

# **Integrated circuits — Measurement of electromagnetic emissions, 150 kHz to 1 GHz —**

## **Part 3: Measurement of radiated emissions — Surface scan method**

ICS 31.200

# National foreword

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According to the replies received by the end of the review period, the responsible BSI Committee will decide whether to support the conversion into an international standard, to extend the life of the Technical Specification for another 3 years or to withdraw it. Comments should be sent in writing to the Secretary of BSI Technical Committee EPL/47, Semiconductors, at British Standards House, 389 Chiswick High Road, London W4 4AL, giving the document reference and clause number and proposing, where possible, an appropriate revision of the text.

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**Cross-references**

The British Standards which implement international publications referred to in this document may be found in the *BSI Catalogue* under the section entitled “International Standards Correspondence Index”, or by using the “Search” facility of the *BSI Electronic Catalogue* or of British Standards Online.

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**Summary of pages**

This document comprises a front cover, an inside front cover, the IEC/TS title page, pages 2 to 25 and a back cover.

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**Amendments issued since publication**

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# TECHNICAL SPECIFICATION

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## **TS 61967-3**

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**Integrated circuits –  
Measurement of electromagnetic  
emissions, 150 kHz to 1 GHz –**

**Part 3:  
Measurement of radiated emissions –  
Surface scan method**



Reference number  
CEI/IEC/TS 61967-3:2005

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## INTEGRATED CIRCUITS – MEASUREMENT OF ELECTROMAGNETIC EMISSIONS, 150 kHz to 1 GHz –

### Part 3: Measurement of radiated emissions – Surface scan method

#### 1 Scope

This part of IEC 61967 provides a test procedure which defines a method for evaluating the near electric, magnetic or electromagnetic field components at or near the surface of an integrated circuit (IC). This diagnostic procedure is intended for IC architectural analysis such as floor planning and power distribution optimization. This test procedure is applicable to measurements from an IC mounted on any circuit board that is accessible to the scanning probe. For comparison of surface scan emissions between different ICs, the standardized test board defined in IEC 61967-1 should be used.

This technique is capable of providing a detailed pattern of the radio frequency (RF) sources internal to the IC. The resolution of the measurement is determined by the capability of the measurement probe and the precision of the probe positioner. This method is intended for use over the 10 MHz to 1 GHz frequency range. Extended upper frequency limits are possible with existing probe technology but are beyond the scope of this specification.

The probe is mechanically scanned according to a programmed pattern in a parallel or perpendicular plane to the IC surface. The data is computer processed to provide a colour-enhanced representation of the field strength at the scan frequency.

#### 2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050(131):2002, *International Electrotechnical Vocabulary (IEV) – Part 131: Circuit theory*

IEC 60050(161):1990, *International Electrotechnical Vocabulary (IEV) – Chapter 161: Electromagnetic compatibility*

IEC 61967-1, *Integrated circuits – Measurement of electromagnetic emissions, 150 kHz to 1 GHz – Part 1: General conditions and definitions*

IEC 61967-6, *Integrated circuits – Measurement of electromagnetic emissions, 150 kHz to 1 GHz – Part 6: Measurement of conducted emissions - Magnetic probe method*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions contained in IEC 61967-1, IEC 60050(131) and IEC 60050(161) apply.

### 4 General

The electric and magnetic fields measured by scanning over the surface of the IC yields information on the relative strength of sources within the IC package. This provides for comparisons between different architectures to facilitate reductions in RF emissions from the IC. The electric and magnetic field patterns over the surface of the IC are related to the electromagnetic radiation potential of the IC and of the electronic module of which it is a part. However, this procedure is intended to provide a comparative measure for ICs and not to predict far field levels for the IC or its circuit board.

Characterizing an IC involves a series of single-frequency spatial scans. Each scan may accumulate thousands of data points across a die or package depending on the number of scan locations. Because of the required precision and the amount of measured data, this test method uses a computer-controlled probe positioning and measurement system to achieve accurate and repeatable probe data. Control software must be written or adapted to control the optical, precision stepper motors typically used in such systems. This method also requires a large amount of data analysis and manipulation typically performed by specialized software programs. Scan time will depend on the number of frequencies, the number of locations at which emissions are measured, and the capability of the data collection system. This procedure may be adapted for use with any positioning system.

Due to the wide array of IC process and packaging technologies and their physical dimensions, this test method does not specify a standard design for the probe positioning system or the near field probe. The design of the positioner and the probe will depend on a number of variables including the desired measurement frequency range, spatial resolution, field type, and the performance of the available components (such as stepper motors, etc.).

Spatial resolution is not specified but is determined by the step size of the positioning system and the physical dimensions of the near field probe. Typical spatial resolutions are measured in micrometers. The actual spatial resolution of the test set-up shall be included in the test report.

The probe height above the IC surface is not specified. Typical values are 100  $\mu\text{m}$  to 200  $\mu\text{m}$ . The actual probe height shall be included in the test report.

The probe step size is not specified. The probe step size shall be chosen such that the desired spatial resolution is achieved while limiting the number of points at which data is taken. Step size can be modified to focus on particular areas of the die or package.

## 5 Test conditions

### 5.1 General

The test conditions shall meet the requirements as described in IEC 61967-1. In addition, the following test conditions shall apply.

### 5.2 Supply voltage

The supply voltage shall be as specified by the IC manufacturer. If the users of this procedure agree to other values, they shall be documented in the test report.

### 5.3 Frequency range

The effective frequency range of this radiated emissions procedure is 10 MHz to 1 GHz.

## 6 Test equipment

### 6.1 General

The test equipment shall meet the requirements as described in IEC 61967-1. In addition, the following test equipment requirements shall apply.

### 6.2 Shielding

Double shielded or semi-rigid coaxial cable is required. Depending on the local ambient conditions, operation in a shielded room may be required.

### 6.3 RF measuring instrument

The RF measuring instrument utilized for this test method will depend on the type of probe selected and whether or not phase information is to be generated. When utilizing a discrete electric or magnetic field probe and measuring only emission amplitude, a one-input device such as a spectrum analyser or receiver shall be used. Alternately, a single input of a network analyser may be used.

When utilizing a discrete electric or magnetic field probe and measuring both emission amplitude and phase, a two-input device such as a network analyser shall be used.

When using an electromagnetic field probe and measuring only emission amplitude, a two-input device such as a network analyser shall be used.

When utilizing an electromagnetic field probe and/or measuring both emission amplitude and phase, a RF vector signal measuring instrument such as shown in Clause B.5 should be used.

The spectrum analyser or receiver resolution bandwidth shall be 9 kHz or 10 kHz and the video bandwidth shall not be less than three times the resolution bandwidth. The instrument shall be configured to use a peak detector with measurements in units of dBμV [for 50 Ω system: (dBm readings) + 107 = dBμV]. For spectrum analysers, the frequency band of interest shall be swept in calibrated or coupled mode (auto sweep).

## 6.4 Preamplifier

A 20 dB to 30 dB gain, low noise preamp may be used to increase sensitivity or to meet the ambient requirements in 8.2.

## 6.5 Near field probe

### 6.5.1 General

The near field probe employed for surface scanning can take many forms depending on user preference, the type of field to be measured, the capabilities of the measurement test equipment, and the desired spatial resolution of the measurement. The design, construction, and performance of near field probes for this method is not specified. It is the responsibility of the user of this test method to design, construct, and calibrate (if needed) a probe to meet the needs of their specific test capability or requirement. The different near field probe types are discussed in the following subclauses.

### 6.5.2 Magnetic (H) field probe

For magnetic field measurements, a single turn, miniature magnetic loop probe is typically used. The probe may be constructed from wire, coaxial cable, printed circuit board (PCB) traces, or any other suitable material. Examples of magnetic field probes are shown in Annex A and in IEC 61967-6.

### 6.5.3 Electric (E) field probe

For electric field measurements, a miniature electric field probe is typically used. The probe may be constructed from wire, coaxial cable, printed circuit board (PCB) traces or any other suitable material. An example electric field probe is shown in Annex A.

### 6.5.4 Electromagnetic (E/H) field probe

For combined electromagnetic field measurements, a single turn, miniature magnetic loop probe is typically used. The probe may be constructed from wire, coaxial cable, printed circuit board (PCB) traces, or any other suitable material. An example electromagnetic field probe is shown in Annex B.

## 6.6 Probe positioning and data acquisition system

A custom precision probe positioning system and data acquisition system are required. The probe positioning system shall be able to move the probe in at least two axes (parallel to the DUT surface) and should have a positioning accuracy greater than the minimum step size. The probe positioning system may have a mechanical structure to rotate the probe and is controlled by the data acquisition system. An example of a probe positioning system is shown in Figure 1. While not shown in Figure 1, the DUT is installed on a PCB that is typically mounted on a test fixture to improve stability.

The data acquisition system is typically a computer installed with software adapted to accept the desired scan parameters, control the measuring instrument, control the probe scanning system, and acquire the data. These systems and any controlling software shall be described in the test report.

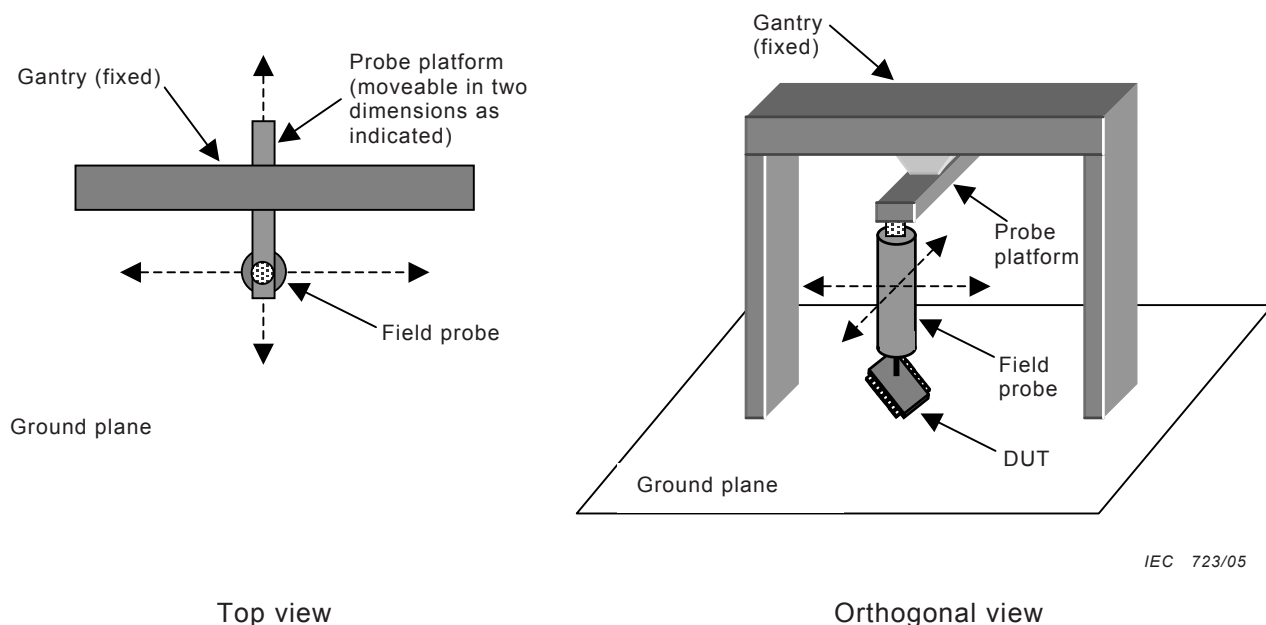


Figure 1 – Example probe positioning system

## 7 Test set-up

### 7.1 General

The test set-up shall meet the requirements as described in IEC 61967-1. In addition, the following test set-up requirements shall apply.

### 7.2 Test configuration

The general test set-ups are shown in Figures 2, 3 and 4. The phase measurement can be added or subtracted from the test set-ups as desired provided that the RF measuring instrument used has the required number of inputs.

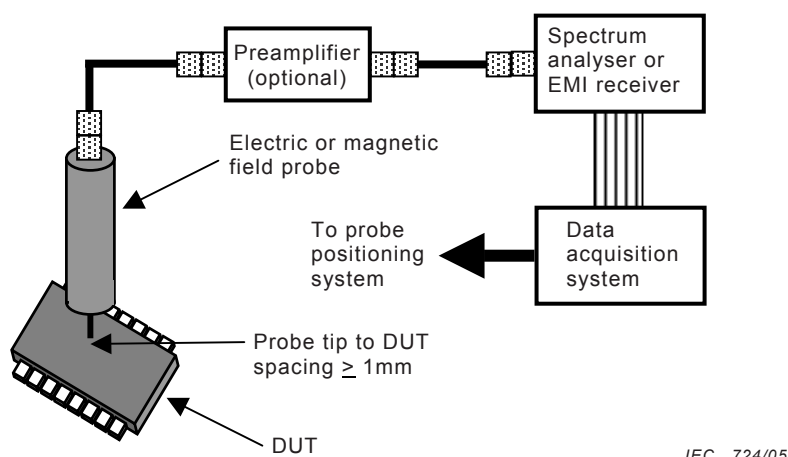


Figure 2 – 1-Input RF measurement set-up (amplitude only)

IEC 724/05