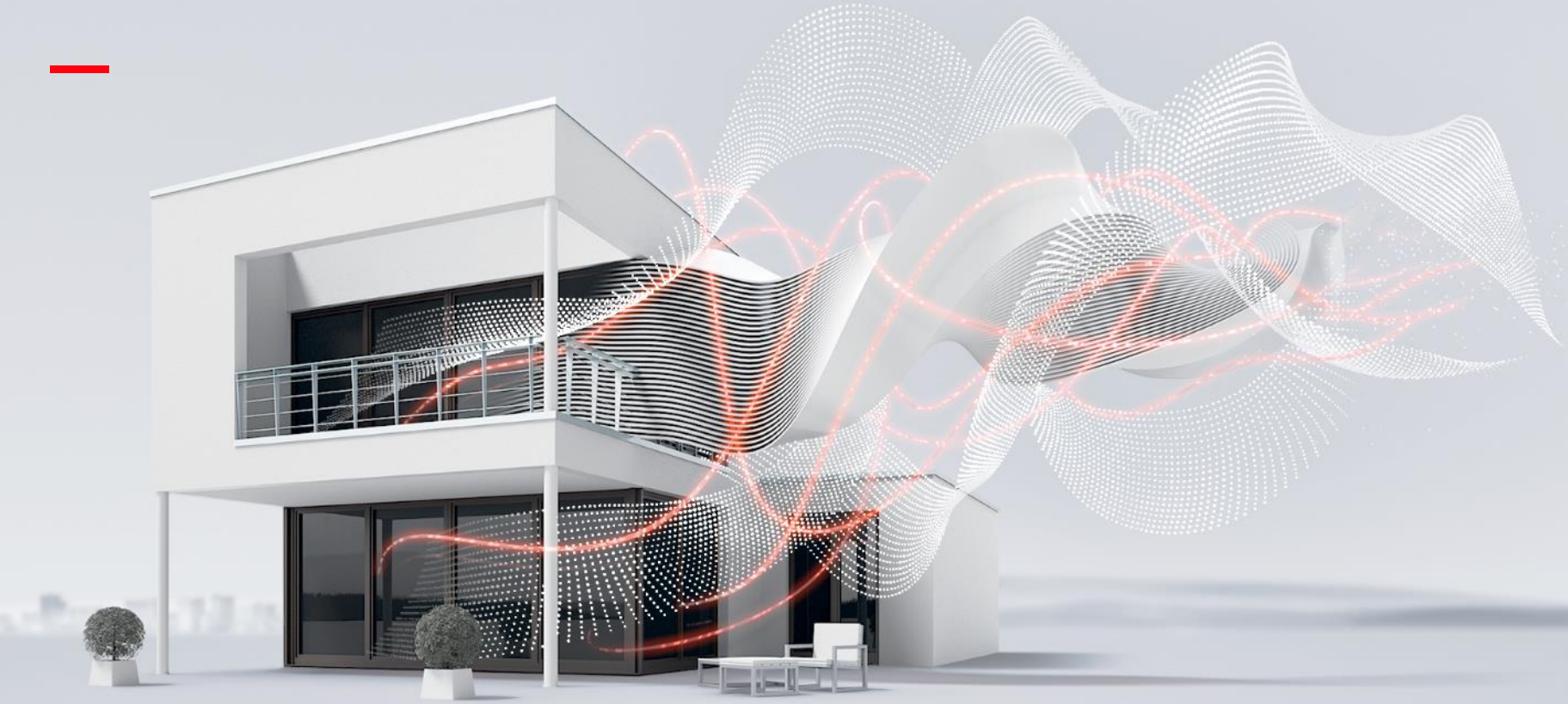


HEIDELBERG, NOVEMBER 2021

KNX DALI Gateways – Practical knowledge about DALI – Part 1

Online Learning Session – Competence Center Europe – Smart Buildings

Juergen Schilder, Thorsten Reibel, Marc-Andre Hahn, Michael Rall, Stefan Grosse & Olaf Stutzenberger

 Document ID.: … Rev.: …

KNX DALI Gateways – Practical knowledge about DALI – Part 1

Online Learning Session

KNX DALI Gateways – Practical knowledge about DALI – Part 1

Part 1: Today (Online Learning Session)

DALI Technology

KNX DALI Gateways DG/S

Manual Operation

DALI Communication (DALI Monitor)

- Commands
- Cyclical queries

… and with live demonstration on Thursday this week (Practical Learning Session)

Part 2: Tuesday next week (Online Learning S.)

Diagnostic

DALI Monitor (more details)

DALI Telegrams

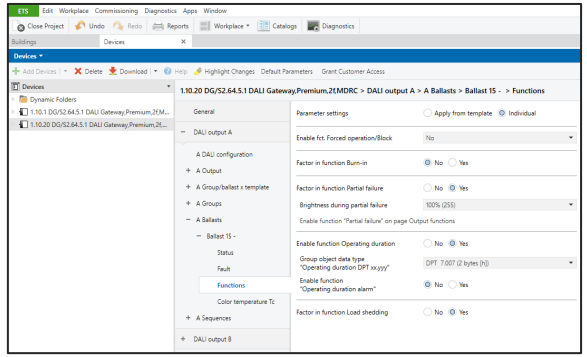
… and with live demonstration on Thursday next week (Practical Learning Session)

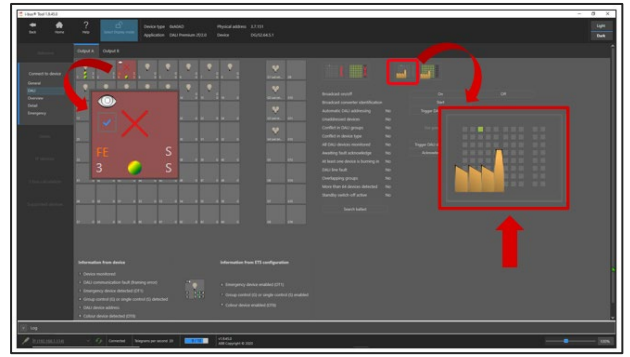
KNX DALI Gateways – Practical knowledge about DALI – Part 1

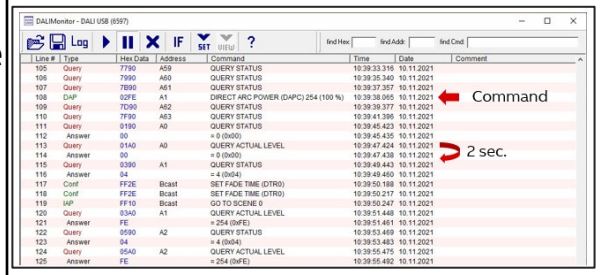
Online Learning Session

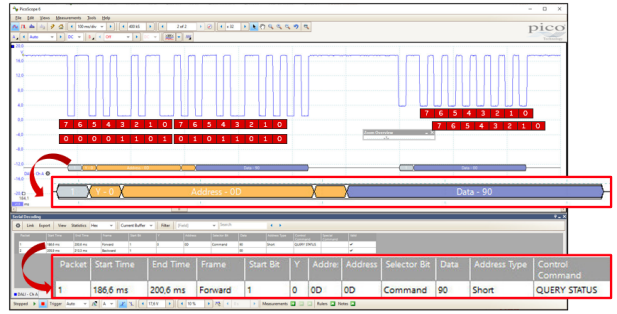
Why going in more Details with DALI?

- 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
- With these learning sessions we want to provide additional content, partly more complex than normal, but very helpful if required
- Few customers need this support, ABB can deliver in such a case









KNX DALI Gateways – Practical knowledge about DALI – Part 1

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DALI technology

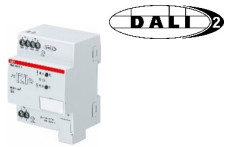
- The DALI protocol is standardized (IEC 62 386) and transmits at 1,200 bit per second
- DALI-1: Single-Master-Slave System without collision control, max. 64 devices (slaves) per DALI line
- DALI-2: Single/Multi-Master-Slave System with collision control, max. 64 devices (slaves) and max. 64 controllers (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 mm^2)
- No SELV – no specific cable required
  The DALI control line can be installed together with mains cable (e.g. by using a 5 wires standard cable)
- Interface voltage U_N 16 V (12 V to 20.5 V)
- DALI Power supply: Max current of 250 mA
- A device may consume a maximum of 2 mA
- DALI allows up to 16 groups and 16 scenes

www.dali-alliance.org

KNX DALI Gateways – Practical knowledge about DALI – Part 1

Overview of all ABB i-bus® KNX DALI Gateways and DALI Light Controller




	Gateway DG/S 1.64.1.1 Basic	Gateway DG/S 2.64.1.1 Basic	Gateway DG/S 1.64.5.1 Premium	Gateway DG/S 2.64.5.1 Premium	Gateway DG/S 8.1	Light Controller DLR/S 8.16.1M	Light Controller DLR/A 4.8.1.1
Controlled	Single/Group control	Single/Group control	Single/Group control	Single/Group control	Broadcast	Group control	Group control
DALI outputs	1	2	1	2	8 (A…H)	1	1
DALI devices	64 (ballasts and Em.Conv.)	2 x 64 (ballasts and Em.Conv.)	64 (ballasts and Em.Conv.)	2 x 64 (ballasts and Em.Conv.)	128 (max. 16 per output)	64	64
DALI addressing	64 individual	A: 64 individual B: 64 individual	64 individual	A: 64 individual B: 64 individual	not necessary	64 individual	64 individual
Lighting groups	16 DALI	2 x 16 DALI	16 DALI	2 x 16 DALI	cable installation	16 DALI	8 DALI
Emerg. Light. con.	Yes	Yes	Yes	Yes	-	-	-
DT8 Color temp. Tunable White T_C	-	-	Yes	Yes	-	-	-
Application V2.0, e.g. DT8 RGB(W), HSV(W), load shedding, sequencer, …	-	-	Yes	Yes	-	-	-

KNX DALI Gateways – Practical knowledge about DALI – Part 1

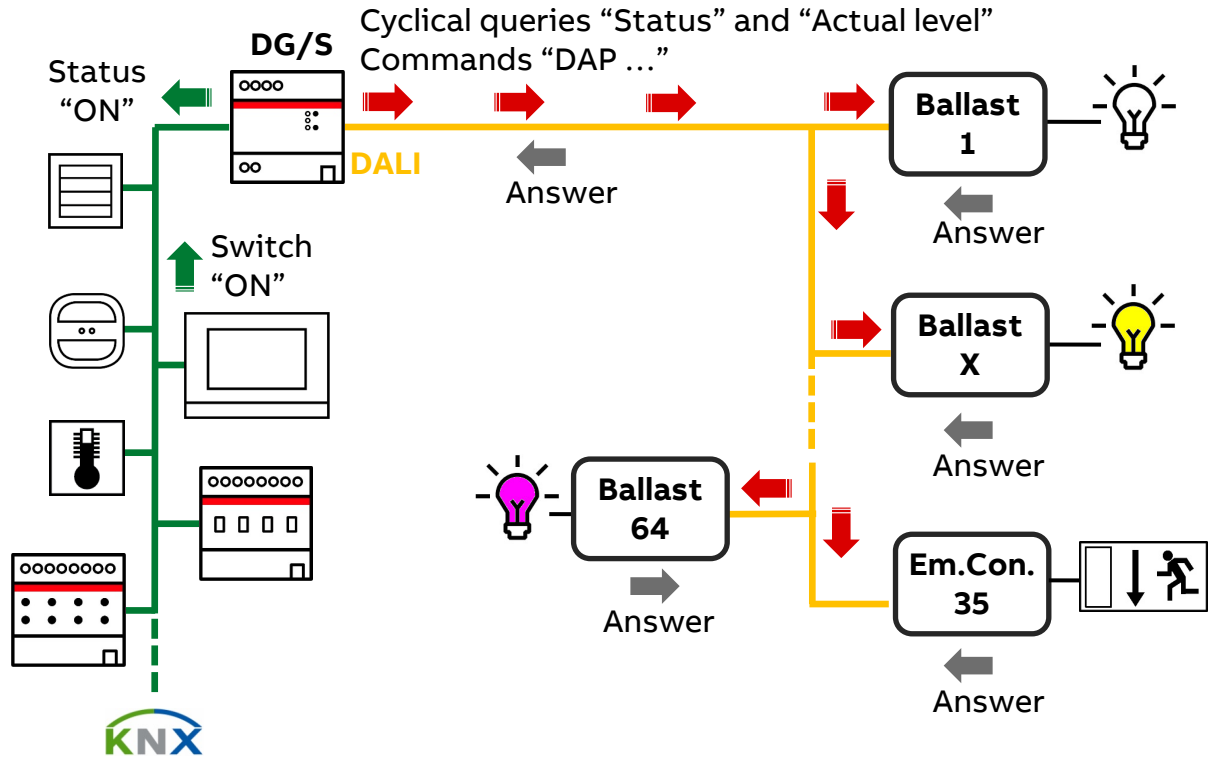
Online Learning Session

DALI technology and KNX DALI Gateways

The DALI Gateway as the Master

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

DALI device:
Ballast (DT0, DT6, DT8,…) or emergency lighting converter (DT1)



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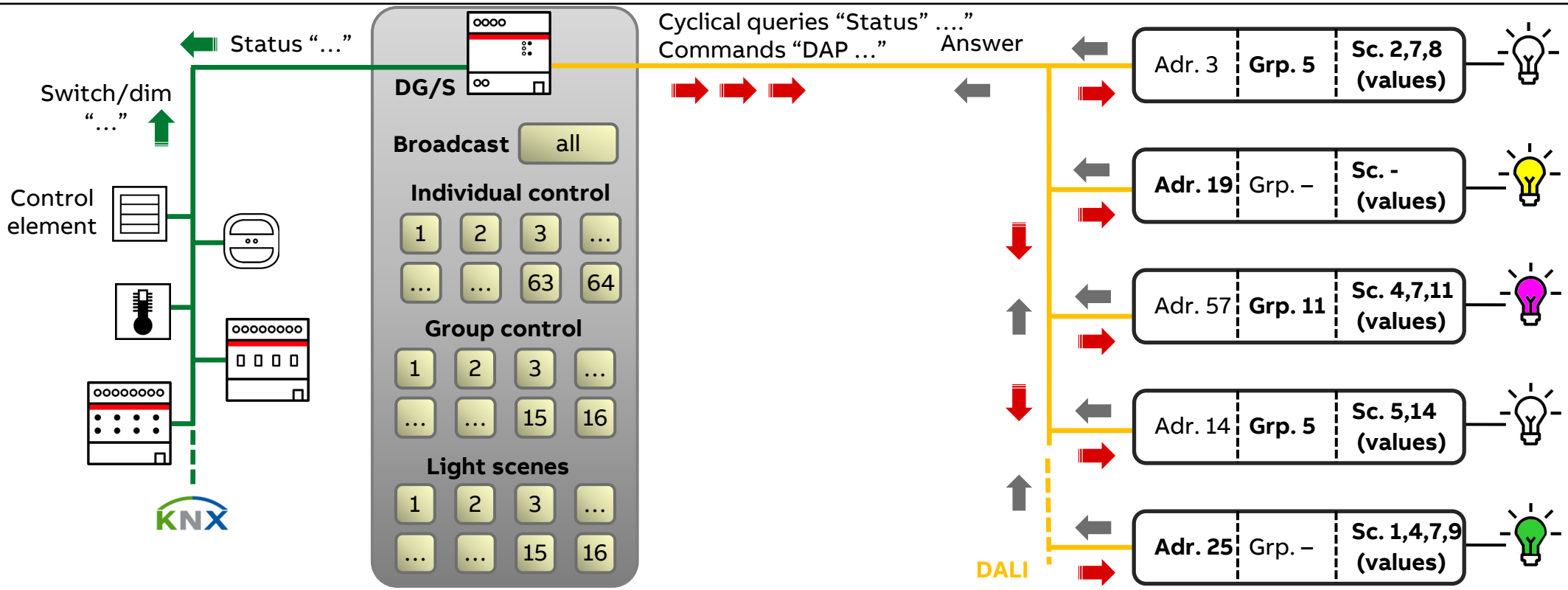
DALI technology and KNX DALI Gateways



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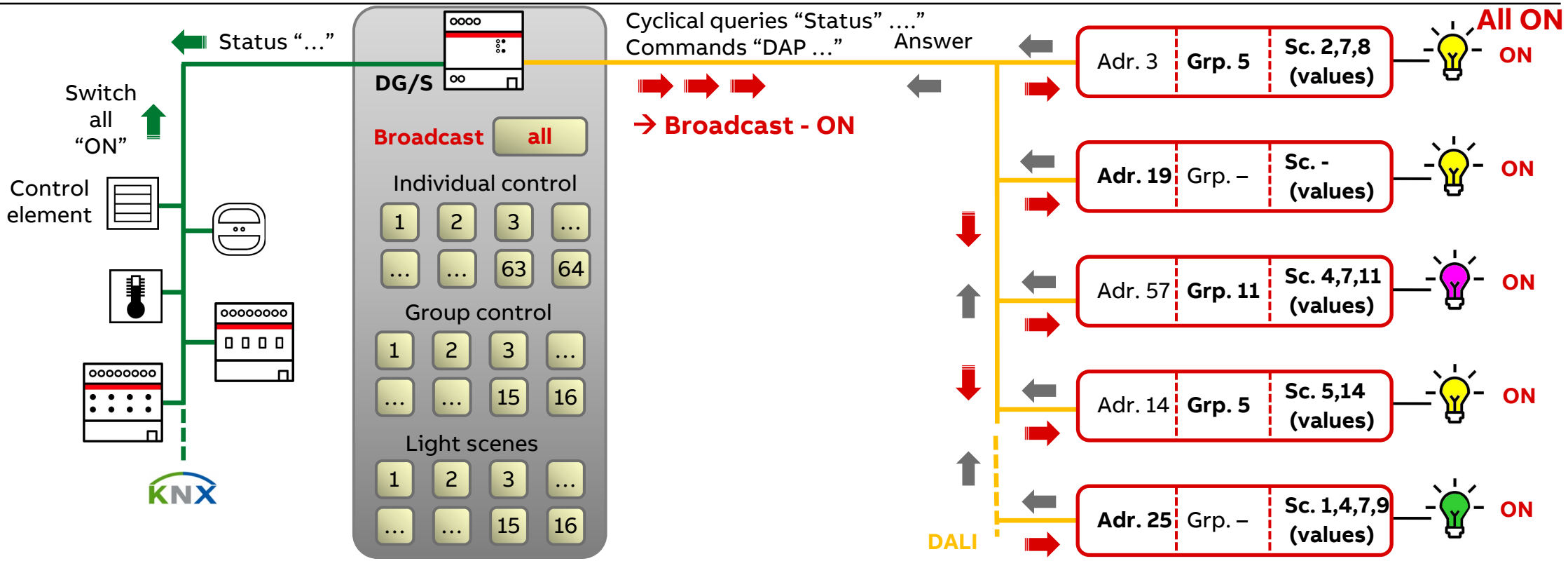
DALI technology and KNX DALI Gateways: Switch Output ON → Command “Broadcast (all) - ON”



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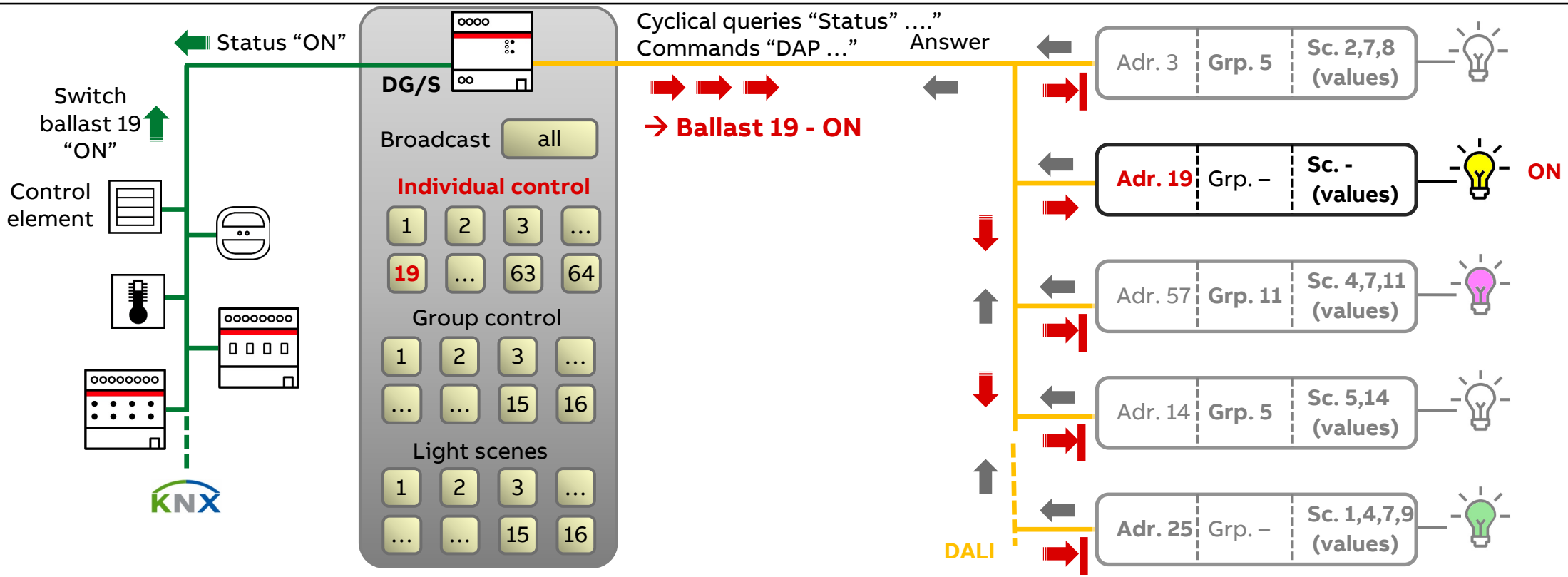
DALI technology and KNX DALI Gateways: Switch Ballast 19 (individual controlled) ON → Command “Ballast 19 - ON”



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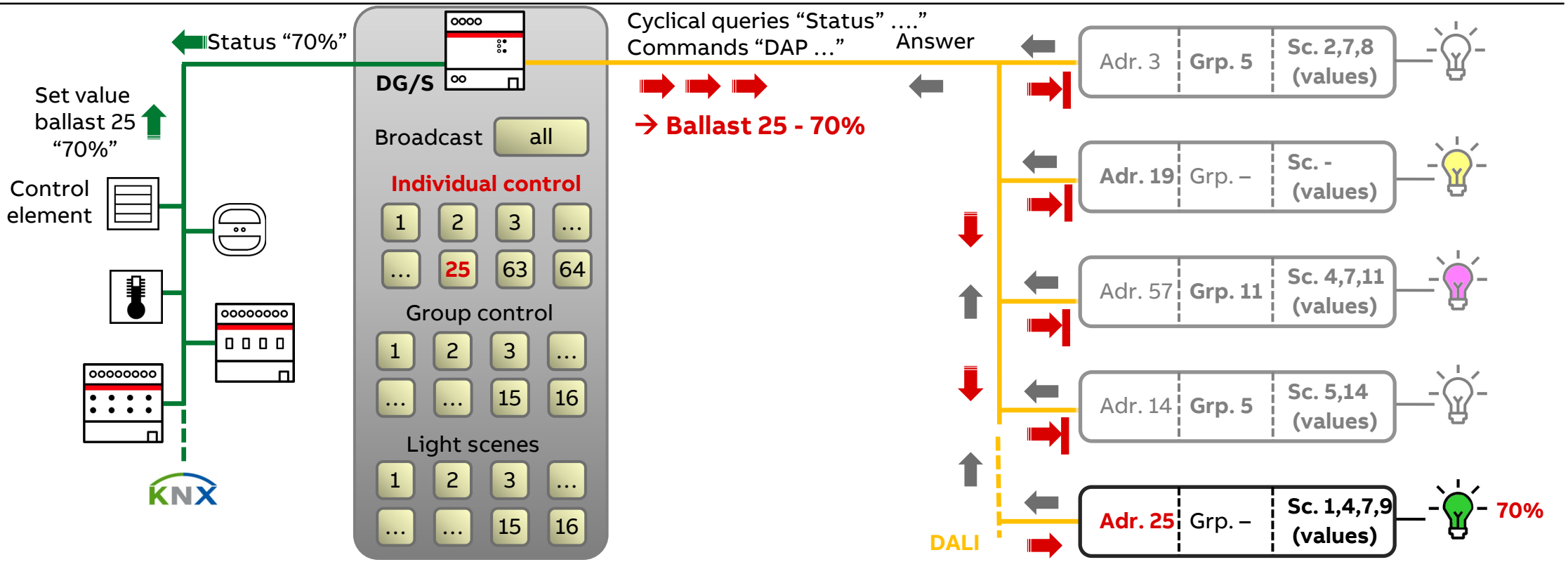
DALI technology and KNX DALI Gateways: Set Value Ballast 25 (individual controlled) 70% → Command “Ballast 25 - 70%”



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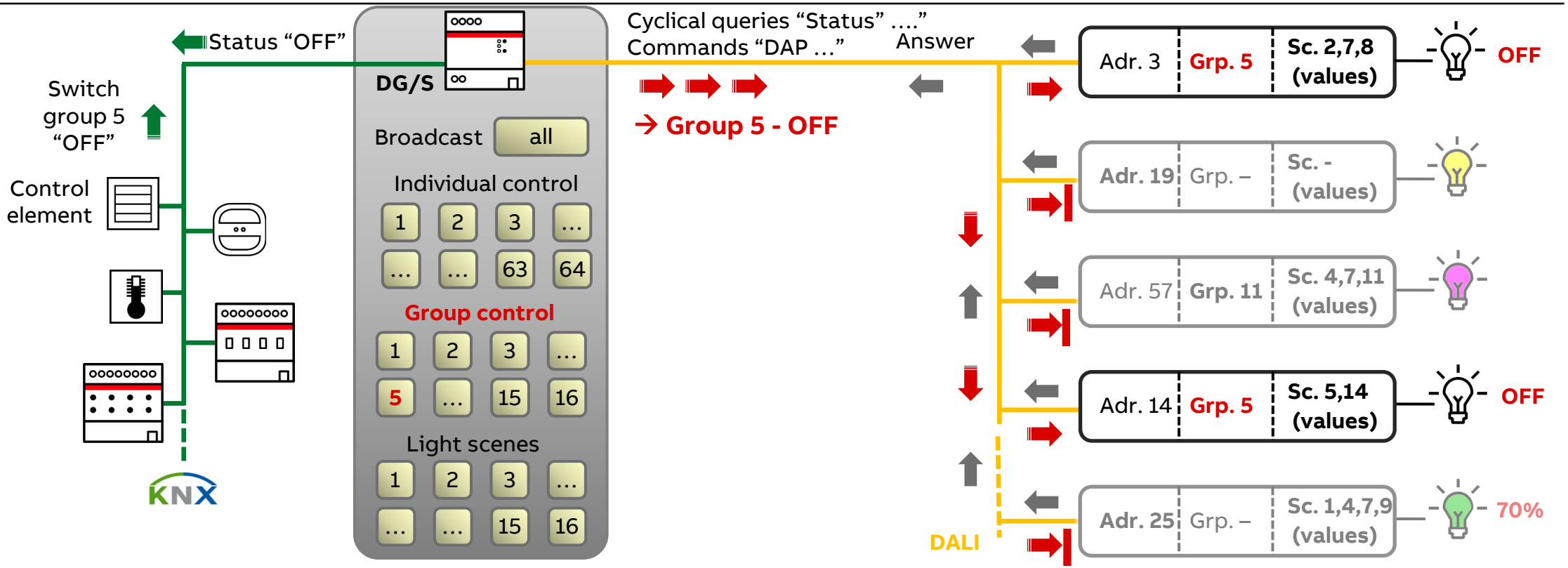
DALI technology and KNX DALI Gateways: Switch Group 5 (group controlled) OFF → Command “Group 5 - OFF”



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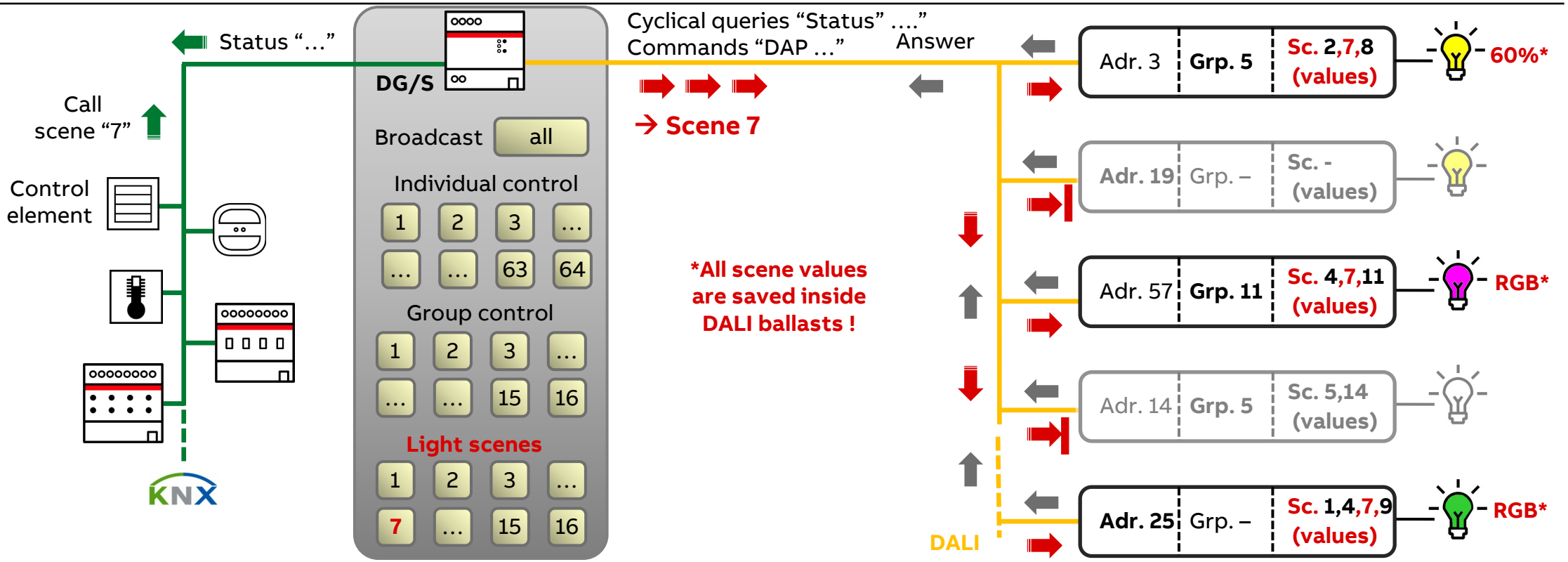
DALI technology and KNX DALI Gateways: Call Scene 7 → Command “Call Scene 7”



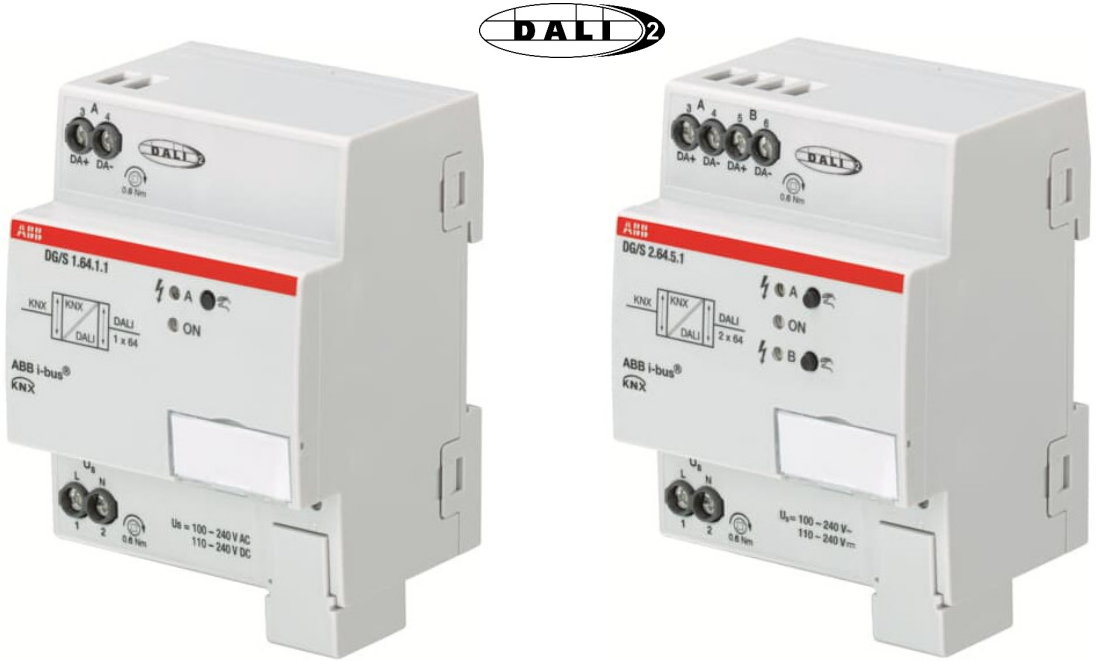
KNX DALI Gateways – Practical knowledge about DALI – Part 1

Online Learning Session

KNX DALI Gateways DG/S – device overview

KNX DALI Basic and Premium / 1-fold and 2-fold

- Supply voltage 100 – 240 V AC/DC, 50/60 Hz → suitable for worldwide use
- Integrated DALI power supply
  → No additional DALI power supply is required and not allowed
- DALI Outputs 230V secure
  →Incorrect connection with mains voltage does not destroy the DALI Gateway
- LEDs for device operation “ON” and “DALI status”
  → Quick and easy diagnostics
- Button for manual switching of DALI output with broadcast function → Test of installation and lighting



DG/S 1.64.1.1
Basic, 1-fold

DG/S 2.64.5.1
Premium, 2-fold

KNX DALI Gateways – Practical knowledge about DALI – Part 1

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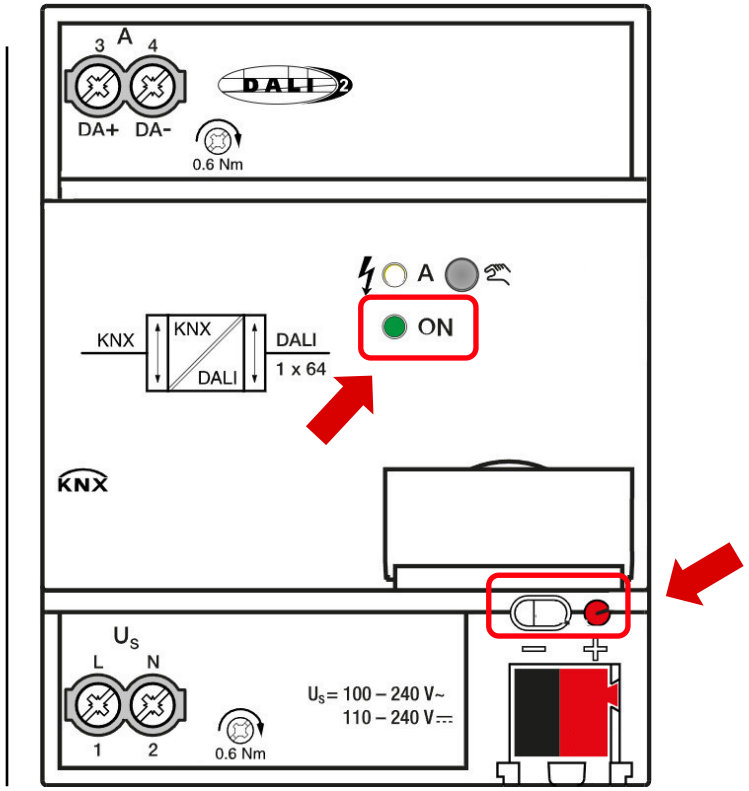
KNX DALI Gateways DG/S – operation LED “ON” (green)

KNX DALI Basic and Premium / 1-fold and 2-fold

- Lights up when operating voltage and KNX voltage are available and the device is functional (system is initialized after booting)
- Flashes quickly (5 Hz) if KNX voltage is available but operating voltage is not
- Slowly flashes (1 Hz) in manual operation mode
- Off
  - If no KNX voltage is available
  - KNX voltage is available and DALI Gateways address and application program have been unloaded

→ If KNX is available, the programming LED lights up when the programming button is pressed



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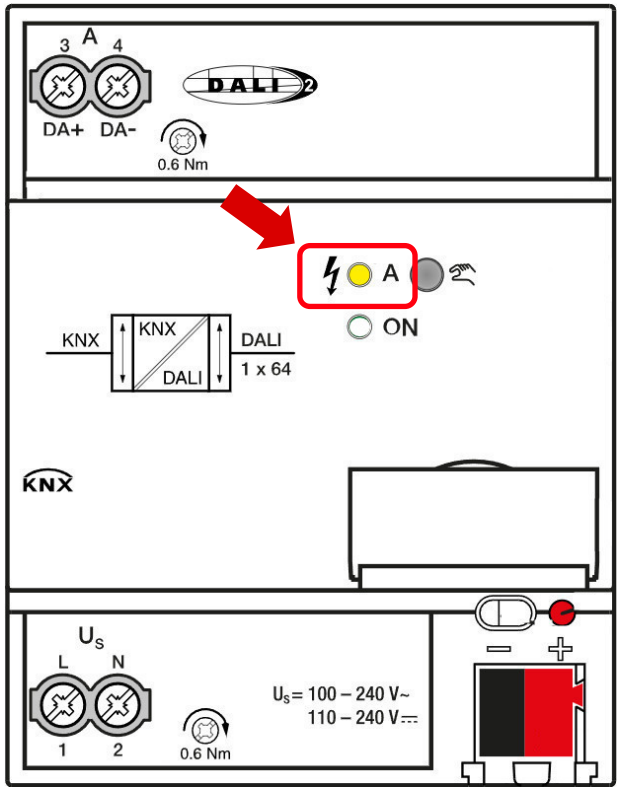
KNX DALI Gateways DG/S – DALI status LED A/B (yellow)

KNX DALI Basic and Premium / 1-fold and 2-fold

- Off: DALI Gateway is in normal mode
- Lights up if a DALI fault occurs, e.g.
  - Lamp fault
  - Ballast fault
  - Function “Acknowledge fault messages” is enabled and a fault has not yet been acknowledged
  - Short circuit on the DALI line
  - Overvoltage (230 V) on the DALI line
- Switch status of the output is indicated during manual operation mode
- Flashes quickly (5 Hz) during DALI address assignment and initialization of a DALI device



KNX DALI Gateways – Practical knowledge about DALI – Part 1

Online Learning Session

KNX DALI Gateways DG/S – manual button

KNX DALI Basic and Premium / 1-fold and 2-fold

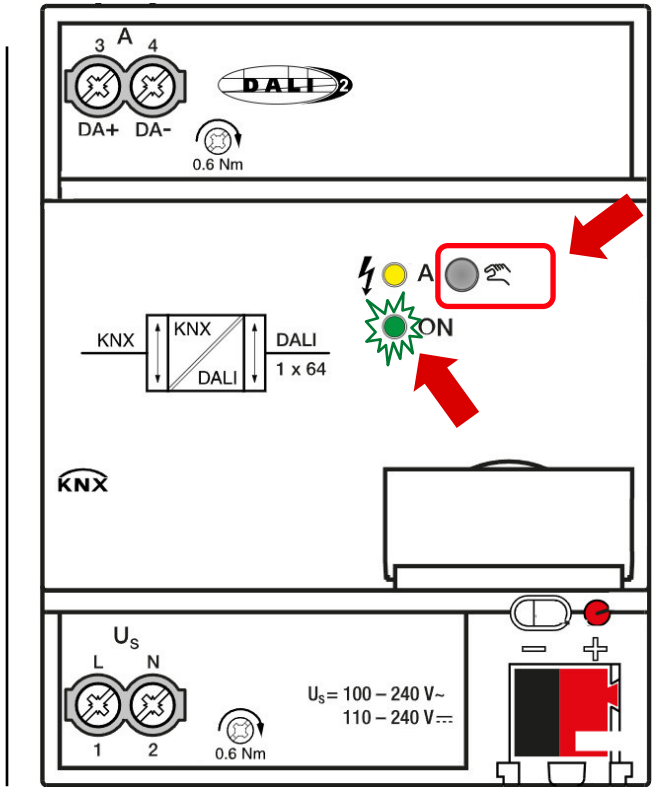
(1) For manual switching of DALI output A / B

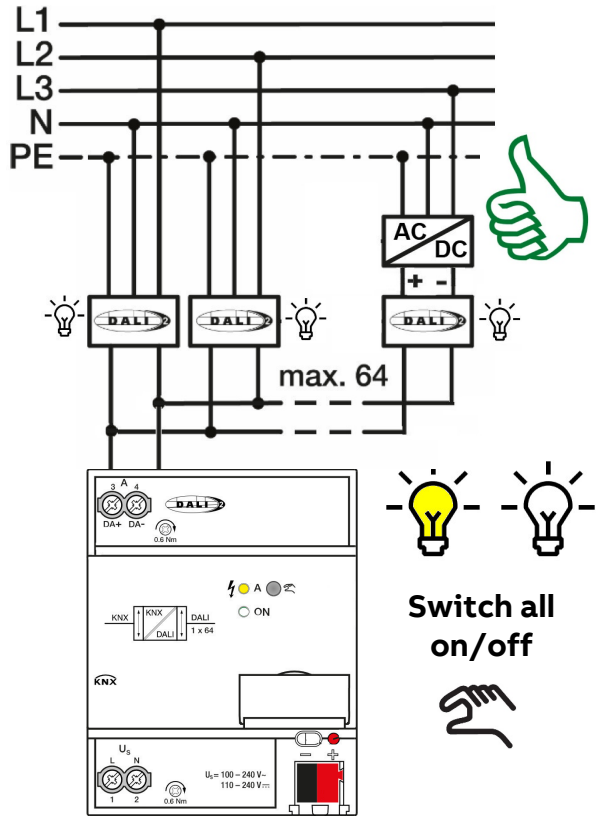
- Pressing button A or B for > 2 sec.< 5 sec. puts the DALI Gateway (outputs A and B) into manual operation mode
- Green LED flashes
- After release, the brightness value of the DALI devices initially stays unchanged
- By pressing (< 2 sec.) button A or B, each DALI output can be switched independently
- Switch status of the output is displayed by yellow LED

→Testing the wiring, installation, lighting and supply voltage of the ballasts and lamps

→ All lamps at the output switch on and off

→Broadcast command:
Ballasts that are not addressed also react to this!





KNX DALI Gateways – Practical knowledge about DALI – Part 1

Online Learning Session

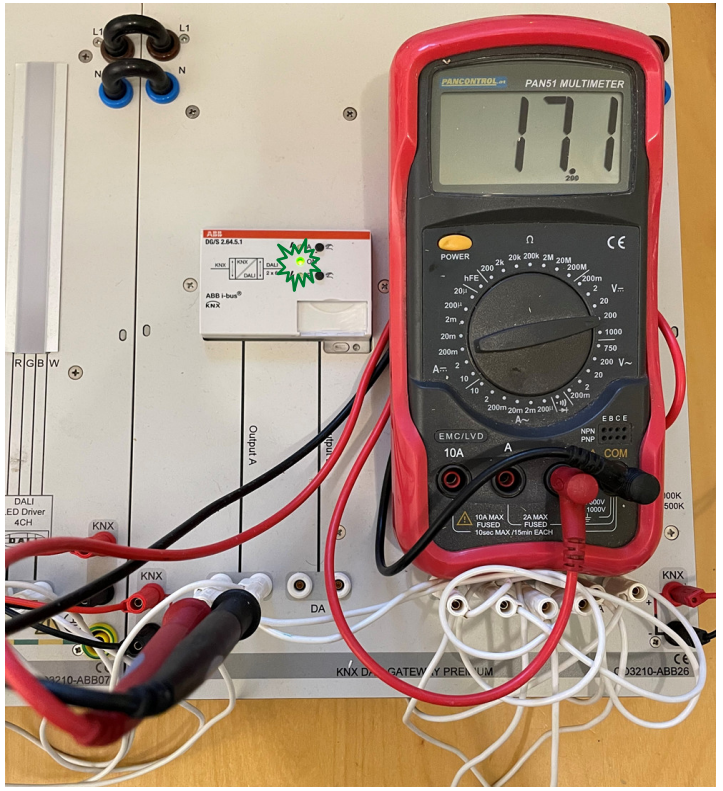
KNX DALI Gateways DG/S – manual button

KNX DALI Basic and Premium / 1-fold and 2-fold

– During manual operation mode

- No communication at the DALI output
  → no commands and no queries are sent!
- The supply voltage is present at the output and can be measured with a voltmeter
- Nominal system voltage U_N 16 V (12 V…20.5 V)
- Minimum voltage U_{min} 10 V (at receiver)

- When the DALI Gateway is disconnected, 0V is measured on the DALI line
- If a voltage is measured, there is another DALI power supply in the line (not permitted) or a ballast has a device fault



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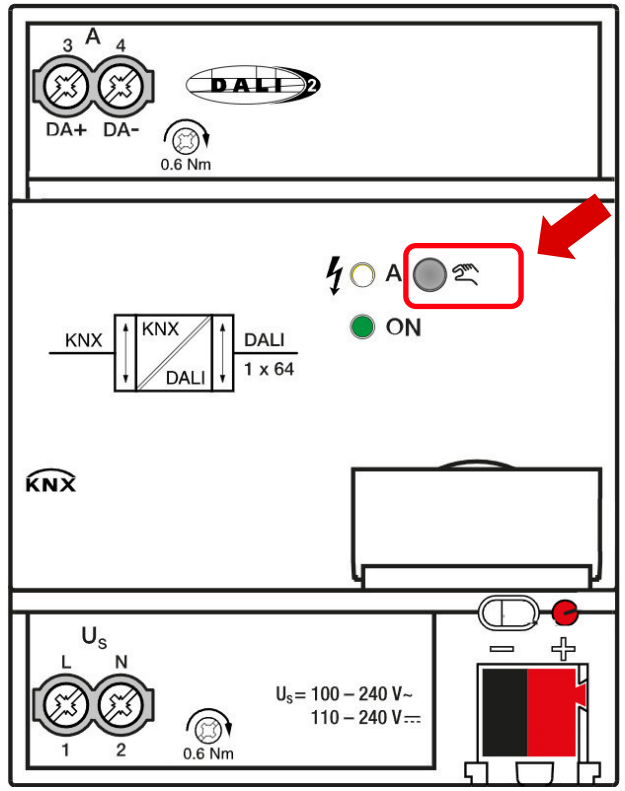
KNX DALI Gateways DG/S – manual button

KNX DALI Basic and Premium / 1-fold and 2-fold

- If button “A” or “B” is pressed for > 2 sec., manual operation mode is left
- The green LED switches back on
- The devices receive the brightness value parameterized via the ETS application program (“Brightness value on exiting manual operation”)



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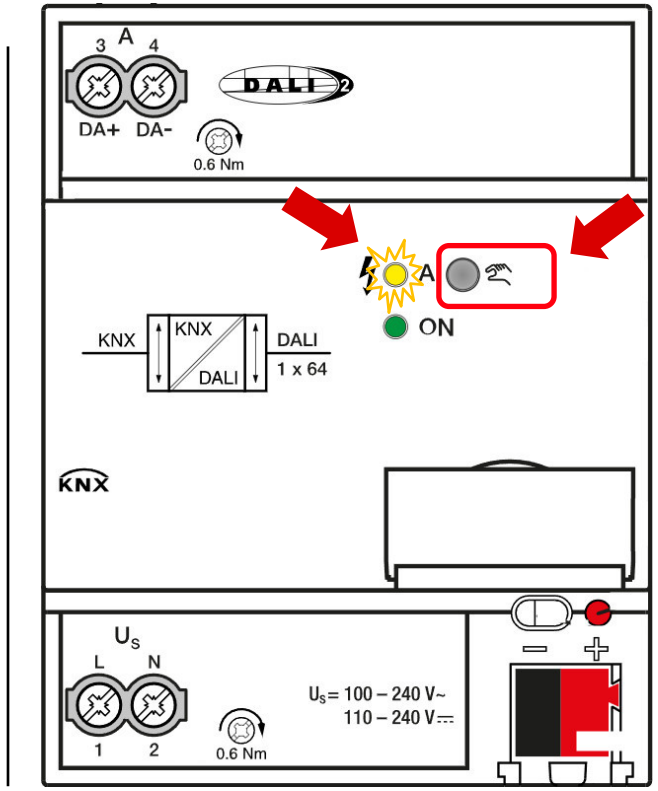
Online Learning Session

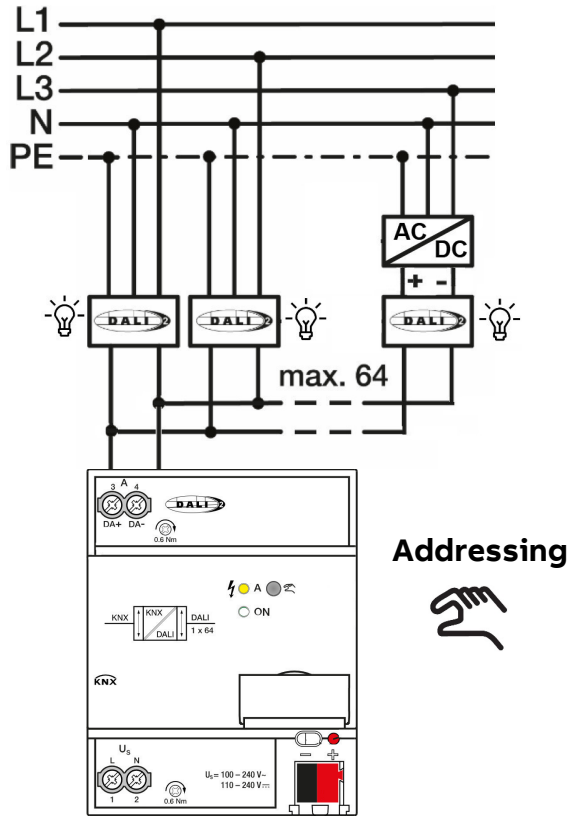
KNX DALI Gateways DG/S – manual button

KNX DALI Basic and Premium / 1-fold and 2-fold

(2) Trigger DALI addressing output A / B

- The “Automatic DALI addressing” is disabled (default) and can be triggered via ABB i-bus Tool®, KNX group telegram or manual button
- If the button is pressed for longer than 5 sec., then DALI devices without a DALI address will receive one
- If the DALI Gateway is in manual operation mode, it is left and no addressing is initiated





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DALI commands and cyclical queries

- The DALI commands are specified in the International Standard IEC 62386 Part 102 “General requirements – Control gear”
- The DALI Gateway 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 actual level, add to group, …)

  and cyclical queries to all DALI devices (slaves), e.g. status, actual level

KNX DALI Gateways – Practical knowledge about DALI – Part 1

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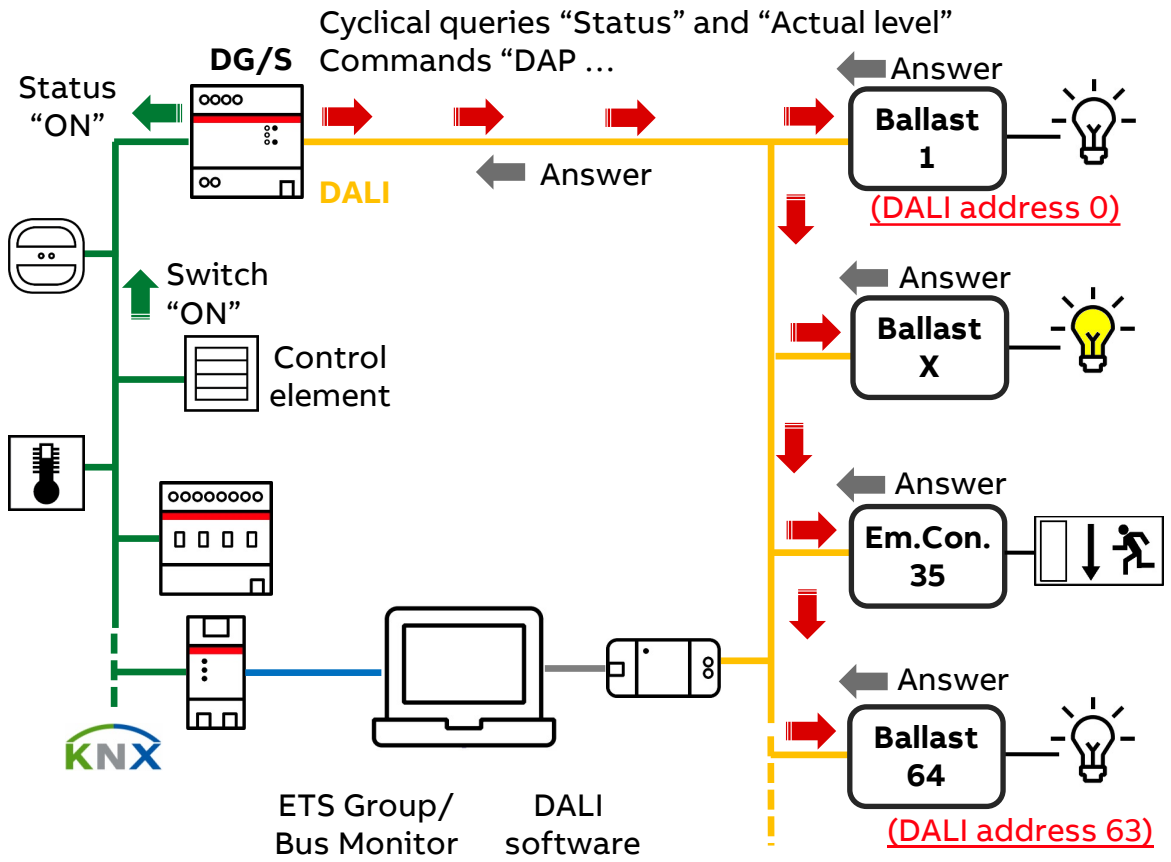
DALI commands and cyclical queries

- ETS: The group- /bus monitor records the KNX telegrams
- DALI software: Records the queries and commands sent by the DALI Gateway and answers from the devices
- Note: All DALI addresses are shifted by the value “1”
  - Address range KNX 1…64 → DALI 0…63
  - KNX DALI device 1 → DALI address 0
    …
    KNX DALI device 64 → DALI address 63
  - KNX DALI group 1 → DALI group 0
    …
    KNX DALI group 16 → DALI group 15
  - KNX DALI scene 1 → DALI scene 0
    …
  - KNX DALI scene 16 → DALI scene 15



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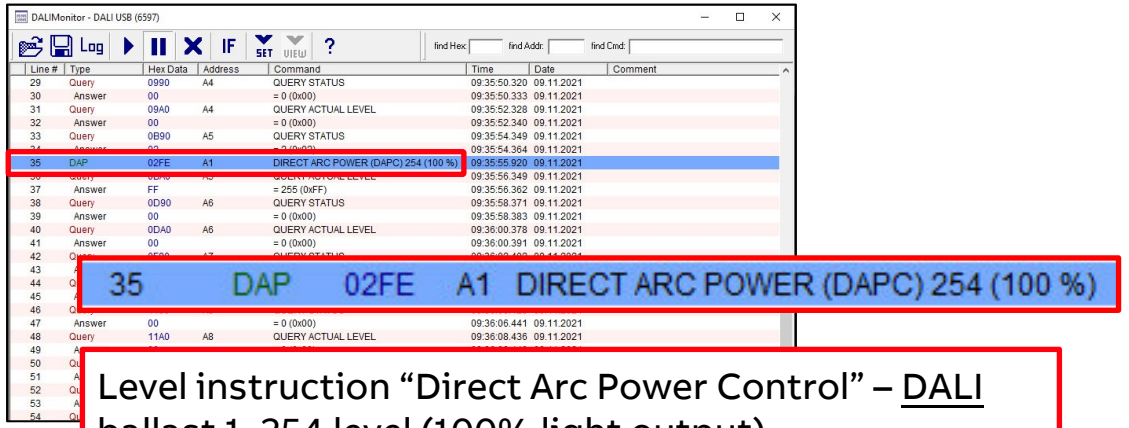
DALI commands and cyclical queries

The most common DALI commands

– Direct Arc Power Control (ballast or group)

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



Level instruction “Direct Arc Power Control” – DALI ballast 1: 254 level (100% light output)
→ KNX ballast 2 !

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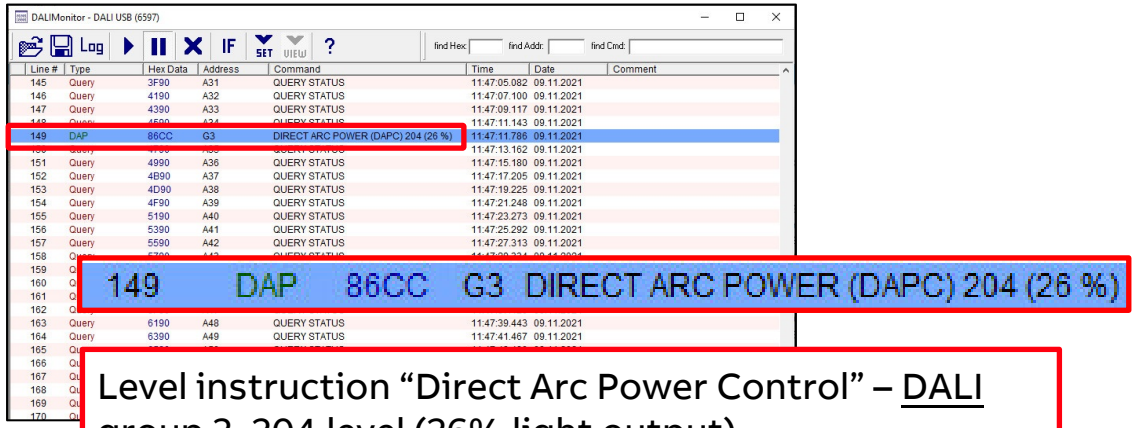
DALI commands and cyclical queries

The most common DALI commands

– Direct Arc Power Control (ballast or group)

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



Level instruction “Direct Arc Power Control” – DALI group 3: 204 level (26% light output)
→ KNX group 4 !

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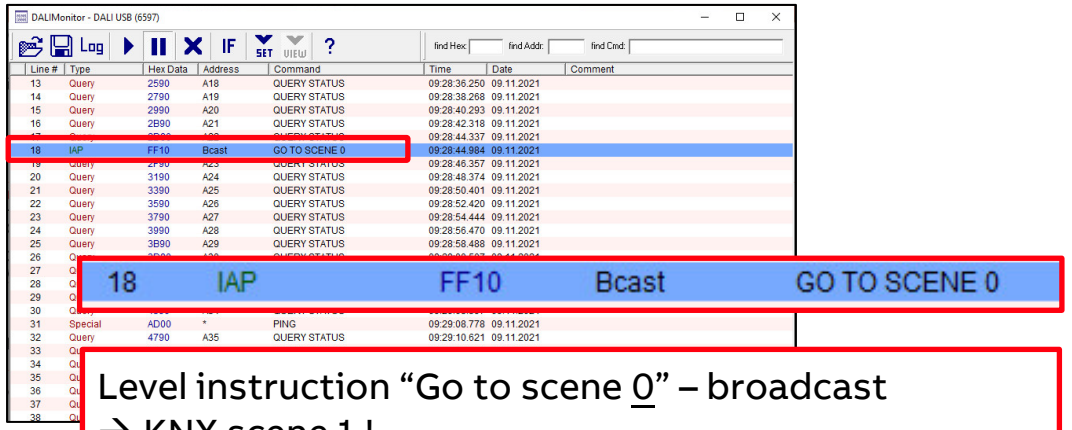
DALI commands and cyclical queries

The most common DALI commands

– Go To Scene

- The scene value stored in the ballast is recalled



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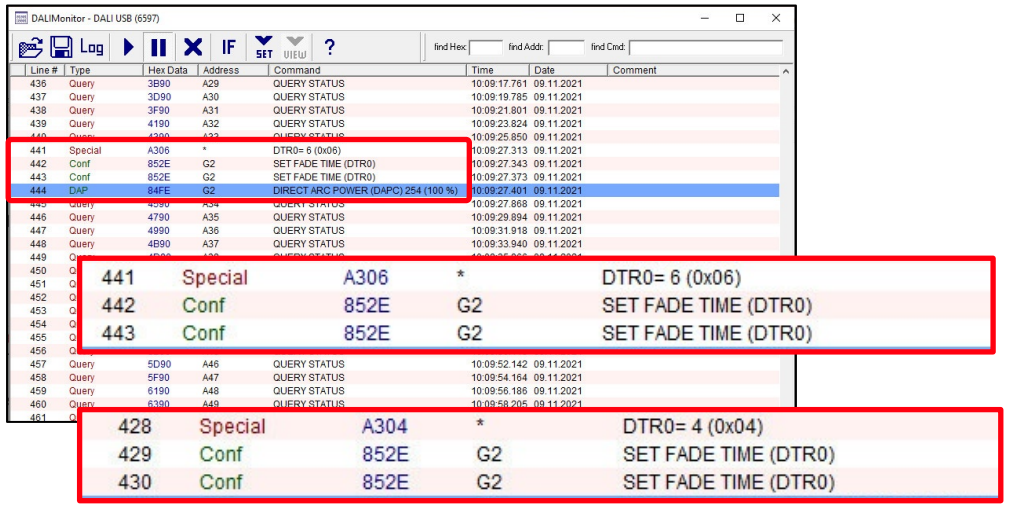
DALI commands and cyclical queries

The most common DALI commands

– Set Fade Time (ballast/group)

- To store a new fade time
- The ballast only has a 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



Switch ON: Fade time of 4 sec.

Switch OFF: Fade time of 2 sec.

Configuration instruction “Set fade time” – DALI group 2: ON 4 sec. and OFF 2 sec.
→ KNX group 3 !

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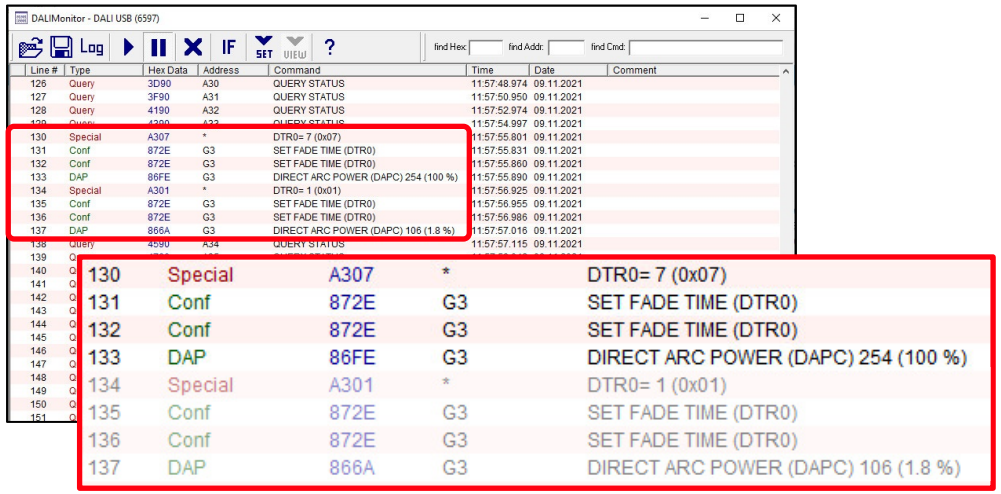
DALI commands and cyclical queries

The most common DALI commands

– 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 dim up/down
- 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 dim and adopts the sent value



Start dim:
- Special command “DTR0 – Send fade time” – 5.7 sec.
- Configuration instruction “Set fade time” – DALI group 3: 5.7 sec.
- Level instruction “Direct Arc Power Control” – DALI group 3: 254 level (100% light output)

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DALI commands and cyclical queries

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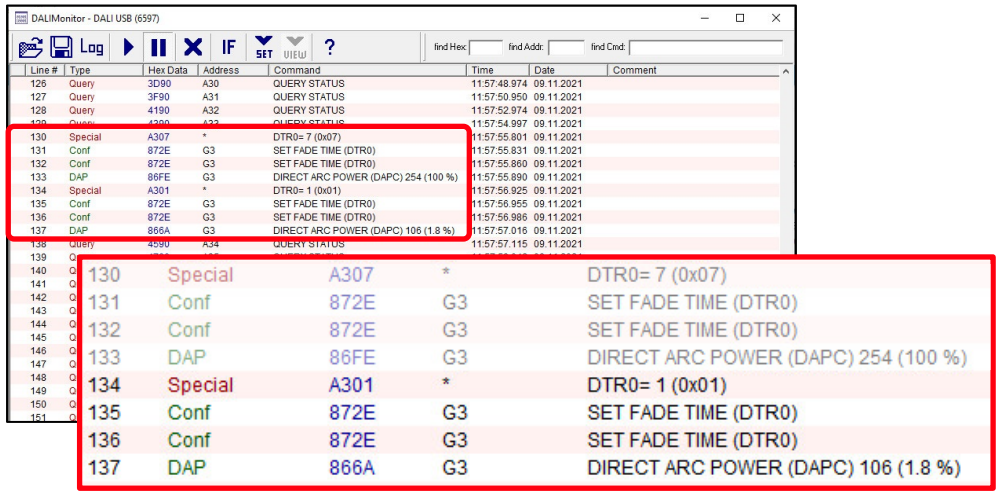
  → Ballast/group starts dim up/down
- Stop dim:
  Send fade time to DTR0=1 (0.7 sec), fastest possible time
  Set fade time (ballast/group)
  The DALI Gateway calculates the dim stop value and sends direct arc power level to synchronize all ballasts of the group
  → Ballast/group stops dim and adopts the sent value



Stop dim:

- Special command “DTR0 – Send fade time” – 0.7 sec.
- Configuration instruction “Set fade time” – DALI group 3: 0.7 sec.
- Level instruction “Direct Arc Power Control” – DALI group 3: 106 level (1.8% light output)

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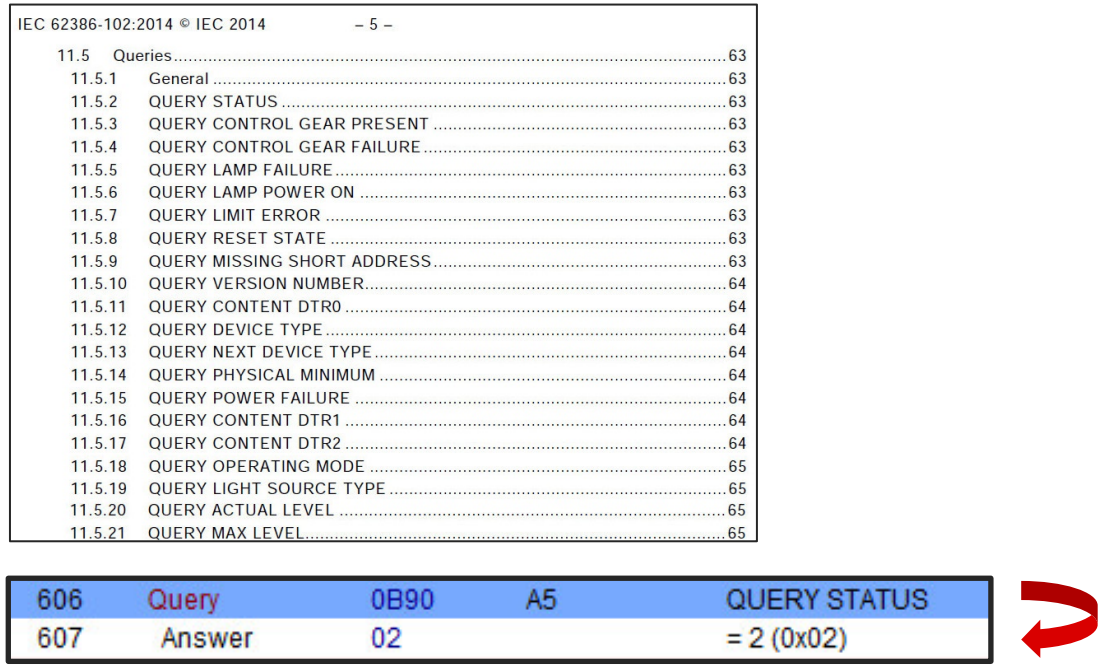
DALI commands and cyclical queries

DALI cyclical queries (DALI address 0…63)

- Queries are used to retrieve property values from a device
- The addressed device returns the queried property value in a backward frame
  - Query status
  - Query actual level
  - Query power on level
  - Query lamp fault
  - Query missing short address
  - Query control gear present
  - Query device type
  - ….



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606	Query	0B90	A5	QUERY STATUS
607	Answer	02		= 2 (0x02)

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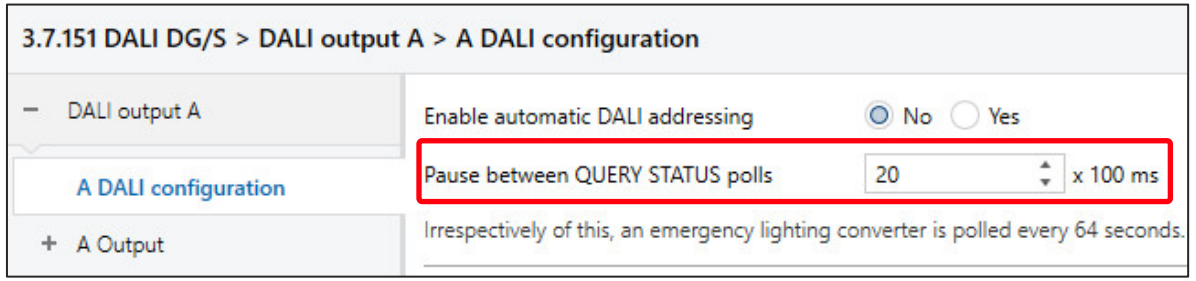
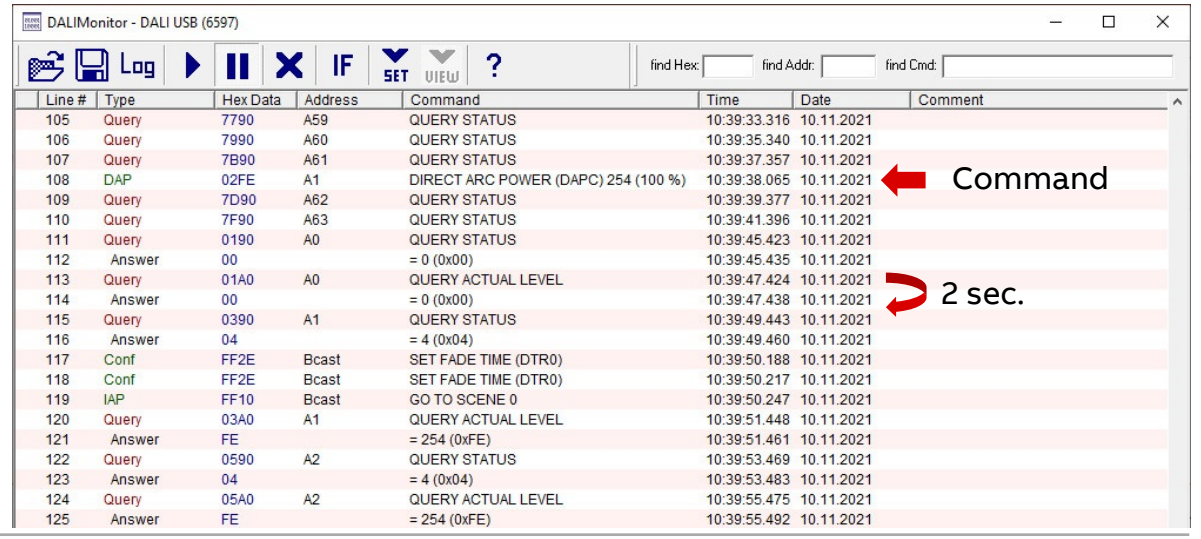
DALI commands and cyclical queries

DALI cyclical queries (DALI address 0…63)

- The DALI Gateway automatically and cyclically sends queries on the DALI line
- The commands are sent between the queries
- This queries are used to determine whether there is a DALI device with a DALI address, lamp fault, …
- The pause between DALI queries can be parameterized
  - Options: 0…20…255 x 100 msec.
  - When accessing with the ABB i-bus® Tool or “0” setting runs the query poll as quickly as possible (pause of 30…40 msec.)
  - This parameter setting has an impact on the DALI telegram load
  - A long interval reduces the load significantly
    → However, a fault on a DALI device may not be detected straight away
    → Pause of 2 sec and 2 queries per device → a fault is detected after 126 seconds at the latest





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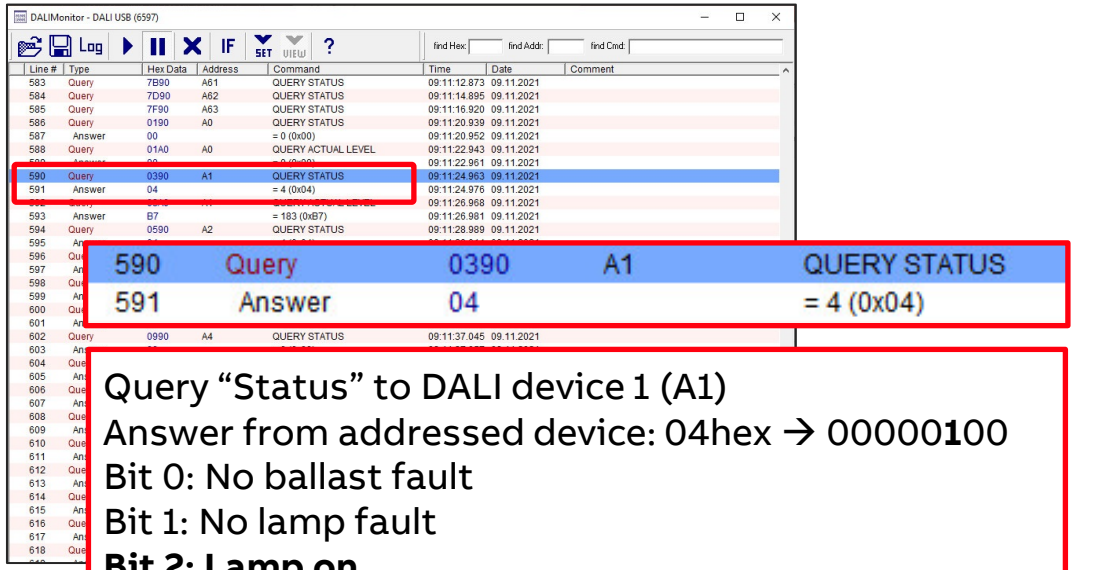
DALI commands and cyclical queries

DALI cyclical queries (DALI address 0…63)

– The DALI Gateway DG/S Basic and Premium as the Master sends

- Query “Status” (8-bit, combination of device properties)
  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
  → The answer is transferred and sent to KNX, e.g. lamp fault
- Query “Actual level” (8-bit)
  The answer is not evaluated and can be used for diagnosis with DALI monitor tool



Query “Status” to DALI device 1 (A1)
Answer from addressed device: 04hex → 00000**1**00
Bit 0: No ballast fault
Bit 1: No lamp fault
Bit 2: 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

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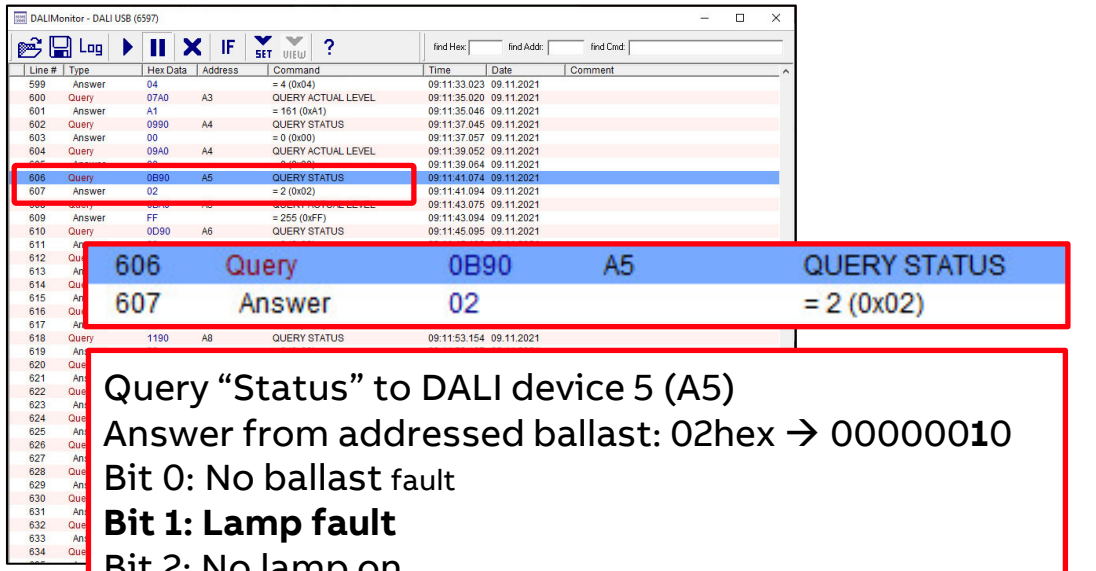
DALI commands and cyclical queries

DALI cyclical queries (DALI address 0…63)

– The DALI Gateway DG/S Basic and Premium as the Master sends

- Query “Status” (8-bit, combination of device properties)
  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
  → The answer is transferred and sent to KNX, e.g. lamp fault
- Query “Actual level” (8-bit)
  The answer is not evaluated and can be used for diagnosis with DALI monitor tool



Query “Status” to DALI device 5 (A5)
Answer from addressed ballast: 02hex → 00000010
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

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Diagnostic with “DALI Monitor“ and DALI USB Interface

- Manufacturers offer interfaces between USB and DALI, e.g. Tridonic, Lunatone
- Together with software, the telegrams can be recorded and analyzed on the DALI line
  - Commands and queries sent by the DALI Gateway
  - Answers from the devices
- It 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
- The DALI USB interface has no DALI address

DALIMonitor - DALI USB (6597)

Log | IF | SET | VIEW | ? | find Hex: | find Addr: | find Cmd:

Line #	Type	Hex Data	Address	Command	Time	Date	Comment
493	Query	7990	A60	QUERY STATUS	08:57:43.390	09.11.2021	
494	Query	7B90	A61	QUERY STATUS	08:57:45.412	09.11.2021	
495	Query	7D90	A62	QUERY STATUS	08:57:47.429	09.11.2021	
496	Query	7F90	A63	QUERY STATUS	08:57:49.454	09.11.2021	
497	Query	0190	A0	QUERY STATUS	08:57:53.479	09.11.2021	
498	Answer	00		= 0 (0x00)	08:57:53.492	09.11.2021	
499	Query	01A0	A0	QUERY ACTUAL LEVEL	08:57:55.483	09.11.2021	
500	Answer	00		= 0 (0x00)	08:57:55.497	09.11.2021	
501	Query	0390	A1	QUERY STATUS	08:57:57.504	09.11.2021	
502	Answer	04		= 4 (0x04)	08:57:57.542	09.11.2021	
503	Query	03A0	A1	QUERY ACTUAL LEVEL	08:57:59.509	09.11.2021	
504	Answer	B7		= 183 (0xB7)	08:57:59.521	09.11.2021	
505	Query	0590	A2	QUERY STATUS	08:58:01.536	09.11.2021	
506	Answer	04		= 4 (0x04)	08:58:01.546	09.11.2021	
507	Query	05A0	A2	QUERY ACTUAL LEVEL	08:58:03.539	09.11.2021	
508	Answer	FE		= 254 (0xFE)	08:58:03.552	09.11.2021	
509	Query	0790	A3	QUERY STATUS	08:58:05.561	09.11.2021	
510	Answer	04		= 4 (0x04)	08:58:05.574	09.11.2021	
511	Query	07A0	A3	QUERY ACTUAL LEVEL	08:58:07.567	09.11.2021	

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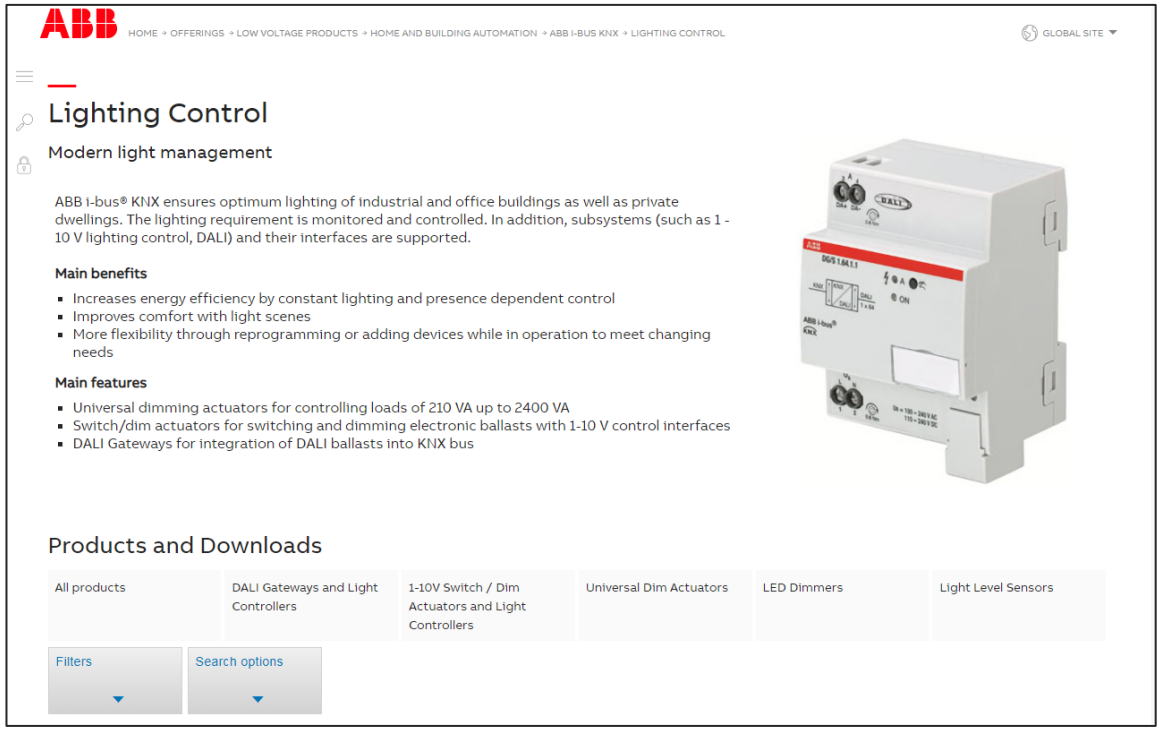
Homepage

www.abb.com/KNX

→ Products and Downloads
→ Lighting Control
→ Search Options DG/S

- ETS Application
- ABB i-bus® Tool
- Product Manual
- Engineering Guides
- Installation and Operating Instructions
- Specification Text
- …



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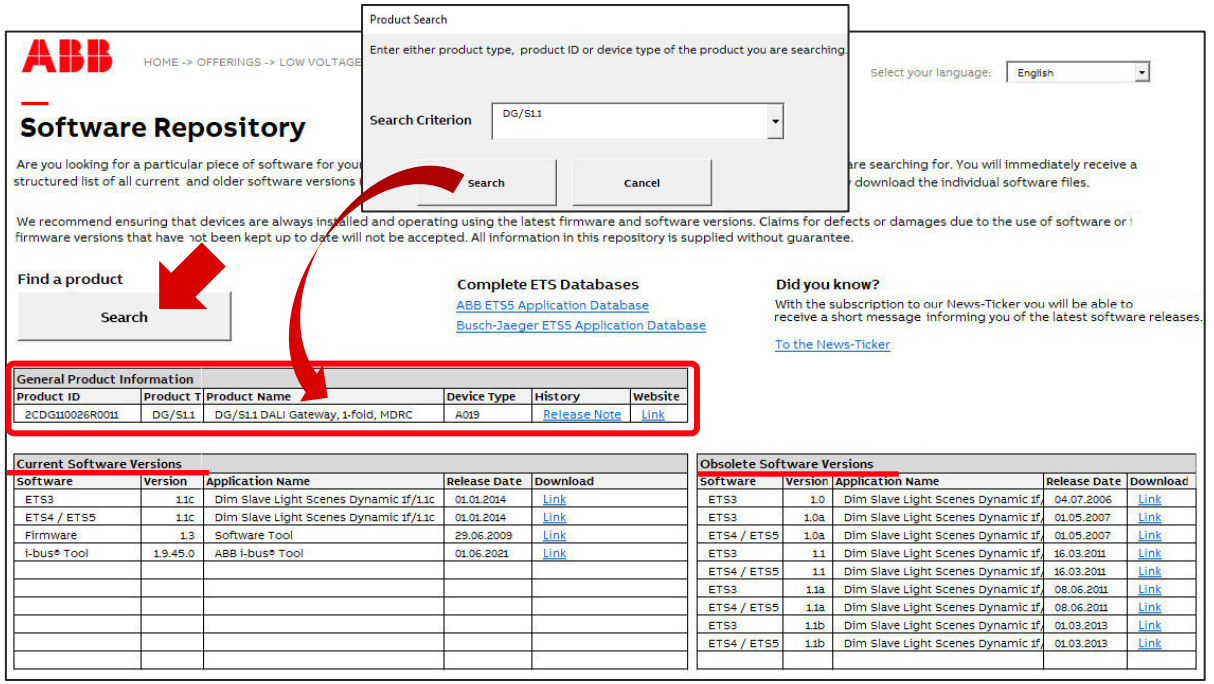
Software Repository

- Excel list in German and English
- Link to general product information
- Search for a KNX product and the corresponding software (firmware, ETS application) will be displayed
- Current firmware of Welcome IP and free@home devices
- A direct download of this software is possible via a link
- Historical ETS applications can also be downloaded (database for ETS App “Reconstruction Tool”)

NEW!!!

- www.abb.com/KNX
  → Additional materials
  → Downloads for KNX
  → Software Repository



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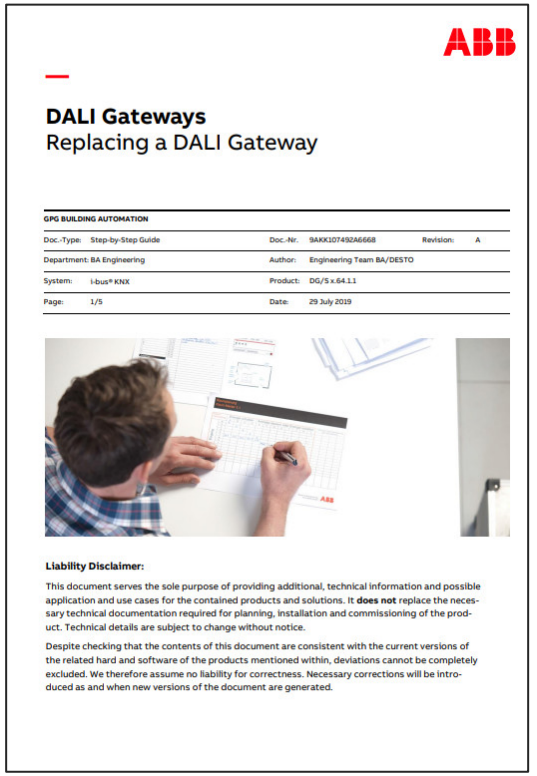
Online Learning Session

Training content

- This training mainly relates to the DALI basics and properties
- Extensive training content is available online for the DALI Gateway and ABB i-bus® Tool, e.g.
  emergency lighting, constant light control, human centric lighting, Dim2Warm, RGBW/HSVW, sequencer, load management, operating duration, standby switch-off, partial failure, …
- Slides, tutorials and video recordings of webinars, online and practical learning sessions
  → Training & Qualification Database
  → YouTube, Channel “ABB Home and Building Automation”
  https://www.youtube.com/user/ABBibusKNX
- Function descriptions, application guides, video tutorials, step-by-step guides:
  → Engineering Guide Database



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Training Material

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
  - ww.abb.com/knx (→ Services & Tools → Training and Qualification → Training Database)

YouTube

– Channel “ABB Home and Building Automation”
  - https://www.youtube.com/user/ABBibusKNX

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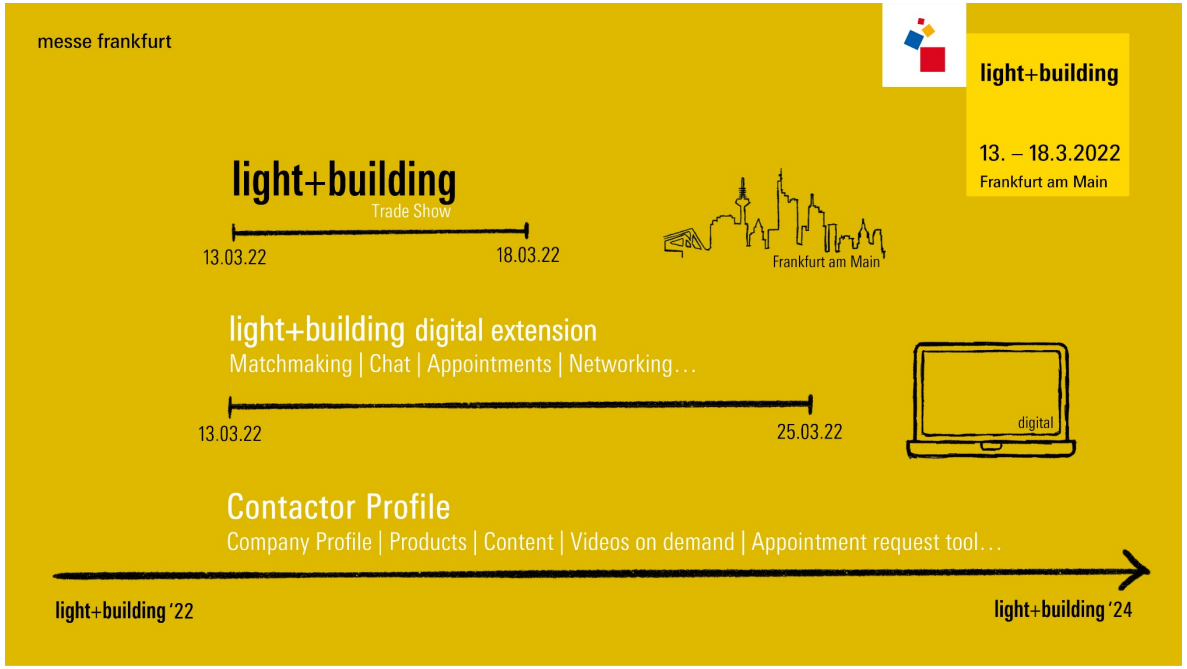
Light + Building will take place in March 2022

Onsite + digital: here we go

- At Light+Building the industry presents every two years the latest products for the fields of lighting, electrical engineering and home and building automation
- Light+Building opens in Frankfurt from 13th to 18th March 2022
- The new Light+Building digital additions functions will also be available at the same time and beyond
- We plan our participation in general as a hybrid event, so that customers can join remotely
- You will find ABB and BUSCH-JAEGER booth in the NEW hall 12.0
- More information to come before the end of this year



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