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Measuring relays and protection equipment - Part 149: Functional requirements for thermal electrical relays

/

Relais de mesure et dispositifs de protection - Partie 149: Exigences fonctionnelles pour les relais électriques thermiques

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29.120.70 Releji Relays

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

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English version

Measuring relays and protection equipment - Part 149: Functional requirements for thermal electrical relays

(IEC 60255-149:2013)

Relais de mesure et dispositifs de protection -
Partie 149: Exigences fonctionnelles pour les relais électriques thermiques
(CEI 60255-149:2013)

Messrelais und Schutzeinrichtungen -
Teil 149: Funktionsanforderungen an den thermischen Überlastschutz
(IEC 60255-149:2013)

This European Standard was approved by CENELEC on 2013-09-03. 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 CEN-CENELEC Management Centre 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 CEN-CENELEC Management Centre has the same status as the official versions.

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CENELEC

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

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Ref. No. EN 60255-149:2013 E

Foreword

The text of document 95/313/FDIS, future edition 1 of IEC 60255-149, prepared by IEC/TC 95 "Measuring relays and protection equipment" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 60255-149:2013.

The following dates are fixed:

• latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2014-06-03
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2016-09-03

This document supersedes EN 60255-8:1998.

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Endorsement notice

The text of the International Standard IEC 60255-149:2013 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 60034-11	NOTE	Harmonized as EN 60034-11.
IEC 60947-4-1	NOTE	Harmonized as EN 60947-4-1.
IEC 60947-4-2	NOTE	Harmonized as EN 60947-4-2.
IEC 61850-9-2	NOTE	Harmonized as EN 61850-9-2.

Annex ZA
(normative)
Normative references to international publications with their corresponding European publications

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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.

Publication	Year	Title	EN/HD	Year
IEC 60050	Series	International Electrotechnical Vocabulary (IEV)	-	-
IEC 60085	2007	Electrical insulation - Thermal evaluation and designation	EN 60085	2008
IEC 60255-1	-	Measuring relays and protection equipment - Part 1: Common requirements	EN 60255-1	-
IEC 61850-7-4	-	Communication networks and systems for power utility automation - Part 7-4: Basic communication structure - Compatible logical node classes and data object classes	EN 61850-7-4	-

IEC 60255-149

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Measuring relays and protection equipment –
Part 149: Functional requirements for thermal electrical relays

Relais de mesure et dispositifs de protection –
Partie 149: Exigences fonctionnelles pour relais électriques thermiques

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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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.
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International Standard IEC 60255-149 has been prepared by IEC technical committee 95: Measuring relays and protection equipment.

This first edition cancels and replaces IEC 60255-8, published in 1990.

The text of this standard is based on the following documents:

FDIS	Report on voting
95/313/FDIS	95/317/RVD

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

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

A list of all parts of IEC 60255 series, under the general title *Measuring relays and protection equipment,* can be found on the IEC website.

Future standards in this series will carry the new general title as cited above. Titles of existing standards in this series will be updated at the time of the next edition.

The committee has decided that the contents of this publication will remain unchanged until the stability 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.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

MEASURING RELAYS AND PROTECTION EQUIPMENT –

Part 149: Functional requirements for thermal electrical relays

1 Scope

This part of the IEC 60255 series specifies minimum requirements for thermal protection relays. This standard includes specification of the protection function, measurement characteristics and test methodologies.

The object of this standard is to establish a common and reproducible reference for evaluating dependent time relays which protect equipment from thermal damage by measuring a.c. current flowing through the equipment. Complementary input energizing quantities such as ambient, coolant, top oil and winding temperature may be applicable for the thermal protection specification set forth in this standard. This standard covers protection relays based on a thermal model with memory function.

The test methodologies for verifying performance characteristics of the thermal protection function and accuracy are also included in this Standard.

This standard does not intend to cover the thermal overload protection trip classes indicated in IEC 60947-4-1 and IEC 60947-4-2, related to electromechanical and electronic protection devices for low voltage motor-starters.

The thermal protection functions covered by this standard are as follows:

Protection function	IEC 61850-7-4	IEEE C37.2
Thermal overload protection	**PTTR**	49
Rotor thermal overload protection	**PROL**	49R
Stator thermal overload protection	**PSOL**	49S

General requirements for measuring relays and protection equipment are specified in IEC 60255-1.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050 (all parts), *International Electrotechnical Vocabulary* (available at *http://www.electropedia.org*)

IEC 60085, *Electrical insulation – Thermal evaluation and designation*

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

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

3 Terms and definitions

For the purpose of this document, the terms and definitions given in IEC 60050-447, as well as the following apply.

3.1
hot curve
for a thermal electrical relay with a total memory function, characteristic curve representing the relationship between specified operating time and current, taking into account thermal effect of a specified steady-state load current before the overload occurs

Note 1 to entry: Hot curve is a plot of a particular time-current solution for a first-order thermal system differential equation, assuming a specific constant overload current and a specific preload current.

3.2
cold curve
for a thermal electrical relay, characteristic curve representing the relationship between specified operating time and current, with the relay at reference and steady-state conditions with no-load current flowing before the overload occurs

Note 1 to entry: Cold curve is a plot of a particular time-current solution for a first-order thermal system differential equation, assuming a specific constant overload current when there is no preload.

3.3
basic current
I_B
specified limiting (nominal) value of the current for which the relay is required not to operate at steady-state conditions of the equipment to be thermally protected

Note 1 to entry: The basic current serves as a reference for the definition of the operational characteristics of thermal electrical relays. The basic settings of a thermal electrical protection function are made in terms of this basic current (I_B) and the thermal time constant (τ) of the protected equipment.

3.4
equivalent heating current
I_{eq}
current which takes into account the additional heating sources such as imbalance currents and/or harmonics

3.5
factor *k*
factor by which the basic current (I_B) is multiplied to obtain the maximum permissible continuous operating current value of the equipment to be thermally protected, which is used in the thermal characteristic function

Note 1 to entry: The factor *k* indicates the maximum permissible constant between phase current (full load) and the basic (nominal) current of the protected equipment.

3.6
previous load ratio
ratio of the load current preceding the overload to basic current under specified conditions

3.7
reference limiting error
limiting error determined under reference conditions

[SOURCE: IEC 60050:2010, 447-08-07]

3.8
temperature rise
difference between the temperature of the part under consideration and a reference temperature

Note 1 to entry: The reference temperature may be for example the ambient air temperature or the temperature of a cooling fluid.

[SOURCE: IEC 60050:2001, 151-16-26]

3.9
thermal equilibrium
thermal state reached when the temperature rise of the several parts of the machine do not vary by more than a gradient of 2 K per hour

[SOURCE: IEC 60050:1996, 411-51-08]

3.10
thermal time constant
T_{th}
time required for the temperature rise of the protected equipment relative to its initial temperature, to reach 63,2 % of its final, asymptotic value following a step increase in current

Note 1 to entry: The initial temperature for example can be ambient temperature.

3.11
thermal level
H
ratio expressed in percentage between the estimated actual temperature of the equipment and the temperature of the equipment when the equipment is operating at its maximum current ($k \times I_B$) for a long period, enough to allow equipment to reach its thermal equilibrium

4 Specification of the function

4.1 General

An example of a thermal protection function with its input energizing quantities, binary input signals, operate (trip), alarm and other binary outputs, and functional logic which includes measuring element, thermal level calculation, settings, and thresholds are shown in Figure 1. The manufacturer shall provide the functional block diagram of the specific thermal protection implementation.

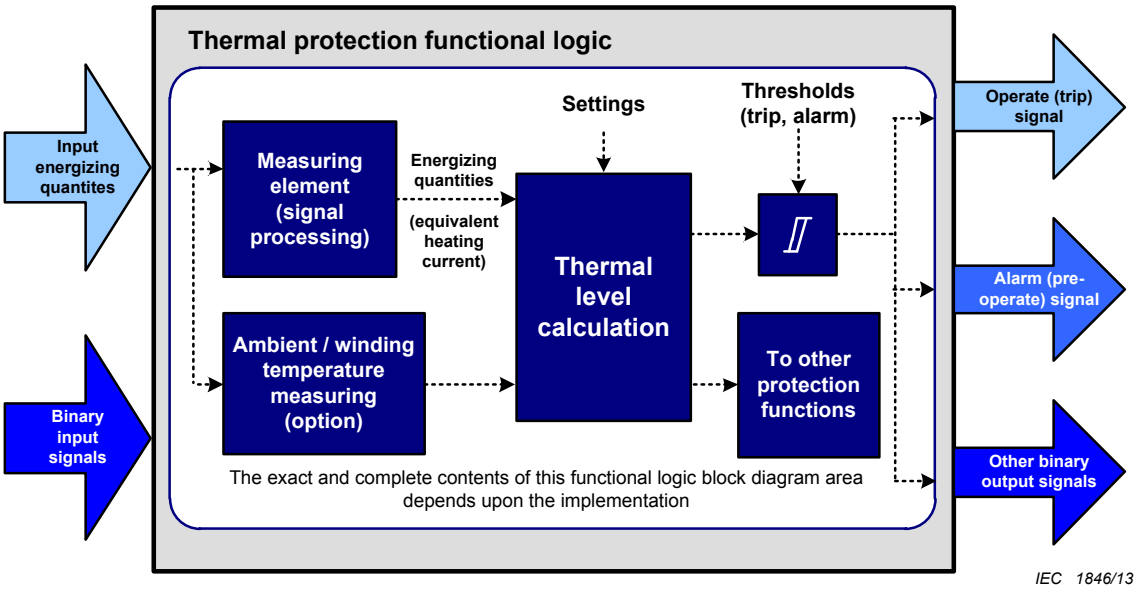

Figure 1 – Simplified thermal protection function block diagram

4.2 Input energizing quantities/energizing quantities

The input energizing quantities are the measuring signals, such as phase (or line) currents, and ambient/environmental or winding temperatures (if required or applicable). Their ratings and relevant requirements are specified in IEC 60255-1.

Input energizing quantities can be presented to the thermal protection functional logic either hardwired from current transformers and any additional input quantities such as ambient or winding temperature, or as a data packet over a communication ports using an appropriate data communication protocol, such as IEC 61850-9-2.

The input energizing quantities used by the thermal protection function need not be the current directly taken from the secondary side of the current transformers. Therefore the protection relay documentation shall state the type of energizing quantities used by the thermal protection function.

Examples of input energizing quantities are:

– single-phase current measurement;
– three-phase current measurement;
– positive and negative sequence current measurement;
– winding or ambient temperature sensor.

NOTE The ambient temperature, coolant temperature, top oil temperature or winding temperature of the equipment to be thermally protected can be measured by temperature sensors, such as resistance temperature detector (RTD), the values of which can be used for biasing the calculation of the thermal level replica specified in this standard. Output signals or values of these temperature sensors can be taken into account for the first-order thermal model algorithm, which can influence and compensate the calculated thermal level (based on the equivalent heating current and heating thermal time constant values).

4.3 Binary input signals

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