
**Merilni releji in zaščitna oprema - 167. del: Funkcionalne zahteve za smerno
nadtokovno zaščito**

Measuring relays and protection equipment - Part 167: Functional requirements for
directional overcurrent protection

Relais de mesure et dispositifs de protection - Partie 167: Exigences fonctionnelles pour
la protection directionnelle de surintensité

Ta slovenski standard je istoveten z: prEN IEC 60255-167:2026

ICS:

29.120.70 Releji Relays

oSIST prEN IEC 60255-167:2026 en

Sample Document

get full document from standards.iteh.ai



95/644/CDV

COMMITTEE DRAFT FOR VOTE (CDV)

PROJECT NUMBER:

IEC 60255-167 ED1

DATE OF CIRCULATION:

2026-08-28

CLOSING DATE FOR VOTING:

2026-11-20

SUPERSEDES DOCUMENTS:

95/610/CD, 95/643/CC

IEC TC 95 : MEASURING RELAYS AND PROTECTION EQUIPMENT

SECRETARIAT:

France

SECRETARY:

Mr Thierry BARDOU

OF INTEREST TO THE FOLLOWING COMMITTEES:

TC 8, TC 13, TC 57

HORIZONTAL FUNCTION(S):

ASPECTS CONCERNED:

Electricity transmission and distribution, Energy Efficiency

☒ SUBMITTED FOR CENELEC PARALLEL VOTING☐ NOT SUBMITTED FOR CENELEC PARALLEL VOTING

Attention IEC-CENELEC parallel voting

The attention of IEC National Committees, members of CENELEC, is drawn to the fact that this Committee Draft for Vote (CDV) is submitted for parallel voting.

The CENELEC members are invited to vote through the CENELEC online voting system.

This document is still under study and subject to change. It should not be used for reference purposes.

Recipients of this document are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

Recipients of this document are invited to submit, with their comments, notification of any relevant "In Some Countries" clauses to be included should this proposal proceed. Recipients are reminded that the CDV stage is the final stage for submitting ISC clauses. (SEE [AC/22/2007](#) OR [NEW GUIDANCE DOC](#)).

TITLE:

Measuring relays and protection equipment - Part 167: Functional requirements for directional overcurrent protection

PROPOSED STABILITY DATE: 2032

NOTE FROM TC/SC OFFICERS:

Copyright © 2026 International Electrotechnical Commission, IEC. All rights reserved. It is permitted to download this electronic file, to make a copy and to print out the content for the sole purpose of preparing National Committee positions. You may not copy or "mirror" the file or printed version of the document, or any part of it, for any other purpose without permission in writing from IEC.

[Link to Committee Draft for Vote \(CDV\) online document:](#)

[Click here](#)

How to access

This link leads you to the Online Standards Development (OSD) platform for National Mirror Committee's (NMC) comments. The project draft may be found further down this document.

Resource materials

We recommend NCs to review the available materials to better understand the member commenting on the OSD platform. This includes the:

- [OSD NC roles overview](#)
- [How to add and submit comments to the IEC](#)

Contact

Should you require any assistance, please contact the [IEC IT Helpdesk](#).

Sample Document

get full document from standards.iteh.ai

CONTENTS

CONTENTS	3
FOREWORD	7
INTRODUCTION	9
1 Scope	10
2 Normative references	10
3 Terms, definitions and abbreviations	11
3.1 Terms and definitions	11
3.2 Symbols and abbreviated terms	14
4 Specification of directional overcurrent protection function	15
4.1 General	15
4.2 Input energizing quantities	15
4.2.1 General	15
4.2.2 Connections	16
4.2.3 Polarizing quantities and operating quantities of directional element	16
4.3 Binary input signals	17
4.4 Functional logic	17
4.4.1 Directional element	17
4.4.2 Operating logic	19
4.5 Binary output signals	19
4.5.1 General	19
4.5.2 Start (pickup) signals	19
4.5.3 Operate (trip) signals	19
4.5.4 Other output signals	20
4.6 Additional influencing functions and conditions	20
4.6.1 General	20
4.6.2 Input energizing quantity failure	20
4.6.3 Load encroachment	20
4.7 Instrument transformer requirements	21
5 Performance specification	21
5.1 General	21
5.2 Effective and operating ranges	21
5.3 Accuracy related to directional element	22
5.4 Operate time of directional element	22
5.5 Disengage time of directional element	22
5.6 Dynamic performance	22
5.6.1 General	22
5.6.2 Typical operate time of directional element	23
5.6.3 Impacts of prefault load and fault resistance	23
5.6.4 Evolving faults	23
5.6.5 Current reversal condition	23
6 Functional tests	23
6.1 General	23
6.1.1 Purpose of the tests	23
6.1.2 Injection of input energizing quantities	24
6.1.3 Binary outputs to be monitored	25
6.1.4 Test Settings and configuration	25

IEC CDV 60255-167 © IEC 2026

6.1.5	Test methods and procedures	25
6.2	Determination of accuracy related to directional element	25
6.2.1	General	25
6.2.2	Angular accuracy of directional element	26
6.2.3	Reset hysteresis of directional element.....	2
6.3	Determination of operate time of directional element.....	6
6.4	Determination of disengage time of directional element	9
6.5	Dynamic performance tests.....	12
6.5.1	General	12
6.5.2	Determination of typical operate time	14
6.5.3	Impacts of prefault load and fault resistance	17
6.5.4	Evolving fault tests	21
6.5.5	Current reversal tests	22
7	Documentation requirements	24
7.1	Type test report	24
7.2	Technical documentation	24
Annex A (informative)	Examples of directional characteristics of directional overcurrent protection functions.....	25
Annex B (normative)	Requirements for a directional overcurrent protection function using digital communication as inputs and outputs.....	27
B.1	General.....	27
B.2	Requirements	27
B.2.1	General requirements for digitally interfaced directional overcurrent protection functions	27
B.2.2	Specific requirements for digitally interfaced directional overcurrent protection functions	28
B.3	Performance requirements	31
B.4	Functional tests	31
B.4.1	Injection of input energizing quantities	31
B.4.2	Tests for nominal conditions of digitally interfaced protection functions.....	31
B.4.3	Performance under abnormal SV and GOOSE	32
B.5	IEC 61850 based settings	34
Annex C (informative)	Ramping methods for testing the angular accuracy	36
C.1	General.....	36
C.2	Pseudo-continuous ramp	36
C.3	Ramp of shots.....	38
C.4	Ramp of shots with binary search algorithm	40
Annex D (normative)	Calculation of mean, median and mode.....	43
D.1	Mean	43
D.2	Median.....	43
D.3	Mode	43
D.4	Example	43
Annex E (normative)	Definition of fault inception angle	44
Bibliography.....		46
Figure 1 – An example of simplified protection functional block diagram		15
Figure 2 – Example of operating characteristic for a directional element		18
Figure 3 – Phase angle ramp of operating quantity for angular accuracy test of directional element		27

Figure 4 – Example test sequence for angular accuracy of directional element	28
Figure 5 – Phase angle ramp of operating quantity for reset hysteresis test of directional element	2
Figure 6 – Example test sequence for reset hysteresis of directional element	3
Figure 7 – Example test sequence for operate time of directional element	7
Figure 8 – Example test sequence for Disengage time of directional element.....	10
Figure 9 – Single line, double-infeed system.....	12
Figure 10 – Double lines, double-infeed system	13
Figure 11 – Example test sequence for typical operate time.....	16
Figure 12 – Fault resistance of phase-to-earth fault	17
Figure 13 – Fault resistance of phase-to-phase fault.....	18
Figure 14 – Fault resistances of phase-to-phase-to-earth fault.....	18
Figure 15 – Three-phase fault.....	18
Figure 16 – Example test sequence for impacts of prefault load and fault resistance	19
Figure C.1 – Pseudo-continuous ramp showing phase angle step change and the time step 37	
Figure C.2 – Ramp of shots showing phase angle step change and the time step	40
Figure C.3 – Ramp of shots with binary search algorithm.....	42
Figure E.1 – Graphical definition of fault inception angle.....	44
Table 1 – Directional overcurrent protection designations	10
Table 2 – Example of effective and operating ranges of directional overcurrent protection function	21
Table 3 – Settings associated with the directional element for type tests	26
Table 4 – Operate angle of directional element	1
Table 5 – Angular accuracy of directional element	2
Table 6 – Reset angle of directional element	5
Table 7 – Angular reset hysteresis of directional element.....	6
Table 8 – Injected quantities for operate time test.....	6
Table 9 – Operate time test results of directional element.....	8
Table 10 – Typical operate time for directional element	9
Table 11 – Injected quantities for disengage time test.....	9
Table 12 – Disengage time test results of directional element	11
Table 13 – Typical disengage time of directional element	12
Table 14 – Operate time of directional element	17
Table 15 – Test cases for impacts of prefault load and fault resistance	19
Table 16 – Test report for impacts of prefault load and fault resistance	21
Table 17 – Evolving faults at the same fault location	21
Table 18 – Evolving faults at different locations	22
Table 19 – Test report for evolving fault tests	22
Table 20 – Current reversal tests	23
Table 21 – Test report for current reversal tests.....	23
Table A.1 – Examples of directional characteristic	25
Table B.1 – Requirements for digitally interfaced functions	27

Table B.2 – Specification of the expected behaviour of the directional overcurrent protection function receiving abnormal SV as energizing quantities	30
Table B.3 – Performance requirements for digitally interfaced directional overcurrent protection functions	31
Table B.4 – Rated primary quantities to be used for functional test of digitally interfaced directional overcurrent protection functions	31
Table B.5 – Test requirements for abnormal GOOSE and SV conditions for digitally interfaced directional overcurrent protection functions	32
Table B.6 – Test results for abnormal GOOSE and SV conditions for digitally interfaced directional overcurrent protection functions	33
Table B.7 – IEC 61850 settings for directional overcurrent protection	34
Table E.1 – Fault type and reference voltage	44

Sample Document

get full document from standards.iteh.ai

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**Measuring relays and protection equipment -
Part 167: Functional requirements for directional overcurrent protection**

FOREWORD

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.

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.

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.

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 indicated in the latter.

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.

All users should ensure that they have the latest edition of this publication.

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.

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.

IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which

may be obtained from the patent database available at <https://patents.iec.ch>. IEC shall not be held responsible for identifying any or all such patent rights.

IEC 60255-167 has been prepared by IEC technical committee 95: Measuring relays and protection equipment. It is an International Standard.

This document partially replaces the standard [IEC 60255-12:1980 \[1\]](#) (Directional relays and power relays with two input energizing quantities) published in 1980. This edition constitutes a technical revision for the [directional overcurrent protection](#) function.

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

- a) this document is applicable to the [directional overcurrent protection](#) function only.
- b) [operating quantity](#) and [polarizing quantity](#) of the directional element are defined.
- c) the operating characteristic, the performance of the [directional overcurrent protection](#) function and corresponding test methods are specified in detail.
- d) digitally interfaced [directional overcurrent protection](#) function is included.

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

Draft	Report on voting
95/XX/FDIS	95/XX/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.

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/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, or
- revised.

INTRODUCTION

This document is part of the IEC 60255-1xx series of functional standards, which functionally describes protection functions and provides a framework for testing and assessing the performance of protection functions. It defines various technical features for protection function whose performance is declared, as well as the corresponding requirements for testing and reporting the performance.

For the standardized definitions of a protection function technical feature (such as operate time or start time) and for the standardized testing methods to evaluate it (e.g., test methods for assessing accuracy using pseudo-continuous ramp or ramp of shots), [Clause 5](#) defines the standardized technical features of the protection function. [Clause 6](#) and the related annexes detail how the performance of this technical feature is tested, evaluated, and reported.

In cases where a protection function technical feature is standardized but lacks a standardized testing method (for example, [effective range](#) , [operating range](#) , or the procedure to determine accuracy), [Clause 5](#) defines the technical feature and requires the manufacturer to provide a report on the performance of this technical feature in a standardized format.

When neither a standardized definition of the technical feature nor a standardized testing method exists but the document needs to address a particular behaviour or application, [Clause 4](#) offers a general description of the topic. In such cases, the manufacturer is required to provide a declaration explaining how they address the topic. This is a requirement in a broad sense.

All the declarations and test results from [Clause 5](#) and [Clause 6](#) are expected to be part of the protection function type tests according to this document. Declarations from [Clause 4](#) are expected to be included in technical manuals or any other relevant technical documents related to the protection function. A note in the type test report, confirming that these declarations have been addressed, is also expected to be available.

[Clause 7](#) provides a comprehensive list of the declarations and tests that are to be included in the type test report.

Overall, the presence of the term "shall" throughout the document indicates a requirement. While these requirements do not always relate strictly to the performance, they ensure transparency and consistency in testing and reporting the functionality. The performance measurement methods specified in this document reflect international consensus and provide a consistent framework for protection function testing and evaluation throughout the industry.

The mention of "minimum requirements" in this document refers to the standardized technical features as well as performance measurement methods where consensus has been reached on their definitions. Protection functions can have additional proprietary technical features not covered in this document, but their performance is also part of the product's type tests. As such, at a minimum, a type test report for the protection function specified in this document is expected to provide the information to support and validate the declarations.

This document focuses on the [directional overcurrent protection](#) function, which is a combination of a directional element and an overcurrent element. This standard defines the specific performance characteristics, requirements and testing methods for the directional element. The requirements and testing methods for the overcurrent element are already specified in IEC 60255-151. Therefore, full compliance with IEC 60255-151 is a prerequisite for evaluating the overcurrent element as part of a [directional overcurrent protection](#) function. Users of this document are expected to refer to IEC 60255-151 for the overcurrent element aspects, making both documents necessary for complete application of the function.

1 Scope

This part of IEC 60255 specifies the minimum requirements for functional and performance evaluation of an a.c. **directional overcurrent protection** function. This document also defines how to document and publish performance test results.

The **directional overcurrent protection** function comprises an overcurrent element combined with a directional element. The directional element supervises the operation of the overcurrent element based on the direction of the fault current. This document specifies the requirements that apply to the directional element, and refers to IEC 60255-151 where relevant to the overcurrent element. This document defines factors that influence the accuracy and dynamic performance of the **directional overcurrent protection** function. The test methods for verifying the declared performance are also included in this document.

This document covers directional phase, positive-sequence, negative-sequence, zero-sequence, and **neutral overcurrent protection** functions, as listed in Table 1. Annex A provides commonly used operating characteristics of these functions.

Table 1 – Directional overcurrent protection designations

Protection function	IEEE/ANSI C37.2-2022 [2] Applicable Function Numbers	IEC 61850-7-4:2010/AMD1:2020 Applicable Logical Nodes
Directional phase overcurrent protection	67	PTOC ^a RDIR+PTOC ^a
Directional positive-sequence overcurrent protection	67	
Directional negative-sequence overcurrent protection	67	
Directional zero-sequence overcurrent protection	67N	PTOC ^a RDIR+PTOC ^a PSDE ^{ab}
Directional neutral overcurrent protection	67G	

^a The direction information of protection Logical Nodes can be available in Data Attribute 'dirGeneral' of its Data Object 'Str', 'Dir' or 'Op'.

^b The Logical Node PSDE can be used for directional earth fault protection in resonant earthed (neutral) system and isolated neutral system.

Additional restraint or blocking elements may be part of the **directional overcurrent protection** function. This document does not specify the functional description of these additional restraint or blocking elements.

This document does not cover directional elements integrated into other protection functions, such as distance protection and power protection.

The general requirements for measuring relays and protection equipment are defined in IEC 60255-1. For digitally interfaced directional overcurrent functions via IEC 61850, Annex B contains the associated requirements based on IEC TS 60255-216-1:2025.

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 60255-1, *Measuring relays and protection equipment - Part 1: Common requirements*

IEC 60255-151:2009, *Measuring relays and protection equipment - Part 151: Functional requirements for over/under current protection*

IEC 60255-151, *Measuring relays and protection equipment - Part 151: Functional requirements for over/under current protection*

IEC TS 60255-216-1:2025, *Measuring relays and protection equipment - Part 216-1: Digital Interface - General Requirements and Tests for Protection Functions using digital communication as input and output*

IEC 61850-7-1:2011/AMD1:2020, *Communication networks and systems for power utility automation - Part 7-1: Basic communication structure - Principles and models*

IEC 61850-7-4:2010/AMD1:2020, *Communication networks and systems for power utility automation - Part 7-4: Basic communication structure - Compatible logical node classes and data object classes*

IEC 61850-8-1:2011/AMD1:2020, *Communication networks and systems for power utility automation - Part 8-1: Specific communication service mapping (SCSM) - Mappings to MMS (ISO 9506-1 and ISO 9506-2) and to ISO/IEC 8802-3*

IEC 61850-9-2, *Communication networks and systems for power utility automation - Part 9-2: Specific communication service mapping (SCSM) - Sampled values over ISO/IEC 8802-3*

IEC/IEEE 61850-9-3:2016, *Communication networks and systems for power utility automation - Part 9-3: Precision time protocol profile for power utility automation*

IEC 61869-9:2016, *Instrument transformers - Part 9: Digital interface for instrument transformers*

IEC 61869-9, *Instrument transformers - Part 9: Digital interface for instrument transformers*

IEC 61869-13, *Instrument transformers - Part 13: Stand-alone merging unit (SAMU)*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

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

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

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

3.1.1

directional overcurrent protection

protection designed to operate only for a fault located in one direction from the installation point, and when the current as an energizing quantity exceeds a predetermined value for a given time

3.1.2**characteristic quantity**

electric quantity, or one of its parameters, the name of which characterizes a protection function and the value of which are the subject of accuracy requirement

[SOURCE: IEC 60050-447:2020 [3], 447-07-01, modified — "measuring relay or protection equipment" has been replaced with "protection function", and the original examples have been deleted.]

3.1.3**operating range**

<of a measuring relay or protection equipment> interval for which the measuring relay or protection equipment under specified conditions is able to perform its intended function(s) in accordance with the specified requirements

Note 1 to entry: When accuracy requirements have to be met, see "effective range (3.1.4)".

[SOURCE: IEC 60050-447:2020 [3], 447-03-16]

3.1.4**effective range**

interval of an input energizing quantity or a **characteristic quantity** (3.1.2) within which the accuracy requirements are met

[SOURCE: IEC 60050-447:2020 [3], 447-07-08]

3.1.5**rated value**

value of a quantity used for specification purposes, established for a specified set of operating conditions of a component, device, equipment, or system

[SOURCE: IEC 60050-151:2001 [4], 151-16-08]

3.1.6**operating quantity**

<of directional element> electric quantity, the phase angle of which with respect to the **polarizing quantity** (3.1.7) is recognized by the directional element to determine the fault direction

3.1.7**polarizing quantity**

electric quantity that provides an angular reference to the directional element to determine the fault direction

3.1.8**characteristic angle**

maximum sensitivity angle

φ_{RCA}

angle between the phasor representing **operating quantity** (3.1.6) and the phasor representing **polarizing quantity** (3.1.7) at which the directional element achieves maximum sensitivity

3.1.9**operate value**

<of a protection function> value of the **characteristic quantity** (3.1.2) at which a protection function operates

[SOURCE: IEC 60050-447:2020 [3], 447-02-10, modified — "measuring relay or protection equipment" has been replaced with "protection function", and the original figure has been deleted.]

3.1.10

reset value

value of the [characteristic quantity \(3.1.2\)](#) at which a protection function resets

[SOURCE: IEC 60050-447:2020 [3], 447-02-12, modified — "measuring relay or protection equipment" has been replaced with "protection function", and the original figure has been deleted.]

3.1.11

angular reset hysteresis

absolute value of the angle difference between a [reset value \(3.1.10\)](#) and an [operate value \(3.1.9\)](#) of directional element

3.1.12

zero-sequence current

<of a three-phase system> one of the three symmetrical sequence components which exists only in an unsymmetrical three-phase system of sinusoidal quantities and which is defined by the following complex mathematical expression:

$$\underline{I}_0 = \frac{1}{3}(\underline{I}_{L1} + \underline{I}_{L2} + \underline{I}_{L3})$$

where $\underline{I}_{L1}$, $\underline{I}_{L2}$ and $\underline{I}_{L3}$ are the complex expressions of the phase current phasors

[SOURCE: IEC 60050-448:1995 [5], 448-11-29, modified — "component" has been replaced with "current" in term and its definition.]

3.1.13

zero-sequence voltage

<of a three-phase system> one of the three symmetrical sequence components which exists only in an unsymmetrical three-phase system of sinusoidal quantities and which is defined by the following complex mathematical expression:

$$\underline{U}_0 = \frac{1}{3}(\underline{U}_{L1} + \underline{U}_{L2} + \underline{U}_{L3})$$

where $\underline{U}_{L1}$, $\underline{U}_{L2}$ and $\underline{U}_{L3}$ are the complex expressions of the phase voltage phasors

[SOURCE: IEC 60050-448:1995 [5], 448-11-29, modified — "component" has been replaced with "voltage" in term and its definition.]

3.1.14

neutral current

electric current in the neutral conductor of a polyphase line

[SOURCE: IEC 60050-141:2004 [6], 141-03-05]

3.1.15

neutral overcurrent protection

ground overcurrent protection (US)

overcurrent protection in the earthing connection of the neutral of transformers, reactors or generators

[SOURCE: IEC 60050-448:1995 [5], 448-14-30, modified — "current protection" has been replaced with "overcurrent protection" in term and its definition.]