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TECHNICAL REPORT

Electrical interface specification for phase-cut dimmer in phase-cut dimmed lighting systems

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IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

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ELECTRICAL INTERFACE SPECIFICATION FOR PHASE-CUT DIMMER IN PHASE-CUT DIMMED LIGHTING SYSTEMS

FOREWORD

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IEC TR 63036, which is a technical report, has been prepared by subcommittee 23B: Plugs, socket-outlets and switches, of IEC technical committee 23: Electrical accessories.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
23B/1201/DTR	23B/1214/RVC

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

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- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
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INTRODUCTION

This document describes the technical requirements for phase-cut dimmers to work with controlgear and self ballasted lamps. For a complete picture of the technical requirements the reader should also refer to IEC TR 63037 that contains technical requirements and testing methods for controlgear and self ballasted lamps.

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ELECTRICAL INTERFACE SPECIFICATION FOR PHASE-CUT DIMMER IN PHASE-CUT DIMMED LIGHTING SYSTEMS

1 Scope

This technical report specifies the electrical interface and test procedures for the control by mains voltage phase-cut dimming of the brightness of mains operated electronic lighting equipment intended to be controlled by mains voltage phase-cut dimmers, such as LED integrated lamps, and light sources with external control gear.

Electronic switches that use a comparable circuitry to a phase-cut dimmer but do not contain means for the adjustability of the phase-cut angle should fulfill the same requirements as a phase-cut dimmer.

Safety requirements are not covered by this document, but by respective product standards.

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 60038, *IEC standard voltages*

IEC 60050-845, *International Electrotechnical Vocabulary (IEV) – Part 845: Lighting* (available at www.electropedia.org)

IEC 60364 (all parts), *Low-voltage electrical installations*

IEC 62504, *General lighting – Light emitting diode (LED) products and related equipment – Terms and definitions*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62504 and IEC 60050-845 as well as the following apply.

3.1
lighting system
combination of a phase-cut dimmer and one or more controlgear and light sources

3.2
off state
state of a lighting system when no light is emitted

3.3
on state
state of a lighting system when light is emitted

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3.4
electrical interface
electrical parameters for supplying power and making the exchange of information between the phase-cut dimmer and controlgear possible

3.5
phase-cut dimmer
electronic switch that is connected in series with a load and changes the supply voltage waveform applied to the load from the pure mains voltage waveform to a leading edge (forward phase) or a trailing edge (reverse phase) AC voltage waveform or is capable of switching between both waveforms

Note 1 to entry: The output voltage waveform of a phase-cut dimmer is applied to one or more loads.

Note 2 to entry: The conduction angle of the voltage waveform is adjustable.

Note 3 to entry: Within this document, where the term “dimmer” is used the term “phase-cut dimmer” is meant.

3.6
two-wire phase-cut dimmer
phase-cut dimmer that is connected in series with the load and has no connection to neutral

3.7
three-wire phase-cut dimmer
phase-cut dimmer that is connected in series with the load and has in addition a connection to neutral

3.8
controlgear
device between the phase-cut dimmer and one or more lamps which may serve to transform the AC mains power, limit the current of the lamp(s) to the required value, provide starting voltage and preheating current, prevent cold starting, correct power factor or reduce radio interference

Note 1 to entry: Lamps may have integrated controlgear such as an integrated LED lamp. Any references to controlgear will include any such integrated lamps.

3.9
load side
wire from the output of the phase-cut dimmer to the supply input of one or more controlgear

3.10
conducting period
time period during which the phase-cut dimmer supplies power to a controlgear

3.11
non-conducting period
time period during which the phase-cut dimmer does not supply power to a controlgear

3.12
half wave
positive or negative 180° of an AC sine wave starting and ending at the zero crossing point

3.13
phase angle
position within a half wave expressed in degree, being in the range of 0° to 180°, in reference to the beginning of the half wave

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4 General description

A phase-cut dimmer either cuts the mains voltage immediately after the zero crossing of the mains (leading edge) or towards the next projected zero crossing of the mains (trailing edge). The functionality of both methods may be implemented in one device (universal dimmers).

This document describes requirements for phase-cut dimmers during the on state of a lighting system. Specifications are provided dependent on the dimming method for the conducting period and the non-conducting period of the phase-cut dimmer and the transitions between conducting and non-conducting period.

In addition, this document describes requirements for phase-cut dimmers during the off state of a lighting system. Specifications are provided independently from the dimming method.

5 General requirements

5.1 Voltage rating

This document applies to one or more of the following mains voltages:

100 V, 120 V, 200 V, 230 V, 277 V, according to IEC 60038.

5.2 Frequency rating

This document applies to one or more of the following mains frequencies:

50 Hz or 60 Hz, according to IEC 60038.

5.3 Marking of phase-cut dimmer

The following information should be provided by the manufacturer on the product or in the accompanying instruction sheets.

Phase-cut dimmers requiring more than one controlgear to function properly should be marked with the required minimum number of connected controlgear.

Phase-cut dimmers requiring a minimum load should be marked with the required minimum load.

Phase-cut dimmers should be marked with the following indication:

DIM

6 Description of the lighting system and its components

6.1 Wiring method

The wiring of the devices is in accordance with the installation rules given in the IEC 60364 series and also with the national wiring rules applicable in the country where the devices are installed.

6.2 Wiring diagram

The wiring of the lighting system uses the traditional method of connecting the phase-cut dimmer to the mains and to the controlgear. Figure 1 is an example of a lighting system with one phase-cut dimmer and one or two controlgear(s).

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Regarding the connections of the phase-cut dimmer shown in Figure 1, the drawn lines represent a two-wire installation and the dashed line represents the direct connection of the phase-cut dimmer to the mains which is used in three-wire installations.

The direct connection of the phase-cut dimmer to neutral (dashed line in Figure 1) will have consequences on the power supply requirements and synchronization to the phase-cut dimmer.

This document defines requirements that enable compatibility between phase-cut dimmers and controlgear in two-wire installations. However, all predications are also valid for three-wire phase-cut dimmers to ensure proper operation of controlgear.

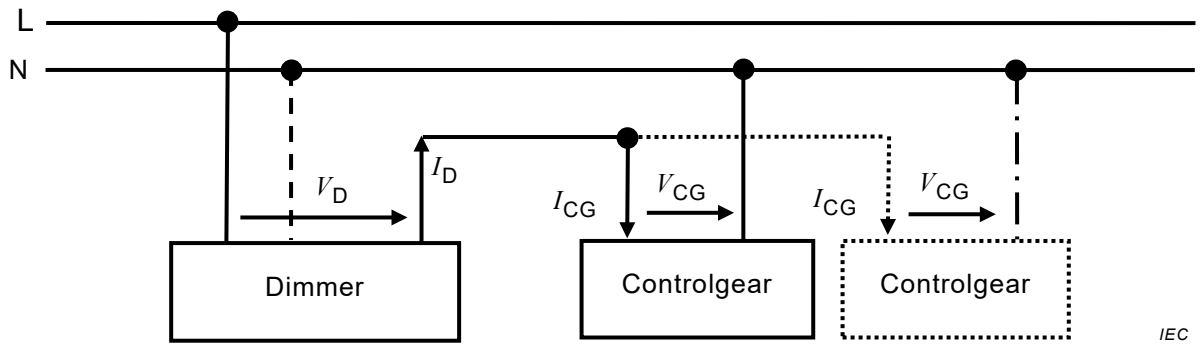

Figure 1 – Example of wiring diagram

7 Electrical specification

7.1 Overview

To describe the electrical characteristics of the electrical interface, the following abbreviations are used:

α_x Angle where the test voltage starts rising with the given slew rate SR as shown in Figure A.1

β_x Angle where the test voltage starts falling with the given slew rate SR as shown in Figure A.2

C_f Filter capacitor to reduce high frequency disturbances

EC_CG Equivalent circuit that represents a controlgear for phase-cut dimmer testing purposes

EC_D Equivalent circuit that represents a phase-cut dimmer for controlgear testing purposes

I_{CG} Current through the input terminals of the controlgear (see Figure 1)

I_{CG_pk} Repetitive peak current of the controlgear in leading edge mode

I_{CG_SL} Current-carrying capability of the controlgear with $V_{CG} \leq V_{SW}$ in leading edge mode

I_{CG_STH} Current -carrying capability of the controlgear with $V_{CG} \leq V_{SW}$ in trailing edge mode

I_{CG_STL} Current-carrying capability of the controlgear with $V_{CG} > V_{SW}$ in trailing edge mode

I_D Current through the load side terminal of the phase-cut dimmer (see Figure 1)

I_{D_nc} Maximum current through the phase-cut dimmer during the non-conducting period, limited by the phase-cut dimmer

I_{PO} Minimum current carrying capability of the controlgear during the electronic off state

I_{trans} Current sourced by the phase-cut dimmer during the transition from the conducting to the non-conducting state in trailing edge mode

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