The probe S603 is an HF current meter. On the IC under test, the total current of several ground pins or the single current of a particular ground pin can be measured. The HF current is conducted through the 1 Ohm shunt. It generates an equivalent voltage (measuring voltage) at the 1 Ohm resistor of the shunt. A current flow of one ampere in the 1 Ohm shunt produces a voltage of one volt ([A] = [V]). The measuring voltage U_{out} is connected to the 50 Ohm output.
In conjunction with the 50 Ohm input resistance of the meter, the voltage U_{out} is divided by 6 dB.

2.1.2 Characteristics

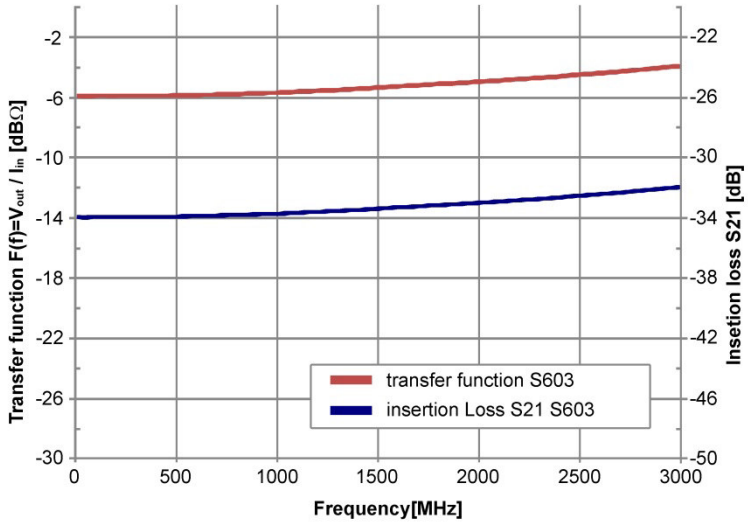

Fig. 2 - Frequency response of S603 Probe to 3GHz

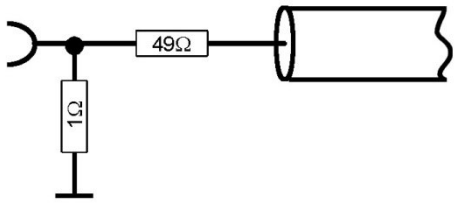

Fig. 3 - Equivalent circuit S603

2.1.3 Using the Correction Factor

With the correction factor, the current I_{in} is calculated from the output voltage of the probe.

The transfer function **Fig. 2**, **Eq 1**

$$F(f)[dB\Omega] = U_{out}[dB\mu V] - I_{in}[dB\mu A] = {}^{1}/_{K(f)} \qquad \textbf{Eq 1}$$

is almost constant over the entire frequency range -6 dBOhm (Fig. **2**).

In generally the constant correction factor K = +6 dB/Ohm could be used.

The correction function K(f) of the probe S603 (Eq 2) allows an exact correction of the measured values in the entire frequency range. The following tailored equation calculates the measured RF current in dBµA directly from the measured output voltage U_{out}

$$I_{in}\,[dB\mu A] = U_{out}\,[dB\mu V] \cdot K(f)\,\left[{}^{1}/_{\Omega}\right] \qquad \textbf{Eq 2}$$

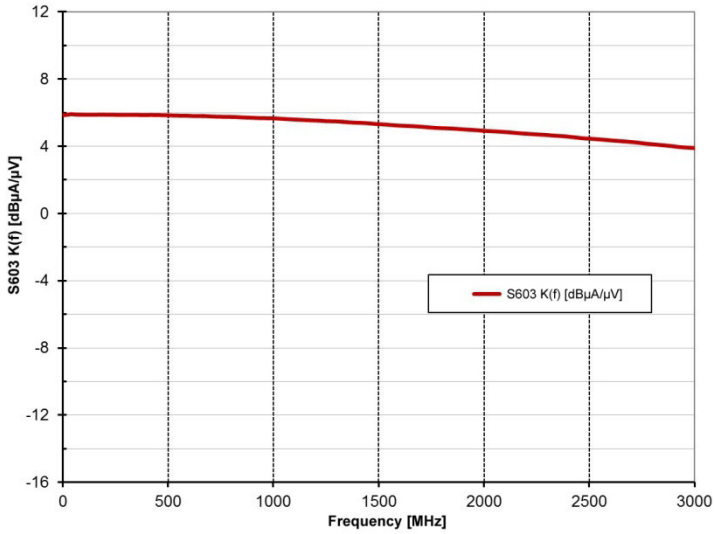

Fig 4 - Frequency response of the correction function S603 K(f)

The correction K(f) can be performed automatically during the measurement with the software for spectrum analyzers "ChipScan-ESA". The software ChipScan-ESA contains the correction function S603 K(f)

2.2 S750 150 Ohm Probe

2.2.1 Setup S750

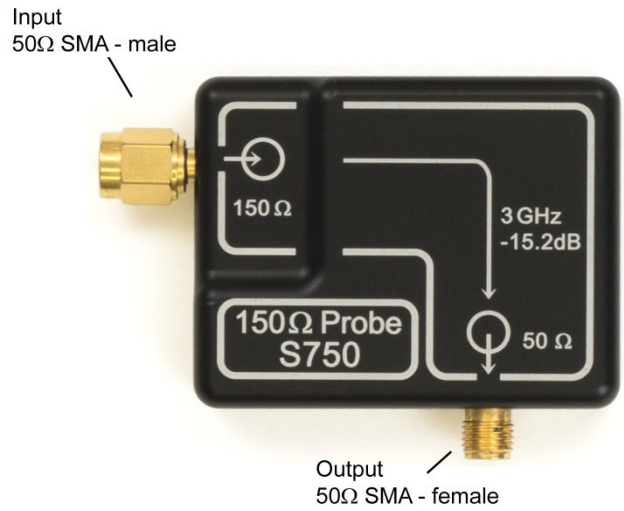

Fig 5 - Connectors of the S750 Probe, 150 Ohm Probe

The closed aluminum housing houses the 150 Ohm coupling network according to IEC 61967-4. The two coaxial SMA connectors are used to connect the probe to the test PCB and to a measuring instrument (spectrum analyzer / test receiver).

The probe S750 is used for RF voltage measurement on signal pins of ICs (integrated circuits). The used 150 Ohm coupling network generates a division of the measurement signal by 15.2 dB.

2.2.2 Characteristics

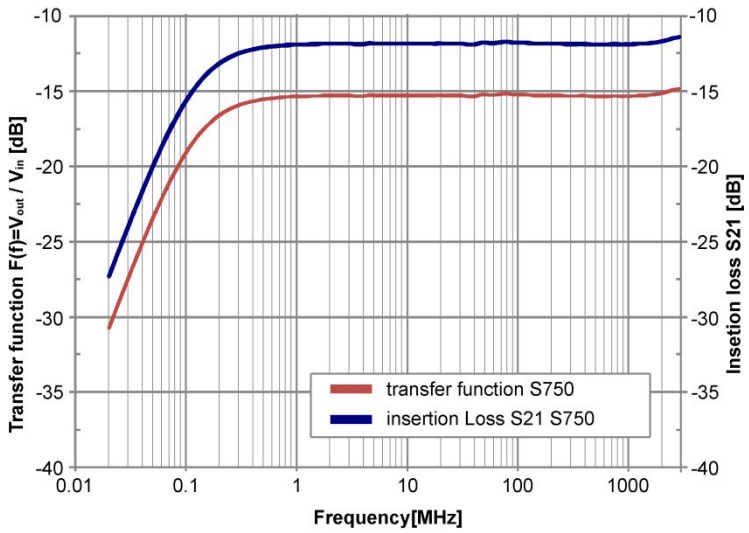

Fig 6 – Frequency response of the S750 Probe to 3GHz

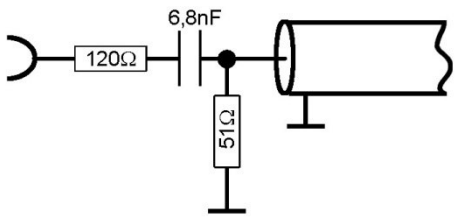

Fig 7 - Equivalent circuit S750

2.2.3 Using the Corrections Factor

The correction factor is used to calculate the voltage U_{in} from the output voltage of the probe.

The transfer function **Fig 6**, **Eq 3**

$$F(f)\ [dB] = U_{out}\ [dB\mu V] - U_{in}\ [dB\mu V] \qquad \textbf{Eq 3}$$

is almost constant over the entire frequency range from 1 MHz to -15.2 dB (**Fig 6**).

Thus, the constant correction factor K = +15.2 dB can generally be used.

The Correction Function K(f) of the S750 probe (Eq 4) allows accurate correction readings over the entire frequency range.

$$U_{in}\ [dB\mu V] = U_{out}\ [dB\mu V] \cdot K(f)\ [dB] \qquad \textbf{Eq 4}$$

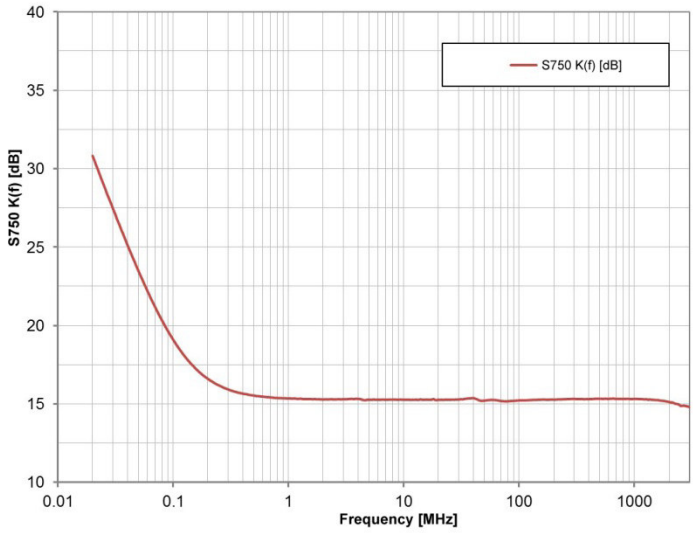

Fig 8 – Frequency Response of the Correction Factor S750 K(f)

The correction can be performed automatically during the measurement with the software for spectrum analyzers "ChipScan-ESA". The software ChipScan-ESA contains the correction function S750 K(f).

2.3 System configuration

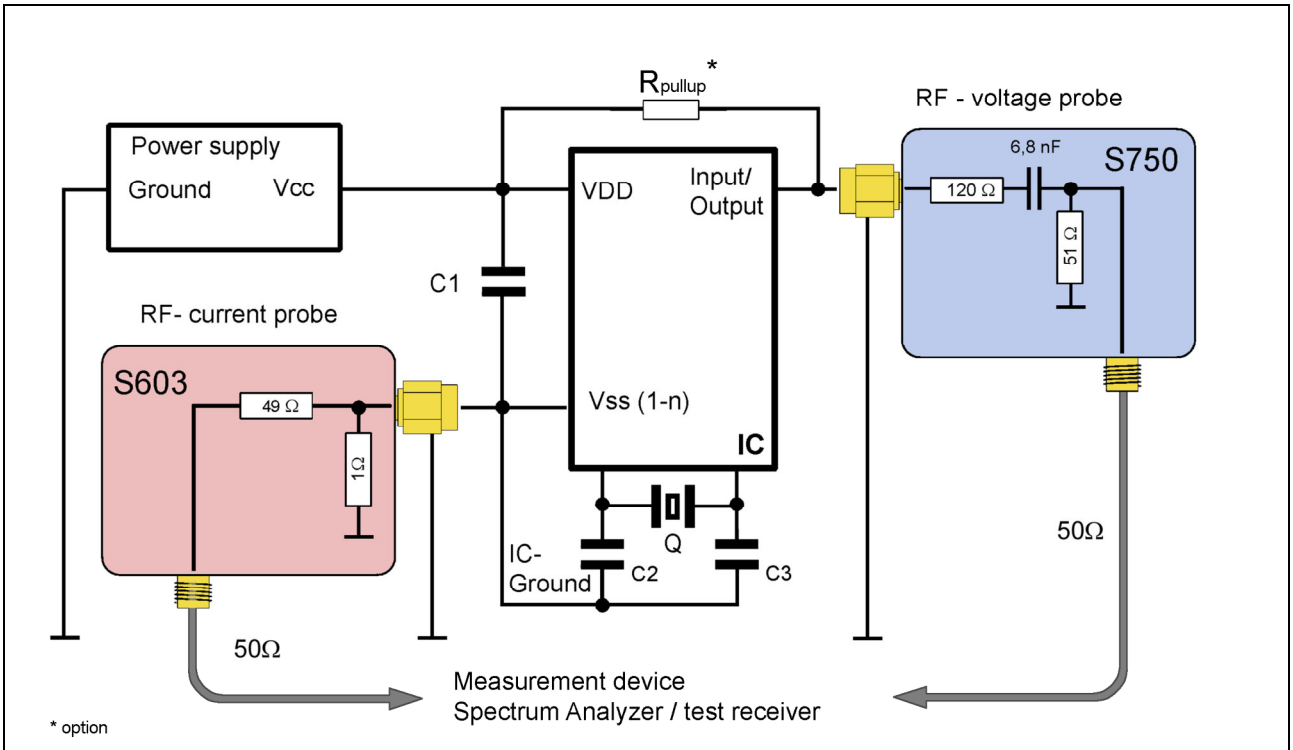

Fig 9 - Probe S603 and S750 with connected IC under test

Fig 9 shows the structure of the IC test system with the S603 / S750 probe set. The probes load the individual pins of the test IC directly. Depending on the type of pins (I / O, V_{ss}), the corresponding coupling network is connected in accordance with IEC 61967-4. The RF outputs of the probes are connected to a spectrum analyzer / test receiver.

- the S603 probe is plugged into the composite GND pins of the test IC
- the S750 probe is connected to I / O pins of the test IC

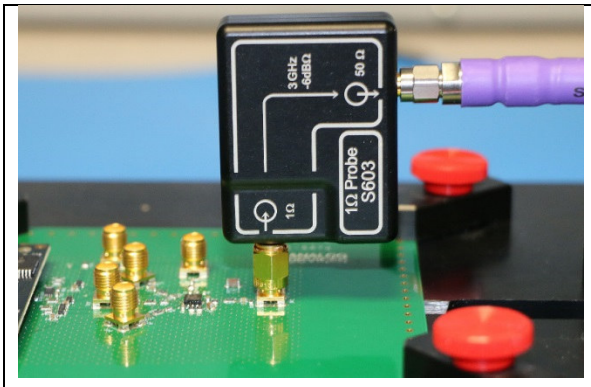

Fig 10: Using the S603 / S750 probes

2.4 Structure of the test IC:

The layout of the test PCB is based on "EN 61967-4, 7.2 Test board layout".

For the connection of the probes SMA female sockets are used for vertical PCB assembly.

3 Safety Instructions

This product complies with the requirements of the following provisions of the European Union: 2004/108 / EC (EMC Directive) and 2006/95 / EC (Low Voltage Directive).
If you use a product of Langer EMV-Technik GmbH, please observe the following safety instructions to protect yourself against electric shock or the risk of injury.

Read and follow the instructions for use and keep them in a safe place for future reference. The application of the device is to be carried out by personnel qualified in the field of EMC and qualified for this work under the influence of interference voltages and bursting fields (electrical and magnetic).

- The operating and safety instructions of all devices used must be observed
- Damaged or defective devices must not be used.
- Before commissioning a measuring station with a product from Langer EMV-Technik GmbH, make a visual inspection. Damaged connection cables must be replaced before commissioning.
- Do not leave a Langer EMV-Technik GmbH product in operation without monitoring.
- The product of Langer EMV-Technik GmbH may only be used for applications for which it is intended. Any other use is not allowed.

- Pacemaker wearers are not allowed to work with the device.
- In principle, the test setup should be operated via a filtered power supply.
- **Danger! During operation of the sample, near fields and spurious emissions may occur due to the function. The task of the user is to take measures to ensure that products installed outside the operational EMC environment are not impaired in their intended function (in particular due to interference emission).**
  This can be done by:
  - Maintaining a corresponding safety distance
  - Using shielded or screening rooms
- Due to their function, the disturbance variables fed into modules can lead to destruction (latch-up) in the device under test. Protection offers:
  - Connecting a protective resistor in the power supply of the IC
  - Gradual increase of the disturbance variable, cancellation in case of malfunction
  - Interruption of the power supply of the device under test in the latch-up case.

- **Warning! It must be ensured that internal functional faults are recognizable from the outside. In the case of non-recognition, destruction of the test specimen may occur when the coupling is increased. If applicable, the following methods are applicable:**
  - Monitoring of representative signals in the test object
  - Special testing software
  - Visible reaction of the test object to input treatments (reaction test of the test object)

No liability can be assumed for the destruction of specimens!

4. 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.

5. Technical Data

3.1 S603

Parameter	S603
Shunt Resistance	1 Ω
Adjustment Resistance	49 Ω
Frequency Range	0 … 3 GHz
Output Impedance (no load)	50 Ω
Connectors	50 Ω, SMA
Max. Dissipatio Power	2,5 W
Transfer Factor Voltage U_{out} / U_{in}	-6 dB
Transfer Factor Current U_{out}/I_{in}	-6 dB Ω
Dimensions LxBxT	60 mm x 45 mm x 14 mm
Weight	42 g

3.2 S750

Parameter	S750
Input Impedance	145 Ω
Frequency Range	100kHz … 3 GHz
Adjustment Resistance	51 Ω
Connectors	50 Ω, SMA
Transfer Factor Voltage U_{out} / U_{in}	-15,2 dB
Max. Input Voltage DC	50 V
Max. Input Voltage HF	3,5 V
Dimensions LxBxT	60mmx45mmx14mm
Weight	39 g

6. Scope of Delivery

Pos.	Designation	Typ	Parameter	Stck.
01	1 Ohm Probe	**S603**		1
02	150 Ohm Probe	**S750**		1
03	Measurement cable	**SMA-SMA 1 m**		1
04	Case			1
05	Manual			1
06	Quick guide			1

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