

KNX DALI Gateways DG/S x.64.x.1 Bas./Prm. Diagnostic with "DALI Monitor" and DALI USB Interface

| BUILDING AND HOME AUTOMATION SOLUTIONS | | | | | | |
|--|----------------------|----------|---------------------------------|------------------|--------|--|
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| System: | i-bus® KNX | Product: | DG/S x.64.1.1, DG/S x.64.5.1 ar | nd DALI USB Inte | erface | |
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Introduction

DALI as a worldwide standard with a huge number of existing installations and even more light circuits has proven its value in commercial projects, a real success story together with KNX. In most of the cases DALI installation and commissioning with ABB i-bus® KNX DALI Gateways works well thanks to long term experiences, standardization and also adaptions in the last years. At the beginning only DALI-1 standard was existing, causing in some cases challenges to deliver a proper solution. DALI-2 with a test procedure for the products helps in this regard.

With ABB i-bus® KNX Gateways, the powerful ETS application and support with ABB i-bus® Tool a smooth implementation is feasible. Nevertheless there are still some challenges in projects, caused by demanding installations or DALI-1 devices. These require knowledge of the DALI properties, functionality and communication between the DALI Gateway DG/S x.64.x.1 and DALI devices.





Fig. 1 KNX DALI Gateway DG/S 1.64.1.1 Basic

Fig. 2 KNX DALI Gateway DG/S 2.64.1.5 Premium

Objectives of the document

This document describes the

•

- Communication and telegrams on the DALI line between the
 - KNX DALI Gateway DG/S x.64.x.1 and DALI devices, e.g. sending commands and cyclical queries
- o Addressed DALI device and KNX DALI Gateway DG/S x.64.x.1, e.g. sending an answer
- Gateway's forwarding of KNX telegrams in DALI commands (checking the Gateway function)
- DALI device response to the Gateway's query (checking the DALI device)

It is explained step by step how to record and evaluate the DALI telegrams.

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Content

1. Overview DALI

DALI is an established protocol for bi-directional, digital communication between lighting-control devices. The DALI Alliance is the global industry organization for DALI lighting control. More information (standards, certification, products): www.dali-alliance.org

DALI Technology

- The DALI protocol is standardized worldwide (IEC 62 386)
- Transmission speed of 1,200 bit per second
- DALI-2: Single/Multi-Master-Slave System with collision control, max. 64 devices (slaves) and max. 64 controllers (masters) per DALI line
- Installation is easy due to the free wiring topology up to 300 m and non-polarity sensitive 2 wire cable (1.5 mm²)
- No SELV no specific cable required
- The DALI control line can be installed together with mains cable (e.g. by using a 5 wires cable)
- Interface voltage U_N 16 V (12 V to 20.5 V)
- DALI Power supply: Max current of 250 mA and a DALI device may consume a maximum of 2 mA
- DALI allows up to 16 groups and 16 scenes

2. DALI technology and KNX DALI Gateways

The KNX DALI Gateway DG/S x.64.x.1 is a DALI <u>single-master</u> controller to DALI standard IEC 62386 Parts 101ed2 and 103ed1. The Gateway is suitable for use with DALI-1 and DALI-2 systems. It supports operating devices/ballasts (DT0, DT6 and DT8) and self-contained emergency converter with batteries (DT1).

The DALI Gateway as the Master

- Transfers commands from KNX to DALI (e.g. "DAP" Direct Arc Power Control (ballast) and sent back status messages to KNX
- Sends cyclical queries ("Status" and "Actual level") to all DALI devices (slaves)
 - Only the addressed DALI device replies with information (answer)
 - This is a continuous process (24/7)
 - \circ The time between each query can be set in the ETS parameters (default 2 sec.)



Fig. 3 Communication in principle on DALI

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3. DALI commands and cyclical queries

The DALI commands are specified in the International Standard IEC 62386 Part 102 "General requirements - Control gear".



Fig. 4 IEC 62386 Part 102

The DALI Gateway DG/S as the Master sends

- Commands
 - Level instructions (direct arc power, go to scene, ...)
 - Special commands (program short address, write memory location, initialize, ping, ...)
 - $_{\odot}$ Configuration instructions (set min/max level, set fade time, store act. level, add to group, ...) and
- Cyclical queries to all DALI devices (slaves), e.g. status, actual level

Telegram recording

- The ETS group-/bus monitor records KNX telegrams
- The DALI monitor software records the queries and commands sent by the DALI Gateway and answers from the DALI devices
 - Note: All DALI addresses are shifted by the value "1" Address range KNX 1...64 → DALI address 0...63 KNX DALI device 1 → DALI address 0 KNX DALI group 5 → DALI group 4 KNX DALI scene 8 → DALI scene 7



Fig. 5 Telegrams on KNX and DALI

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4. KNX DALI Gateway DG/S x.64.x.1: The most common DALI commands

- Direct Arc Power Control (ballast)
 - $_{\odot}$ $\,$ When "DAP (level)" is received, the ballast starts fading to the desired level
 - The transition begins with the corresponding fade time



Fig. 6 Command "Direct Arc Power - Ballast"

- Direct Arc Power Control (group)
 - \circ When "DAP (level)" is received, the group starts fading to the desired level
 - \circ $\,$ The transition begins with the corresponding fade time $\,$

| | 1.000 | | | | | | - 0 | 1 × | | | |
|-----|---------|---------------|--------|------------------|-------------------------------------|---------|-------|-----|----------|-------|-----------|
| | LOQ | E II 3 | K IF | : X X ? | Ind Hex Ind Adds | Ind Cod | | | | | |
| | lipe . | Hex Data | Addres | as Command | Time Date | Comer | ent . | | | | |
| 1 | Duery | 3F90 | A31 | QUERY STATUS | 11.47.05.082 09.11 | 2021 | | | | | |
| 1 | Duery | 4190 | A32 | OUERY STATUS | 11.47.07.100 09.11 | 2021 | | | | | |
| - 3 | Juniy . | 4500 | 134 | OUERY STATUS | 11 47 11 143 09 1 | 2021 | | | | | |
| | SAP. | 86CC | 63 | DIRECT ARC POWER | OAPCI 204 (26 %) 11.47 11.785 00 11 | 2021 | | | | | |
| - | | 47.20 | 107 | Sector Strates | 11:47:13:162:09:11 | 2021 | | | | | |
| 1 | Duery | 4990 | 66A | QUERY STATUS | 11.47.15.180 09.11 | 2021 | | | | | |
| | Juery | 4005 | 426 | QUERT STATUS | 11.47.57.200 09.11 | 2923 | | | | | |
| | Suary | 4590 | A39 | QUERY STATUS | 11.47.21.248 09.11 | 2021 | | | | | |
| | Duery | 5190 | A40 | QUERY STATUS | 11.47.23.273 09.11 | 2021 | | | | | |
| 1 | Duery | 5390 | A41 | QUERY STATUS | 11.47.25.292 09.11 | 2021 | | | | | |
| | opery | 5590 | A82 | QUERY STATUS | 11.47.27.313 02.11 | 2021 | | | | | |
| | | 149 | | DAP 8 | SCC G3 DI | RECT | ARCP | OW | | C) 20 | 4 (26 %) |
| | | 145 | | 014 01 | 00 05 01 | LOI | 74101 | 0 | LIC (D/a | 0,20 | 4 (20 /0) |
| | Duery | 6192 | A48 | QUERY STATUS | 11.47.38.443 09.11 | 2021 | | | | | |
| -3 | JUBRY | 6399 | A49 | QUERY STATUS | 11.47.41.467 02.1 | 2021 | | | | | |
| | | | | | | | | | | | |
| | 2 | aval | in | structio | "Diract A | Do Do | MORC | ont | trol" [| LIVC | |
| | 3 L | ever | 1113 | Structio | DIECLA | CPU | wer c | On | 101 - 1 | JALI | |
| - | | | - | | | | 14 | | | | |
| | 10 | arout | רר | · 204 lev | el (26% lia | nt ou | tout) | | | | |
| | 1 2 | 2.001 | | | ci (Lo /o lig | 10 00 | cpuc) | | | | |
| | | N 1/1 | 11/ | | 1 | | | | | | |
| | | → KIN | IX (| aroup 4 | 1 | | | | | | |
| | | | | 9 | | | | | | | |

Fig. 7 Command "Direct Arc Power – Group"

• Go To Scene

 \circ $\;$ The scene value stored in the ballast is recalled

| 11 | | - | V V a | Lengt ann | - Lateral | | | |
|---------|---------------|---------|-----------------|-------------------------|------------------|----|------------|---|
| Log | P II 2 | | SIT HEN I | find Hex Ind Add: | feed Cond. | | | |
| Tipe | Hex Data | Address | Command | Time Date | Comment | | | |
| Query | 2500 | A18 | QUERY STATUS | 09 28 36 250 09 11 2021 | | | | |
| Query | 2790 | A19 | QUERY STATUS | 09:28:38:268 09:11:2021 | | | | |
| Ouery | 2990 | A20 | QUERY STATUS | 09 28 40 293 09 11 2021 | | | | |
| Ouery | 2890 | A21 | QUERY STATUS | 09:28:42:318 09:11:2021 | | | | |
| _ | 30.01 | 100 | ALCONOTATION OF | 09.28.44.337 00.11.2021 | | | | |
| 342 | PF10 | DCast | GO TO SCENE 0 | 09 28 44 984 08 11 2021 | | | | |
| CONT | 27.95 | 742.3 | GOERT STATUS | 09:28:46:357 09:11:2021 | | | | |
| Ouery | 3195 | A24 | QUERY STATUS | 09/28/48/374 09/11/2021 | | | | |
| Query | 3399 | A25 | QUERY STATUS | 09.28:50.401 09.11.2021 | | | | |
| Query | 3590 | A26 | QUERY STATUS | 09 28 52 420 09 11 2021 | | | | |
| Query | 3790 | A27 | QUERY STATUS | 092854.444 09.112021 | | | | |
| QUEY | 3990 | A28 | QUERT STATUS | 09/28/56.470 09/11/2021 | | | | |
| Contry | 36790 | 129 | GUERR STATUS | 09.26.56.466 09.11.2021 | | | | |
| | | | | | COMPLETE STOCKED | | | |
| 1 | 8 | IAF | 2 | FF10 | Bcast | GO | TO SCENE (|) |
| 1 | | | | | | | | |
| Special | AD00 | | PING | 09 29:08 778 09:11 2021 | | | | |
| Query | 4790 | A35 | QUERY STATUS | 092910.621 09.112021 | | | | |

Fig. 8 Command "Go to Scene"

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- Set Fade Time (ballast/group)
 - To store a new fade time
 - The ballast has only one fade time. If the times are different (ON 4 sec. and OFF 2 sec.) it is sent again to DTRO (data transfer register 0) and stored (set fade time G2) before a command (e.g. direct arc power) follows
 - DTR0=0: 0.0 sec.
 DTR0=1: 0.7 sec.
 DTR0=2: 1.0 sec
 DTR0=3: 1.4 sec
 DTR0=4: 2.0 sec.
 DTR0=6: 4.0 sec
 DTR0=12: 32.0 sec.

DTR0=15: 90.5 sec

. . .



Fig. 9 Command "Set Fade Time"

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- Dimming
 - With DALI there is no start/stop dimming as specified for KNX
 - Therefore, dimming is implemented as follows:
 - Start dim: Send fade time to DTR0 (e.g. 7=5.7 sec)
 Set fade time (ballast/group)
 Send direct arc power to max level (dim up) or min level (dim down)
 → Ballast/group starts to dim up/down

| Log Tigs Outry Outry | III X IF 1000 A59 3000 A39 3000 A30 3070 4190 4190 A32 4190 A32 4190 A32 8726 G3 8726 G3 8726 G3 8704 G3 8726 G3 | Command Country Status Country Statu | End Hiss Include: 115748374 001 010 115748374 001 010 115755801 010 115755801 010 115755801 011 115756801 011 115755801 011 115755801 011 115755801 011 115755800 011 115755800 011 115755800 011 115755800 011 115755800 011 115755800 011 115755800 011 115755800 011 115755800 011 115755800 011 115755800 011 115755800 011 115755800 011 115757115 011 | Med Casi Construct 1 Construct - 1 Construct - |
|--|--|--|---|--|
| 8 130 | Special | A307 | * | DTR0= 7 (0x07) |
| 8 131 | Conf | 872E | G3 | SET FADE TIME (DTR0) |
| 8 132 | Conf | 872E | G3 | SET FADE TIME (DTR0) |
| 8 133 | DAP | 86FE | G3 | DIRECT ARC POWER (DAPC) 254 (100 %) |
| 8 134 | Special | A301 | * | DTR0= 1 (0x01) |
| ° 135 | Conf | 872E | G3 | SET FADE TIME (DTR0) |
| 136 | Conf | 872E | G3 | SET FADE TIME (DTR0) |
| 137 | DAP | 866A | G3 | DIRECT ARC POWER (DAPC) 106 (1.8 %) |
| <u>St</u> • S • C | art din Special Configu 5.7 sec. | n: comman iration in: struction | d "DTRO struction "Direct | – Send fade time" – 5.7 sec. n "Set fade time" – <u>DALI group 3:</u> |

Fig. 10 Command "Start dim"

Stop dim:

Send fade time to DTR0=1 (0.7 sec), fastest possible time Set fade time (ballast/group)

The DALI Gateway calculates the dim stop value and sends direct arc power level to synchronize all ballasts of the group

 \rightarrow Ballast/group stops dimming and adopts the sent value

| Log Text Outry Outry Outry Outry Date Special Conf Conf Date Special Conf Conf Conf Conf Conf Conf Conf Conf | Her. Outling Address 1990 A30 37090 A30 37090 A31 41900 A22 41900 A22 8726 G3 8726 G3 | ST 10100 ? CARPY TATUS CARPY TATUS CARPY TATUS CARPY TATUS CARPY TATUS CARPY TATUS CARPY TATUS CONTROL (INC.) DIRECT | find Hex Time 11.57 | Dear Common Desr Common Desr Common Desr Common Desr Desr Desr Desr <tddesr< td=""> Desr <tdd< th=""></tdd<></tddesr<> |
|---|---|---|--|--|
| 8 130 | Special | A307 | . 9. | DTR0= 7 (0x07) |
| ° 131 | Conf | 872E | G3 | SET FADE TIME (DTR0) |
| 8 132 | Conf | 872E | G3 | SET FADE TIME (DTR0) |
| 8 133 | DAP | 86FE | G3 | DIRECT ARC POWER (DAPC) 254 (100 %) |
| 134 | Special | A301 | * | DTR0= 1 (0x01) |
| 8 135 | Conf | 872E | G3 | SET FADE TIME (DTR0) |
| 136 | Conf | 872E | G3 | SET FADE TIME (DTR0) |
| 137 | DAP | 866A | G3 | DIRECT ARC POWER (DAPC) 106 (1.8 %) |
| <u>St</u> •S •C •C | op dim ipecial Configu).7 sec. .evel ins | <u>::</u> command iration ins ⁻ struction " | "DT truc 'Dire | R0 – Send fade time" – 0.7 sec. tion "Set fade time" – <u>DALI group 3:</u> ect Arc Power Control" – <u>DALI group 3</u> : |

Fig. 11 Command "Stop dim"

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5. KNX DALI Gateway DG/S x.64.x.1: DALI cyclical queries

- Queries are used to retrieve property values from a device (DALI address 0...63)
- The DALI Gateway automatically and cyclically sends queries on the DALI line
- These queries are used to read out the status of the ballasts (see below for more information)
- The addressed device returns the queried property value in a backward frame
- The pause between DALI queries can be parameterized in the ETS
- Commands are sent between the queries

| DALIM | onitor - DALI US | 8 (6597) | | | | | | | - 0 |) |
|--------|------------------|----------|---------|---------------------------|-------------|--------------|------------|-----------|-------|---|
| £ [| Log | | K IF | SET VIEW ? | find Hex | c find A | ddr. | find Cmd: | | |
| Line # | Туре | Hex Data | Address | Command | | Time | Date | Comment | | |
| 105 | Query | 7790 | A59 | QUERY STATUS | | 10:39:33.316 | 10.11.2021 | | | |
| 106 | Query | 7990 | A60 | QUERY STATUS | | 10:39:35.340 | 10.11.2021 | | | |
| 107 | Query | 7890 | A61 | QUERY STATUS | | 10:39:37.357 | 10.11.2021 | 2 CAS | | |
| 108 | DAP | 02FE | A1 | DIRECT ARC POWER (DAPC) 2 | 254 (100 %) | 10:39:38.065 | 10.11.2021 | Col | mmand | |
| 109 | Query | 7D90 | A62 | QUERY STATUS | | 10:39:39.377 | 10.11.2021 | | | |
| 110 | Query | 7F90 | A63 | QUERY STATUS | | 10:39:41.396 | 10.11.2021 | | | |
| 111 | Query | 0190 | AO | QUERY STATUS | | 10:39:45.423 | 10.11.2021 | | | |
| 112 | Answer | 00 | | = 0 (0x00) | | 10:39:45.435 | 10.11.2021 | | | |
| 113 | Query | 01A0 | AO | QUERY ACTUAL LEVEL | | 10:39:47.424 | 10.11.2021 | - | | |
| 114 | Answer | 00 | | = 0 (0x00) | | 10:39:47.438 | 10.11.2021 | 2 se | C. | |
| 115 | Query | 0390 | A1 | QUERY STATUS | | 10:39:49.443 | 10.11.2021 | - | | |
| 116 | Answer | 04 | | = 4 (0x04) | | 10:39:49.460 | 10.11.2021 | | | |
| 117 | Conf | FF2E | Bcast | SET FADE TIME (DTR0) | | 10:39:50.188 | 10.11.2021 | | | |
| 118 | Conf | FF2E | Bcast | SET FADE TIME (DTR0) | | 10:39:50.217 | 10.11.2021 | | | |
| 119 | IAP | FF10 | Bcast | GO TO SCENE 0 | | 10:39:50.247 | 10.11.2021 | | | |
| 120 | Query | 03A0 | A1 | QUERY ACTUAL LEVEL | | 10:39:51.448 | 10.11.2021 | | | |
| 121 | Answer | FE | | = 254 (0xFE) | | 10:39:51.461 | 10.11.2021 | | | |
| 122 | Query | 0590 | A2 | QUERY STATUS | | 10:39:53.469 | 10.11.2021 | | | |
| 123 | Answer | 04 | | = 4 (0x04) | | 10:39:53.483 | 10.11.2021 | | | |
| 124 | Query | 05A0 | A2 | QUERY ACTUAL LEVEL | | 10:39:55.475 | 10.11.2021 | | | |
| 125 | Answer | FE | | = 254 (0xFE) | | 10:39:55.492 | 10.11.2021 | | | |

Fig. 12 Cyclical queries

- The DALI Gateway as the Master sends
 - Query "Status" (8-bit, combination of device properties)
 → The answer is transferred and sent to KNX, e.g. lamp fault
 - Bit 0: Ballast fault
 - Bit 1: Lamp fault
 - Bit 2: Lamp on
 - Bit 3: Limit error
 - Bit 4: Fade running
 - Bit 5: Reset state
 - Bit 6: Short address is masked
 - Bit 7: Power cycle seen

| 5 | l Log | | C IF | SET VIEW ? |
|--------|--------|----------|---------|--------------------|
| Line # | Туре | Hex Data | Address | Command |
| 583 | Query | 7890 | A61 | QUERY STATUS |
| 584 | Query | 7D90 | A62 | QUERY STATUS |
| 585 | Query | 7F90 | A63 | QUERY STATUS |
| 586 | Query | 0190 | AO | QUERY STATUS |
| 587 | Answer | 00 | | = 0 (0x00) |
| 588 | Query | 01A0 | AO | QUERY ACTUAL LEVEL |
| 589 | Answer | 00 | | = 0 (0x00) |
| 590 | Query | 0390 | A1 | QUERY STATUS |
| 591 | Answer | 04 | | = 4 (0x04) |
| 592 | Query | 03A0 | A1 | QUERY ACTUAL LEVEL |
| 593 | Answer | B7 | | = 183 (0xB7) |

Fig. 13 Query "Status" and answer from the ballast

Query "Actual level" (8-bit)
 The answer is not evaluated and can be used for diagnosis with DALI monitor tool

6. Diagnostic with "DALI Monitor" software and DALI USB Interface

Some manufacturers of DALI devices offer interfaces between USB and DALI, e.g. Tridonic or Lunatone. Together with a software, the telegrams can be displayed on the DALI line (like the ETS Group/Bus Monitor). The DALI USB interface has no DALI address and can also be used to address, program DALI devices and set parameters (e.g. Tridonic "masterCONFIGURATOR" software) \rightarrow With the KNX DALI Gateway DG/S, however, this is done via the i-bus[®] Tool and the ETS.



Fig. 14 Tridonic DALI USB Interface





Fig. 16 Diagnostic with ETS Group/Bus Monitor and DALI USB Interface

Test set-up (using the DALI USB Interface and "DALI Monitor" software from Tridonic as an example)

- The KNX and DALI devices are programmed and in operation
- Start the ETS
- Select a tunnel connection of an IP Router IPR/S or IP Interface IPS/S as the interface. The ETS Group/Bus Monitor communicates with the KNX line via this tunnel connection.
- Connect the DALI USB Interface to the USB port of the laptop (the green LED lights up) and to the DALI line
- Start the "DALI Monitor" software and record the telegrams

| | | 🗙 IF 💡 | IET VIEW ? | | |
|------------------|------------|---------|------------|----------|--|
| ind Hex: find Ad | ddr: fin | d Cmd: | | | |
| Line # Type | Hex Data | Address | Command | Time | |
| Enten Tippe | TICK D'did | Address | Command | Time | |
| | | | | | |
| | | | | | |

Fig. 17 DALI Monitor software

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6.1 Telegram analysis on KNX and DALI

Step-by-step sequence from pressing a KNX button to switching on the DALI lamp:

- The KNX sensor sends a telegram
- The ETS Group/Bus monitor records it
 - ✓ The KNX telegram content is displayed and can be checked (sent group address, value)
- The DALI Gateway receives this KNX telegram, converts it into a DALI command and sends it to the DALI line
- The "DALI Monitor" records it
 - \checkmark The DALI telegram content is displayed in and can be checked (command, value, ...)
- The DALI device receives the command and executes it (e.g. switches the lamp on)

In this way, it can be checked step by step whether

- The sent KNX telegram contains the correct group address and content (on, off, dimming value)
- The DALI Gateway converts the received KNX telegram and sends it to the DALI line (DALI command)

Thus the DALI Gateway works correctly.

If this has happened and the DALI device or the lamp does not react to the DALI command, <u>then the</u> <u>cause is not in the DALI Gateway</u> but in the DALI device or lamp (not addressed, not connected to DALI, no supply voltage, lamp fault, ...) .

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6.2 Switch on DALI output A

- A control element sends the group address 3/4/101 with value "1"
- The ETS Group/Bus monitor records telegram with group address 3/4/101 with value "1"
- The DALI Gateway converts KNX group address 3/4/101 with value "1" into DALI command "Bcast direct arc power level 254" (100% light output) and sends it to the DALI line
- All ballasts switch on
- The DALI Gateway simulates the switch on behavior of all ballasts and sends KNX group addresses with corresponding values to the KNX line (depends on fade time and parameter "Behavior Switch On Value")



Fig. 18 Switch on DALI output A

| Time | Source Source Name | Destinatio | Destination Name | Info |
|-------------------------|-------------------------|------------|------------------|-----------|
| 09.11.2021 14:38:31,636 | 3.7.154 Control element | 3/4/101 | Output A: Switch | \$01 On |

Fig. 19 Control element sends group address 3/4/101 with value "1"

| Line # | Туре | Hex Data | Address | Command |
|--------|------|----------|---------|-------------------------------------|
| 1 | DAP | FEFE | Bcast | DIRECT ARC POWER (DAPC) 254 (100 %) |

Fig. 20 DALI Gateway sends the DALI command "Bcast – direct arc power 254 level (100% light output)"

| Time | Source | Source Name | Destinatio | Destination Name | Info |
|---|---------|-------------|------------|---|----------------|
| 09.11.2021 14:38:31,794 | 3.7.151 | DALI DG/S | 3/4/42 | Bal. 1: RGBW LED strip left Status Switch | \$01 On |
| 09.11.2021 14:38:31,814 | 3.7.151 | DALI DG/S | 3/4/62 | Bal. 2: White LED strip mid. Status Switch | \$01 On |
| 09.11 <mark>.</mark> 2021 14:38: <mark>31</mark> ,834 | 3.7.151 | DALI DG/S | 3/4/72 | Bal. 3: Tc LED strip right Status Switch | \$01 On |
| 09.11 <mark>.</mark> 2021 14:38:31,858 | 3.7.151 | DALI DG/S | 3/4/78 | Bal. 3: Tc LED strip right Color temp. status | 0D 20 3360 K |
| 09.11.2021 14:38:31,968 | 3.7.151 | DALI DG/S | 3/4/2 | G1: Led strips RED Status Switch | \$01 On |
| 09.11 <mark>.</mark> 2021 14:38:31,988 | 3.7.151 | DALI DG/S | 3/4/12 | G2: Led strips GREEN Status Switch | \$01 On |
| 09.11.2021 14:38:32,008 | 3.7.151 | DALI DG/S | 3/4/22 | G3: Led strips BLUE Status Switch | \$01 On |
| 09.11 <mark>.</mark> 2021 14:38:32,040 | 3.7.151 | DALI DG/S | 3/4/32 | G4: Led strips WHITE Status Switch | \$01 On |
| 09.11.2021 14:38:33,748 | 3.7.151 | DALI DG/S | 3/4/47 | Bal. 1: RGBW LED strip left Set value red/Stat. | \$59 35 % |
| 09.11.2021 14:38:33,769 | 3.7.151 | DALI DG/S | 3/4/48 | Bal. 1: RGBW LED strip left Set value green/Stat. | \$FF 100 % |
| 09.11 <mark>.</mark> 2021 14:38:33,790 | 3.7.151 | DALI DG/S | 3/4/49 | Bal. 1: RGBW LED strip left Set value blue/Status | \$00 0 % |
| 09.11 <mark>.</mark> 2021 14:38:33,812 | 3.7.151 | DALI DG/S | 3/4/50 | Bal. 1: RGBW LED strip left Set value white/Stat. | \$00 0 % |
| 09.11.2021 14:38:33,834 | 3.7.151 | DALI DG/S | 3/4/65 | Bal. 2: White LED strip mid. Status Bright. value | \$FF 100 % |
| 09.11.2021 14:38:33,856 | 3.7.151 | DALI DG/S | 3/4/75 | Bal. 3: Tc LED strip right Status Bright. value | \$FF 100 % |
| 09.11.2021 14:38:33,901 | 3.7.151 | DALI DG/S | 3/4/5 | G1: Led strips RED Status Bright, value | \$FF 100 % |

Fig. 21 DALI Gateway sends status to KNX

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6.3 Switch on DALI ballast 2

- A control element sends group address 3/4/61 with value "1"
- The ETS Group/Bus monitor records telegram with group address 3/4/61 with value "1"
- The DALI Gateway converts KNX group address 3/4/61 with value "1" into DALI command "A1 direct arc power level 254" (100% light output) and sends it to the DALI line
- Ballast no. 2 (= DALI address 1) switches on
- The DALI Gateway simulates the switch on behavior of ballast no. 2 and sends KNX group address 3/4/62 with value "ON" and 3/4/65 with value "100%" to the KNX line (depends on fade time and parameter "Behavior Switch On Value")



Fig. 22 Switch on DALI ballast 2

| Time | Source Source Name | Destinatio | Destination Name | Info |
|-------------------------|------------------------|------------|-------------------------------------|-----------|
| 09.11.2021 15:11:18,705 | 3.7.153 6127/02 contrl | 3/4/61 | Bal. 2: White LED strip mid. Switch | \$01 On |

Fig. 23 Control element sends group address 3/4/61 with value "1"

| Line # | Туре | Hex Data | Address | Command |
|--------|------|----------|---------|-------------------------------------|
| 1 | DAP | 02FE | A1 | DIRECT ARC POWER (DAPC) 254 (100 %) |

Fig. 24 DALI Gateway sends the DALI command "A1 - direct arc power level 254"

| Time | Source | Source Name | Destinatio | Destination Name | Info |
|-------------------------|---------|-------------|------------|---|--------------|
| 09.11.2021 15:11:18,799 | 3.7.151 | DALI DG/S | 3/4/62 | Bal. 2: White LED strip mid. Status Switch | \$01 On |
| 09.11.2021 15:11:20,797 | 3.7.151 | DALI DG/S | 3/4/65 | Bal. 2: White LED strip mid. Status Bright. value | \$FF 100 % |

Fig. 25 DALI Gateway sends status to KNX

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6.4 Switch off group 3

- The group membership is already saved in the ballasts
- A control element sends group address 3/4/21 with value "0"
- The ETS Group/Bus monitor records telegram with group address 3/4/21 with value "0"
- The DALI Gateway converts KNX group address 3/4/21 with value "0" into DALI command "G2 direct arc power level 0" (OFF light output) and sends it to the DALI line
- Group no. 3 (= DALI group 2) switches off
- DALI Gateway simulates the switch off behavior of the group and sends KNX group address 3/4/22 with value "OFF" and 3/4/25 with value "0%" to the KNX line (both depends on fade time and parameter "Behavior Switch Off Value")



Fig. 26 Switch off group 3

| Time | Source | Source Name | Destinatio | Destination Name | Info |
|---|---------|----------------|------------|----------------------------|------------|
| 09.11 <mark>.</mark> 2021 <mark>15:19:52,333</mark> | 3.7.152 | 6127/02 contrl | 3/4/21 | G3: Led strips BLUE Switch | \$00 Off |

Fig. 27 Control element sends group address 3/4/21 with value "0"

| Line # | Type | Hex Data | Address | Command |
|--------|------|----------|---------|---------------------------------|
| 1 | DAP | 8400 | G2 | DIRECT ARC POWER (DAPC) 0 (OFF) |

Fig. 28 DALI Gateway sends the DALI command "G2 – direct arc power level 0"

| Time | Source | Source Name | Destinatio | Destination Name | Info |
|-------------------------|---------|-------------|------------|--|------------|
| 09.11.2021 15:19:54,631 | 3.7.151 | DALI DG/S | 3/4/22 | G3: Led strips BLUE Status Switch | \$00 Off |
| 09.11.2021 15:19:54,652 | 3.7.151 | DALI DG/S | 3/4/25 | G3: Led strips BLUE Status Bright. value | \$00 0 % |

Fig. 29 DALI Gateway sends status to KNX

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6.5 Dim down group 4

- ٠ The group membership is already saved in the ballasts
- Press rocker of control element • \rightarrow Group address 3/4/33 with value "01" (start dimming down) is sent
 - The ETS Group/Bus monitor records telegram with group address 3/4/33 with value "01"
- The DALI Gateway converts KNX group address 3/4/33 with value "01" into DALI commands
 - "DTR0=7" send fade time (e.g. 7=5.7 sec)
 - o "G3 set fade time" store new fade time in all ballasts of the group
 - o "G3 direct arc power level 1 (0.1% light output)" group starts dim down to level "1" and sends them to the DALI line
- Group no. 4 (= DALI group 3) starts dimming down



Fig. 30 Start dimming down group 4

| Time | Source | Source Name | Destinatio | Destination Name | Info |
|-------------------------|-----------|----------------|------------|--------------------------------|------------------------|
| 09.11.2021 15:56:34,172 | 3.7.152 (| 6127/02 contrl | 3/4/33 | G4: Led strips WHITE rel. dim. | \$01 Decrease, 100 % |

Fig. 31 Control element sends group address 3/4/33 with value "01" \rightarrow start dimming down

| Line # | Туре | Hex Data | Address | Command |
|--------|---------|----------|---------|-----------------------------------|
| 1 | Special | A307 | * | DTR0= 7 (0x07) |
| 2 | Conf | 872E | G3 | SET FADE TIME (DTR0) |
| 3 | Conf | 872E | G3 | SET FADE TIME (DTR0) |
| 4 | DAP | 8601 | G3 | DIRECT ARC POWER (DAPC) 1 (0.1 %) |

Fig. 32 DALI Gateway sends DALI commands

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- Release rocker of control element
 → Group address 3/4/33 with value "00" (stop dimming down) is sent
- The ETS Group/Bus monitor records telegram with group address 3/4/33 with value "00"
- The DALI Gateway converts KNX group address 3/4/33 with value "00" into DALI commands
 - "DTR0=1" send fade time (1=0.7 sec, fastest possible time)
 - o "G3 set fade time" store new fade time in all ballasts of the group
 - "G3 direct arc power level 106 (1.8% light output)" group stops dim down, the DALI Gateway calculates the dim stop value and send this value "106" (to synchronize all ballasts of the group to the value 106)

and sends them to the DALI line

- Group no. 4 (= DALI group 3) stops dimming down
- DALI Gateway sends KNX group address 3/4/35 with value "58%" (106) to the KNX line



Fig. 33 Stop dimming down group 4

| Time | Source Source Name | Destinatio | Destination Name | Info |
|-------------------------|------------------------|------------|--------------------------------|------------------------|
| 09.11.2021 15:56:37,449 | 3.7.152 6127/02 contrl | 3/4/33 | G4: Led strips WHITE rel. dim. | \$00 Decrease, Break |

Fig. 34 Control element sends group address 3/4/33 with value "00" → stop dimming down

| Line # | Туре | Hex Data | Address | Command |
|--------|---------|----------|---------|-------------------------------------|
| 7 | Special | A301 | * | DTR0= 1 (0x01) |
| 8 | Conf | 872E | G3 | SET FADE TIME (DTR0) |
| 9 | Conf | 872E | G3 | SET FADE TIME (DTR0) |
| 10 | DAP | 866A | G3 | DIRECT ARC POWER (DAPC) 106 (1.8 %) |

Fig. 35 DALI Gateway sends DALI commands

| Time | Source | Source Name | Destinatio | Destination Name | Info |
|-------------------------|---------|-------------|------------|---|-------------|
| 09.11.2021 15:51:12,674 | 3.7.151 | DALI DG/S | 3/4/35 | G4: Led strips WHITE Status Bright. value | \$94 58 % |

Fig. 36 DALI Gateway sends status to KNX

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6.6 Call KNX scene 5

- A control element sends group address 3/4/141 with value "4" (call scene 5)
- The ETS Group/Bus monitor records telegram with group address 3/4/141 with value "4" (activate scene 5)
- The DALI Gateway converts KNX group address 3/4/141 with value "4" into DALI command "Bcast – go to scene X" and sends it to the DALI line → Scene number depends on scene mapping (ETS parameter), e.g. KNX scene "5" is mapped top DALI scene "1" (value "0")
- The scene values and fade times are saved in the ballasts
 → These values are called up for a scene
- The DALI Gateway simulates the behavior of all ballasts/groups which are members of the scene and sends KNX group addresses with corresponding values (depends on fade time) to the KNX line



Fig. 37 Call KNX scene 5

| Time | Source | Source Name | Destinatio | Destination Name | Info |
|---------------------------------------|---------|-----------------|------------|-------------------------|-------------------|
| 09.11.2021 <mark>1</mark> 5:33:08,836 | 3.7.154 | Control element | 3/4/141 | Output A: KNX scene 164 | \$04 Activate 5 |

Fig. 38 Control element sends group address 3/4/141 with value "4" (call scene 5)

| 2 | Line # | Туре | Hex Data | Address | Command | |
|---|--------|------|----------|---------|---------------|--|
| | 1 | IAP | FF10 | Bcast | GO TO SCENE 0 | |

Fig. 39 DALI Gateway sends DALI command "Bcast - go to scene X" (e.g. DALI scene 0)

| Time | Source | Source Name | Destinatio | Destination Name | Info | |
|-------------------------|---------|-------------|------------|--|--------------|--|
| 09.11.2021 15:33:09,150 | 3.7.151 | DALI DG/S | 3/4/2 | G1: Led strips RED Status Switch | \$01 On | |
| 09.11.2021 15:33:09,169 | 3.7.151 | DALI DG/S | 3/4/22 | G3: Led strips BLUE Status Switch | \$01 On | |
| 09.11.2021 15:33:11,218 | 3.7.151 | DALI DG/S | 3/4/5 | G1: Led strips RED Status Bright. value | \$FF 100 % | |
| 09.11.2021 15:33:11,238 | 3.7.151 | DALI DG/S | 3/4/25 | G3: Led strips BLUE Status Bright. value | \$FF 100 % | |

Fig. 40 DALI Gateway sends status to KNX

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6.7 Cyclical queries

The DALI Gateway as the master sends cyclical queries ("Status" and "Actual level") to all 64 DALI devices. The addressed device returns the queried property value in a backward frame. The response time is a maximum of 12 milliseconds. The DALI Gateway converts the answer and sends it to the KNX line, e.g. lamp fault of DALI device 6.

- Answer from addressed DALI device to a query "Status":
 - Bit 0: No ballast fault
 - o Bit 1: Lamp fault
 - Bit 2: No lamp on
 - Bit 3: No limit error
 - Bit 4: No fade running
 - o Bit 5: No reset state
 - Bit 6: No short address is masked
 - Bit 7: No power cycle seen

Example:

- Query "Status" to DALI device 6 (= DALI address 5)
- o Answer "02hex"
 - → 000000**1**0bin

 \rightarrow means "Lamp fault"

| | | | e 15 | V V a |
|--------|--------|----------|---------|--------------------|
| ין כ | | | | SET VIEW |
| Line # | Туре | Hex Data | Address | Command |
| 599 | Answer | 04 | | = 4 (0x04) |
| 600 | Query | 07A0 | A3 | QUERY ACTUAL LEVEL |
| 601 | Answer | A1 | | = 161 (0xA1) |
| 602 | Query | 0990 | A4 | QUERY STATUS |
| 603 | Answer | 00 | | = 0 (0x00) |
| 604 | Query | 09A0 | A4 | QUERY ACTUAL LEVEL |
| 605 | Answer | 00 | | = 0 (0x00) |
| 606 | Query | 0B90 | A5 | QUERY STATUS |
| 607 | Answer | 02 | | = 2 (0x02) |
| 608 | Query | 0BA0 | A5 | QUERY ACTUAL LEVEL |
| 609 | Answer | FF | | = 255 (0xFF) |
| 610 | Query | 0D90 | A6 | QUERY STATUS |

Fig. 41 Query "Status" and answer from a ballast

• The answer to a query "Actual level" is not evaluated and can be used for diagnosis with DALI monitor tool.

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6.8 Framing error

A "framing error" exists if no clear DALI telegram is received when a DALI device is polled.

This can occur if

- The DALI device does not send a DALI compliant telegram
- The DALI telegram was disrupted by external signal interference
- Several DALI devices reply and their superimposed telegrams result in an unidentifiable DALI telegram being received (DALI double addresses)

| 36 | log 🕨 | | CIF 🚮 | |
|--------|--------|----------|----------|---------------------------|
| Line # | Туре | Hex Data | Address | Command |
| 135360 | Query | 0790 | A1 | QUERY STATUS |
| 135361 | Answer | 00 | | = 0 (0x00) |
| 135362 | Query | 07A0 | A1 | QUERY ACTUAL LEVEL |
| 135363 | Answer | 00 | | = 0 (0x00) |
| 135364 | Query | 0990 | A2 | QUERY STATUS |
| 135365 | Error | 1011010 | | framing error |
| 135366 | Query | 0990 | A2 | QUERY STATUS |
| 135367 | Error | | | framing error |
| 135368 | Query | 0990 | A2 | QUERY STATUS |
| 135369 | Error | | | framing error |
| 135370 | Query | 0990 | A2 | QUERY STATUS |
| 135371 | Error | 10000 | | framing error |
| 135372 | Query | 0B90 | A3 | QUERY STATUS |
| 135373 | Answer | 00 | The quer | y is repeated three times |
| 35374 | Query | 0BA0 | A.S | QUERT ACTUAL LEVEL |
| 135375 | Answer | 00 | | = 0 (0x00) |

Fig. 42 Framing error on a DALI line

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6.9 More information and training material

Competence Center Europe – Smart Buildings: Training & Qualification Database

- The database contains extensive training content
 - \circ Webinar, Learning Sessions, slides and videos, presentations, video tutorials and more \dots
 - o https://go.abb/ba-training
 - www.abb.com/knx (\rightarrow Services & Tools \rightarrow Training and Qualification \rightarrow Training Database)
- YouTube
 - $\circ~$ Channel "ABB Home and Building Automation"
 - www.youtube.com/user/ABBibusKNX
- Online Learnings Session: Slides "KNX DALI Gateways Practical knowledge about DALI Part 1"
 - https://search.abb.com/library/Download.aspx?DocumentID=9AKK108466A2493&LanguageCode=en&DocumentPartId=PDF&Action=Launch
- Online Learnings Session: Video "KNX DALI Gateways Practical knowledge about DALI Part 1"
 - https://search.abb.com/library/Download.aspx?DocumentID=9AKK108466A2493&LanguageCode=en&DocumentPartId=MP4&Action=Launch
- Practical Learnings Session: Video "KNX DALI Gateways Pract. knowledge about DALI Part 1"
 - https://search.abb.com/library/Download.aspx?DocumentID=9AKK108466A2528&LanguageCode=en&DocumentPartId=MP4&Action=Launch
- Online Learnings Session: Slides "KNX DALI Gateways Practical knowledge about DALI Part 2"
 - https://search.abb.com/library/Download.aspx?DocumentID=9AKK108466A2825&LanguageCode=en&DocumentPartId=PDF&Action=Launch
- Online Learnings Session: Video "KNX DALI Gateways Practical knowledge about DALI Part 2"
 - https://search.abb.com/library/Download.aspx?DocumentID=9AKK108466A2825&LanguageCode=en&DocumentPartId=MP4&Action=Launch
- Practical Learnings Session: Video "KNX DALI Gateways Pract. knowledge about DALI Part 2"
 - https://search.abb.com/library/Download.aspx?DocumentID=9AKK108466A2826&LanguageCode=en&DocumentPartId=MP4&Action=Launch

ABB DALI Gateways DG/s x.64.x.1

- Product and downloads
 - https://new.abb.com/low-voltage/products/building-automation/product-range/abb-ibus-knx/products/lighting-control

KNX DALI Gateway Premium DG/S x.64.5.1

- Overview, main benefits and features
 - https://new.abb.com/low-voltage/products/building-automation/news-and-highlights/abb-i-bus-knx-dali-gateways-premium

References to other documents

- FAQ Home and Building Automation
- Engineering Guide Database
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