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TECHNICAL REPORT

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Equipment for general lighting purposes – EMC immunity requirements – Part 1: Objective light flickermeter and voltage fluctuation immunity test method

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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EQUIPMENT FOR GENERAL LIGHTING PURPOSES – EMC IMMUNITY REQUIREMENTS –

Part 1: Objective light flickermeter and voltage fluctuation immunity test method

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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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

The main task of IEC technical committees is to prepare International Standards. However, a technical committee may propose the publication of a Technical Report when it has collected data of a different kind from that which is normally published as an International Standard, for example "state of the art".

IEC TR 61547-1, which is a Technical Report, has been prepared by IEC technical committee 34: Lighting.

This third edition cancels and replaces the second edition published in 2017. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) the scope of this document has been clarified to make a distinction between flicker testing without voltage fluctuations to measure the intrinsic performance of lighting equipment and flicker testing in which a specific set of voltage fluctuations are applied in order to measure the immunity of the lighting equipment to voltage fluctuations present on the mains;
b) the test procedure for flicker testing has been clarified.

The text of this Technical Report is based on the following documents:

Draft TR	Report on voting
34/668/DTR	34/701/RVDTR

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

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

A list of all parts in the IEC 61547 series, published under the general title *Equipment for general lighting purposes – EMC immunity requirements*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
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- 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.

INTRODUCTION

The fast rate at which solid state light (SSL) sources can change their intensity is one of the main drivers behind the revolution in the lighting world and applications of lighting. Linked to the fast rate of the intensity change is a direct transfer of the modulation of the driving current, both intended and unintended, to a modulation of the luminous output. This light modulation can give rise to changes in the perception of the environment. While in some very specific entertainment, scientific or industrial applications a change of perception due to light modulation is desired, for most everyday applications and activities the change is detrimental and undesired. ~~The general term used for~~ These changes in the perception of the environment ~~is~~ are called "temporal light artefacts" (TLAs) and can have a large influence on the judgment of the light quality. Moreover, the visible modulation of light can lead to a decrease in performance, increased fatigue as well as ~~acute~~ health problems like epileptic seizures and migraine episodes [17][18][1].

Different terms exist to describe the different types of TLAs that may be perceived by humans. The term "flicker" refers to light variation that may be directly perceived by an observer. "Stroboscopic effect" is an effect which may become visible for an observer when a moving or rotating object is illuminated (CIE TN 006:2016 [26]).

Possible causes for light modulation of lighting equipment that may give rise to flicker or stroboscopic effect are:

– AC supply combined with light source technology and its driver topology;
– ~~dimming~~ light regulation technology of externally applied ~~dimmers~~ light level regulators or internal light level regulators;
– mains voltage fluctuations caused by electrical apparatus connected to the mains (conducted electromagnetic disturbances) or intentionally applied for mains-signalling purposes.

Lighting products that show unacceptable flicker ~~or stroboscopic effect~~ are considered as poor-quality lighting.

This document provides a description of an objective light flickermeter and a method for measuring the intrinsic flicker of lighting equipment as well as testing the immunity of lighting equipment against mains voltage fluctuations caused by electrical apparatus connected to the mains at levels that are allowed through IEC 61000-3-3.

Flicker perception, as well as IEC 61000-3-3 and IEC 61000-4-15, the associated standards for voltage fluctuations and the flickermeter, are based on the 60 W incandescent lamp. As a result of the phasing out of incandescent lamps and the widespread introduction of alternative lighting equipment technologies, a new reference lamp was considered. It has been demonstrated that new lighting technologies are in general less but sometimes also more sensitive to supply voltage fluctuations than the current 60 W incandescent lamp. A CIGRE working group has assessed the impact of new lighting technologies on the existing flicker standards [16]. For the moment, the present flicker sensitivity curve of IEC 61000-3-3 remains as the reference. However, because of the increased diversity of sensitivity of lighting equipment to voltage fluctuations, there is a future need for a voltage-fluctuation immunity test specifically for lighting equipment. In this way, the full EMC approach (Figure 1) is introduced for flicker, i.e. with a view to limiting voltage fluctuations caused by equipment connected to the grid, and in addition to establishing a minimum level of flicker immunity of lighting equipment against these voltage fluctuations.

This document will allow the lighting industry to gain experience in flicker immunity test methods. Results of actual tests will be reported in a separate IEC Technical Report. Based

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1 Numbers in square brackets refer to the Bibliography.

on the experience gained on this immunity test method, the adoption of a similar test to be applied for IEC 61547, the immunity standard for lighting equipment, will be considered.

EQUIPMENT FOR GENERAL LIGHTING PURPOSES – EMC IMMUNITY REQUIREMENTS –

Part 1: Objective light flickermeter and voltage fluctuation immunity test method

1 Scope

This part of IEC 61547 describes an objective light flickermeter, which can be applied for~~, amongst others,~~ the following purposes:

~~– testing the intrinsic performance of all lighting equipment without voltage fluctuations;~~

~~– testing the immunity performance of lighting equipment against (unintentional) voltage fluctuation disturbance on the AC power port;~~

~~– testing the immunity performance of lighting equipment against intentional voltage fluctuation on the AC power port arising for example from ripple control systems.~~

– measuring the intrinsic performance of all lighting equipment without the application of voltage fluctuations in terms of illuminance flicker; during this measurement, the lighting equipment is supplied with a stable mains;

– testing the immunity performance of lighting equipment against (unintentional) voltage fluctuation disturbance on the AC mains in terms of illuminance flicker; during this test a set of defined voltage fluctuations are applied to the AC mains and the immunity of the lighting equipment to the disturbance is determined.

Apart from the above two purposes, the immunity performance of lighting equipment can also be tested against intentional voltage fluctuation on the AC mains arising for example from mains signalling. This is however not described in further detail in this document.

NOTE 1 IEC 61000-4-13:2015 [24] provides guidance regarding test levels and frequencies for mains signalling.

The object of this document is to establish a common and objective reference for evaluating the performance of lighting equipment in terms of illuminance flicker. Temporal changes in the colour of light (chromatic flicker) are not considered in this test.

This method can be applied to lighting equipment which is within the scope of IEC technical committee 34, such as lamps and luminaires, intended for connection to a low voltage electricity supply. Independent auxiliaries such as drivers can also be tested by application of a representative light source to that auxiliary.

The objective light flickermeter and voltage fluctuation immunity method described in this document are based on the IEC 61000-3-3 standard for voltage fluctuation limits and the flickermeter standard IEC 61000-4-15.

The objective light flickermeter described in this document can be applied to objectively assess flicker of lighting equipment that is powered from any type of source, AC mains, DC mains, battery fed or fed through an external ~~dimmer~~ light level regulator. The specific voltage fluctuation immunity test method described in this document applies to lighting equipment rated for 120 V AC and 230 V AC, 50 Hz and 60 Hz.

NOTE 2 The principle of the method can be applied for other nominal voltages and frequency ratings.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

IEC 61000-3-3:2013, *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*

IEC 61000-4-15:2010, *Electromagnetic compatibility (EMC) – Part 4-15: Testing and measurement techniques – Flickermeter – Functional and design specifications*

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Equipment for general lighting purposes – EMC immunity requirements – Part 1: Objective light flickermeter and voltage fluctuation immunity test method



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Different terms exist to describe the different types of TLAs that may be perceived by humans. The term "flicker" refers to light variation that may be directly perceived by an observer. "Stroboscopic effect" is an effect which may become visible for an observer when a moving or rotating object is illuminated (CIE TN 006:2016 [26]).

Possible causes for light modulation of lighting equipment that may give rise to flicker or stroboscopic effect are:

– AC supply combined with light source technology and its driver topology;
– light regulation technology of externally applied light level regulators or internal light level regulators;
– mains voltage fluctuations caused by electrical apparatus connected to the mains (conducted electromagnetic disturbances) or intentionally applied for mains-signalling purposes.

Lighting products that show unacceptable flicker are considered as poor-quality lighting.

This document provides a description of an objective light flickermeter and a method for measuring the intrinsic flicker of lighting equipment as well as testing the immunity of lighting equipment against mains voltage fluctuations caused by electrical apparatus connected to the mains at levels that are allowed through IEC 61000-3-3.

Flicker perception, as well as IEC 61000-3-3 and IEC 61000-4-15, the associated standards for voltage fluctuations and the flickermeter, are based on the 60 W incandescent lamp. As a result of the phasing out of incandescent lamps and the widespread introduction of alternative lighting equipment technologies, a new reference lamp was considered. It has been demonstrated that new lighting technologies are in general less but sometimes also more sensitive to supply voltage fluctuations than the current 60 W incandescent lamp. A CIGRE working group has assessed the impact of new lighting technologies on the existing flicker standards [16]. For the moment, the present flicker sensitivity curve of IEC 61000-3-3 remains as the reference. However, because of the increased diversity of sensitivity of lighting equipment to voltage fluctuations, there is a future need for a voltage-fluctuation immunity test specifically for lighting equipment. In this way, the full EMC approach (Figure 1) is introduced for flicker, i.e. with a view to limiting voltage fluctuations caused by equipment connected to the grid, and in addition to establishing a minimum level of flicker immunity of lighting equipment against these voltage fluctuations.

This document will allow the lighting industry to gain experience in flicker immunity test methods. Results of actual tests will be reported in a separate IEC Technical Report. Based on the experience gained on this immunity test method, the adoption of a similar test to be applied for IEC 61547, the immunity standard for lighting equipment, will be considered.

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[1] Numbers in square brackets refer to the Bibliography.

EQUIPMENT FOR GENERAL LIGHTING PURPOSES – EMC IMMUNITY REQUIREMENTS –

Part 1: Objective light flickermeter and voltage fluctuation immunity test method

1 Scope

This part of IEC 61547 describes an objective light flickermeter, which can be applied for the following purposes:

– measuring the intrinsic performance of all lighting equipment without the application of voltage fluctuations in terms of illuminance flicker; during this measurement, the lighting equipment is supplied with a stable mains;

– testing the immunity performance of lighting equipment against (unintentional) voltage fluctuation disturbance on the AC mains in terms of illuminance flicker; during this test a set of defined voltage fluctuations are applied to the AC mains and the immunity of the lighting equipment to the disturbance is determined.

Apart from the above two purposes, the immunity performance of lighting equipment can also be tested against intentional voltage fluctuation on the AC mains arising for example from mains signalling. This is however not described in further detail in this document.

NOTE 1 IEC 61000-4-13:2015 [24] provides guidance regarding test levels and frequencies for mains signalling.

The object of this document is to establish a common and objective reference for evaluating the performance of lighting equipment in terms of illuminance flicker. Temporal changes in the colour of light (chromatic flicker) are not considered in this test.

This method can be applied to lighting equipment which is within the scope of IEC technical committee 34, such as lamps and luminaires, intended for connection to a low voltage electricity supply. Independent auxiliaries such as drivers can also be tested by application of a representative light source to that auxiliary.

The objective light flickermeter and voltage fluctuation immunity method described in this document are based on the IEC 61000-3-3 standard for voltage fluctuation limits and the flickermeter standard IEC 61000-4-15.

The objective light flickermeter described in this document can be applied to objectively assess flicker of lighting equipment that is powered from any type of source, AC mains, DC mains, battery fed or fed through an external light level regulator. The specific voltage fluctuation immunity test method described in this document applies to lighting equipment rated for 120 V AC and 230 V AC, 50 Hz and 60 Hz.

NOTE 2 The principle of the method can be applied for other nominal voltages and frequency ratings.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

IEC 61000-3-3:2013, *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*

IEC 61000-4-15:2010, *Electromagnetic compatibility (EMC) – Part 4-15: Testing and measurement techniques – Flickermeter – Functional and design specifications*