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SIST R064-003:2000

Določanje prereza vodnikov in izbira zaščitnih naprav

Determination of cross-sectional area of conductors and selection of protective devices

Festlegung von Leiterquerschnitten und Auswahl von Schutzeinrichtungen

Détermination des sections des conducteurs et choix des dispositifs de protection

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TECHNICAL REPORT

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Détermination des sections des conducteurs et choix des dispositifs de protection

Festlegung von Leiterquerschnitten und Auswahl von Schutzeinrichtungen

This Technical Report was approved by CENELEC on 2011-01-02.

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CENELEC

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

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Foreword

This Technical Report was prepared by CENELEC Technical Committee 64, Electrical installations and protection against electric shock.

The text of the draft was circulated for voting in accordance with the Internal Regulations, Part 2, Subclause 11.4.3.3 (simple majority) and was approved by CENELEC as CLC/TR 50480 on 2011-01-13.

This Technical Report supersedes R064-003:1998.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN and CENELEC shall not be held responsible for identifying any or all such patent rights.

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Introduction

The harmonised rules for the erection of electrical low voltage installations, HD 384/HD 60364, require selection, dimensioning and calculation for the components of an electrical installation.

In complex installations long and detailed calculations may be needed. The rules of HD 384/HD 60364 give the basic principles without the details necessary for an accurate application.

Computers with appropriate software enable the applicable rules for the determination of conductor cross-section area and selection of protective devices to be applied readily.

It is important that the results of such software programs are in accordance with the harmonised rules.

Therefore this Technical Report defines the different reference parameters necessary for the calculation of the cross-sectional area of the conductors and for the selection of the protective devices. It also gives the reference methods for calculation according to the different safety rules defined in the Harmonisation Documents of the series HD 384/HD 60364.

1 Scope

This Technical Report applies to low-voltage installations with a nominal system frequency of 50 Hz in which the circuits consist of insulated conductors, cables or busbar trunking systems.

It defines the different parameters used for the calculation of the characteristics of electrical wiring systems in order to comply with rules of HD 384/HD 60364.

These rules are mainly the following:

- current-carrying capacities of the conductors;
- characteristics of protective devices in regard to protection against overcurrent;
- verification of thermal stress in conductors due to short-circuit current or earth fault current;
- fault protection (protection against indirect contact) in TN systems and IT systems;
- limitation of voltage drop;
- verification of mechanical stresses during short-circuit in busbar trunking systems (BTS) according to EN 60439-2 or powertrack systems according to EN 61534 series.

The calculations provided in this Technical Report are only applicable where the characteristics of the circuits are known.

For the purpose of this document, when referring to Busbar Trunking Systems, Powertrack Systems are also considered.

NOTE 1 Mechanical stress during short-circuit is covered by IEC 60865.

NOTE 2 In general these calculations concern supply by HV/LV transformer, but they are also applicable to supply by LV/LV transformer and LV back-up generators.

NOTE 3 Effects of harmonics currents are not covered by this document.

This Technical Report is also applicable for checking the compliance of the results of calculations performed by software programs for calculation of cross-sectional area of insulated conductors, cross-sectional area of cables and characteristics for selection of busbar trunking systems with HD 384/HD 60364.

2 Reference documents

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.

EN 60076 series		Power transformers (IEC 60076 series)
EN 60228		Conductors of insulated cables (IEC 60228)
EN 60269 series		Low voltage fuses (IEC 60269 series)
EN 60269-1		Low-voltage fuses - Part 1: General requirements (IEC 60269-1)
HD 60269-2		Low-voltage fuses - Part 2: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application) - Examples of standardized systems of fuses A to J (IEC 60269-2)
HD 60269-3		Low-voltage fuses - Part 3: Supplementary requirements for fuses for use by unskilled persons (fuses mainly for household or similar applications) - Examples of standardized systems of fuses A to F (IEC 60269-3)
EN 60439-1	1999	Low-voltage switchgear and controlgear assemblies - Part 1: Type-tested and partially type-tested assemblies (IEC 60439-1:1999)
EN 60439-2	2000	Low-voltage switchgear and controlgear assemblies - Part 2: Particular requirements for busbar trunking systems (busways) (IEC 60439-2:2000)
EN 60898 series		Electrical accessories - Circuit-breakers for overcurrent protection for household and similar installations (IEC 60898 series)
EN 60947-2		Low-voltage switchgear and controlgear - Part 2: Circuit-breakers (IEC 60947-2)
EN 61439-1	2009	Low-voltage switchgear and controlgear assemblies - Part 1: General rules (IEC 61439-1:2009, mod.)
EN 61534 series		Powertrack systems (IEC 61534 series)
HD 384/HD 60364 series		Low-voltage electrical installations (IEC 60364 series)
HD 60364-4-41	2007	Low-voltage electrical installations - Part 4-41: Protection for safety - Protection against electric shock (IEC 60364-4-41:2005, mod.)
HD 60364-4-43	2010	Low-voltage electrical installations - Part 4-43: Protection for safety - Protection against overcurrent (IEC 60364-4-43:2008, mod. + corrigendum October 2008)
HD 60364-5-52,	2010	Low-voltage electrical installations - Part 5-52: Selection and erection of electrical equipment - Wiring systems (IEC 60364-5-52:2009, mod.)
HD 384-5-54		Electrical installation of buildings - Part 5: Selection and erection of electrical equipment - Chapter 54: Earthing arrangements and protective conductors (IEC 60364-5-54)
IEC 60909 series		Short-circuit currents in three-phase a.c. systems (IEC 60909 series)

3 Symbols

In this Technical Report, the following symbols are used:

I_2 *Current ensuring effective operation in conventional time of the protective device and generally given in the product standard, [A]*

I_B *Design current of the circuit being considered, [A](IEV 826-11-10)*

I_{ef} *Earth fault current, [kA]*

I_n *Nominal current of the protective device (fuse rating or breaker setting), [A]*

I_{nc} *Rated current of busbar trunking system, at an ambient temperature of 30 °C,[A]*

I_p *Maximum peak value of highest short-circuit current,[kA]*

I''_{kQ} *Initial symmetrical short-circuit current at the feeder connection point Q [kA]*

I_{k1} *Steady state short-circuit current for a line-to-neutral short circuit [kA]*

I_{k2} *Steady state short-circuit current for a line-to-line short circuit [kA]*

I_{k3} *Steady state short-circuit current for a three line short circuit [kA]*

NOTE 1 In some cases the I_{k1} can be higher than the I_{k3} (e.g. at the terminals of the delta-star transformer).

I_Z *Continuous current-carrying capacity of cable, insulated conductors or busbar trunking system as applied in a circuit [A]*

$(I_0^2 \cdot t_0)$ *Thermal stress capacity of line, neutral or PE (PEN) conductor given in general for one second, [A².s], (IEV 447-07-17)*

$(I_{cw}^2 \cdot t_{cw})$ *Thermal stress capacity of line, neutral or PE (PEN) conductor given in general for one second for busbar trunking systems, [A².s], (EN 60439-2, 4.3)*

l_1 *Route length (insulated conductors and cables), [m],* *subscript u: upstream* *subscript d: downstream*

l_2 *Length of BTS (Busbar Trunking System), [m]* *subscript u: upstream* *subscript d: downstream*

R_C *Resistance of the conductor between the transformer and the main switchboard [mΩ]*

$R_{c1\ ph}$ *Resistance of line conductor per metre, consisting of insulated conductor or cable, at steady-state operating temperature, [mΩ/m]*

$R_{c1\ N}$ *Resistance of neutral conductor per metre, consisting of insulated conductor or cable, at steady-state operating temperature, [mΩ/m]*

$R_{c1\ PE}$ *Resistance of protective earthing conductor per metre, consisting of insulated conductor or cable, at steady-state operating temperature, [mΩ/m]*

R_N *Resistance of the neutral conductor upstream of the circuit being considered,* $R_N = \sum R_{neutral}$ *, [mΩ]*

R_{PE} *Resistance of the protective conductor from the main equipotential bonding to the origin of the circuit being considered,*

$$R_{PE} = \sum R_{protective\ conductor} \text{ , [m}\Omega\text{]}$$

R_{PEN} *Resistance of the PEN conductor from the main equipotential bonding to the origin of the circuit being considered,*

$$R_{PEN} = \sum R_{PEN\ conductor} \text{ , [m}\Omega\text{]}$$

R_Q *Resistance of the HV network, [mΩ]*

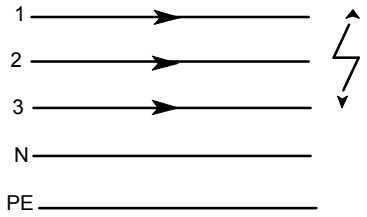
R_{SUP} *Resistance of the LV upstream network, [mΩ]*

R_T *Resistance of the transformer, [mΩ]*

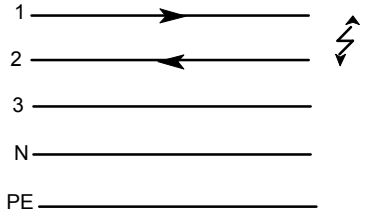
$R_{b0\ ph}$ *Mean ohmic resistance of BTS (BusbarTrunking System) per meter, per line, at 20 °C, [mΩ / m]*

$R_{b1\ ph}$ *Mean ohmic resistance of BTS per meter, per line, at rated current I_{nc}, at the steady-state operating temperature, [mΩ / m]*

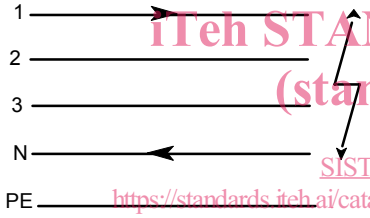
Symbols used for resistances in the context of short-circuits in busbar trunking systems



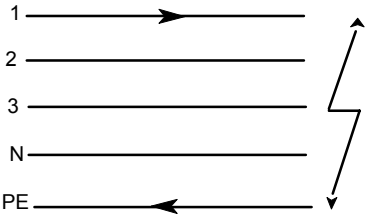
R_{bxph} Three-line short-circuit



$R_{bxph\ ph}$ Line to line short-circuit between L1 and L2, note may be between any two lines



R_{bxph-N} Line to neutral short-circuit between L1 and N



$R_{bxph-PE}$ fault between L1 and PE

NOTE 2 The value of x depends on the circuit configuration and on the type of protective device, see Table 5.

NOTE 3 For busbar trunking systems the subscript ph is used in order to align with the symbols used in EN 60439-2.

R_{b0} *Resistive term of mean line-line, line-neutral or line-PE (-PEN) BTS loop impedance per metre, at 20 °C, [mΩ / m]*

R_{b1} *Resistive term of mean line-line, line-neutral or line-PE (-PEN) BTS loop impedance per metre, at rated current I_{nc}, at the steady-state operating temperature, [mΩ / m]*

R_{b2} *Resistive term of mean line-line, line-neutral or line-PE (-PEN) BTS loop impedance per metre, at the mean temperature between the operating temperature at rated current Inc, and the maximum temperature under short-circuit conditions, [mΩ / m]*

R_{SUP} *Resistance from the LV side of the upstream network (LV + MV) upstream the main switchboard, [mΩ]*