IEC 62733

Edition 1.0 2015-05

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Programmable components in electronic lamp controlgear – General and safety requirements

Composants programmables dans les appareillages électroniques de lampes – Exigences générales et exigences de sécurité

IEC 62733:2015-05(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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PROGRAMMABLE COMPONENTS IN ELECTRONIC LAMP CONTROLGEAR – GENERAL AND SAFETY REQUIREMENTS

FOREWORD

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

FDIS	Report on voting
34C/1140/FDIS	34C/1156/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.

NOTE In this standard the following print types are used:

– Requirements proper: in Roman type.

– Test specifications: *in Italic type*.

– Explanatory matter: in smaller roman type.

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- withdrawn,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.

The contents of the corrigendum of August 2017 have been included in this copy.

INTRODUCTION

This International Standard provides safety requirements and test methods for programmable components when in electronic lamp controlgear. It provides additional safety requirements for electronic lamp controlgear containing programmable components to the requirements of IEC 61347 series.

In general, the two means of protection safety principle is used for protection against hazards such as electric shock. Consequently one single fault condition or abnormal operation of the electrical equipment will not lead to a hazardous situation.

Until recent technology, two means of protection have been realized in traditional hardware. Examples are the provision of basic insulation and supplementary insulation between hazardous live parts and accessible parts, and provision of basic insulation combined by disconnection of the mains supply by a fuse.

Nowadays however programmable components (with embedded software) may be used as a measure to provide safety under normal conditions, single fault conditions and/or abnormal operation.

Since the traditional lighting standards do not provide requirements for programmable components, this standard has been drawn up.

This standard recognizes the internationally accepted level of protection against hazards such as electrical, mechanical, thermal, fire and radiation of appliances when operated as in normal use taking into account the manufacturer's instructions. It also covers conditions for electromagnetic phenomena that can be expected in practice with influence on the operation of the programmable component, for taking into account the way this can affect the safe operation of the electronic lamp controlgear.

This first edition is based upon IEC 60730-1:2010 and IEC 60335-1:2010 and adapted for electronic lamp controlgear

NOTE The terms and definitions and Tables A.1 and A.2 respectively of this standard are equivalent to terms and definitions and Table R.1 and R.2 of IEC 60335-1:2010, and equivalent terms and definitions and Table H.1 (class B and class C software) of IEC 60730-1:2010.

PROGRAMMABLE COMPONENTS IN ELECTRONIC LAMP CONTROLGEAR – GENERAL AND SAFETY REQUIREMENTS

1 Scope

This International Standard provides general and safety requirements for programmable components used in products covered by IEC 61347.

The requirements of this standard are only applicable to the programmable components (including its embedded software) in the electronic lamp controlgear. For other electric/electronic circuits and their components in the electronic lamp controlgear, the requirements of IEC 61347 series apply.

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 61000-4-13:2002, *Electromagnetic compatibility (EMC) – Part 4-13: Testing and measurement techniques – Harmonics and interharmonics including mains signalling at a.c. power port, low frequency immunity tests*
IEC 61000-4-13:2002/AMD 1:2009

IEC 61347-1, *Lamp controlgear – Part 1: General and safety requirements*

IEC 61347-2 (all parts)[1], *Lamp controlgear – Part 2: Particular requirements*

IEC 61547:2009, *Equipment for general lighting purposes – EMC immunity requirements*

IEC 61508-4:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 4: Definitions and abbreviations*

IEC 61508-5:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 5: Examples of methods for the determination of safety integrity levels*

IEC 61508-7:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 7: Overview of techniques and measures*

3 Terms and definitions

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

3.1
central processing unit
CPU
part of a computing and controlling system that interprets and executes instructions

[1] Relevant parts of the series depend on the context.

Note 1 to entry: This note applies to the French language only.

3.2
programmable component
based on computer technology which comprised of hardware, software, and of input and/or output units

EXAMPLE The following are all programmable components:

– microprocessors;
– micro-controllers;
– programmable controllers;
– application specific digital integrated circuits (ASICs with programmable part);
– programmable logic controllers (PLCs);
– other computer-based devices (for example smart sensors, transmitters, actuators).

Note 1 to entry: This term covers microelectronic devices based on one or more central processing units (CPUs) together with associated memories, etc.

Note 2 to entry: The term programmable component is from ANSI/UL1998:2010, definition 2.39 [2].The definition in ANSI/UL for programmable component is: "Any microelectronic hardware that can be programmed in the design centre, the factory, or in the field. Here the term 'programmable' is taken to be 'any manner in which one can alter the software wherein the behaviour of the component can be altered." This term covers microelectronic devices based on one or more central processing units (CPUs) together with associated memories, etc.

[SOURCE: IEC 61508-4:2010, 3.2.12, modified — "Programmable electronic" is replaced by "programmable component" which better describes that it is only a part of the controlgear.]

3.3
protective programmable component
PPC
programmable component that prevents a hazardous situation under abnormal operating conditions, or programmable component for which none of the output signals can lead to a hazardous situation

Note 1 to entry: This note applies to the French language only.

3.4
software
intellectual creation comprising the programs, procedures, data, rules and any associated documentation pertaining to the operation of a data processing system

[SOURCE: IEC 61508-4:2010, 3.2.5, modified — The notes to entry are deleted.]

3.5
software code
code written by a programmer in a high-level computer language and readable by people but not computers

3.6
safety software
part of the software that counteracts possible hazardous situations, which are created from abnormal and/or fault conditions

Note 1 to entry: Software is independent of the medium on which it is recorded.

3.7
fault condition
condition as required by Clause 14 of IEC 61347-1 or its relevant Part 2

3.8
single fault condition
fault condition under normal operating condition of a single component or a device

[SOURCE: IEC 62368-1:2010, 3.3.7.10, modified]

3.9
normal operating
mode of operation that represents as closely as possible the most severe conditions of normal use that can reasonably be expected

[SOURCE: IEC 62368-1:2010, 3.3.7.4, modified]

3.10
abnormal operating
temporary operating condition that is not a normal operating condition and is not a single fault condition of the equipment itself

Note 1 to entry: An abnormal operating condition may be introduced by the equipment or by a person.

Note 2 to entry: The equipment, installation, instructions, and specifications should be examined to determine those abnormal operating conditions that might reasonably be expected to occur.

Note 3 to entry: Faults that are the direct consequence of the abnormal operating condition are deemed to be a single fault condition.

[SOURCE: IEC 62368-1:2010, 3.3.7.1, modified]

3.11
fault tree analysis
FTA

top down, deductive failure analysis method in which a hazardous or serious event is analyzed using Boolean logic to combine a series of events causing this event

Note 1 to entry: The FTA technique represents a ‘top-down’ analysis technique. Annex B of IEC 61508-7:2010 provides information for the minimum setup for an FTA report.

3.12
failure modes and effects analysis
FMEA
analytical technique in which the failure modes of each hardware and software component are identified and examined for their effects on the safety-related functions of the control

Note 1 to entry: The FMEA technique represents a ‘bottom-up’ analysis technique. Annex B provides information for the minimum setup for an FMEA report.

[SOURCE: IEC 60730-1:2010, H.2.20.3, modified]

3.13
rated voltage
value of voltage assigned by the manufacturer to a component, device or equipment and to which operation and performance characteristics are referred

Note 1 to entry: Equipment may have more than one rated voltage value or may have a rated voltage range.

Note 2 to entry: For three-phase supply, the phase-to-phase voltage applies.

[SOURCE: IEC 62368-1:2010, 3.3.10.4, modified]

3.14
tolerable risk
risk level as defined in 5.2

3.15
intolerable risk
risk level which cannot be justified, except in extraordinary circumstances

3.16
acceptable risk
risk level that is broadly accepted in the society

3.17
ALARP
as low as is reasonably practicable
level of risk for a risk that falls between acceptable risk and intolerable risk and has to be reduced to the lowest practicable level, bearing in mind the benefits resulting from its acceptance and taking into account the practicability of any further reduction

Note 1 to entry: This note applies to the French language only.

Note 2 to entry: The specification of the level ALARP is described in Annex D.

Note 3 to entry: This definition is according to IEC 61508-5:1998, Annex B. In this standard it is used as one possible variant of the tolerable risk.

3.18
injury
damage to the human body, less than 2 % incapacity, usually reversible and not usually requiring hospital treatment

EXAMPLE Minor cuts, very minor fractures or minor burns or sprains.

3.19
serious injury
injury that directly or indirectly:

a) threatens life,

b) results in permanent impairment of a body function or permanent damage to a body structure, or

c) necessitates medical or surgical intervention to prevent permanent impairment of a body function or permanent damage to a body structure

3.20
hazardous situation
circumstance in which people, property or the environment are exposed to one or more potential sources of physical injury or damage to the health of people, or damage to property or the environment

4 General requirements

Software of programmable components within electronic lamp controlgear shall be so designed and constructed that in normal use it operates without danger to the user or surroundings.

A risk assessment shall be done to determine which parts of this standard are applicable. If the risk assessment shows that the software built-in used to prevent the controlgear from becoming unsafe, has a risk above the tolerable risk, then this standard is mandatory.

The focus of the risk assessment shall be the possible risks by the electronic controlgear including the abnormal operation and fault conditions of the relevant Part 2 of IEC 61347.

5 Risk assessment

5.1 General

Possible risks by the controlgear shall be the focus of the risk assessment. The risk assessment shall identify and classify known or reasonably foreseeable risks of a possible malfunction of the software (including the risk originating from potential internal fault conditions and abnormal operation of the controlgear described in the relevant Part 2 of IEC 61347) under the assumption of expected use.

If the risk assessment shows that the software built-in to prevent the controlgear from becoming unsafe, has a risk above the tolerable risk (and is not reduced by additional hardware measures) then all parts of this standard are applicable.

If the risk assessment shows that the risk is tolerable then the controlgear does comply with this standard. In this case only the parts relevant for describing the risk assessment of this standard do apply. This means that the following parts of the standard do not apply: Clauses 6, 7, 8 and Annexes A, B, C.

If the safety risk assessment for a programmable component results in being identified not as a protective programmable component, or not evaluated as a protective programmable component, then the component is exempted from software code.

5.2 Specification of tolerable risk

There are three ways to specify tolerable risk:

a) The risk is classified as tolerable if the effects by potential software malfunction are mitigated by hardware measures (e.g. hardware over-temperature shut down) so that the controlgear is prevented from becoming unsafe and if the hardware measures and the controlgear comply with the IEC 61347 series. Alternatively a second PPC can be used to mitigate a potential software malfunction as long as it is independent from the first PPC.

b) Alternatively a more general specification can be used.

   1) The risk is tolerable if the risk of the controlgear with software has the same level as that of a comparison controlgear where the respective safety relevant functions are realised by hardware and which complies with the IEC 61347 series.

   2) The goal is to verify a safety level of the controlgear (under assessment) having at least the same level of safety as that of a comparison controlgear where the safety relevant functions are realised by hardware and which complies with the IEC 61347 series. The comparison controlgear can be real or imagined, based on known hardware controlgears (or parts of these controlgears) that comply with the IEC 61347 series.

c) An alternative way to specify the tolerable risk is provided by a general risk classification described in Annex D. In this case the risk is tolerable if the risk is in the class ‘As low as is reasonably practicable (ALARP)’ or lower.

5.3 Documentation

The risk assessment and results out of it shall be documented by the manufacturer.

For each risk addressed by this process, a risk description and a potential cause shall be provided.

To document possible fault and failure modes a fault tree analysis (FTA) or a failure mode and effect analysis (FMEA) can be used. Annex B provides information for the minimum setup

for a FTA and FMEA analysis report. The FTA technique represents a ‘top down’ analysis technique; the FMEA technique represents a ‘bottom up” analysis technique.

The documentation of the risk assessment can be checked to show compliance with this standard.

6 Requirements for abnormal operating and fault conditions

6.1 Abnormal operating and fault conditions in the application of the electronic lamp controlgear

The safety software shall be tested in the fault and abnormal conditions as given in the relevant standard of the IEC 61347 series.

During and after the tests, the electronic lamp controlgear shall comply with the compliance criteria of the relevant electronic lamp controlgear standard IEC 61347 series.

If a programmable component (PC) in the electronic lamp controlgear is provided to ensure compliance with this clause, the software shall comply with the requirements in Clauses 7 and 8 of this standard for a protective programmable component (PPC).

A programmable component, identified not being a protective programmable component, or not evaluated as a protective programmable component, is exempt from software code evaluation. Annex C describes possible methods for the identification of protective programmable components.

In case of PPC safety provisions, compliance with Clauses 7 and 8 makes the PPC robust so that any potential failure in the PPC will not render the electronic lamp controlgear unsafe.

6.2 Fault conditions for the programmable component

For electronic lamp controlgear incorporating a programmable component the following fault conditions for the programmable component are considered and, if necessary, applied one at a time, consequential faults being taken into consideration.

a) Short circuit of functional insulation between adjacent programmable component terminals if clearances or creepage distances are less than the values specified in the relevant clause of IEC 61347-1.

NOTE 1 This is covered by 14.1 of IEC 61347-1.

b) Open circuit of any terminal of the programmable component.

NOTE 2 This is covered by 14.2 of IEC 61347-1.

c) If the software code is not accessible, alternatively, based upon the safety risk assessment, the pins of the programmable component are brought to a state in which it is expected that a safety issue could occur.

d) As an alternative for c) if the code is accessible, all outputs are considered for faults occurring within the programmable component. If it can be shown based upon the safety risk assessment that a particular output signal is unlikely to occur, then the relevant fault is not considered. The relevant faults are neither considered and can be excluded if the programmable component complies with the requirements in Clauses 7 and 8 of this standard for protective programmable component.

A FTA or FMEA should be conducted to include the results of multiple steady-state conditions to outputs and programmed bi-directional terminals for the purpose of identifying additional fault conditions for consideration, likely or unlikely to occur.

NOTE 3 A not to disclose programmable component is evaluated by FTA/FMEA analysis on the output signals.

If FTA or FMEA determine that only specific and well-defined critical failure conditions can occur, then a simulation or justification of the impact of the failure conditions during the evaluation can be chosen as an alternative to individual tests.

Compliance is checked by inspection and appropriate tests if necessary.

During and after the tests, the electronic lamp controlgear shall comply with the compliance criteria of 14.1, first paragraph, of IEC 61347-1 and relevant Part 2.

7 Requirements for software

Electronic lamp controlgear incorporating a protective programmable component the software of the programmable component shall contain measures to control the fault/error conditions specified in Table A.1. The fault/error evaluation includes the sensors and actuators that are associated with the software safety function.

Table A.2 is to be used when the software contains measures to control the fault/error conditions specified in Table A.2, when it is specified in the relevant Part 2 of IEC 61347 for particular constructions or to address specific hazards.

Measures used for software to control the fault/error conditions specified in Table A.2 are inherently acceptable for measures used for software to control the fault/error conditions specified in Table A.1.

Compliance is checked by evaluating the software in accordance with the relevant requirements of Annex A.

If the software is modified, the evaluation and relevant tests are repeated if the modification influences the results of the test involving protective programmable components.

Software compliance is checked by inspection of the risk assessment and the relevant part of the software and/or by carrying out appropriate tests of the electronic lamp controlgear.

Compliance check is in case of a protective programmable component or making use of the exclusion of 6.2 d)

8 Requirements for EMC immunity

8.1 Electronic lamp controlgear incorporating a protective programmable component to function correctly are subjected to the test B of 8.2, unless restarting at any point in the operating cycle after interruption of operation due to a supply voltage dip will not result in a hazard. The test is carried out after removal of all batteries and other components intended to maintain the programmable component supply voltage during mains supply voltage dips, interruptions and variations.

8.2 Electronic lamp controlgear incorporating a protective programmable component are subjected to the tests for electromagnetic phenomena. The tests are carried out in the operating condition valid for the protective programmable component, specified in Clause 6 of this standard, if applicable.

With respect to electromagnetic phenomena, the EMC immunity tests shall be done according IEC 61547.

In addition the following tests shall be performed: