

CONFIRMED  
SEPTEMBER 1997

Method of

# Measurement of current noise generated in fixed resistors

UDC 621.316.8.014:534.83

NO COPYING WITHOUT BSI PERMISSION EXCEPT AS PERMITTED BY COPYRIGHT LAW

**BSI**  
Documents

AVA

Document Sharing Hub

# Co-operating organizations

The Telecommunication Industry Standards Committee, under whose supervision this British Standard was prepared, consists of representatives from the following Government departments and scientific and industrial organizations:

|                                                                                     |                                                              |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------|
| British Broadcasting Corporation                                                    | Institution of Electrical Engineers*                         |
| British Electrical and Allied Manufacturers' Association                            | Institution of Electronic and Radio Engineers                |
| British Radio Equipment Manufacturers' Association*                                 | Institution of Production Engineers                          |
| British Radio Valve Manufacturers' Association                                      | Ministry of Aviation*                                        |
| British Railways Board                                                              | Ministry of Defence, Navy Department*                        |
| Cable and Wireless Ltd.                                                             | Ministry of Labour, H.M. Factory Inspectorate                |
| Crown Agents for Oversea Governments and Administrations                            | Post Office*                                                 |
| Electrical Contractors Association (Incorporated)                                   | Radio and Electronic Component Manufacturers' Federation*    |
| Electrical Research Association*                                                    | Relay Services Association of Great Britain                  |
| Electricity Council, the Generating Board and the Area Boards in England and Wales* | Science Research Council, Radio and Space Research Station*  |
| Electronic Engineering Association*                                                 | Telecommunication Engineering and Manufacturing Association* |
| Electronic Valve and Semi-Conductor Manufacturers' Association                      |                                                              |

The Government departments and scientific and industrial organizations marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this British Standard:

|                                                |                                        |
|------------------------------------------------|----------------------------------------|
| Radio Society of Great Britain                 | United Kingdom Atomic Energy Authority |
| Society of British Aerospace Companies Limited |                                        |

This British Standard, having been approved by the Telecommunication Industry Standards Committee and endorsed by the Chairman of the Engineering Divisional Council, was published under the authority of the General Council on 23 January 1967

© BSI 04-2000

The following BSI references relate to the work on this standard:  
Committee reference TLE/4 and TLE/4/6  
Draft for comment 66/2219

ISBN 0 580 04366 5

## Amendments issued since publication

| Amd. No. | Date | Comments |
|----------|------|----------|
|          |      |          |
|          |      |          |
|          |      |          |
|          |      |          |
|          |      |          |

# Contents

|                                                            | Page               |
|------------------------------------------------------------|--------------------|
| Co-operating organizations                                 | Inside front cover |
| Foreword                                                   | ii                 |
| 1 Scope                                                    | 1                  |
| 2 Object                                                   | 1                  |
| 3 Terminology                                              | 1                  |
| 4 Current-noise measurement system                         | 2                  |
| 5 Determination of calibration voltage                     | 4                  |
| 6 Measurement procedures                                   | 4                  |
| 7 Accuracy                                                 | 5                  |
| 8 Notes and precautions                                    | 5                  |
| Figure 1 — Block diagram of system                         | 9                  |
| Table 1 — Recommended operating conditions                 | 6                  |
| Table 2 — Correction factor for presence of “system noise” | 8                  |

## Foreword

This British Standard method is based on, and is identical in technical content with, IEC Publication 195 “*Method of measurement of current noise generated in fixed resistors*”, except where indicated otherwise by a footnote.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

**Compliance with a British Standard does not of itself confer immunity from legal obligations.**

### Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 9 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

## 1 Scope

The method of measurement described in this British Standard applies to all classes of fixed resistors used in circuits where current noise is critical, e.g. in some low-signal-level audio and other low-frequency circuits. It is not intended as a general specification requirement.

## 2 Object

The object of this British Standard is to specify a method of measurement and the associated test conditions for use in the determination of the magnitude of current noise generated in fixed resistors so as to make possible the comparison of the results of measurements. Limiting values of the magnitude of current noise for acceptable performance are not specified.

The standard constitutes a description of the measurement system and procedures recommended for use in assessing the “noisiness” or magnitude of current noise generated in fixed resistors of any given type.

## 3 Terminology

### 3.1

#### noise voltage

a spontaneous fluctuating voltage having instantaneous amplitude values which, because they are distributed in a random manner, cannot be predicted except in terms of probability statements. Usually the amplitude characteristic of principal interest is not the instantaneous value but the “time-averaged” value. The measurement of amplitude commonly used and adopted for this standard is the root of the mean-square value of voltage (r.m.s.) transmitted in a particular frequency pass band

### 3.2

#### thermal noise voltage

a fluctuating voltage caused by random motion of thermally agitated charges. It is present in all resistors. It is not necessary to determine the magnitude of thermal noise by measurement because the mean-square value of the fluctuating voltage appearing at the open-circuit terminals of a resistor, which would be indicated by the measuring system, may be calculated using Nyquist’s equation:

$$V_n^2 = 4 k T R \Delta f$$

where:

$k$  is Boltzmann’s constant,  $1.38 \times 10^{-23}$  watt seconds per degree Kelvin

$T$  is the absolute temperature in degrees Kelvin

$R$  is the resistance value in ohms

$\Delta f$  is the effective pass band of the measuring system in Hz (cycles/second).

A resistor may be represented as a thermal noise source having a zero-impedance noise voltage generator connected in series with a noise-free resistor.

although this British Standard is concerned with measurement of current noise in resistors, the presence of thermal noise cannot be ignored because thermal noise of the resistor under test is frequently a major source of interference in the measurement

### 3.3

#### current-noise voltage

the increase in the noise voltage over the thermal noise voltage resulting from a direct current flowing in a fixed resistor

a resistor exhibiting current noise may be represented as a noise source having a zero-impedance current-noise voltage generator connected in series with an independent (i.e. a non-coherent) thermal-noise voltage generator and noise-free resistor

the mean-square value of current-noise voltage per unit pass band varies substantially inversely with frequency. If the mean-square voltage is inversely proportional to frequency, then ideal rectangular pass bands, having equal ratios of upper to lower band-pass limits, transmit equal magnitudes of noise voltage from a given noise source