

Radio disturbance characteristics for the protection of receivers used on board vehicles, boats, and on devices — Limits and methods of measurement — Specifications for active antennas

ICS 33.100.10; 33.100.20

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Summary of pages

This document comprises a front cover, an inside front cover, the IEC/PAS title page, pages 2 to 12, an inside back cover and a back cover.

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**PUBLICLY
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**IEC
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INTERNATIONAL SPECIAL COMMITTEE ON RADIO INTERFERENCE

**Radio disturbance characteristics for the
protection of receivers used on board vehicles,
boats, and on devices –
Limits and methods of measurement –
Specifications for active antennas**



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INTERNATIONAL ELECTROTECHNICAL COMMISSION
INTERNATIONAL SPECIAL COMMITTEE ON RADIO INTERFERENCE

**RADIO DISTURBANCE CHARACTERISTICS FOR THE PROTECTION
OF RECEIVERS USED ON BOARD VEHICLES, BOATS, AND ON DEVICES –
LIMITS AND METHODS OF MEASUREMENT –
SPECIFICATIONS FOR ACTIVE ANTENNAS**

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IEC-PAS 62437 has been processed by CISPR subcommittee D: Electromagnetic disturbances related to electric/electronic equipment on vehicles and internal combustion engine powered devices.

During the maintenance of CISPR 25, the need for additional information regarding the use of active antennas for on-board reception was raised. Since it is necessary to gather experience with the described methods, CISPR subcommittee D decided not to include it as an annex in CISPR 25 for the time being, but to publish it as separate document.

The text of this PAS is based on the following document:

This PAS was approved for publication by the P-members of the committee concerned as indicated in the following document

Draft PAS	Report on voting
CISPR/D/308/NP	CISPR/D/315/RVN

Following publication of this PAS, the technical committee or subcommittee concerned will investigate the possibility of transforming the PAS into an International Standard.

This PAS shall remain valid for an initial maximum period of 3 years starting from 2005-09. The validity may be extended for a single 3-year period, following which it shall be revised to become another type of normative document, or shall be withdrawn.

INTRODUCTION

Use of active antennas is today the state of the art in vehicles. In principle, active antennas can be handled like any other component/module used in vehicles, but, since they become part of the test equipment when performing radiated emission tests according to Clause 5 of CISPR 25, it must be guaranteed that the emissions produced by the active antenna itself will allow these emission measurements.

RADIO DISTURBANCE CHARACTERISTICS FOR THE PROTECTION OF RECEIVERS USED ON BOARD VEHICLES, BOATS, AND ON DEVICES – LIMITS AND METHODS OF MEASUREMENT – SPECIFICATIONS FOR ACTIVE ANTENNAS

1 Scope

Active antennas used on board vehicles are electronic components in the sense of CISPR 25. Therefore, the requirements regarding emissions apply to it in its function as EUT. In addition to this, vehicle active antennas are used as part of the measurement chain for the evaluation of emissions produced by any other component in the vehicle. With a passive antenna no special considerations were necessary because it can neither generate emissions nor harmonics due to its linearity.

This Publicly Available Specification (PAS) gives additional information for the use of active antennas for radiated emission measurement according to CISPR 25. Test set-ups at component level are defined for the determination of noise floor.

The current vehicle antenna technology provides two categories of active antennas. The first category (I) consists of an active part (electronic part) and a passive part (antenna structure). These parts can be considered as two separate “black boxes”. During the emission tests (antenna as EUT), the passive antenna part is normally replaced by an “artificial antenna network”.

Antennas with their active and passive parts inseparably combined within one housing are defined as category (II) antennas.

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.

CISPR 25, *Radio disturbance characteristics for the protection of receivers used on board vehicles, boats, and on devices – Limits and methods of measurement*

3 Terms and definitions

For the purposes of this document, the following definitions apply.

3.1

antenna matching unit

unit for matching the impedance of an antenna output to that of the 50 Ω measuring instrument over the antenna measuring-frequency range

3.2

antenna noise floor

voltage measured at the output of an active antenna via an original coaxial cable in the absence of a reception field strength (category II) or when the passive part of the antenna is replaced by a terminated artificial antenna network (category I)

3.3**artificial antenna network (AAN)**

electrical circuit consisting of lumped inductors, capacitors and resistors giving the same complex scattering parameter S_{22} as the passive part of the antenna installed in the vehicle, boat or device

3.4**artificial network (AN)**

line impedance stabilization network (LISN¹⁾)

network inserted in the supply lead or signal/load lead of apparatus to be tested which provides, in a given frequency range, a specified load impedance for the measurement of *disturbance voltages* and which may isolate the apparatus from the supply or signal sources/loads in that frequency range

[IEV 161-04-05, modified]

3.5**r.f.-amplifier**

electronic part of the antenna system

3.6**shielded enclosure****screened room**

mesh or sheet metallic housing designed expressly for the purpose of separating electromagnetically the internal and the external environment

[IEV 161-04-37]

3.7**vehicle active antenna**

antenna consisting of the passive part, the active part (r.f.-electronic) and the whole vehicle body including the cable harnesses acting as counterpoise

4 Set-up for noise-floor measurement

Knowledge of the noise floor is strongly required for assessment of emissions when the active antenna is part of the measurement chain. It is not useful to define limits for the noise floor. However, it shall be measured according to the following method and shall be recorded to allow interpretation of measurement results. Noise-floor measurements are required only in the frequency bands for which the antenna is designed. It applies to both category I and II antennas. The measurements shall be performed with the active antenna mounted in a shielded enclosure (see Figures 1 and 2). In the case of a category I antenna, an artificial antenna network (see Annex A) shall be used. The intended coaxial cable shall be used for the connection between the antenna and the measurement receiver or the antenna matching unit (usually applicable for AM bands). Bandwidths and detectors shall be chosen in order to cover all emission measurement necessities described in CISPR 25 for which the antenna will be used.

1) In the USA.

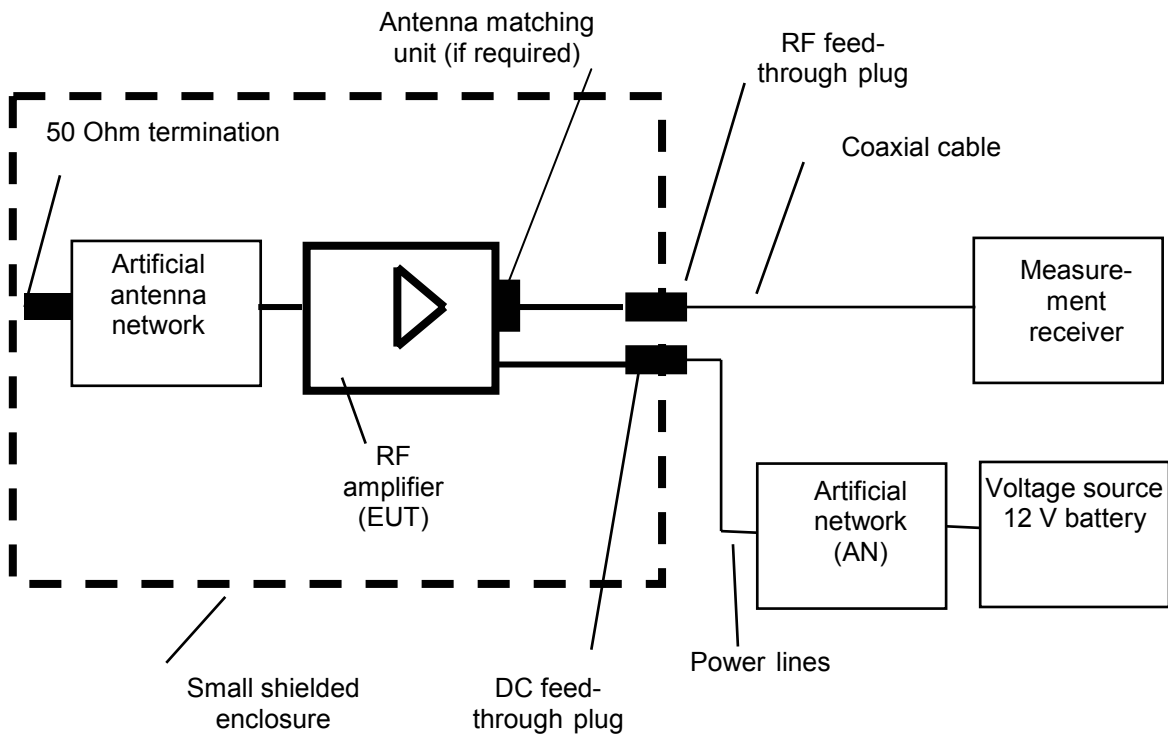


Figure 1 – Example test set-up for noise-floor measurements (Category I antennas)

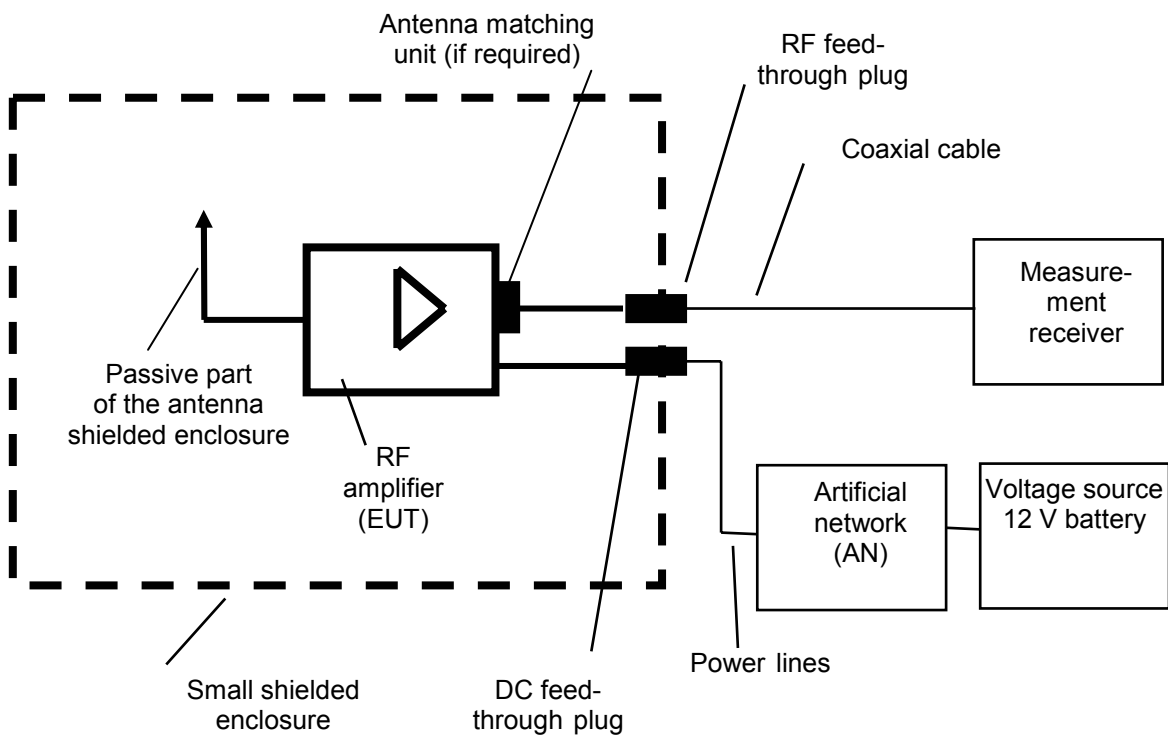


Figure 2 – Example test set-up for noise-floor measurements (Category II antennas)

The process steps described in Annex I of CISPR 25 for vehicle-mounted antennas are applied also at component level.

- a) The active antenna is replaced by a termination at the antenna matching unit r.f. input (if applicable) or directly at the end of the coaxial cable (if no antenna matching unit is required). The noise floor of the test equipment (measurement receiver and antenna matching unit) is measured in the radio bands for which the antenna is designed ($U_{\text{Equipment noise}}$ in dB(μV)).
- b) The active antenna is installed according to Figures 1 and 2 and the noise floor of the active vehicle antenna including the noise floor of the test equipment is measured ($U_{\text{Equipment noise plus antenna noise}}$ in dB(μV)).
- c) From these two measurements, the active antenna noise floor $U_{\text{antenna noise}}$ is calculated with formula (1):

$$U_{\text{antenna noise}} = 10 \cdot \log \left(10^{\frac{U_{\text{Equipment noise plus antenna noise}}}{10}} - 10^{\frac{U_{\text{Equipment noise}}}{10}} \right) \text{ in dB}(\mu\text{V}) \quad (1)$$

Annex A (informative)

Examples for artificial antenna networks

A.1 Example of an artificial antenna network for antennas intended for rear-screen installation

This type of artificial antenna network consists of three main parts as shown in Figure A.1. These parts simulate the impedance behaviour of the vehicle passive antenna in AM frequency ranges (number 3 in Figure A.1), FM/TV/GPS frequency ranges (number 2 in Figure A.1) and also the d.c. behaviour of the vehicle's screen heater (number 6 in Figure A.1).

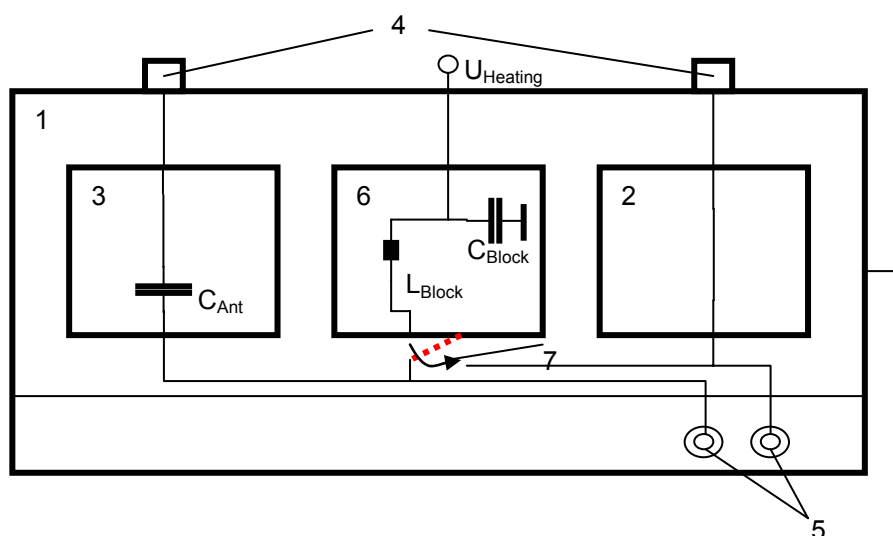
The elements of AM and high-frequency networks for use with a $50 \Omega^1$ measuring system are defined as follows.

Place of heating structure	L_{Block}	C_{Block}
On AM structure	$\geq 160 \mu\text{H}$	$\leq 8 \text{ nF}$ (optional)
FM, TV, GPS, GSM structure	$\geq 2 \mu\text{H}$	$\geq 100 \text{ pF}$

These elements are preferably the same as those installed in a vehicle.

When the antenna structure is designed for installation at the rear screen, the network (number 2 in Figure A.1) for FM and/or TV bands is reduced to a $50 \Omega^1$ system (real impedance, given by the $50 \Omega^1$ termination or measurement receiver).

The network for AM bands (number 3 in Figure A.1) is built by a high-impedance system in accordance with Figure A.1. The corresponding capacitor is given as $C_{\text{Ant}} \approx 56 \text{ pF}$.



Key

- | | | | |
|---|--|---|--|
| 1 | Shielded enclosure | 5 | AM/FM double push-button output to amplifier |
| 2 | Matching network for FM, TV, GPS, ..., bands | 6 | Simulation of d.c. screen heater |
| 3 | DC isolation AM network ($C_{\text{Ant}} \approx 56 \text{ pF}$) | 7 | Switch for screen heater (FM, TV, GPS, ..., or AM) |
| 4 | AM/FM BNC input connector $50 \Omega^1$ | | |

Figure A.1 – Block circuit of an artificial antenna network for antennas intended for rear-screen installation

¹⁾ This value depends on the impedance of the measurement system used (for example, 50Ω or 75Ω).

A.2 Example of an artificial antenna network for antennas intended for side-screen installation

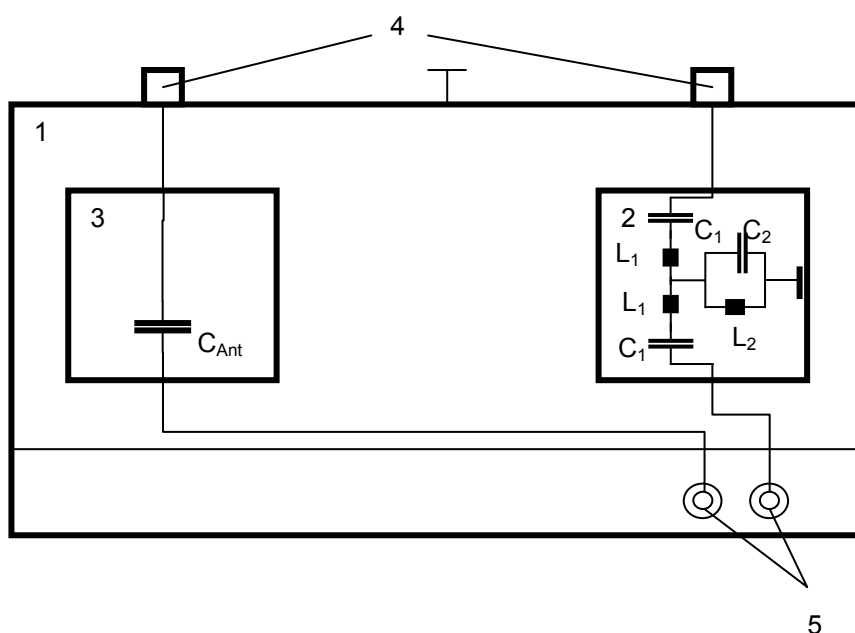
This type of artificial antenna network consists of two main parts as shown in Figure A.2. These parts simulate the impedance behaviour of the vehicle passive antenna in AM frequency ranges (number 3 in Figure A.2) and FM/TV/GPS,..., frequency ranges (number 2 in Figure A.2).

For side-screen antennas, the high-frequency network is built as shown in number 2 in Figure A.2. The corresponding “T” or “ π -terms” are needed to achieve the matching between the DUT and the passive antenna (characteristic impedance of the side screen). The elements L_1 , C_1 and L_2 , C_2 shall be determined according to the vehicle considered. Usually, the values of these elements for a $50 \Omega^1$ measurement system are as follows.

L1 [nH]	L2 [nH]	C1 [pF]	C2 [pF]
$\approx 10 \dots 390$	≈ 10 to 390	≈ 5 to 220	≈ 5 to 220

When the antenna structure is designed for installation at the side screen, the network (number 2 in Figure A.2) for FM and/or TV bands is reduced to a $50 \Omega^1$ system (real impedance, given by the connected $50 \Omega^1$ termination or connected measurement receiver).

For the AM bands, the network (number 3 in Figure A.2) is built in accordance with Figure A.2. The corresponding capacitor is given as $C_{Ant} \approx 56$ pF.



Key

- 1 Shielded enclosure
- 2 Matching network for FM, TV, GPS, ..., bands
- 3 DC isolation AM matching network ($C_{Ant} \approx 56$ pF)
- 4 AM/FM BNC input connector $50 \Omega^1$
- 5 AM/FM double push-button output to amplifier

Figure A.2 – Block circuit of an artificial antenna network for antennas intended for side-screen installation

¹⁾ This value depends on the impedance of the measurement system used (for example, 50Ω or 75Ω).

Bibliography

IEC 60050-161, *International Electrotechnical Vocabulary (IEV) – Chapter 161: Electro-magnetic compatibility*

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