

TECHNICAL REPORT

RAPPORT TECHNIQUE

General requirements for residual current operated protective devices

Exigences générales pour les dispositifs de protection à courant différentiel résiduel

IEC/TR 60755:2008

<https://standards.iteh.ai/en/standards/iec/60755/2008>



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2008 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 la CEI ou du Comité national de la CEI du pays du demandeur.

Si vous avez des questions sur le copyright de la CEI ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de la CEI de votre pays de résidence.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: 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 corrigenda or an amendment might have been published.

- Catalogue of IEC publications: www.iec.ch/searchpub

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 It also gives information on projects, withdrawn and replaced publications.

- IEC Just Published: www.iec.ch/online_news/justpub

Stay up to date on all new IEC publications. Just Published details twice a month all new publications released. Available on-line and also by email.

- Electropedia: www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 20 000 terms and definitions in English and French, with equivalent terms in additional languages. Also known as the International Electrotechnical Vocabulary online.

- Customer Service Centre: www.iec.ch/webstore/custserv

If you wish to give us your feedback on this publication or need further assistance, please visit the Customer Service Centre FAQ or contact us:

Email: csc@iec.ch

Tel.: +41 22 919 02 11

Fax: +41 22 919 03 00

A propos de la CEI

La Commission Electrotechnique internationale (CEI) 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 CEI

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

- Catalogue des publications de la CEI: www.iec.ch/searchpub/cur_fut-f.htm

Le Catalogue en-ligne de la CEI vous permet d'effectuer des recherches en utilisant différents critères (numéro de référence, texte, comité d'études,...). Il donne aussi des informations sur les projets et les publications retirées ou remplacées.

- Just Published CEI: www.iec.ch/online_news/justpub

Restez informé sur les nouvelles publications de la CEI. Just Published détaille deux fois par mois les nouvelles publications parues. Disponible en-ligne et aussi par email.

- Electropedia: www.electropedia.org

Le premier dictionnaire en ligne au monde de termes électroniques et électriques. Il contient plus de 20 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans les langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International en ligne.

- Service Clients: www.iec.ch/webstore/custserv/custserv_entry-f.htm

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions, visitez le FAQ du Service clients ou contactez-nous:

Email: csc@iec.ch

Tél.: +41 22 919 02 11

Fax: +41 22 919 03 00

TECHNICAL REPORT

RAPPORT TECHNIQUE

General requirements for residual current operated protective devices

Exigences générales pour les dispositifs de protection à courant différentiel résiduel

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE
CODE PRIX

W

CONTENTS

FOREWORD.....	5
INTRODUCTION.....	7
1 Scope.....	8
2 Normative references	9
3 Terms and definitions	9
3.1 Definitions relating to currents flowing from live parts to earth.....	9
3.2 Definitions relating to the energization of a residual current device.....	10
3.3 Definitions relating to the operation and to the functions of the residual current device	10
3.4 Definitions relating to values and ranges of energizing quantities.....	12
3.5 Definitions relating to values and ranges of influencing quantities	13
3.6 Conditions of operation	14
3.7 Test.....	15
3.8 short-circuit protective device (SCPD).....	15
4 Classification.....	15
4.1 Classification according to the method of operation.....	15
4.2 Classification according to the type of installation.....	15
4.3 Classification according to the number of poles and current paths.....	15
4.4 Classification according to overcurrent protection.....	16
4.5 Classification according to the possibility of adjusting the residual operating current	16
4.6 Classification according to resistance against unwanted tripping due to current surges caused by impulse voltages	16
4.7 Classification of residual current devices according to their operating characteristics in case of residual currents with d.c. components	16
4.8 Classification according to the range of ambient air temperature	16
4.9 Classification according to time-delay in presence of a residual current exceeding $I_{\Delta n}$	16
4.10 Classification according to the method of construction.....	16
5 Characteristics of residual current devices	16
5.1 Summary of characteristics	16
5.2 Characteristics common to all residual current devices.....	17
5.3 Characteristics specific to residual current devices without integral overcurrent protection (see 4.4a) and to residual current devices with integral overload protection only (see 4.4c).....	19
5.4 Preferred or standard values	19
6 Marking and other product information.....	23
7 Standard conditions for operation in service and for installation.....	24
7.1 Preferred ranges of application, reference values of influencing quantities/factors and their associated test tolerances.....	24
7.2 Limits of extreme range of temperature during storage and transportation.....	25
8 Conditions for construction and operation.....	25
8.1 Information and marking	25
8.2 Mechanical design.....	26
8.3 Operating characteristics.....	27

8.4	Test device.....	29
8.5	Temperature rise.....	29
8.6	Resistance to humidity.....	30
8.7	Dielectric properties.....	30
8.8	Limiting value of non-operation in case of balanced load and unbalanced load.....	30
8.9	EMC compliance and unwanted tripping.....	30
8.10	Behaviour of residual current devices in case of overcurrent conditions.....	30
8.11	Resistance of the insulation against impulse voltages.....	30
8.12	Mechanical and electrical endurance.....	30
8.13	Resistance to mechanical shock.....	31
8.14	Reliability.....	31
8.15	Condition for reclosing a reset residual current device (3.3.13).....	31
8.16	Protection against electric shock.....	31
8.17	Resistance to heat.....	31
8.18	Resistance to abnormal heat and to fire.....	31
8.19	Behaviour of residual current device within ambient temperature range.....	31
8.20	Behaviour of residual current device after exposure to extreme temperatures during storage and transportation.....	32
9	Guidance for type tests.....	32
	Annex A (informative).....	33
	Annex B.....	36
	Bibliography.....	38
	Figure A.1 – Diagram for all the short-circuit tests.....	34
	Figure A.2 – Detail of impedance Z or Z_1	35
	Figure B.1 – Possible load and fault currents according to the different electronic circuits.....	36
	Table 1 – Standard values of maximum break time of non-time-delay type RCDs for a.c. residual current.....	21
	Table 2 – Standard values of maximum break time of non-time-delay type RCDs for half-wave pulsating d.c. residual current.....	21
	Table 3 – Standard values of maximum break time of non-time-delay type RCDs for residual direct currents which result from rectifying circuits and/or smooth d.c. residual current.....	21
	Table 4 – Acceptable alternative standard values of maximum break times for RCD with a rated residual current of 6mA and non-time-delay type intended to be used in bi-phase system 120V with middle point.....	21
	Table 5 – Standard values of break time for a.c. residual current for time-delay type residual current devices.....	22
	Table 6 – Standard values of break time for pulsating d.c. residual current for time-delay type residual current devices.....	22
	Table 7 – Standard values of break time for smooth d.c. residual current for time-delay type residual current devices.....	23
	Table 8 – Tripping current ranges for type B RCDs at frequencies which differ from the rated frequency 50/60 Hz.....	23
	Table 9 – Values of influencing quantities.....	25
	Table 10 – Tripping current limits.....	27

INTERNATIONAL ELECTROTECHNICAL COMMISSION

GENERAL REQUIREMENTS FOR RESIDUAL CURRENT OPERATED PROTECTIVE DEVICES

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 provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with an IEC Publication.
- 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.

The main task of IEC technical committees is to prepare International Standards. However, a technical committee may propose the publication of a technical report when it has collected data of a different kind from that which is normally published as an International Standard, for example "state of the art".

IEC 60755, which is a technical report, has been prepared by subcommittee 23E: Circuit-breakers and similar equipment for household use, of IEC technical committee 23: Electrical accessories.

The text of this technical report is based on the following documents:

DTR	Report on voting
23E/635/DTR	23E/640/RVC

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

This second edition of IEC 60755 cancels and replaces the first edition published in 1983, its first amendment published in 1988 and its second amendment published in 1992.

It constitutes a technical revision.

IEC 60755 has been revised in order to align the previous version with the latest editions of IEC 61008, IEC 61009, IEC 62423 and IEC 60947-2.

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

The committee has decided that the contents of this publication will remain unchanged until the maintenance result 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

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

WITHDRAWN

iTech Standards
(<https://standards.itih.ai>)
Document Preview

IEC TR 60755:2008

[https://standards.itih.ai/standards/iec/60755-2008](https://standards.itih.ai/standards/iec/60755/standards/iec/60755-2008)

INTRODUCTION

Residual current devices are primarily intended to give protection against the risk of dangerous, and possibly lethal, electric shocks and to provide protection against fire hazards due to a persistent earth fault current.

This technical report specifies the operational characteristics for these devices; details of how they should be installed to provide the desired level of protection are specified in the various parts of IEC 60364.

This technical report is intended for use by technical committees in the preparation of standards for residual current devices. It is not intended to be used as a stand-alone standard, for example, for certification.

It has been prepared by subcommittee 23E in accordance with its pilot function for residual current devices.

There are two basic conditions of protection against the risk of electric shock: fault protection (indirect contact) and basic protection (direct contact).

Fault protection implies that the device is used to prevent dangerous voltages persisting on accessible installation metalwork, which are earthed but become live under earth fault conditions.

Under such conditions, the risk arises not from the user making direct contact with a live conductive part but from making contact with earthed metalwork, which itself is in contact with a live conductive part.

The primary or basic function of residual current devices is to give fault protection, but, with devices of adequate sensitivity (i.e., units having operating residual currents not exceeding 30 mA), there is the additional benefit that, should other methods of protection fail, the device will give a high degree of protection to a user making direct contact with a live conductive part.

The operating characteristics given in this technical report are therefore based on requirements, which themselves are based on the information contained in IEC 60479.

These devices also provide protection against the risk of fire resulting from earth fault currents which can persist for lengthy periods without operating the overcurrent protective device.

GENERAL REQUIREMENTS FOR RESIDUAL CURRENT OPERATED PROTECTIVE DEVICES

1 Scope

The requirements of this technical report apply to residual current operated protective devices (hereinafter referred to as “residual current devices” (RCD)) for rated voltages not exceeding 440 V a.c., intended primarily for protection against shock hazard. They are intended to be used by technical committees when drafting product standards and apply only if they are incorporated or are referred to in the relevant standards. This report is not intended to be used as a stand-alone standard, for example, for certification.

NOTE 1 This technical report may also be used as a guide for residual current devices of rated voltages up to 1 000 V, a.c.

It applies to

- a single device which detects a residual current (see 3.3.2), compares it to a reference value (see 3.3.3) and opens the protected circuit when the residual current exceeds this reference value (see 3.3.4);
- an association of devices, each one of them performing separately one or two of the above-mentioned functions, but acting together in order to accomplish all three functions. Particular requirements may be necessary for devices intended for accomplishing only one or two of the above three functions.

This report applies for conditions as stated in Clause 7. For other conditions, additional requirements may be necessary.

Residual current devices are intended to protect persons and livestock against harmful effects of electric shock due to contact with exposed conductive parts by automatic disconnection of supply in accordance with IEC 61140 and IEC 60364-4-41.

NOTE 2 In this context “harmful effects” include the risk of occurrence of heart fibrillation.

In accordance with IEC 60364-5-53, residual current devices with a rated residual operating current not exceeding 300 mA may also be used to provide protection against fire hazards due to a persistent earth fault current.

In accordance with IEC 60364-4-41, residual current devices with a rated residual operating current not exceeding 30 mA may also be used for additional protection in case of failure of the basic protective provisions or carelessness of the user of the installation or equipment.

For residual current devices performing additional functions, this technical report applies together with the relevant standard covering the additional functions; for example, when residual current devices incorporate a circuit-breaker it should comply with the relevant circuit-breaker standard.

Supplementary or particular requirements may be necessary, for example, for

- residual current devices intended for use by uninstructed persons;
- socket-outlets, plugs, adapters and couplers incorporating residual current devices.

This technical report states

- the definitions of terms used for residual current devices (Clause 3) ;
- the classification of residual current devices (Clause 4);
- the characteristics of residual current devices (Clause 5);
- the preferred values of the operating and influencing quantities (5.4);

- the marking and information to be provided for residual current devices (Clause 6);
- the standard conditions for installation and operation in service (Clause 7);
- the requirements for construction and operation (Clause 8);
- the list of minimum requirements to be tested (Clause 9).

NOTE 3 Devices having a residual current function for specific purposes other than those mentioned above (for example, motor protection) are not covered by this technical report.

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 60038, *IEC standard voltages*

IEC 60050-411:1996, *International Electrotechnical Vocabulary – Part 411: Rotating machines*

IEC 60050-426:1990, *International Electrotechnical Vocabulary – Part 426: Electrical apparatus for explosive atmospheres*

IEC 60050-441:1984, *International Electrotechnical Vocabulary – Part 441: Switchgear, controlgear and fuses*

IEC 60050-442:1998, *International Electrotechnical Vocabulary – Part 442: Electrical accessories*

IEC 60050-471:2007, *International Electrotechnical Vocabulary – Part 471: Insulators*

IEC 60364-4-41, *Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock*

IEC 60364-5-53, *Electrical installations of buildings – Part 5-53: Selection and erection of electrical equipment – Isolation, switching and control*

IEC 60998-1, *Connecting devices for low-voltage circuits for household and similar purposes – Part 1: General requirements*

IEC 61140, *Protection against electric shock – Common aspects for installation and equipment*

3 Terms and definitions

For the purposes of this document, definitions given in IEC 60050-411, IEC 60050-426, IEC 60050-441, IEC 60050-442 and IEC 60050-471, as well as the following, apply.

3.1 Definitions relating to currents flowing from live parts to earth

3.1.1

earth fault current

current flowing to earth due to an insulation fault

3.1.2

earth leakage current

current flowing from the live parts of the installation to earth in the absence of an insulation fault

3.1.3**pulsating direct current**

current of pulsating wave form which assumes, in each period of the rated power frequency, the value 0 or a value not exceeding 0,006 A d.c. during one single interval of time, expressed in angular measure, of at least 150°

3.1.4**current delay angle α**

time, expressed in angular measure, by which the starting instant of the current conduction is delayed by phase control

3.1.5**smooth direct current**

direct current which is ripple-free

NOTE A current is considered to be ripple-free when the coefficient of ripple is below 10 %.

3.2 Definitions relating to the energization of a residual current device**3.2.1****residual current I_{Δ}**

vector sum of the instantaneous values of the current flowing in the main circuit of the residual current device (expressed as r.m.s. value)

3.2.2**residual operating current**

value of residual current which causes the residual current device to operate under specified conditions

3.2.3**residual non-operating current**

value of residual current at which and below which the residual current device does not operate under specified conditions

3.3 Definitions relating to the operation and to the functions of the residual current device**3.3.1****residual current device (RCD)**

mechanical switching device or association of devices designed to make, carry and break currents under normal service conditions and to cause the opening of the contacts when the residual current attains a given value under specified conditions

3.3.2**detection**

function consisting in sensing the presence of a residual current

3.3.3**evaluation**

function consisting in giving to the residual current device the possibility to operate, when the detected residual current exceeds a specified reference value

3.3.4**interruption**

function consisting in bringing automatically the main contacts of the residual current device from the closed position into the open position, thereby interrupting the current(s) flowing through them

3.3.5**switching device**

device designed to make or to break the current in one or more electric circuits
[IEV 442-01-46]

3.3.6**trip-free mechanism of a residual current device**

mechanism, the moving contacts of which return to and remain in the open position when the opening operation is initiated after the initiation of the closing operation, even if the closing command is maintained

NOTE To ensure proper breaking of the current which may have been established, it may be necessary that the contacts momentarily reach the closed position.

[IEV 441-16-31, modified]

3.3.7**residual current device without integral overcurrent protection**

residual current device not designed to perform the functions of protection against overloads and/or short circuits

3.3.8**residual current device with integral overcurrent protection**

residual current device designed to perform the functions of protection against overloads and/or short circuits

NOTE This definition includes residual current devices intended to be coupled to a circuit breaker (r.c. units, see 3.3.9)

3.3.9**r.c. unit**

device performing simultaneously the functions of detection of the residual current and of comparison of the value of this current with the residual operating value and incorporating the means of operating the tripping mechanism of a circuit-breaker with which it is designed to be assembled or associated

3.3.10**break-time of a residual current device**

time which elapses between the instant the residual operating current is attained and the instant of arc extinction in all poles

3.3.11**limiting non-actuating time**

maximum time during which the residual operating current can be applied to the residual current device without causing it to operate

3.3.12**time-delay residual current device**

residual current device specially designed to attain a predetermined value of limiting non-actuating time, corresponding to a given value of residual current

3.3.13**reset residual current device**

residual current device which should be intentionally reset prior to reclosing by a means different from the operation means to be able to be reclosed and to operate again

3.3.14**test device**

device incorporated in the residual current device simulating the residual current conditions for the operation of the residual current device under specified conditions

3.4 Definitions relating to values and ranges of energizing quantities

3.4.1 non-operating overcurrent

3.4.1.1 limiting value of the non-operating over-current in the case of a single-phase load

maximum value of a single-phase overcurrent which, in the absence of a residual current, can flow through a residual current device (whatever the number of poles) without causing it to operate

NOTE 1 In the case of an overcurrent in the main circuit, unwanted tripping may occur in the absence of residual current, due to asymmetry existing in the detecting device itself.

NOTE 2 In the case of a residual current device with integral overcurrent protection, the limiting value of the non-operating current may be determined by the overcurrent protection means.

3.4.1.2 limiting value of the non-operating current in the case of a balanced load

maximum value of the current which, in the absence of a residual current, can flow through a residual current device with a balanced load (whatever the number of poles) without causing it to operate

NOTE 1 In the case of an overcurrent in the main circuit, unwanted tripping may occur in the absence of residual current, due to asymmetry existing in the detecting device itself.

NOTE 2 In the case of a residual current device with integral overcurrent protection, the limiting value of the non-operating current may be determined by the overcurrent protection means.

3.4.2 residual short-circuit withstand current

maximum value of the residual current for which the operation of the residual current device is assured under specified conditions and above which that device may undergo irreversible alterations

3.4.3 limiting thermal value of the short-time current

highest value of current (r.m.s.) which the device is capable of carrying for a specified short period and under specified conditions without undergoing, by heating effect, permanent deterioration of its characteristics

3.4.4 prospective current

current that would flow in the circuit, if each main current path of the residual current device and of the overcurrent protective device (if any) were replaced by a conductor of negligible impedance

NOTE The prospective current may be qualified in the same manner as an actual current, for example, prospective breaking current, prospective peak current, prospective residual current, etc.

[IEV 442-01-47, modified]

3.4.5 making capacity

value of the a.c. component of a prospective current that a residual current device is capable of making at a stated voltage under prescribed conditions of use and behaviour

[IEV 442-01-48, modified]

3.4.6 breaking capacity

value of the a.c. component of a prospective current that a residual current device is capable of breaking at a stated voltage under prescribed conditions of use and behaviour

[IEV 442-01-49, modified]