



BSI Standards Publication

Digital addressable lighting interface

Part 102: General requirements – Control gear

National foreword

This British Standard is the UK implementation of EN 62386-102:2014+A1:2018. It is identical to IEC 62386-102:2014, incorporating amendment 1:2018. It supersedes BS EN 62386-102:2014, which will be withdrawn on 2 November 2021.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to IEC text carry the number of the IEC amendment. For example, text altered by IEC amendment 1 is indicated by **A1** **A1**.

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A list of organizations represented on this committee can be obtained on request to its committee manager.

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31 March 2019	Implementation of IEC amendment 1:2018 with CENELEC endorsement A1:2018
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English Version

**Digital addressable lighting interface -
Part 102: General requirements - Control gear
(IEC 62386-102:2014)**

Interface d'éclairage adressable numérique -
Partie 102: Exigences générales - Appareillages de
commande
(CEI 62386-102:2014)

Digital adressierbare Schnittstelle für die Beleuchtung -
Teil 102: Allgemeine Anforderungen - Betriebsgeräte
(IEC 62386-102:2014)

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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

Foreword

The text of document 34C/1099/FDIS, future edition 2 of IEC 62386-102, prepared by SC 34C "Auxiliaries for lamps" of IEC/TC 34 "Lamps and related equipment" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 62386-102:2014.

The following dates are fixed:

- latest date by which the document has to be (dop) 2015-09-12
implemented at national level by
publication of an identical national
standard or by endorsement
- latest date by which the national (dow) 2017-12-12
standards conflicting with the
document have to be withdrawn

This document supersedes EN 62386-102:2009.

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Endorsement notice

The text of the International Standard IEC 62386-102:2014 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 60598-1	NOTE	Harmonized as EN 60598-1.
IEC 60669-2-1	NOTE	Harmonized as EN 60669-2-1.
IEC 60921	NOTE	Harmonized as EN 60921.
IEC 60923	NOTE	Harmonized as EN 60923.
IEC 60925 ¹⁾	NOTE	Harmonized as EN 60925 ¹⁾ .
IEC 61547	NOTE	Harmonized as EN 61547.
IEC 62386-102:2009	NOTE	Harmonized as EN 62386-102:2009.
CISPR 15	NOTE	Harmonized as EN 55015.

Foreword to amendment A1

The text of document 34/523/FDIS, future IEC 62386-102/A1, prepared by IEC/TC 34 "Lamps and related equipment" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 62386-102:2014/A1:2018.

The following dates are fixed:

- latest date by which the document has to be implemented at national (dop) 2019-08-02
level by publication of an identical national standard or by endorsement
- latest date by which the national standards conflicting with the (dow) 2021-11-02
document have to be withdrawn

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¹⁾ Withdrawn publication.

Endorsement notice

The text of the International Standard IEC 62386-102:2014/A1:2018 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 61347 (series) NOTE Harmonized as EN 61347 (series)

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

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.

NOTE 1 Where 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 62386-101	2014	Digital addressable lighting interface - Part 101: General requirements - System components	EN 62386-101	2014
+A1	2018		+A1	2018
IEC 62386-103	2014	Digital addressable lighting interface - Part 103: General requirements - Control devices	EN 62386-103	2014
+A1	2018		+A1	2018

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

DIGITAL ADDRESSABLE LIGHTING INTERFACE –

Part 102: General requirements – Control gear

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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International Standard IEC 62386-102 has been prepared by subcommittee 34C: Auxiliaries for lamps, of IEC technical committee 34: Lamps and related equipment.

This second edition cancels and replaces the first edition published in 2009. This edition constitutes a technical revision.

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

- a) elimination of all non-control gear relevant definitions,
- b) improvement of the requirements for control gear by clarifying the description,
- c) improvement of the test command iterations to increase the compatibility,
- d) addition of new commands, and
- e) the deletion of the requirements for:

- 1) timing;
- 2) control devices.

The requirements for timing are now in Part 101 and the requirements for control devices are in Part 103.

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

FDIS	Report on voting
34C/1099/FDIS	34C/1112/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.

This Part 102 is intended to be used in conjunction with Part 101, which contains general requirements for the relevant product type (system), and with the appropriate Part 2xx (particular requirements for control gear) containing clauses to supplement or modify the corresponding clauses in Parts 101 and 102 in order to provide the relevant requirements for each type of product.

A list of all parts of the IEC 62386 series, under the general title: *Digital addressable lighting interface*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC website 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.

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

IEC 62386 contains several parts, referred to as series. The 1xx series includes the basic specifications. Part 101 contains general requirements for system components, Part 102 extends this information with general requirements for control gear and Part 103 extends it further with general requirements for control devices.

The 2xx parts extend the general requirements for control gear with lamp specific extensions (mainly for backward compatibility with Edition 1 of IEC 62386) and with control gear specific features.

The 3xx parts extend the general requirements for control devices with input device specific extensions describing the instance types as well as some common features that can be combined with multiple instance types.

A1 This second edition of IEC 62386-102 is intended to be used in conjunction with IEC 62386-101:2014 and IEC 62386-101:2014/AMD1:2018 and with the various parts that make up the IEC 62386-2xx series for control gear, together with IEC 62386-103:2014 and IEC 62386-103:2014/AMD1:2018 and the various parts that make up the IEC 62386-3xx series of particular requirements for control devices. **A1** The division into separately published parts provides for ease of future amendments and revisions. Additional requirements will be added as and when a need for them is recognised.

The setup of the standard is graphically represented in Figure 1 below.

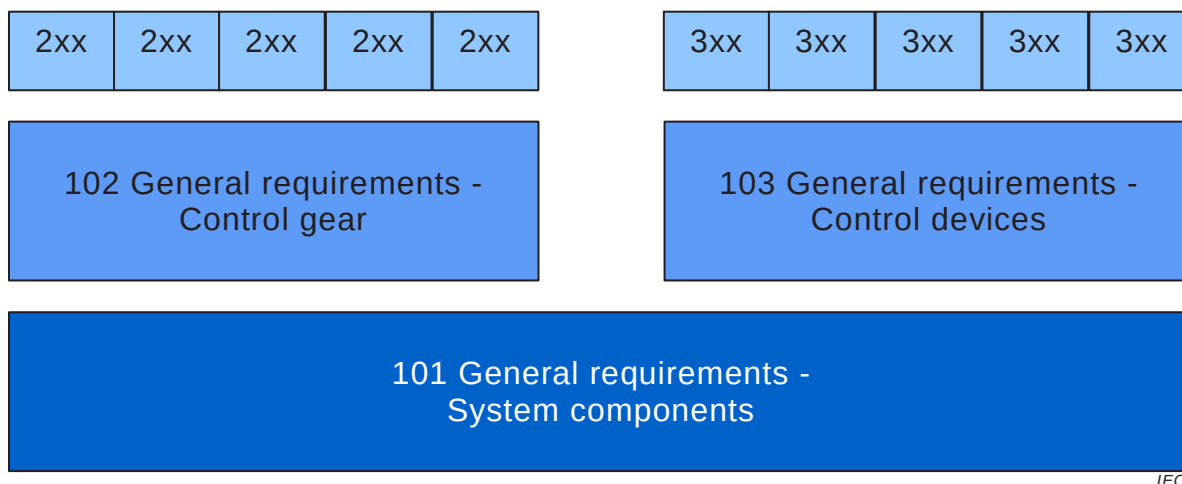


Figure 1 – IEC 62386 graphical overview

When this part of IEC 62386 refers to any of the clauses of the other two parts of the IEC 62386-1xx series, the extent to which such a clause is applicable and the order in which the tests are to be performed are specified. The other parts also include additional requirements, as necessary.

All numbers used in this International Standard are decimal numbers unless otherwise noted. Hexadecimal numbers are given in the format 0xVV, where VV is the value. Binary numbers are given in the format XXXXXXXXb or in the format XXXX XXXX, where X is 0 or 1 and "x" in binary numbers means "don't care".

The following typographic expressions are used:

Variables: *variableName* or *variableName[3:0]*, giving only bits 3 to 0 of *variableName*

Range of values: [lowest, highest]

Command: "COMMAND NAME"

DIGITAL ADDRESSABLE LIGHTING INTERFACE –

Part 102: General requirements – Control gear

1 Scope

This Part of IEC 62386 is applicable to control gear in a bus system for control by digital signals of electronic lighting equipment ^{A1} which is in line with the requirements of IEC 61347 (all parts), with the addition of DC supplies. ^{A1}

NOTE Tests in this standard are type tests. Requirements for testing individual control gear during production are not included.

2 Normative references

^{A1} 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 62386-101:2014, *Digital addressable lighting interface – Part 101: General requirements – System components*
IEC 62386-101:2014/AMD1:2018

IEC 62386-103:2014, *Digital addressable lighting interface – Part 103: General requirements – Control devices*
IEC 62386-103:2014/AMD1:2018 ^{A1}

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62386-101 and the following apply.

^{A1} 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> ^{A1}

3.1

actual level

value representing the current light output

3.2

arc power

power supplied to the light sources (lamps)

3.3

broadcast

type of address used to address all control gear in the system at once

3.4

broadcast unaddressed

type of address used to address all control devices in the system that have no short address at once

3.5

DAPC

direct arc power control

a method to directly control the light output

Note 1 to entry: The note to entry in French concerns the French text only.

3.6

DTR

data transfer register

multipurpose register used to exchange data

Note 1 to entry: The note to entry in French concerns the French text only.

3.7

group address

type of address used to address a group of control gear in the system all at once

3.8

GTIN

global trade item number

number used for the unique identification of trade items worldwide

Note 1 to entry: For further information see <http://en.wikipedia.org/wiki/GTIN>

Note 2 to entry: The number is comprised of a GS1 or U.P.C. company prefix followed by an item reference number and a check digit. It is described in the "GS1 General Specifications".

Note 3 to entry: The note 3 to entry in French concerns the French text only.

3.9

identification

temporary state used during commissioning that allows the installer to identify particular control gear

3.10

level

8 bit value

3.11

MASK

the value 0xFF

3.12

monotonic

a function f defined on a subset of the real numbers with real values is called monotonically non-decreasing, if for all x and y such that $x \leq y$ one has $f(x) \leq f(y)$, so f preserves the order. Likewise, a function is called monotonically non-increasing if, whenever $x \leq y$, then $f(x) \geq f(y)$, so it reverses the order. For this standard monotonic is defined as either monotonically non-decreasing or monotonically non-increasing

3.13

NO

 answer used to deny or refuse a query

Note 1 to entry: If a query is asked where the answer is NO, there will be no response, such that the sender of the query will conclude "no backward frame" following IEC 62386-101:2014 and IEC62386-101:2014/AMD1:2018, 8.2.5.

Note 2  to entry: The answer NO could also be triggered by a missed query.

3.14**NVM**

non-volatile read/write memory, the content of which can be changed and will not be lost due to a power cycle

3.15**opcode****operation code**

 part of a forward frame that identifies the command to be executed 

3.16**operating mode**

set of states identified by a number in the range [0,255], characterised by a collection of variables and memory settings, and used to select a set of functionality to be exhibited by a control gear, including its required reaction to commands

Note 1 to entry: Control gear may support more than one operating mode

3.17**PHM**

physical minimum level corresponding to the minimum light output the control gear can operate at

3.18**RAM**

volatile read/write memory, the content of which can be changed and will be lost due to a power cycle

3.19**random address**

random 24 bit number generated by the control gear on request during system initialisation

Note 1 to entry: Annex A.1 provides an example of how the search and random addresses are used.

3.20**reset state**

state in which all NVM variables of the control gear have their reset value, except those that are marked “no change” or are otherwise explicitly excluded

3.21**ROM**

non-volatile read only memory, the content of which is fixed

Note 1 to entry: In this standard read only is meant from a system perspective. A ROM variable may actually be implemented in NVM, but this standard does not provide any mechanism to change its value.

3.22**scene**

configurable preset level

3.23**search address**

24 bit number used to identify an individual control gear in the system during initialisation

Note 1 to entry: Annex A.1 provides an example of how the search and random addresses are used.

3.24**short address**

type of address used to address an individual control gear in the system

3.25

startup

time needed to change from lamp off to normal operation of the lamp or failure state

Note 1 to entry: This time includes preheat and ignition.

3.26

strictly monotonic

a function f defined on a subset of the real numbers with real values is called monotonically increasing, if for all x and y such that $x < y$ one has $f(x) < f(y)$, so f preserves the order. Likewise, a function is called monotonically decreasing if, whenever $x < y$, then $f(x) > f(y)$, so it reverses the order. For this standard strictly monotonic is defined as either monotonically increasing or monotonically decreasing

3.27

target level

the target light output expected after completion of the current level command

3.28

YES

 answer used to accept or affirm a query 

 Note 1 to entry: If a query is asked where the answer is YES, the response will be a backward frame containing the value of MASK. 

4 General

4.1 General

 The requirements of IEC 62386-101:2014 and IEC 62386-101:2014/AMD1:2018, Clause 4 apply, with the restrictions, changes and additions identified below. 

4.2 Version number

 This subclause replaces IEC 62386-101:2014 and IEC 62386-101:2014/AMD1:2018, 4.2. 

The version shall be in the format "x.y", where the major version number x is in the range of 0 to 62 and the minor version number y is in the range of 0 to 2. When the version number is encoded into a byte, the major version number x shall be placed in bits 7 to 2 and the minor version number y shall be placed in bits 1 to 0.

At each amendment to an edition of IEC 62386-102 the minor version number shall be incremented by one.

At a new edition of IEC 62386-102 the major version number shall be incremented by one and the minor version number shall be set to 0.

 The current version number is "versionNumber" as defined in Table 14. 

NOTE Normally 2 amendments on IEC documents are made before a new edition is created.

5 Electrical specification

 The requirements of IEC 62386-101:2014 and IEC 62386-101:2014/AMD1:2018, Clause 5 apply. 

6 Interface power supply

 If a bus power supply is integrated into a control gear, the requirements of IEC 62386-101:2014 and IEC 62386-101:2014/AMD1:2018, Clause 6 apply. 

7 Transmission protocol structure

7.1 General

 The requirements of IEC 62386-101:2014 and IEC 62386-101:2014/AMD1:2018, Clause 7 apply, with the following additions. 

7.2 16 bit forward frame encoding

7.2.1 General

For commands, the 16 bit forward frame shall be encoded as is depicted in Table 1.

Table 1 – 16-bit command frame encoding

Bytes/Bits								Device addressing method		
Address byte							Opcode byte			
15	14	13	12	11	10	9	8 ^a		7...0	
0	64 short addresses						x			Short addressing
1	0	0	16 group addresses			x	Group addressing			
1	1	1	1	1	1	0	x	Broadcast unaddressed		
1	1	1	1	1	1	1	x	Broadcast		
1010 0000 to 1100 1011								Special command		
1100 1100 to 1111 1011								Reserved		
^a Selector bit, see 7.2.2; 0 indicates DAPC, 1 indicates other command										

7.2.2 Address byte

The address byte provides

- the method of device addressing used by the application controller;
- the type of command transmitted in the opcode byte;
Bit 8 = '1': standard command;
Bit 8 = '0': direct arc power control (DAPC) command;
- address spaces for special commands;
- reserved device addresses.

Reserved addresses should not be used by the application controller.

7.2.3 Opcode byte

The opcode byte provides

- for DAPC commands, the requested light output;
- for standard commands, the opcode;
- command specific information for special commands;
- reserved information for reserved commands.

8 Timing

 The requirements of IEC 62386-101:2014 and IEC 62386-101:2014/AMD1:2018, Clause 8 apply. 

9 Method of operation

9.1 General

A1 The requirements of IEC 62386-101:2014 and IEC 62386-101:2014/AMD1:2018, Clause 9 apply with the following additions. **A1**

9.2 Control gear

A1 9.2.1 General

Control gear may receive commands from an application controller. The application controller is specified in IEC 62386-103:2014 and IEC 62386-103:2014/AMD1:2018.

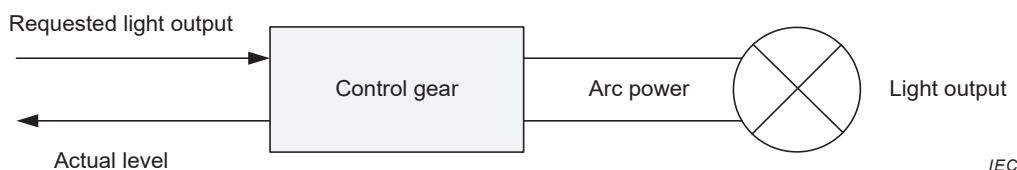


Figure 2 – Control gear directly operating a light source

Figure 2 shows how the various levels lead to light output. The maximum (light) output level of a control gear is referred to as 100 %. All levels are specified in a relative way. Physically there is a minimum that the control gear can supply whilst there is still light output. This is known as the physical minimum level (PHM).

NOTE PHM is control gear specific, and is greater than 0.

9.2.2 Control gear phases

9.2.2.1 General

Depending on the light source various phases of operation can be identified within a control gear. In general these are as follows.

9.2.2.2 Standby

During this phase, the lamp is off and only in this phase both “*targetLevel*” and “*actualLevel*” are 0.

9.2.2.3 Startup

Startup is a transitional phase changing from standby to normal operation or failure. This phase is sometimes noticeable as a delay. Examples are:

- preheat: the lamp is heated to prepare for ignition. This is typically seen for fluorescent light sources;
- ignition: the lamp is ignited. This is typically seen for HID light sources and fluorescent light sources after preheat;
- power stage preparation.

For further information and exceptions refer to 9.16.3.

9.2.2.4 Normal operation

While in normal operation the lamp is emitting light and can be operated as expected.

For further information and exceptions refer to 9.16.3.

9.2.2.5 Failure

During the failure phase the lamp cannot be operated as expected.

For further information and exceptions refer to 9.16.3. **A1**

9.3 Dimming curve

The dimming curve determines how the level shall be translated into light output.

An “*actualLevel*” greater than or equal to 1 and less than or equal to 254 shall be translated into light output according to

$$\text{Light output (actualLevel)} = 10^{\frac{\text{actualLevel}-1}{253/3}-1} \%.$$

Light output is expressed relative to the maximum possible light output of a given control-gear-lamp combination. The dimming curve starts at 0,1 % for “*actualLevel*” equal to 0x01 and ends at 100 % for “*actualLevel*” equal to 0xFE. The dimming curve is strictly monotonic, and the relative accuracy shall be $\pm\frac{1}{2}$ step. This shall be tested using a fade, excluding PHM.

NOTE 1 The dimming curve is intended to compensate the light sensitivity curve of the human eye.

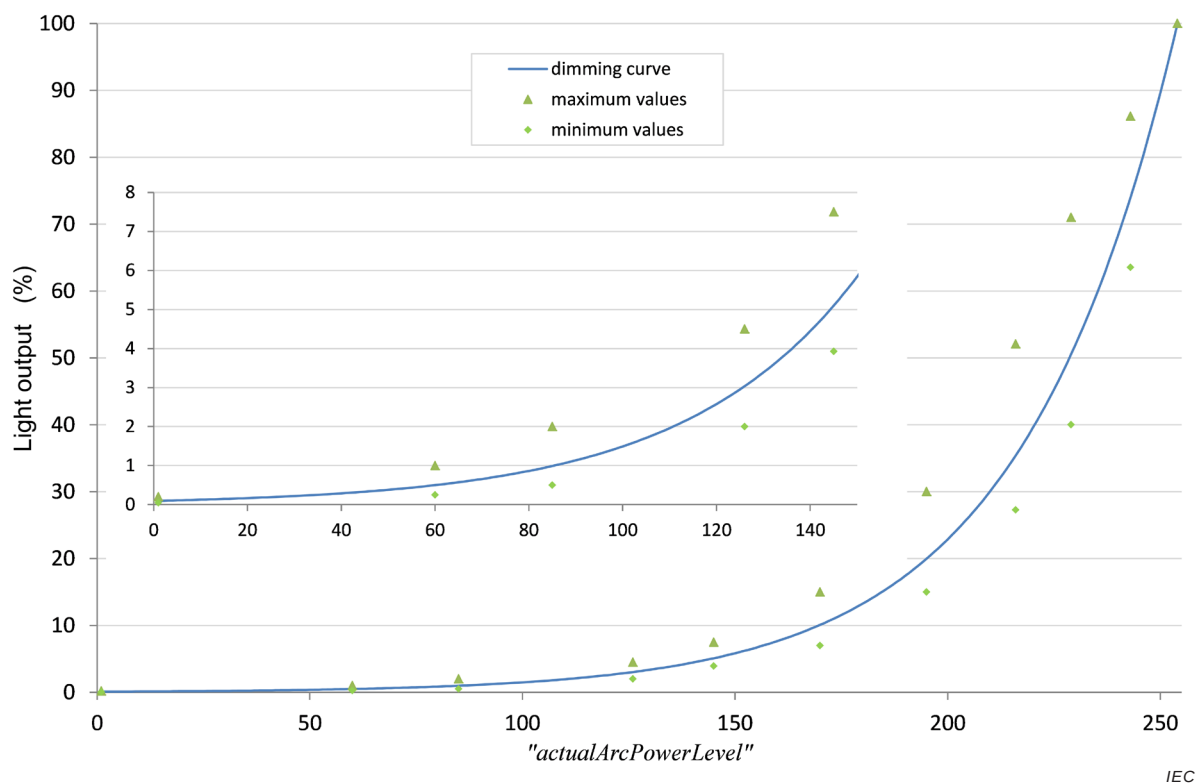


Figure 3 – Dimming curve

The accuracy of light output is specified by the test points given in Table 2. The test points of Table 2 and the dimming curve are depicted in Figure 3, and Table 3 shows the light output versus the level. The lamp type or load used during testing shall be stated for

reproducibility.

NOTE 2 The minimum and maximum values are based on the test values that can be found in IEC 62386-102:2009.

Table 2 – Dimming curve tolerance (% , rounded to two decimals)

Level	1	60	85	126	145	170	195	216	229	243	254
Minimum value	0,05	0,25	0,50	2,00	3,93	7,00	15,00	27,28	40,00	63,53	
Nominal value	0,10	0,50	0,99	3,04	5,10	10,09	19,97	35,43	50,53	74,05	100,00
Maximum value	0,20	1,00	2,00	4,50	7,50	15,0	30,00	52,09	71,00	86,14	

Table 3 – Dimming curve

Level	Light output	Level	Light output	Level	Light output	Level	Light output	Level	Light output
1	0.100	52	0.402	103	1.620	154	6.520	205	26.241
2	0.103	53	0.414	104	1.665	155	6.700	206	26.967
3	0.106	54	0.425	105	1.711	156	6.886	207	27.713
4	0.109	55	0.437	106	1.758	157	7.076	208	28.480
5	0.112	56	0.449	107	1.807	158	7.272	209	29.269
6	0.115	57	0.461	108	1.857	159	7.473	210	30.079
7	0.118	58	0.474	109	1.908	160	7.680	211	30.911
8	0.121	59	0.487	110	1.961	161	7.893	212	31.767
9	0.124	60	0.501	111	2.015	162	8.111	213	32.646
10	0.128	61	0.515	112	2.071	163	8.336	214	33.550
11	0.131	62	0.529	113	2.128	164	8.567	215	34.479
12	0.135	63	0.543	114	2.187	165	8.804	216	35.433
13	0.139	64	0.559	115	2.248	166	9.047	217	36.414
14	0.143	65	0.574	116	2.310	167	9.298	218	37.422
15	0.147	66	0.590	117	2.374	168	9.555	219	38.457
16	0.151	67	0.606	118	2.440	169	9.820	220	39.522
17	0.155	68	0.623	119	2.507	170	10.091	221	40.616
18	0.159	69	0.640	120	2.577	171	10.371	222	41.740
19	0.163	70	0.658	121	2.648	172	10.658	223	42.895
20	0.168	71	0.676	122	2.721	173	10.953	224	44.083
21	0.173	72	0.695	123	2.797	174	11.256	225	45.303
22	0.177	73	0.714	124	2.874	175	11.568	226	46.557
23	0.182	74	0.734	125	2.954	176	11.888	227	47.846
24	0.187	75	0.754	126	3.035	177	12.217	228	49.170
25	0.193	76	0.775	127	3.119	178	12.555	229	50.531
26	0.198	77	0.796	128	3.206	179	12.902	230	51.930
27	0.203	78	0.819	129	3.294	180	13.260	231	53.367
28	0.209	79	0.841	130	3.386	181	13.627	232	54.844
29	0.215	80	0.864	131	3.479	182	14.004	233	56.362
30	0.221	81	0.888	132	3.576	183	14.391	234	57.922
31	0.227	82	0.913	133	3.675	184	14.790	235	59.526
32	0.233	83	0.938	134	3.776	185	15.199	236	61.173
33	0.240	84	0.964	135	3.881	186	15.620	237	62.866
34	0.246	85	0.991	136	3.988	187	16.052	238	64.607
35	0.253	86	1.018	137	4.099	188	16.496	239	66.395
36	0.260	87	1.047	138	4.212	189	16.953	240	68.233
37	0.267	88	1.076	139	4.329	190	17.422	241	70.121
38	0.275	89	1.105	140	4.449	191	17.905	242	72.062
39	0.282	90	1.136	141	4.572	192	18.400	243	74.057
40	0.290	91	1.167	142	4.698	193	18.909	244	76.107
41	0.298	92	1.200	143	4.828	194	19.433	245	78.213
42	0.306	93	1.233	144	4.962	195	19.971	246	80.378
43	0.315	94	1.267	145	5.099	196	20.524	247	82.603
44	0.324	95	1.302	146	5.240	197	21.092	248	84.889
45	0.332	96	1.338	147	5.385	198	21.675	249	87.239
46	0.342	97	1.375	148	5.535	199	22.275	250	89.654
47	0.351	98	1.413	149	5.688	200	22.892	251	92.135
48	0.361	99	1.452	150	5.845	201	23.526	252	94.686
49	0.371	100	1.492	151	6.007	202	24.177	253	97.307
50	0.381	101	1.534	152	6.173	203	24.846	254	100.000
51	0.392	102	1.576	153	6.344	204	25.534		

9.4 Calculating “targetLevel”

An application controller instructs the control gear on the requested light output and on the behaviour during the transition from the “actualLevel” to the “targetLevel” by means of appropriate opcodes.

The “targetLevel” shall be calculated on the basis of the requested light output as follows:

- 0x00 shall be accepted as “targetLevel” and turn off the light.
- Any value between 0x01 and “minLevel” shall result in “targetLevel”=“minLevel”.
- Any value between “maxLevel” and 0xFE shall result in “targetLevel”=“maxLevel”.
- “MASK” shall have no effect on “targetLevel” except when a fade is running, see subclause 9.5.9.
- All other values shall be accepted as “targetLevel”.

The requested target level calculation of “targetLevel” shall also be applied if the request is based on an internally stored value, such as a scene, “powerOnLevel”, or “systemFailureLevel”.

On every change of “targetLevel”, with the exception of the initialisation caused by a power cycle, the control gear shall update “limitError” (see subclause 9.16.5) and shall set “lastLightLevel” to the new “targetLevel”. If “targetLevel” is not 0x00, “lastActiveLevel” shall be set to “targetLevel”.

9.5 Fading

9.5.1 General

Fading is a linear transition in time from “actualLevel” to “targetLevel”. The “actualLevel”, and thus the light output, shall be strictly monotonic according to the applicable dimming curve.

A fade can be started in two ways:

- using a fade time: this sets a time to use for the fade process;
- using a fade rate: this sets a speed to use for the fade process.

A fade shall not be started if the calculated “targetLevel” is equal to “actualLevel”.

When a fade starts, the fade timer shall be started and “fadeRunning” shall be set to TRUE (see 9.16.6.).

During the fade, the light output shall be maintained as close to the ideal fading curve as possible.

- A1** During a process of fading up, “actualLevel” shall be incremented at a time corresponding to the intersection of an ideal fading curve with the mid-point between “actualLevel” and “actualLevel” + 1. Likewise, when fading down, “actualLevel” shall be decremented at a time corresponding to the intersection of an ideal fading curve with the mid-point between “actualLevel” and “actualLevel” – 1. Figure 4 illustrates this, and applies for fades started using either fade time or fade rate. **A1**

Measurements of fade time / fade rate shall start after the stop condition of the command that triggers it. If the fade takes place immediately after startup, measurement shall be done from the moment “lampOn” is TRUE or, in case of total lamp failure, from the moment “lampFailure” is confirmed TRUE. A fade shall automatically end when the fade timer has been active for the applicable fade time. At this point the fade timer shall be stopped and “fadeRunning” shall be set to FALSE (see subclause 9.16.6.).

This means that the control gear fades to the target level even in case of a total lamp error. If a lamp is to be switched off at the end of the fade, the step from "*minLevel*" to 0x00 shall not contribute to the fade time. The step from "*minLevel*" to 0x00 shall be taken immediately after the fade time has elapsed.

- A1** If a lamp is to be lit at the beginning of the fade and dimmed to a certain value, the step from 0x00 to "*minLevel*" shall not contribute to the fade time. This means that the fade time starts when the startup phase has finished. **A1**

NOTE The transition from 0x00 to "*minLevel*" incorporates startup.

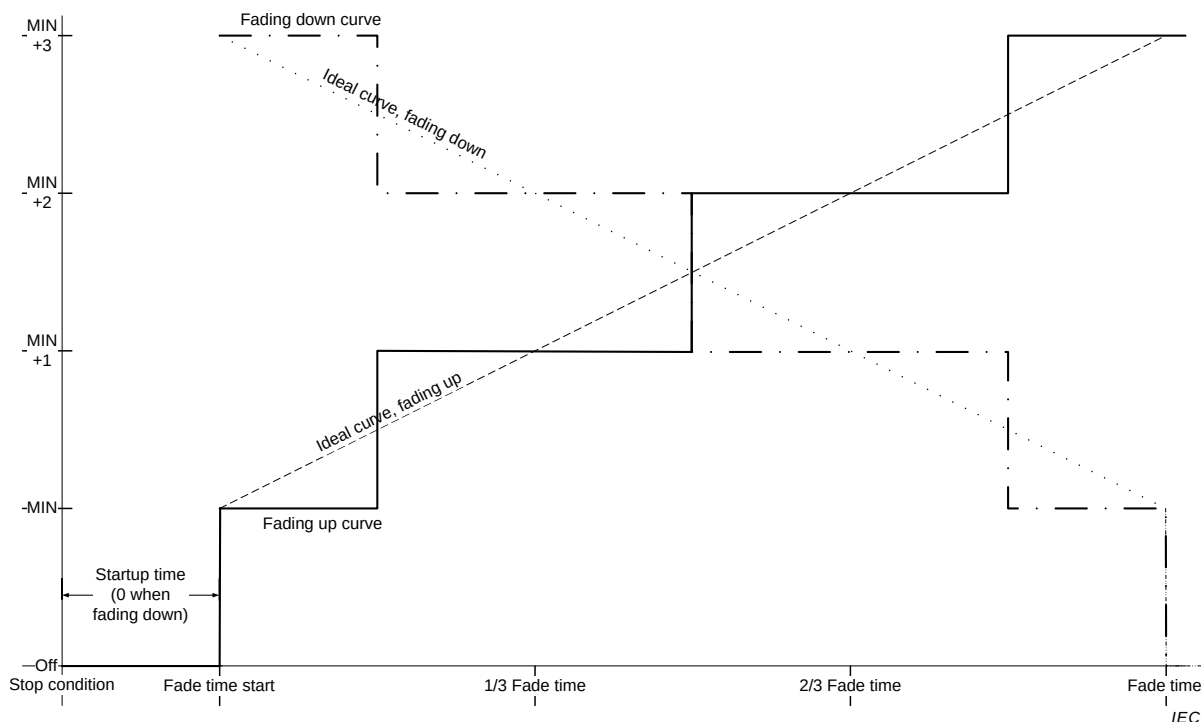


Figure 4 – Level over time, fading up and down

Testing shall be done with "*minLevel*" $\geq$ PHM+1. For further information, see Annex B.

9.5.2 Fade time

The fade time shall be according to Table 4:

"*fadeTime*" shall be set on receipt of the command "SET FADE TIME (DTR0)". "*fadeTime*" can be queried using QUERY FADE TIME/FADE RATE.

The "*fadeTime*" shall be set to a value according to the following steps:

- if "*DTR0*" > 15: 15
- in all other cases: "*DTR0*"

The fade time shall be calculated on the basis of "*fadeTime*" as follows:

- if "*fadeTime*" = 0: use Extended fade time
- if "*fadeTime*" is in the range [1,15]: $\frac{1}{2} \cdot \sqrt{2^{\text{"fadeTime"}}} \cdot 1 \text{ s}$

Table 4 lists the possible fade time values.

Table 4 – Fade times

<i>“fadeTime”</i>	Minimum fade time s	Nominal fade time s	Maximum fade time s
0	Extended fade		
1	0,6	0,7	0,8
2	0,9	1,0	1,1
3	1,3	1,4	1,6
4	1,8	2,0	2,2
5	2,5	2,8	3,1
6	3,6	4,0	4,4
7	5,1	5,7	6,2
8	7,2	8,0	8,8
9	10,2	11,3	12,4
10	14,4	16,0	17,6
11	20,4	22,6	24,9
12	28,8	32,0	35,2
13	40,7	45,3	49,8
14	57,6	64,0	70,4
15	81,5	90,5	99,6

9.5.3 Fade rate

A1 The fade rate shall be according to Table 5: **A1**

“fadeRate” shall be set on receipt of the command “SET FADE RATE (*DTR0*)”. *“fadeRate”* can be queried using QUERY FADE TIME/FADE RATE.

The *“fadeRate”* shall be set to a value according to the following steps:

- if *“DTR0”* > 15: 15
- if *“DTR0”* = 0: 1
- in all other cases: *“DTR0”*

The fade rate shall be calculated on the basis of *“fadeRate”* as follows:

$$\text{Fade rate} = \frac{506}{\sqrt{2^{\text{“fadeRate”}}}} \text{ steps/s.}$$

Table 5 lists the possible fade rate values.