



BSI Standards Publication

**Equipment for general lighting purposes
— Objective test method for stroboscopic
effects of lighting equipment**

National foreword

This Published Document is the UK implementation of IEC TR 63158:2018.

The UK participation in its preparation was entrusted to Technical Committee CPL/34, Lamps and Related Equipment.

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 2018
Published by BSI Standards Limited 2018

ISBN 978 0 580 51702 0

ICS 29.140.01

Compliance with a British Standard cannot confer immunity from legal obligations.

This Published Document was published under the authority of the Standards Policy and Strategy Committee on 30 April 2018.

Amendments/corrigenda issued since publication

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



TECHNICAL REPORT



**Equipment for general lighting purposes – Objective test method for
stroboscopic effects of lighting equipment**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 29.140.01

ISBN 978-2-8322-5488-2

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
1 Scope.....	7
2 Normative references	7
3 Terms, definitions, abbreviated terms and symbols.....	7
3.1 Terms and definitions.....	7
3.2 Abbreviated terms.....	9
3.3 Symbols.....	10
4 General	7
5 Laboratory and equipment requirements.....	11
5.1 Schematic of the measurement setup	11
5.2 Laboratory and environmental conditions	12
5.3 Electrical power source.....	12
5.4 Optical test environment	12
5.5 Light sensor and amplifier.....	13
5.6 Signals to be measured	13
5.7 Duration of the measurement.....	13
5.8 Signal processing	13
5.8.1 Anti-aliasing filter.....	13
5.8.2 Sampling frequency.....	14
5.8.3 Signal resolution.....	14
5.9 SVM calculation.....	14
5.10 Verification noise-level of the setup	14
6 Stroboscopic effect visibility meter.....	15
6.1 General.....	15
6.2 Verification.....	15
6.3 Evaluation of results	15
7 Test setup and operating conditions	16
7.1 General.....	16
7.2 Ageing.....	16
7.3 Mounting.....	16
7.4 Stabilization before measurement	16
7.5 Operation.....	16
8 General test procedure.....	16
9 Application-specific equipment, procedures and conditions.....	17
9.1 General.....	17
9.2 Phase cut dimmer compatibility test of lighting equipment.....	17
9.3 Controlgear testing	17
9.4 In-situ testing.....	18
10 Test report.....	18
11 Measurement uncertainties.....	18
11.1 General.....	18
11.2 Verification tests	18
11.2.1 General	18
11.2.2 Stroboscopic effect visibility meter.....	18
11.2.3 Electrical power source parameters	18

11.2.4	Electromagnetic compatibility and test environment	19
11.2.5	Light sensor and amplifier	19
11.2.6	Overall noise-level of the setup	19
11.2.7	Repeatability	19
11.3	Quality assurance	19
Annex A (normative)	Specification of the stroboscopic effect visibility meter	20
A.1	Background	20
A.2	Detailed specifications of the stroboscopic effect meter	21
A.2.1	Schematic of the SVM meter	21
A.2.2	Block a: illuminance adapter	21
A.2.3	Block b: calculation of spectrum	22
A.2.4	Block c: weighting with the stroboscopic effect sensitivity curve	22
A.2.5	Block d: summation of the weighted spectrum	22
A.3	Numerical implementation of SVM	23
A.4	Example	24
A.5	Verification waveform of the stroboscopic effect meter	24
A.6	Example of SVM implementation in MATLAB®	27
Annex B (informative)	Uncertainty considerations	28
B.1	General	28
B.2	General symbols	28
B.3	Measurand	28
B.4	Influence quantities	28
Annex C (informative)	Examples of test results	31
C.1	SVM measurement results of conventional lighting equipment	31
C.2	SVM test under dimming conditions	32
Bibliography	34
Figure 1	– Schematic of the stroboscopic effect measurement method	10
Figure 2	– Different possible applications for an SVM test	11
Figure 3	– Schematic of the TLA measurement method	12
Figure 4	– Dimmer compatibility testing	17
Figure 5	– Controlgear testing	17
Figure A.1	– Structure of the stroboscopic effect visibility meter	21
Figure A.2	– SVM sensitivity threshold T	23
Figure A.3	– Example of an illuminance signal with a ripple	26
Figure B.1	– Fishbone diagram representing the categories of influence quantities contributing to the uncertainty of the SVM measurement	29
Figure C.1	– Normalized light ripple of conventional lighting equipment	32
Figure C.2	– Graphical SVM results of four samples of lighting equipment under dimming conditions	33
Table A.1	– Specification of the parameters of the verification waveforms	27
Table B.1	– Influence quantities and their recommended tolerances	30
Table C.1	– Numerical results of SVM calculations of conventional lighting equipment	31
Table C.2	– Numerical results of SVM calculations of four samples of lighting equipment under dimming conditions	33

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**EQUIPMENT FOR GENERAL LIGHTING PURPOSES –
OBJECTIVE TEST METHOD FOR STROBOSCOPIC
EFFECTS OF LIGHTING EQUIPMENT**

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.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

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 63158, which is a Technical Report, has been prepared by IEC technical committee 34: Lamps and related equipment.

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

Draft TR	Report on voting
34/436/DTR	34/496/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.

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,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

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 flux. 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 “temporal light artefacts” (TLAs) and these 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 [1][3]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).

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 controlgear topology;
- dimming technology of externally applied dimmers 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 stroboscopic effect are considered as poor quality lighting.

Until recently, modulation depth (MD) – also called percent flicker – and flicker index (FI) were often used to quantify flicker or stroboscopic effect. It has been shown that both these metrics are not able to objectively score the level of flicker or stroboscopic effect as actually perceived by humans [1]. Therefore, instead of MD and FI, for ‘flicker’ the IEC-standardized ‘short-term flicker severity’ (P_{st}^{LM}) is used, which is derived from the widely applied and accepted IEC-standardized P_{st} metric to assess the impact of voltage fluctuations on flicker [5]. For the objective assessment of stroboscopic effect, the stroboscopic effect visibility measure (SVM) is available [6].

In 2013, a clear need was identified for an objective test method for testing lighting equipment against flicker caused by voltage fluctuations induced by switching loads such as household appliances. Technical committee 34 developed and verified an objective test method for flicker using the flicker metric P_{st}^{LM} . This objective flicker test method is described in IEC 61547-1 [5].

In recent years the interest in objective testing of stroboscopic effect has also increased considerably. In the near future, CIE will start developing a basic standard on TLA metrology including objective test methods for flicker and stroboscopic effect.

This document provides practical considerations and application examples on how to objectively quantify the stroboscopic effect performance of lighting equipment in terms of SVM.

¹ Numbers in square brackets refer to the Bibliography.

EQUIPMENT FOR GENERAL LIGHTING PURPOSES – OBJECTIVE TEST METHOD FOR STROBOSCOPIC EFFECTS OF LIGHTING EQUIPMENT

1 Scope

This document describes an objective stroboscopic effect visibility (SVM) meter, which can be applied for performance testing of lighting equipment under different operational conditions.

The stroboscopic effects considered in this document are limited to the objective assessment by a human observer of visible stroboscopic effects of temporal light modulation of lighting equipment in general indoor applications, with typical indoor light levels ($> 100 \text{ lx}$) and with moderate movements of an observer or nearby handled object ($< 4 \text{ m/s}$). Details on restriction of the applicability of the stroboscopic effect visibility measure is given in Clause A.1.

For assessing unwanted stroboscopic effects in other applications, such as the misperception of rapidly rotating or moving machinery in an industrial environment for example, other metrics and methods can be required.

The object of this document is to establish a common and objective reference for evaluating the performance of lighting equipment in terms of stroboscopic effect. Temporal changes in the colour of the light (chromatic effects) are not considered in this test. This document describes the methodology for SVM and does not define any limits.

The objective method and procedure described in this document are based on CIE TN 006:2016 on temporal light artefacts (TLAs).

The method described in this document can be applied to objectively assess the stroboscopic effect of lighting equipment that is powered from any type of source, AC mains, DC mains, battery fed or fed through an external dimmer.

2 Normative references

There are no normative references in this document.

3 Terms, definitions, abbreviated terms and symbols

3.1 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1.1

auxiliary equipment

AuxEq

peripheral equipment that is part of the system under test