

AS/NZS IEC 62386.102:2024
IEC 62386-102:2022



STANDARDS
Australia



Australian/New Zealand Standard™

Digital addressable lighting interface

Part 102: General requirements — Control gear



AS/NZS IEC 62386.102:2024

This Joint Australian/New Zealand Standard™ was prepared by Joint Technical Committee EL-041, Lighting. It was approved on behalf of Standards Australia's Standards Development and Accreditation Committee on 06 February 2024 and by the New Zealand Standards Approval Board on 01 November 2023.

This Standard was published on 15 March 2024.

The following are represented on Committee EL-041:

- Australian Industry Group
- Better Regulation Division (Fair Trading, SafeWork NSW, TestSafe)
- Consumer Electronics Suppliers Association
- Consumers Federation of Australia
- Department of Climate Change, Energy, the Environment and Water
- Electrical Compliance Testing Association of Australia
- Electrical Regulatory Authorities Council, Australia
- Energy Efficiency & Conservation Authority of New Zealand
- Energy Efficiency Council
- IES: The Lighting Society
- Joint Accreditation System of Australia & New Zealand
- Joint Accreditation System of Australia and New Zealand — New Zealand
- Lighting Council Australia
- Lighting Council New Zealand
- Master Electricians NZ
- National Association of Testing Authorities Australia

This Standard was issued in draft form for comment as DR AS/NZS IEC 62386.102:2024.

Keeping Standards up-to-date

Ensure you have the latest versions of our publications and keep up-to-date about Amendments, Rulings, Withdrawals, and new projects by visiting:

www.standards.org.au

www.standards.govt.nz

ISBN 978 1 76139 553 6

Australian/New Zealand Standard™

Digital addressable lighting interface

Part 102: General requirements — Control gear

First published as AS/NZS 62386.102:2020.
Revised and redesignated as AS/NZS IEC 62386.102:2024.



© IEC Geneva Switzerland 2024 — All rights reserved
© Standards Australia Limited/the Crown in right of New Zealand, administered by the New Zealand Standards Executive 2024

All rights are reserved. No part of this work may be reproduced or copied in any form or by any means, electronic or mechanical, including photocopying, without the written permission of either the IEC or the publisher, unless otherwise permitted under the Copyright Act 1968 (Cth) or the Copyright Act 1994 (New Zealand). If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please see the contact details on the back cover or the contact us page of the website for further information.

Preface

This Standard was prepared by the Australian members of the Joint Standards Australia/Standards New Zealand Committee EL-041, Lighting, to supersede AS/NZS 62386.102:2020, *Digital addressable lighting interface, Part 102: General requirements — Control gear (IEC 62386-102:2014 AMD1:2018 CSV (ED. 2.1) MOD)*.

The objective of this document is to specify requirements for control gear for control by digital signals of electronic lighting equipment.

This document is identical with, and has been reproduced from, IEC 62386-102:2022, *Digital addressable lighting interface — Part 102: General requirements — Control gear*.

As this document has been reproduced from an International Standard, the following applies:

- (a) In the source text “part of IEC 62386” should read “this Australian/New Zealand document”.
- (b) A full point substitutes for a comma when referring to a decimal marker.

Australian or Australian/New Zealand Standards that are identical adoptions of international normative references may be used interchangeably. Refer to the online catalogue for information on specific Standards.

The terms “normative” and “informative” are used in Standards to define the application of the appendices or annexes to which they apply. A “normative” appendix or annex is an integral part of a Standard, whereas an “informative” appendix or annex is only for information and guidance.

Contents

Preface	ii
FOREWORD	vii
INTRODUCTION	ix
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 General	4
4.1 General	4
4.2 Version number	4
5 Electrical specification	4
6 Bus power supply	4
7 Transmission protocol structure	5
7.1 General	5
7.2 16-bit forward frame encoding	5
7.2.1 General	5
7.2.2 Address byte	5
7.2.3 Opcode byte	5
8 Timing	6
9 Method of operation	6
9.1 General	6
9.2 Control gear	6
9.2.1 General	6
9.2.2 Control gear phases	6
9.3 Dimming curve	7
9.4 Calculating "targetLevel"	9
9.5 Fading	10
9.5.1 General	10
9.5.2 Fade time	11
9.5.3 Fade rate	12
9.5.4 Extended fade time	13
9.5.5 Using the fade time	14
9.5.6 Using the fade rate	15
9.5.7 System response to changes during a fade	15
9.5.8 System response to changes during standby and startup	15
9.5.9 Stopping a fade	16
9.6 Min and max level	16
9.7 Commands	17
9.7.1 General	17
9.7.2 Level instructions without fade	17
9.7.3 Level instructions initiating a fade	18
9.7.4 Configuration instructions	18
9.7.5 Queries	18
9.7.6 Special commands	18
9.7.7 Application extended commands	18
9.8 Command iterations	18
9.8.1 General	18
9.8.2 Command iteration of "UP" and "DOWN" commands	18
9.8.3 DAPC SEQUENCE (deprecated)	19
9.9 Modes of operation	19
9.9.1 General	19
9.9.2 Operating mode 0x00: standard mode	19

9.9.3	Operating mode 0x01 to 0x7F: reserved.....	20
9.9.4	Operating mode 0x80 to 0xFF: manufacturer-specific modes.....	20
9.10	Memory banks.....	20
9.10.1	General.....	20
9.10.2	Memory map.....	21
9.10.3	Selecting a memory bank location.....	22
9.10.4	Protectable memory locations.....	22
9.10.5	Memory bank reading.....	22
9.10.6	Memory bank writing.....	24
9.10.7	Memory bank 0.....	25
9.10.8	Memory bank 1 (optional).....	27
9.10.9	Manufacturer-specific memory banks.....	29
9.10.10	Reserved memory banks.....	29
9.11	Reset.....	29
9.11.1	Reset operation.....	29
9.11.2	Reset memory bank operation.....	29
9.12	System failure.....	29
9.13	Power on.....	30
9.14	Assigning short addresses.....	31
9.14.1	General.....	31
9.14.2	Random address allocation.....	31
9.14.3	Identification of a device.....	32
9.14.4	Direct address allocation.....	33
9.15	Failure state behaviour.....	33
9.16	Status information.....	33
9.16.1	General.....	33
9.16.2	Bit 0: Control gear failure.....	33
9.16.3	Bit 1: lamp failure.....	34
9.16.4	Bit 2: lamp on.....	35
9.16.5	Bit 3: limit error.....	35
9.16.6	Bit 4: fade running.....	35
9.16.7	Bit 5: reset state.....	35
9.16.8	Bit 6: missing short address.....	36
9.16.9	Bit 7: power cycle seen.....	36
9.17	Non-volatile memory.....	36
9.18	Device types and features.....	36
9.19	Using scenes.....	37
9.20	Current bus unit configuration.....	37
10	Declaration of variables.....	38
11	Definition of commands.....	40
11.1	General.....	40
11.2	Overview sheets.....	40
11.3	Level instructions.....	45
11.3.1	DAPC (<i>level</i>).....	45
11.3.2	OFF.....	45
11.3.3	UP.....	45
11.3.4	DOWN.....	45
11.3.5	STEP UP.....	45
11.3.6	STEP DOWN.....	46
11.3.7	RECALL MAX LEVEL.....	46
11.3.8	RECALL MIN LEVEL.....	46
11.3.9	STEP DOWN AND OFF.....	47
11.3.10	ON AND STEP UP.....	47
11.3.11	ENABLE DAPC SEQUENCE.....	47
11.3.12	GO TO LAST ACTIVE LEVEL.....	47
11.3.13	CONTINUOUS UP.....	48
11.3.14	CONTINUOUS DOWN.....	48

11.3.15	GO TO SCENE (<i>sceneNumber</i>).....	48
11.4	Configuration instructions.....	48
11.4.1	General.....	48
11.4.2	RESET.....	48
11.4.3	STORE ACTUAL LEVEL IN DTR0.....	48
11.4.4	SET OPERATING MODE (<i>DTR0</i>).....	49
11.4.5	RESET MEMORY BANK (<i>DTR0</i>).....	49
11.4.6	IDENTIFY DEVICE.....	49
11.4.7	SET MAX LEVEL (<i>DTR0</i>).....	50
11.4.8	SET MIN LEVEL (<i>DTR0</i>).....	50
11.4.9	SET SYSTEM FAILURE LEVEL (<i>DTR0</i>).....	50
11.4.10	SET POWER ON LEVEL (<i>DTR0</i>).....	50
11.4.11	SET FADE TIME (<i>DTR0</i>).....	50
11.4.12	SET FADE RATE (<i>DTR0</i>).....	51
11.4.13	SET EXTENDED FADE TIME (<i>DTR0</i>).....	51
11.4.14	SET SCENE (<i>DTR0, sceneX</i>).....	51
11.4.15	REMOVE FROM SCENE (<i>sceneX</i>).....	51
11.4.16	ADD TO GROUP (<i>group</i>).....	52
11.4.17	REMOVE FROM GROUP (<i>group</i>).....	52
11.4.18	SET SHORT ADDRESS (<i>DTR0</i>).....	52
11.4.19	ENABLE WRITE MEMORY.....	52
11.5	Queries.....	52
11.5.1	General.....	52
11.5.2	QUERY STATUS.....	52
11.5.3	QUERY CONTROL GEAR PRESENT.....	53
11.5.4	QUERY CONTROL GEAR FAILURE.....	53
11.5.5	QUERY LAMP FAILURE.....	53
11.5.6	QUERY LAMP POWER ON.....	53
11.5.7	QUERY LIMIT ERROR.....	53
11.5.8	QUERY RESET STATE.....	53
11.5.9	QUERY MISSING SHORT ADDRESS.....	53
11.5.10	QUERY VERSION NUMBER.....	53
11.5.11	QUERY CONTENT DTR0.....	53
11.5.12	QUERY DEVICE TYPE.....	53
11.5.13	QUERY NEXT DEVICE TYPE.....	54
11.5.14	QUERY PHYSICAL MINIMUM.....	54
11.5.15	QUERY POWER FAILURE.....	54
11.5.16	QUERY CONTENT DTR1.....	54
11.5.17	QUERY CONTENT DTR2.....	54
11.5.18	QUERY OPERATING MODE.....	54
11.5.19	QUERY LIGHT SOURCE TYPE.....	54
11.5.20	QUERY ACTUAL LEVEL.....	55
11.5.21	QUERY MAX LEVEL.....	55
11.5.22	QUERY MIN LEVEL.....	55
11.5.23	QUERY POWER ON LEVEL.....	56
11.5.24	QUERY SYSTEM FAILURE LEVEL.....	56
11.5.25	QUERY FADE TIME/FADE RATE.....	56
11.5.26	QUERY EXTENDED FADE TIME.....	56
11.5.27	QUERY MANUFACTURER SPECIFIC MODE.....	56
11.5.28	QUERY SCENE LEVEL (<i>sceneX</i>).....	56
11.5.29	QUERY GROUPS 0-7.....	56
11.5.30	QUERY GROUPS 8-15.....	56
11.5.31	QUERY RANDOM ADDRESS (H).....	56
11.5.32	QUERY RANDOM ADDRESS (M).....	57
11.5.33	QUERY RANDOM ADDRESS (L).....	57
11.5.34	READ MEMORY LOCATION (<i>DTR1, DTR0</i>).....	57
11.6	Application extended commands.....	57
11.6.1	General.....	57

11.6.2	QUERY EXTENDED VERSION NUMBER.....	57
11.7	Special commands.....	57
11.7.1	General.....	57
11.7.2	TERMINATE.....	58
11.7.3	DTR0 (<i>data</i>).....	58
11.7.4	INITIALISE (<i>device</i>).....	58
11.7.5	RANDOMISE.....	58
11.7.6	COMPARE.....	59
11.7.7	WITHDRAW.....	59
11.7.8	SEARCHADDRH (<i>data</i>).....	59
11.7.9	SEARCHADDRM (<i>data</i>).....	59
11.7.10	SEARCHADDRL (<i>data</i>).....	59
11.7.11	PROGRAM SHORT ADDRESS (<i>data</i>).....	59
11.7.12	VERIFY SHORT ADDRESS (<i>data</i>).....	60
11.7.13	QUERY SHORT ADDRESS.....	60
11.7.14	ENABLE DEVICE TYPE (<i>data</i>).....	60
11.7.15	DTR1 (<i>data</i>).....	60
11.7.16	DTR2 (<i>data</i>).....	60
11.7.17	WRITE MEMORY LOCATION (<i>DTR1, DTR0, data</i>).....	61
11.7.18	WRITE MEMORY LOCATION – NO REPLY (<i>DTR1, DTR0, data</i>).....	61
11.7.19	PING.....	61
Annex A	(informative) Examples of algorithms	62
Annex B	(normative) High resolution dimmer	64
Bibliography		66

List of Figures

Figure 1	— IEC 62386 graphical overview.....	ix
Figure 2	— Control gear directly operating a light source.....	6
Figure 3	— Dimming curve.....	8
Figure 4	— Level over time, fading up and down.....	11
Figure 5	— Timing and response when executing command iteration.....	19
Figure 6	— Correlation between " <i>lampFailure</i> ", " <i>lampOn</i> " and " <i>fadeRunning</i> " bits.....	35
Figure B.1	— Level behaviour in case of off-grid starting points.....	65

List of Tables

Table 1	— 16-bit command frame encoding.....	5
Table 2	— Dimming curve tolerance.....	8
Table 3	— Dimming curve.....	8
Table 4	— Fade times.....	11
Table 5	— Fade rates.....	12
Table 6	— Extended fade time – Base value.....	13
Table 7	— Extended fade time – Multiplier.....	13
Table 8	— Memory types.....	21
Table 9	— Basic memory map of memory banks.....	21
Table 10	— Memory map of memory bank 0.....	25
Table 11	— Memory map of memory bank 1.....	28
Table 12	— Power on timing.....	31
Table 13	— Control gear status.....	33
Table 14	— Scenes.....	37
Table 15	— Current bus unit configuration.....	37
Table 16	— Declaration of variables.....	38
Table 19	— Light source type encoding.....	55
Table 20	— Device addressing with "INITIALISE (<i>device</i>)".....	58

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.

IEC 62386-102 has been prepared by IEC technical committee 34: Lighting. It is an International Standard.

This third edition cancels and replaces the second edition published in 2014 and Amendment 1:2018. This edition constitutes a technical revision.

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

- the scope has been updated;
- references have been updated;
- memory bank reading of multi-byte values has been added;

- memory bank 0 and common memory bank requirements have been updated;
- reserved memory banks have been updated;
- non-volatile memory (NVM) save time has been added, and SAVE PERSISTENT VARIABLES removed;
- version number has been updated;
- bus unit configuration has been added.

The text of this International Standard is based on the following documents:

Draft	Report on voting
34/948/FDIS	34/989/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

This Part 102 of IEC 62386 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 Part 101 and Part 102 in order to provide the relevant requirements for each type of product.

A list of all parts in the IEC 62386 series, published under the general title *Digital addressable lighting interface*, 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 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.

IMPORTANT — The "colour inside" logo on the cover page of this document 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 IEC 62386 series specifies a bus system for control by digital signals of electronic lighting equipment. The IEC 62386-1xx 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. Part 104 and Part 105 can be applied to control gear or control devices. Part 104 gives requirements for wireless and alternative wired system components. Part 105 describes firmware transfer. Part 150 gives requirements for an auxiliary power supply which can be stand-alone, or built into control gear or control devices.

The IEC 62386-2xx series extends 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 IEC 62386-3xx series extends 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.

This third edition of IEC 62386-102 is intended to be used in conjunction with IEC 62386-101 and with the various parts that make up the IEC 62386-2xx series for control gear, and can be used together with IEC 62386-103 for control devices. 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 standards is graphically represented in [Figure 1](#) below.

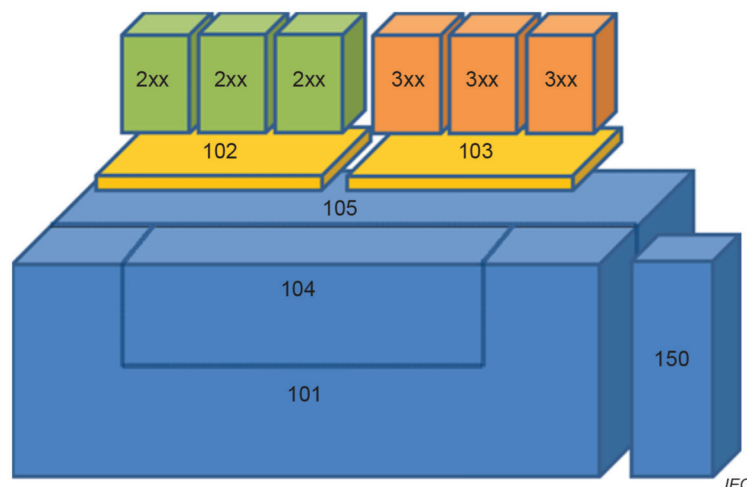


Figure 1 — IEC 62386 graphical overview

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

All numbers used in this document 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".

Australian/New Zealand Standard

Digital addressable lighting interface

Part 102: General requirements — Control gear

1 Scope

This part of IEC 62386 is applicable to control gear for control by digital signals of electronic lighting equipment.

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 62386-101:2022, *Digital addressable lighting interface – Part 101: General requirements – System components*

IEC 62386-103:2022, *Digital addressable lighting interface – Part 103: General requirements – Control devices*

IEC 62386-2xx (all parts), *Digital addressable lighting interface – Part 2xx: Particular requirements for control gear*

3 Terms and definitions

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

ISO and IEC maintain terminology 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

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 simultaneously address all control gear in the system

3.4

broadcast unaddressed

type of address used to simultaneously address all control gear in the system that have no short address

3.5

DAPC

direct arc power control

method to directly control the light output

3.6

DTR

data transfer register

multipurpose register used to exchange data

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 global trade item 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" (see [\[1\]](#)).

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

value with all binary digits set to 1

Note 1 to entry: This means that an 8-bit backward frame of *MASK* is a value of 0xFF, and a multi-byte memory location of 24 bits containing *MASK* is a value of 0xFFFFFF.

3.12

NO

answer to a query where no backward frame is sent

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 62386-101:2022, 8.2.5.

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

3.13

NVM

non-volatile memory

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

3.14

NVM-RO

NVM that cannot be written using any command

3.15

NVM-RW

NVM that can be modified using one or more commands

3.16

opcode

operation code

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

3.17**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 functionalities to be exhibited by a control gear, including its required reaction to commands

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

3.18**PHM****physical minimum level**

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

3.19**RAM**

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

3.20**RAM-RO**

RAM that cannot be written using any command

3.21**RAM-RW**

RAM that can be modified using one or more commands

3.22**random address**

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

Note 1 to entry: [Clause A.1](#) provides an example of how the search and random addresses are used.

3.23**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

3.24**ROM**

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

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

3.25**scene**

configurable preset level

3.26**search address**

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

Note 1 to entry: [Clause A.1](#) provides an example of how the search and random addresses are used.

3.27**short address**

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

3.28**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.

3.29**strictly monotonic**

either entirely increasing or decreasing without repeating values

3.30**target level**

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

3.31**TMASK**

value with the least significant bit set to 0 and all other binary digits set to 1

Note 1 to entry: This means that an 8-bit backward frame of *TMASK* is a value of 0xFE, and a multi-byte memory location of 24 bits containing *TMASK* is a value of 0xFFFFFE.

3.32**YES**

answer to a query where a backward frame of *MASK* is sent

4 General**4.1 General**

The requirements of IEC 62386–101:2022, Clause 4 apply, with the restrictions, changes and additions identified below.

4.2 Version number

This subclause replaces IEC 62386–101:2022, 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 16](#).

NOTE IEC documents are generally subject to two amendments before a new edition is prepared.

5 Electrical specification

The requirements of IEC 62386–101:2022, Clause 5 apply.

6 Bus power supply

If a bus power supply is integrated into a control gear, the requirements of IEC 62386–101:2022, Clause 6 apply.

7 Transmission protocol structure

7.1 General

The requirements of IEC 62386-101:2022, 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 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 62386–101:2022, Clause 8 apply.

9 Method of operation

9.1 General

The requirements of IEC 62386–101:2022, Clause 9 apply with the following additions.

9.2 Control gear

9.2.1 General

Control gear receive commands from application controllers. Application controllers are specified in IEC 62386–103:2022.

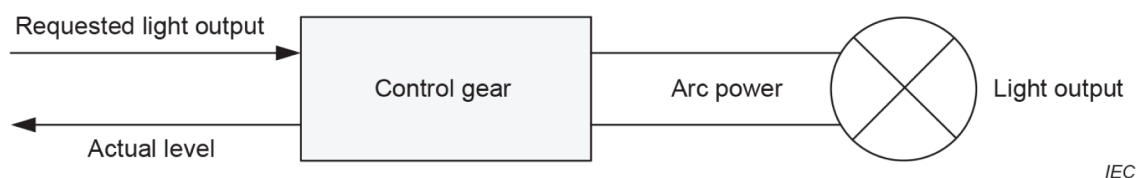


Figure 2 — Control gear directly operating a light source

[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. See [9.2.2.2](#) through [9.2.2.5](#).

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 high intensity discharge (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](#).

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

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.

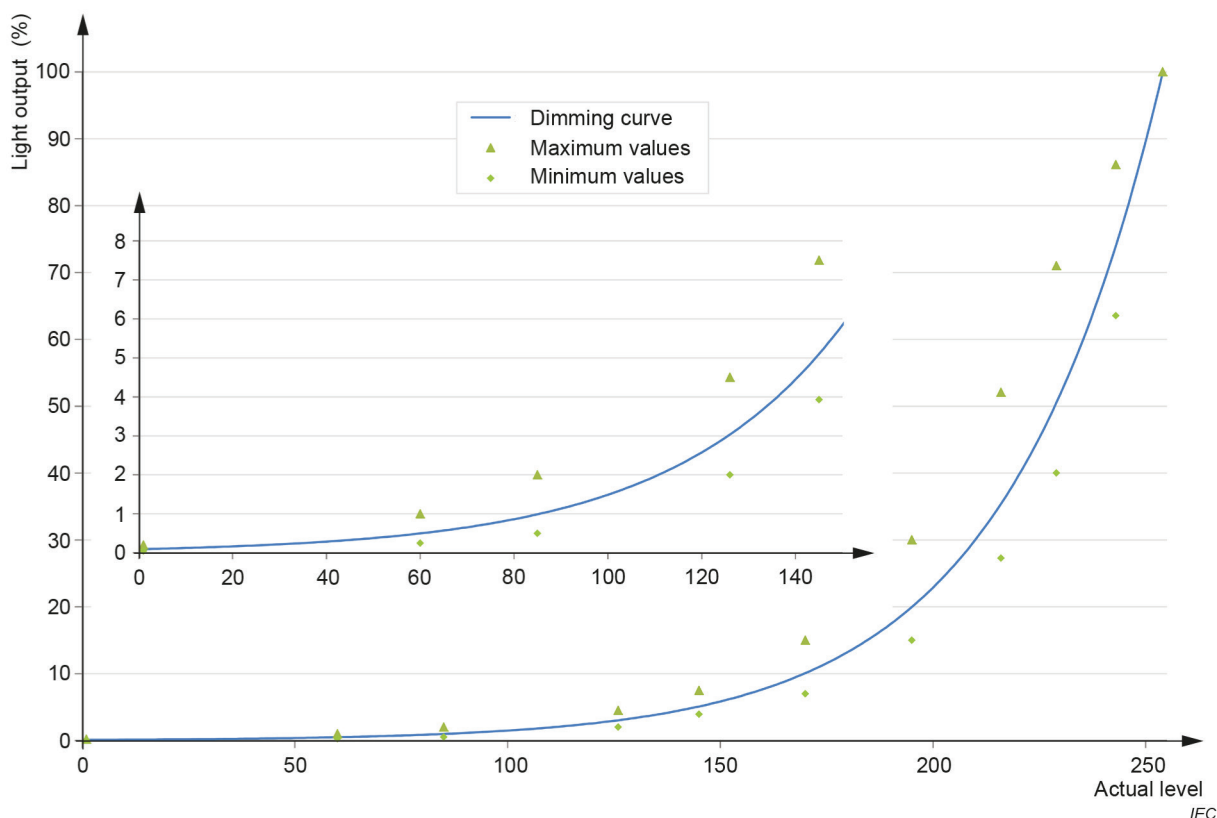


Figure 3 — Dimming curve

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.

Table 2 — Dimming curve tolerance

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	

Tolerances are given in % and rounded to two decimal places.

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

Table 3 (continued)

Level	Light output	Level	Light output	Level	Light output	Level	Light output	Level	Light output
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 [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 [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.

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.

Measurements of fade time or 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 [9.16.6](#)).

This means that the control gear fades to the target level even in the case of a total lamp failure. 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.

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.

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

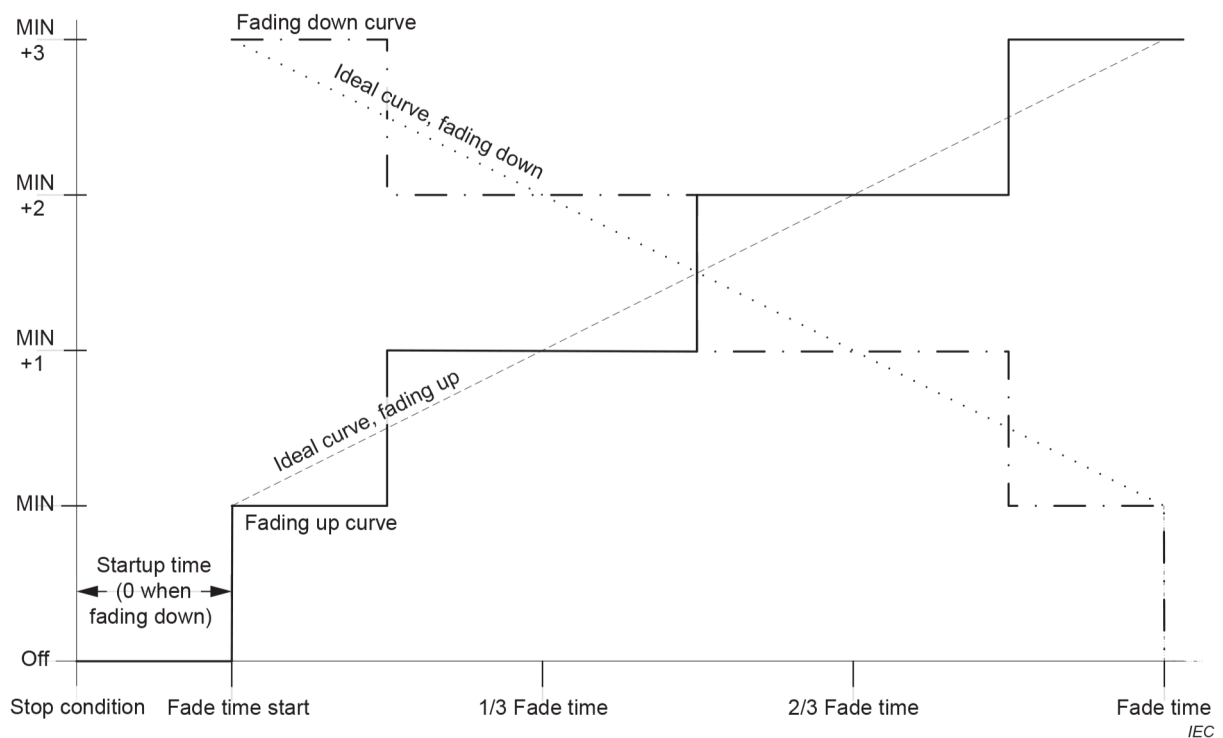


Figure 4 — Level over time, fading up and down

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 in accordance with [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 the extended fade time (see [9.5.4](#));
- if "*fadeTime*" is in the range [1,15]: s.

[Table 4](#) lists the possible fade time values.

Table 4 — Fade times

" <i>fadeTime</i> "	<i>Minimum fade time</i> s	<i>Nominal fade time</i> s	<i>Maximum fade time</i> 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

Table 4 (continued)

<i>"fadeTime"</i>	<i>Minimum fade time</i> s	<i>Nominal fade time</i> s	<i>Maximum fade time</i> s
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

The fade rate shall be in accordance with [Table 5](#).

"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:

.

[Table 5](#) lists the possible fade rate values.

Table 5 — Fade rates

<i>"fadeRate"</i>	<i>Minimum fade rate</i> steps/s	<i>Nominal fade rate</i> steps/s	<i>Maximum fade rate</i> steps/s
1	322	358	394
2	228	253	278
3	161	179	197
4	114	127	139
5	80,5	89,4	98,4
6	56,9	63,3	69,6
7	40,3	44,7	49,2
8	28,5	31,6	34,8
9	20,1	22,4	24,6
10	14,2	15,8	17,4
11	10,1	11,2	12,3