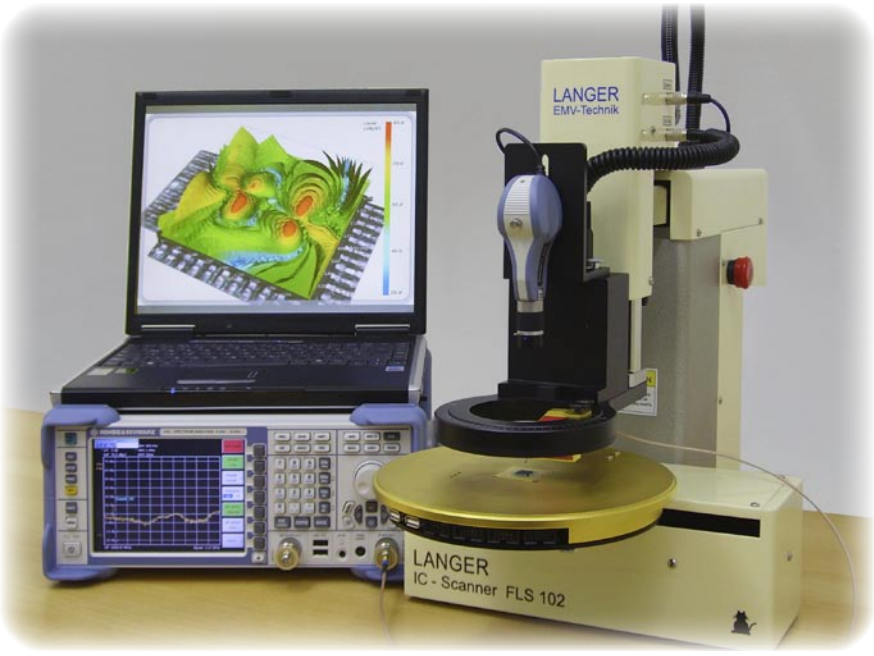
LANGER
EMV-Technik

IC TEST SYSTEM

Langer IC Scanner
with
Near-field microprobes
and
„ChipScan“ Software



1. ICR probes (near-field microprobes)

The near-field microprobes developed by Langer EMV-Technik can be used to measure magnetic or electric near fields with a high resolution and sensitivity. The probes are suitable for field measurement on ICs. The type designation of the probes is ICR probes.

2. IC scanner

The IC scanner is a modular device system with near-field microprobes for the automatic measurement of electric and magnetic near fields on die surface, bond wires, IC-pins.

Apart from the holder for the near-field microprobes, the system includes a 4-axis positioning system to guide the microprobes, a motor controller with cables for the connection and the modular software. The system works via USB with a PC and is connected to a spectrum analyser.

The components are:

1. Mover with 3 linear axes (x, y, z) or optional 4 axes (3 linear x, y, z and α rotating)
2. Test board TB 1022 (GND plane, DUT holder and Connecting board)
3. Motor controller to drive the mover
4. Spectrum analyser
5. PC with ChipScan control and operating software

3. ChipScan software

The software comprises components to operate and control the entire measuring set-up. The devices are centrally managed and controlled. The mover can be controlled with a program or operated by a graphic joystick. The measuring algorithms are carried out in an interactive mode and the results of the measurement are shown in a three-dimensional graphic. The measured data can be exported and used for other applications.

The measuring algorithms are free-programmable scans based on scripts generated by the user.

The prepared measuring algorithms are:
- point scan (ptp scan)
- line scan (continuous scan)
- surface scan
- volume scan

1. ICR probes

Field of application

The dimensions of the near-field microprobes (ICR probes) are in the micrometer range. Thanks to their design and small size, they can be used to separately examine electrical (E-) and magnetical (H-) fields on ICs (die surface, bond wires, pins). They move approximately 20 µm above the respective device under test. E- and H- fields can be detected separately at a high resolution.

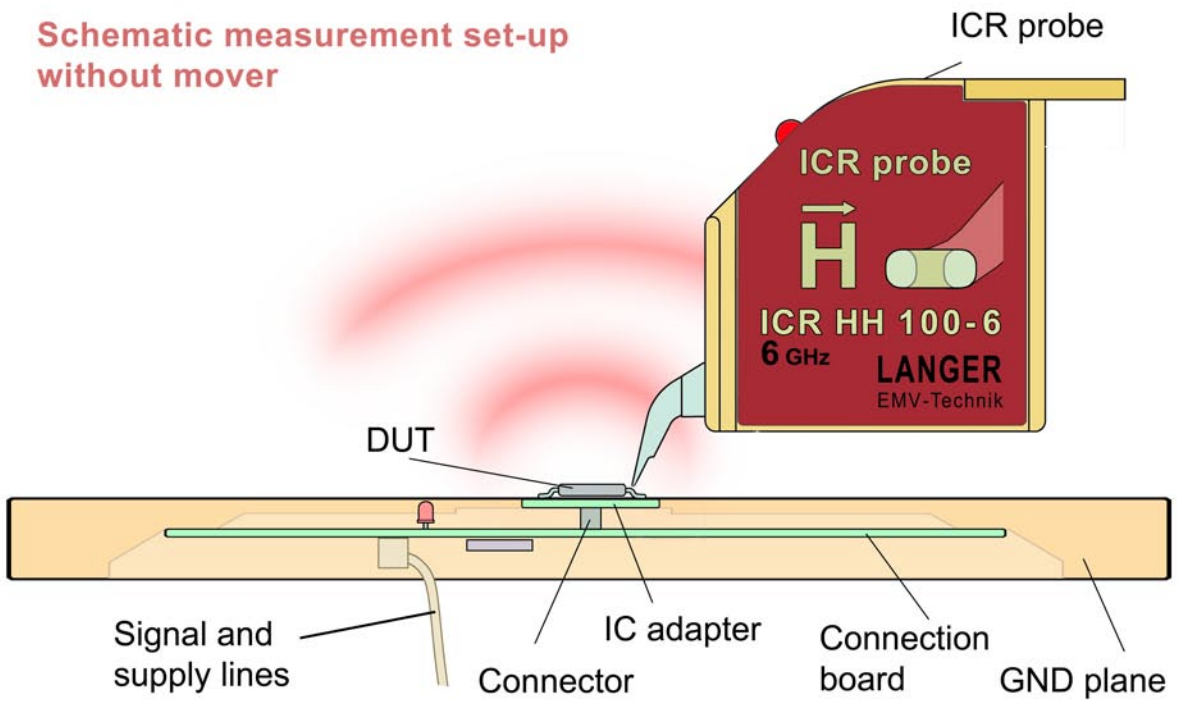
The near-field probes are microprobes which due to their high resolution and sensitivity could no longer guided by hand but have to be computer-controlled by a mover.

The E- and H-probes are mounted at the tip of the probe - the probe‘s head. An amplifier integrated in the probe case.

The probe holder can alternatively be adapted to the customer‘s existing mover or robot systems as desired.

The data sheets of the ICR-probes shows typical sets of characteristics.

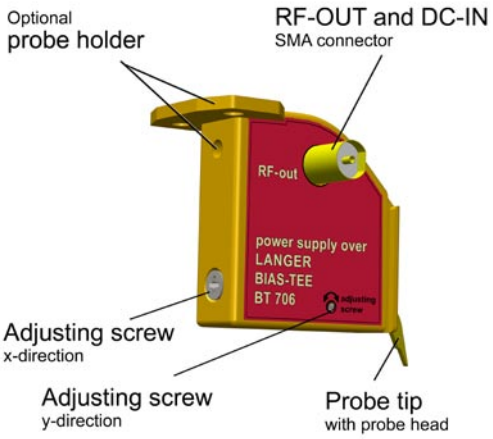
Near-field microprobes can be delivered for a wide variety of measurement tasks during development work. The portfolio of products allows the user to make an optimum choice for a wide range of practical measurement purpose.



1. Probe case with amplifier
The probe head is mounted at the probe tip. The pre-amplifier is arranged in a screened metal case.

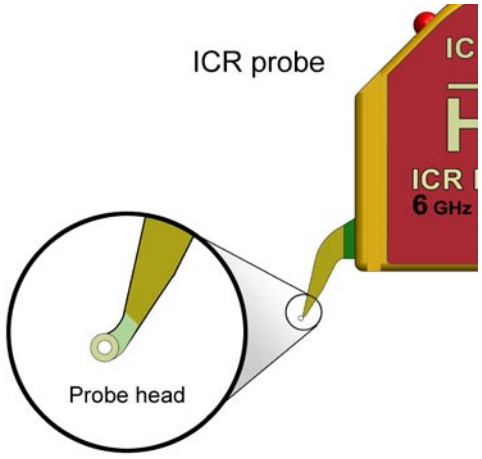
The probe case is attached to the rotary ring of the mover via clamping bolt. A rigid connection between the probes and a prober is also possible as an alternative.

Note:
Due to its design the microprobe is susceptible to shocks and thus it is delivered with a transport and handling protective cap.



2. Probe tip
The probe tip protrudes from the amplifier case and allows optical positioning of the ICR probe above the DUT.

3. Probe head
The probe head is the sensing element of the near-field microprobe.
Horizontal and vertical probe heads with different inside diameters are available for measuring the magnetic field.

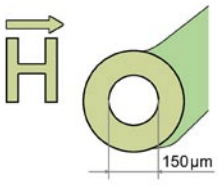
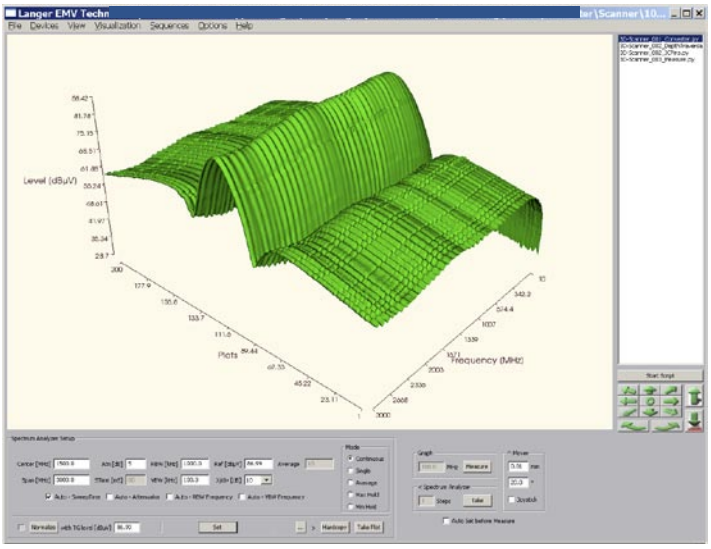
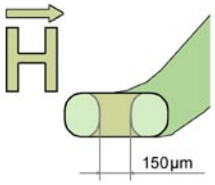
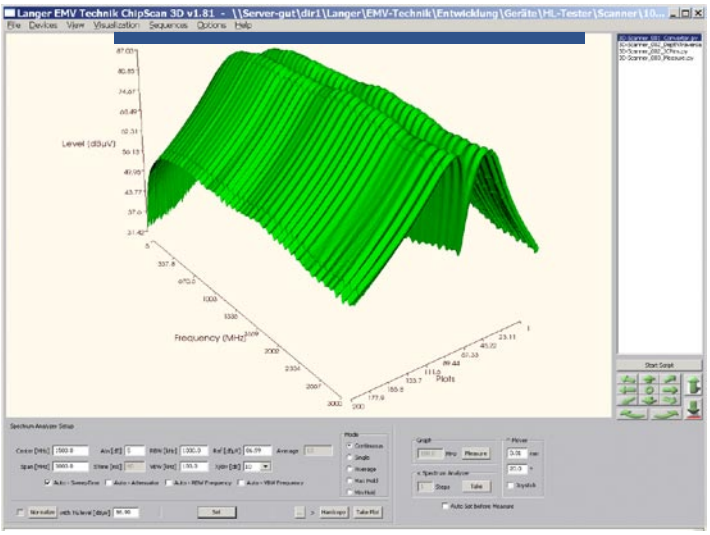
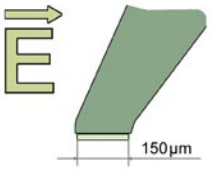
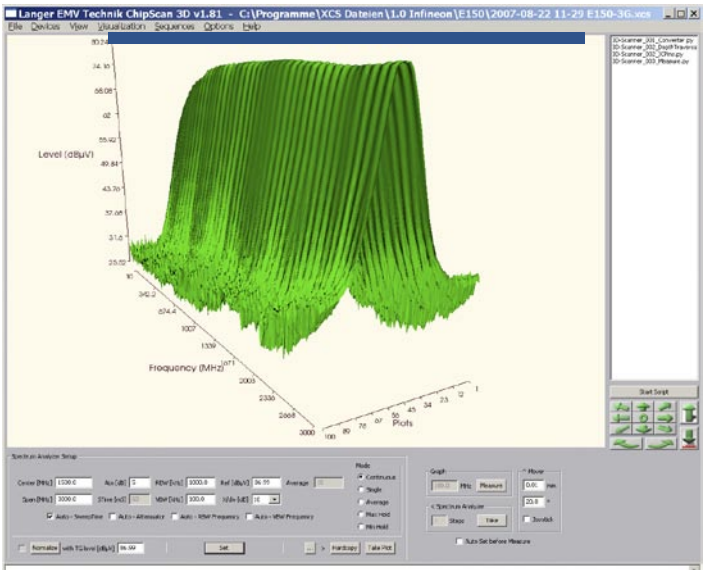


4. BT 706 Bias-Tee
The power supply to the integrated amplifier via the bias-tee.
This BT 706 has an impedance of 50 ohm and stabilises the current (9 V, 100 mA) for the ICR probe.

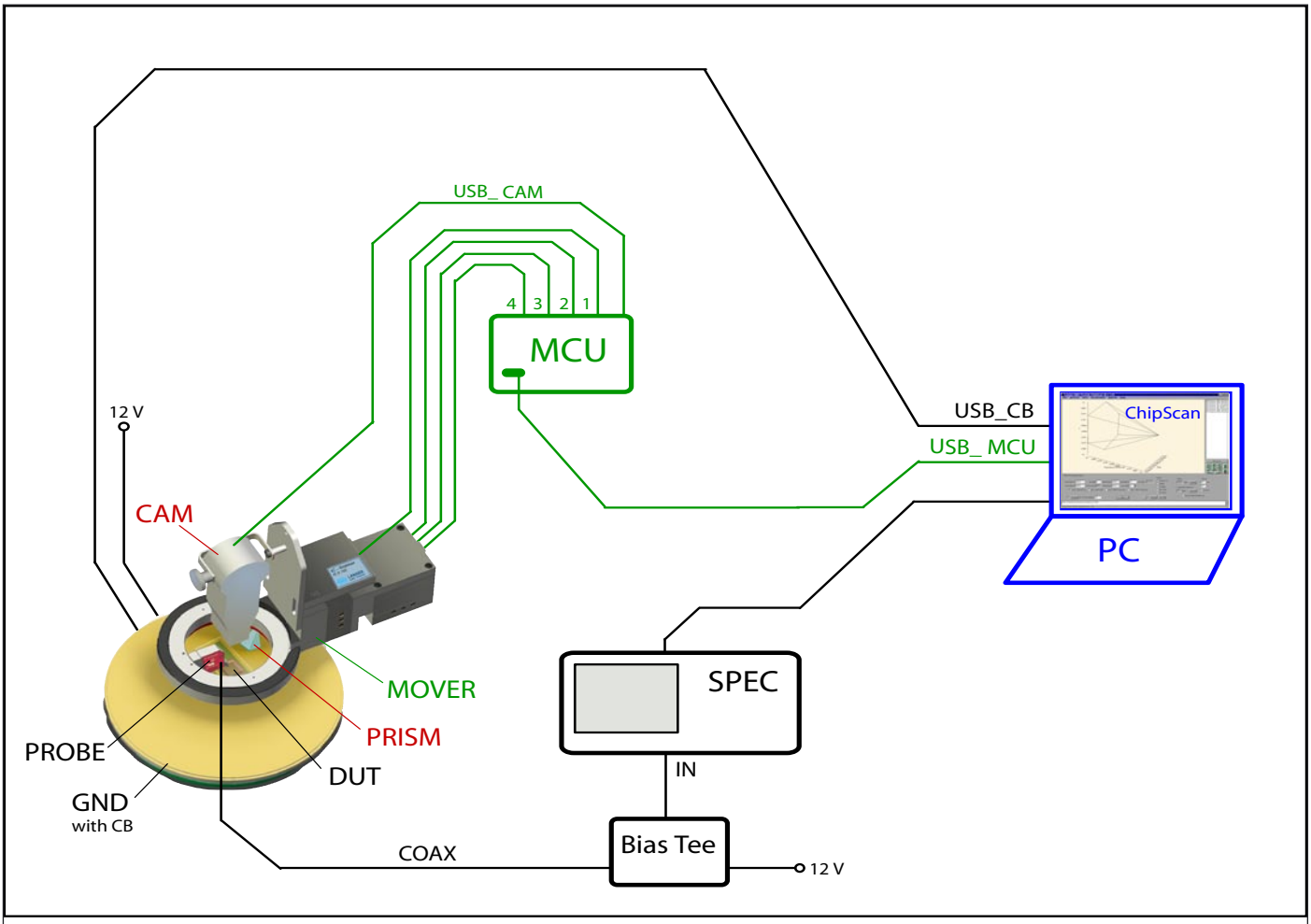
Frequency range: 500 kHz to 6 GHz
Connection: SMA connector
Plug-in power supply unit 12 V / 70 mA

Note:
The bias tee from LANGER EMV-Technik GmbH features integrated voltage stabilisation at 9 V. The ICR probes can thus only be used with this bias tee.

1. ICR probes	ICR probe Sets 150, (100, 250 and 500)

Probes	Characteristics
H-field probes  **ICR HV 150** - **Vertical** measuring coil to 6 GHz - Resolution 100 µm - Inside diameter 150 µm - Screened measuring coil	
H-field probes  **ICR HH 150** - **Horizontal** measuring coil to 6 GHz - Resolution 80 µm - Inside diameter 150 µm - Screened measuring coil	
E-field probe  **ICR E 150** - **Horizontal** electrode to 3 GHz - Resolution 65 µm - 150 µm x 35 µm	

In addition to the Set 150 the probe Set 250 and the probe Set 500 are offered.
The inside diameter of this probes are 100 µm, 250 µm and 500 µm respectively



1. Board measuring system with spectrum analyzer

DUT	Device under test (Test IC)	
GND	Ground plane (GND22)	} **Test board**
CB	Connection board under the GND	
Probe	Near-field microprobe (ICR .....) or other probe	
SPEC	Spectrum analyzer	
COAX	HF coaxial cable 50 Ohm	

2. Linear positioning system

MOVER	Linear positioning system
MCU	Mover control unit

3. Video inspection microscope

PRISM	Reflector (45° prism)
CAM	Video inspection microscope

4. Computer and software

PC	Personal computer with USB interface
Software	Scanner control software „ChipScan“ (device manager and manual measurements)
	Scanner Control Scripts (automatical measurements)
	Connection Board Control (control the DUT)
	Video Microscope Control (control the measuring process)

2. IC scanner	Scanner ICS 103

Application:

- Scan the DUT surface
- Move the E- and H-field probes with high solution of micrometers

System component parts:

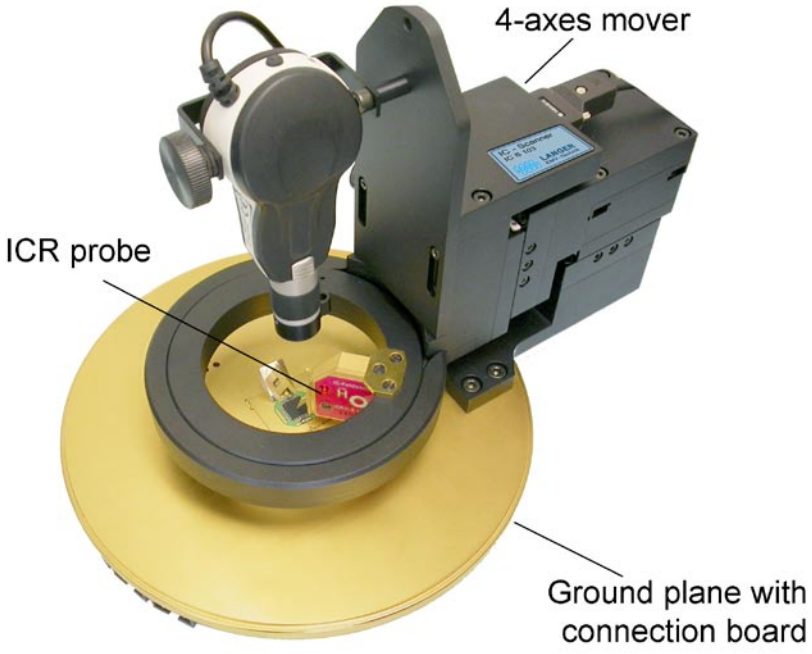
- 4-axes mover (x, y, z, α)
- Test board with
  Ground plane GND 22 and
  Connection board
- optinal Universal holder UH-DUT
- Software ChipScan

Properties:

The IC scanner can be adapted with different ICR probes to measure E- and H-near fields. The probes can be moved above the chip surface in all three axes and around the z-axis.

The scanner allows the user to check the position of the probe tip visually through a microscope.

The scanner is controlled via PC with the Software ChipScan.



Axes	x	y	z	α-rotation
Max. measuring range	25 mm	25 mm	25 mm	+/- 180°
Accuracy	10 µm	10 µm	100 µm	1°
Repeatability	+/- 1 µm	+/- 1 µm	+/- 1 µm	+/- 1°
Max. speed	5 mm/s	5 mm/s	5 mm/s	90°/s

Control	USB
Supply voltage	110 / 230 V
Dimension / total weight	(320 x 220 x 270) mm / 4.35 kg

Software:	**ChipScan** - zero position, manual or script-based probe movement - visualisation of the measuring results in 2 D or 3 D - output as excel data
optional Accessories:	- Near-field microprobes for E and H-fields - Video inspection microscope with holder
Scope of delivery:	- IC scanner ICS 103 - Control and supply unit with link cable - Ground plane or UH-DUT - Software ChipScan

2. IC scanner	Scanner FLS 102

Application:

- Scan the DUT surface
- Move the E- and H-field probes with higt solution of micrometers

System component parts:

- 3-axes mover *(only optional α the 4th rotating axis)*
- Ground plane GND 22
- Connection board
- Universal holder UH-DUT (optional)
- Software ChipScan

Properties:

The IC scanner can be adapted with different ICR probes to measure E- and H-near fields. The probes can be moved above the chip surface in all three axes and can be around the z-axis.

The scanner allows the user to check the position of the probe tip visually through a microscope.

The scanner is controlled via PC with the Software ChipScan.

Axes	x	y	z	α-rotation
Measuring range	200 mm	150 mm	50 mm	+/- 180°
Accuracy	20 µm	20 µm	20 µm	1°
Repeatability	+/- 20µm	+/- 20µm	+/- 20µm	+/- 1°
Max. speed	500 mm/s	500 mm/s	200 mm/s	90°/s

Control	USB
Supply voltage	110 / 230 V
Dimension / total weight	(325 x 450 x 450) mm / 12 kg

Software:	**ChipScan** - zero position, manual or script-based probe movement - visualisation of the measuring results in 2D or 3D - output as excel data
optinal Accessories:	- Near-field microprobes for E and H-fields - Video microscope camera with holder
Scope of delivery:	- IC scanner FLS 102 - Ground plane or UH-DUT - Software ChipScan

2. IC scanner	Scanner FLS 106

Application:

- Scan the DUT surface
- Move the E- and H-field probes with higt solution of micrometers

System component parts:

- 3-axes mover
  (only optional α the 4th rotating axis)
- Software ChipScan
- Universal holder UH-DUT
  (optional for PCB measurement)

or

- Ground plane
  (optional for IC measurement IEC 61967-3)

Properties:

The IC scanner can be adapted with RF near-field probes and different ICR probes to measure E- and H-near fields.

The probes can be moved above the chip surface in all three axes and can be around the z-axis.

The scanner allows the user to check the position of the probe tip visually through a video microscope. The scanner is controlled via PC with the Software ChipScan.

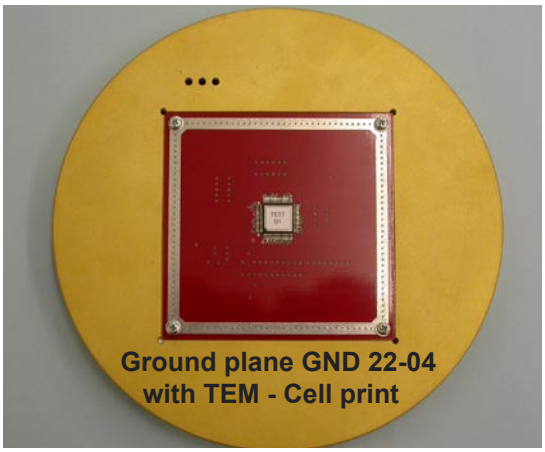
Axes	x	y	z	α-rotation
Measuring range	600 mm	400 mm	125 mm	+/- 180°
Accuracy	10 µm	10 µm	10 µm	1°
Repeatability	+/- 20 µm	+/- 20 µm	+/- 20 µm	+/- 1°
Max. speed	800 mm/s	800 mm/s	320 mm/s	90°/s

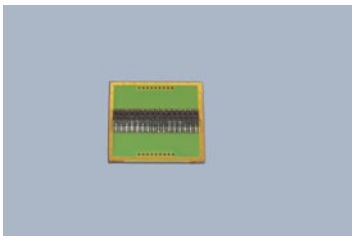
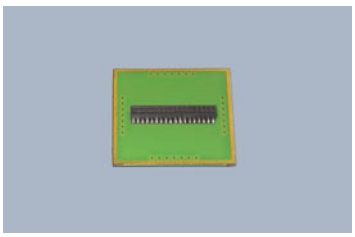
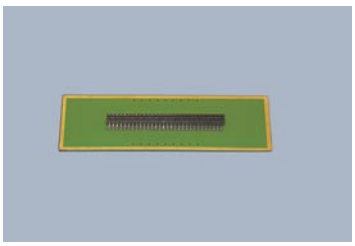
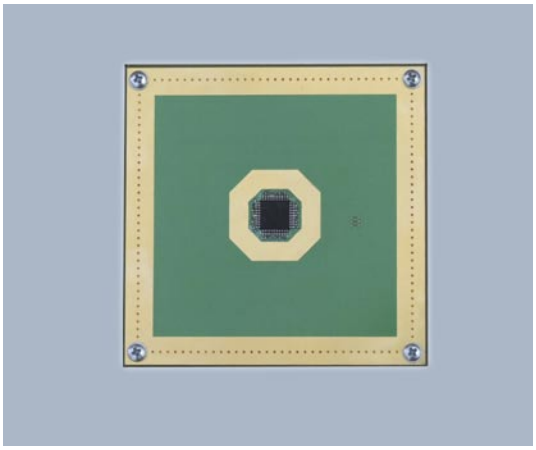
Control	USB
Supply voltage	110 / 230 V, 0.4 kW
Dimension / total weight	(1030 x 775 x 990) mm / 75 kg

Software:	**ChipScan** - zero position, manual or script-based probe movement - visualisation of the measuring results in 2D or 3D - output as excel data
optinal Accessories:	- RF near-field probes for E and H-fields - ICR near-field microprobes for E and H-fields - Video microscope camera with holder
Scope of delivery:	- IC scanner FLS 106 - Software ChipScan

2. IC scanner	**Ground plane and IC adapter**
	Top view of the ground plane with DUT adapters

Properties:
The IC adapter planes for the ground plane GND22 are avarilable in four different types.
The size of the IC to be tested determines the connect size of the IC adapter.
The plug on the back side of the IC adapter connects the IC to be tested to the connection board.
The top side is intended to be used for the DUT equipment and free wiring.



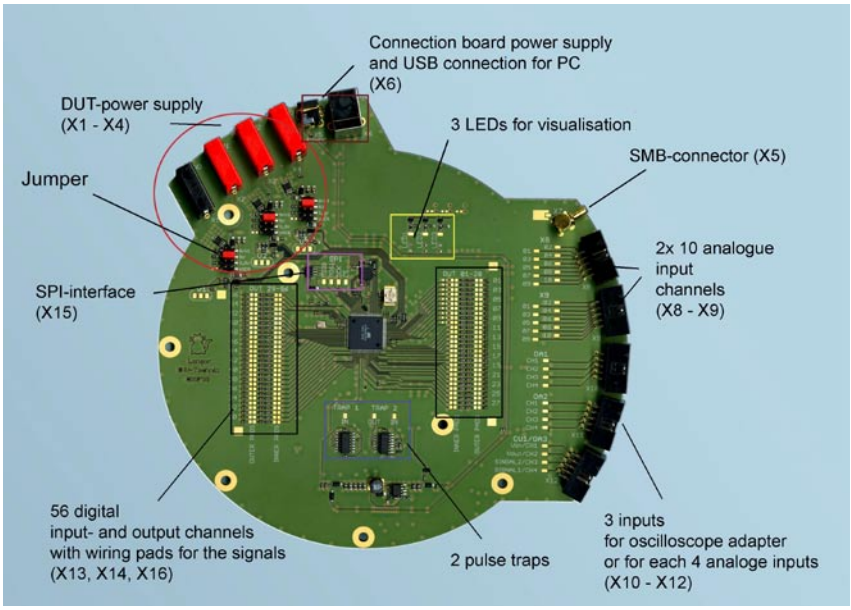
Order destination	IC adapter height / mm	IC adapter width / mm	Adapter planes
GND 22-01	22.7	22.7	
GND 22-02	32.7	32.7	
GND 22-03	22.7	68.1	
GND 22-04 **for TEM - Cell prints**	100	100	

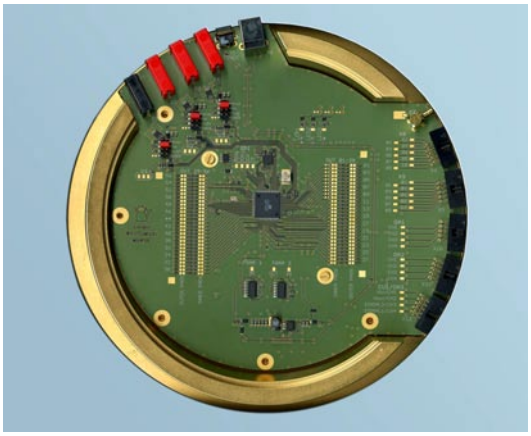
2. IC scanner	**Connection board CB 0708**
	Bottom view of the connection board to control the DUT

Properties:
The CB 0708 Connection board with a microcontroller to monitor and control a DUT during a measurement.

The CB 0708 is controlled through control commands from a PC via USB.

Power supply via USB or from an external power supply unit



Performance parameters:	
Up to 56 digital input and output channels	- freely-programmable
Up to 10 analogue input channels	- each with optional input voltage divider
1 SPI port	- for control and monitoring tasks of the DUT
3 power supplies (3-24 V, 500 mA)	- each with volt and current metering - can be activated and deactivated via the control software
2 pulse traps (pulse stretching)	- 1 x 100 ms pulse stretching as a fast and independent pulse indicator - 1 x variable trap programmable via the controller
3 LEDs for independet use	- as indicators for various signals
Wiring field to freely wire the DUT pins	- 10-pole connector - up to three connectors for OA 4005 4-channel oscilloscope adapter - one connector for CU22 control unit - one SMB connector to connect a clock generator or similar
Connection board CB 0708 mounted beneath the ground plane GND 22 (Bottom view with wiring for the DUT)	

2. IC scanner	**Ground plane universal holder**
	Top view of the universal holder with DUT

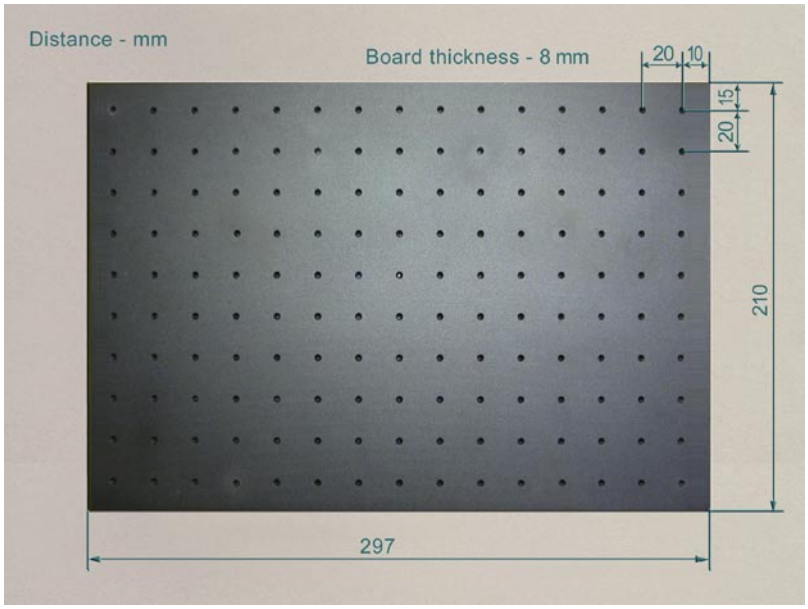
Properties:
The UH-DUT ground plane is fixed on the FLS scanner so that the DUT to be measured can be fastened with several claws.

An adapter is used to fix the UH-DUT on an ICS scanner and allows the user to take measurements over the IC of the respective DUT board.

Order destination

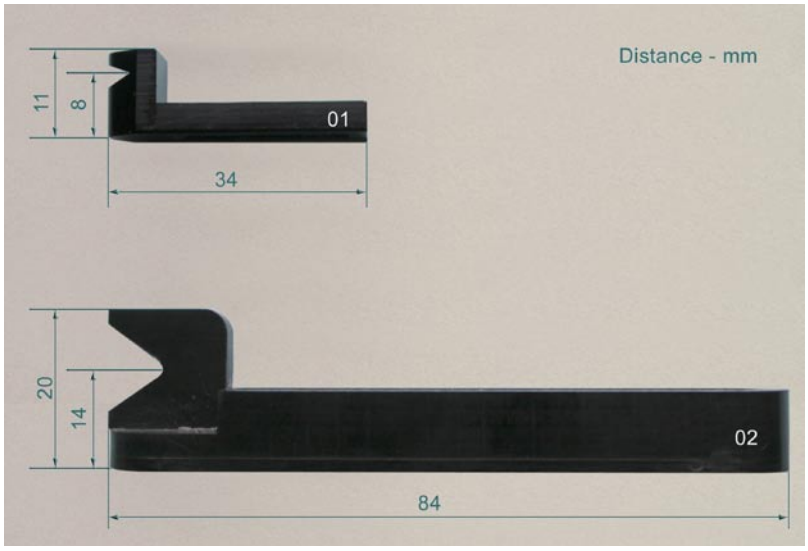
UH-DUT
Universal holder

Thanks to its dimensions and breadboard design, DUT's of different sizes can be attached to it.



Claw fasteners (01 / 02)

These fasteners are used to fix the DUT and maintain a defined distance between the DUT and universal holder. The claws are fastened to the UH DUT with screws.



3. ChipScan	Graphical user interface

The IC scanner from Langer EMV-Technik is operated and controlled with the modular ChipScan“ program system. The device manager initialises the connected measuring and control devices when the program is started. After this the measurement data ranges can be set for the spectrum analyser and the positioning system via the program‘s user interface. The command control set (script) is now started to execute the measuring algorithms. All measurements are carried out automatically. The data measured are displayed in real time in the visualisation area.

ChipScan program is started:

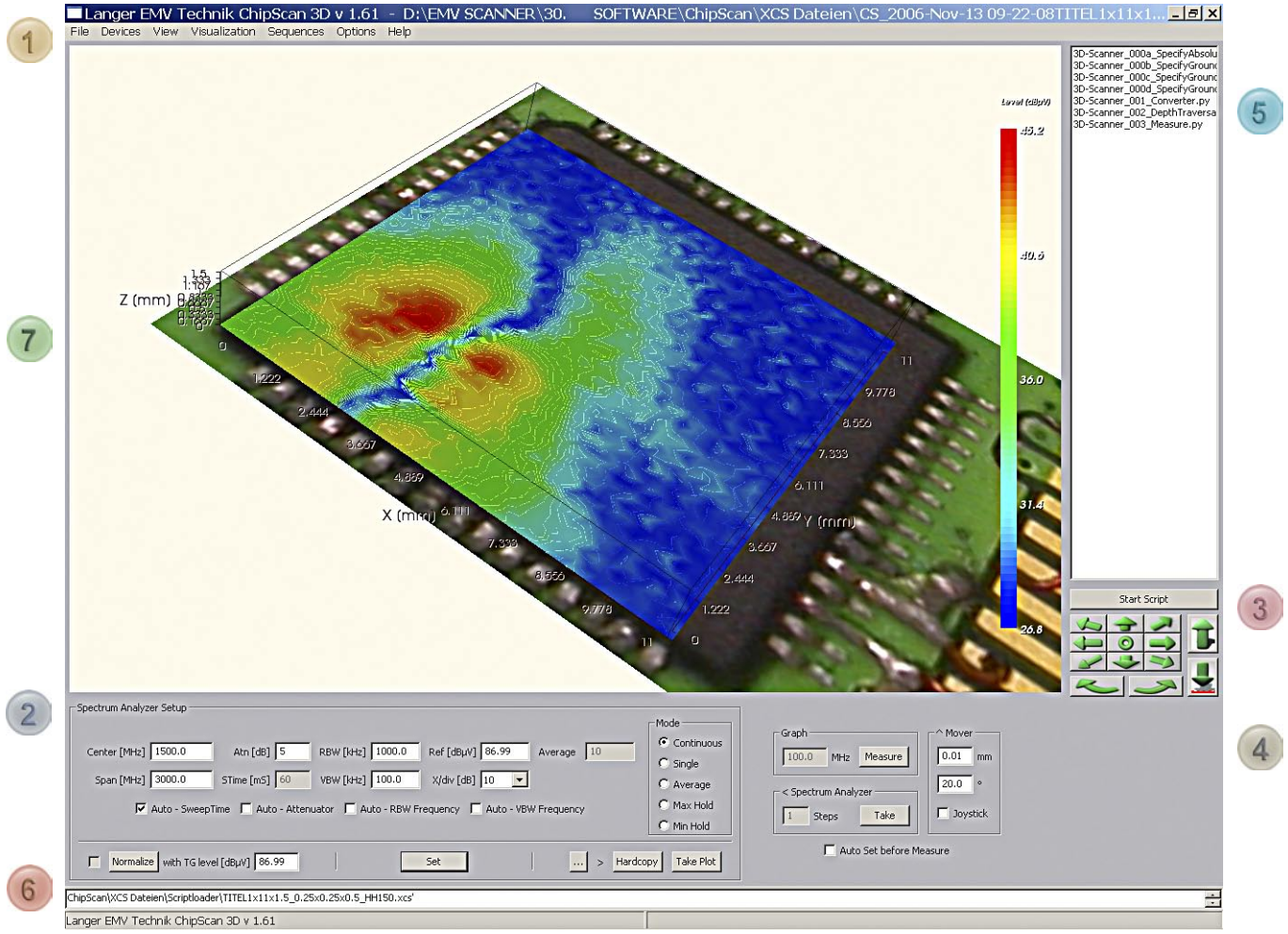


Figure 1: User interface of the modular ChipScan program system

Areas of the user interface:

1. Menu bar
2. Spectrum analyser setup to set up the device via the user interface
3. Graphic joystick to manually guide the positioning device (x, y, z, α)
   (Options: setting the step width in mm and degrees)
4. Spectrum analyser measure for individual measurements
5. Script window and start button for scripts
   (Command scripts for mover control and measuring algorithms)
6. Output window for program messages and alphanumeric script output
7. Visualisation range for 2D and 3D graphics of the measurement results
   (Options in the View and Visualisation menu)

Device initialisation (device manager):
The device manager initialises all connected devices when the program is started. (Menu – Devices – Device Manager – Scan – OK)
The result of the link set-up is displayed as a program message.

The spectrum analyser operating parameters are set for the respective measurement.
The settings carried out on the user interface are sent to the spectrum analyser by the „set“ command.

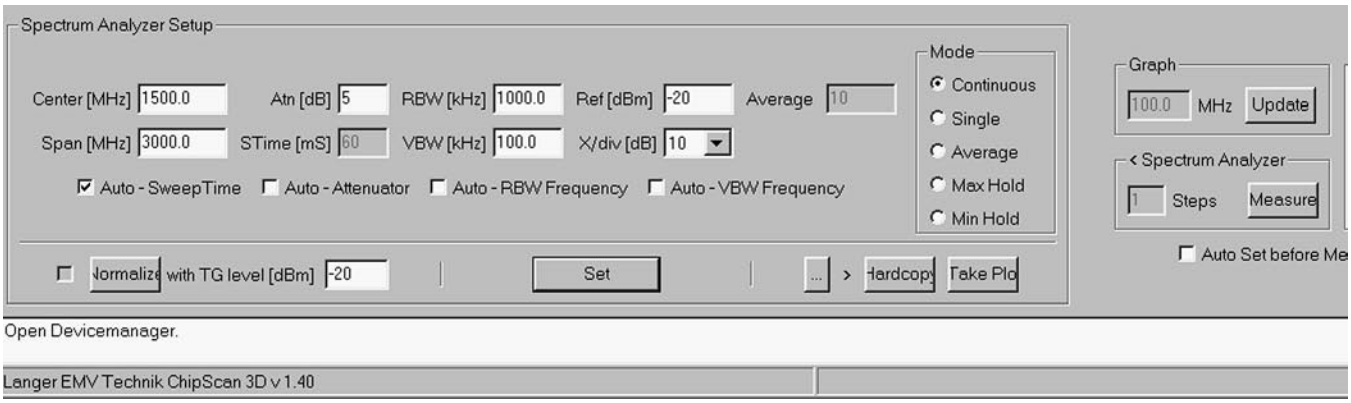


Figure 2: Spectrum analyser set-up data

Control of the positioning device (x, y, z, α)
The near-field microprobe is manually moved to the initial measurement position with the graphic joystick.

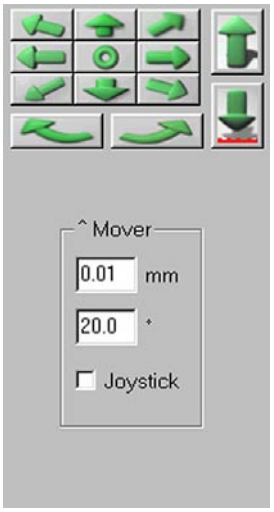


Figure 3: Manual mover control with graphic joystick

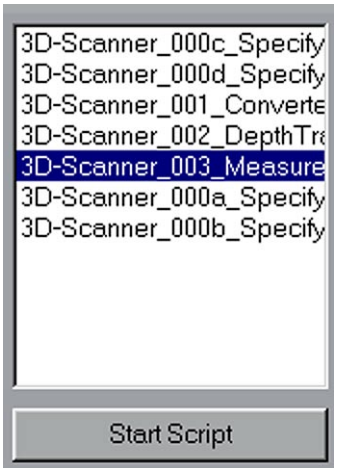


Figure 4: Script window and start button

The command control set (script) for the scheduled measurement is chosen in the script window and started. The measurement process is executed in accordance with the script as a point, line or volume scan.

Possible measurement algorithms are:
- free programable scans through a user definedset of control commands (scripts)

Following measurement algorithms are ready to use:
- point scan
- line scan
- surface scan
- volume scan

Display of the measurement results
The measured spectra are displayed three-dimensionally in the visualisation area in real time during the measurement. The user may choose between a large amount of diffrent views to display the measured curves.

- 2D-view of a set ot measured curves
- 3D-graphics can be viewed from any angle
- 3D-graphics can be zoomed and shifted
- 3D-graphics can be converted into two-dimensional graphics
- Hardcopy function of the measured frequency spectrum
- Export of individual sweeps to Excel (Take plot) Export of 2D- and 3D-graphics to Excel
- Save Image Function (*.png, *.jpg, *.tiff)

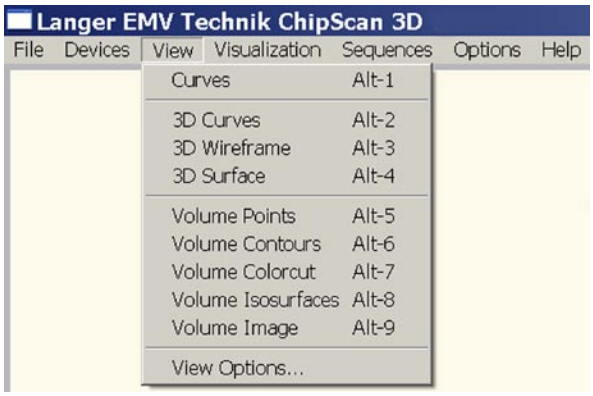


Figure 5: Display of the measurement results

With the data manager in the „Visualisation“ menu a set of measured curves may be selected. Also each curve may be altered in its type of display:

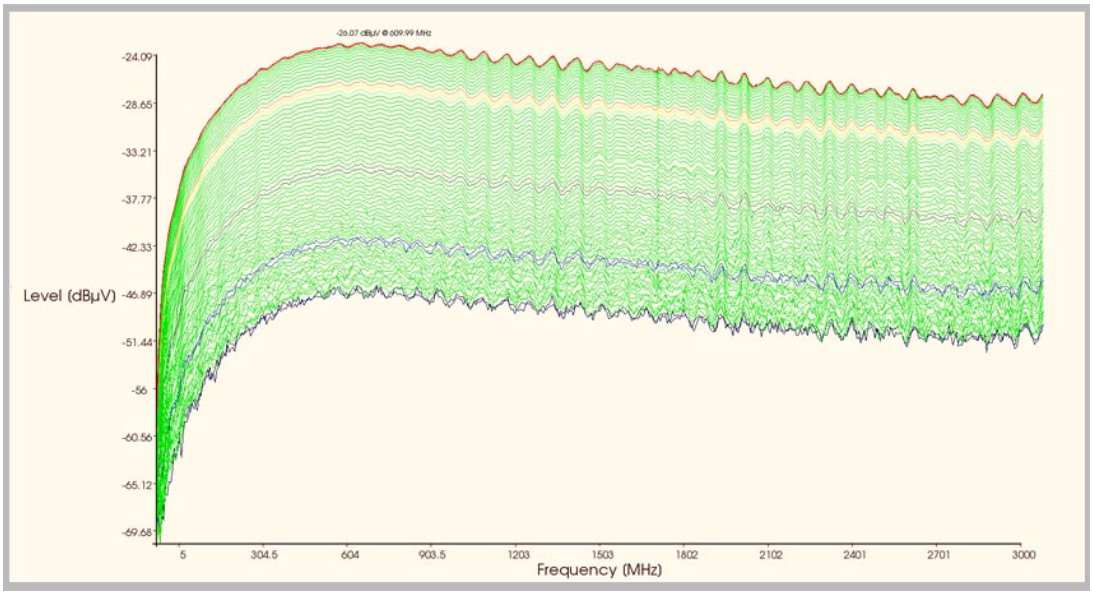


Figure 6: 2D-view of a set ot measured curves

Measurement of the radiated emission of the test IC with the surface scan method IEC 61967-3 using near-field micro probes

The measuring spatial points are defined. At every point the radiated emission up to 3 (6) GHz is meassured.

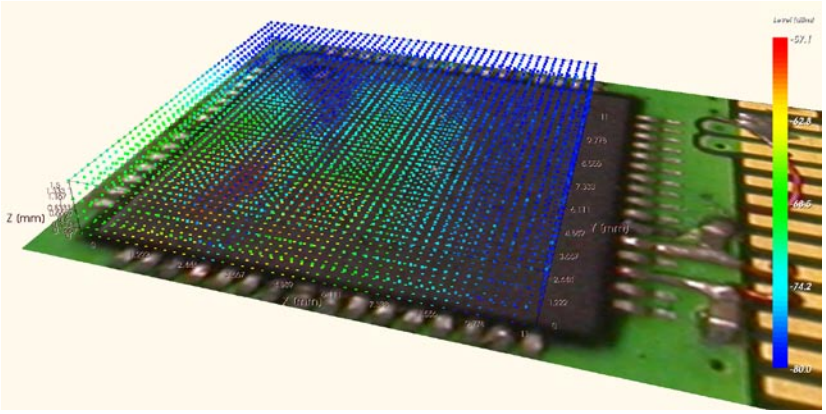


Fig. 7:
Scan volume and measuring range (menu: View – Volume Points Alt-5)

Visualization of the magnetic emission over the scanned IC-area (red: high level). The displayed surface can be moved with the cursor in z-axis.

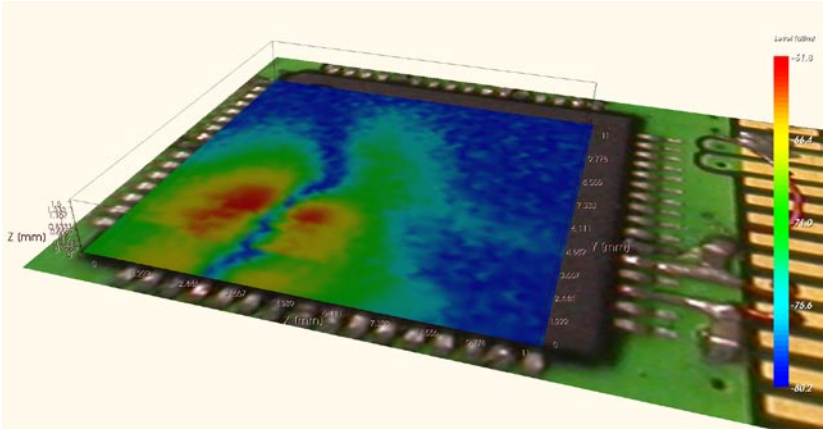


Fig. 8:
Magnetic field of measuring range displayed as colorcut (menu: View – Volume Colorcut Alt-7)

Additionally the colorcut surface may be spinned by 90° and be dragged over the IC. Fig. E9 shows several equidistant snap shots of the magnetic near field. .

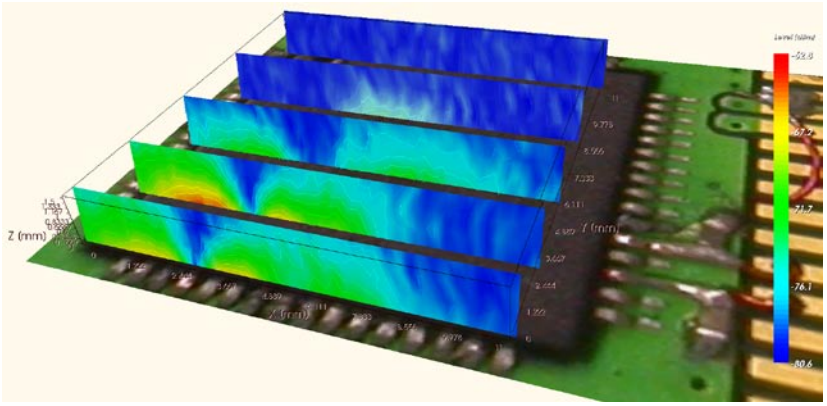


Fig. 9: Magnetic field of measuring range displayed as equidistant colorcuts (menu: View – Volume Colorcut Alt-7))

Spatial visualization of the magnetic field as ISO-surfaces displays equal magnetic field intensities with different colors.

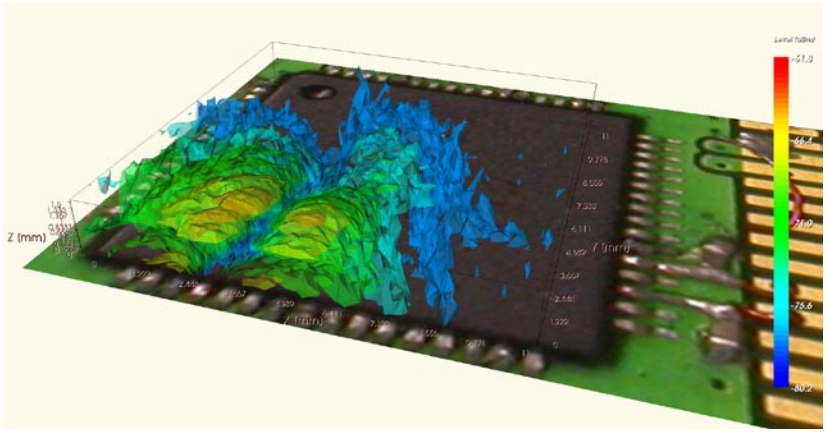
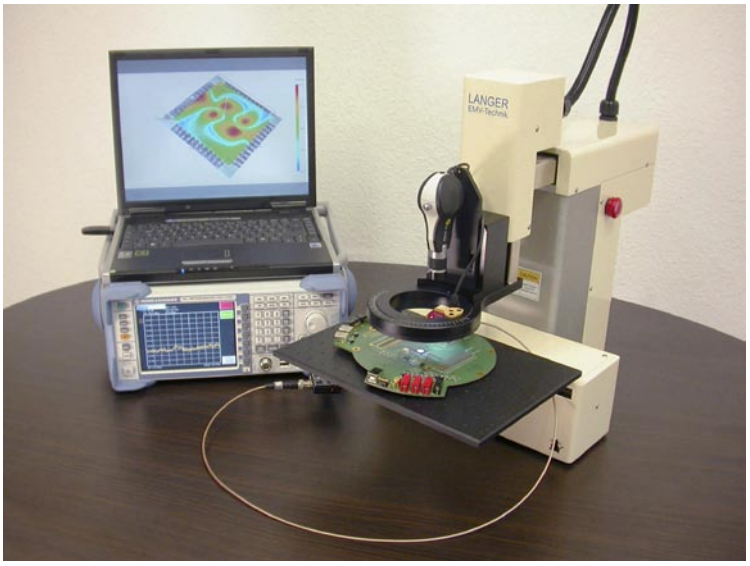


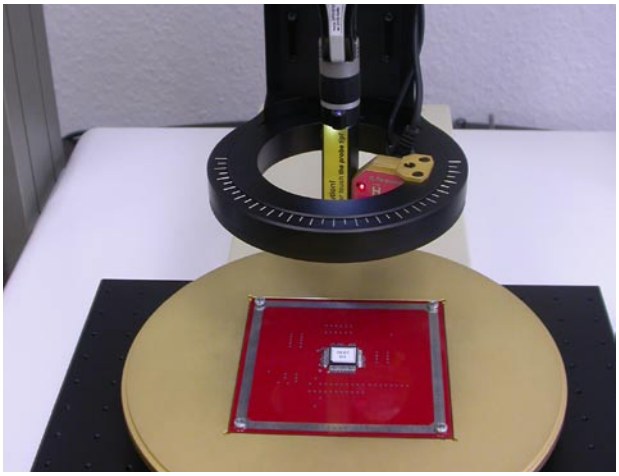
Fig. 10: Magnetic field of measuring range displayed as ISO-surfaces (menu: View-Volume Isosurfaces Alt-8)

4.1 IEC 61967	Measurement of the radiated emissions above TEM cell print or IC on a PCB

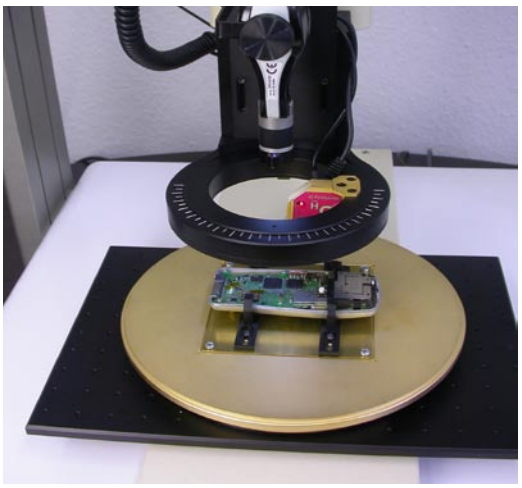


Test setup of IC Scanner FLS 102
with an universal PCB holder (UH-DUT).

A circular solid state circuit board
is mounted on the PCB holder and
fixed with claw fasteners.



TEM Cell prints can be fixed on
the ground plane GND 22-04.



Small PCB applications are controled
and fixed by an adapter with
claw fasteners.

Surface Scan Methods with near-field micro probes

The surface scan method is a technique of measuring the radiated emissions from ICs by evaluating the near-field electromagnetic component over the surface of the package or the die in the frequency range up to 3 or 6 GHz. In order to perform such an evaluation, the IC is scanned by near-field micro probe.

This method is capable of providing a detailed pattern of the emission sources within the DUT with a spatial resolution that depends from both the precision of the mechanical positioning system and the employed near-field micro probe. Our technology allows spatial resolution of ICR HH 150 of 100 µm and mechanical precision of ICS 103 up to 5 µm and FLS 103 up to 10 µm.

In example 1 the surface scan method is used on a mobile phone. Measurement is a “Volume Scan” of an IC area of mobile phone.

Example 1: Volume Scan of a IC area on a mobile phone

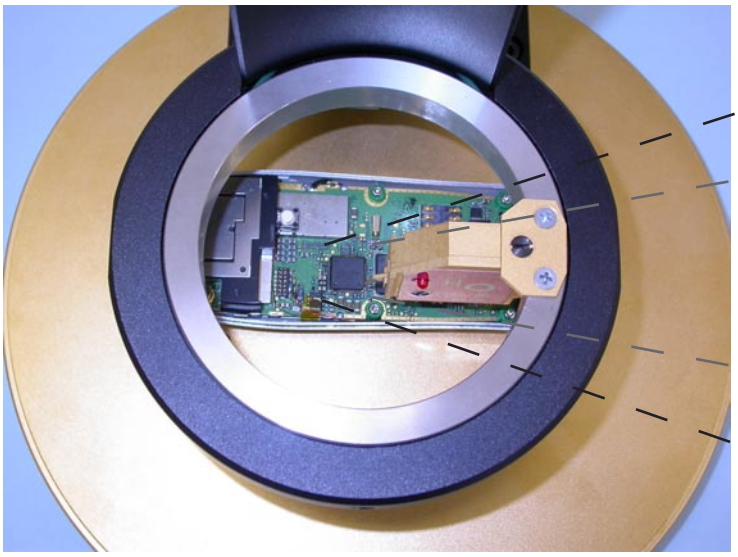


Fig. E1: DUT adapted to the GND-plane

Fig. E2: Zoomed measuring IC area

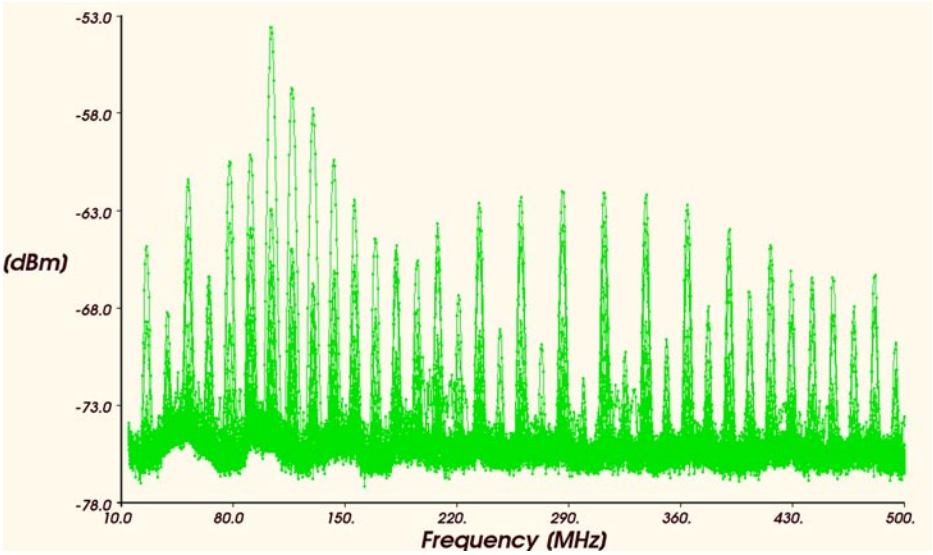


Fig. E3: 2D-graphic of an a array of measured spectra (menu: View - Curves Alt-1)

Surface Scan Methods with near-field microprobes

The DUT has to be mounted onto the ground plane GND 22. It is adapted to the Connection Board CB 0706 via sixty point connector. The near-field microprobe is mechanically scanned by means of a PC-controlled probe positioning system. In particular, the probe is scanned over the DUT surface according to a programmed pattern while an automatic acquisition system enables the control of the scan parameters.

Measuring range and spatial points are defined as input information to the program.

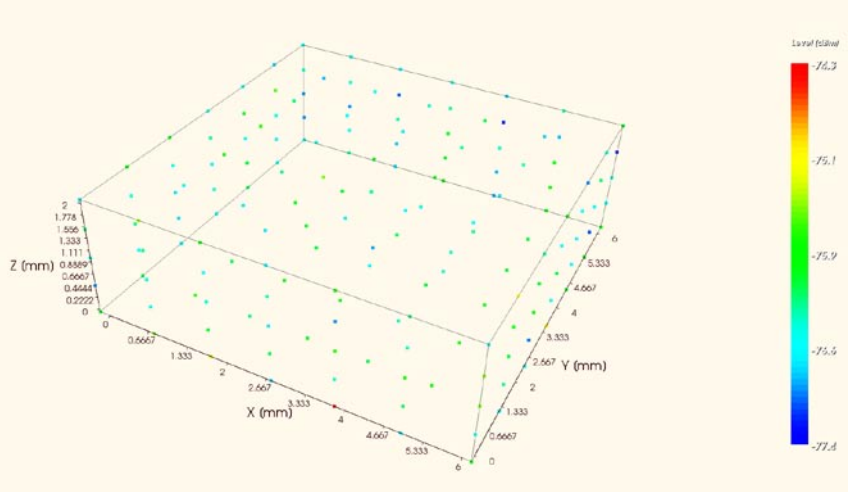


Fig. E4:
Scan volume and measuring range (menu: View – Volume Points Alt-5)

Visualization of magnetic emission over the scanned IC-area (red: high level). The displayed surface can be moved in z-direction.

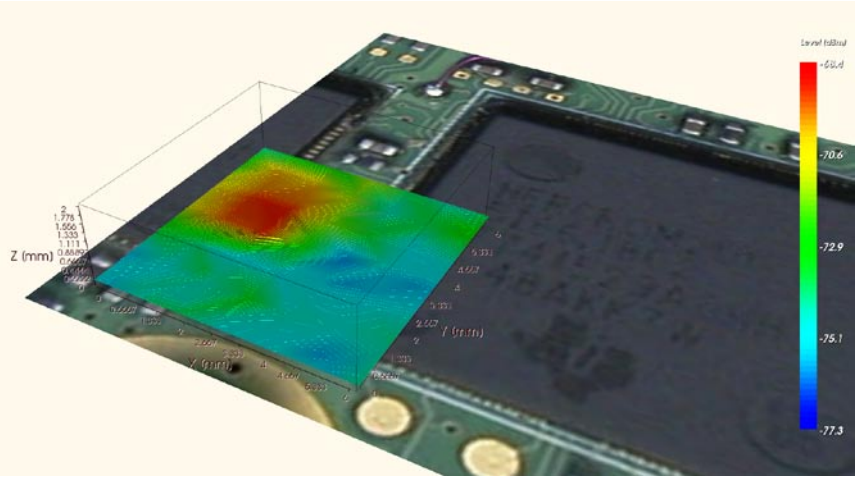
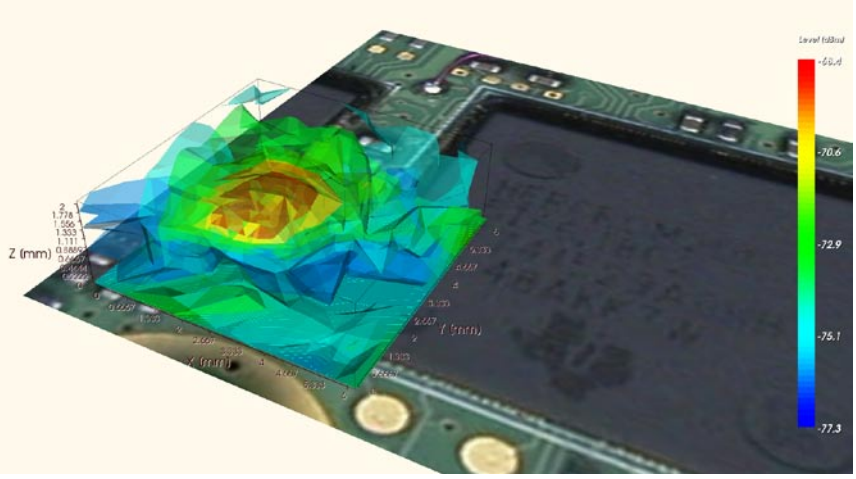


Fig. E5:
Magnetic field of measuring range displayed as colorcut (menu: View – Volume Contours and Colorcut Alt-6 and Alt-7)

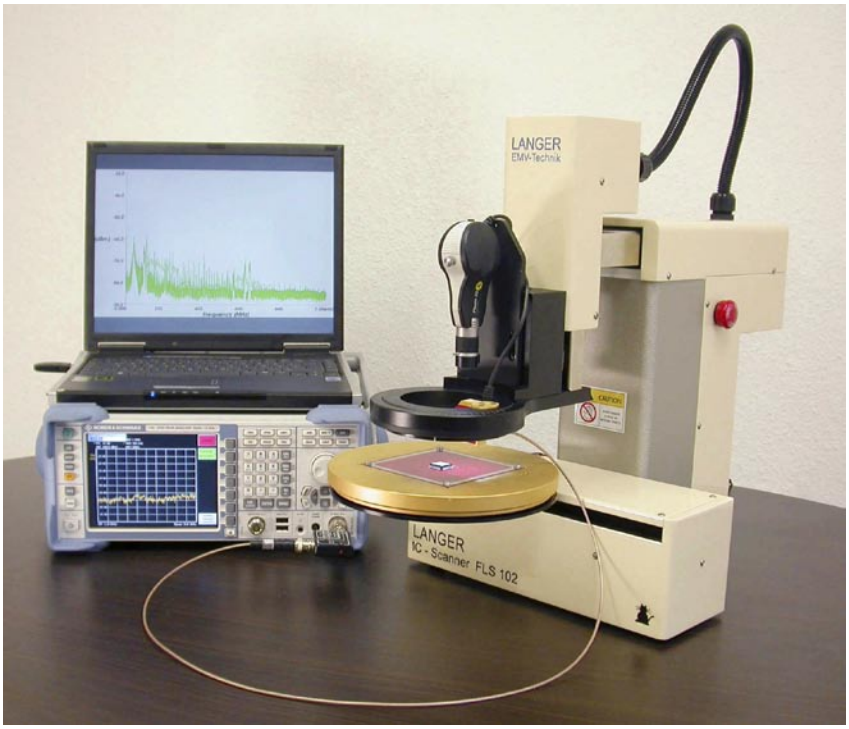
Spatial visualization of the magnetic field as ISO-surfaces shows the constant magnetic field intensities with different colors.

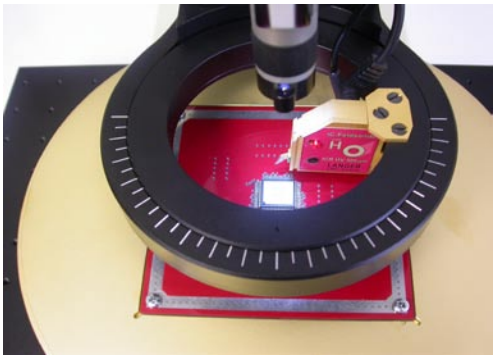


Fig, E6:
Magnetic field of measuring range displayed as ISO-surfaces (menu: View-Volume Isosurfaces Alt-8)

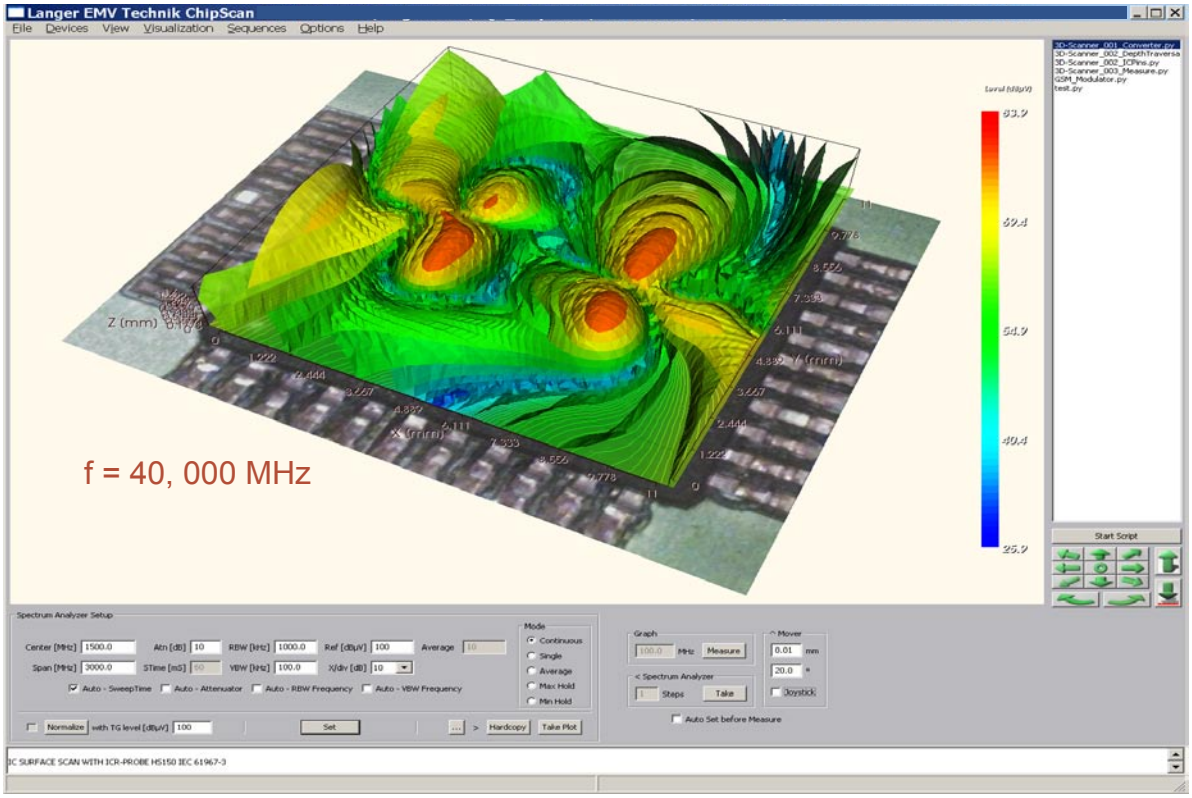
Measurement of the radiated emission of the test IC with high resolution and accuracy

IC Scanner System FLS 102





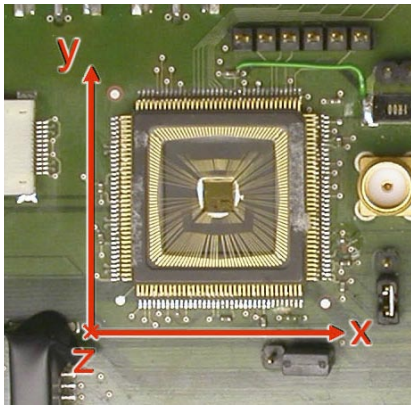
The ICR probe moves in steps of µm above the test IC.



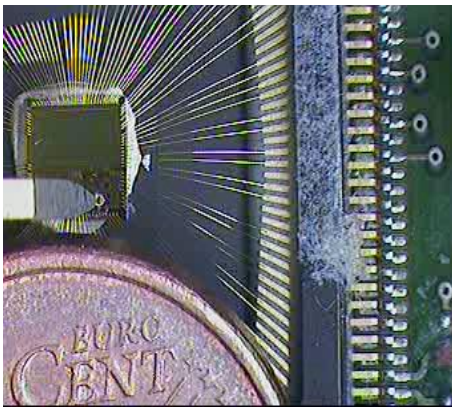
At the result of measurement the ChipScan software displays the spatial amplitude / frequency characteristic of the magnetic near field.

4.4 IC Emission	Measurement of the radiated emission of the test DIE with high resolution and accuracy

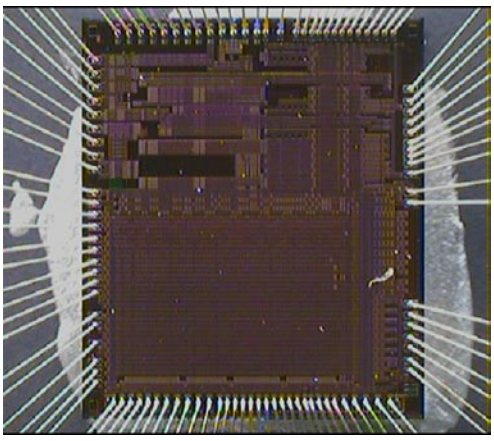
IC Scanner System ICS 102 with DIE test adapter



Surface scan with near-field microprobe above the DIE

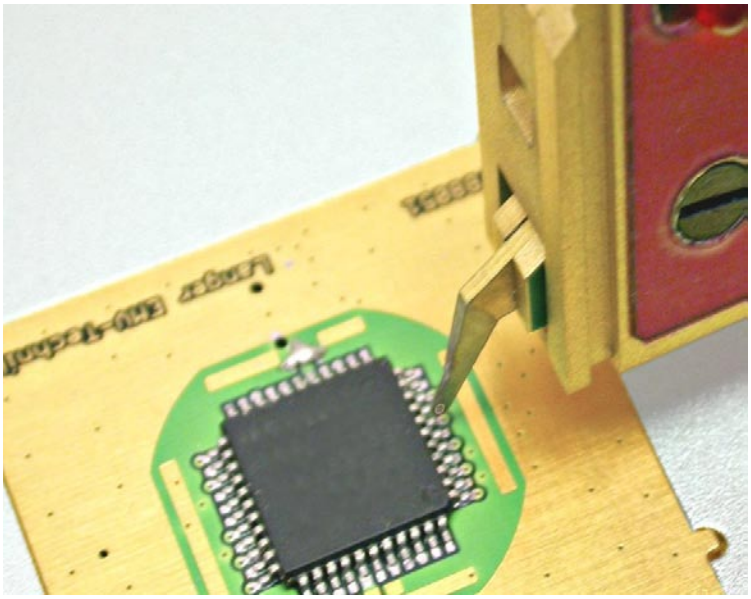


3D Volume scan of the magnetic near field area above the DIE

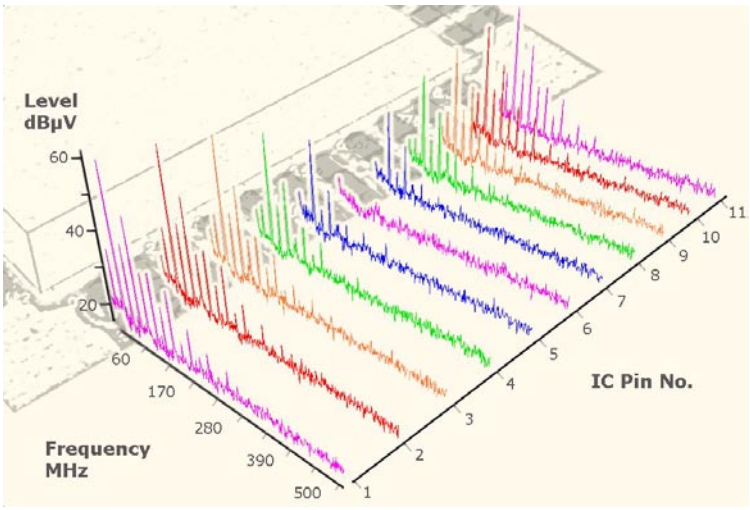


4.5 Pin-Scan	Measurement of the radiated emission of IC-Pins

In this application the emission of an IC-Pin is be measured as a near-field above the IC-Pin. The emission is measured step by step above several IC-Pins.
The measurement is done with the HV or E-field probe.

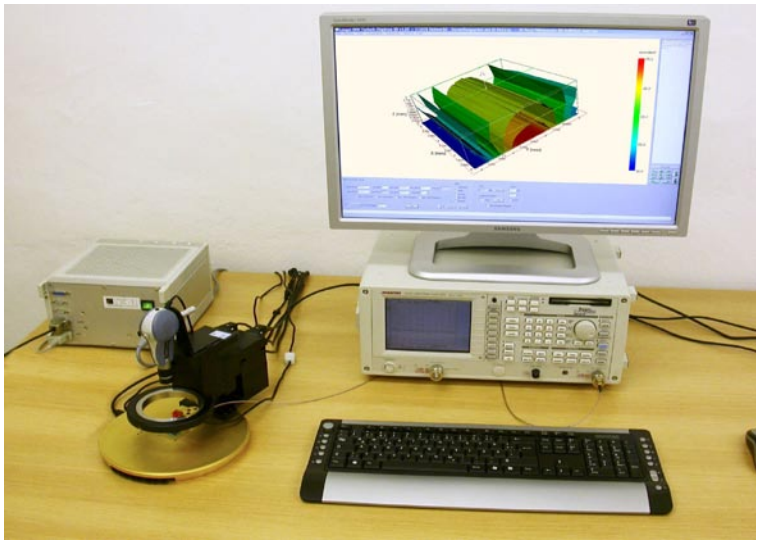


The results of the near-field scan are shown in ChipScan. IC-Pins with a high emission are visible.
The RF near-fields are source of radiated emission on a PCB. With the knowledge of the IC-Pin Scan this emission can be reduced beforehand, e.g. by using filters on the according pins.

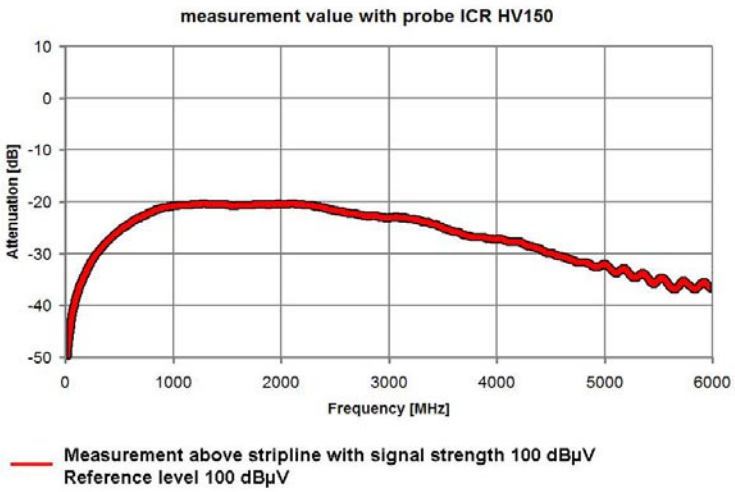


Calibration of ICR-Probes above Stripline analogue to IEC 61967-6

IC Scanner System ICS 103
In this application the scanner is used as the probe test setup to calibrate the near field microprobes.
The near-field microprobes are calibrated above a stripline.



The calibration data is measured above the stripline. The measurement takes place analogue to norm IEC 61967-6.



For practical measurement the calibration data for the individual probe is used.
The measured curve is corrected by the calibration curve.
The measurement above the stripline with calibration results in a horizontal line.
So the measurements with different microprobes are compareable.