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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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
  - 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.

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 single-master 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)
  - The time between each query can be set in the ETS parameters (default 2 sec.)

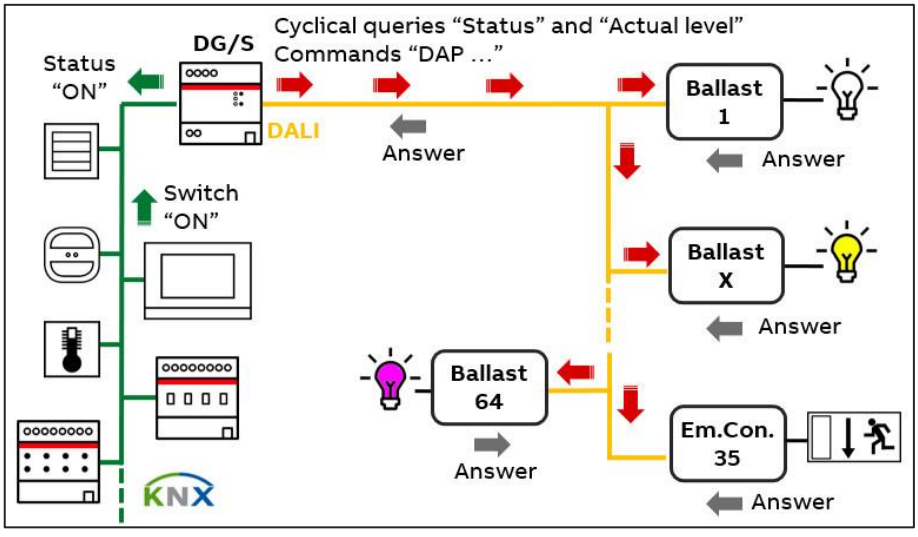


Fig. 3 Communication in principle on DALI

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, …)
  - 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

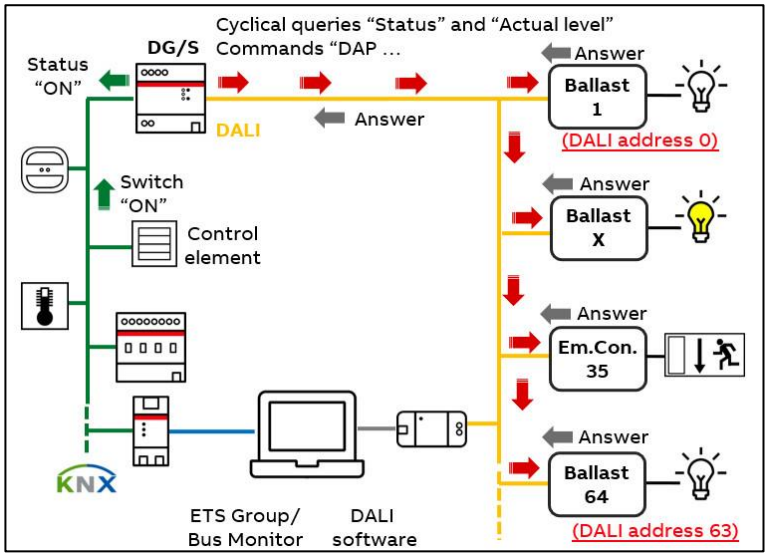


Fig. 5 Telegrams on KNX and DALI

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

- Direct Arc Power Control (ballast)
  - When “DAP (level)” is received, the ballast starts fading to the desired level
  - The transition begins with the corresponding fade time

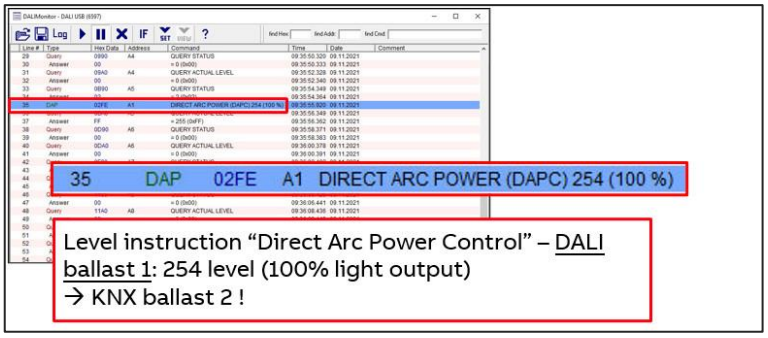


Fig. 6 Command “Direct Arc Power – Ballast”

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

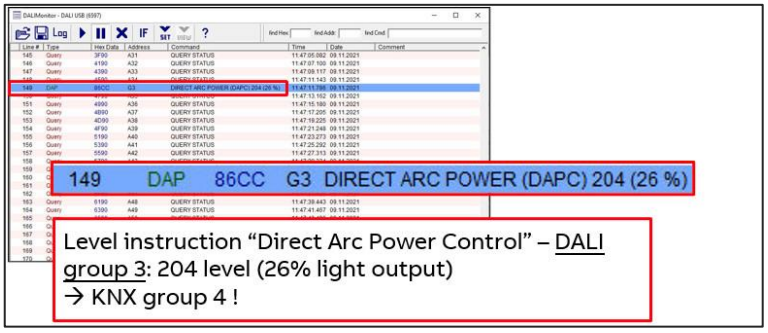


Fig. 7 Command “Direct Arc Power – Group”

- Go To Scene
  - The scene value stored in the ballast is recalled

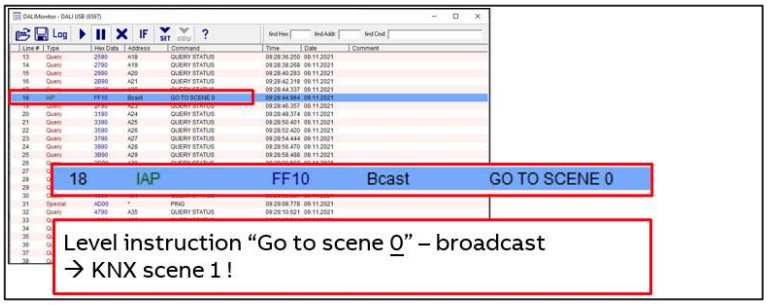


Fig. 8 Command “Go to Scene”

- 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 DTR0 (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

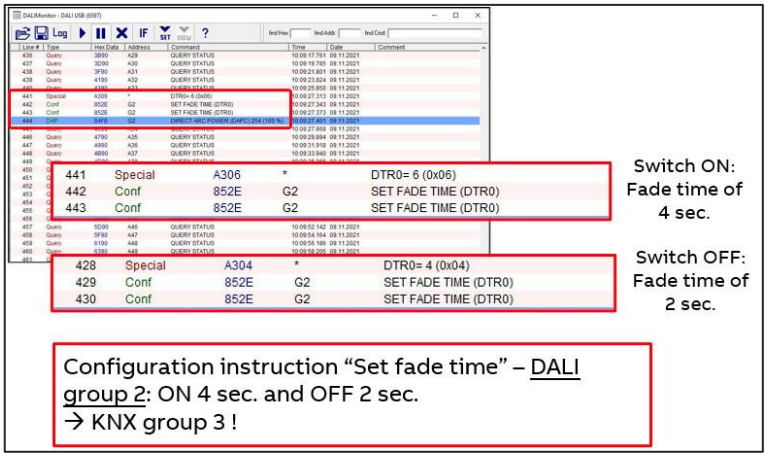


Fig. 9 Command "Set Fade Time"

- 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

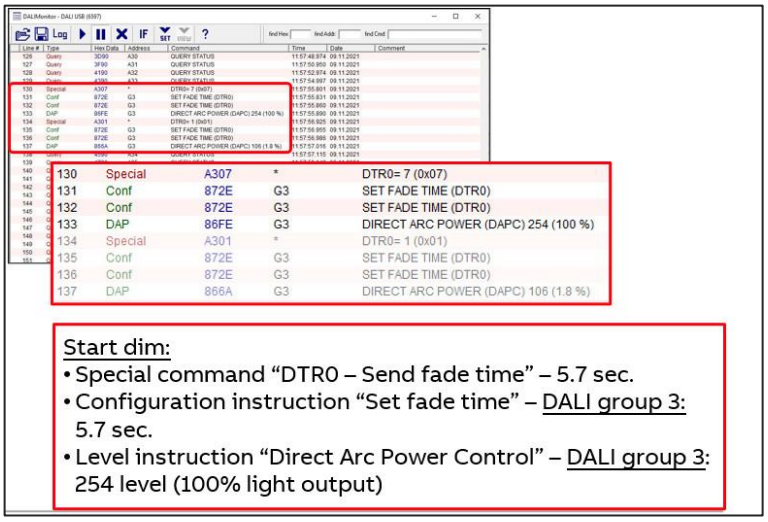


Fig. 10 Command “Start dim”

    - 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
      → Ballast/group stops dimming and adopts the sent value

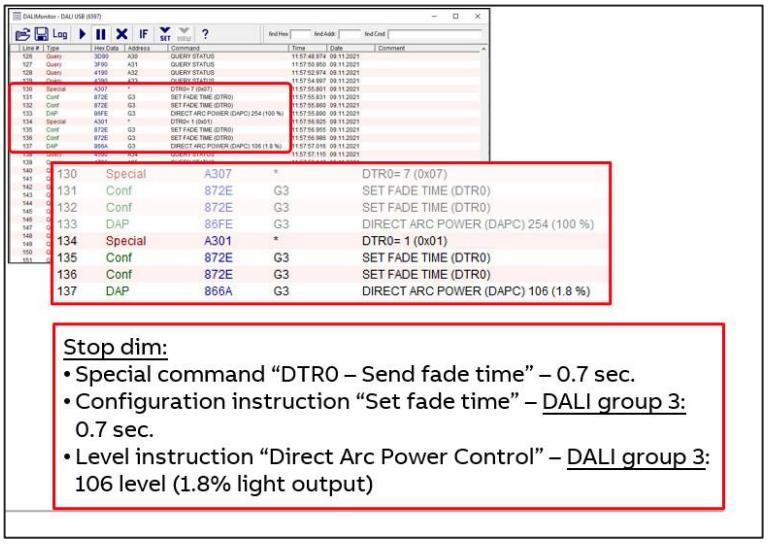


Fig. 11 Command “Stop dim”

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

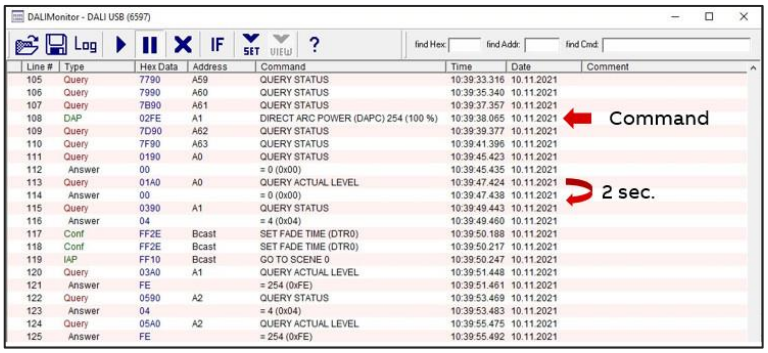
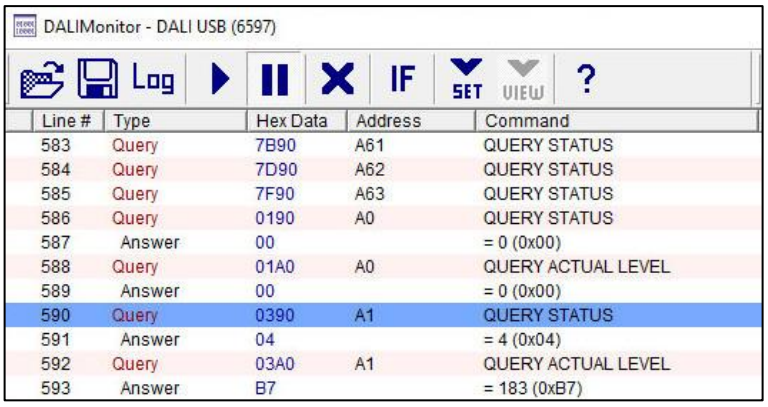


Fig. 12 Cyclical queries

- 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



Line #	Type	Hex Data	Address	Command
583	Query	7B90	A61	QUERY STATUS
584	Query	7D90	A62	QUERY STATUS
585	Query	7F90	A63	QUERY STATUS
586	Query	0190	A0	QUERY STATUS
587	Answer	00		= 0 (0x00)
588	Query	01A0	A0	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) → 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. 15 Lunatone DALI USB Interface

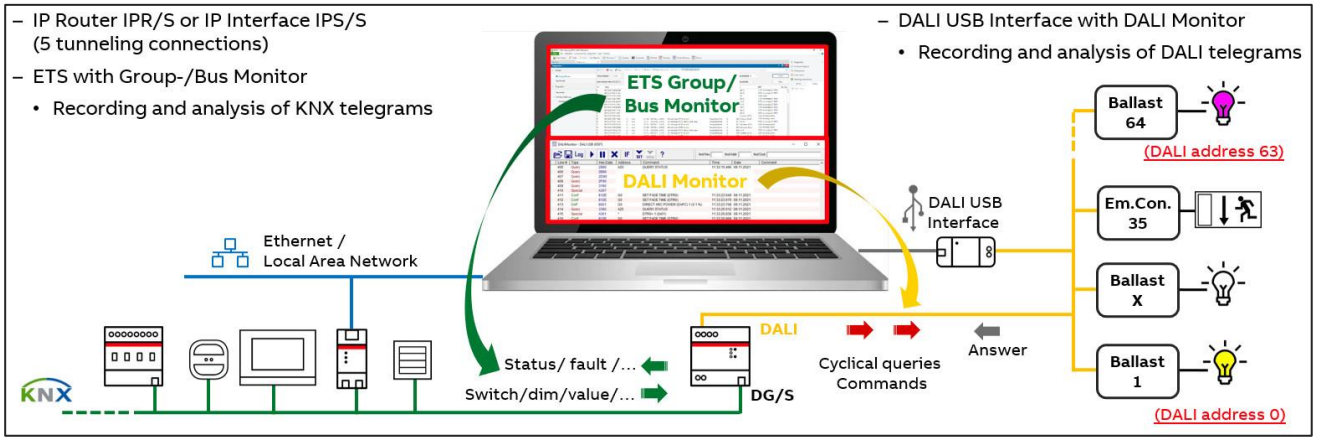


Fig. 16 Diagnostic with ETS Group/Bus Monitor and DALI USB Interface

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

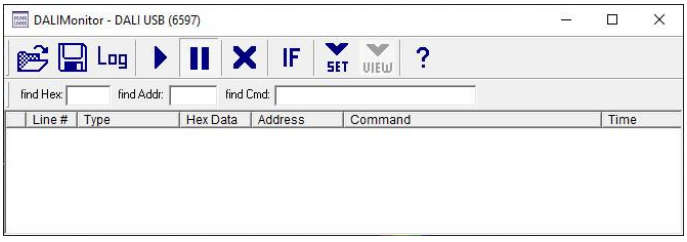


Fig. 17 DALI Monitor software

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
  - ✓ 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, then the cause is not in the DALI Gateway but in the DALI device or lamp (not addressed, not connected to DALI, no supply voltage, lamp fault, ...) .

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”)

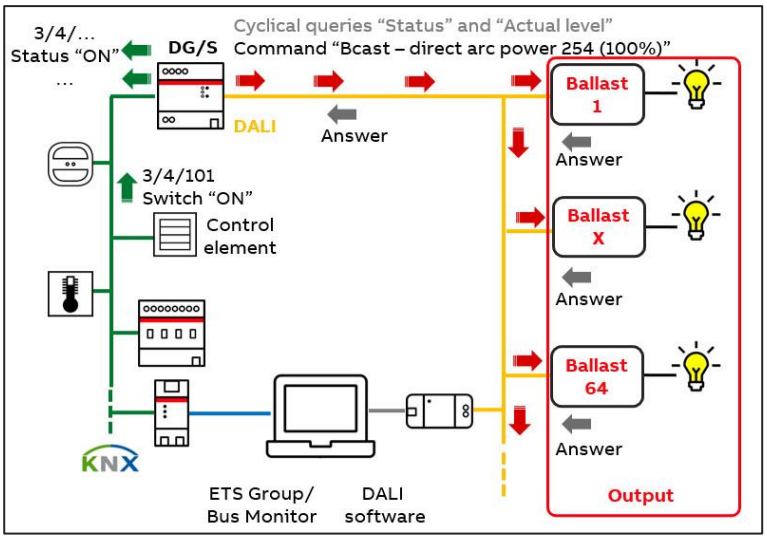


Fig. 18 Switch on DALI output A

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 #	Type	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
09.11.2021 14:38:31,834	3.7.151	DALI DG/S	3/4/72	Bal. 3: Tc LED strip right Status Switch	$01 | On
09.11.2021 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
09.11.2021 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
09.11.2021 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 %
09.11.2021 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 %
09.11.2021 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

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”)

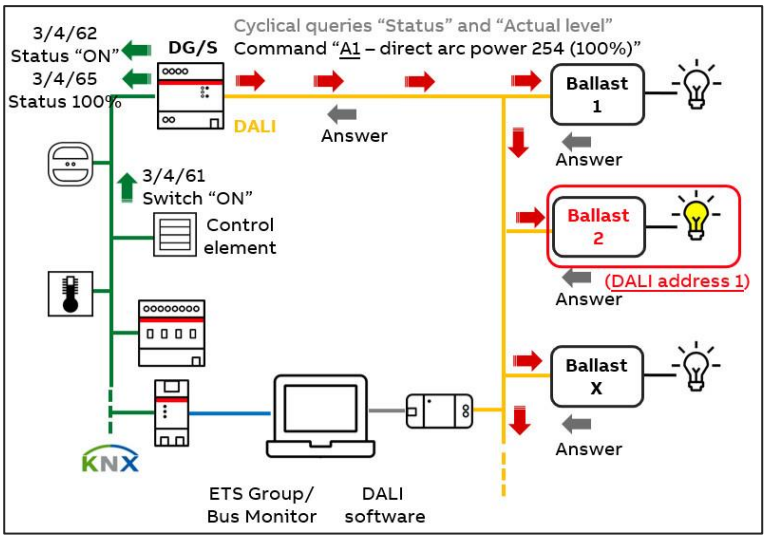


Fig. 22 Switch on DALI ballast 2

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 #	Type	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

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”)

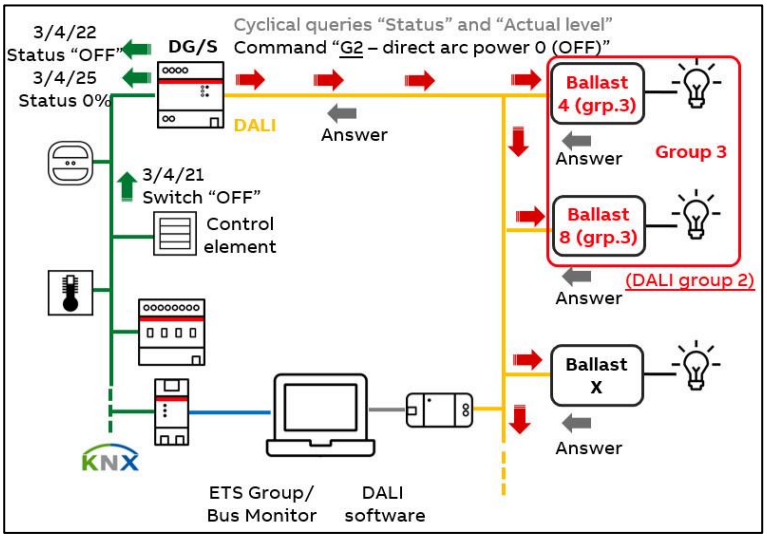


Fig. 26 Switch off group 3

Time	Source	Source Name	Destinatio	Destination Name	Info
09.11.2021 15:19:52,333	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

6.5 Dim down group 4

- The group membership is already saved in the ballasts
- Press rocker of control element
  → 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)
  - “G3 - set fade time” – store new fade time in all ballasts of the group
  - “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

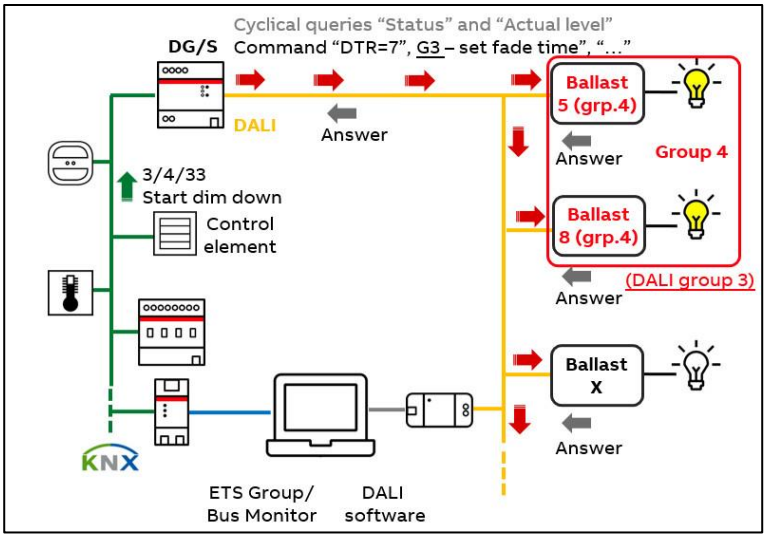


Fig. 30 Start dimming down group 4

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” → start dimming down

Line #	Type	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

- 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)
  - “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

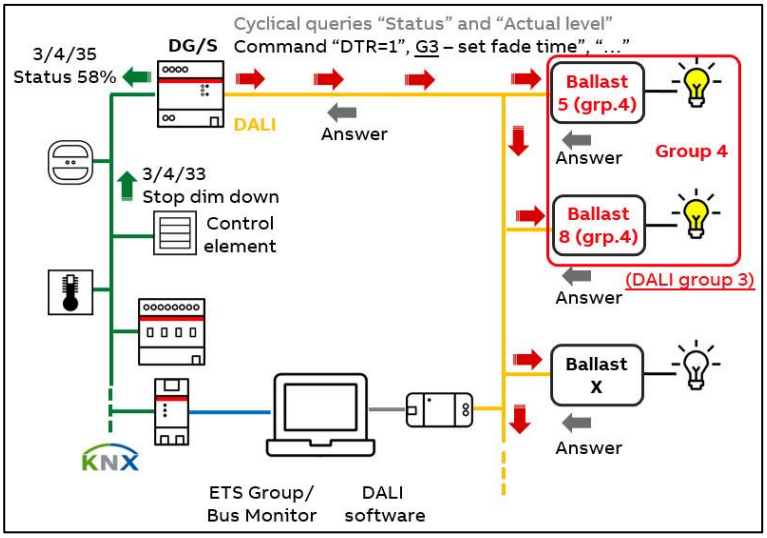


Fig. 33 Stop dimming down group 4

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 #	Type	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

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

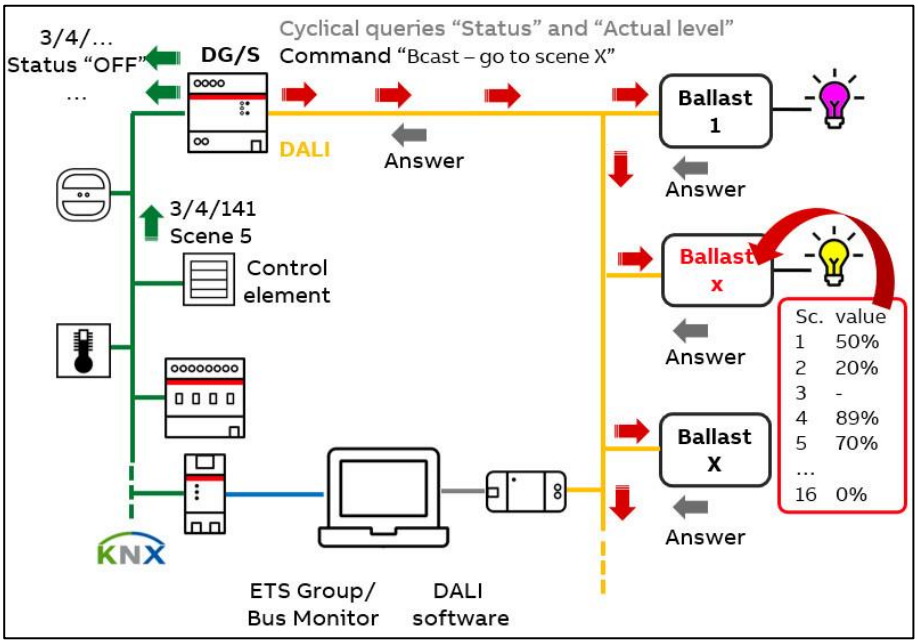


Fig. 37 Call KNX scene 5

Time	Source	Source Name	Destinatio	Destination Name	Info
09.11.2021 15:33:08,836	3.7.154	Control element	3/4/141	Output A: KNX scene 1...64	$04 | Activate 5

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

	Line #	Type	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 %

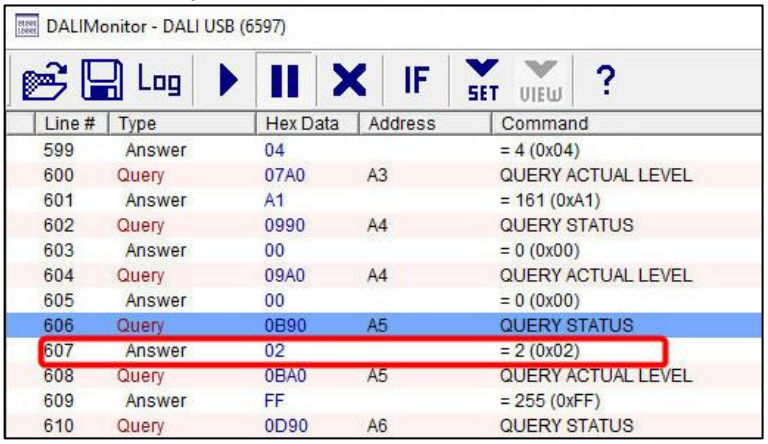
Fig. 40 DALI Gateway sends status to KNX

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
  - Bit 1: Lamp fault
  - Bit 2: No lamp on
  - Bit 3: No limit error
  - Bit 4: No fade running
  - 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)
  - Answer “02hex”
    → 00000010bin
    → means “Lamp fault”



Line #	Type	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.

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)

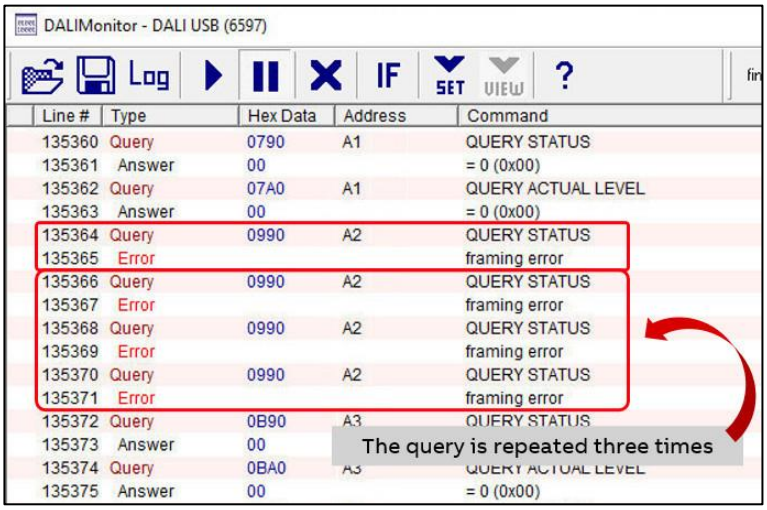


Fig. 42 Framing error on a DALI line

6.9 More information and training material

Competence Center Europe – Smart Buildings: Training & Qualification Database

- The database contains extensive training content
  - Webinar, Learning Sessions, slides and videos, presentations, video tutorials and more …
  - https://go.abb/ba-training
  - www.abb.com/knx (→ Services & Tools → Training and Qualification → Training Database)
- YouTube
  - 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"
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  - 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-i-bus-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

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