

## Application note CODESYS Control SL and DALI

DALI-Aktoren via DALI-BACnet - Gateway MBS UGW

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## 1 Introduction

CODESYS is an automation platform based on a development interface under Windows and runtime environments for customer-specific or standard devices such as PCs or boards with ARM/Linux. The engineering of applications is carried out according to the international standard IEC 61131-3 and can also be used for tasks in building automation.

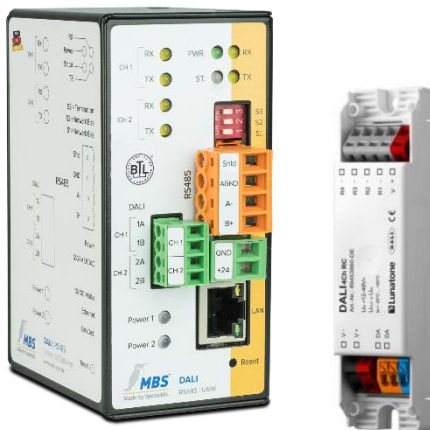
DALI is a fieldbus for controlling lighting control gear such as power supplies for combinational circuits or dimmers. The transmission takes place serially on a two-wire line with polarity reversal protection in almost any topology.

BACnet is one of the most important communication protocols in the field of building automation. The product CODESYS BACnet SL expands the functionality of a PLC by adding the possibility to implement applications in the field of building automation in compliance with ANSI/ASHRAE Standard 135-2012, directly integrated into the CODESYS Development System.

CODESYS BACnet SL can be licensed for PLCs with CODESYS Control SL and is available in the CODESYS Store: <https://store.codesys.com/codesys-bacnet-sl.html>.: <https://store.codesys.com/codesys-bacnet-sl.html>.

The integration of DALI operating devices with CODESYS Control SL can be implemented effortlessly using a DALI / BACnet IP gateway.

This example demonstrates an integration of DALI control gear with a product of MBS GmbH, the "UGW Double-X DALI" (<https://www.mbs-solutions.de/dali>) and a 4-channel relay controller from Lunatone Industrielle Elektronik GmbH (<https://www.lunatone.com/produkt/dali-4ch-rc>) .



## 2 Important features of the MBS "Universal Gateway" UGW Double-X DALI

The MBS "Universal Gateway" UGW Double-X DALI maps DALI data points as BACnet server objects. Important features of the UGW Double-X DALI are:

- Integrated web server for configuration and analysis
- Autoconfig for DALI according to BACnet
- 25 - 2,500 data points
- No moving parts like fans or the like

## 3 Basic steps for integration

The following steps are necessary for an integration:

1. Installation of the DALI operating devices
2. Addressing of the DALI operating devices
3. Configuration of the DALI BACnet gateway
4. Integration of BACnet data points (of the DALI operating devices and of the DALI BACnet gateway if necessary) in the application

### 3.1 Installation of the DALI operating devices

Connection elements (plugs) and wiring for DALI are not standardized, but wiring is generally unproblematic.

Important aspects:

- A special DALI bus supply is necessary
- The polarity of the DALI bus wiring does not need to be observed.
- Different topologies are possible: star, tree, and line wiring.
- Limited number of DALI devices in one bus (max. 64)

### 3.2 Addressing the DALI operating devices

When delivered, DALI control gears usually only respond to broadcast commands. The DALI devices used must therefore be initially addressed for many applications. Each DALI control gear is assigned a unique short address.

### 3.3 Configuration of the DALI-BACnet gateway

The DALI BACnet Gateway maps the data points of the DALI control gear as BACnet (server) objects. A DALI control gear usually has a smaller number of data points (5 to 10), not all of which are necessarily relevant for the application. Furthermore, larger numbers of DALI control gears tend to be installed in a plant / installation. Therefore, a manual configuration of the mapping of DALI control gear data points to BACnet objects is usually too time-consuming and also rarely necessary. A DALI-BACnet gateway should therefore provide a DALI bus device scan and easy-to-use mapping rules from DALI data points to BACnet objects.

### 3.4 Integration of BACnet data points into the application

Data points of the DALI operating devices and the DALI-BACnet gateway are represented as BACnet (server) objects (of the gateway). The properties of these objects can be read or written with the CODESYS BACnet function blocks BACnetClientReadProperty and BACnetClientWriteProperty. BACnet COV/event subscriptions and any device discovery that may be required can also be performed using CODESYS BACnet function blocks.

## 4 Specific integration steps based on the example

### 4.1 Installation of the DALI control gear based on the example

In the example, the following devices are wired to the DALI bus:

- Lunatone DALI 4Ch RC
- Lunatone DALI PS24 100mA (DALI bus supply)
- MBS UGW Double-X DALI

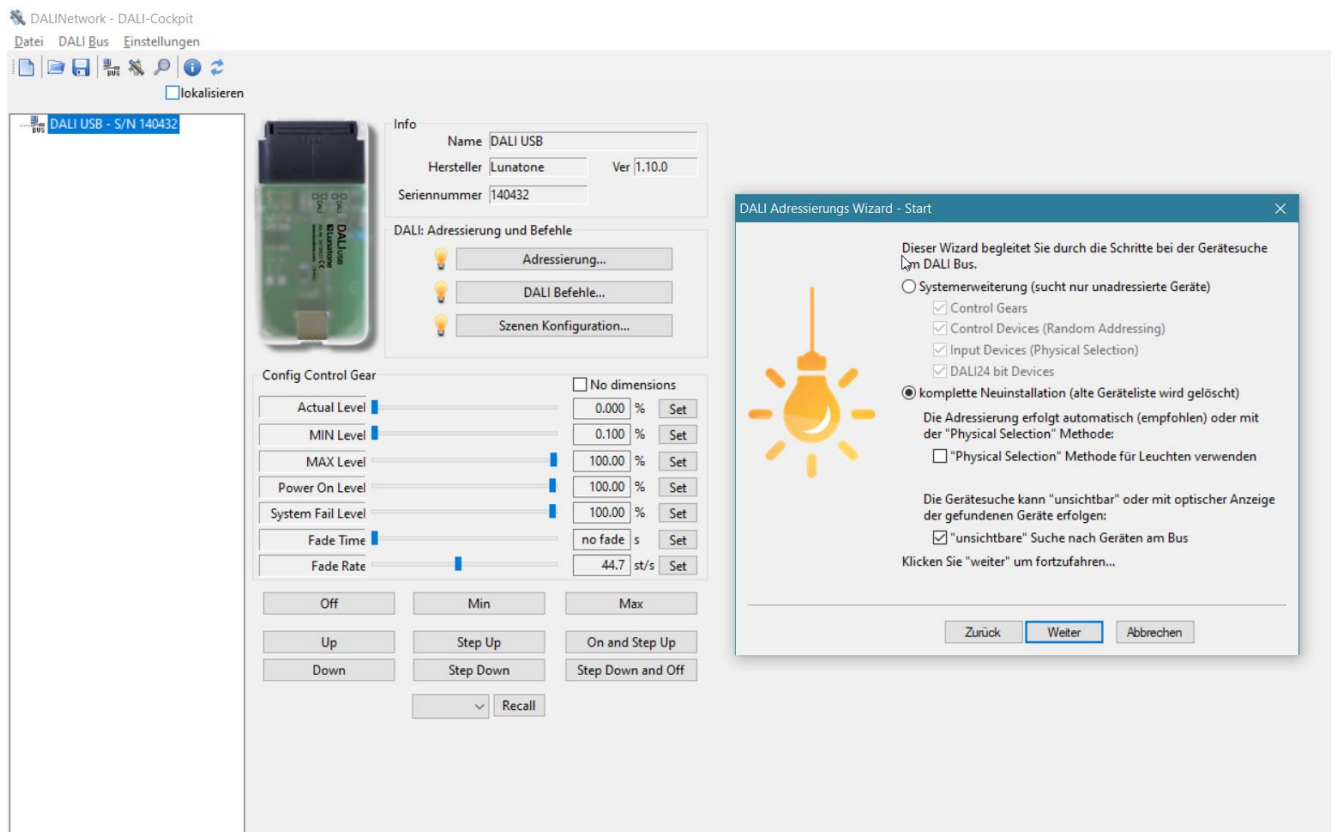
The MBS UGW Double-X DALI and the DALI bus are supplied with a suitable operating voltage - in this case 24V.

### 4.2 Addressing the DALI control gear based on the example

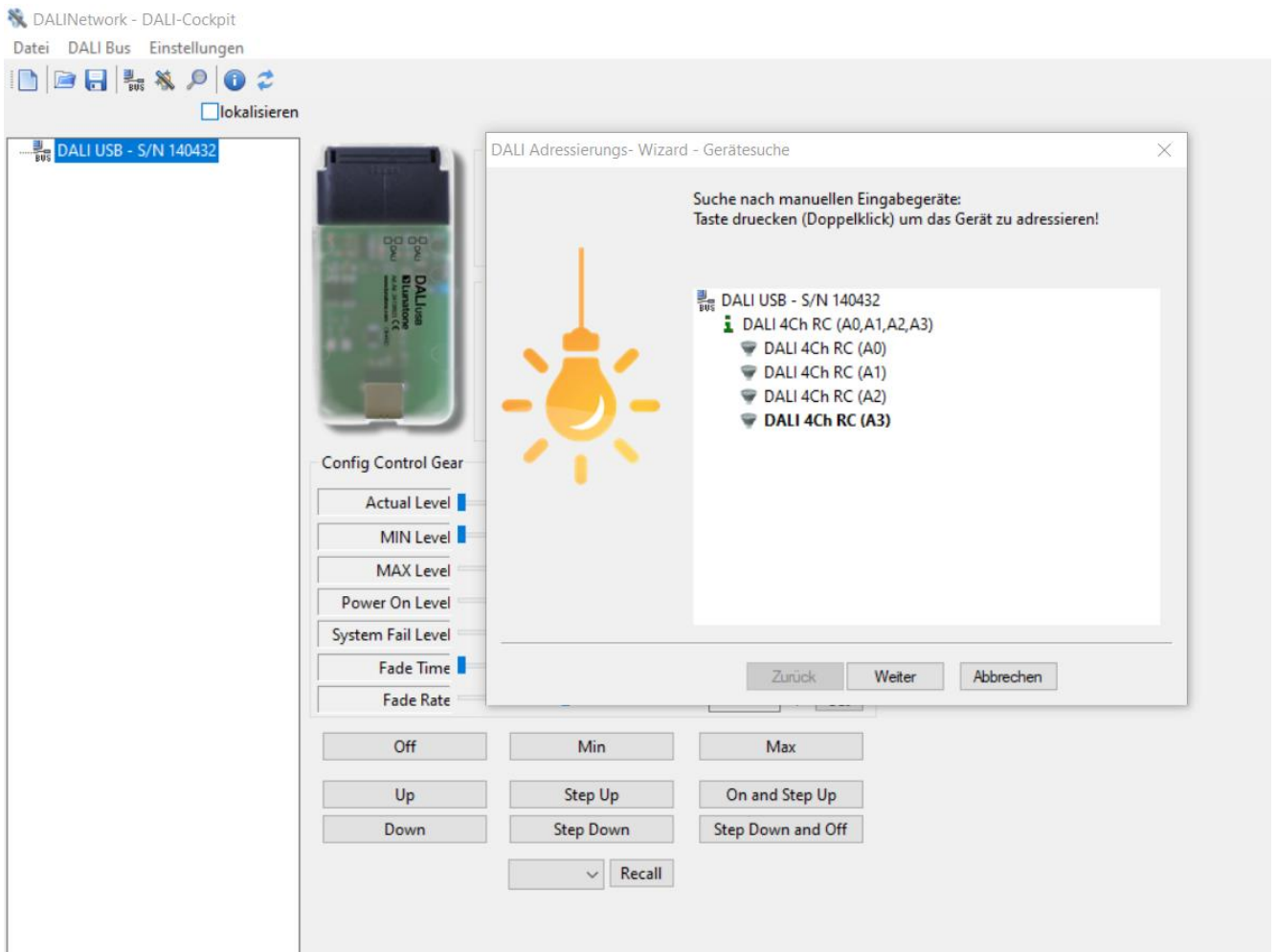
The initial addressing of the DALI control gear can be performed either with a manufacturer-specific software and a DALI USB adapter or directly with the DALI / BACnet IP Gateway.

#### 4.2.1 Addressing the DALI control gear with manufacturer-specific software

In the example, Lunatone DALI Cockpit (<https://www.lunatone.com/produkt-kategorie/software/dali-cockpit/>) and Lunatone DALI USB (<https://www.lunatone.com/produkt-kategorie/interfaces-und-tools/dali-usb/>) are used for addressing.



A distinction can be made between a new installation and a system expansion.  
The DALI bus is searched for DALI operating devices which are assigned a short address.




For the used DALI control gear Lunatone DALI 4Ch RC (or its four channels), four short addresses are assigned. The project information can be saved in a file if required.


#### 4.2.2 Addressing the DALI control gear with the DALI / BACnet IP Gateway

In order to carry out the addressing of the DALI operating devices with the DALI / BACnet IP gateway, the IP network configuration of the gateway must first be defined. The "UGW Double-X DALI" can be accessed in the delivery state via the following specifications:

- IP-Adresse 169.254.0.1
- Subnet mask 255.255.0.0
- User name gw
- Password GATEWAY

After successful login, the IP network configuration of the gateway can be adjusted accordingly.




**MBS Universal Gateway | UGW**  
 General    UGW    BACnet    DALI    Help    User: gw    

---

**General**

- Overview
- Details
- IP-Network
- System time
- Dropbox
- Web-Services
- E-Mail
- User
- Backup/Restore
- Update
- Restart

**IP network settings** Last Refresh: 2021/01/27 11:50:34 

Network adapter LAN1

|              |  |  |  |
|--------------|--|--|--|
| MAC address: | 00:1F:25:04:38:A5                          |  |  |
| IP address:  | <input type="text" value="192.168.1.52"/>  |  |  |
| Netmask:     | <input type="text" value="255.255.255.0"/> |  |  |

Default gateway

|          |  |                                       |
|----------|--|---------------------------------------|
| Gateway: | <input type="text" value="192.168.1.1"/> | <input type="button" value="Delete"/> |
|----------|--|---------------------------------------|

Advanced IP-Routing

| Nr.                                | IP | Netmask | Gateway | Adapter | Edit |
|------------------------------------|----|---------|---------|---------|------|
| <input type="button" value="Add"/> |    |         |         |         |      |

Network name info

|               |   |  |  |
|---------------|---|--|--|
| Hostname:     | <input type="text" value="MBS-UGW-DALI"/> |  |  |
| Nameserver 1: | <input type="text"/>                      |  |  |
| Nameserver 2: | <input type="text"/>                      |  |  |

Services

|                    |   |                         |                                       |
|--------------------|---|-------------------------|---------------------------------------|
| Webserver access:  | <input type="text" value="https (80 redirected to 443)"/> |                         |                                       |
| HTTPS Certificate: | <input type="button" value="Durchsuchen..."/>             | Keine Datei ausgewählt. | <input type="button" value="Upload"/> |
| SSH:               | Off <input checked="" type="checkbox"/> On                |                         |                                       |

Subsequently, the "DALI Bus Configurator" of the gateway can be used to address the DALI control gears.

The screenshot shows the MBS Universal Gateway web interface. The top navigation bar includes the MBS logo, menu items (General, UGW, BACnet, DALI, Help), and user information (User: gw, language flags, and a refresh button). The main content area is titled "1300 - DALI Bus Configurator" and shows the "Configuration settings" section. It prompts the user to select DALI channels for initializing. The "DALI-Channel" section has checkboxes for channel 1 and 2, both of which are checked. The "Initialize" section has radio buttons for "Unaddressed devices" and "All devices", with "All devices" selected. An "Initialize" button is visible below these options. A "Configuration control gears" section is partially visible at the bottom.

The screenshot shows the MBS Universal Gateway web interface, specifically the "Configuration control gears" section. It displays a table for setting groups/scenes for the control gears. The table has columns for Status, Channel, Address, Type, Scene/Group Settings, and Advanced Settings. There are four rows of data, all with a status of "Online" and "not supported" in the Scene/Group Settings column. The table is filtered by "Channel" and shows a total device count of 4. There are navigation buttons for page size (20) and filter options.

| Status | Channel | Address | Type           | Scene/Group Settings | Advanced Settings |
|--------|---------|---------|----------------|----------------------|-------------------|
| Online | 1       | 0       | Switching func | not supported        |                   |
| Online | 1       | 1       | Switching func | not supported        |                   |
| Online | 1       | 2       | Switching func | not supported        |                   |
| Online | 1       | 3       | Switching func | not supported        |                   |

Again, four short addresses are assigned to the used DALI operating device Lunatone DALI 4Ch RC (more precisely, its four channels).


### 4.3 Configuration of the DALI-BACnet gateway based on the example

The following steps are then performed:

- Selection of the DALI operating devices found
- Selection of the data points of the DALI operating devices
- Definition of the mapping rule DALI data points → BACnet objects



### Selection of the DALI operating devices found



General
UGW
BACnet
DALI
Help

MBS Universal Gateway | UGW

User: gw

**DALI**

- Status
- Settings
- DALI-Bus Configurator
- Gateway Configurator
- Files

#### 1300 – DALI Gateway Configurator

▸ Scan settings

▾ Scan result - select control gears

**List of control gears**

←
Page size: 20
Total Device Count: 5
Filter Channel: --
→

| Use                                 | Channel | Address   | Device type        | Info |
|-------------------------------------|---------|-----------|--------------------|------|
| <input type="checkbox"/>            | 1       | 0         | Switching function |      |
| <input type="checkbox"/>            | 1       | 1         | Switching function |      |
| <input type="checkbox"/>            | 1       | 2         | Switching function |      |
| <input type="checkbox"/>            | 1       | 3         | Switching function |      |
| <input checked="" type="checkbox"/> | 1       | broadcast | Switching function |      |


Delete scan result

▸ Scan result - select datapoints

▸ Generate configuration

Last Refresh: 2021/01/27 12:05:11

### Selection of the data points of the DALI operating devices



General
UGW
BACnet
DALI
Help

MBS Universal Gateway | UGW

User: gw

**DALI**

- Status
- Settings
- DALI-Bus Configurator
- Gateway Configurator
- Files

#### List of datapoints

←
Page size: 20
Datapoints Count: 31
Filter Channel: --
→

| Use                                 | Channel | Address                   | Datapoint name                             |
|-------------------------------------|---------|---------------------------|--|
| <input checked="" type="checkbox"/> | 1       | 1 gearshort 0 switch      | (Switch) Channel:1 Address:0               |
| <input checked="" type="checkbox"/> | 1       | 1 gearshort 0 level       | (Actual level) Channel:1 Address:0         |
| <input checked="" type="checkbox"/> | 1       | 1 gearshort 0 scene       | (Goto scene) Channel:1 Address:0           |
| <input checked="" type="checkbox"/> | 1       | 1 gearshort 0 gearfailure | (Control gear failure) Channel:1 Address:0 |
| <input checked="" type="checkbox"/> | 1       | 1 gearshort 0 lampfailure | (Lamp failure) Channel:1 Address:0         |
| <input checked="" type="checkbox"/> | 1       | 1 gearshort 0 failure     | (failure) Channel:1 Address:0              |
| <input checked="" type="checkbox"/> | 1       | 1 gearshort 0 lampon      | (Lamp On) Channel:1 Address:0              |
| <input checked="" type="checkbox"/> | 1       | 1 gearshort 1 switch      | (Switch) Channel:1 Address:1               |
| <input checked="" type="checkbox"/> | 1       | 1 gearshort 1 level       | (Actual level) Channel:1 Address:1         |
| <input checked="" type="checkbox"/> | 1       | 1 gearshort 1 scene       | (Goto scene) Channel:1 Address:1           |
| <input checked="" type="checkbox"/> | 1       | 1 gearshort 1 gearfailure | (Control gear failure) Channel:1 Address:1 |
| <input checked="" type="checkbox"/> | 1       | 1 gearshort 1 lampfailure | (Lamp failure) Channel:1 Address:1         |
| <input checked="" type="checkbox"/> | 1       | 1 gearshort 1 failure     | (failure) Channel:1 Address:1              |
| <input checked="" type="checkbox"/> | 1       | 1 gearshort 1 lampon      | (Lamp On) Channel:1 Address:1              |
| <input checked="" type="checkbox"/> | 1       | 1 gearshort 2 switch      | (Switch) Channel:1 Address:2               |
| <input checked="" type="checkbox"/> | 1       | 1 gearshort 2 level       | (Actual level) Channel:1 Address:2         |
| <input checked="" type="checkbox"/> | 1       | 1 gearshort 2 scene       | (Goto scene) Channel:1 Address:2           |
| <input checked="" type="checkbox"/> | 1       | 1 gearshort 2 gearfailure | (Control gear failure) Channel:1 Address:2 |
| <input checked="" type="checkbox"/> | 1       | 1 gearshort 2 lampfailure | (Lamp failure) Channel:1 Address:2         |
| <input checked="" type="checkbox"/> | 1       | 1 gearshort 2 failure     | (failure) Channel:1 Address:2              |

## Generation of BACnet data points

MBS Universal Gateway | UGW  
User: gw

General UGW BACnet DALI Help

Restart required!

**DALI**

- Status
- Settings
- DALI-Bus Configurator
- Gateway Configurator**
- Files

**1300 – DALI Gateway Configurator** Last Refresh: 2021/01/27 12:08:25

Scan settings

Scan result - select control gears

Scan result - select datapoints

**Generate configuration**

The last step will generate the DALI configuration files.

Generate complete configuration, delete previous configuration  
 Add only new datapoints

**BACnet Configuration**

Generate BACnet objects  
 with priority array

**Generate**

This creates a correct configuration of the "UGW Double-X DALI". To activate this configuration, the gateway must be restarted.

MBS Universal Gateway | UGW  
User: gw

General UGW BACnet DALI Help

Restart required!

**General**

- Overview**
- Details
- IP-Network
- System time
- Dropbox
- Web-Services
- E-Mail
- User
- Backup/Restore
- Update
- Restart

**UGW Restart** Last Refresh: 2021/01/27 12:10:25

Configuration check Restart Gateway

The current Universal Gateway configuration was checked.

The configuration OK.

0 Errors 0 Warnings

**Next** **Cancel**

|        |      |      |        |               |
|--------|------|------|--------|---------------|
| Online | 940  | bac  | BACnet |               |
| Online | 1300 | dali | DALI   | intern (COM3) |

Afterwards, the gateway can be found as a BACnet device in the BACnet network.

The screenshot displays the BACeye software interface. On the left, a table lists discovered devices:

| Netz | Inst.-Nr. | Gerätename | Beschreibung        |
|------|-----------|------------|---------------------|
| 0    | 0         | BACeye     | BACeye MBS GmbH     |
| 0    | 2000      | UGW        | UGW-C Client/Server |

The right pane shows the details for 'Device 2000':

- BACnet ID: 2000
- Device Name: UGW
- BACnet MAC: COA80134BAC0 => 192.168.1.52:47808
- Beschreibung: UGW-C Client/Server
- Manufacturer: MBS GmbH Krefeld

The 'Objekte' table lists various BACnet objects:

| Obj. Type | Inst.-Nr | Present Value | Objekt Name                   | Description                                |
|-----------|----------|---------------|-------------------------------|--|
| MV        | 2030     | 1             | Broadcast (Goto scene) Char   | Broadcast (Goto scene) Channel:1           |
| MV        | 2023     | ----          | (Goto scene) Channel:1 Addi   | (Goto scene) Channel:1 Address:3           |
| MV        | 2016     | ----          | (Goto scene) Channel:1 Addi   | (Goto scene) Channel:1 Address:2           |
| MV        | 2009     | ----          | (Goto scene) Channel:1 Addi   | (Goto scene) Channel:1 Address:1           |
| MV        | 2002     | ----          | (Goto scene) Channel:1 Addi   | (Goto scene) Channel:1 Address:0           |
| NC        | 1        |               | NOTIF1                        |  |
| DEV       | 2000     |               | UGW                           | UGW-C Client/Server                        |
| BV        | 2028     | [0, inactive] | Broadcast (Switch) Channel:1  | Broadcast (Switch) Channel:1               |
| BV        | 2021     | [1, active]   | (Switch) Channel:1 Address:3  | (Switch) Channel:1 Address:3               |
| BV        | 2014     | [1, active]   | (Switch) Channel:1 Address:2  | (Switch) Channel:1 Address:2               |
| BV        | 2007     | [1, active]   | (Switch) Channel:1 Address:1  | (Switch) Channel:1 Address:1               |
| BV        | 2000     | [1, active]   | (Switch) Channel:1 Address:0  | (Switch) Channel:1 Address:0               |
| BI        | 2027     | [1, active]   | (Lamp On) Channel:1 Address:3 | (Lamp On) Channel:1 Address:3              |
| BI        | 2026     | [0, inactive] | (failure) Channel:1 Address:3 | (failure) Channel:1 Address:3              |
| BI        | 2025     | [0, inactive] | (Lamp failure) Channel:1 Adc  | (Lamp failure) Channel:1 Address:3         |
| BI        | 2024     | [0, inactive] | (Control gear failure) Chann  | (Control gear failure) Channel:1 Address:3 |
| BI        | 2020     | [1, active]   | (Lamp On) Channel:1 Address:2 | (Lamp On) Channel:1 Address:2              |
| BI        | 2019     | [0, inactive] | (failure) Channel:1 Address:2 | (failure) Channel:1 Address:2              |
| BI        | 2018     | [0, inactive] | (Lamp failure) Channel:1 Adc  | (Lamp failure) Channel:1 Address:2         |
| BI        | 2017     | [0, inactive] | (Control gear failure) Chann  | (Control gear failure) Channel:1 Address:2 |
| BI        | 2013     | [1, active]   | (Lamp On) Channel:1 Address:1 | (Lamp On) Channel:1 Address:1              |
| BI        | 2012     | [0, inactive] | (failure) Channel:1 Address:1 | (failure) Channel:1 Address:1              |
| BI        | 2011     | [0, inactive] | (Lamp failure) Channel:1 Adc  | (Lamp failure) Channel:1 Address:1         |
| BI        | 2010     | [0, inactive] | (Control gear failure) Chann  | (Control gear failure) Channel:1 Address:1 |
| BI        | 2006     | [1, active]   | (Lamp On) Channel:1 Address:0 | (Lamp On) Channel:1 Address:0              |
| BI        | 2005     | [0, inactive] | (failure) Channel:1 Address:0 | (failure) Channel:1 Address:0              |
| BI        | 2004     | [0, inactive] | (Lamp failure) Channel:1 Adc  | (Lamp failure) Channel:1 Address:0         |
| BI        | 2003     | [0, inactive] | (Control gear failure) Chann  | (Control gear failure) Channel:1 Address:0 |
| AV        | 2029     | 0.00          | Broadcast (Actual level) Cha  | Broadcast (Actual level) Channel:1         |
| AV        | 2022     | 100.00        | (Actual level) Channel:1 Add  | (Actual level) Channel:1 Address:3         |
| AV        | 2015     | 100.00        | (Actual level) Channel:1 Add  | (Actual level) Channel:1 Address:2         |
| AV        | 2008     | 100.00        | (Actual level) Channel:1 Add  | (Actual level) Channel:1 Address:1         |
| AV        | 2001     | 100.00        | (Actual level) Channel:1 Add  | (Actual level) Channel:1 Address:0         |

#### 4.4 Integration of the BACnet data points into the application based on the example

All data points of the DALI devices and the DALI-BACnet gateway are represented as BACnet (server) objects. The properties of these objects can be read or written with the CODESYS BACnet function blocks `BACnetClientReadProperty` and `BACnetClientWriteProperty`. BACnet COV/event subscriptions and any device discovery that may be required are also possible using CODESYS BACnet function blocks.

The CODESYS BACnet package includes detailed sample applications.

The sample application `BACnet_examples.project` demonstrates the use of the function blocks `BACnetClientReadProperty` and `BACnetClientWriteProperty` (`BACnet_examples.project - BACnetClient - ClientReadWriteProperty`). The registration and evaluation of BACnet COV/event subscriptions is also demonstrated in this sample application (`BACnet_examples.project - BACnetClient - ClientSubscribeCOVProperty` and `ConfirmedCOVNotificationCallback`).

The sample application `BACnet_DeviceDiscovery.project` demonstrates how to perform a device discovery.