

BS EN 60255-151:2009



BSI Standards Publication

Measuring relays and protection equipment

Part 151: Functional requirements for over/under current protection

bsi.

...making excellence a habit.
AVA Documents™
Document Sharing Hub

National foreword

This British Standard is the UK implementation of EN 60255-151:2009. It is identical to IEC 60255-151:2009. Together with BS EN 60255-127, it will supersede BS EN 60255-3:1998 which will be withdrawn on the publication of BS EN 60255-127.

The UK participation in its preparation was entrusted to Technical Committee PEL/95, Measuring relays and protection systems.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

© BSI 2010

ISBN 978 0 580 59473 1

ICS 29.120.70

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 August 2010.

Amendments issued since publication

Amd. No.	Date	Text affected
----------	------	---------------

English version

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

Relais de mesure
et dispositifs de protection -
Partie 151: Exigences fonctionnelles
pour les protections à maximum
et minimum de courant
(CEI 60255-151:2009)

Messrelais und Schutzeinrichtungen -
Teil 151: Funktionsanforderungen
für Über-/Unterstromschutz
(IEC 60255-151:2009)

This European Standard was approved by CENELEC on 2009-09-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: Avenue Marnix 17, B - 1000 Brussels

Foreword

The text of document 95/255/FDIS, future edition 1 of IEC 60255-151, prepared by IEC TC 95, Measuring relays and protection equipment, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60255-151 on 2009-09-01.

This European Standard supersedes EN 60255-3:1998 + corrigendum January 1998.

The following dates were fixed:

- latest date by which the EN has to be implemented
at national level by publication of an identical
national standard or by endorsement (dop) 2010-06-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2012-09-01

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60255-151:2009 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60044	NOTE	Harmonized in EN 60044 series (partially modified).
IEC 60255-8	NOTE	Harmonized as EN 60255-8:1998 (modified).
IEC 61850	NOTE	Harmonized in EN 61850 series (not modified).
IEC 61850-7-4	NOTE	Harmonized as EN 61850-7-4:2003 (not modified).

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

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.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60050-447	200X ¹⁾	International Electrotechnical Vocabulary - Part 447: Measuring relays	-	-
IEC 60255-1	- ²⁾	Measuring relays and protection equipment - Part 1: Common requirements	EN 60255-1	200X ³⁾

¹⁾ To be published.

²⁾ Undated reference.

³⁾ To be ratified.

CONTENTS

1	Scope and object.....	6
2	Normative references	6
3	Terms and definitions	6
4	Specification of the function.....	8
4.1	General.....	8
4.2	Input Energizing quantities / energizing quantities	8
4.3	Binary input signals	9
4.4	Functional logic	9
4.4.1	Operating characteristics	9
4.4.2	Reset characteristics	12
4.5	Binary output signals	16
4.5.1	Start (pick-up) signal	16
4.5.2	Operate (trip) signal.....	16
4.5.3	Other binary output signals.....	16
4.6	Additional influencing functions/conditions	16
4.7	Specific characteristics.....	16
5	Performance specification	17
5.1	Accuracy related to the characteristic quantity.....	17
5.2	Accuracy related to the operate time	18
5.3	Accuracy related to the reset time	18
5.4	Transient performance	19
5.4.1	Transient overreach.....	19
5.4.2	Overshoot time	19
5.4.3	Response to time varying value of the characteristic quantity	19
5.5	Current transformer requirements.....	19
6	Functional test methodology	20
6.1	General.....	20
6.2	Determination of steady state errors related to the characteristic quantity	20
6.2.1	Accuracy of setting (start) value	20
6.2.2	Reset ratio determination.....	22
6.3	Determination of steady state errors related to the start and operate time	23
6.4	Determination of steady state errors related to the reset time	23
6.5	Determination of transient performance	24
6.5.1	General	24
6.5.2	Transient overreach.....	24
6.5.3	Overshoot time	25
6.5.4	Response to time varying value of the characteristic quantity for dependent time relays	26
7	Documentation requirements	27
7.1	Type test report.....	27
7.2	Other user documentation	27
Annex A	(normative) Constants for dependent time operating and reset characteristics	29
Annex B	(informative) Reset time determination for relays with trip output only.....	30
Bibliography		31

Figure 1 – Simplified protection function block diagram.....	8
Figure 2 – Overcurrent independent time characteristic	10
Figure 3 – Undercurrent independent time characteristic	10
Figure 4 – Dependent time characteristic	11
Figure 5 – Definite time reset characteristic	13
Figure 6 – Definite time reset characteristic (alternative solution with instantaneous reset after relay operation).....	14
Figure 7 – Dependent time reset characteristic	15
Figure 8 – Dependent time reset characteristic (alternative solution with instantaneous reset after relay operation).....	16
Figure 9 – Voltage restrained characteristics	17
Figure 10 – Voltage controlled characteristics.....	17
Figure 11 – Typical test waveform for transient overreach	25
Figure 12 – Test waveform	26
Figure B.1 – Dependent reset time determination	30
Table 1 – Multiplier factor on operated time assigned error	18
Table 2 – Multiplier factor on reset time assigned error	19
Table 3 – Test points for overcurrent elements	23
Table 4 – Test points for undercurrent elements	23
Table 5 – Test points for overcurrent elements	24
Table 6 – Test points for undercurrent elements	24
Table 7 – Recommended values for the test	26
Table A.1 – Constants for dependent time operating and reset characteristics	29

MEASURING RELAYS AND PROTECTION EQUIPMENT –

Part 151: Functional requirements for over/under current protection

1 Scope and object

This part of IEC 60255 specifies minimum requirements for over/under current relays. This standard includes a specification of the protection function, measurement characteristics and time delay characteristics.

This part of IEC 60255 defines the influencing factors that affect the accuracy under steady state conditions and performance characteristics during dynamic conditions. The test methodologies for verifying performance characteristics and accuracy are also included in this standard.

The over/under current functions covered by this standard are the following:

	IEEE/ANSI C37.2 Function Numbers	IEC 61850-7-4 Logical nodes
Instantaneous phase overcurrent protection	50	PIOC
Time delayed phase overcurrent protection	51	PTOC
Instantaneous earth fault protection	50N/50G	PIOC
Time delayed earth fault protection	51N/51G	PTOC
Negative sequence overcurrent or current unbalance protection	46	PTOC
Phase undercurrent protection	37	PTUC
Voltage-dependent overcurrent protection	51V	PVOC

This standard excludes thermal electrical relays as specified in IEC 60255-8. General requirements for measuring relays and protection equipment are specified in IEC 60255-1.

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 60050-447, *International Electrotechnical Vocabulary – Part 447: Measuring relays*

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

3 Terms and definitions

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

3.1

theoretical curve of time versus characteristic quantity

curve which represents the relationship between the theoretical specified operate time and the characteristic quantity

3.2

curves of maximum and minimum limits of the operate time

curves of the limiting errors on either side of the theoretical time versus characteristic quantity which identify the maximum and minimum operate times corresponding to each value of the characteristic quantity

3.3

setting value (start) of the characteristic quantity

G_S

reference value used for the definition of the theoretical curve of time versus characteristic quantity

3.4

threshold value of the characteristic quantity

G_T

lowest value and highest value for dependent time overcurrent and undercurrent relays, respectively, of the input quantity for which the relay is guaranteed to operate

3.5

start time

duration of the time interval between the instant when the characteristic quantity of the measuring relay in reset condition is changed, under specified conditions, and the instant when the start signal asserts

3.6

operate time

duration of the time interval between the instant when the characteristic quantity of the measuring relay in reset condition is changed, under specified conditions, and the instant when the relay operates

[IEV 447-05-05]

3.7

disengaging time

duration of the time interval between the instant a specified change is made in the value of input energizing quantity which will cause the relay to disengage and instant it disengages

[IEV 447-05-10, modified]

3.8

reset time

duration of the time interval between the instant when the characteristic quantity of the measuring relay in operate condition is changed, under specified conditions, and the instant when the relay resets

[IEV 447-05-06]

3.9

overshoot time

difference between the operate time of the relay at the specified value of the input energizing quantity and the maximum duration of the value of input energizing quantity which, when suddenly reduced (for the overcurrent relay)/increased (for the undercurrent relay) to a specified value below (for the overcurrent relay)/above (for the undercurrent relay) the setting value is insufficient to cause operation

3.10

time multiplier setting

TMS

setting which describes an adjustable factor that may be provided by a relay manufacturer which is applicable to the theoretical curve of time versus characteristic quantity

NOTE Its purpose is to allow adjustment of the relay operating times. This adjustable *TMS* factor is usually expressed in “per unit”. The preferred reference setting of *TMS* for declaration of relay characteristic is 1,0.

3.11

threshold of independent time operation

G_D

value of the characteristic quantity at which the relay operate time changes from dependent time operation to independent time operation

3.12

reset ratio

disengaging ratio

ratio between the point where the relay just ceases to start (start signal changes from ON to OFF) and the actual start current of the element

NOTE It is usually defined as a percentage such that for an overcurrent element the reset ratio is less than 100 % and for an undercurrent element the reset ratio is greater than 100 %.

3.13

transient overreach

measure of the effect of the d.c. component of a waveform on the start signal of the functional element. Generally this d.c. component will result in the relay reaching further than the setting should permit, or specifically in the terms of an overcurrent relay, starting at a value of a.c. current below the set threshold

4 Specification of the function

4.1 General

The protection function with its inputs, outputs, measuring element, time delay characteristics and functional logic is shown in Figure 1. The manufacturer shall provide the functional block diagram of the specific implementation.

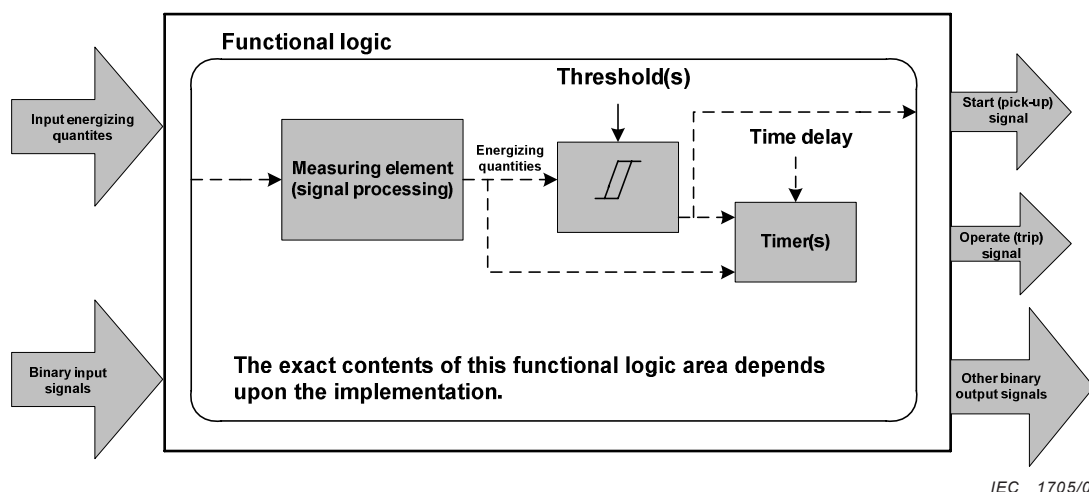


Figure 1 – Simplified protection function block diagram

4.2 Input Energizing quantities / energizing quantities

The input energizing quantities are the measuring signals, e.g. currents and voltages (if required). Their ratings and relevant standards are specified in IEC 60255-1. Input energizing quantities can come with wires from current and voltage transformers or as a data packet over a communication port using an appropriate communication protocol (such as IEC 61850-9-2).

The energizing quantities used by the protection function need not be directly the current at the secondary side of the current transformers. Therefore, the measuring relay documentation shall state the type of energizing quantities used by the protection function. Examples are:

- single phase current measurement;
- three phase current measurement;
- neutral current or residual current measurement;
- positive, negative or zero sequence current measurement.

The type of measurement of the energizing quantity shall be stated. Examples are:

- RMS value of the signal;
- RMS value of the fundamental component of the signal;
- RMS value of a specific harmonic component of the signal;
- peak values of the signal;
- instantaneous value of the signal.

4.3 Binary input signals

If any binary input signals (externally or internally driven) are used, their influence on the protection function shall be clearly described on the functional logic diagram. Additional textual description may also be provided if this can further clarify the functionality of the input signals and their intended usage.

4.4 Functional logic

4.4.1 Operating characteristics

4.4.1.1 General

The relationship between operate time and characteristic quantity can be expressed by means of a characteristic curve. The shape of this curve shall be declared by the manufacturer by an equation (preferred) or by graphical means.

This standard specifies two types of characteristics:

- independent time characteristic (i.e. definite time delay);
- dependent time characteristic (i.e. inverse time delay).

The time characteristic defines the operate time which is the duration between the instant when the input energizing quantity crosses the setting value (G_S) and the instant when the relay operates.

4.4.1.2 Independent time characteristic

Independent time characteristic is defined in terms of the setting value of the characteristic quantity G_S and the operate time t_{op} . When no intentional time delay is used, then the independent time relay is denoted as an instantaneous relay.

For overcurrent relays, $t(G) = t_{op}$ when $G > G_S$. The independent time characteristic is presented in Figure 2.