

DALI 4Net

Manual

Central Control Device



Central Control Device for 4 DALI-lines

Version 0.4

DALI 4Net Central Control Device

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1. DALI 4Net – Features and Installation

1.1 Intended Use

The DALI 4Net can be used for commissioning and control of DALI lighting systems. DALI is a standardized digital protocol for the control of electronic ballasts for lighting systems according to standard IEC62386. Exclusively ballast or control devices with DALI interface may be connected to one of the DALI-lines.

1.2 Safety Instructions

When operating the DALI 4Net the following precautions must be considered:

Each user must carefully read and follow the instructions given in the manual.

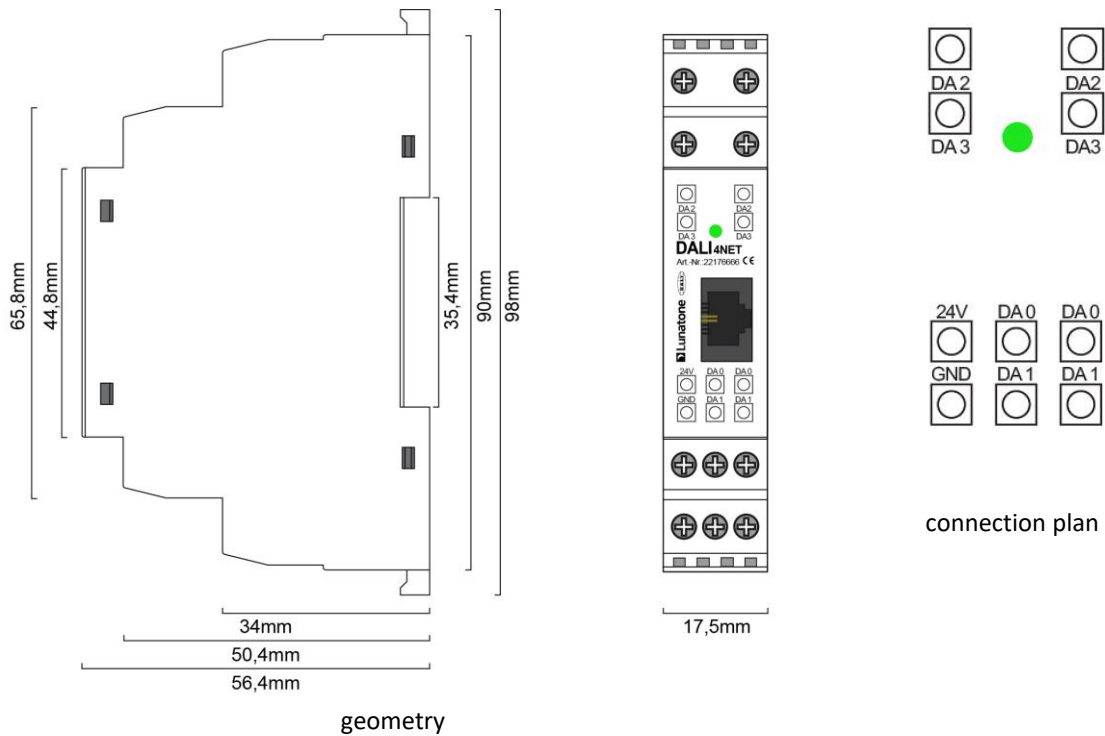
The operator must ensure that the wiring instructions and specifications for DALI lines are considered, the installation of the DALI 4Net must be performed by an qualified technician, who can perform the required tasks and recognize potential danger due to professional training, knowledge and experience, in particular the knowledge of pertinent regulations and standards.

1.3 Features

The DALI 4Net has connectors for four DALI lines (DALI 0-3). This allows installing up to 256 DALI ballasts and additional control devices.

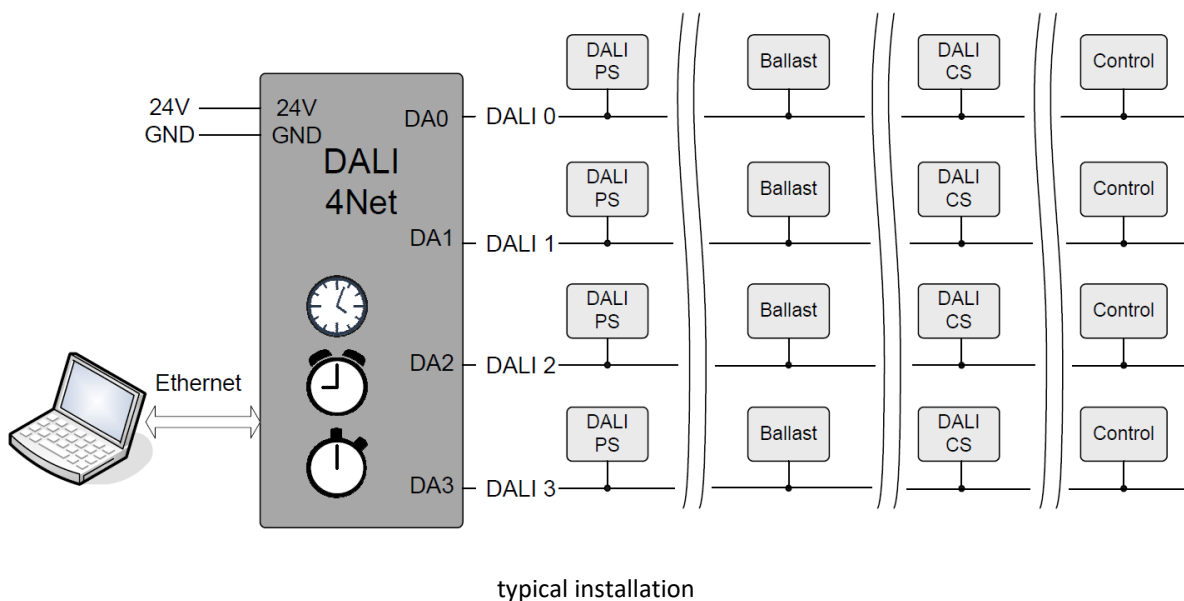
1.4 Specification

article number	22176666
electrical data:	
rated supply voltage	24VDC
typ. current consumption	90 mA
Ethernet	1 x Ethernet 10/100Base-T, galvanic isolated 1500V AC, RJ45-connector
DALI	4 x DALI, galvanic isolated
technical data:	
ambient temperature	-20°C to +60°C
protection class	IP20
max. connecting wire cross-section	2,5 mm ²
mounting	DIN rail
dimensions	98 x 17 x 56 mm



1.5 Installation

The DALI4Net does not provide any power supply for the DALI-lines. Therefore an external DALI power supply (e.g. DALI PS, Lunatone Art.Nr. 24033444) has to be installed for each DALI-line. For the power supply we recommend to use the PS24V from Lunatone (Art.Nr. 24166012-24HS) which is suited for DIN rail mounting as well.



2. Basic Setup

2.1 General

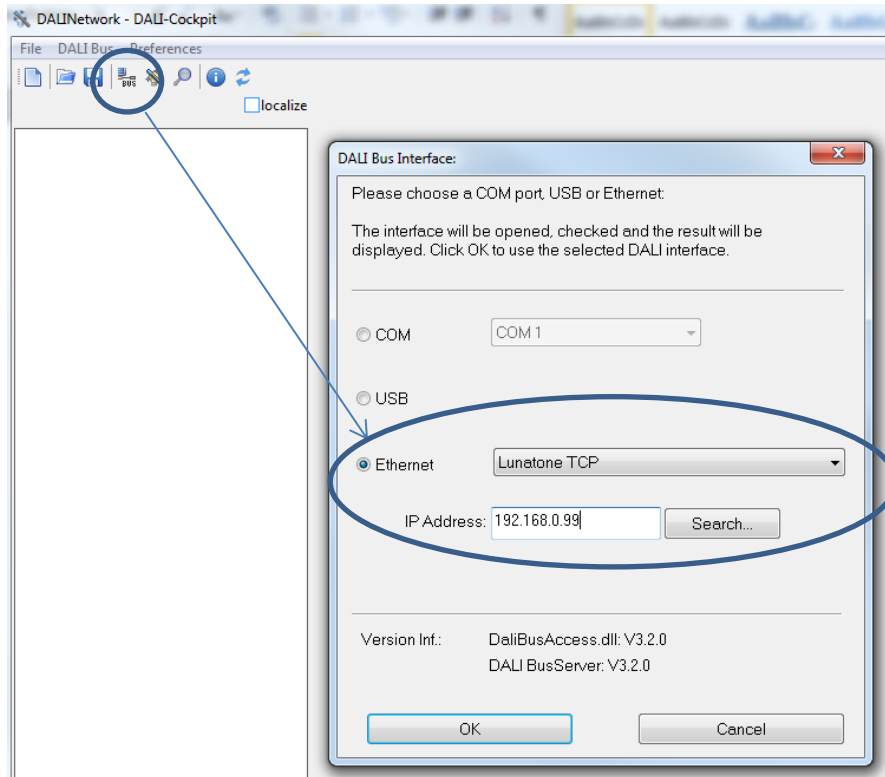
The DALI4Net can be set up with the help of the DALI Cockpit software tool. Furthermore the configuration can be done via Modbus TCP/IP access as well. However, this chapter will deal with the setup in the Cockpit only.

2.2 Initial Connection to the DALI4Net

In the DALI Cockpit the interface can be defined in the bus server menu (menu **DALI-Bus -> Bus Interface**).

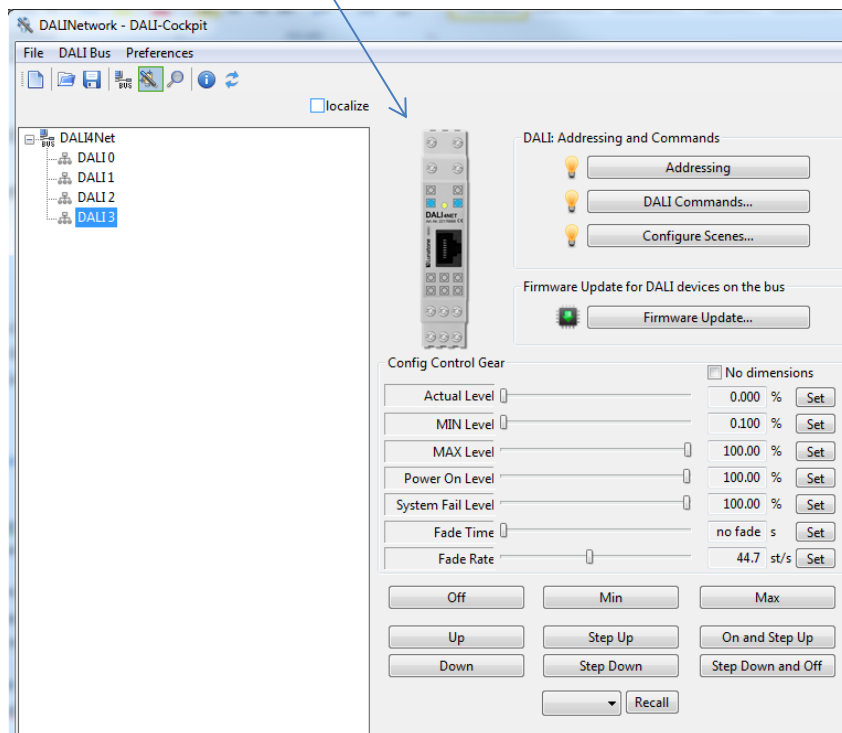
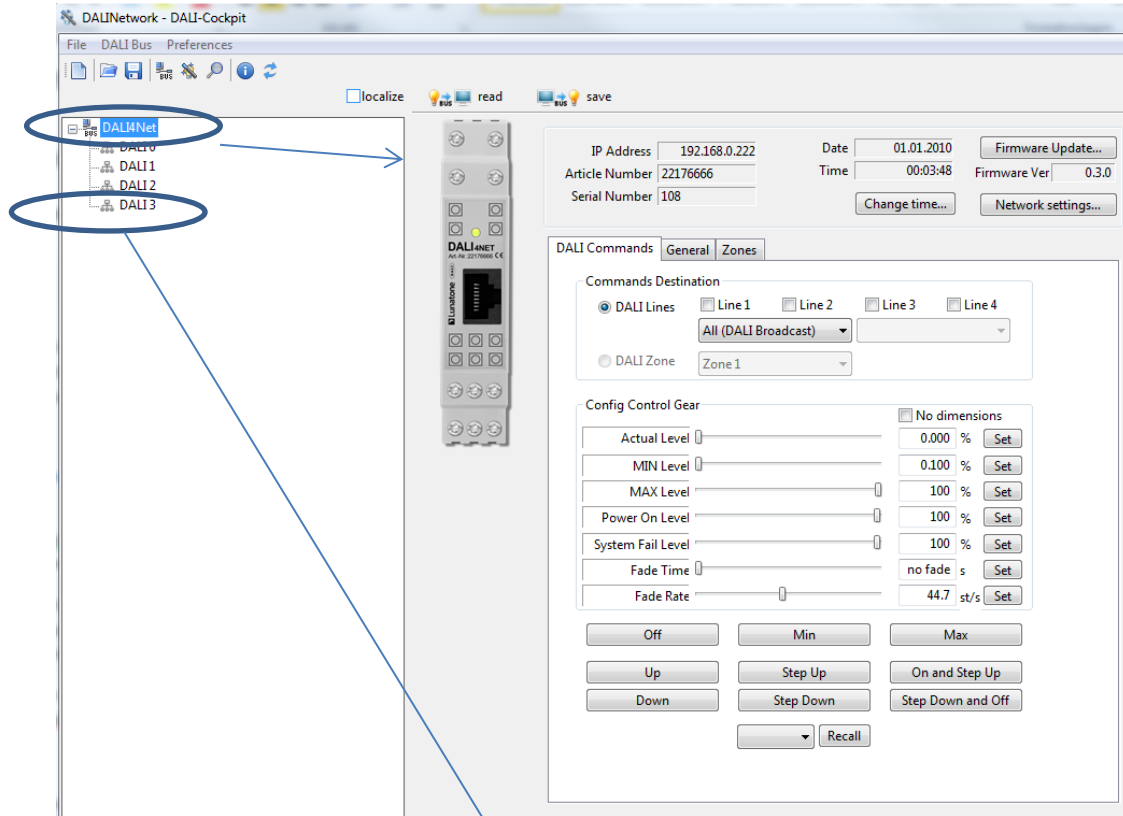
Select **Ethernet -> Lunatone TCP** and enter IP of the device. Alternatively, the network can be scanned for devices (for this option use the "Search"-Button). The DALI4Net is delivered with the following default network settings:

IP-Adresse: 192.168.0.99
 Subnetmask: 255.255.255.0
 Gateway: 192.168.0.1



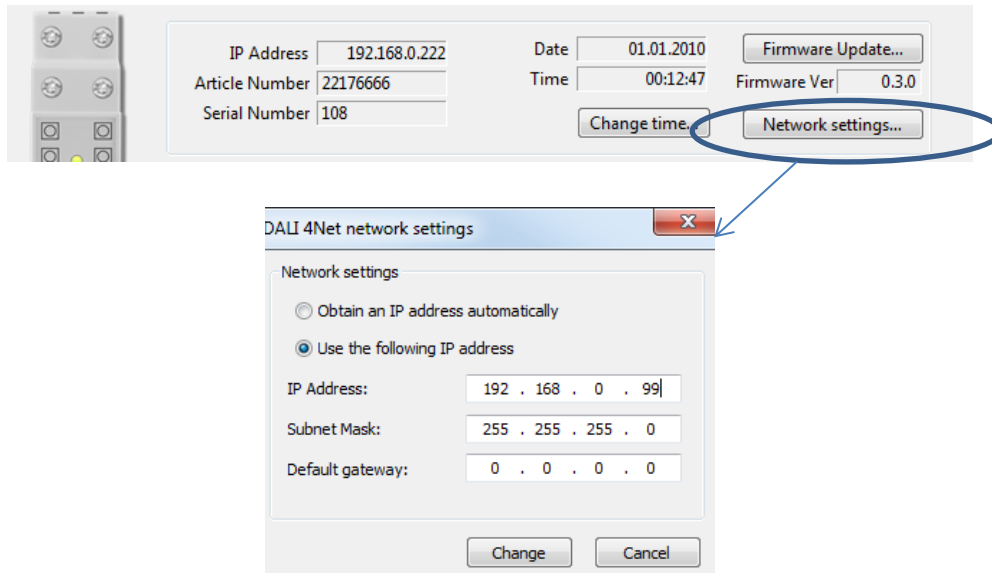
After an IP-address has been entered finally press “OK” to connect.

You will see a DALI4Net device in the component tree (on the left) and the corresponding menu on the right. By selecting one of the 4 DALI-lines (DALI 0 ... DALI3) the corresponding menu of the DALI-line can be entered.



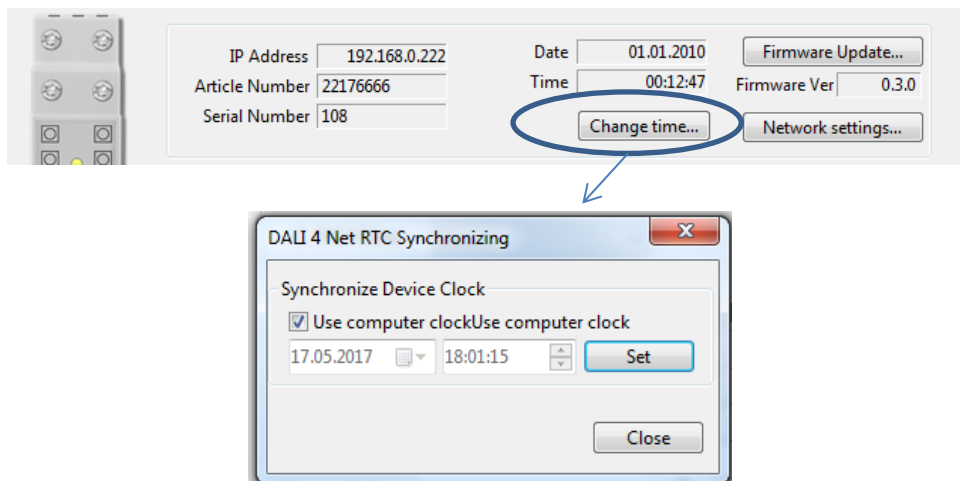
2.3 Change Network Settings

In the Network settings you can set up a static IP address or if the IP should be obtained by a DHCP-server.



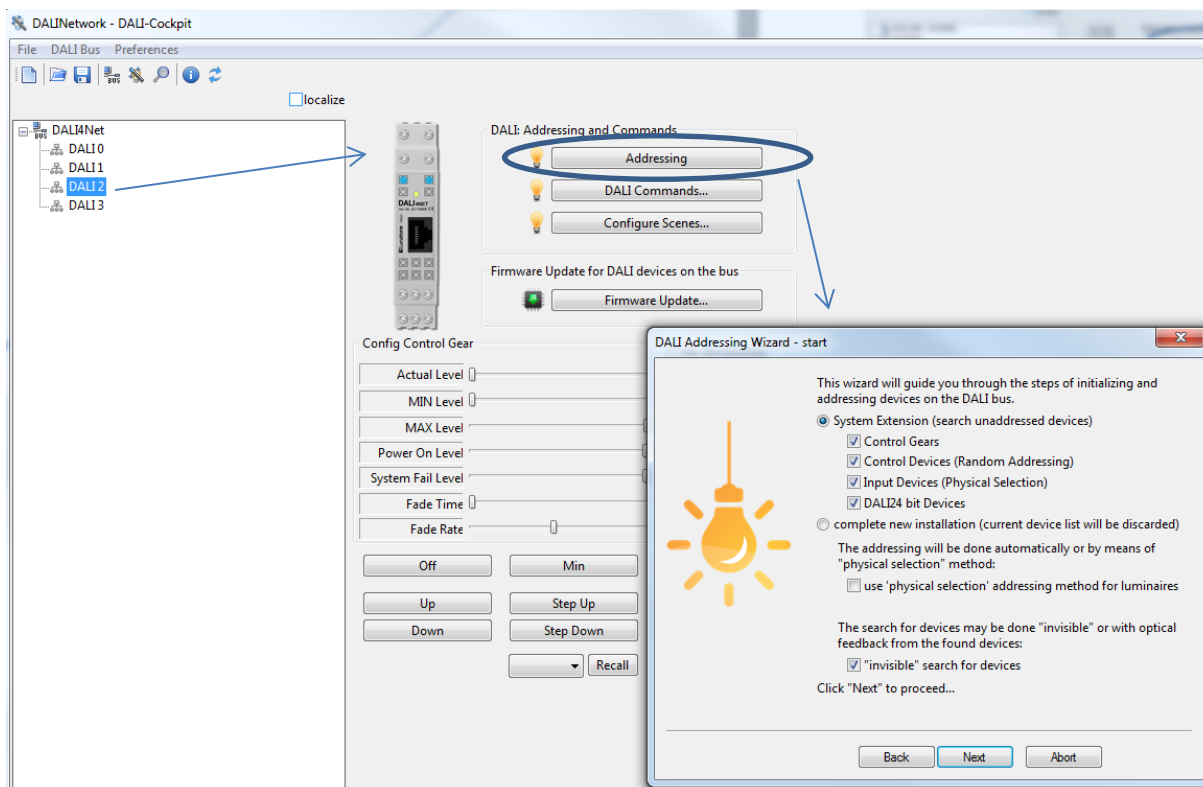
Please note that after selecting DHCP (obtain IP automatically) you will have to search for the DALI4Net again.

2.4 Change Date&Time



2.5 Addressing of DALI-lines

The DALI-Cockpit provides a simple menu for each DALI-line which allows addressing, testing and configuration of the DALI-line. It can be accessed by selecting the corresponding DALI-line in the component tree.

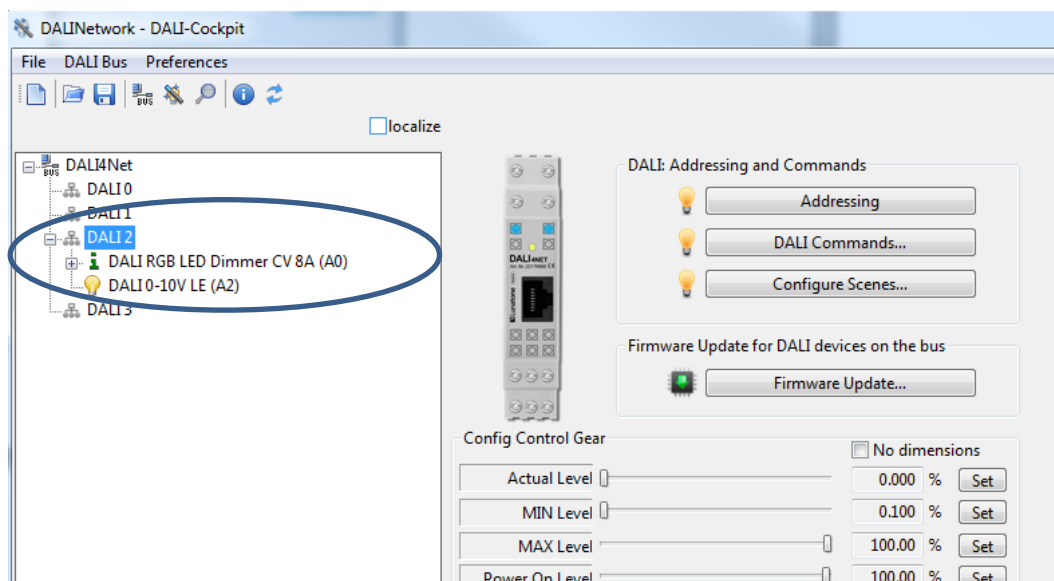


When setting up a DALI-line we recommend testing the communication first. With the help of the control buttons on the bottom of the site (e.g. OFF, MIN, MAX) the devices on the DALI-line can be controlled broadcast. In the second step the devices have to be addressed. There are two options:

1. System Extension:
Searching for addressed devices and addressing unaddressed devices.
2. Complete New Installation:
Deleting all existing addresses and group assignments and addressing unaddressed devices

When addressing input devices you will be asked for double press buttons of the input devices. The order of the activity can be used for spatial localization of the input devices.

When addressing is finished all devices are listed as subset of the DALI-line in the component tree.



Each component listed in the component tree can be selected and configured. The procedure is the same for each DALI-line.

3. Polling Status and Sensor Values

Status and Actual Level:

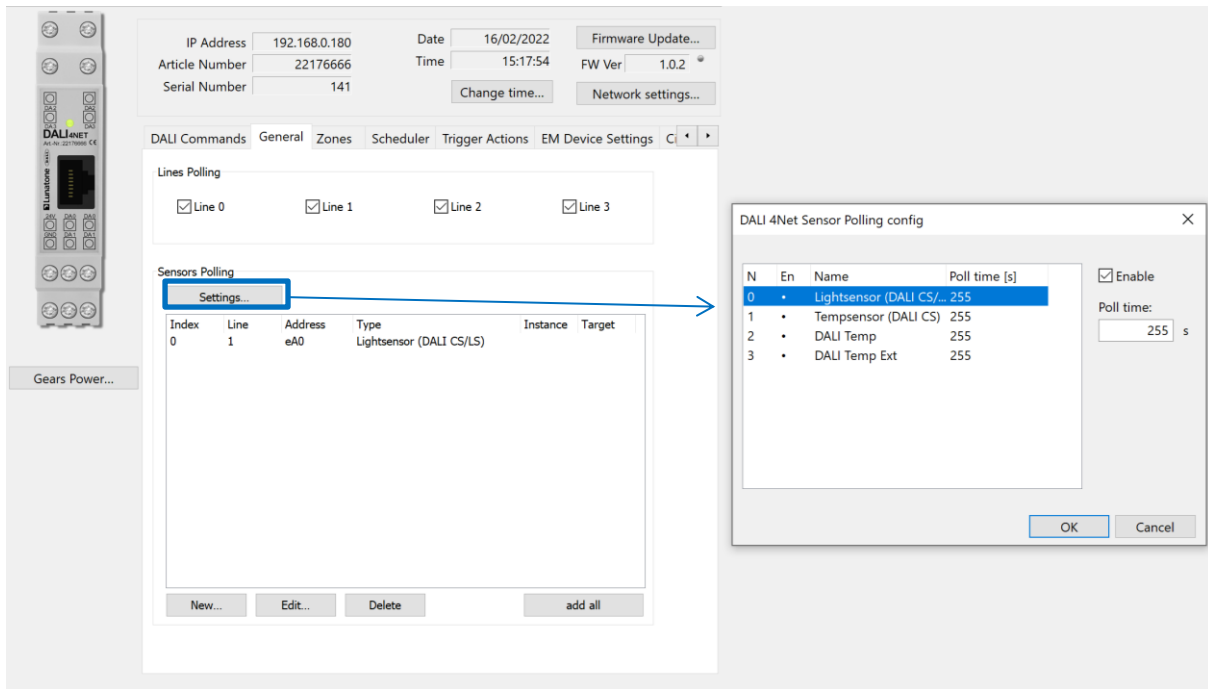
Polling of status and actual level is available in DALI 4Net and DALI 4Net basic – the status polling can be activated in the DALI Cockpit on the tab “General”. Polling can be activated for each line individually by checking the respective checkbox. The most recent status is stored in registers 9100 to 9163 – see section 5.6.8, page 18

Sensor Values:

Polling for sensor values (supported sensors are DALI-CS, DALI LS, DALI Temp) is only available for the DALI 4Net (not the DALI 4Net Basic). The most recent sensor values are stored and can be queried via registers 6100-7123, see section 5.6.6 page 16.

The DALI4Net must be configured accordingly. This is possible in the DALI Cockpit, under the tab "General" section “Sensor Polling”, by adding the sensor via "New..." and specifying its line and address (if all sensors in the system are to be added, this can be done using the button "add all").

The index number in the table indicates the register number for the query: index 0 corresponds to register 6101.

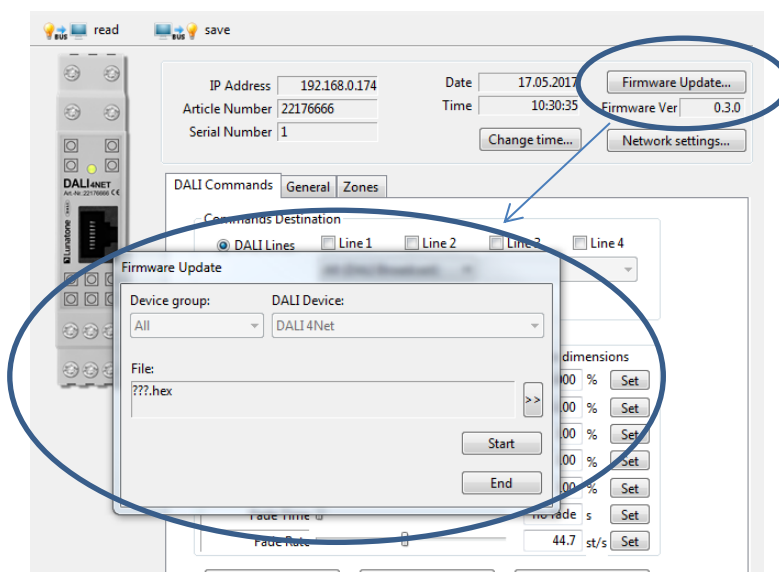


Under "Settings..." the polling time for the various sensor types (light and temperature) can be set.

4. Firmware Update

To ensure that all features explained in the manual are supported by your DALI4Net check the Lunatone website for firmware updates. If a newer version is available download and install it as described below:

Press the "Firmware Update" button, afterwards a window will appear where you can enter the name of the file.



After the firmware update the DALI4Net will reboot.

5. DALI 4Net – ModBus TCP Access

5.1 General

Modbus TCP/IP is a type of the serial modbus protocol for TCP/IP networks using port 502. The Modbus standard provides several functions for data exchange. The DALI4Net functions as a Modbus Server i.e. it only responds to Modbus Register Reads/Writes initiated by a Modbus Client, and cannot initiate any Modbus transaction on the network by itself.

5.2 Frame Structure

A Modbus TCP/IP Frame has a header called “MBAP Header” and consists of the following 7 byte:

Name	Length (bytes)	Function
Transaction identifier	2	For synchronization between messages of server & client
Protocol identifier	2	Zero for Modbus/TCP
Length field	2	Number of remaining bytes in this frame
Unit identifier	1	Slave address (255 if not used) – used for line selection
Function Code	1	Modbus Function Codes as described below
Data	n	Number of bytes as needed

5.2.1 Unit Identifier: DALI Bus Line Selection:

In the DALI4Net the “Unit identifier” is used to select which bus is addressed for certain registers. It’s used in this format:

ZZZZBBBB (binary):

Z .. Zones: 1-15, 0 means bus selection is active (e.g. addressing zone 5: UID = 0x50)

B .. Bus line: Binary selection for bus lines (e.g. only addressing line 0 UID = 0x01, addressing line 0 and line 1: UID = 0x03, ...)

Note: in some central control units the UID is referred to simply as “id”.

This is i.e. used for sending DALI commands. With the help of the unit identifier DALI commands can be sent either to zones or (multiple) DALI-lines.

When using Zones in the Unit ID to send a DALI command as in “5.6.4 Register 100 – Write DALI-Command”, only DALI16 commands are allowed. Other DALI commands (DALI24, eDALI) cannot be used in combination with Zones.

5.3 ModBus Commands

Supported Modbus functions:

Function Name	Function Code	Description
Read Multiple Holding Registers	03	Read Data Blocks From Device
Write Multiple Holding Registers	16	Write Data Blocks To Device
Read/Write Holding Registers	23	First Write, then Read from Specific Address, function used to send DALI commands

With the help of the mentioned functions Modbus registers can be accessed and data can be exchanged between a modbus client (the Control Unit in the System initiating transaction) and the server (DALI 4NET).

5.4 Frame Examples

Read multiple registers (FC 03):

Request

- Byte 0: 03 (Read multiple registers)
- Byte 1-2: Register Address (also called „reference number“)
- Byte 3-4: Word count (1-125)

Response

- Byte 0: 03 (Read multiple registers)
- Byte 1: Byte count of response
- Remaining Bytes: Register values

Exceptions

- Byte 0: FC = 0x83
- Byte 1: exception code = Illegal Function (01) or Illegal Data Address (02)

Write multiple registers (FC 16):

Request

- Byte 0: 0x10 (Write multiple registers)
- Byte 1-2: Register Address (also called „reference number“)
- Byte 3-4: Word count (1-100)
- Byte 5: Byte count
- Remaining Bytes: Register values

Response

- Byte 0: 0x10 (Write multiple registers)
- Byte 1-2: Register Address (also called „reference number“)
- Byte 3-4: Word count

Exceptions

- Byte 0: FC = 0x90
- Byte 1: exception code = Illegal Function (01) or Illegal Data Address (02)

Read/Write registers (FC 23):

Request

- Byte 0: 0x17 (Read/Write registers)
- Byte 1-2: READ Register Address (also called „read reference number“)
- Byte 3-4: Word count for read (1-125)
- Byte 5-6: WRITE Register Address (also called „write reference number“)
- Byte 7-8: Word count for write (1-100)
- Byte 9: Byte count
- Remaining Bytes: Register values

Response

- Byte 0: 0x17 (Read/Write registers)
- Byte 1: Byte count
- Remaining Bytes: Register values

Exceptions

- Byte 0: FC = 0x97
- Byte 1: exception code = Illegal Function (01) or Illegal Data Address (02)

5.5 ModBus Registers

Register	Name	Length (Word)	Read/Write	Function
1	Polling Configuration	4	RW	Enable/Disable Polling from DALI4Net
10	Network Configuration	7	RW	Read/Write Network Configuration (DHCP or static)
20	System Configuration	32	R (W partial)	Read System Configuration and Write Nametag
100	Write DALI Command	6	W	Write DALI Command (100&101 used with FC 23)
101	Read DALI Command	5	R	Read Answer from previously sent Command
6100-7123	Read Sensor Values		R	Read 16bit sensor value (depending on type)
9000-9063	Query Actual Level and Short Address	1	R	Query Actual level and Short Address of given devices
9100-9163	Query Status	1	R	Query DALI Status and Extended Status of given devices
9200-9263	Energy Monitor for given device address	1-64	R	Percent as 16bit value 0.00-100.00% -> 0-10000

5.6 Register Details

5.6.1 Register 1 – Polling Configuration

If polling is activated, the DALI4Net cyclically polls status and actual level of the DALI ballasts. If polling is inactive the status and actual level of the device may be wrong (you will then receive the internal calculated refence value of the ballast which in most cases is correct, but can deviate e.g. in case of communication error or lamp failure).

Polling Configuration			
Byte	Name	Line	Description
0	Config	0	Bit 0: 1=Enable 0=Disable
1	Reserved		Reserved for future use
2	Config	1	Bit 0: 1=Enable 0=Disable
3	Reserved		Reserved for future use

4	Config	2	Bit 0: 1=Enable 0=Disable
5	Reserved		Reserved for future use
6	Config	3	Bit 0: 1=Enable 0=Disable
7	Reserved		Reserved for future use

5.6.2 Register 10 – Network Configuration

With the network configuration you can read out and configure the network settings. After changing the network settings the device will reboot. The default network settings are:

Static IP:
 IP-Address: 192.168.0.99
 Subnetmask: 255.255.255.0
 Gateway: 192.168.0.1

Network Configuration		
Byte	Name	Description
0	DHCP	0x01=DHCP 0x00=Static
1-4	IP Address	i.e. 1=192 2=168 3=0 4=99
5-8	Subnet Mask	i.e. 5=255 6=255 7=255 8=0
9-12	Gateway	i.e. 9=192 10=168 11=0 12=1

5.6.3 Register 20 – System Configuration

With Modbus register 20 you can read out info about hardware, firmware, serial, production data etc. Furthermore you can set a name for the device with a maximum length of 30 characters.

System Configuration		
Byte	Name	Description
0-29	Nametag	Up to 30 characters nametag
30-31	HW Version	Major.Minor
32-35	Serialnumber	4 Byte serial number
36-39	Articlenumber	4 Byte article number
40	LTDT	Lunatone specific device type
41	Build number	FW Version build number
42	FW Minor	FW Version minor
43	FW Major	FW Version major
44-45	Production	Week,Year
46-63	Info	Device info
62	reserved	reserved
63	reserved	reserved

5.6.4 Register 100 – Write DALI-Command

For direct access to the DALI-lines Modbus Register 100 and 101 are used.

Write DALI Command																						
Byte	Name	Description																				
0	CmdByte	Command Byte = 0x12 always																				
1	Sequence number	Command Sequence number (will be sent back)																				
2	Control	<table border="1"> <thead> <tr> <th colspan="2">Command Control byte</th> </tr> </thead> <tbody> <tr> <td>Bit 7</td> <td>unused, set to 0</td> </tr> <tr> <td>Bit 6</td> <td>if set no data is sent out on the DALI line (used to test connection status)</td> </tr> <tr> <td>Bit 5</td> <td>send twice, cmd will be sent twice on DALI-line (required for some DALI commands)</td> </tr> <tr> <td>Bit 4</td> <td>Send DTR before DALI command (only with DALI-16 and eDALI commands)</td> </tr> <tr> <td>Bit 3</td> <td>Send DALI Device Type before DALI command (only with DALI-16 and eDALI commands)</td> </tr> <tr> <td>Bit 2</td> <td>Send "Set Actual Level to DTR" before DALI command (only with DALI-16 and eDALI commands, not to be used with DALI-16 DAP commands)</td> </tr> </tbody> </table>	Command Control byte		Bit 7	unused, set to 0	Bit 6	if set no data is sent out on the DALI line (used to test connection status)	Bit 5	send twice, cmd will be sent twice on DALI-line (required for some DALI commands)	Bit 4	Send DTR before DALI command (only with DALI-16 and eDALI commands)	Bit 3	Send DALI Device Type before DALI command (only with DALI-16 and eDALI commands)	Bit 2	Send "Set Actual Level to DTR" before DALI command (only with DALI-16 and eDALI commands, not to be used with DALI-16 DAP commands)						
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3	Mode	<table border="1"> <thead> <tr> <th colspan="2">Command Mode Byte</th> </tr> </thead> <tbody> <tr> <td>value = 0,1</td> <td>not used</td> </tr> <tr> <td>value = 2</td> <td>send DALI answer (8Bit, DATA_LO)</td> </tr> <tr> <td>value = 3</td> <td>send DALI (16 Bit, DATA_MID, DATA_LO)</td> </tr> <tr> <td>value = 4</td> <td>send eDALI (25Bit, DATA_HI, DATA_MID, DATA_LO)</td> </tr> <tr> <td>value = 5</td> <td>reserved</td> </tr> <tr> <td>value = 6</td> <td>send 3Byte DALI (24Bit, DATA_HI, DATA_MID, DATA_LO)</td> </tr> <tr> <td>value = 7</td> <td>reserved</td> </tr> <tr> <td>value = 8</td> <td>reserved</td> </tr> <tr> <td>value = 12</td> <td>reserved</td> </tr> </tbody> </table>	Command Mode Byte		value = 0,1	not used	value = 2	send DALI answer (8Bit, DATA_LO)	value = 3	send DALI (16 Bit, DATA_MID, DATA_LO)	value = 4	send eDALI (25Bit, DATA_HI, DATA_MID, DATA_LO)	value = 5	reserved	value = 6	send 3Byte DALI (24Bit, DATA_HI, DATA_MID, DATA_LO)	value = 7	reserved	value = 8	reserved	value = 12	reserved
Command Mode Byte																						
value = 0,1	not used																					
value = 2	send DALI answer (8Bit, DATA_LO)																					
value = 3	send DALI (16 Bit, DATA_MID, DATA_LO)																					
value = 4	send eDALI (25Bit, DATA_HI, DATA_MID, DATA_LO)																					
value = 5	reserved																					
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value = 7	reserved																					
value = 8	reserved																					
value = 12	reserved																					
4	Reserved																					
5	DALI High	Highest DALI Byte (DATA_HI)																				
6	DALI Mid	Mid DALI Byte (DATA_MI)																				
7	DALI Low	Low DALI Byte (DATA_LO)																				
8	DTR	Value to be set to DTR																				
9	Priority	Priority for DALI command (not applicable if control bit 2 or control bit 4 are set)																				
10	Device type	Device type to be sent																				

Note for writing *Registers 100 – Sending DALI commands*: it is recommended to use the Function Code FC 23 "Read/Write Holding Registers". Herewith the registers are written and read and it can be captured if the DALI command was successfully sent on the DALI bus. The answer will contain a status information if the command could not be sent (e.g. bus short) or the DALI answer to the according command.

For some example DALI Frames or looking up the necessary DALI frames see sample selection:

<https://www.lunatone.com/wp-content/uploads/2021/01/DALI-4Net-Access-via-Modbus-Sample-Collection.pdf>

Example: send "RECALL MAX to A0 on Line 0":

UID = 1 to reach line 0,

FC 23: write/read multiple registers - number registers write: 6, start register 100, (base address = 0)

byte	0	1	2	3	4	5	6	7	8	9	10
name	cmd	#	control	mode	res	high	mid	low	DTR	Prio.	DT
value (hex)	0x12	0x00	0x00	0x03	0x00	0x00	0x01	0x05	0x00	0x00	0x00

number registers read: 5 → received answer interpretation see next section

5.6.5 Register 101 – Read DALI Answer

Read DALI Command		
Byte	Name	Description
0	Cmd Byte	Command Byte = 0x12 always
1	Status	Command Status byte: High nibble: reserved (value = 8) Low nibble: status value <hr/> value = 1 DALI answer = "NO" <hr/> value = 2 DALI 8bit data <hr/> value = 7 Error/Info, if set: Collision / DALI answer = "Yes": DATA_LO=1; DALI-line short circuit: DATA_LO=2;
2	Reserved	
3	Reserved	
4	Reserved	
5	Answer	DALI_LO (answer to previous command)
6	Reserved	
7	Sequence number	Command sequence number same as previously sent
8	Reserved	
9	Reserved	

Note: Answers can only be read from single lines (on reading Answers with UID set to multiple lines, the answer from the lowest line is returned. On reading answers from zones, the answer from line 0 will be returned)

5.6.6 Registers 6100 to 7123 – Read Sensor Values

Query the most recent sensor values of specified sensors. Configuration for sensor polling in the DALI Cockpit is required – see section 3, page 9. The index given for sensor polling indicates the register for querying the sensor value: index 0 corresponds to register 6100.

Query most recent Sensor Values		
Byte	Name	Description
Use the polling index for selection of the sensor – see section 3, page 9		
0	Sensor value	low byte of sensor value
1	Sensor value	high byte of sensor value

Note: Queries need to start at register 6100 (value of lowest sensor index), all entries up to the desired index (e.g. index 5) need to be queried (e.g. read register 6100 - 6 words, receive status of index 0 – index 5) and filtered as desired.

Interpretation of the returned sensor values:

- Light sensor values, DALI CS and DALI LS - range [0lux ... 2500lux]
 Light Level (lux) = *answer*

- Temperature value DALI CS - range [-40 ... 87,5°]
Temperature (°C) = (answer – 80) / 2
- Temperature value DALI Temp - range [-40 ... 87,5°]
Temperature (°C) = answer_HighByte + (answer_LowByte/256)
with:
HighByte (signed): [-128 ... +127] for temperature range [-128 ... +127]
LowByte (unsigned): [0...255] for temperature range [0,00°C 0,99°C]
See also the DALI Temp datasheet for examples and temperature table
https://www.lunatone.com/wp-content/uploads/2018/03/86459544_DALI_Temp_EN_D0061.pdf

5.6.7 Registers 9000 to 9063 – Query Actual Level and Short Address

Query actual level and short address of DALI control gear. The actual level of up to 64 device can be read with one command only.

Query Actual Level and Short address (ballasts)		
Byte	Name	Description
Use Unit identifier for Bus selection! Command is usable for up to 64 registers which are equal to DALI addresses. 9000 with 1 word would return level and address from control gear 0. 9000 with 64 words returns actual level and address of all control gears.		
0	Actual level	DALI actual level
1	Short address	DALI short address (255 if unaddressed > no device)

Note: Queries need to start at register 9000 (lowest address e.g. A0), all entries up to the desired address (e.g. A5) need to be queried (e.g. read register 9000 - 6 words, receive A0-A5) and filtered as desired. It is not possible to singularly read a higher entry (e.g. address A5 at register 9005).

Interpretation of the returned actual level:

The actual level is returned as value between 0-254, where 0 represents 0% and 254 100%, the light level in % can be calculated from the “actual level” as such:

$$\text{Light output} = 10 \frac{\text{actualLevel}-1}{\frac{253}{3}} 1 \%$$

5.6.8 Registers 9100 to 9163 – Query Status

Query status of DALI control gear. The status of up to 64 device can be read with one command only. The status includes the DALI device status and info about communication. This query only makes sense if automatic polling (ModBus Register 1) is activated (can also be set via DALI Cockpit – see section 3 page 9) – otherwise the answer can differ from the current status of the DALI devices.

Query Status (ballasts)		
Byte	Name	Description
Uses Unit identifier for Bus selection! Command is usable like command 9000.		
0	Extended Status	AxxxxxC(bin) → A .. device is addressed, C .. Communication Error (device is not answering to poll)
1	DALI Status	DALI device status

Note: Queries need to start at register 9100 (status of lowest address e.g. A0), all entries up to the desired address (e.g. A5) need to be queried (e.g. read register 9100 - 6 words, receive status of A0-A5) and filtered as desired. It is not possible to singularly read a higher entry (e.g. address A5 at register 9005).

Interpretation of the returned DALI status:

The Returned DALI Status contains following information:

Bit	Description	Value
0	Control Gear Failure	"1" = Yes
1	Lamp Failure	"1" = Yes
2	Lamp On	"1" = Yes
3	Limit Error	"1" = Yes
4	Fade Running	"1" = Yes
5	Reset State	"1" = Yes
6	Short Address is MASK	"1" = Yes
7	Power Cycle Seen	"1" = Yes

5.7 Modbus TCP examples

For more examples for accessing Modbus TCP registers as well as examples on most common DALI frames please see: <https://www.lunatone.com/wp-content/uploads/2021/01/DALI-4Net-Access-via-Modbus-Sample-Collection.pdf>

Additional Information

DALI-Cockpit – free configuration tool from Lunatone for DALI systems
<https://www.lunatone.com/en/product/dali-cockpit/>

Lunatone DALI products
<https://www.lunatone.com/>

Lunatone datasheets and manuals
<https://www.lunatone.com/downloads-a-z/>

Contact

Technical Support: support@lunatone.com

Requests: sales@lunatone.com

www.lunatone.com

Disclaimer

Subject to change. Information provided without guarantee.
The datasheet refers to the current delivery.

The compatibility with other devices must be tested in advance to the installation.