

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Digital addressable lighting interface –
Part 105: Particular requirements for control gear and control devices –
Firmware transfer**

**Interface d'éclairage adressable numérique –
Partie 105: Exigences particulières pour appareillages et dispositifs de
commande – Transfert du microprogramme**



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CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
1 Scope.....	8
2 Normative references	8
3 Terms and definitions	8
4 General	9
4.1 General.....	9
4.2 Logical units in a bus unit	9
4.3 Updating control gear for emergency lighting	9
5 Electrical specification	9
6 Bus power supply	9
7 Transmission protocol structure	10
7.1 General.....	10
7.2 32-bit forward frame encoding.....	10
8 Timing	10
9 Method of operation.....	10
9.1 General.....	10
9.2 Commands	10
9.3 Data transmission	11
9.4 Duration of firmware update	11
9.5 Security	11
9.6 Firmware update features	11
9.7 Update process.....	12
9.7.1 Start firmware update	12
9.7.2 Data transfer	12
9.7.3 Persistent variables during firmware update	14
9.7.4 Firmware version number	15
9.7.5 Firmware update in a system	15
9.7.6 Error recovery.....	15
9.8 Power-on	15
10 Declaration of variables	16
11 Definition of commands	16
11.1 General.....	16
11.2 Overview sheets	16
11.3 Control instructions.....	17
11.3.1 General	17
11.3.2 START FW TRANSFER.....	17
11.3.3 RESTART FW.....	18
11.3.4 ENABLE RESTART	18
11.3.5 FINISH FW UPDATE	18
11.3.6 CANCEL FW UPDATE.....	19
11.4 Queries.....	19
11.4.1 QUERY FW UPDATE FEATURES	19
11.4.2 QUERY FW RESTART ENABLED.....	19
11.4.3 QUERY FW UPDATE RECEIVER READY	19
11.4.4 QUERY BLOCK INCOMPLETE OR FAULT	20

11.4.5	QUERY FW TRANSFER VERSION.....	20
11.4.6	QUERY BLOCK 0 ACCEPTED.....	20
11.5	Data transfer commands	20
11.5.1	General	20
11.5.2	BEGIN BLOCK (<i>data h, data m, data l</i>)	20
11.5.3	TRANSFER BLOCK DATA (<i>data h, data m, data l</i>)	21
Annex A (normative)	Update file description	22
Annex B (normative)	CRC16 calculation	23
Annex C (informative)	Firmware update process example	24
Annex D (informative)	Firmware update management check sheet.....	28
Bibliography.....		30
Figure 1 – IEC 62386 graphical overview		6
Figure C.1 – Example of a firmware update process		26
Table 1 – 32-bit command frame encoding.....		10
Table 2 – Firmware update features.....		11
Table 3 – Block 0 definitions		13
Table 4 – Block 1.. <i>n</i> definitions		14
Table 5 – Declaration of variables.....		16
Table 6 – Standard commands.....		17
Table 7 – Data transfer commands		17
Table D.1 – Example check sheet for firmware update of control gear		28

INTERNATIONAL ELECTROTECHNICAL COMMISSION

DIGITAL ADDRESSABLE LIGHTING INTERFACE –

**Part 105: Particular requirements for control gear and control devices –
Firmware transfer**

FOREWORD

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IEC 62386-105 has been prepared by IEC technical committee 34: Lighting. It is an International Standard.

This second edition cancels and replaces the first edition published in 2020. This edition constitutes a technical revision.

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

- a) several commands have been modified, renamed and added;
- b) variables have been modified and added;
- c) recommendations for implementation within emergency control gear have been added;
- d) requirements for block acceptance have been changed;

- e) example process-flow diagrams have been added;
- f) requirements for restarting and power-on have been changed.

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

Draft	Report on voting
34/1258/FDIS	34/1281/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/publications.

This document is intended to be used in conjunction with:

- IEC 62386-101, which contains general requirements for system components;
- IEC 62386-102, which contains general requirements for the relevant product type (control gear), and with the appropriate parts of the IEC 62386-2xx series (particular requirements for control gear);
- IEC 62386-103, which contains general requirements for the relevant product type (control devices), and with the appropriate parts of the IEC 62386-3xx series (particular requirements for control devices);
- IEC 62386-104, which contains general requirements for wireless and alternative wired system components.

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, or
- revised.

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INTRODUCTION

IEC 62386 contains several parts, referred to as a 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. IEC 62386-101 contains general requirements for system components, IEC 62386-102 extends this information with general requirements for control gear and IEC 62386-103 extends it further with general requirements for control devices. IEC 62386-104 and IEC 62386-105 can be applied to control gear or control devices. IEC 62386-104 gives requirements for wireless and alternative wired system components. IEC 62386-105 describes firmware transfer. IEC 62386-150 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 second edition of IEC 62386-105 is intended to be used in conjunction with IEC 62386-101, IEC 62386-102 and the various parts that make up the IEC 62386-2xx series for control gear, together with IEC 62386-103 and the various parts that make up the IEC 62386-3xx series of particular requirements 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 recognized.

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

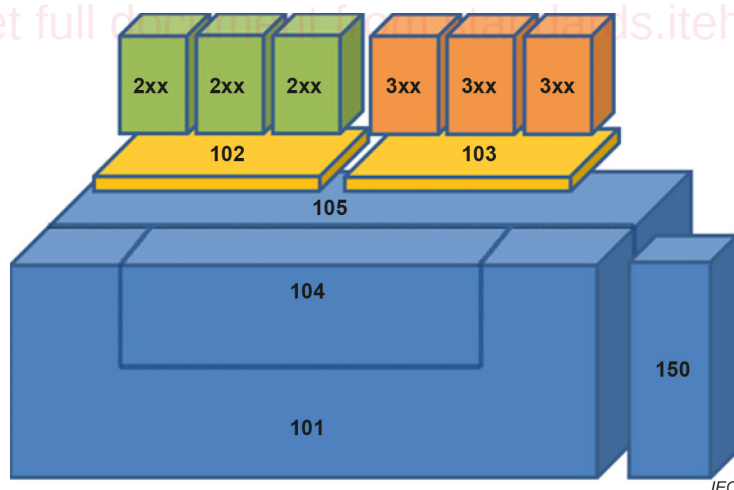


Figure 1 – IEC 62386 graphical overview

When this document refers to any of the clauses 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, "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".

Function or command parameters: *parameter name*.

Sample Document

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DIGITAL ADDRESSABLE LIGHTING INTERFACE –

Part 105: Particular requirements for control gear and control devices – Firmware transfer

1 Scope

This part of IEC 62386 applies to control gear and control devices for control by digital signals of electronic lighting equipment.

Typically, a bus unit according to the IEC 62386 series contains firmware. There are circumstances where it can be necessary to change the firmware after production or shipping of the product, for example if the bus unit does not operate as intended. In such a case, a firmware update of a bus unit via the interface is beneficial.

This firmware update process is primarily designed to be a bug fix process, not a feature extension process. Nevertheless, the firmware update process can be used for feature extensions. But it is important that the risk of negative effects to the complete system be considered in detail.

NOTE Annex D provides a "Firmware update management check sheet" to support risk estimation.

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 62386-102:2022, *Digital addressable lighting interface – Part 102: General requirements – Control gear*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62386-101, IEC 62386-102, IEC 62386-103 and the following apply.

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

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

3.1**FW****firmware**

software programmed into a control gear or control device

Note 1 to entry: Firmware can be changed during an update.

3.2**CRC****cyclic redundancy check**

checksum used to prevent data corruption

Note 1 to entry: Annex B provides detailed information about CRC calculation.

3.3**block**

unit of data containing information

Note 1 to entry: Information in a firmware update block usually contains firmware content.

3.4**programming**

writing firmware transfer data to non-volatile memory (NVM)

3.5**normal operation**

operation according to IEC 62386-102 or IEC 62386-103

4 General**4.1 General**

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

NOTE Systems with a single-master application controller are unlikely to operate correctly when other master control devices, such as firmware update tools, are connected.

4.2 Logical units in a bus unit

If the firmware update process is started on a bus unit, all logical units inside the bus unit shall be affected. All variables defined in Table 5 shall be shared by all logical units of the bus unit. Commands addressed to one or more logical units within the bus unit shall be accepted by the bus unit according to the requirements of 9.2.

4.3 Updating control gear for emergency lighting

If IEC 62386-105 is implemented in control gear for emergency lighting, the product manual or data sheet should include guidance on the safety implications of a firmware update that should be considered.

5 Electrical specification

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

6 Bus power supply

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 32-bit forward frame encoding

The forward frame format used for firmware update consists of $n = 32$ data bits as described in IEC 62386-101:2022, 7.4.3 (32-bit forward frame).

For commands, the 32-bit forward frame shall be encoded as shown in Table 1.

Table 1 – 32-bit command frame encoding

Bytes/Bits								Device addressing method					
Address byte											Opcode byte		
											1	2	3
31	30	29	28	27	26	25	24 ^a	23...16	15...8	7...0			
0	64 short addresses						x				Short addressing		
1	0	1	1	1	1	0	1				Data transfer command ^b		
1	1	0	0	1	0	1	1				Data transfer command ^b		
1	1	1	1	1	1	0	x				Broadcast unaddressed		
1	1	1	1	1	1	1	x				Broadcast		
All other address byte values											Reserved		

^a Where bit 24 is shown as "x", 0 indicates address space for control gear, 1 indicates address space for control devices.

^b See Table 7 for data transfer 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 exception that the total duration of a transaction may exceed 400 ms (IEC 62386-101:2022, 9.3).

9.2 Commands

A bus unit shall check the device addressing scheme to see if it is addressed by a command. The bus unit shall accept the command, unless any of the following conditions hold:

- The command is sent using short address, broadcast addressing or broadcast unaddressed addressing, and bit 24 of the command frame does not match the type of bus unit (control gear or control device).
- The command is sent using short addressing and the given short address is not equal to its short address.
- The command is sent using reserved addressing.

- The command is sent using broadcast unaddressed addressing and the short address is not MASK.
- The command is not defined (e.g. reserved command).

The following command groups can be identified:

- standard commands;
 - instructions;
 - queries;
- data transfer commands.

9.3 Data transmission

A bus unit receives a new FW block by block. The first block (block 0) contains information about the type of bus unit (see Table 3), which receives a new FW. This avoids transferring the wrong FW to a bus unit if more than one bus unit is updated at a time.

The update file shall contain release notes as described in Annex A.

9.4 Duration of firmware update

A data transmission frame consists of a start bit, a 32-bit data transfer command and a stop condition, which occupies the bus for around 30 ms. With a settling time of less than 15 ms (priority 1 settling time), the transmission of three bytes takes less than 45 ms. For an update of 64 kB it is expected to take less than 20 min.

9.5 Security

This document specifies the use of CRC checksums to help ensure error-free transfer of data. In addition, it is recommended that the individual manufacturer ensures firmware image integrity and authenticity, for example by making use of the device key.

9.6 Firmware update features

Each bus unit shall expose its firmware update features as a combination of device properties as given in Table 2.

Table 2 – Firmware update features

Bit	Description	Value	See
0	"fwUpdateCancelSupported" is TRUE?	"1" = "YES"	9.7.2.3
1	Integrated bus power supply is present and is disabled during firmware update	"1" = "YES" "0" = bus power supply state is unchanged during firmware update, or is not present	
2 to 7	Reserved – Not implemented	"0" = "NO"	

The bus unit firmware update features can be queried using QUERY FW UPDATE FEATURES.

Bit 1: "1" shall indicate that an integrated bus power supply is present and is automatically disabled during the firmware update process. "0" shall indicate that either there is no integrated bus power supply, or if there is an integrated bus power supply then its state shall not be automatically changed when starting, during, or at the end of the firmware update. To help prevent loss of bus power during a firmware update, a lock-out mechanism is described in 11.3.2.

NOTE For bus units with bit 1 = "1", using a firmware update tool that is unable to apply suitable bus power can result in a system with no bus power and so no communications are possible. In such cases, a bus power supply can be temporarily connected to the system to allow the firmware update process to continue.

9.7 Update process

9.7.1 Start firmware update

A bus unit shall enable the firmware update process whenever *"fwUpdateProcessEnabled"* is TRUE. This can be due to execution of the command START FW TRANSFER, or after a power cycle where the previous update failed (see Table 5). Several bus units can be addressed in this way to update more than one bus unit at a time.

NOTE 1 Annex C provides an example of the firmware update process.

The bus unit shall be capable of returning to normal operation until at least a block 0 has been successfully verified.

NOTE 2 This means that bus units with a single flash image of the firmware used for normal operation cannot erase that firmware until at least block 0 has been verified.

Whilst *"fwUpdateProcessEnabled"* is TRUE, the operation of the bus unit is manufacturer-specific except for the requirements given in this document.

NOTE 3 This includes, for example, the reaction to commands of other parts of the IEC 62386 series.

9.7.2 Data transfer

9.7.2.1 Block 0 (information block)

Block 0 contains all data for the bus unit to decide if it will accept the new firmware or not.

The global trade item number (GTIN), the hardware version number and the firmware version number contained in the bus unit are described in IEC 62386-102:2022, 9.10.7 (Memory bank 0 for control gear) and IEC 62386-103:2022, 9.11.7 (Memory bank 0 for control devices).

If *"currentBlock"* is 0, then upon reception of a complete block 0, the following information shall be checked, where Table 3 shows block 0 content:

- The received block 0 "Size of block" is equal to the value shown in Table 3.
- The received block 0 "Session key" is not MASK or 0.
- The received block 0 "Block number" is equal to the value shown in Table 3.
- The received block 0 "Block 0 version" is equal to the value shown in Table 3.
- The received block 0 "GTIN" matches the GTIN stored in memory bank 0.
- (Received block 0 "FW version min") ≤ (memory bank 0, Firmware version) ≤ (received block 0 "FW version max").
- (Received block 0 "HW version min") ≤ (memory bank 0, Hardware version) ≤ (received block 0 "HW version max").
- (Received block 0 "Identification number min") ≤ (memory bank 0, Identification number) ≤ (received block 0 "Identification number max").
- The received block 0 "Device key" meets manufacturer-specific requirements.
- The received block 0 "CRC" matches the calculated value based on the block 0 content; Annex B is applicable).

If the above check is successful, the following operation shall result:

- *"sessionKey"* shall be set to the received block 0 "Session key",
- previously received block data that is unwritten may be discarded.

Otherwise, the following operation shall result:

- The block 0 content shall be discarded.

NOTE In the case where block 0 content is discarded, "*fwUpdateProcessEnabled*" remains TRUE, so the bus unit will continue looking for valid block 0 data. This enables multiple devices to be updated, even where these devices use identical firmware but have different GTINs, due to the possibility of an update tool sending multiple block 0s.

Table 3 – Block 0 definitions

Offset (hex)	Size (bytes)	Description
00..01	2	Size of block 0 (MSB first, fixed value of 0x0041 for block 0)
02..09	8	Session key ^a
0A..0C	3	Block number (always 0x000000 for block 0)
0D	1	Block 0 version (always 0x01)
0E..10	3	Total block count (MSB first) ^b
11..16	6	GTIN (MSB first)
17..18	2	HW version min (MSB first)
19..1A	2	HW version max (MSB first)
1B..1C	2	FW version min (MSB first)
1D..1E	2	FW version max (MSB first)
1F..26	8	Identification number min (MSB first)
27..2E	8	Identification number max (MSB first)
2F..3E	16	Device key ^c
3F..40	2	CRC (MSB first)

Key

MSB Most significant byte

^a The session key is generated by the FW update tool which transfers the firmware update.

^b This is the number of blocks, excluding block 0, being transferred during the firmware update.

^c The device key and its use is manufacturer-specific. It allows the manufacturer to specify different areas or options in their firmware. The device key shall be independent of the session key, allowing a firmware update tool to change the session key without requiring a change to the device key.

It is recommended to calculate the CRC checksums with the incoming bytes to minimize delay at the end of the block reception.

9.7.2.2 Block 1..n (data block)

Table 4 shows the content of a data block. A bus unit shall only accept a data block if the following conditions are true:

- "*fwUpdateProcessEnabled*" is TRUE, and
- the session key matches "*sessionKey*", and is not MASK or 0, and
- the block number matches "*currentBlock*", and
- "*currentBlock*" is not 0.

After reception of a whole block, the consistency of the firmware data inside the block shall be verified by CRC (offset 0x0D...0x0E). The data consistency of the whole block shall be verified by a second CRC (offset s + 0x0F...s + 0x10). The block may optionally be discarded if "size of whole block" is an unexpected size, as determined by the manufacturer. If the verification fails, the bus unit shall discard the block. If a block is valid, but is the same as the last programmed block, it is recommended to discard the block to prevent unnecessary write cycles.