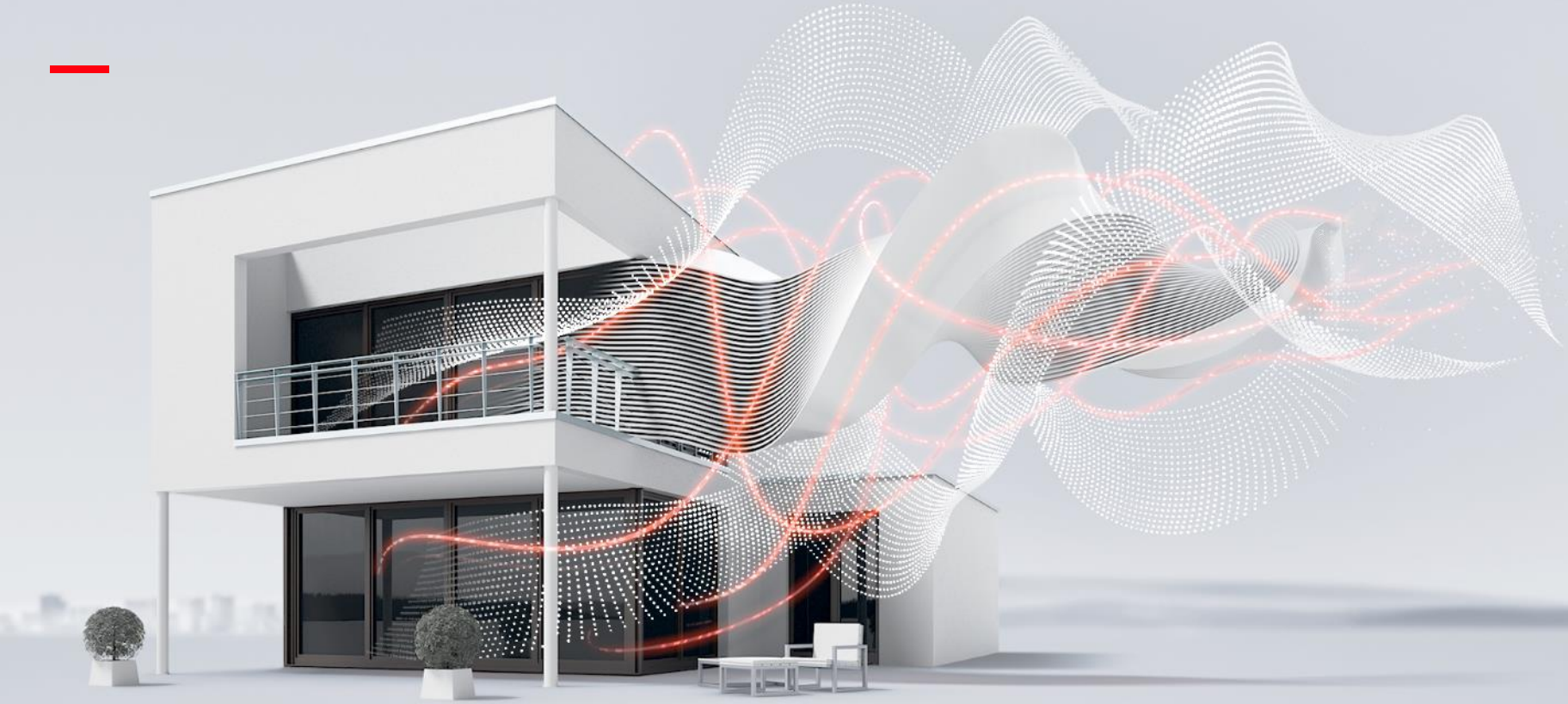


HEIDELBERG, DECEMBER 2021

KNX DALI Gateways – Practical knowledge about DALI – Part 2

Online Learning Session – Competence Center Europe – Smart Buildings

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

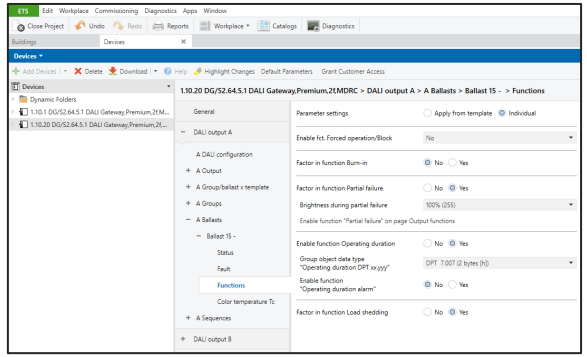
 Document ID.: … Rev.: …

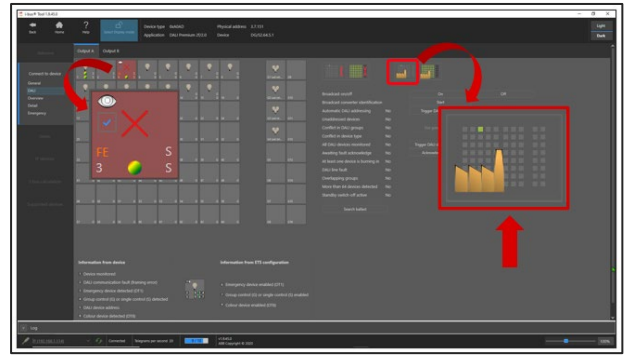
KNX DALI Gateways – Practical knowledge about DALI – Part 2

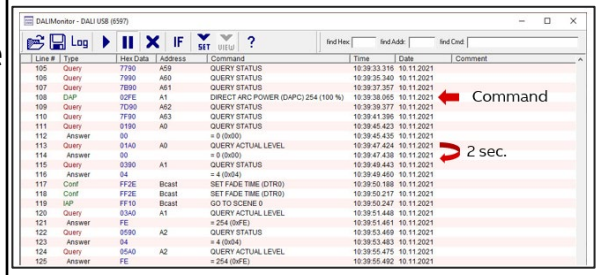
Online Learning Session

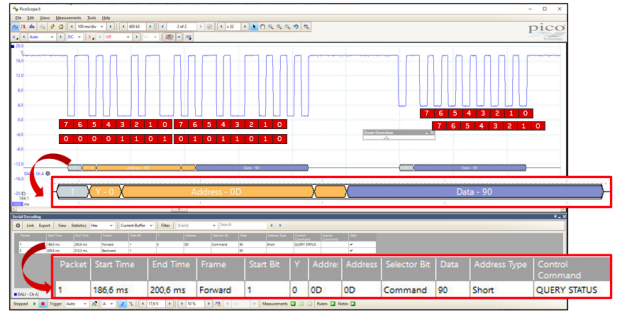
Why going in more Details with DALI?

- 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







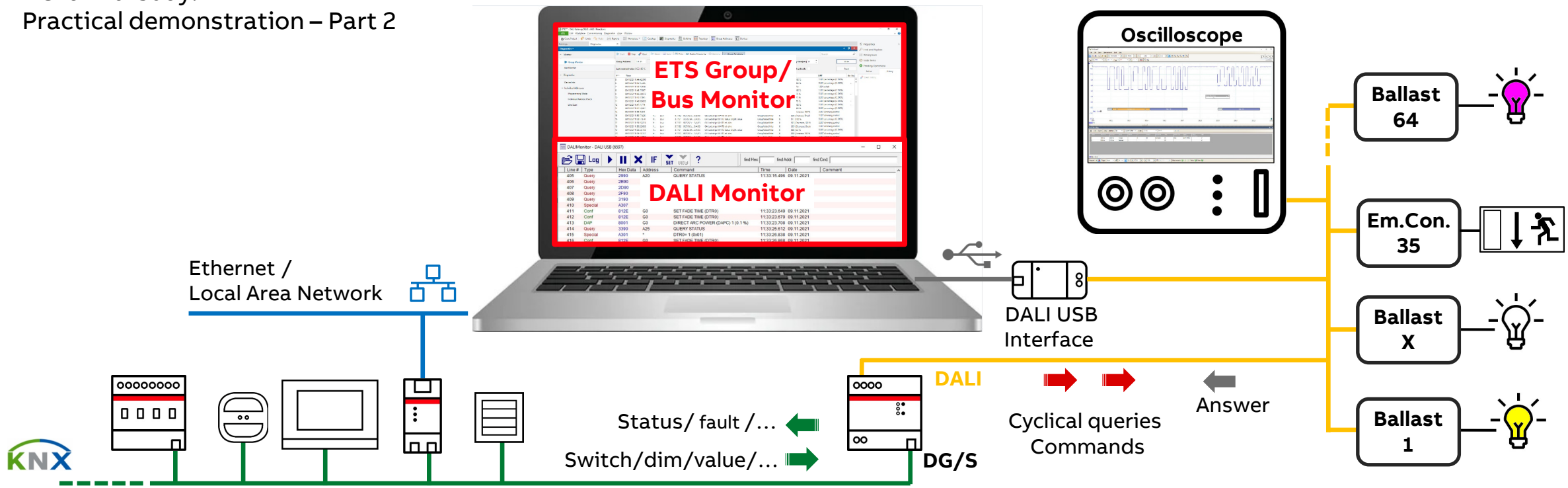


KNX DALI Gateways – Practical knowledge about DALI – Part 2

Online Learning Session

Diagnostic with “DALI Monitor“ and DALI USB Interface

– Next Thursday:
Practical demonstration – Part 2



KNX DALI Gateways – Practical knowledge about DALI – Part 2

Part 2: Today (Online Learning Session)

DALI diagnostic with

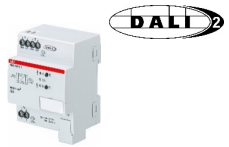
- Software “DALI Monitor” and DALI USB interface
- ETS Group Monitor
- Oscilloscope

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

KNX DALI Gateways – Practical knowledge about DALI – Part 2

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 2

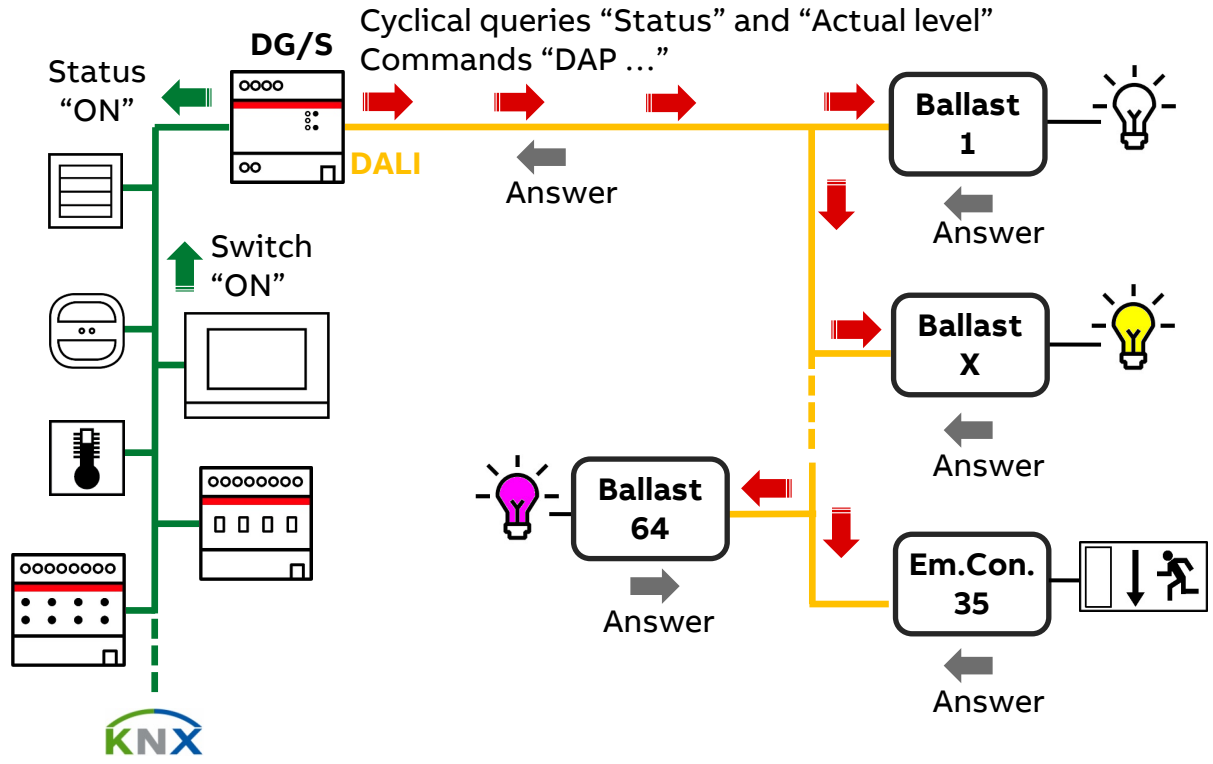
Online Learning Session

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)



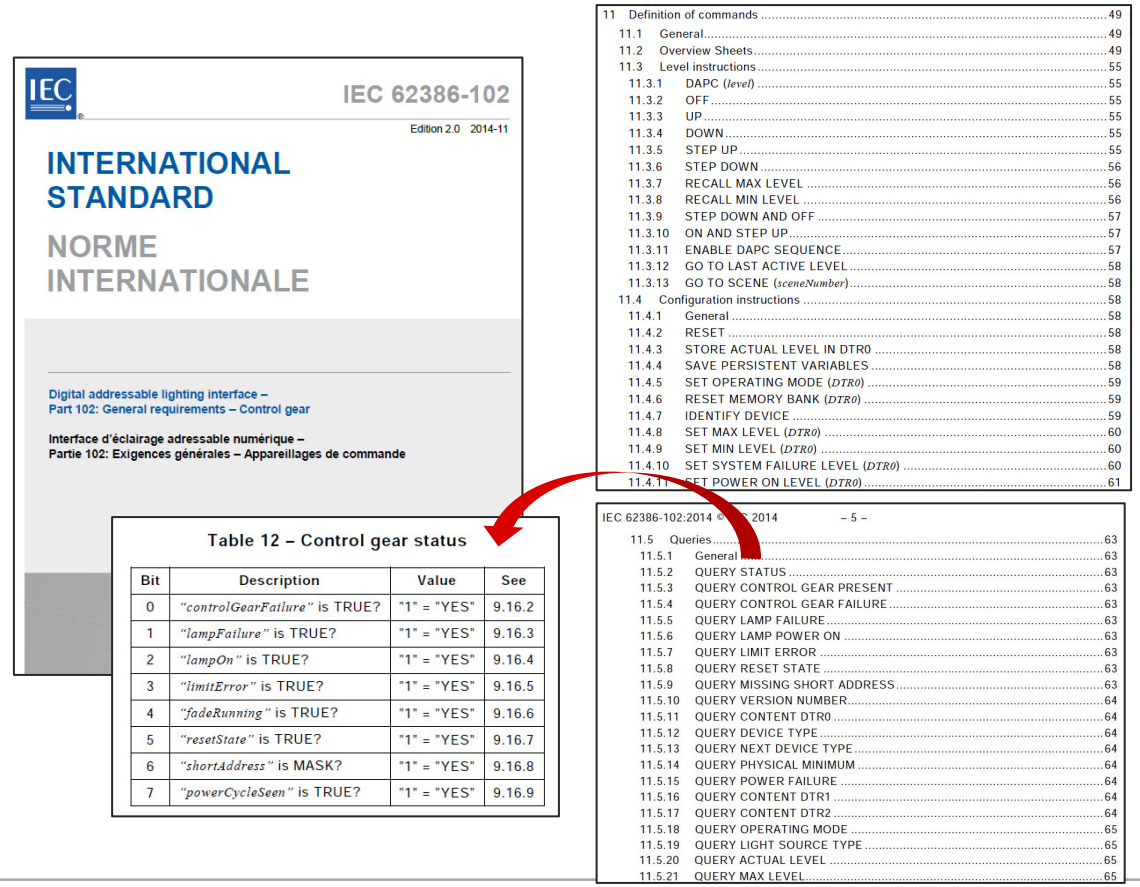
KNX DALI Gateways – Practical knowledge about DALI – Part 2

Online Learning Session

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)
  - Status
  - Actual level

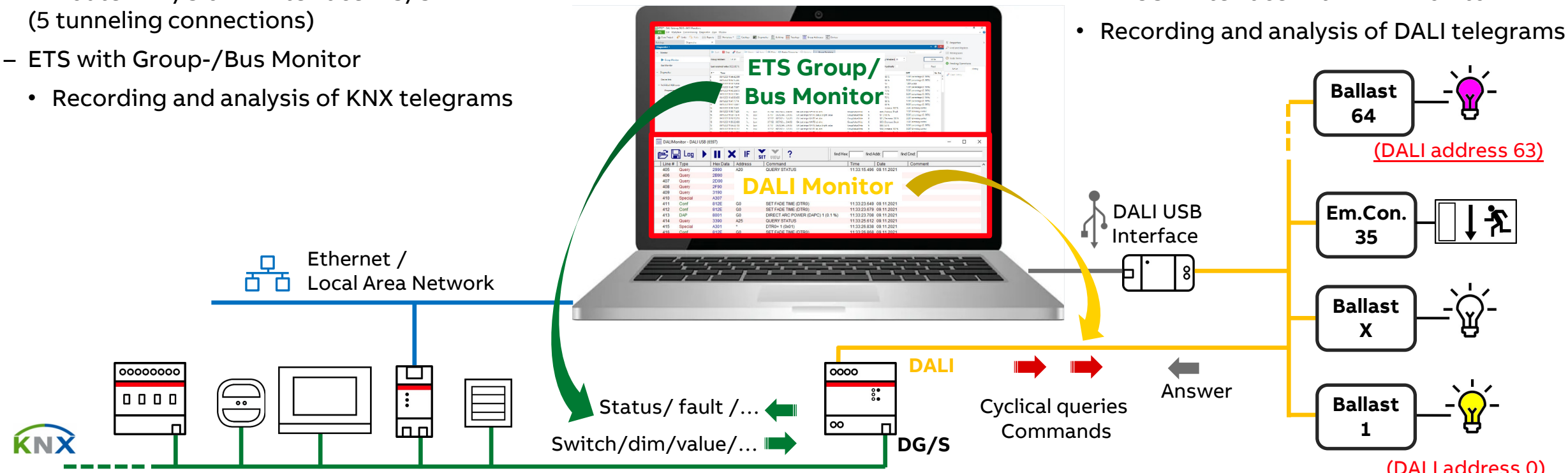


KNX DALI Gateways – Practical knowledge about DALI – Part 2

Online Learning Session

Diagnostic with “DALI Monitor“ and DALI USB Interface

- IP Router IPR/S or IP Interface IPS/S (5 tunneling connections)
- ETS with Group-/Bus Monitor
  - Recording and analysis of KNX telegrams



- DALI USB Interface with DALI Monitor
  - Recording and analysis of DALI telegrams

KNX DALI Gateways – Practical knowledge about DALI – Part 2

Online Learning Session

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	

KNX DALI Gateways – Practical knowledge about DALI – Part 2

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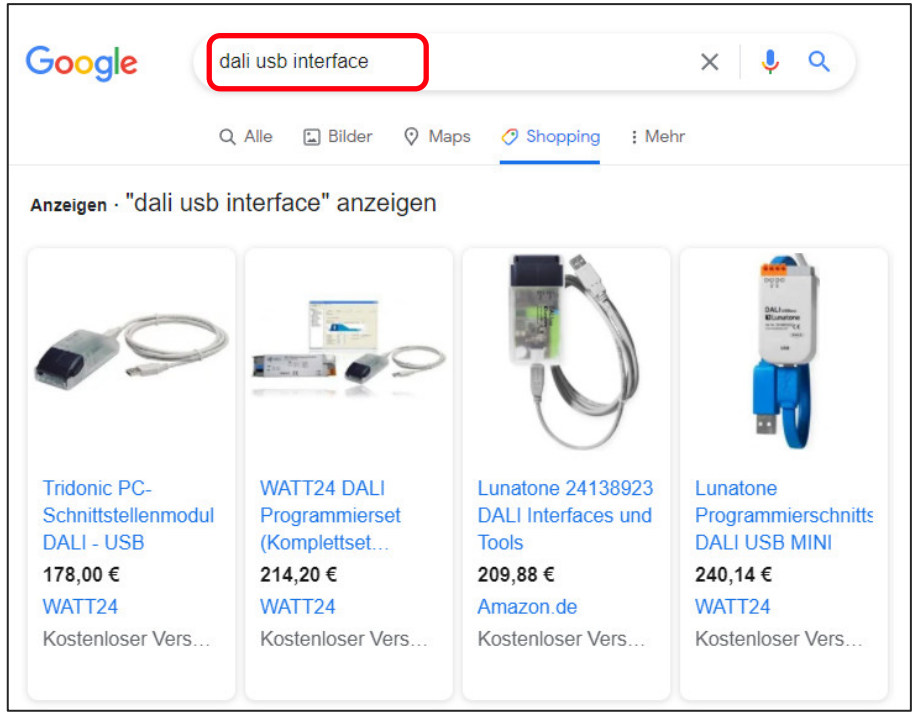
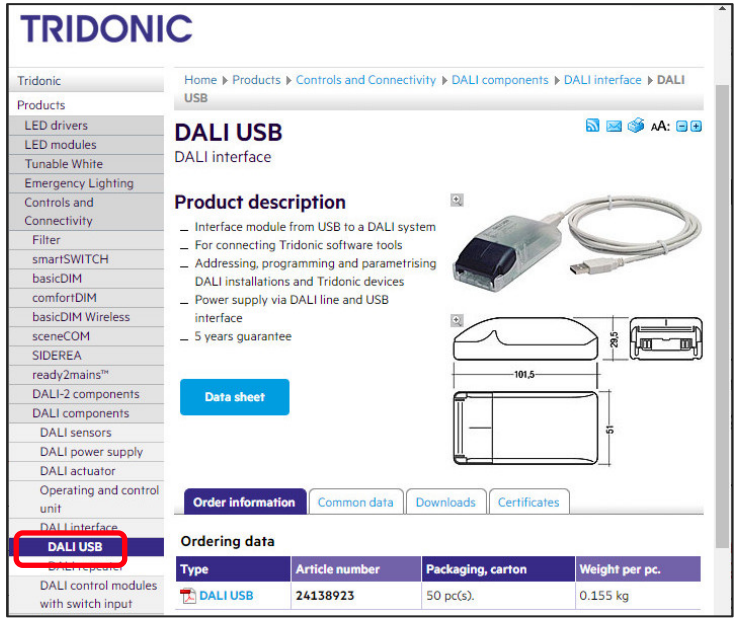
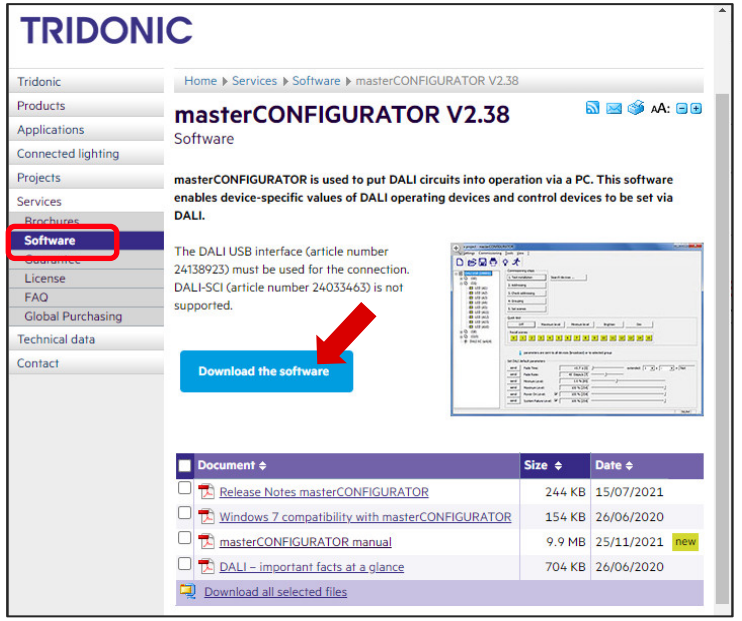
Diagnostic with “DALI Monitor“ and DALI USB Interface



~ 200 €



www.tridonic.com



→ Download “masterCONFIGURATOR” (free of charge)
The program **”DALI Monitor”** is also installed with the “masterCONFIGURATOR” software

KNX DALI Gateways – Practical knowledge about DALI – Part 2

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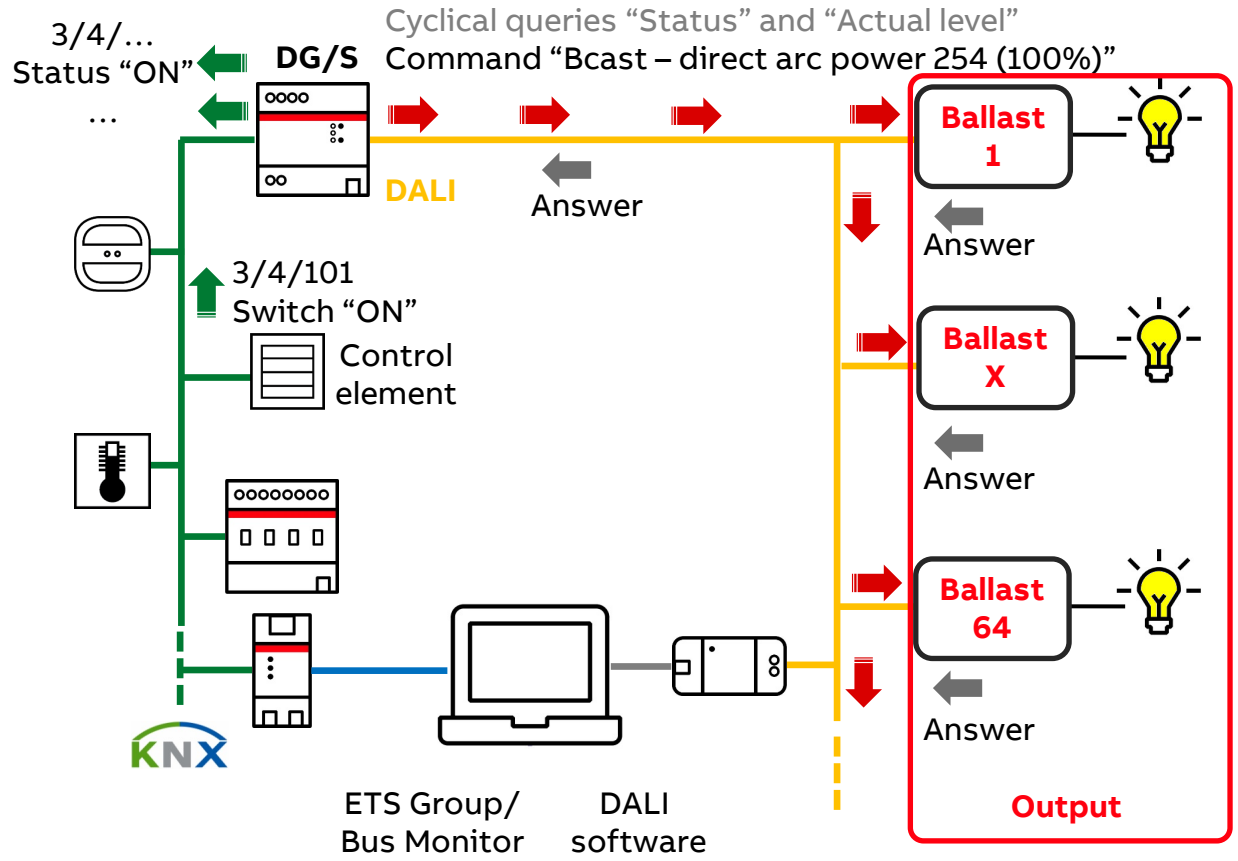
Diagnostic with “DALI Monitor“ and DALI USB Interface

Example: Switch ON output A

- Control element sends group address 3/4/101 with value “1”
- ETS group monitor records telegram with group address 3/4/101 with value “1”
- DALI Gateway converts KNX group address 3/4/101 with value “1” into DALI command **“Bcast – direct arc power level 254 (100% light output)**
- All ballasts switch on
- DALI Gateway simulates the switch on behavior of all ballasts and sends KNX group addresses with corresponding values (depends on fade time and parameter “Behavior Switch On Value”)



KNX DALI Gateways – Practical knowledge about DALI – Part 2

Online Learning Session

Diagnostic with “DALI Monitor“ and DALI USB Interface – Example: Switch ON output

– Control element sends group address 3/4/101 with value “1”

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

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 %
09.11.2021 14:38:33,923	3.7.151	DALI DG/S	3/4/15	G2: Led strips GREEN Status Bright. value	$FF | 100 %
09.11.2021 14:38:33,945	3.7.151	DALI DG/S	3/4/25	G3: Led strips BLUE Status Bright. value	$FF | 100 %
09.11.2021 14:38:33,967	3.7.151	DALI DG/S	3/4/35	G4: Led strips WHITE Status Bright. value	$FF | 100 %

– DALI Gateway converts KNX group address 3/4/101 with value “1” into DALI command “Bcast – direct arc power 254 level (100% light output)”

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

– All ballasts switch on

– DALI Gateway simulates the switch on behavior of all ballasts and sends KNX group addresses with corresponding values (depends on fade time and parameter “Behavior Switch On Value”)

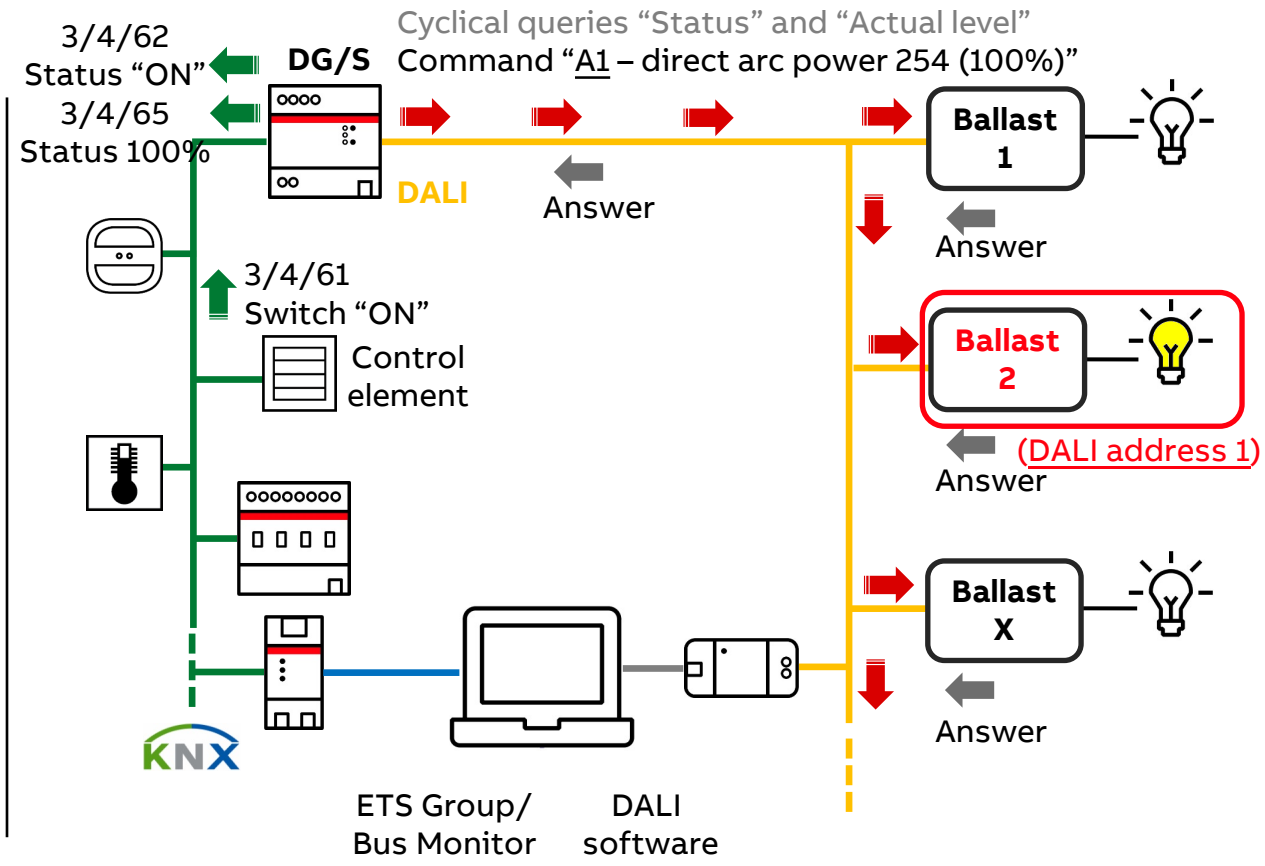
KNX DALI Gateways – Practical knowledge about DALI – Part 2

Online Learning Session

Diagnostic with “DALI Monitor“ and DALI USB Interface

Example: Switch ON ballast 2

- Control element sends group address 3/4/61 with value “1”
- ETS group monitor records telegram with group address 3/4/61 with value “1”
- DALI Gateway converts KNX group address 3/4/61 with value “1” into DALI command **“A1 – direct arc power level 254 (100% light output)**
- Ballast no. 2 (= DALI address 1) switches on
- 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%” (depends on fade time and parameter “Behavior Switch On Value”)



KNX DALI Gateways – Practical knowledge about DALI – Part 2

Online Learning Session

Diagnostic with “DALI Monitor“ and DALI USB Interface – Example: Switch ON ballast 2

– Control element sends group address 3/4/61 with value “1”

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

– DALI Gateway converts KNX group address 3/4/61 with value “1” into DALI command “A1 – direct arc power 254 level (100% light output)

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

– Ballast no. 2 (= DALI address 1) switches on

– 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%” (depends on fade time and parameter “Behavior Switch On Value”)

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 %

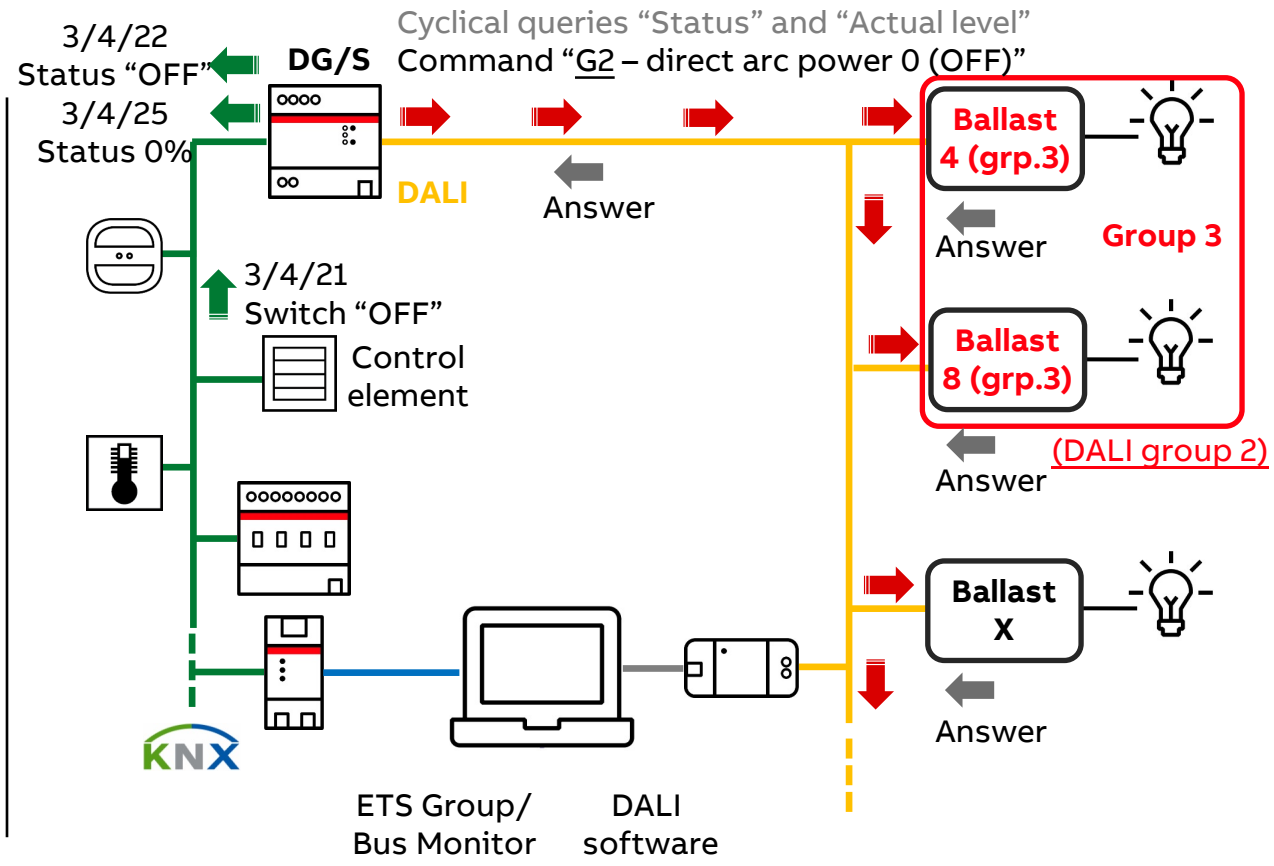
KNX DALI Gateways – Practical knowledge about DALI – Part 2

Online Learning Session

Diagnostic with “DALI Monitor“ and DALI USB Interface

Example: Switch OFF group 3

- The group membership is already saved in the ballasts
- Control element sends group address 3/4/21 with value “0”
- ETS group monitor records telegram with group address 3/4/21 with value “0”
- DALI Gateway converts KNX group address 3/4/21 with value “0” into DALI command **“G2 – direct arc power level 0 (OFF light output)”**
- 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%” (both depends on fade time and parameter “Behavior Switch Off Value”)



KNX DALI Gateways – Practical knowledge about DALI – Part 2

Online Learning Session

Diagnostic with “DALI Monitor“ and DALI USB Interface – Example: Switch OFF group 3

– Control element sends group address 3/4/21 with value “0”

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

– DALI Gateway converts KNX group address 3/4/21 with value “0” into DALI command “G2 – direct arc power 0 level (OFF light output)”

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

– Group no. 3 (= DALI group 2) switches off

– The group membership is already saved in the ballasts

– DALI Gateway simulates the switch off behavior of the group and sends KNX group address 3/4/22 with value “0” and 3/4/25 with value “0%” (both depends on fade time and parameter “Behavior Switch Off Value”)

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 %

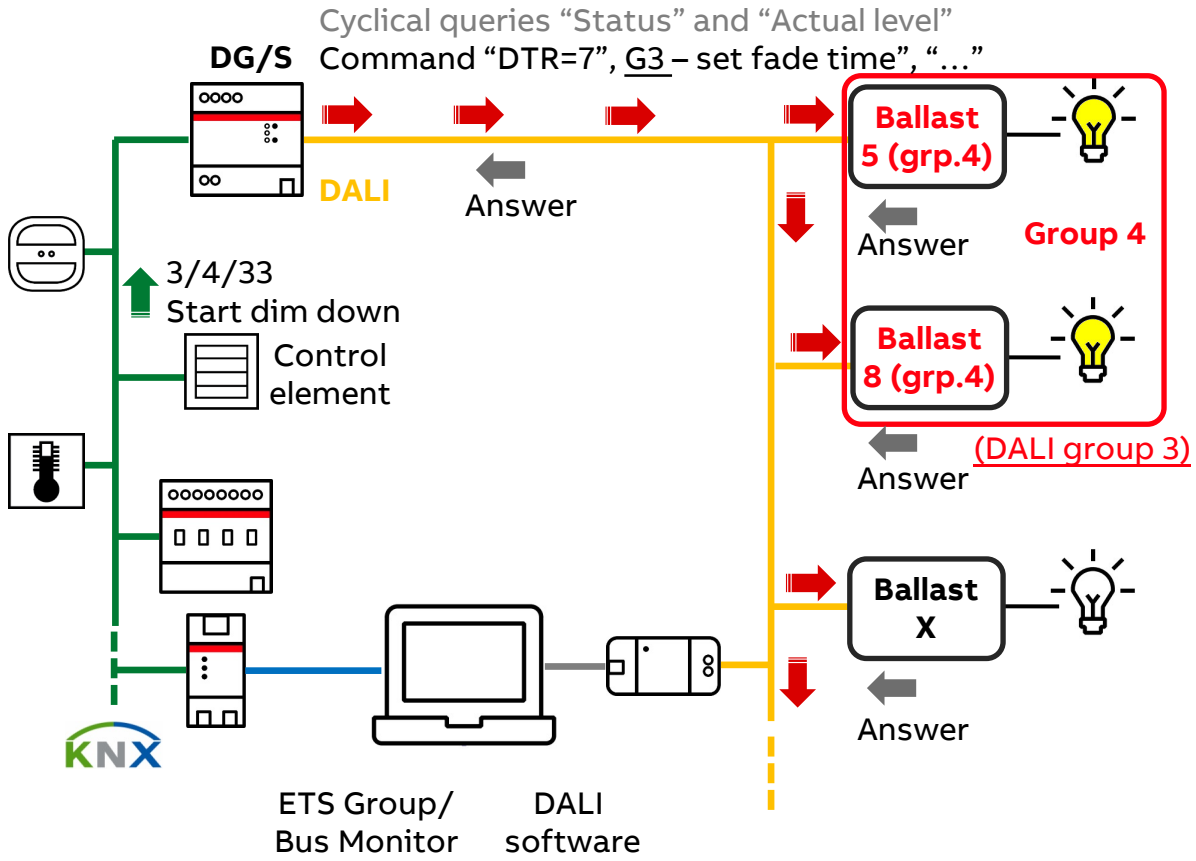
KNX DALI Gateways – Practical knowledge about DALI – Part 2

Online Learning Session

Diagnostic with “DALI Monitor“ and DALI USB Interface

Example: Dim group 4 down

- Press rocker of control element
  → Group address 3/4/33 with value “01” (start dim down) is sent
- ETS group monitor records telegram with group address 3/4/33 with value “01”
- 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”



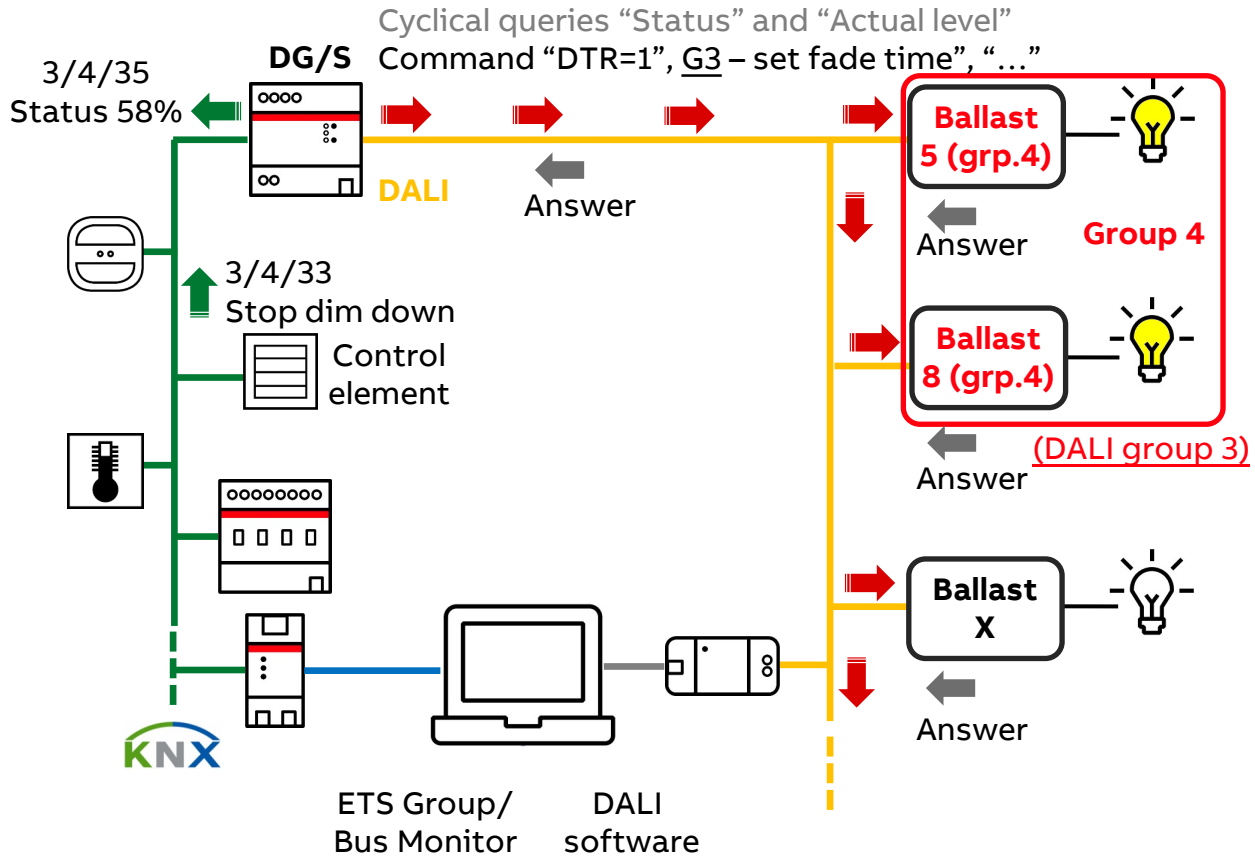
KNX DALI Gateways – Practical knowledge about DALI – Part 2

Online Learning Session

Diagnostic with “DALI Monitor“ and DALI USB Interface

Example: Dim group 4 down

- Release rocker of control element
  → Group address 3/4/33 with value “00” (stop dim down) is sent
- ETS group monitor records telegram with group address 3/4/33 with value “00”
- 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)
- DALI Gateway sends KNX group address 3/4/35 with value “58%” (106)



KNX DALI Gateways – Practical knowledge about DALI – Part 2

Online Learning Session

Diagnostic with “DALI Monitor“ and DALI USB Interface – Example: Dim group 4 down

– Press rocker of control element
→ Group address 3/4/33 with value “01” (start dim down) is sent

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 %

– 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”

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 %)

* Values written into the memory are sent twice

KNX DALI Gateways – Practical knowledge about DALI – Part 2

Online Learning Session

Diagnostic with “DALI Monitor“ and DALI USB Interface – Example: Dim group 4 down

– Release rocker of control element
→ Group address 3/4/33 with value “00” (stop dim down) is sent

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

– 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

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 %)

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 %

– DALI Gateway sends KNX group address 3/4/35 with value “58%” (106)

* Values written into the memory are sent twice

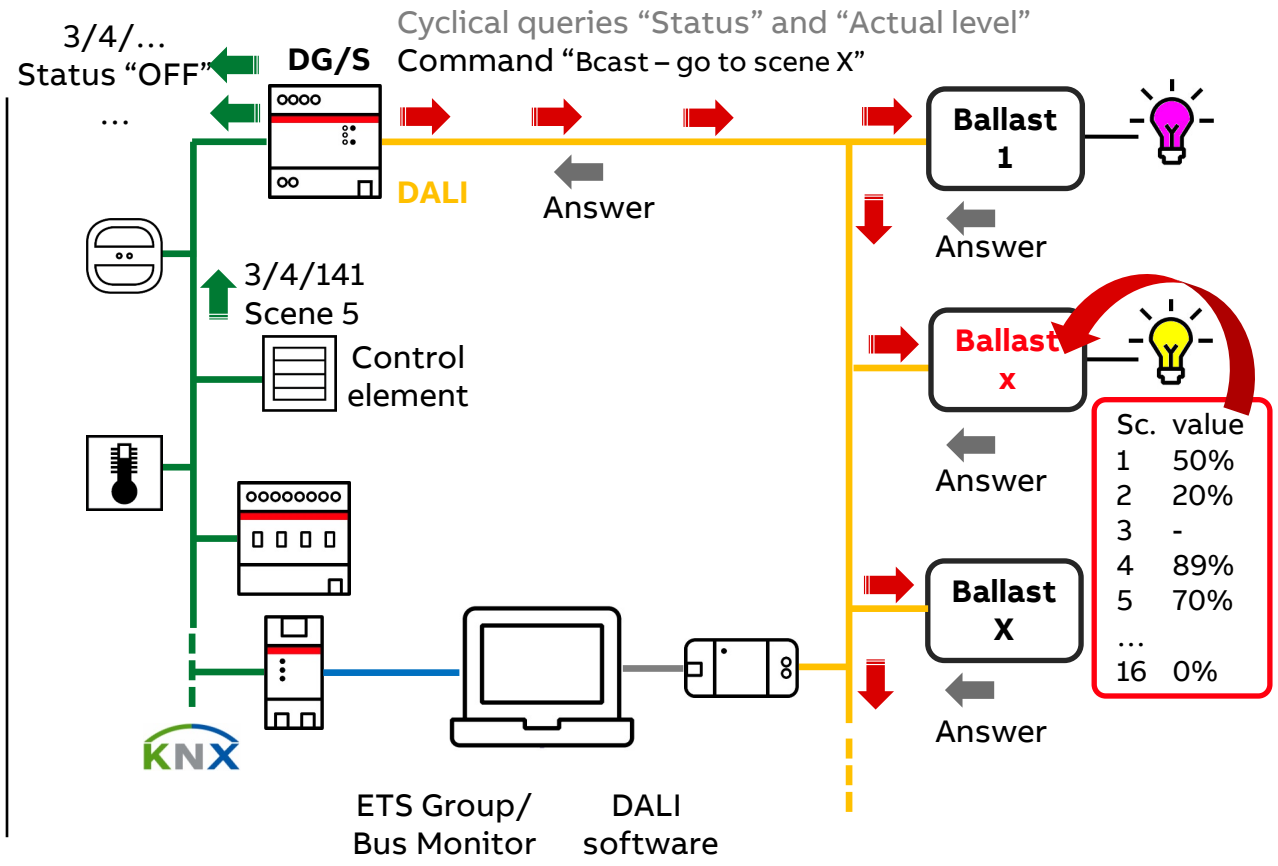
KNX DALI Gateways – Practical knowledge about DALI – Part 2

Online Learning Session

Diagnostic with “DALI Monitor“ and DALI USB Interface

Example: Call scene 5

- Control element sends group address 3/4/141 with value “4” (call scene 5)
- ETS group monitor records telegram with group address 3/4/141 with value “4” (activate scene 5)
- DALI Gateway converts KNX group address 3/4/141 with value “4” into DALI command **“Bcast – go to scene X”**
  Scene number depends on scene mapping (ETS parameter)
- The scene values and fade times are saved in the ballasts
  → This 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)



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Diagnostic with “DALI Monitor“ and DALI USB Interface

– Control element sends group address 3/4/141 with value “4” (call 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

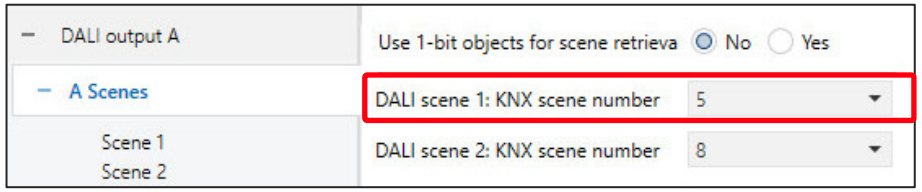
– DALI Gateway converts KNX group address 3/4/141 with value “4” into DALI command “Bcast – go to scene 0”
Scene number depends on scene mapping (ETS parameter)

	Line #	Type	Hex Data	Address	Command
	1	IAP	FF10	Bcast	GO TO 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 %

– The scene values are stored in the ballasts
→ The stored 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)



KNX scene 1…64 can be mapped to a DALI scene 1…16 (0…15), e.g.
KNX scene 5 is mapped to DALI scene 1 (0)

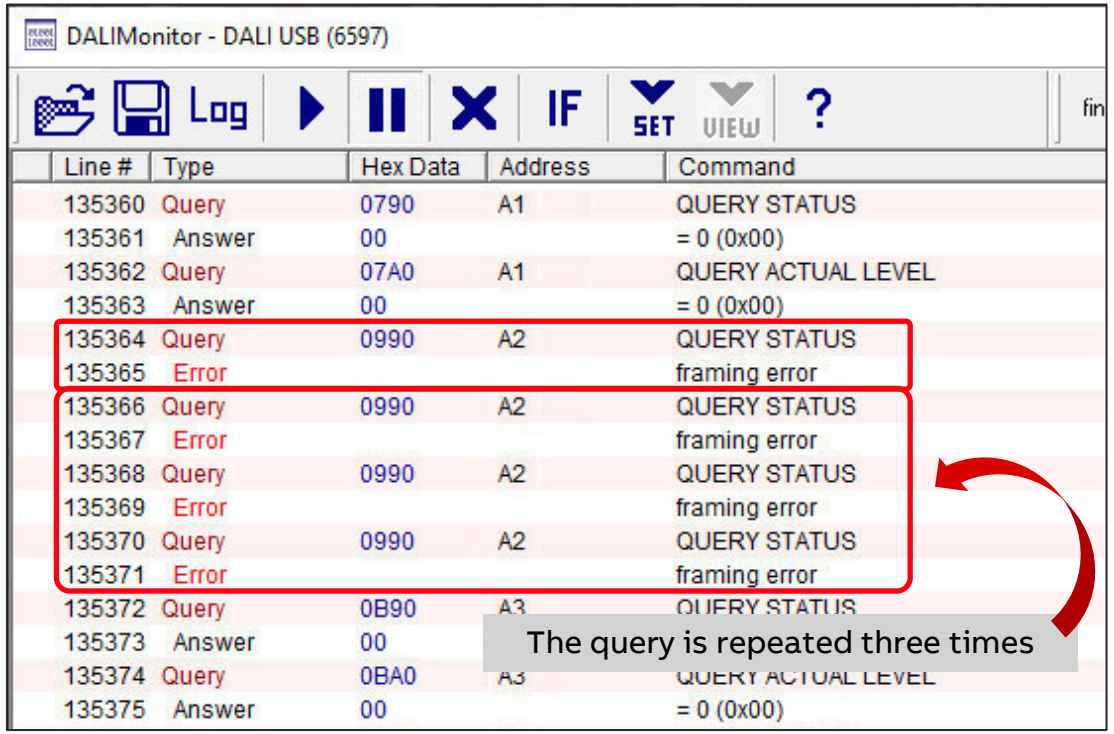
KNX DALI Gateways – Practical knowledge about DALI – Part 2

Online Learning Session

Diagnostic with “DALI Monitor“ and DALI USB Interface

Example: “FE” – Framing Error

- A framing error exists if no clear DALI telegram is received when the 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)



KNX DALI Gateways – Practical knowledge about DALI – Part 2

Online Learning Session

Diagnostic with an Oscilloscope – Why?

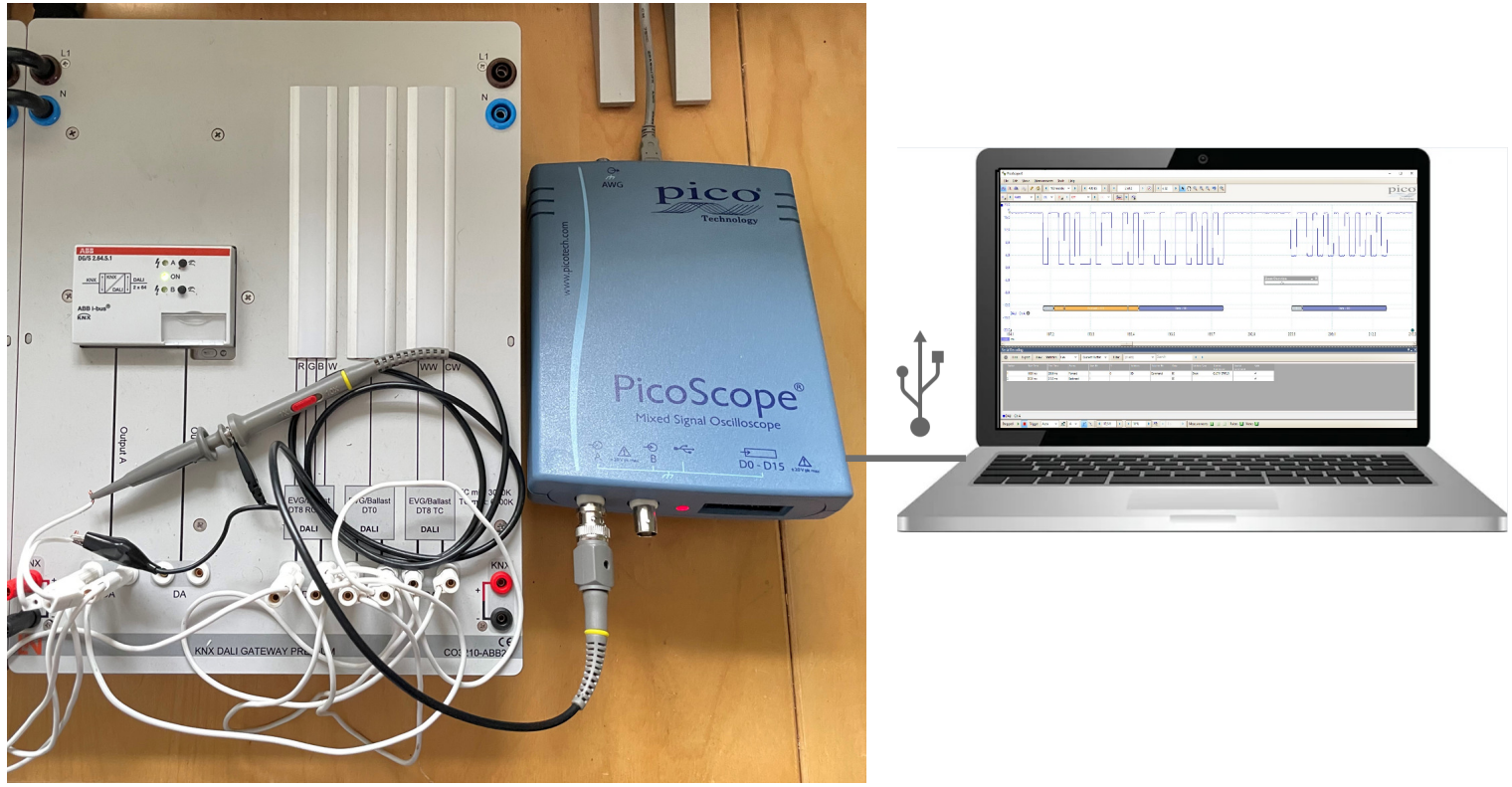
- KNX and DALI are standardized worldwide
- The DALI Gateways DG/S are certified according to DALI-2
- DALI-2 certification brings a significantly improved interoperability
- Nevertheless, problems can occur
  - DALI Installation guidelines observed?
    The cabling and the installation of the DALI devices was not done by the KNX commissioning engineer
    → Wiring error, more than 64 DALI devices per output, permissible cable length exceeded (longer telegram runtimes)
  - DALI-2 devices installed? DALI-1 devices have been installed which do not work in accordance with the DALI standard.
    DALI-1 is based on self-declaration
    → the DALI device does not respond in the specified time

KNX DALI Gateways – Practical knowledge about DALI – Part 2

Online Learning Session

Diagnostic with an Oscilloscope

- PC oscilloscope with USB connection, e.g.
  - From the company "Pico Technology“
  - Software “PicoScope” can decode DALI waveforms (DALI protocol is available)
  - Further information: https://www.picotech.com/library/oscilloscopes/dali-serial-protocol-decoding
- DALI uses Manchester (biphase) encoding to send the start bit and the information bits
- The nominal data rate is 1,200 bit per second, so one bit time is 833.33 µs



KNX DALI Gateways – Practical knowledge about DALI – Part 2

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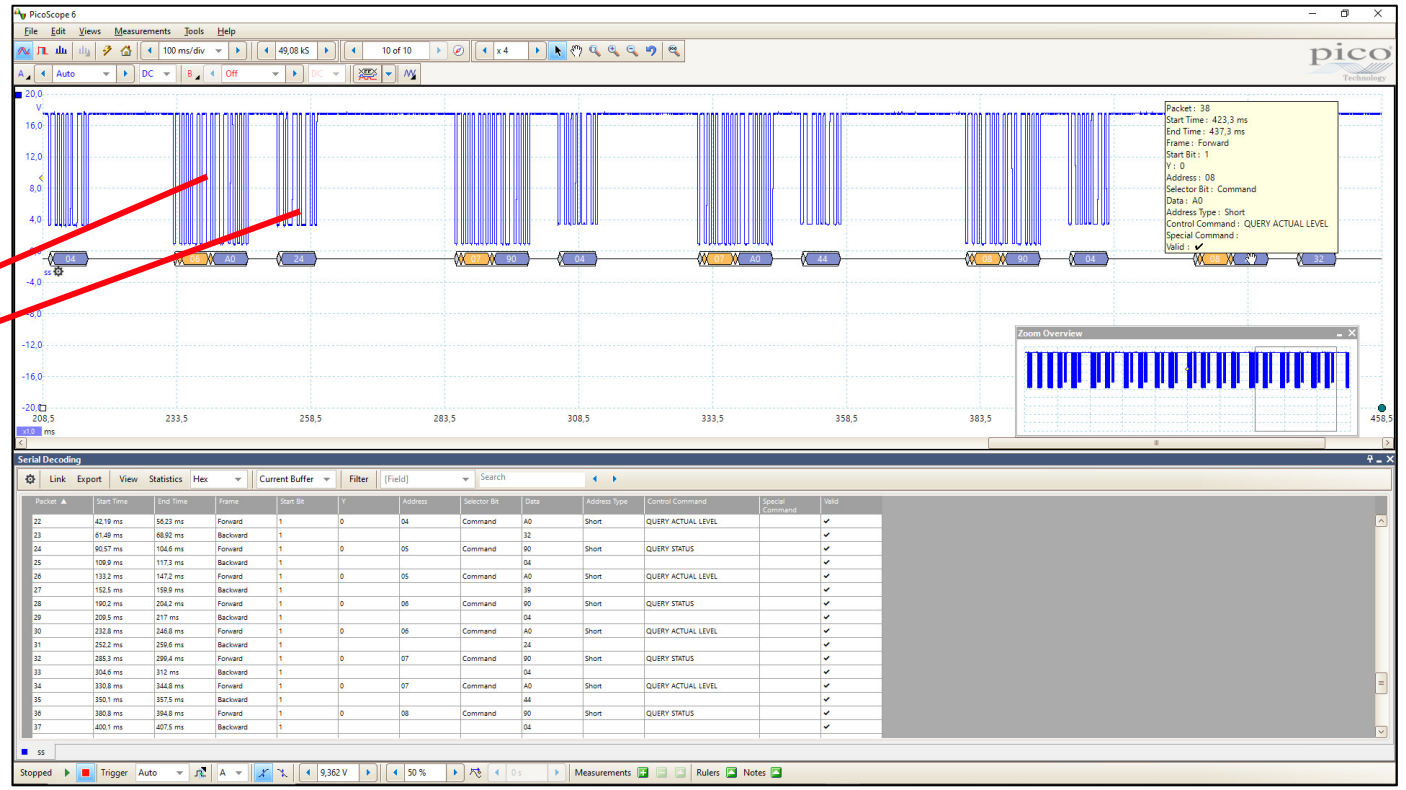
Diagnostic with an Oscilloscope

DALIMonitor - DALI USB (6597)

Log | IF | SET | VIEW | ?

Line #	Type	Hex Data	Address	Command
493	Query	7990	A60	QUERY STATUS
494	Query	7B90	A61	QUERY STATUS
495	Query	7D90	A62	QUERY STATUS
496	Query	7F90	A63	QUERY STATUS
497	Query	0190	A0	QUERY STATUS
498	Answer	00		= 0 (0x00)
499	Query	01A0	A0	QUERY ACTUAL LEVEL
500	Answer	00		= 0 (0x00)
501	Query	0390	A1	QUERY STATUS
502	Answer	04		= 4 (0x04)
503	Query	03A0	A1	QUERY ACTUAL LEVEL
504	Answer	B7		= 183 (0xB7)
505	Query	0590	A2	QUERY STATUS
506	Answer	04		= 4 (0x04)
507	Query	05A0	A2	QUERY ACTUAL LEVEL
508	Answer	FE		= 254 (0xFE)
509	Query	0790	A3	QUERY STATUS
510	Answer	04		= 4 (0x04)
511	Query	07A0	A3	QUERY ACTUAL LEVEL



KNX DALI Gateways – Practical knowledge about DALI – Part 2

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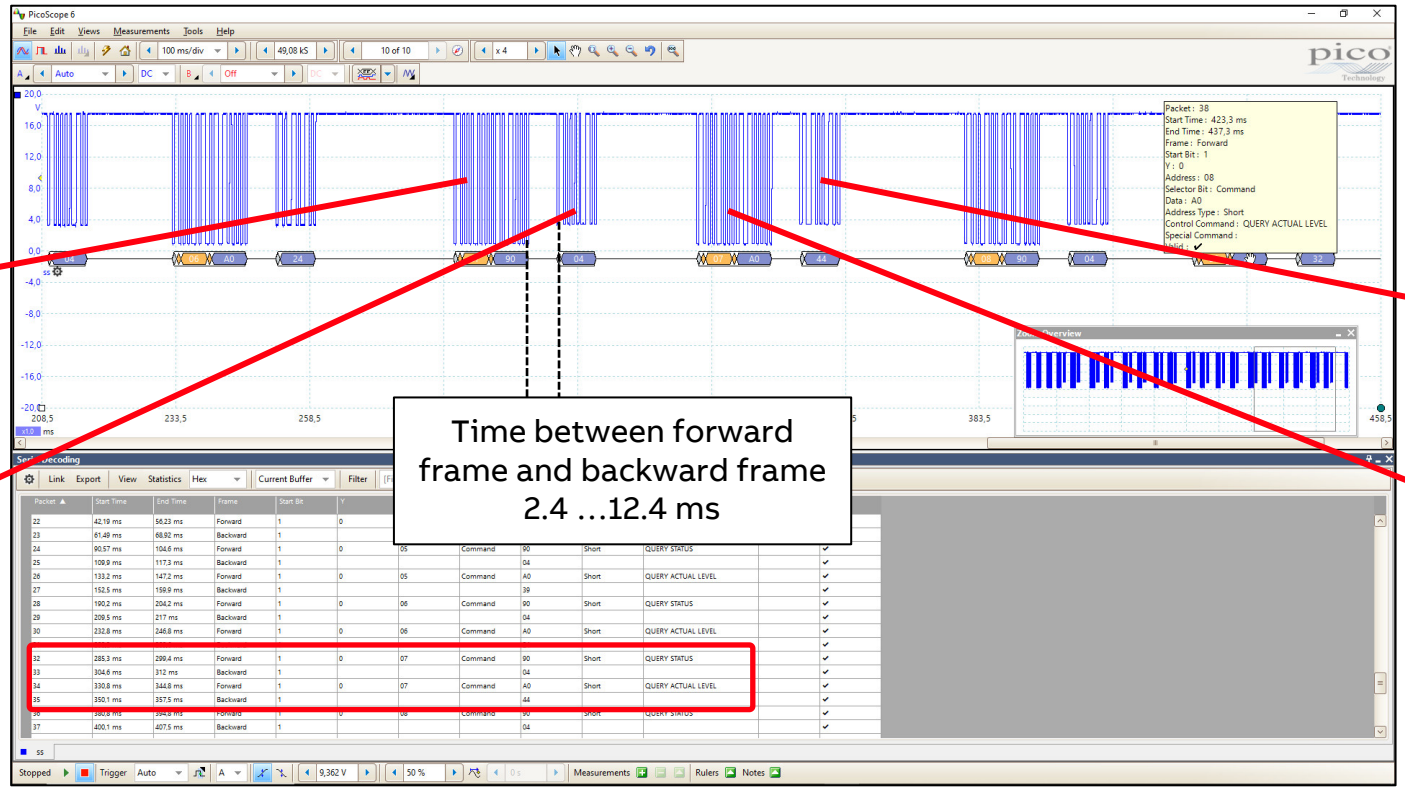
Diagnostic with an Oscilloscope

1 Command to address 07 with data 90 → query status

2 Answer with data 04 → Bit 2 = “1”: Lamp on



4 Answer with data 44

3 Command to address 07 with data A0 → query actual level

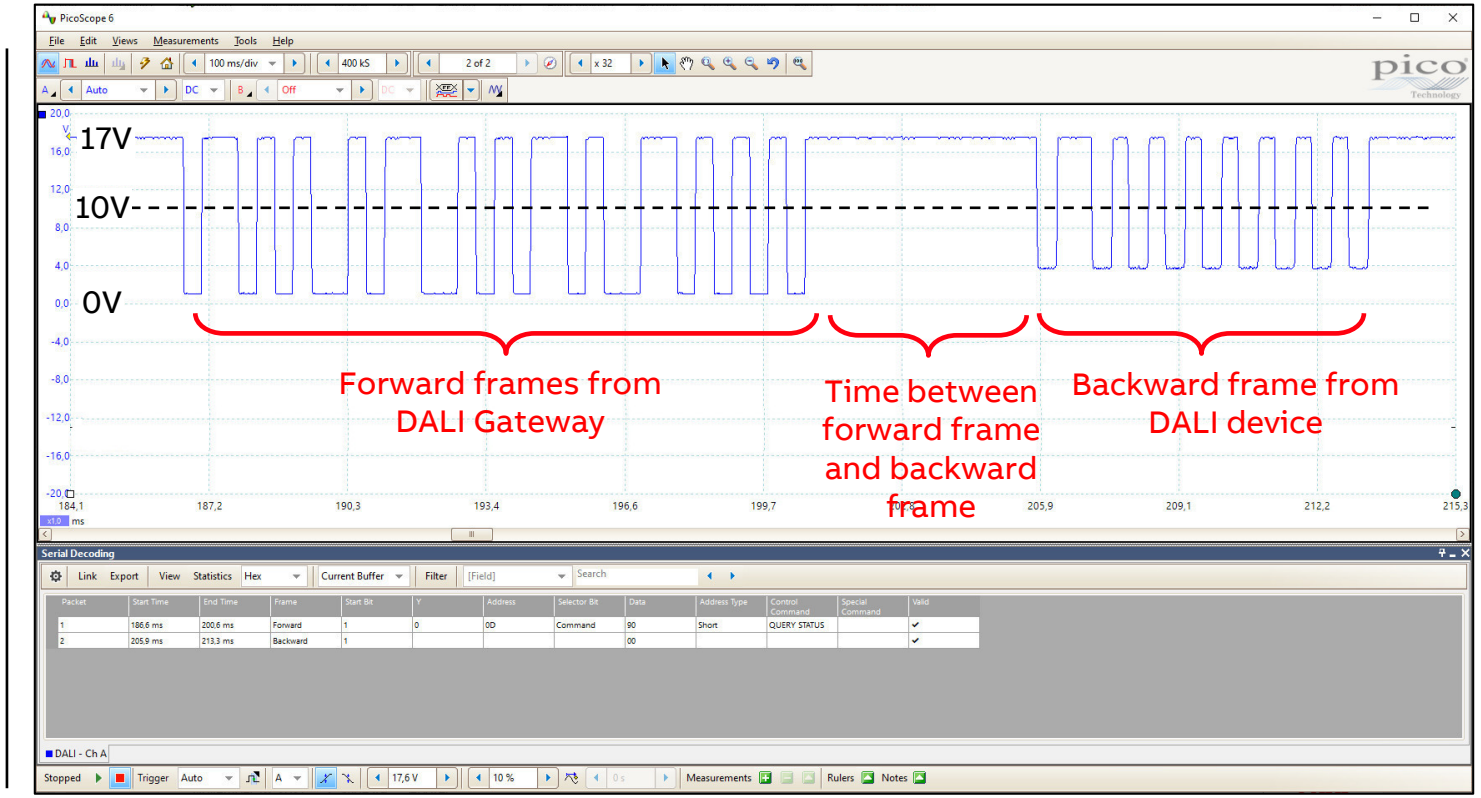
KNX DALI Gateways – Practical knowledge about DALI – Part 2

Online Learning Session

Diagnostic with an Oscilloscope

DALI telegram traffic

- Typical communication
  - Forward frames sent by the DALI Gateway to the DALI devices
  - Backward frames are sent back as a response from the DALI devices to the DALI Gateway
  - The voltage level is pulled below 10V
- In the event of communication problems, the following can be checked:
  - Are there overlaid backward frames?
  - Does the DALI device pull the voltage level below 10 volts in its response?
  - Does the DALI device send the response within the specified time?



KNX DALI Gateways – Practical knowledge about DALI – Part 2

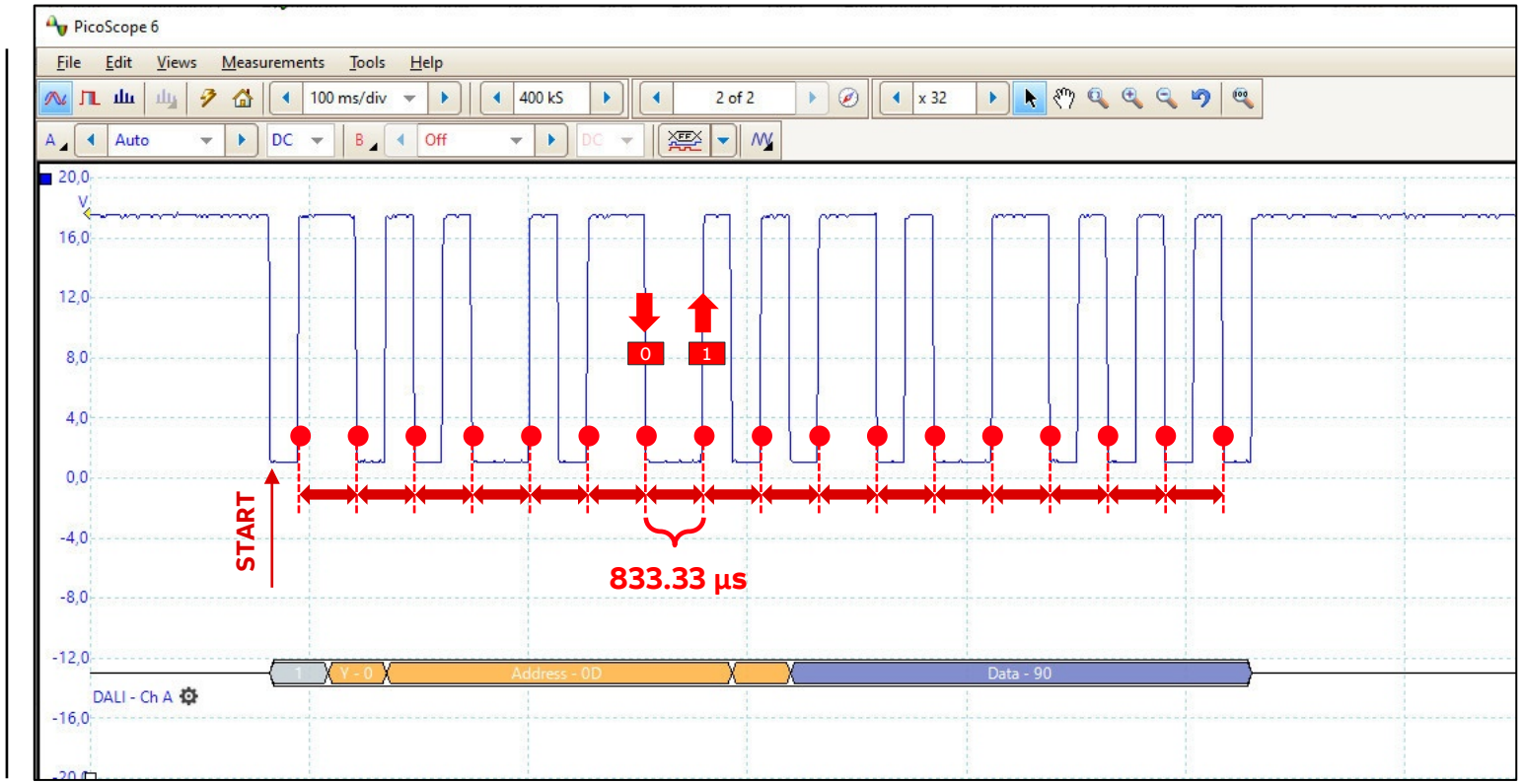
Online Learning Session

Diagnostic with an Oscilloscope

DALI telegram traffic

– The bits are bi-phased encoded:
  - Logical 1: Rising edge
  - Logical 0: Falling edge

– Nominal DALI data rate of 1,200 bit per second
  → one bit time is 833.33 µs



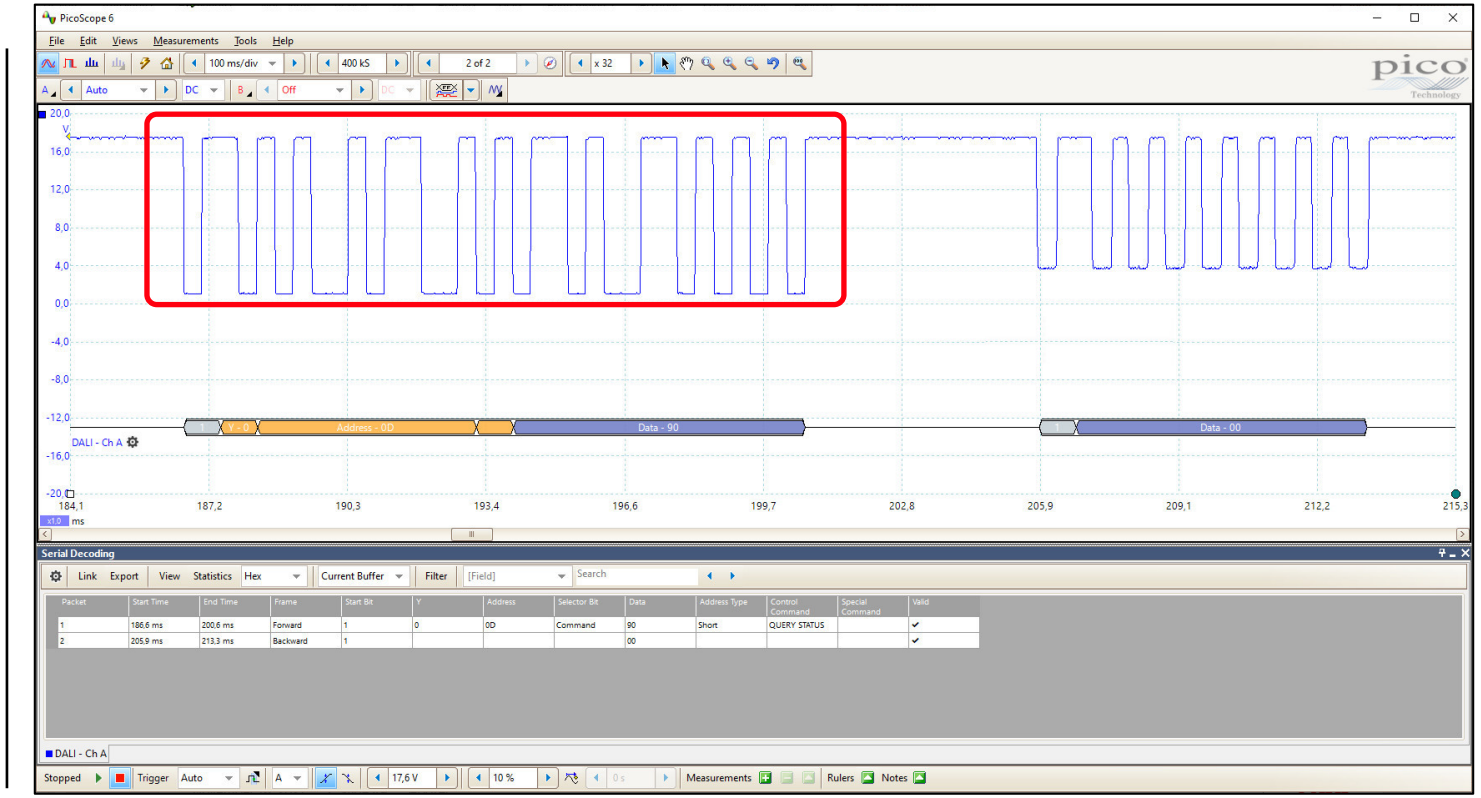
KNX DALI Gateways – Practical knowledge about DALI – Part 2

Online Learning Session

Diagnostic with an Oscilloscope

Forward frames

- Forward frames are packets sent by the DALI Gateway to the DALI devices (ballasts and emergency lighting converters)
- They have one start bit (A), eight address bits (address byte) and eight data bits (data byte)
- More details: IEC 62386 Part 102: “General requirements – Control gear”



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Diagnostic with an Oscilloscope

Forward frames

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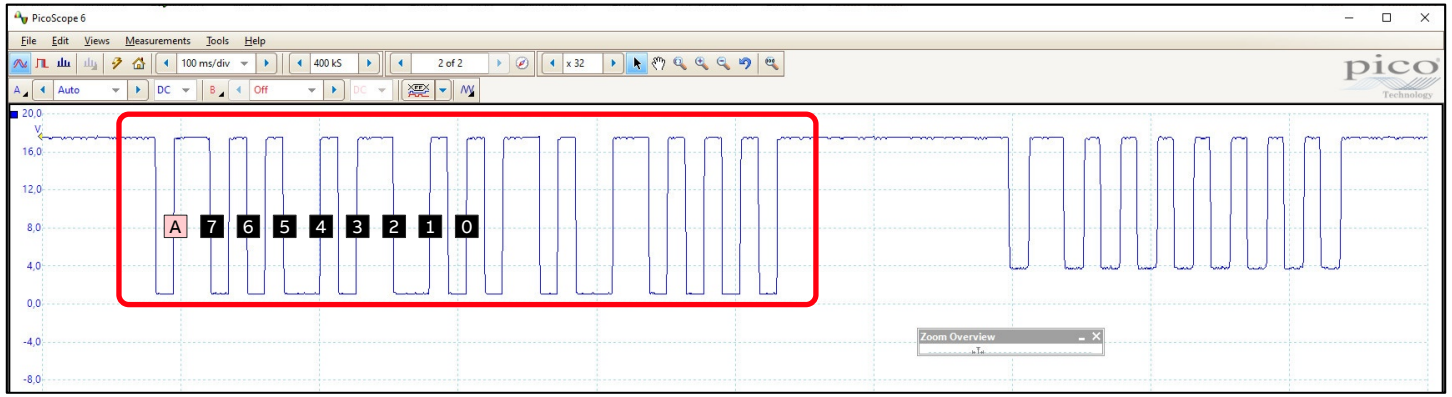
- They have one start bit (A), eight address bits (address byte) and eight data bits (data byte)
- More details: IEC 62386 Part 102: “General requirements – Control gear”
- The address byte is structured as follows:
  - The first address bit 7 defines “0” as a short address for individual devices or “1” for group or broadcast messages
  - The last address bit is the selector (S), which defines the following data byte with “0” as a direct arc power level or “1” as a command



Encoding of address byte

7	6	5	4	3	2	1	0	
0	64 short addresses						S	Short addressing
1	0	0	16 group addresses				S	Group addressing
1	1	1	1	1	1	0	S	Broadcast unaddressed
1	1	1	1	1	1	1	S	Broadcast addressed

KNX DALI Gateways – Practical knowledge about DALI – Part 2

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Diagnostic with an Oscilloscope

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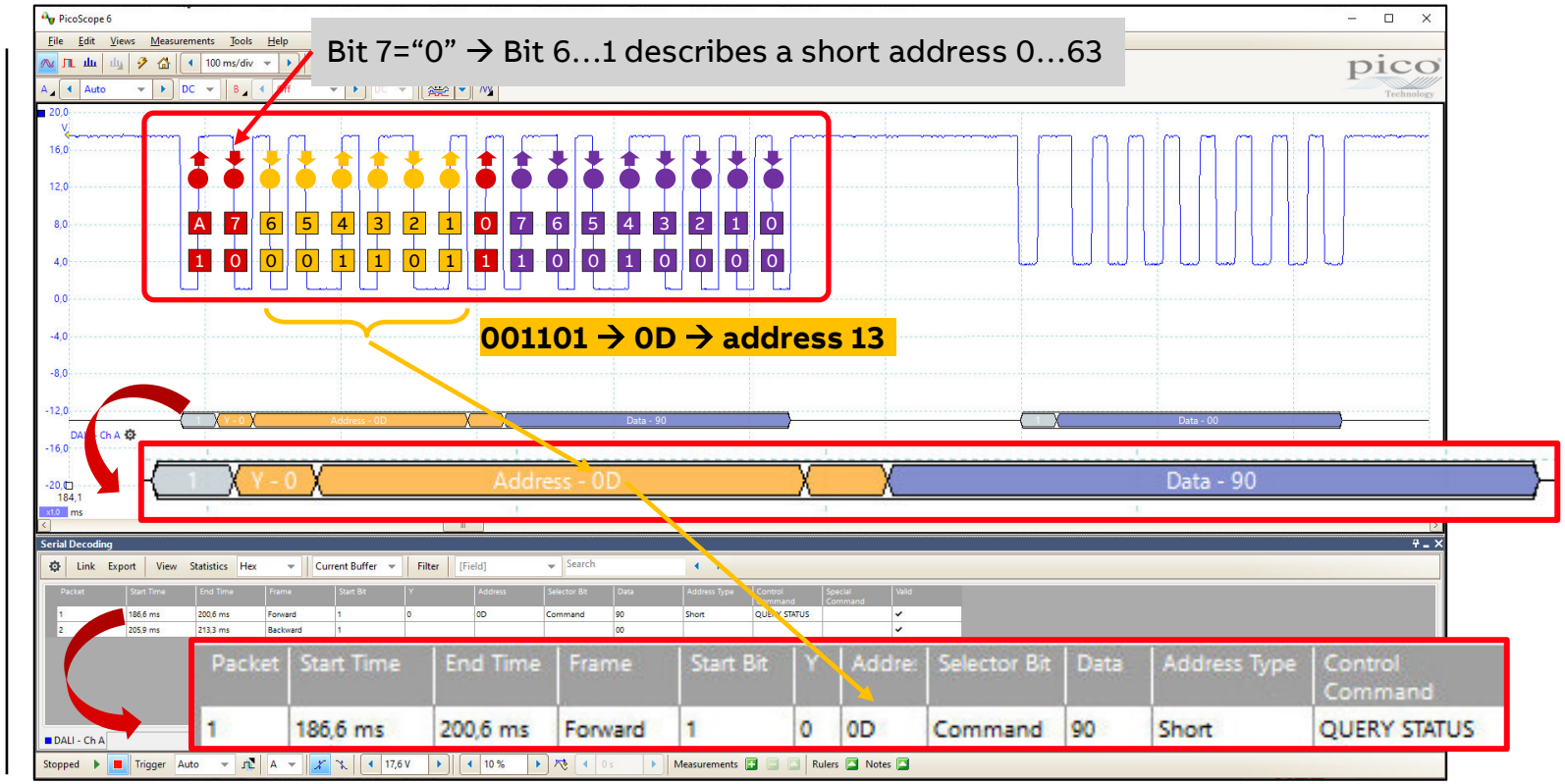

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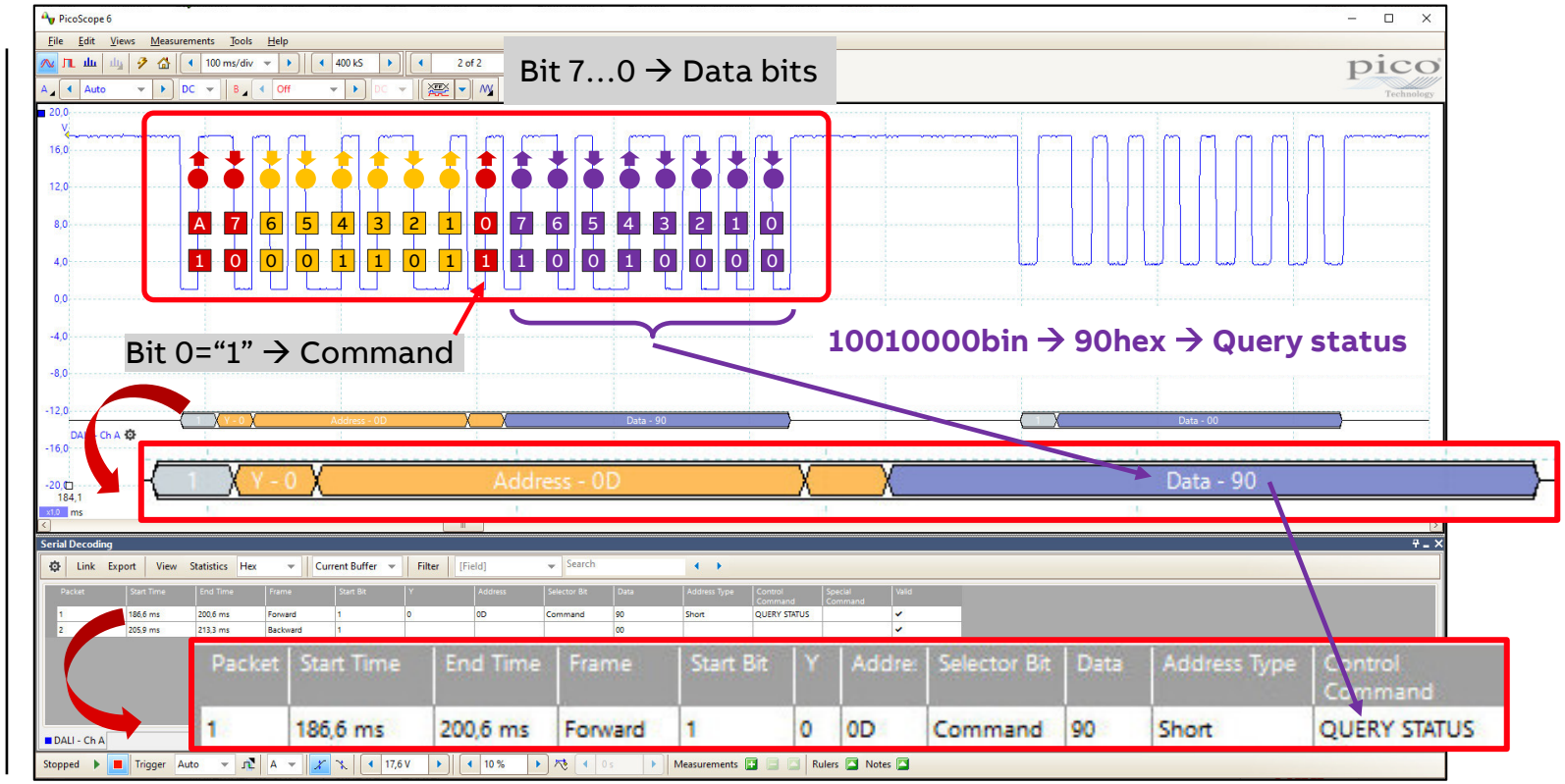
Online Learning Session

Diagnostic with an Oscilloscope

Forward frames

- Forward frames are packets sent by the DALI Gateway to the DALI devices (ballasts and emergency lighting converters)
- They have one start bit (A), eight address bits (address byte) and eight data bits (data byte)
- More details: IEC 62386 Part 102: “General requirements – Control gear”
- The data byte is structured as follows:
  - Direct arc power command (DAPC), the requested light output (0…100%)
  - Standard commands, e.g. query lamp failure (92hex), query missing short address (96hex), query status (90hex), query device type (99hex), query max level (A1hex), …



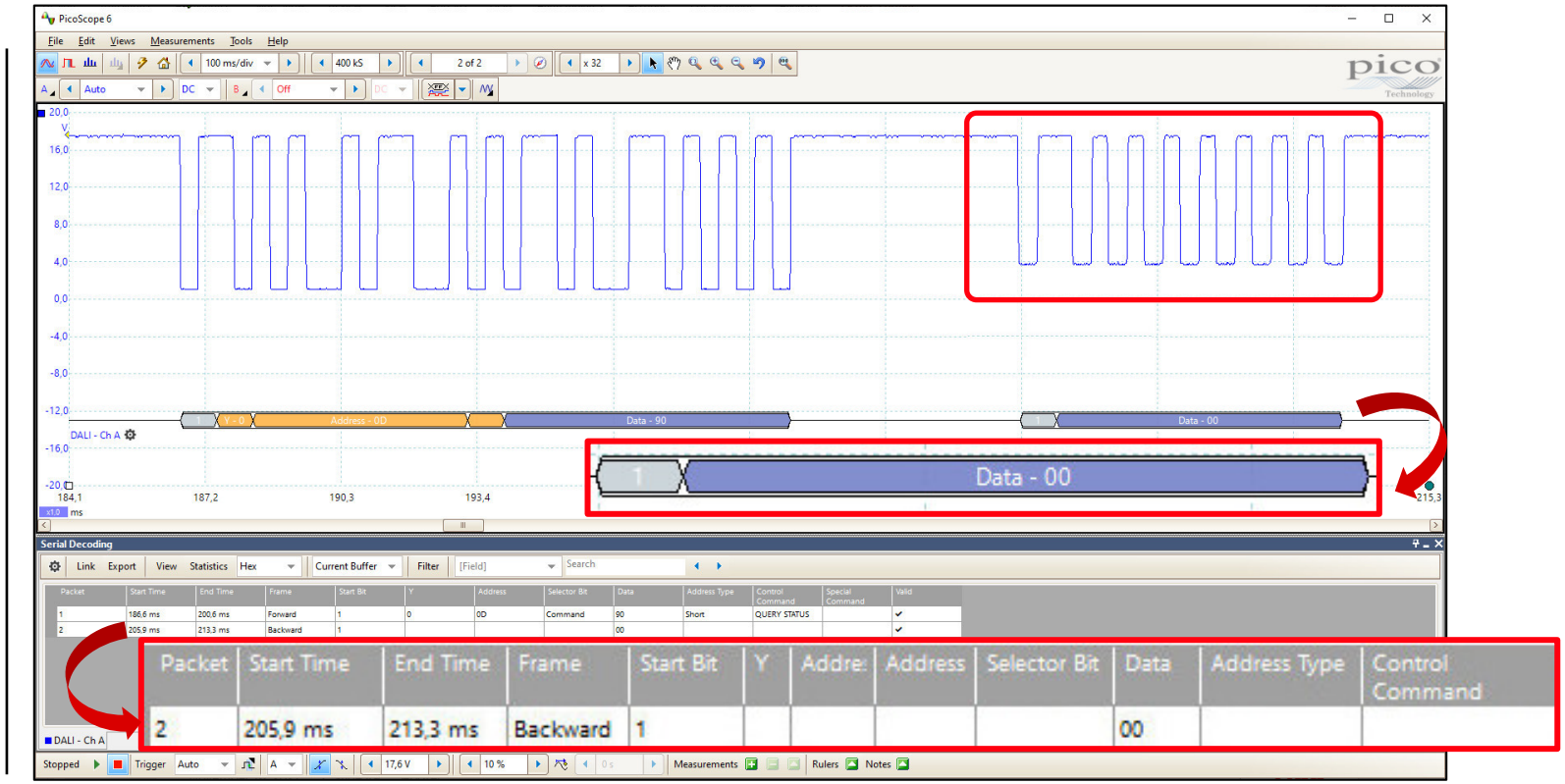
KNX DALI Gateways – Practical knowledge about DALI – Part 2

Online Learning Session

Diagnostic with an Oscilloscope

Backward frame

- A backward frame is the response packet sent by the DALI device back to the DALI Gateway
- It consists of one start bit (A) and eight data bits
- More details: IEC 62386 Part 102: “General requirements – Control gear”



KNX DALI Gateways – Practical knowledge about DALI – Part 2

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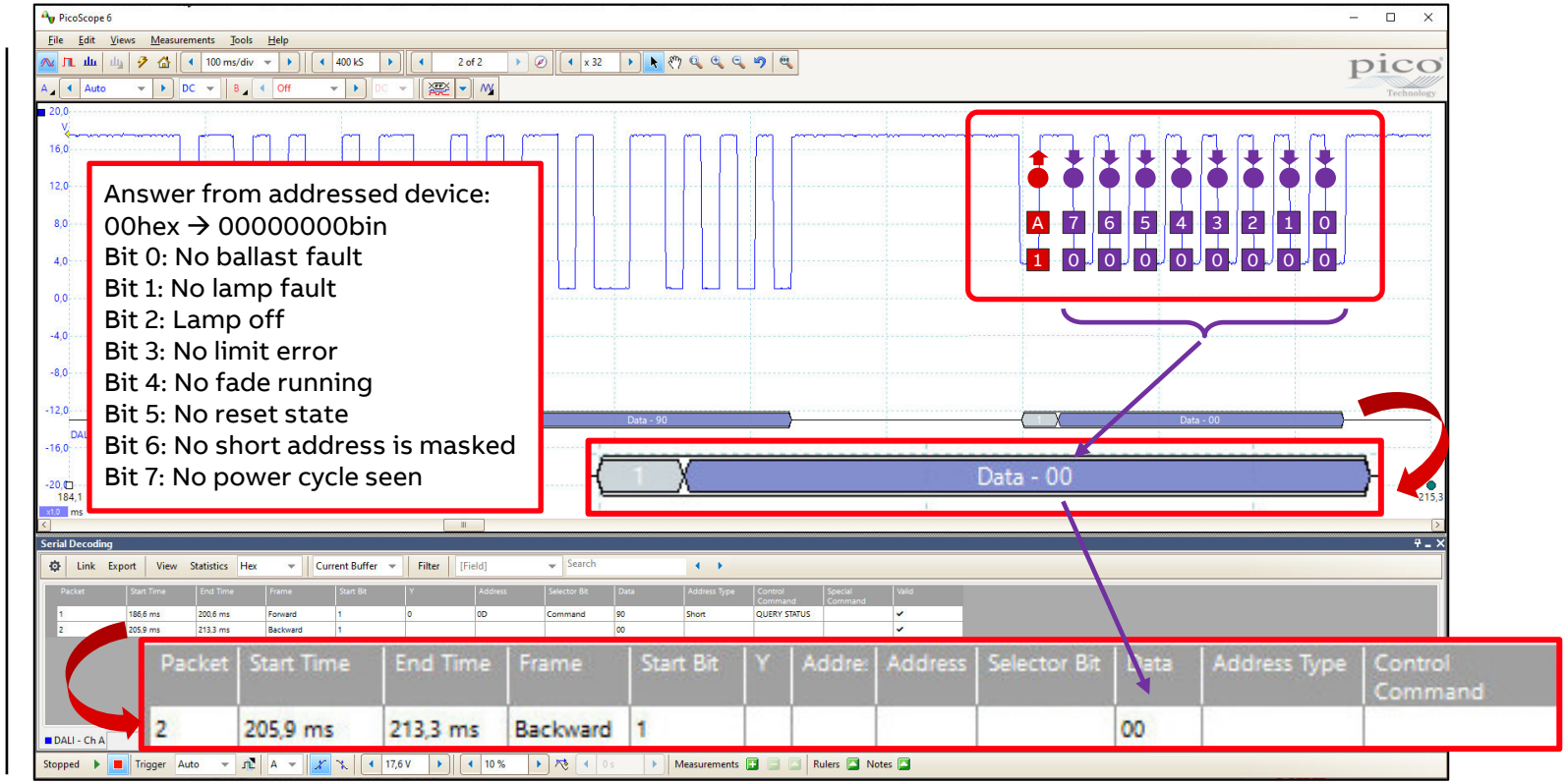
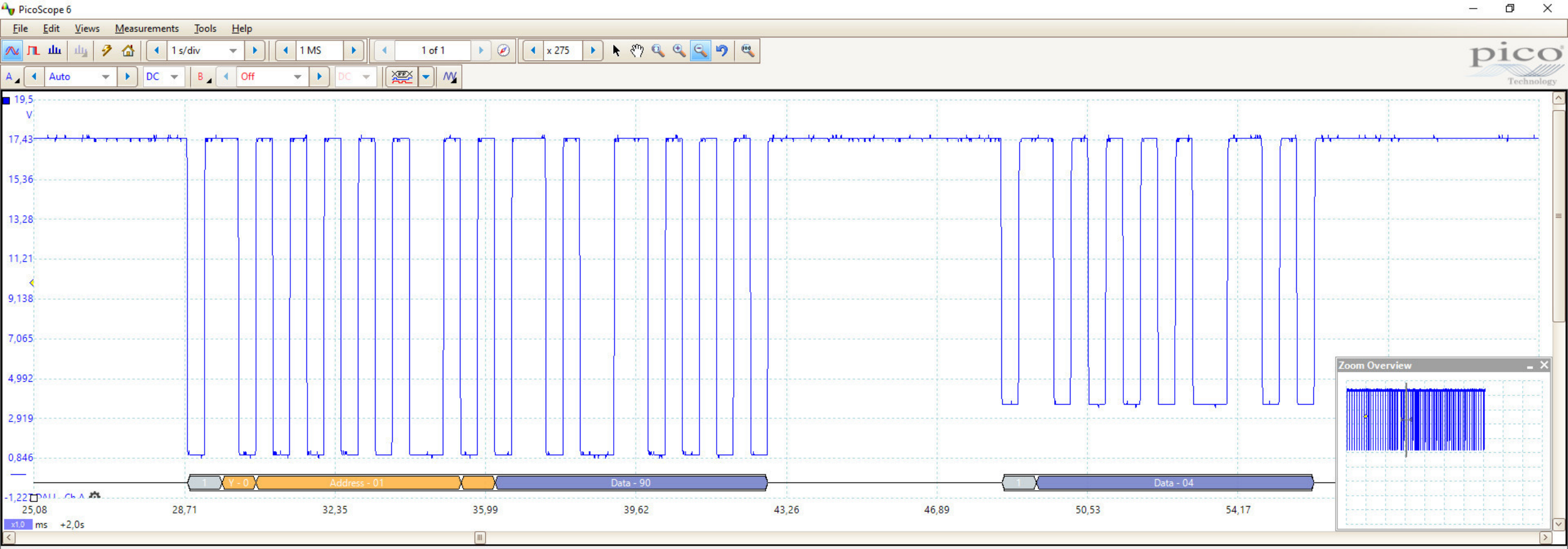
Diagnostic with an Oscilloscope

Backward frame

- A backward frame is the response packet sent by the DALI device back to the DALI Gateway
- It consists of one start bit (A) and eight data bits
- More details: IEC 62386 Part 102: “General requirements – Control gear”
- Example:
  The addressed DALI device “13” returns the queried property value (command “Query status 90hex”) in a backward frame with a status byte “00hex”





Serial Decoding

Link Export View Statistics Hex Current Buffer Filter [Field] Search

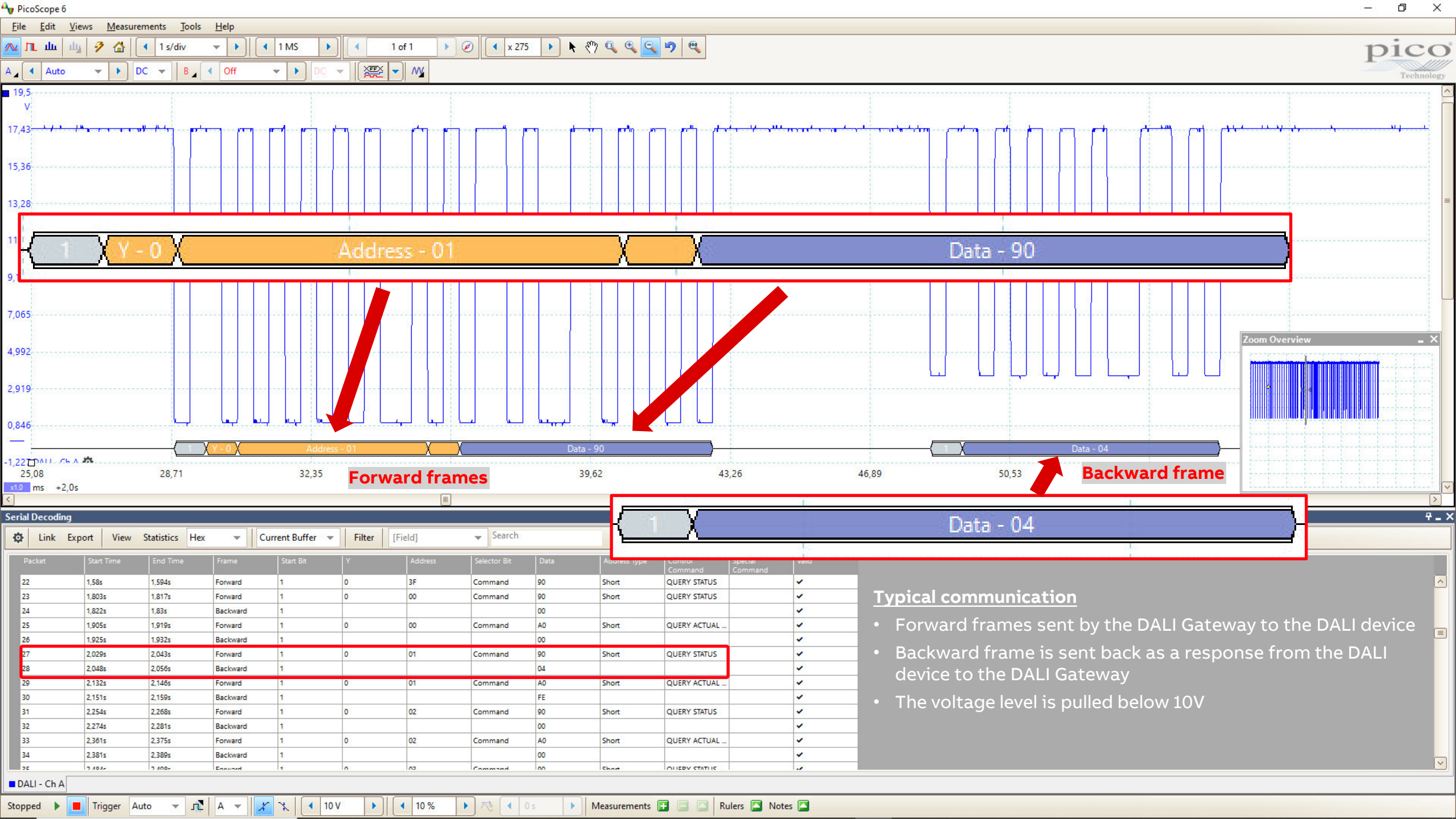
Packet	Start Time	End Time	Frame	Start Bit	Y	Address	Selector Bit	Data	Address Type	Control Command	Special Command	Valid
22	1,58s	1,594s	Forward	1	0	3F	Command	90	Short	QUERY STATUS		✔
23	1,803s	1,817s	Forward	1	0	00	Command	90	Short	QUERY STATUS		✔
24	1,822s	1,83s	Backward	1				00				✔
25	1,905s	1,919s	Forward	1	0	00	Command	A0	Short	QUERY ACTUAL ...		✔
26	1,925s	1,932s	Backward	1				00				✔
27	2,029s	2,043s	Forward	1	0	01	Command	90	Short	QUERY STATUS		✔
28	2,048s	2,056s	Backward	1				04				✔
29	2,132s	2,146s	Forward	1	0	01	Command	A0	Short	QUERY ACTUAL ...		✔
30	2,151s	2,159s	Backward	1				FE				✔
31	2,254s	2,268s	Forward	1	0	02	Command	90	Short	QUERY STATUS		✔
32	2,274s	2,281s	Backward	1				00				✔
33	2,361s	2,375s	Forward	1	0	02	Command	A0	Short	QUERY ACTUAL ...		✔
34	2,381s	2,389s	Backward	1				00				✔

Typical communication

- Forward frames sent by the DALI Gateway to the DALI device
- Backward frame is sent back as a response from the DALI device to the DALI Gateway
- The voltage level is pulled below 10V

DALI - Ch A

Stopped Trigger Auto A 10 V 10 % 0 s Measurements Rulers Notes


PicoScope 6
File Edit Views Measurements Tools Help
1 s/div
1 MS
1 of 1
x 275
Auto
DC
Off
19,5
17,43
15,36
13,28
7,065
4,992
2,919
0,846
1
Y - 0
Address - 01
Data - 90
Zoom Overview
25,08
28,71
32,35
39,62
43,26
46,89
50,53
Forward frames
Backward frame
Data - 04
Serial Decoding
Link Export View Statistics Hex Current Buffer Filter [Field] Search
Packet Start Time End Time Frame Start Bit Y Address Selector Bit Data Address Type Control Command Special Command Valid
22 1,58s 1,594s Forward 1 0 3F Command 90 Short QUERY STATUS
23 1,803s 1,817s Forward 1 0 00 Command 90 Short QUERY STATUS
24 1,822s 1,83s Backward 1 00
25 1,905s 1,919s Forward 1 0 00 Command A0 Short QUERY ACTUAL ...
26 1,925s 1,932s Backward 1 00
27 2,029s 2,043s Forward 1 0 01 Command 90 Short QUERY STATUS
28 2,048s 2,056s Backward 1 04
29 2,132s 2,146s Forward 1 0 01 Command A0 Short QUERY ACTUAL ...
30 2,151s 2,159s Backward 1 FE
31 2,254s 2,268s Forward 1 0 02 Command 90 Short QUERY STATUS
32 2,274s 2,281s Backward 1 00
33 2,361s 2,375s Forward 1 0 02 Command A0 Short QUERY ACTUAL ...
34 2,381s 2,389s Backward 1 00
Typical communication
• Forward frames sent by the DALI Gateway to the DALI device
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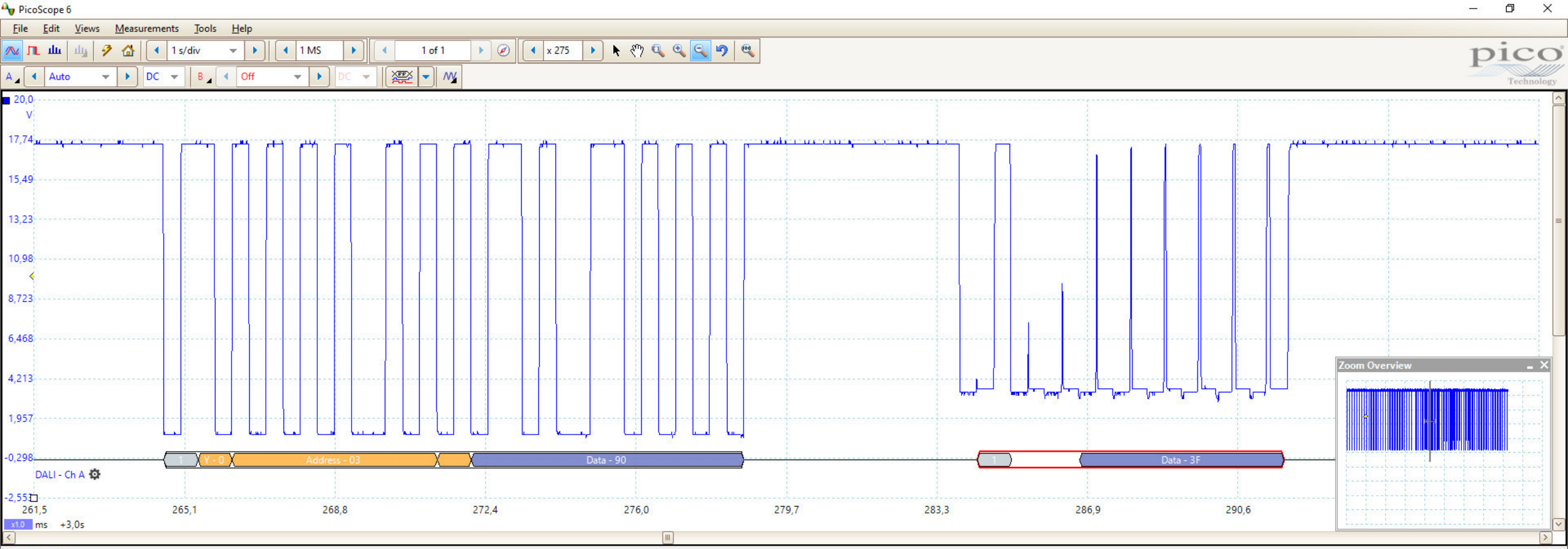
DALI - Ch A
Stopped Trigger Auto A 10 V 10 % Measurements Rulers Notes



Serial Decoding

Link Export View Statistics Hex Current Buffer Filter [Field] Search

Packet	Start Time	End Time	Frame	Start Bit	Y	Address	Selector Bit	Data	Address Type	Control Command	Special Command	Valid
40	3,12s	3,127s	Backward	1				00				✔
41	3,221s	3,235s	Forward	1	0	03	Command	90	Short	QUERY STATUS		✔
42	3,284s	3,292s	Invalid	1				3F				✗
43	3,265s	3,279s	Forward	1	0	03	Command	90	Short	QUERY STATUS		✔
44	3,284s	3,292s	Invalid	1				3F				✗
45	3,308s	3,322s	Forward	1	0	03	Command	90	Short	QUERY STATUS		✔
46	3,328s	3,335s	Invalid	1				3F				✗
47	3,352s	3,366s	Forward	1	0	03	Command	90	Short	QUERY STATUS		✔
48	3,372s	3,379s	Invalid	1				1F				✗
49	3,4s	3,414s	Forward	1	0	04	Command	90	Short	QUERY STATUS		✔
50	3,419s	3,427s	Backward	1				00				✔
51	3,499s	3,513s	Forward	1	0	04	Command	A0	Short	QUERY ACTUAL ...		✔
52	3,519s	3,526s	Backward	1				00				✔

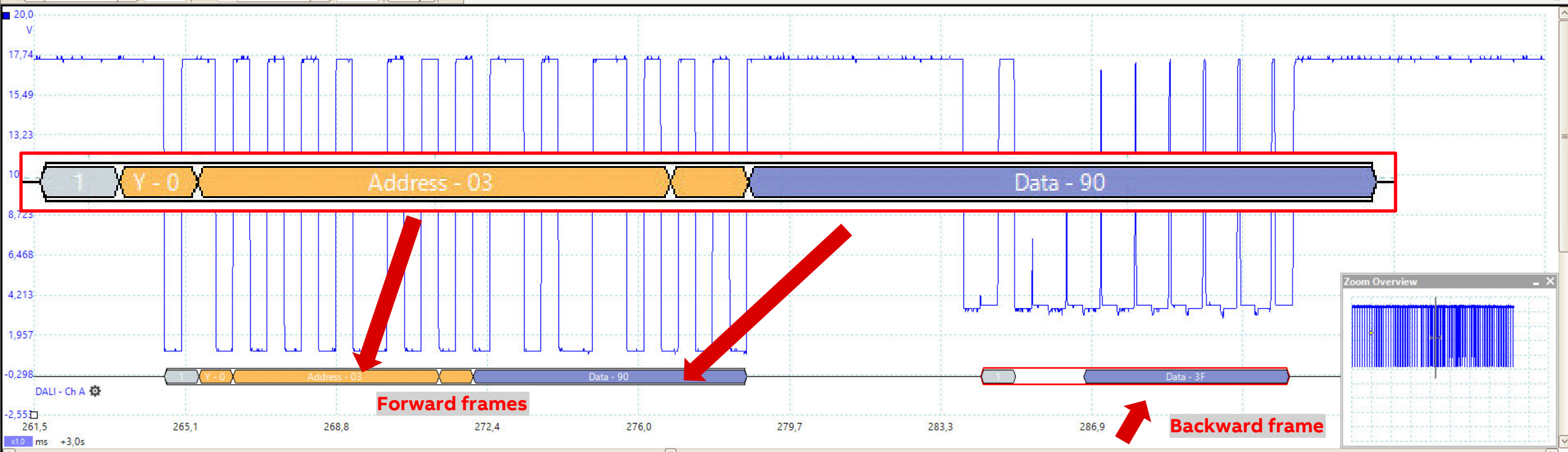
Framing error

- Forward frames sent by the DALI Gateway to the DALI device
- No clear DALI telegram is received
- Several DALI devices reply and their superimposed telegrams result in an unidentifiable DALI telegram being received

→ DALI double addresses of device 4 (address 03)

PicoScope 6

File Edit Views Measurements Tools Help



Serial Decoding

Link Export View Statistics Hex Current Buffer Filter [Field] Search

Packet	Start Time	End Time	Frame	Start Bit	Y	Address	Selector Bit	Data	Address Type	Control Command	Special Command	Valid
40	3,12s	3,127s	Backward	1				00				✓
41	3,221s	3,235s	Forward	1	0	03	Command	90	Short	QUERY STATUS		✓
42	3,284s	3,292s	Invalid	1				3F				✗
43	3,265s	3,279s	Forward	1	0	03	Command	90	Short	QUERY STATUS		✓
44	3,284s	3,292s	Invalid	1				3F				✗
45	3,308s	3,322s	Forward	1	0	03	Command	90	Short	QUERY STATUS		✓
46	3,328s	3,335s	Invalid	1				3F				✗
47	3,352s	3,366s	Forward	1	0	03	Command	90	Short	QUERY STATUS		✓
48	3,372s	3,379s	Invalid	1				1F				✗
49	3,4s	3,414s	Forward	1	0	04	Command	90	Short	QUERY STATUS		✓
50	3,419s	3,427s	Backward	1				00				✓
51	3,499s	3,513s	Forward	1	0	04	Command	A0	Short	QUERY ACTUAL ...		✓
52	3,519s	3,526s	Backward	1				00				✓

Framing error

- Forward frames sent by the DALI Gateway to the DALI device
- No clear DALI telegram is received
- Several DALI devices reply and their superimposed telegrams result in an unidentifiable DALI telegram being received

→ DALI double addresses of device 4 (address 03)

DALI - Ch A

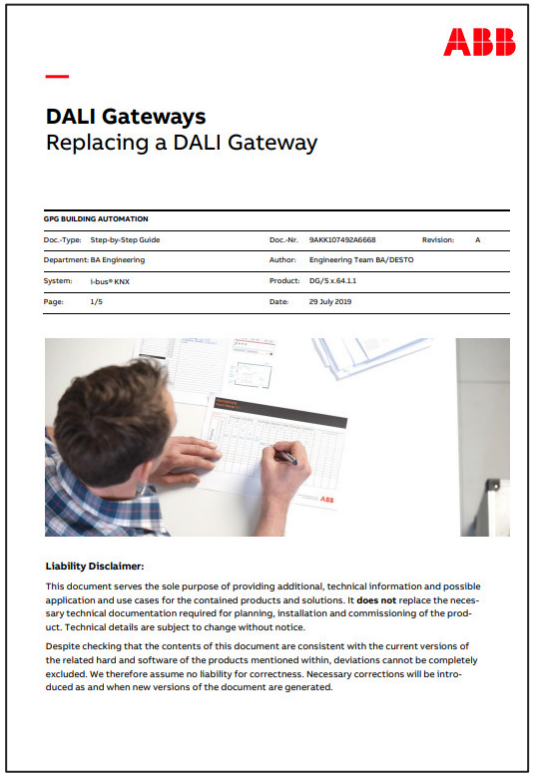
Stopped Trigger Auto A 10 V 10 % 0 s Measurements Rulers Notes

KNX DALI Gateways – Practical knowledge about DALI – Part 2

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



KNX DALI Gateways – Practical knowledge about DALI – Part 2

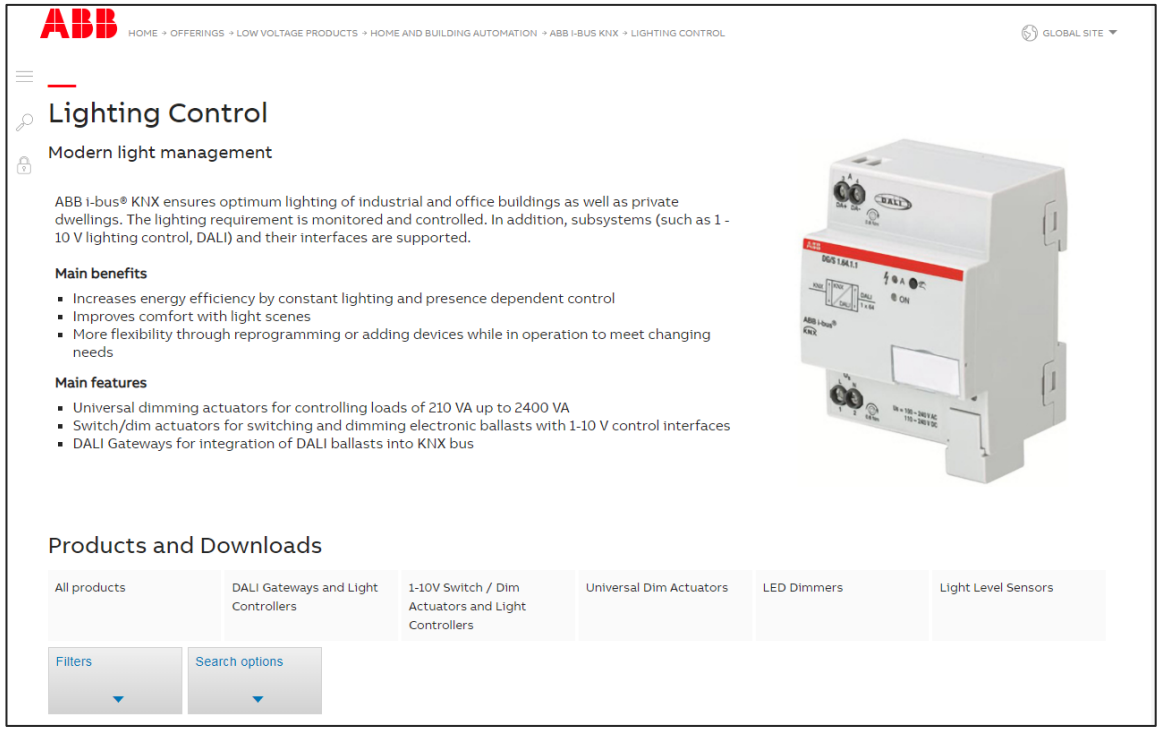
Online Learning Session

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
- …



KNX DALI Gateways – Practical knowledge about DALI – Part 2

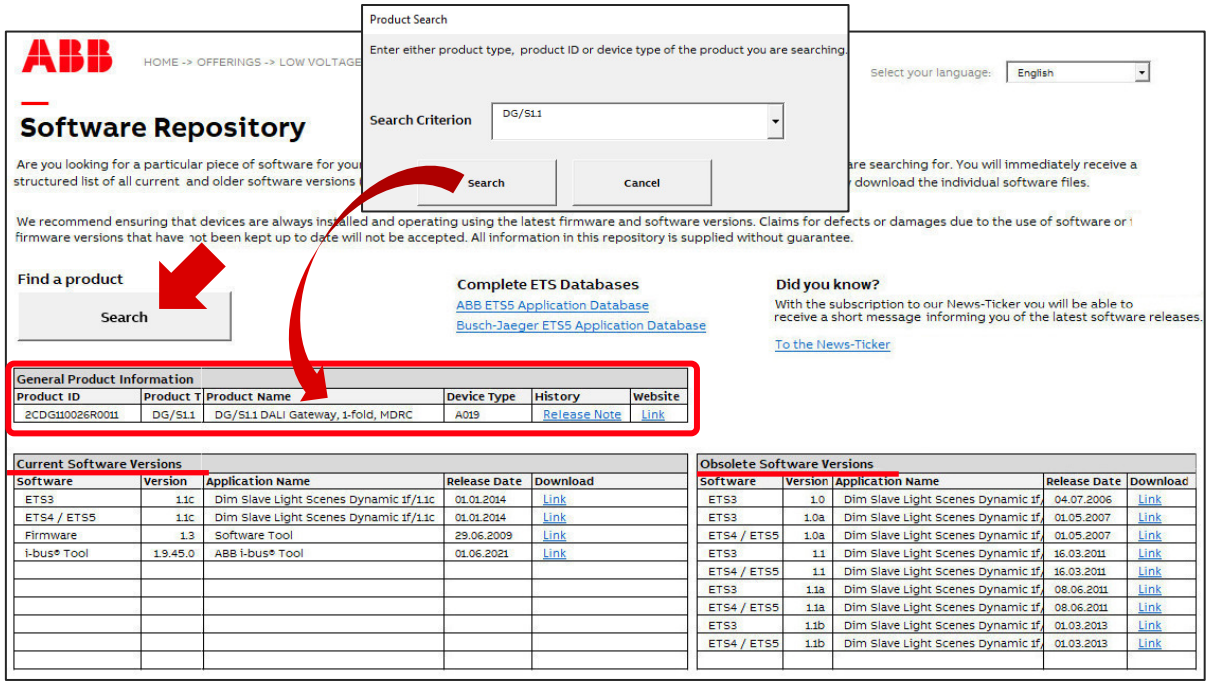
Online Learning Session

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



KNX DALI Gateways – Practical knowledge about DALI – Part 2

Online Learning Session

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

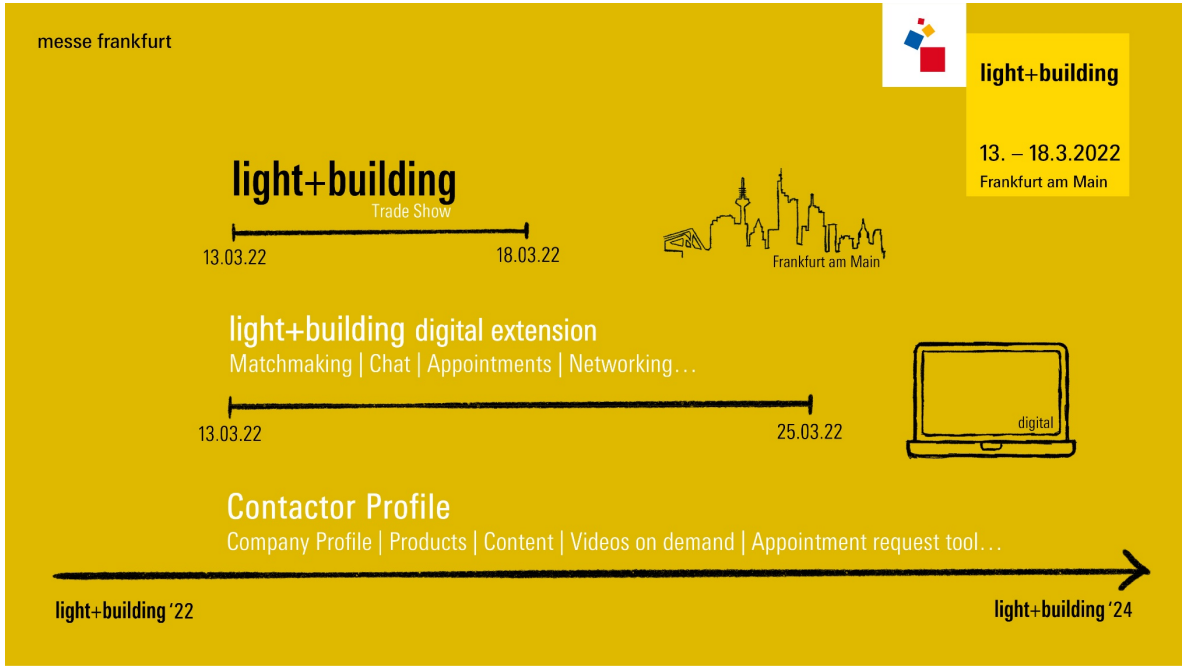
KNX DALI Gateways – Practical knowledge about DALI – Part 2

Online Learning Session

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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