



BSI Standards Publication

Low-voltage switchgear and controlgear

Part 2: Circuit-breakers (IEC 60947-2:2016)

National foreword

This British Standard is the UK implementation of EN 60947-2:2017. It is identical to IEC 60947-2:2016. It supersedes BS EN 60947-2:2006+A2:2013, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PEL/121/1, Low voltage switchgear and controlgear.

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.

© The British Standards Institution 2017
Published by BSI Standards Limited 2017

ISBN 978 0 580 81864 6

ICS 29.130.20

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 30 November 2017.

Amendments/corrigenda issued since publication

Date	Text affected
------	---------------

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 60947-2

October 2017

ICS 29.130.20

Supersedes EN 60947-2:2006

English Version

**Low-voltage switchgear and controlgear -
Part 2: Circuit-breakers
(IEC 60947-2:2016 + COR1:2016)**

Appareillage à basse tension - Partie 2: Disjoncteurs
(IEC 60947-2:2016 + COR1:2016)

Niederspannungsschaltgeräte - Teil 2: Leistungsschalter
(IEC 60947-2:2016 + COR1:2016)

This European Standard was approved by CENELEC on 2016-07-12. 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.

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



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

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

European foreword

The text of document 121A/71/FDIS, future edition 5 of IEC 60947-2, prepared by SC 121A “Low-voltage switchgear and controlgear” of IEC/TC 121 “Switchgear and controlgear and their assemblies for low voltage” was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 60947-2:2017.

The following dates are fixed:

- latest date by which the document has to be (dop) 2018-04-13
implemented at national level by
publication of an identical national
standard or by endorsement
- latest date by which the national (dow) 2020-10-13
standards conflicting with the
document have to be withdrawn

This document supersedes EN 60947-2:2006.

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

This document has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directives.

For the relationship with EU Directives and the standardization requests see informative Annex ZZA and Annex ZZB, which are integral parts of this document.

Endorsement notice

The text of the International Standard IEC 60947-2:2016 + COR1:2016 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 60051 Series	NOTE	Harmonized as EN 60051 Series.
IEC 60112	NOTE	Harmonized as EN 60112.
IEC 60898 Series	NOTE	Harmonized as EN 60898 Series.
IEC 60934	NOTE	Harmonized as EN 60934.
IEC 60947-3	NOTE	Harmonized as EN 60947-3.
IEC 60947-5-1	NOTE	Harmonized as EN 60947-5-1.
IEC 61000-4-13	NOTE	Harmonized as EN 61000-4-13.
IEC 61008-1:2010	NOTE	Harmonized as EN 61008-1:2012 (modified).
IEC 61008-1:2010/A1:2012	NOTE	Harmonized as EN 61008-1:2012/A1:2014 (modified).
IEC 61008-1:2010/A2:2013	NOTE	Harmonized as EN 61008-1:2012/A2:2014 (modified).
IEC 61009-1:2010	NOTE	Harmonized as EN 61009-1:2012 (modified).
IEC 61009-1:2010/A1:2012	NOTE	Harmonized as EN 61009-1:2012/A1:2014 (modified).
IEC 61009-1:2010/A2:2013	NOTE	Harmonized as EN 61009-1:2012/A2:2014 (modified).
IEC 61131-1:2003	NOTE	Harmonized as EN 61131-1:2003 (not modified).
IEC 61439 Series	NOTE	Harmonized as EN 61439 Series.

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 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60068-2-14	-	Environmental testing - Part 2-14: Tests - Test N: Change of temperature	EN 60068-2-14	2009
IEC 60068-2-30	-	Environmental testing - Part 2-30: Tests - Test Db: Damp heat, cyclic (12 h + 12 h cycle)	EN 60068-2-30	2005
IEC 60269-1	2006	Low-voltage fuses - Part 1: General requirements	EN 60269-1	2007
IEC 60364	Series	Low-voltage electrical installations	HD 60364	Series
IEC 60664-1	2007	Insulation coordination for equipment within low-voltage systems - Part 1: Principles, requirements and tests	EN 60664-1	2007
IEC 60947-1	2007	Low-voltage switchgear and controlgear - Part 1: General rules	EN 60947-1	2007
+A1	2010		+A1	2011
+A2	2014		+A2	2014
IEC 60947-4-1	-	Low-voltage switchgear and controlgear - Part 4-1: Contactors and motor-starters - Electromechanical contactors and motor- starters	EN 60947-4-1	2010
IEC 61000-3-2	-	Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)	EN 61000-3-2	2014
IEC 61000-3-3	-	Electromagnetic compatibility (EMC) - Part 3-3: Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤ 16 A per phase and not subject to conditional connection	EN 61000-3-3	2013
IEC 61000-4-2	-	Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test	EN 61000-4-2	2009

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 61000-4-3	2006	Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test	EN 61000-4-3	2006
+A1	2007		+A1	2008
+A2	2010		+A2	2010
IEC 61000-4-4	2012	Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test	EN 61000-4-4	2012
IEC 61000-4-5	2014	Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test	EN 61000-4-5	2014
IEC 61000-4-6	2013	Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields	EN 61000-4-6	2014
IEC 61000-4-11	-	Electromagnetic compatibility (EMC) - Part 4-11: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests	EN 61000-4-11	2004
IEC 61140	-	Protection against electric shock - Common aspects for installation and equipment	EN 61140	2016
IEC 62475	2010	High-current test techniques - Definitions and requirements for test currents and measuring systems	EN 62475	2010
CISPR 11	-	Industrial, scientific and medical equipment - Radio-frequency disturbance characteristics - Limits and methods of measurement	EN 55011	2016
CISPR 22	-	Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement	EN 55022 + AC	2010 ¹⁾ 2011 ¹⁾

¹⁾ Superseded by EN 50561-1:2013.

Annex ZZA (informative)

Relationship between this European standard and the essential requirements of Directive 2014/30/EU [2014 OJ L96] aimed to be covered and the standardisation request M/552

This European standard has been prepared under the European Commission standardisation request C(2016) 7641 final of 30.11.2016¹, ('M/552'), as regards harmonised standards in support of Directive 2014/30/EU relating to electromagnetic compatibility, to provide one voluntary means of conforming to essential requirements of Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility [2014 OJ L96].

Once this standard is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of this standard given in Table ZZA.1 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding essential requirements of that Directive, and associated EFTA regulations.

Table ZZA.1 – Correspondence between this European standard and the Essential Requirements set out in Directive 2014/30/EU [2014 OJ L96]

Essential requirements of Directive 2014/30/EU	Clause(s) / sub-clause(s) of this EN	Remarks / Notes
Annex I. 1(a) (electromagnetic disturbances)	7.3, B.7.3, B.8.12.2, F.5, J.1, J.3, M.7.2.12, M.8.16.2, N.3, P.7.3 and no others.	
Annex I. 1(b) (electromagnetic immunity)	7.3, B.7.3, B.8.12.1, F.2.2, F.3, F.4, J.1, J.2, M.7.2.12, M.8.16.1, N.1, N.2, P.7.3 and no others.	Full coverage of requirements for conducted and radiated disturbances in the range 150 kHz to 2,7 GHz

WARNING 1: Presumption of conformity stays valid only as long as a reference to this European standard is maintained in the list published in the Official Journal of the European Union. Users of this standard should consult frequently the latest list published in the Official Journal of the European Union.

WARNING 2: Other Union legislation may be applicable to the product(s) falling within the scope of this standard.

¹ COMMISSION IMPLEMENTING DECISION C(2016) 7641 final of 30.11.2016 on a standardisation request to the European Committee for Standardisation, to the European Committee for Electrotechnical Standardisation and to the European Telecommunications Standards Institute as regards harmonised standards in support of Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility.

Annex ZZB (informative)

Relationship between this European standard and the safety objectives of Directive 2014/35/EU [2014 OJ L96] aimed to be covered

This European Standard has been prepared under a Commission's standardization request relating to harmonized standards in the field of the Low Voltage Directive, M/511, to provide one voluntary means of conforming to safety objectives of Directive 2014/35/EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to the making available on the market of electrical equipment designed for use within certain voltage limits [2014 OJ L96].

Once this standard is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of this standard given in Table ZZB.1 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding safety objectives of that Directive, and associated EFTA regulations.

Table ZZB.1 – Correspondence between this European standard and Annex I of Directive 2014/35/EU [2014 OJ L96]

Safety objectives of Directive 2014/35/EU	Clause(s) / sub-clause(s) of this EN	Remarks/note
1 a)	Foreword, 1.1, 4, 5, B.5, H.5, L.5, M.5, O.5, P.5, R.5	
1 b)	5, L.5, M.5, O.4, P.5	
1 c)	5.3	
2 a)	5.2, 5.3, 7.1.3, 7.1.4, 7.2.3, 8.3, 8.4	
2 b)	7.2.2, 7.3, 8.3.2, F.1, J.3	
2 c)	5.3, 7.1, 7.1.2, 7.1.3, 7.1.5, 7.2.1, 7.3, 8.3.3 to 8.3.6, 8.4, 8.5, F.1, J.2, J.3	
2 d)	5.2, 7.1.3, 7.1.4, 7.2.3, 8.3.2, F.2.2	
3 a)	5.3, 7.1.2, 7.1.5, 7.2.1, 8.3.3 to 8.3.6, 8.4, 8.5	
3 b)	7.3, F.1, J.3	
3 c)	1.1, 7.2, 8.3	

WARNING 1 — Presumption of conformity stays valid only as long as a reference to this European standard is maintained in the list published in the Official Journal of the European Union. Users of this standard should consult frequently the latest list published in the Official Journal of the European Union.

WARNING 2 — Other Union legislation may be applicable to the product(s) falling within the scope of this standard.

CONTENTS

FOREWORD	14
1 General	16
1.1 Scope and object	16
1.2 Normative references	17
2 Terms and definitions	18
3 Classification	22
4 Characteristics of circuit-breakers	23
4.1 Summary of characteristics	23
4.2 Type of circuit-breaker	23
4.3 Rated and limiting values of the main circuit	23
4.3.1 General	23
4.3.2 Rated voltages	23
4.3.3 Currents	24
4.3.4 Rated frequency	24
4.3.5 Rated duty	24
4.3.6 Short-circuit characteristics	24
4.4 Selectivity categories	27
4.5 Control circuits	27
4.5.1 Electrical control circuits	27
4.5.2 Air-supply control circuits (pneumatic or electro-pneumatic)	27
4.6 Auxiliary circuits	27
4.7 Releases	28
4.7.1 Types	28
4.7.2 Characteristics	28
4.7.3 Current setting of over-current releases	28
4.7.4 Tripping time setting of over-current releases	29
4.8 Integral fuses (integrally fused circuit-breakers)	29
5 Product information	29
5.1 Nature of the information	29
5.2 Marking	29
5.3 Instructions for installation, operation and maintenance	31
6 Normal service, mounting and transport conditions	31
7 Constructional and performance requirements	31
7.1 Constructional requirements	31
7.1.1 General	31
7.1.2 Withdrawable circuit-breakers	31
7.1.3 Additional requirements for circuit-breakers suitable for isolation	32
7.1.4 Clearances and creepage distances	32
7.1.5 Requirements for the safety of the operator	32
7.1.6 List of construction breaks	32
7.1.7 Additional requirements for circuit-breakers provided with a neutral pole	33
7.1.8 Digital inputs and outputs for use with programmable logic controllers (PLCs)	33
7.2 Performance requirements	33
7.2.1 Operating conditions	33
7.2.2 Temperature-rise	36

7.2.3	Dielectric properties	37
7.2.4	Ability to make and break under no load, normal load and overload conditions	37
7.2.5	Ability to make and break under short-circuit conditions	38
7.2.6	Vacant	38
7.2.7	Additional requirements for circuit-breakers suitable for isolation	38
7.2.8	Specific requirements for integrally fused circuit-breakers	39
7.2.9	Co-ordination between a circuit-breaker and another short-circuit protective device	39
7.3	Electromagnetic compatibility (EMC)	39
8	Tests	39
8.1	Kind of tests	39
8.1.1	General	39
8.1.2	Type tests	39
8.1.3	Routine tests	40
8.2	Compliance with constructional requirements	40
8.3	Type tests	40
8.3.1	Test sequences	40
8.3.2	General test conditions	48
8.3.3	Test sequence I: General performance characteristics	56
8.3.4	Test sequence II: Rated service short-circuit breaking capacity	65
8.3.5	Test sequence III: Rated ultimate short-circuit breaking capacity	66
8.3.6	Test sequence IV: Rated short-time withstand current	68
8.3.7	Test sequence V: Performance of integrally fused circuit-breakers	69
8.3.8	Test sequence VI: combined test sequence	71
8.3.9	Critical d.c. load current test	72
8.4	Routine tests	73
8.4.1	General	73
8.4.2	Mechanical operation tests	74
8.4.3	Verification of the calibration of overcurrent releases	74
8.4.4	Verification of the operation of undervoltage and shunt releases	75
8.4.5	Additional tests for CBRs	75
8.4.6	Dielectric tests	75
8.4.7	Test for the verification of clearances less than those corresponding to case A of Table 13 of IEC 60947-1:2007	76
8.5	Special tests – Damp heat, salt mist, vibration and shock	76
Annex A (normative)	Co-ordination between a circuit-breaker and another short-circuit protective device associated in the same circuit	79
A.1	General	79
A.2	Scope and object	79
A.3	General requirements for the co-ordination of a circuit-breaker with another SCPD	80
A.3.1	General considerations	80
A.3.2	Take-over current	80
A.3.3	Behaviour of C_1 in association with another SCPD	80
A.4	Type and characteristics of the associated SCPD	80
A.5	Verification of selectivity	81
A.5.1	General	81
A.5.2	Consideration of selectivity by desk study	81
A.5.3	Selectivity determined by test	82

A.6	Verification of back-up protection	83
A.6.1	Determination of the take-over current.....	83
A.6.2	Verification of back-up protection	83
A.6.3	Tests for verification of back-up protection	83
A.6.4	Results to be obtained.....	84
Annex B (normative)	Circuit-breakers incorporating residual current protection	90
B.1	General.....	90
B.1.1	Preamble	90
B.1.2	Scope and object	90
B.2	Terms and definitions.....	91
B.2.1	Terms and definitions relating to currents flowing from live parts to earth.....	91
B.2.2	Terms and definitions relating to the energization of a CBR	91
B.2.3	Terms and definitions relating to the operation and the functions of a CBR.....	92
B.2.4	Terms and definitions relating to values and ranges of energizing quantities.....	93
B.3	Classification	94
B.3.1	Classification according to the method of operation of the residual current function.....	94
B.3.2	Classification according to the possibility of adjusting the residual operating current.....	94
B.3.3	Classification according to time-delay of the residual current function	94
B.3.4	Classification according to behaviour in presence of a d.c. component.....	94
B.4	Characteristics of CBRs concerning their residual current function.....	94
B.4.1	Rated values.....	94
B.4.2	Preferred and limiting values	95
B.4.3	Value of the rated residual short-circuit making and breaking capacity ($I_{\Delta m}$)	96
B.4.4	Operating characteristics in case of an earth fault current in the presence or absence of a d.c. component	96
B.5	Marking.....	96
B.6	Normal service, mounting and transport conditions	97
B.7	Design and operating requirements	98
B.7.1	Design requirements	98
B.7.2	Operating requirements.....	98
B.7.3	Electromagnetic compatibility	100
B.8	Tests	100
B.8.1	General.....	100
B.8.2	Verification of the operating characteristic	103
B.8.3	Verification of dielectric properties.....	104
B.8.4	Verification of the operation of the test device at the limits of rated voltage.....	105
B.8.5	Verification of the limiting value of the non-operating current under over-current conditions.....	105
B.8.6	Verification of the resistance against unwanted tripping due to surge currents resulting from impulse voltages	106
B.8.7	Verification of the behaviour of CBRs of type A in the case of an earth fault current comprising a d.c. component	107
B.8.8	Verification of the behaviour of CBRs functionally dependent on line voltage classified under B.3.1.2.1	108