IEC 61800-5-1

Edition 2.0 2016-08

INTERNATIONAL STANDARD

NORME INTERNATIONALE

AMENDMENT 1
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Adjustable speed electrical power drive systems – Part 5-1: Safety requirements – Electrical, thermal and energy

Entraînements électriques de puissance à vitesse variable – Partie 5-1: Exigences de sécurité – Électrique, thermique et énergétique

IEC 61800-5-1:2007-07/AMD1:2016-08(en-fr)

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Partie 5-1: Exigences de sécurité – Electrique, thermique et énergétique

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 29.130

ISBN 978-2-8322-3611-6

FOREWORD

This amendment has been prepared by subcommittee SC 22G: Adjustable speed electric drive systems incorporating semiconductor power converters, of IEC technical committee 22: Power electronic systems and equipment.

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

FDIS	Report on voting
22G/338/FDIS	22G/342/RVD

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

The committee has decided that the contents of this amendment and the base 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- withdrawn,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.

2 Normative references

Add the following normative references:

IEC 60947-4-1:2009, *Low-voltage switchgear and controlgear – Part 4-1: Contactors and motor-starters – Electromechanical contactors and motor-starters*
IEC 60947-4-1:2009/AMD1:2012

IEC 60364-4-41:2005, *Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock*
IEC 60364-4-41:2005/AMD1:—[1]

3 Terms and definitions

Add the following new terms and definitions:

3.45
electronic motor overload protection
PDS/CDM/BDM circuitry which protects a motor during overload conditions by reducing current to the motor

[1] Under preparation. Stage at the time of publication: IEC DEC 60364-4-41:2016.

Note 1 to entry: The protection circuitry is usually a combination of hardware and software.

Note 2 to entry: This protection is typically achieved through an algorithm based on the I^2t of the current to the motor.

3.46
electronic power output short-circuit protection circuitry
circuitry integral to *PDS/CDM/BDM* that acts to significantly reduce current flow to the power output upon sensing a short-circuit condition

Note 1 to entry: The protection circuitry is usually a combination of hardware and software.

3.47
thermal memory
ability of an overload protective system to approximate the heating and cooling of a protected motor during operation

3.48
thermal memory retention
ability to retain a representation of the thermal state of a motor prior to shutdown or loss of power

Note 1 to entry: Typically, this information will be used by the overload protective system to approximate the thermal state of the motor upon restart.

Note 2 to entry: This may include an ongoing reduction of the thermal representation to reflect cooling of the motor during shutdown or loss of power.

3.49
trip
controlled rapid reduction or elimination of the transfer of energy to any device or process initiated by a detected fault or abnormal operating condition

4.3.6.1.4 Supply earthing systems

Add, at the end of the first bullet point, the following new sentence:

A corner-earthed system is a TN system with one phase earthed.

Add, at the end of the second bullet point, the following new sentence:

A corner-earthed system is a TT system with one phase earthed.

Add, after the third bullet point, the following new paragraph:

In a PDS designed for operation on a corner-earthed system, the

- insulation between phases of the mains supply, including the earthed phase, may be designed for *functional insulation* according to clause 4.3.6.3, and
- circuits within the *PDS/CDM/BDM* directly connected to any phase of a corner-earthed system shall be separated from earthed parts by at least *basic insulation*.

Table 7 — Insulation voltage for low voltage circuits

Replace, at the bottom of Table 7, Note 1 by the following new paragraph;

Interpolation of *system voltage* is not permitted when determing the impulse voltage for mains supply. Interpolation of *system voltage* is permitted when determining the *temporary overvoltage* for mains supply.

Replace, at the bottom of Table 7, the indication "NOTE 2" *by* "NOTE".

Add, at the bottom of Table 7, after the note, the following indication:

SOURCE: IEC 62477-1:2012, Table 9

4.3.6.4.1 Determination

Replace, in the fourth paragraph, the first bullet point by the following new bullet point:

- for *low-voltage PDS*, the value corresponding to the next higher impulse voltage, or 1,6 times the *temporary overvoltage*, or 1,6 times the *working voltage* shall be used (see IEC 60664-1:2007, 5.1.6 and IEC 62477-1: 2012, 4.4.7.4.1);

4.3.6.8.3.1 General

Add, after the first paragraph, the following new paragraph:

4.3.6.8.3 also applies to components providing insulation. See 4.3.6.8.1 for the use of component standards.

4.3.9 Output short-circuit requirements

Add, after the first *paragraph, the following new paragraphs:*

The short-circuit evaluation of each power output of the *CDM/BDM* shall include short-circuits of both

- phase to phase, and
- each phase to earth.

If the *CDM/BDM* provides galvanic isolation between all power ports and a power output, then evaluation of phase to earth short-circuits for that specific power output, and any additional power outputs with galvanic isolation is not necessary.

Compliance with the requirement of IEC 60364-4-41:2005/AMD1:—[2], Clause 411 and Annex D is shown by

- testing according to 5.2.3.6.5, or
- supplementary protective equipotential bonding in accordance with IEC 60364-4-41:2005/AMD1:—, 415.2.

The *electronic power short-circuit protection circuitry* relied on to demonstrate compliance with the short-circuit test in 5.2.3.6.3 shall also comply with the requirement of 5.2.9.

NOTE IEC 60364-4-41:2005/AMD1:—, 411.3.2, provides more information about protection against indirect contact in case of a short-circuit between hazardous *live parts* and protective earth.

Consideration shall be given to compliance with different type of system earthing (e.g. TN, TT, IT or corner- earthed) as the short-circuit current to protective earth depends on the type of system earthing.

NOTE Especially, the short-circuit fault current to earth is expected to be lower or equal to the rated output current of the power output depending on system earthing.

For information requirements, see 6.3.7.

[2] Under preparation. Stage at the time of publication: IEC DEC 60364-4-41:2016.

4.4.5.2.7 Insulation requirements for coolant hoses

Add, after 4.4.5.2.7, the following new subclause:

4.4.6 Motor overload and overtemperature protection

4.4.6.1 Means of protection

A motor of a *PDS* shall be protected against overtemperature. Depending on the application of the motor, one or more of the following means of protection for each motor driven shall be selected by the *PDS* manufacturer:

a) thermal or electronic overload relay that complies with the applicable requirements in IEC 60947-4-1;

b) a *CDM/BDM* with *electronic motor overload protection* according to 4.4.6.2, which might include

   i) *thermal memory retention* according to 4.4.6.3, and/or

   ii) speed sensitivity according to 4.4.6.4.

c) a *CDM/BDM* with monitoring and automatic reduction of motor current based upon a signal from a thermal sensor mounted in or on the motor according to 4.4.6.5;

d) an embedded motor thermal protection which disconnects the motor;

e) information in accordance with 6.3.8.1.

NOTE 1 a) and d) are the only possible motor overload protections in the case that several motors in parallel are supplied from the same *CDM/BDM* motor power output.

For information requirements, see 6.3.8.

NOTE 2 In the United States, compliance with NFPA 70 overload protection according to NFPA 70:2014, 430.32 are achieved by a), b), c), or d); compliance with NFPA 70 overtemperature according to NFPA 70:2014, 430.126 is achieved by b) i) and ii), c), or d) .

4.4.6.2 *CDM/BDM* with *electronic motor overload protection*

Electronic motor overload protection shall comply with 5.2.8.1 to 5.2.8.4 and is subjected to the requirements in 5.2.9.

Adjustable *electronic motor overload protection* shall not be adjustable in such a way that the limits of Table 29 are exceeded.

a) For *PDS* where motor and *CDM/BDM* are known, limits other than those in Table 29 can be specified and tested in accordance with 5.2.8.1 to 5.2.8.4.

b) For information requirements, see 6.3.8.2.

4.4.6.3 *CDM/BDM* with *electronic motor overload protection* with *thermal memory retention*

Electronic motor overload protection with *thermal memory retention* shall comply with 5.2.8.1 to 5.2.8.6 and is subjected to the requirements in 5.2.9.

4.4.6.4 *CDM/BDM* with *electronic motor overload protection* which is speed sensitive

Electronic motor overload protection that is speed sensitive shall comply with 5.2.8.1 to 5.2.8.7 and is subjected to the requirements in 5.2.9.

4.4.6.5 *CDM/BDM* providing monitoring and automatic reduction of motor current by means of thermal sensors

CDM/BDM intended to be used with motors that have thermal protection or thermal sensor in or on the motors requiring signal interface shall be provided with means to connect to that protection.

Insulation requirements for the connection of the thermal protector or thermal sensor shall be taken into account.

5.1.6 Test overview

*Add, in Table 17, under "*abnormal operation tests*", the following new test:*

Electronic motor overload protection test	X			5.2.8	4.4.6.2, 4.4.6.3, 4.4.6.4
Circuit functionality evaluation		X	X	5.2.9	4.3.9, 4.4.6.2

5.2.3.6.3.2 Location of short-circuit

Replace 5.2.3.6.3.2 by the following new subclause:

5.2.3.6.3.2 Short-circuit between phase terminals of power outputs

Power outputs shall be provided with conductors of a cross-section and material appropriate to the rated current available at the power output. The length of the loop (forth and back) shall be approximately 2 m, unless the size of the *PDS* requires a greater length, in which case the length shall be as short as practical to perform the test.

All phase terminals of each power output tested shall be simultaneously connected together, using an appropriate switching device.

NOTE Terminals connected to the d.c. link are, for the tests of 5.2.3.6.3.2 and 5.2.3.6.3.3, treated as phases.

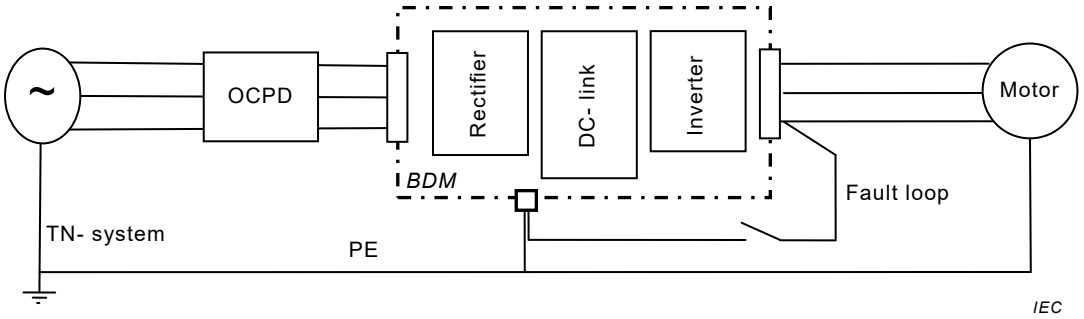
Add, after 5.2.3.6.3.2, the following new subclause:

5.2.3.6.3.3 Short-circuit between phase terminals of power output and protective earth

The phase to protective earth fault condition shall be evaluated for each phase, one at a time, as a protective earth short-circuit.

It is permitted to operate only one test per output if a symmetry per phase can be demonstrated and if the selected phase to be tested represents the most severe case.

See Figures 11, 12 and 13 for examples.



Key

OCPD Over current protective device

Figure 11 – Example of short-circuit test between *CDM/BDM* motor power output and protective earth (motor separately earthed)

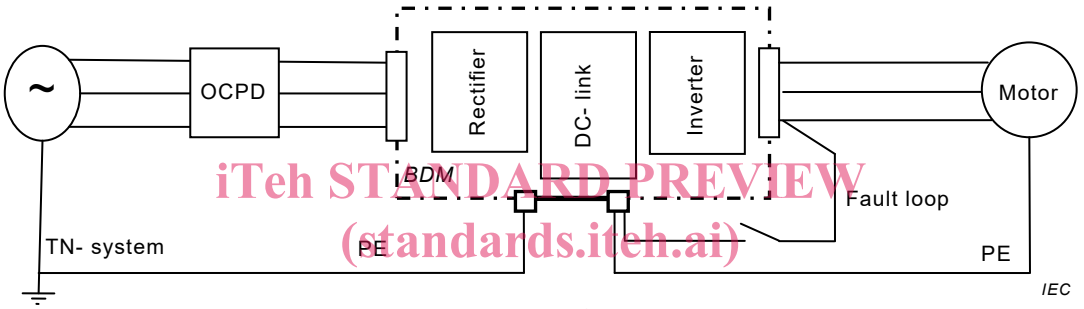


Figure 12 – Example of short-circuit test between *CDM/BDM* motor power output and protective earth (motor earthed through *CDM/BDM*)

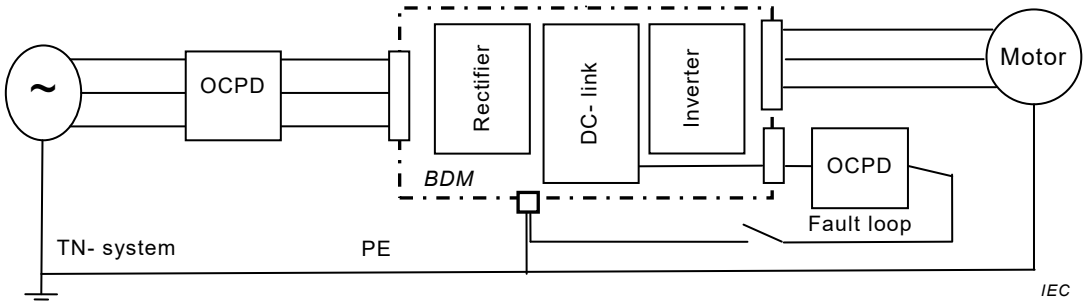


Figure 13 – Example of short-circuit test between *CDM/BDM* d.c. link power output and protective earth

5.2.3.6.5 Test sequence

Replace the second paragraph by the following paragraph:

For the short-circuit test of 5.2.3.6.3.2 and breakdown of components test of 5.2.3.6.4, the *PDS* shall be operated until one or more of the following ultimate results are obtained:

a) the operation of *electronic power output short-circuit protection circuitry*;

b) the opening of a short-circuit protection device; or

c) a steady state temperature is attained after a minimum of 10 min.

Add, after the second paragraph, the following new paragraph:

For the short-circuit test of 5.2.3.6.3.3, the *PDS* shall be operated until one or more of the following ultimate results are obtained:

i) an *electronic power output short-circuit protection circuitry* that reduces the fault current to a value that ensures the voltage with respect to earth at the output phase under test is reduced to 50 V a.c. or 120 V d.c. or less. The voltage reduction shall be accomplished within 40 ms or in a time as given in IEC 60364-4-41:2005/AMD1:—, 411.3.2.2, 411.3.2.3 or 411.3.2.4, as applicable; or

ii) a disconnection is achieved by a short circuit protective device specified by the manufacturer within the time specified in IEC 60364-4-41:2005/AMD1:—, 411.3.2.

For pass criteria, also refer to 5.2.3.6.6.

5.2.7 Hydrostatic pressure (*type test* and *routine test*)

Add, after 5.2.7, the following new subclauses:

5.2.8 *Electronic motor overload protection* test (*type test*)

5.2.8.1 General requirements

This test shall demonstrate on one sample of a representative model that the *electronic motor overload protection* operates within the specified limits.

PDS/CDM/BDM series that incorporate *electronic motor overload protection* shall comply with test in 5.2.8.4.

PDS/CDM/BDM series that incorporate *electronic motor overload protection* that has *thermal memory retention* shall have one sample of the representative model used complying with the tests in 5.2.8.4, 5.2.8.5 and 5.2.8.6.

PDS/CDM/BDM series that incorporate *electronic motor overload protection* that is speed sensitive shall have one sample of the representative model used complying with the tests in 5.2.8.4 and 5.2.8.7.

5.2.8.2 Test set-up

Before all operation tests, the test sample shall be mounted, connected, and operated as described in the temperature rise test and then subjected to the overload condition.

The motor may be simulated by an electronic load or a reactor.

5.2.8.3 Pass criteria

The *PDS/CDM/BDM* is required to be operational after testing and shall comply with each requirement of the tests in 5.2.8.4, 5.2.8.5, 5.2.8.6 and 5.2.8.7.

5.2.8.4 *CDM/BDM electronic motor overload protection* test (*type test*)

For the verification of the functionality of the *electronic motor overload protection*, the test shall be conducted at any current being able to verify the overload tripping condition according to Table 29.

CDM/BDM with fixed overload protection levels shall comply with Table 29 under those fixed settings. *CDM/BDM* with adjustable overload protection levels shall comply with Table 29 under the highest and lowest settings.

The *electronic motor overload protection* in the representative model shall *trip* at any point below the limits from Table 29:

Table 29 – Maximum tripping time for *electronic motor overload protection* test

Multiple of current setting	Maximum tripping time
7,2	20 s
1,5	8 min
1,2	2 h
NOTE 1 The current setting is defined as the rated current for the motor according to its nameplate, which is intended to be protected. NOTE 2 Table 29 covers the minimum requirement for electronic overload relays of class 20 according to IEC 60947-4-1:2009, 8.2.1.5.1.1.	

5.2.8.5 *CDM/BDM* electronic motor *thermal memory retention* shutdown test (*type test*)

The purpose of this test is to verify that the *electronic motor overload protection* functionality evaluated under 5.2.8.4 maintains the *thermal memory* when the *CDM/BDM* is restarted after a *trip*. The test shall be conducted under the conditions specified in 5.2.8.5.

The test is conducted as follows:

a) the *thermal memory* of the *CDM/BDM* is reset;

b) the *CDM/BDM* shall be operated at any multiple of current setting according to Table 29 until the overload protection *trips* the *CDM/BDM*;

c) the duration between the start of the overload condition and tripping is the first elapsed time;

d) without removing the power supply, the test shall be restarted with the same overload condition, within a time shorter than the first elapsed time;

e) the *CDM/BDM* shall be operated until the overload protection *trips* the *CDM/BDM* again;

f) the duration between the start of the second overload condition and tripping is the second elapsed time.

Compliance is shown when the second elapsed time until tripping is less than the first elapsed time.

For information requirements, see 6.3.8.

5.2.8.6 *CDM/BDM* electronic motor *thermal memory retention* loss of power test (*type test*)

The purpose of this test is to verify that the *electronic motor overload protection* evaluated under 5.2.8.4 maintains the *thermal memory* when the *CDM/BDM* is restarted after a *trip* and loss of the supply voltage. The test shall be conducted under the conditions specified in 5.2.8.6.

The test is conducted as follows:

a) the *thermal memory* of the *CDM/BDM* is reset;

b) the *CDM/BDM* shall be operated at any multiple of current setting according to Table 29 until the overload protection *trips* the *CDM/BDM*;

c) the duration between the start of the overload condition and tripping is the first elapsed time;

d) all power supplies shall be removed from the *CDM/BDM*;