DiiA Guidelines

DALI Quick Start Guide

Version 1.1

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For any further explanation of the contents of this document, or in case of any perceived inconsistency or ambiguity of interpretation, please contact the DiiA:

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Document History

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18 April 2018	V1.0	First publication DiiA(SW)075d
	V1.1	General update. Addition of D4i.

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1. What is DALI?

DALI (**D**igital **A**ddressable **L**ighting **I**nterface) is a **protocol (language) for bi-directional digital communication** between lighting control products. It is based on IEC 62386[1].

The **2-wire DALI bus** is used for communication (commands/data) as well as for supplying power to some devices. The bus voltage is typically around 16 V when there is no communication, but can be significantly above or below this.

Commands allow **control, configuration and querying** of the products.

- Examples of **control** commands include those that start a fade to a defined light output level, recall scenes or turn the lights off.
- Examples of **configuration** commands include those that change the fade time, change the light level stored in a scene, or change the group a push-button belongs to.
- Examples of **query** commands include those that ask what the current light output level is, or whether there is a lamp failure.

Commands can be **addressed** to **individual** devices, to a **group** of devices, or **broadcast** to all devices (see 4.1). This makes communication very efficient.

Scenes allow fast and efficient recall of light levels across the system (see 4.2).

2. What is DALI-2?

DALI-2 is the certification program based on the latest version of the DALI protocol. The main differences from DALI version-1 are in two areas:

2.1 Control gear

- For DALI-2, the IEC 62386 standard was re-written, making it much clearer and more tightly specified, resulting in significantly improved product interoperability.
- Additionally, there has been a large increase in the amount of testing. As an example, a DALI-2 LED driver takes about three times longer to test than a DALI version-1 LED driver. This more-thorough testing results in a large increase in interoperability, with fewer problems expected in installations.
- Some new features were added, the most significant being the *extended fade time*, allowing fades from 0.1 seconds up to 16 minutes.

2.2 Control devices

- Control devices such as application controllers and input devices are new to DALI-2 (see IEC 62386, Part 103 and Parts 3xx).

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[1] DALI is based on the open, global IEC 62386 standard (available from the IEC webstore and national standards organisations), together with changes and additions published by DiiA.

- Control devices were not specified in DALI version-1. Any control devices that connected to the DALI bus were proprietary solutions. This meant that such control devices had to be from the same manufacturer, to ensure they would work together.
- DALI-2 gives requirements for application controllers and input devices, allowing devices from different manufacturers to be used together on the same DALI bus.

2.3   DALI-2 certification

The DALI Alliance created and launched the DALI-2 certification program in 2017. DALI-2 product test results are verified by the DALI Alliance before certification is granted. Every certified product is publicly listed in the DALI Alliance Product Database (www.dali-alliance.org/products).

3.   DALI devices

The DALI standard (IEC 62386) describes three basic kinds of device:

- Bus power supplies
- Control gear
- Control devices

Combinations of these are allowed within the same product.

3.1   Why is a bus power supply required?

The DALI bus must be powered to allow communication. The bus voltage is typically 16 V, with connected **bus power supplies** providing up to 250 mA. This is used for DALI communication, but can also be used by bus-powered devices – for example push-buttons, sensors or small relay devices. Bus power supplies can be separate products, or can be integrated with control devices or control gear.

The guaranteed supply current from all bus power supplies must be sufficient to provide the bus current consumption of all devices attached to the bus. These currents can be found on the product details pages in the Product Database.

The maximum supply current from all bus power supplies must not exceed 250 mA, which is the maximum allowed for DALI systems.

3.2   What are control gear?

Power to the lamps, and therefore control of light output, is provided by **control gear**. For example, an LED driver typically converts the AC mains supply to a low-voltage regulated DC output, for connection to LED lamps.

3.2.1   Types of control gear

All control gear must comply with Part 102 of IEC 62386 (General requirements – Control gear). Additionally, there are optional parts with lamp-specific and other functionality defined in parts 2xx (see Table 1).

Part	Type of control gear	Device type (DT) number
201	Fluorescent lamp control gear	0
202	Self-contained emergency control gear	1
203	Discharge (HID) lamp control gear	2
204	Low-voltage halogen lamp control gear	3
205	Incandescent lamp dimmer	4
206	Conversion to D.C. voltage (1-10V, 0-10V converter)	5
207	LED lamp control gear	6
208	Switching (relay) control gear	7
209	Colour control gear	8
220	Centrally supplied emergency operation	19
224	Non-replaceable light source	23
250	Integrated Bus Power Supply	49
251	Memory Bank 1 Extension	50
252	Energy Reporting	51
253	Diagnostics & Maintenance	52

Table 1 - Types of control gear

Shaded cells in the above table are already included in DALI-2 certification. Part 220 is planned to become part of DALI-2. See the DALI-2 certification status page for the latest information on each part that is included in certification.

As an example, an LED driver needs to comply with Parts 101, 102 and optionally Part 207 of IEC 62386.

3.2.2   Emergency lighting control gear (Part 202)

Part 202 gives specific requirements for control gear for self-contained emergency lighting. "Self-contained" emergency luminaires have the emergency control gear and battery inside or attached to the luminaire, and automatically turn on the emergency lamp when the normal supply is cut.

Part 202 defines two types of tests that can be triggered by commands or automatically:

- Function test
  - Short test to check the emergency lamp, battery, circuit and changeover device.
- Duration test
  - Longer test to check the capability of the battery to supply the control gear and lamp for the rated duration time.

IEC 62386 also includes Part 220 for centrally-supplied emergency lighting where a central battery or generator supplies the emergency lighting when the normal supply fails. Development is in progress to add this Part to DALI-2 (January 2023).

For more information on control gear for emergency lighting, see: www.dali-alliance.org/dali/emergency.html

3.2.3 Colour control gear (Part 209)

If a colour controllable luminaire is required, then control gear designed to meet Part 209 of the standard is used. This provides several colour types (methods to control the colour):

- Tc (colour temperature): "**Tunable white** colour control". The correlated colour temperature (CCT) of the light can be controlled.
- RGBWAF: "**RGB** colour control". A method to control up to 6 colour channels.
- xy coordinate: "**xy** colour control": This allows precise and repeatable colour selection from the CIE colour space chromaticity "triangle". A further option – calibration – allows the highest accuracy of colour selection and repeatability.

Luminaires with colour types Tc or xy are often calibrated in the factory, allowing repeatable colour selection across different luminaires, within the colour accuracy defined by the manufacturer.

Colour control gear can implement 1 or more colour type. DALI-2 allows the following combinations:

- Tunable white: Tc only
- RGB colour control: RGBWAF only
- Multi-type colour control: Tc + RGBWAF + xy

In all cases, the colour can be controlled without affecting the light output level, or the level can be controlled without affecting the colour, or both can be controlled together.

3.3 What are control devices?

Control devices include **application controllers** and **input devices**. These have two different purposes, but are sometimes combined into the same product. All control devices implement Part 103.

3.3.1 Application controllers

Application controllers are the "brains" of a system. They use information from any source, make decisions and send commands to control, configure or query the lights (control gear) or other devices on the bus.

Application controllers often support the use of input devices such as push-buttons or sensors. For fast response to events or measurements from input devices, multi-master application controllers can make use of event messages from input devices. The Product Database allows application controllers to be searched that support specific input devices and that support event messages.

3.3.2   Input devices

Input devices provide event or measurement information for use by application controllers. The information could be from push-buttons, occupancy sensors, light sensors, rotary controls, slider controls, temperature sensors or other devices. Table 2 shows the relevant specifications for input devices – shaded types are already included in DALI-2.

Part	Type of input device
301	Push buttons
302	Absolute input devices
303	Occupancy sensors
304	Light sensors
305	Colour sensors
306	General-purpose sensors

Table 2 - Input devices

Input devices cannot directly control the lights – this is done by application controllers, although some products combine both in the same device.

All input devices are multi-master, meaning that multiple devices can share use of the DALI bus. Input devices comprise of one or more "instances" of the types shown in Table 2.

Up to 32 "instances" can be in the same product (using one address). This could be a combination of different instance types. For example: an occupancy sensor and up to 31 push-buttons.

More information on DALI-2 input devices is available on the DiiA website (www.dali-alliance.org/dali/sensors.html)

3.4   Bus wiring

A 2-wire bus is used to carry the communication signals and can be used to power some devices, such as sensors, push-buttons and some converters.

Bus wiring can use daisy-chain or star connections, or combinations of these. A closed loop should not be used.

It is recommended to use 1.5 mm^2 cable (15 AWG), allowing 300m maximum distance between the two farthest-apart devices on the bus, when using the maximum rated bus power supply of 250 mA. The two bus-wires should be adjacent.

The total bus cable may be more than 300m, provided the above rule for maximum distance is maintained. As an example, having the application controller and bus power supply in the centre of a star, with each branch being 100m from the application controller, gives a maximum of 200m

between any two devices. However, if this example is taken to an extreme, other effects such as cable capacitance become important. The total cable length where these other effects can start to cause problems depends on the cable type, but is likely to be much more than 300m.

4. Addresses, groups and scenes

4.1 Addresses and groups

- A single DALI bus allows **64 addresses for control gear**, as well as **64 addresses for control devices**.
- There are **16 groups for control gear**; each control gear can be a member of any combination of the 16 groups.
- There are **32 groups for control devices**; each control device can be a member of any combination of the 32 groups.
- There are **32 groups for instances of input devices** (such as individual buttons within a panel); each instance can be a member of up to 3 of these groups.

Some devices, especially control gear, can use more than one address. An example is an LED driver with two lamp connections, with each lamp being independently controllable. Such a control gear contains 2 "logical units", with each logical unit using one address.

4.2 Scenes

Scenes in control gear contain a light level, or can be set to "ignore". When the scene is recalled, the output will fade to the stored light level, or will have no effect if an "ignore" is stored.

Each control gear has 16 scenes. A single GO TO SCENE command instructs all the lights, or any combination of the lights, to go to individually pre-defined levels.

Scenes in colour control gear also store a colour and colour type, in addition to the light level.

4.3 Example of groups and scenes

Four fixtures are shown, A-D, each containing one control gear such as an LED driver:

Fixtures: A B C D

We want to be able to control A&B together, and C&D together, and A, B, C & D together, so 3 groups are created:

- Group 1: A, B
- Group 2: C, D
- Group 3: A, B, C, D (this group may not be needed if there are no other fixtures on the same bus, because broadcast can be used instead).

We want to control the levels so that all fixtures in a group are at the same level, so no scenes are needed. In this case we can use the DAPC (Direct Arc Power Control) command to alter the light levels:

- <Group 1> DAPC 50%   sends all fixtures in group 1 (A, B) to 50%
- <Group 2> DAPC 75%   sends all fixtures in group 2 (C, D) to 75%
- <Group 3> DAPC 0%   sends all fixtures in group 3 (A, B, C, D) to 0% (off)

Scenes can be used if we want fixtures within a group to be at different levels. For example:

Scene 1: A=10%, B=20%, C=30%, D=40%

- <Group 1>GO TO SCENE 1   A goes to 10% and B to 20%. C and D are unaffected.
- <Group 2>GO TO SCENE 1   C goes to 30% and D to 40%. A and B are not affected.
- <Group 3>GO TO SCENE 1   A goes to 10%, B to 20%, C to 30% and D to 40%.
- <Group 3> OFF   A, B, C, D go off without fading.

5. Using DALI-2 products

5.1   Do I need to choose DALI-2 control gear for my new system?

DALI-2 control gear have several advantages over DALI version-1 control gear, including improved interoperability and new features such as extended fade times.

If DALI-2 control gear are not available with the required properties, then DALI version-1 control gear can be used. This is unlikely to give a problem, but the new features of DALI-2 control gear will not be available.

5.2   How can I check if a product is really DALI-2 certified?

Every DALI-2 certified product is listed in the Product Database (www.dali-alliance.org/products) on the DiiA website. If a product does not appear in the list, it is **not** DALI-2 certified.

5.3   Can I check if a product is DALI version-1 registered?

The Product Database also lists [DALI version-1 registered products](#). Registration of new DALI version-1 products is now closed.

5.4   Can I use the DALI trademarks?

The logos and wordmarks are trademarks in various countries in the exclusive use of Digital Illumination Interface Alliance. More details are available on the DiiA website: (www.dali-alliance.org/trademarks/). Members may use the trademarks in accordance with the *DiiA Charter* and *Trademark Guidelines* documents.

[*Community registration*](#) is available (with no fee) for luminaire manufacturers, allowing trademark use on luminaires, in accordance with the signed Community Registration and Trademark Guidelines documents.

Other use of the trademarks is not allowed.

6. D4i and Zhaga-D4i

6.1 What is D4i?

D4i is a logo and certification program for intra-luminaire DALI. It extends the existing DALI-2 program by adding a specific set of new features.

Intra-luminaire DALI refers to a small DALI network inside an individual luminaire. D4i specifications ensure that power is available for control devices – such as sensors or wireless communication devices – that are attached or built into the luminaire. Meanwhile, D4i drivers inside the luminaire are able to store and report a wide range of data in a standardized manner.

D4i luminaires can be use in larger DALI systems, but care is needed to ensure the maximum bus current of 250 mA is not exceeded. This is likely to require the bus power supplies in D4i luminaires to be configured to the disabled state before installation.

Further information on D4i can be found here: www.dali-alliance.org/d4i/

6.2 What is Zhaga-D4i?

Zhaga-D4i is a joint certification program launched by DiiA and the Zhaga Consortium.

Based on complementary specifications from Zhaga and DiiA, Zhaga-D4i makes it easy to add or upgrade sensors and/or communication nodes to luminaires. This enables smart, future-proof LED luminaires with IoT connectivity.

Zhaga-D4i luminaires have a powered Zhaga receptacle, which can accommodate a sensor or communication node with a corresponding Zhaga plug. Also, Zhaga-D4i luminaires use LED drivers meeting the D4i requirements, including the availability of DALI-2 luminaire, energy and diagnostics data.

More details on Zhaga-D4i are available on the DiiA website (www.dali-alliance.org/zhaga-d4i/).

6.3 AUX power supplies

DiiA Part 150 defines a low-voltage (nominal 24V) Auxiliary power supply (AUX). This provides power to DALI control devices that do not have a separate mains supply and cannot be powered by the DALI bus. One example is a wireless communication node attached to a luminaire.

AUX power supplies are not DALI devices – they do not connect to the DALI bus.

An AUX power supply can be a standalone device, or can be integrated with control gear.

For more information, please contact us:

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