

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Laboratory resistors –
Part 2: Laboratory AC resistors**

**Résistances de laboratoire –
Partie 2: Résistances de laboratoire à courant alternatif**



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2022 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

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

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

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, ...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch

Discover our powerful search engine and read freely all the publications previews. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 300 terminological entries in English and French, with equivalent terms in 19 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Recherche de publications IEC - webstore.iec.ch/advsearchform

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études, ...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et une fois par mois par email.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch

Découvrez notre puissant moteur de recherche et consultez gratuitement tous les aperçus des publications. Avec un abonnement, vous aurez toujours accès à un contenu à jour adapté à vos besoins.

Electropedia - www.electropedia.org

Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 300 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 19 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Laboratory resistors –
Part 2: Laboratory AC resistors**

**Résistances de laboratoire –
Partie 2: Résistances de laboratoire à courant alternatif**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 17.220.20; 31.040.01

ISBN 978-2-8322-1092-7

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

FOREWORD.....	4
1 Scope.....	6
2 Normative references	6
3 Terms and definitions	6
4 Resistor characterization and construction.....	8
4.1 Resistor characterization	8
4.2 Resistor construction	9
5 General requirements	9
5.1 DC resistance, AC resistance and time constant.....	9
5.2 Multiple resistors.....	10
5.3 Multi-dial resistors.....	10
5.4 Connecting leads.....	10
5.5 Conditions for the determination of DC and AC characteristics.....	11
6 Permissible variations.....	11
7 Further electrical and mechanical requirements.....	12
8 Information, markings and symbols.....	12
8.1 Information	12
8.2 Markings and symbols	12
Annex A (informative) Examples of markings	14
A.1 Example of marking for a single AC resistor.....	14
A.2 Example of marking for a five-dial AC resistor.....	14
Annex B (informative) General considerations regarding laboratory AC resistors	16
Annex C (informative) Equivalent circuits of an AC resistor.....	18
C.1 General.....	18
C.1.1 Two-element equivalent circuit of an AC resistor	18
C.1.2 Three-element equivalent circuits	20
C.2 Guard terminal.....	23
Annex D (informative) Construction of AC resistors.....	24
D.1 Construction and electrical definition of the impedance.....	24
D.2 Two-terminal resistor	24
D.3 Three-terminal resistor.....	24
D.4 Four-terminal resistor.....	25
D.5 Five-terminal resistor	25
D.6 Four-terminal coaxial resistor.....	26
D.7 Two-terminal-pair resistor	26
D.8 Four-terminal-pair resistor.....	27
Figure A.1 – Example of marking for a single AC resistor.....	14
Figure A.2 – Example of marking for a five-dial resistor	14
Figure C.1 – The three-element equivalent circuit of an AC resistor (Category A)	20
Figure C.2 – The three-element equivalent circuit of an AC resistor (Category C)	22
Figure D.1 – Two-terminal resistor	24
Figure D.2 – Three-terminal resistor	25
Figure D.3 – Four-terminal resistor	25

Figure D.4 – Five-terminal resistor	26
Figure D.5 – Four-terminal coaxial resistor	26
Figure D.6 – Two-terminal-pair resistor	27
Figure D.7 – Four-terminal-pair resistor	27
Table 1 – Limits of the AC resistance relative uncertainty	9
Table 2 – Limits of the AC/DC difference	10
Table 3 – Upper limit of the nominal range of use for frequency	11

INTERNATIONAL ELECTROTECHNICAL COMMISSION

LABORATORY RESISTORS –**Part 2: Laboratory AC resistors****FOREWORD**

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

IEC 60477-2 has been prepared by IEC technical committee 85: Measuring equipment for electrical and electromagnetic quantities. It is an International Standard.

This second edition cancels and replaces the first edition published in 1979, and Amendment 1:1997. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) extended the AC resistor frequency range to 1 MHz;
- b) updated the terms and definitions according to IEC 60050 series;
- c) added the definition of AC/DC difference of an AC resistor;
- d) added the resistor classification according to the AC resistance or AC/DC difference index;
- e) updated the classification according to the AC resistor construction;
- f) updated the safety symbols and requirements according to IEC 60477-1;
- g) added the three-element equivalent circuits of an AC resistor in Annex C;

h) added the annex on constructions of AC resistors.

The text of this International Standard is based on the following documents:

Draft	Report on voting
85/822/FDIS	85/825/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

A list of all parts in the IEC 60477 series, published under the general title *Laboratory resistors*, can be found on the IEC website.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

LABORATORY RESISTORS –

Part 2: Laboratory AC resistors

1 Scope

This part of IEC 60477 applies to resistors intended as laboratory AC resistors for use over a range of frequencies from DC up to a stated frequency which is not in excess of 1 MHz. Such resistors are hereinafter referred to as "AC resistors".

In addition to satisfying the requirements of IEC 60477-1, resistors satisfying the requirements of this document are designed to have a small variation of resistance and a small phase displacement over the stated frequency range.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60477-1, *Laboratory resistors – Part 1: Laboratory DC resistors*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <http://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1

equivalent electric circuit

circuit composed of ideal circuit elements which has, at the terminals or ports, a behaviour equivalent to that of a given electric or magnetic circuit or device

Note 1 to entry: Equivalent electric circuits can also be used to represent other kinds of devices or phenomena.

[SOURCE: IEC 60050-131:2002, 131-15-07]

3.2

circuit element

in electromagnetism, mathematical model of a device characterized by one or more relations between integral quantities

[SOURCE: IEC 60050-131:2002, 131-11-03]