

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Noise suppression sheet for digital devices and equipment –
Part 2: Measuring methods**

**Plaque réduisant le bruit des dispositifs et appareils numériques –
Partie 2: Méthodes de mesure**

IEC 62333-2:2006

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IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

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**NOISE SUPPRESSION SHEET
FOR DIGITAL DEVICES AND EQUIPMENT –****Part 2: Measuring methods**

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IEC 62333-2 edition 1.1 contains the first edition (2006-05) [documents 51/853/FDIS and 51/861/RVD] and its amendment 1 (2015-08) [documents 51/1068/CDV and 51/1088/RVC].

In this Redline version, a vertical line in the margin shows where the technical content is modified by amendment 1. Additions and deletions are displayed in red, with deletions being struck through. A separate Final version with all changes accepted is available in this publication.

International Standard IEC 62333-2 has been prepared IEC technical committee 51: Magnetic components and ferrite materials.

This standard is to be used in conjunction with IEC 62333-1.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

IEC 62333 consists of the following parts, under the general title *Noise suppression sheet for digital devices and equipment*:

Part 1: Definitions and general properties

Part 2: Measuring methods

The committee has decided that the contents of the base publication and its amendment will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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NOISE SUPPRESSION SHEET FOR DIGITAL DEVICES AND EQUIPMENT –

Part 2: Measuring methods

1 Scope

This part of IEC 62333 specifies the methods for measuring the electromagnetic characteristics of a noise suppression sheet. Those methods are intended to provide useful and repeatable measurements to characterize the performance of the noise suppression sheets, so that manufacturers and their customers are able to obtain the same results.

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 amendment) applies.

IEC 62333-1, *Noise suppression sheet for digital devices and equipment – Part 1: Definitions and general properties*

CISPR 16-1, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1: Radio disturbance and immunity measuring apparatus*

CISPR 22, *Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement*

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3 General

Electromagnetic interference between electronic devices, and emission of radiation from electronic devices are caused, in part, by RF current generated by active devices which are driven at high frequency. Printed-circuit board (PCB), devices mounted on the PCB, and all other connected circuits or cables can act as antennas to radiate the RF noise. Levels of the electromagnetic interference and the emission are proportional to the RF current, and are also affected significantly by PCB design, radiation efficiency of the antennas, and noise coupling coefficients between the devices and the antennas.

The noise suppression sheet (NSS) is used for decoupling of the noise path, suppressing RF noise current, and reducing radiation. The noise suppression effect of the NSS can be evaluated by four parameters. They are defined as intra-decoupling ratio (R_{da}), inter-decoupling ratio (R_{de}), transmission attenuation power ratio (R_{tp}) and radiation suppression ratio (R_{rs}).

A pair of antennas is held close to each other for the measuring intra-decoupling ratio (R_{da}) and inter-decoupling ratio (R_{de}). One antenna acts as a noise source and another one as a receiver. Both decoupling ratios are derived from comparison before and after the NSS is installed nearby the antennas. These measuring procedures represent practical configurations of the NSS. Practically, the NSS is installed near the noise source or the noise interfered part, inside of the electronic equipments.

A micro-strip line (MSL) test fixture is used for the measuring transmission attenuation power ratio (R_{tp}) as a transmission line that would be a noise path. The ratio is derived from comparison before and after the NSS installation. This measuring procedure represents another practical configuration that the NSS is utilized for reducing the RF current along the transmission line.

The MSL test fixture is also used for measuring radiation suppression ratio (R_{rs}) as the antenna. The ratio is derived from a comparison before and after the NSS installation. This measuring procedure represents another practical configuration that the NSS is utilized for reducing the radiation from the antenna.

4 Measuring methods

4.1 Intra-decoupling ratio: R_{da}

4.1.1 Principle

The following measuring method is applied for evaluating a reduction of coupling between lines or circuit boards on one side of the NSS, from 100 MHz to 6 GHz.

A pair of loop antennas is employed. One is for noise source and the other one for receiver. They are simulating a general electromagnetic interference situation that often exists inside electronic equipment (see Figure 1).

The NSS is placed so that the centre of the antenna pair comes to the centre of the NSS. The coupling between two antennas with the NSS is measured, as well as the coupling without the NSS as a reference value. Consequently, intra-decoupling ratio R_{da} (dB) can be obtained.

RF magnetic field raised by one antenna is coupled with another one (see Figure 2a). By setting the NSS, the antennas (see Figure 2b), a part of the magnetic flux is led to the NSS, and the coupling is reduced by electromagnetic loss in the material.

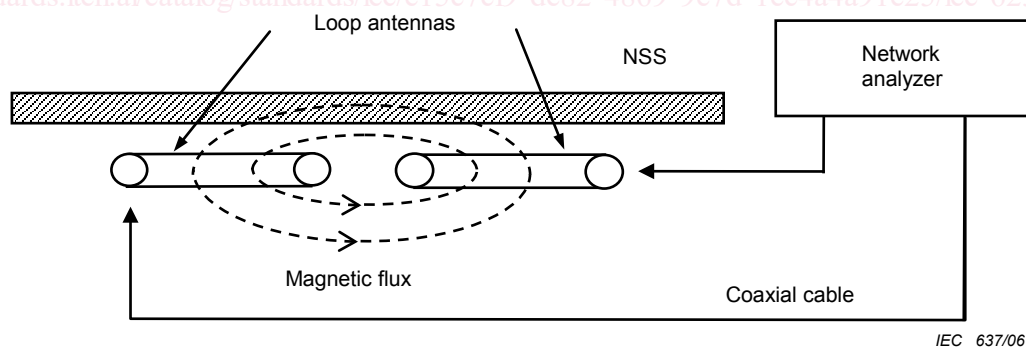
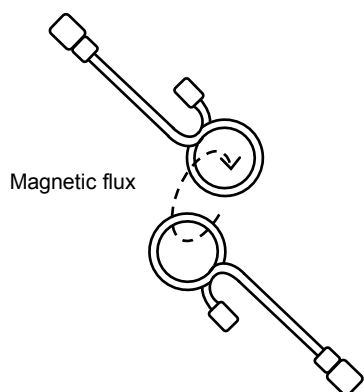
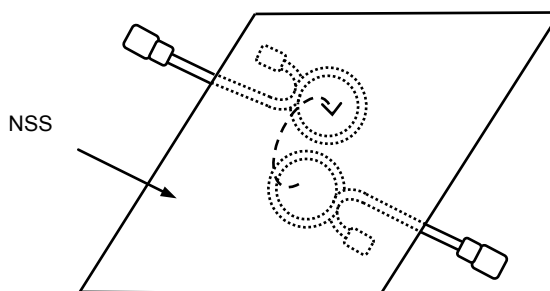


Figure 1 – Schematic diagram of a pair of antennas and NSS under test



IEC 638/06

Figure 2a – Loop antennas



IEC 639/06

Figure 2b – NSS under test

Figure 2 – A pair of antennas and NSS under test

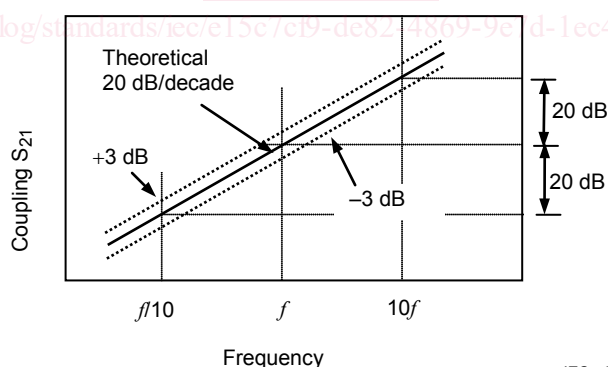
4.1.2 Apparatus

Figure 1 shows the schematic diagram of the measuring method of intra-decoupling ratio.

NOTE The test sample and the loop antennas are set at least 30 mm away from any other material except for the coaxial cable, using low dielectric and low loss material such as the styrene foam and air gap.

Small loop antennas shall be used for the generation of the RF magnetic field and the detection of the magnetic flux.

The S_{21} of the ideal loop antenna pair is proportional to the frequency. This means that S_{21} increases 20 dB with the decade of frequency. The usable frequency range of the loop antenna is defined by the deviation of S_{21} from the theoretical value. The deviation should be less than ± 3 dB as shown in Figure 3.



IEC 640/06

Figure 3 – Frequency response of coupling between a pair of antennas

Several loop antenna designs shown in Figure 4 are capable of achieving the 20 dB/decade frequency response that defines a valid R_{da}/R_{de} measurement.

4.1.2.1 Loop antenna

Recommended examples of the small antennas are shown in Figure 4. Merits and limitations of recommended examples of the antennas are described in Table 1.

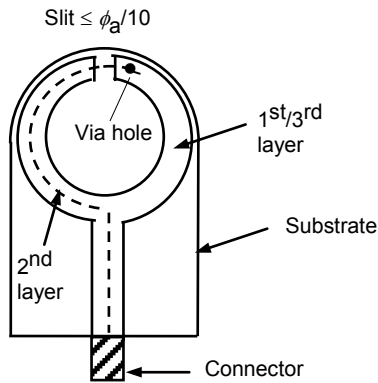


Figure 4a – Shielded multi-layered antenna with slit

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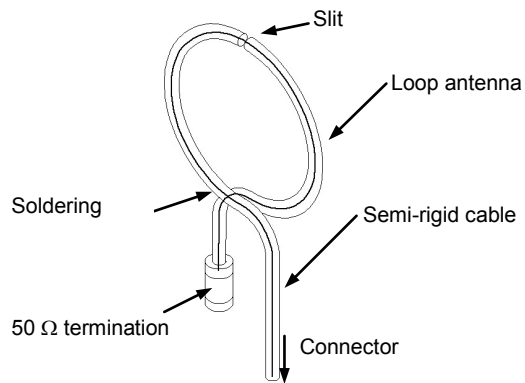


Figure 4b – Shielded loop antenna with slit and 50 Ω termination

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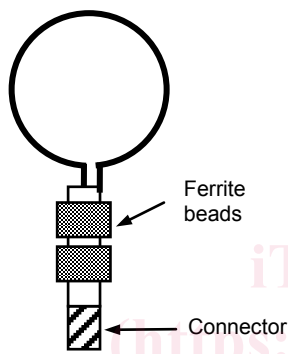


Figure 4c – One turn antenna with ferrite beads

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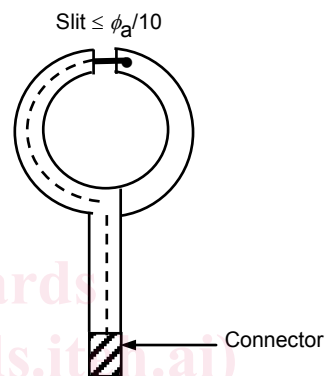


Figure 4d – Shielded coaxial antenna with slit

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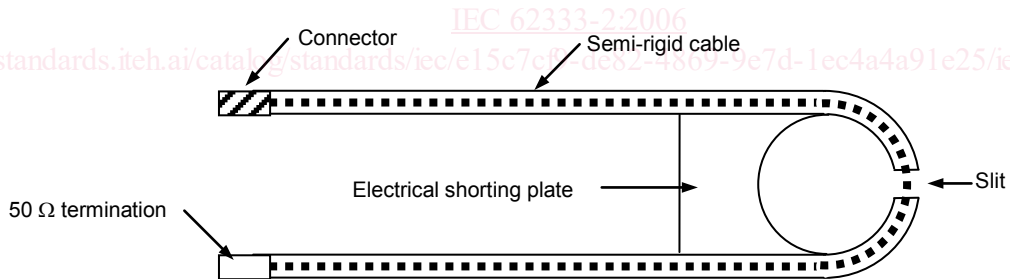


Figure 4e – Shield loop antenna with electrical shorting plate

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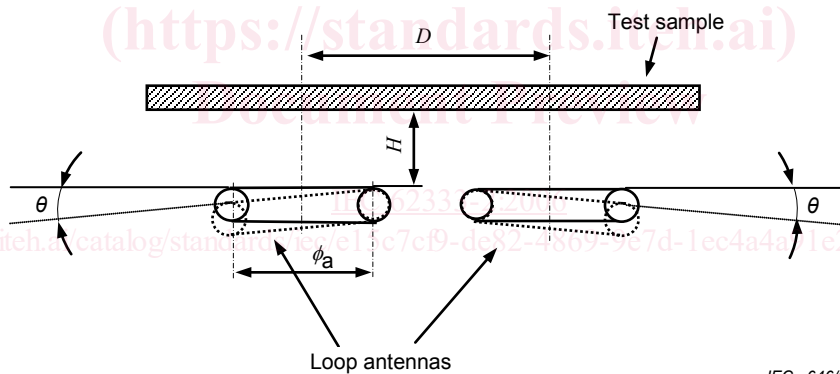
Figure 4 – Recommended examples of small loop antennas for the measurement

Table 1 – Merits and limitations of the recommended antennas

	Loop antenna type	Frequency range (approx.) GHz	Fabrication	Materials
a)	Shielded multi-layer antenna with slit	0,1 to 3	PCB manufacturing process required	PCB material Ex. FR-4
b)	Shielded loop antenna with 50 Ω termination	0,1 to 6	Engineering skills required	Semi-rigid cable
c)	One turn antenna with ferrite beads	0,1 to 2	Easy	Semi-rigid cable Ferrite beads Ex. NiCuZn ferrite
d)	Shielded coaxial antenna with slit	0,1 to 2	Easy	Semi-rigid cable
e)	Shield loop antenna with electrical shorting plate	0,1 to 6	Easy	Semi-rigid cable

Slit width shown in Figures 4a), b), d) and e) shall be less than $\phi_a/10$, where ϕ_a is average diameter of the loop antenna.

A pair of loop antennas shall be arranged as shown in Figure 5. The dimensions of loop antennas are specified as shown in Table 2.



IEC 646/06

- D is the distance between centres of the loop antennas;
- ϕ_a is the average diameter of the loop antenna;
- H is the clearance between test sample and the antenna surface;
- θ is the angle between test sample and each loop antenna surface.

Figure 5 – Cross-sectional view of the measuring configuration

Table 2 – Dimensions of loop antennas

Distance D mm	Diameter ϕ_a mm	Clearance H mm	Angle θ radian
$6,0 \pm 0,2$	$3,0 \pm 0,2$	$3,0 \pm 0,2$	$\leq \pi/18^a$
$a \leq 10$ degrees			