LOYTEC Bluetooth Devices

Device Operation for LOYTEC Products

User Manual

Delta Intelligent Building Technologies (Europe) GmbH



Contact

Delta Intelligent Building Technologies (Europe) GmbH
Blumengasse 35
1170 Vienna
AUSTRIA/EUROPE
support@loytec.com
http://www.loytec.com

Version 2.6.0

Document № 88094506

LOYTEC MAKES AND YOU RECEIVE NO WARRANTIES OR CONDITIONS, EXPRESS, IMPLIED, STATUTORY OR IN ANY COMMUNICATION WITH YOU, AND
LOYTEC SPECIFICALLY DISCLAIMS ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. THIS PRODUCT IS NOT DESIGNED OR INTENDED FOR USE IN EQUIPMENT INTENDED FOR SURGICAL IMPLANT INTO THE BODY OR OTHER APPLICATIONS INTENDED TO SUPPORT OR SUSTAIN LIFE, FOR USE IN FLIGHT CONTROL OR ENGINE CONTROL EQUIPMENT WITHIN AN AIRCRAFT, OR FOR ANY OTHER APPLICATION IN WHICH IN THE FAILURE OF SUCH PRODUCT COULD CREATE A SITUATION IN WHICH PERSONAL INJURY OR DEATH MAY OCCUR. LOYTEC MAKES NO REPRESENTATION AND OFFERS NO WARRANTY OF ANY KIND REGARDING OF ANY THIRDPARTY COMPONENTS MENTIONED IN THIS MANUAL.

No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of LOYTEC.

LC3020™, L-Chip™, L-Core™, L-DALI™, L-GATE™, L-INX™, L-IOB™, LIOB-Connect™, LIOB-FT™, L-IP™, LPA™, L-Proxy™, L-Switch™, L-Term™, L-VIS™, L-WEB™, L-ZIBI™, ORION™ stack and Smart Auto-Connect™ are trademarks of LOYTEC electronics GmbH.

LonTalk®, LONWORKS®, Neuron®, LONMARK®, LonMaker®, *i*.LON®, and LNS® are trademarks of Echelon Corporation registered in the United States and other countries.

Contents

1 Introduction 7
1.1 Overview 7
1.2 Scope 7
2 Safety Instructions 8
3 Bluetooth Low Energy (BLE) 14
3.1 Introduction 14
3.1.1 Bluetooth Mesh Basics 14
3.1.2 Bluetooth Mesh Network Limitations 16
3.2 Thyra Config app 16
3.2.1 Projects and PIN Protection 17
3.2.2 Secured Connection 17
3.2.3 Unlinked Devices 17
3.2.4 Enabling and Disabling the App 18
3.2.5 Self-Describing Devices 18
4 LOYTEC Controllers with Bluetooth Mesh Interface 20
4.1 Overview 20
5 LOYBT - Input Devices 21
5.1 Overview 21
5.2 LOYTEC LOYBT-TEMPx Battery Powered Environmental Sensor 21
5.2.1 Device Description 21
5.2.2 Intended Use 25
5.2.3 Installation Instructions 25
5.3 LOYTEC LOYBT-MSx(-B) Multi-Sensor 26
5.3.1 Device Description 26
5.3.2 Intended Use 35
5.3.3 Installation Instructions 36
5.4 LOYTEC LOYUNO-L UNOlite Indoor Air Quality Sensor 37
5.4.1 Device Description 37
5.4.2 Intended Use 41
5.4.3 Installation Instructions 42
6 LOYBT - Actuators 45
6.1 Overview 45
6.2 LOYTEC LOYBT-SBM1 Sunblind Module 45
6.2.1 Device Description 45
6.2.2 Intended Use 50
6.2.3 Installation Instructions 50

6.3 LOYTEC LOYBT-IO1 I/O-Module 51
6.3.1 Device Description 51
6.3.2 Intended Use 54
6.3.3 Installation Instructions 55
6.4 LOYTEC RT1 – Radiator Valve 56
6.4.1 Device Description 56
6.4.2 Intended Use 62
6.4.3 Installation Instructions 63
6.5 LOYTEC LOYBT-LEDDRV 64
6.5.1 Device Description 64
6.5.2 Intended Use 67
6.5.3 Installation Instructions 68
6.6 LOYTEC LOYBT-PP20A / LOYBT-PP20A-EM 69
6.6.1 Device Description 69
6.6.2 Intended Use 77
6.6.3 Installation Instructions 77
7 Troubleshooting 79
7.1 Technical Support 79
8 References 80
9 Revision History 81

Abbreviations

100Base-T	100 Mbps Ethernet network with RJ-45 plug
Aggregation	Collection of several CEA-709 packets into a single CEA-852 packet
AST	Alarming, Scheduling, Trending
BACnet	Building Automation and Control Network
BBMD	BACnet Broadcast Management Device
BDT	Broadcast Distribution Table
BBMD	BACnet Broadcast Management Device
BLE	Bluetooth Low Energy
BOOTP	Bootstrap Protocol, RFC 1497
CA	Certification Authority
CEA-709	Protocol standard for LONWORKS networks
CEA-852	Protocol standard for tunneling CEA-709 packets over IP channels
CN	Control Network
COV	change-of-value
CR	Channel Routing
CRPL	Challenge Response Pair List (Replay Protection)
CS	Configuration Server that manages CEA-852 IP devices
DA	Data Access (Web service)
DALI	Digital Addressable Lighting Interface, see IEC 62386
DFU	Device Firmware Update
DHCP	Dynamic Host Configuration Protocol, RFC 2131, RFC 2132
DIF, DIFE	Data Information Field, Data Information Field Extension
DL	Data Logger (Web service)
DNS	Domain Name Server, RFC 1034
DST	Daylight Saving Time
EEP	EnOcean Equipment Profile
GMT	Greenwich Mean Time
IP	Internet Protocol
IP-852	logical IP channel that tunnels CEA-709 packets according CEA-852
IV	Initialization Vector
LAN	Local Area Network
LSD Tool	LOYTEC System Diagnostics Tool
MAC	Media Access Control
MD5	Message Digest 5, a secure hash function, see Internet RFC 1321
M-Bus	Meter-Bus (Standards EN 13757-2, EN 13757-3)
MIB	Management Information Base
MS/TP	Master/Slave Token Passing (this is a BACnet data link layer)
NAT	Network Address Translation, see Internet RFC 1631
NV	Network Variable
OPC	Open Process Control
OPC UA	OPC Unified Architecture
PEM	Privacy Enhanced Mail

PIR ..... Passive Infra-Red
PLC ..... Programmable Logic Controller
RNI ..... Remote Network Interface
RSTP ..... Rapid Spanning Tree Protocol (Standard IEEE 802.1D-2004)
RTT ..... Round-Trip Time
RTU ..... Remote Terminal Unit
SCPT ..... Standard Configuration Property Type
SIG ..... Special Interest Group (Bluetooth-SIG)
SL ..... Send List
SMI ..... Standard Motor Interface
SMTP ..... Simple Mail Transfer Protocol
SNMP ..... Simple Network Management Protocol
SNTP ..... Simple Network Time Protocol
SSH ..... Secure Shell
SSL ..... Secure Socket Layer
STP ..... Spanning Tree Protocol (Standard IEEE 802.1D)
TLS ..... Transport Layer Security
TTL ..... Time To Live (parameter, Bluetooth Mesh Protocol)
UCPT ..... User-defined Configuration Property Type
UI ..... User Interface
UNVT ..... User-defined Network Variable Type
UTC ..... Universal Time Coordinated
VIF, VIFE ..... Value Information Field, Value Information Field Extension
WIFI ..... Wireless Fidelity (Wi-Fi Alliance)
WLAN ..... Wireless LAN
XML ..... eXtensible Markup Language

1 Introduction

1.1 Overview

The LOYTEC product family includes high performance, reliable and secure network infrastructure components, embedded automation servers, universal gateways, touch panels, I/O modules, room controllers, and lighting controllers. The different device models contain a number of components and network technologies, such as BACnet, CEA-709, KNX, Modbus, M-Bus, MP-Bus, DALI, Bluetooth, SMI, EnOcean and Bluetooth.

This user manual describes the Bluetooth-related behavior of LOYTEC LOYBT devices. The manual covers installation guidelines, the basic functionalities and description of the device dependent feature sets.

LOYTEC LOYBT devices are separated in several main categories according to their Bluetooth-mesh functionality. After a general short introduction to Bluetooth Mesh and installation guidelines, the categories of LOYTEC Controller with Bluetooth Mesh Interface, LOYBT input devices and LOYBT ballasts are covered in different chapters.

1.2 Scope

This document covers common operations on LOYTEC LOYBT devices with firmware version 2.4.0 (if not explicitly stated otherwise).

For integration and specific usage in a LOYTEC environment refer to the LOYTEC Device User Manual [1].

2 Safety Instructions



ATTENTION

General Safety Instructions

Please regard the following general instructions for project planning and execution:

- Regard all measures or prohibitions of the respective country to avoid danger of electricity and high voltage.
- Other relevant regulations of the respective country.
- House installation regulations of the respective country.
- Regulations of the utility company.
- Any specifications, diagrams, dispositions, cable lists and regulations of the customer or system integrator.
- Any third-party regulations (e.g., general contractor or client).



ATTENTION

Country-specific Safety Regulations

Failure to observe country-specific safety regulations can lead to property damage and personal injury. Therefore, comply with the country-specific regulations and the corresponding safety guidelines.



CAUTION

Electrical Safety

Essentially, electrical safety in building automation systems from LOYTEC is based on the use of extra-low voltage and safe isolation from mains voltage.



CAUTION

IEC (SELV, PELV) (world-wide)

Depending on the extra-low voltage earthing (24VAC), this results in an application according to SELV or PELV in accordance with IEC 60364-4-41:

- Ungrounded = SELV (Safety Extra Low Voltage),
- Earth ground = PELV (Protected Extra Low Voltage).



CAUTION

NEC (North America)

Class 2 transformers with energy limitation to 100 VA or Class 2 circuits with max. 100 VA (using a non-energy-limiting transformer of max. 400VA) combined with overcurrent limits (T-4A fuses) can be used for each individual 24VAC device. Several fuses for several isolated secondary circuits per transformer are possible. The same applies to power supplies with 24VDC.



CAUTION

Device Safety

Device safety is guaranteed by supply with low voltage 24VAC or 24VDC and a double insulation between mains voltage 230VAC, 24VAC circuits and the housing or by supply via Power over Ethernet (PoE Class 1). In addition, the specific regulations for electrical wiring according to this manual must be observed.



ATTENTION

Installation Personnel

Only qualified staff may carry out electrical installations.



CAUTION

Installation according Safety Class II

LOYTEC devices, which are designed in compliance with safety class II, must be mounted accordingly.

The following requirements apply:

- Protection against electric shock has to be ensured by an appropriate enclosure.
- Ensure proper working cable relief for installation in safety class II equipment.



ATTENTION

Mounting Location

LOYTEC devices are designed to be installed in an enclosure:

- Switching cabinets
- Distribution boxes
- Mounting in false ceilings
- Luminaire integration



ATTENTION

Environment Conditions

LOYTEC devices have to be installed in a dry and clean environment. In addition, the permissible environment conditions specified in the product data sheet must be observed.



CAUTION

Earth Ground of ⊥ (System Zero AC/DC 24V)

The following items must be observed when earth-grounding system zero ⊥ 24VAC:

- In principle, both earth-grounding and non-grounding of system zero of the operating voltage 24VAC is permitted. Important are the local regulations and customs. Due to functional requirements, earth ground may be necessary or inadmissible.
- It is recommended to ground 24VAC systems unless this contradicts the manufacturer's instructions.
- To avoid earth loops, systems with PELV may only be connected to earth ground at one point in the system. Unless otherwise stated, usually at the transformer.
- The same applies to 24VDC power supplies.



CAUTION

Functional Earth ⏚

Functional earth must be connected to the building's protective earthing (PE) system on the installation side.



CAUTION

Operating Voltage 24V AC/DC

The power supply must meet the requirements for SELV or PELV. Permitted deviation of the nominal voltage:

- At the transformer or power supply: 24V AC/DC ±10%
- At the device: 24V AC or DC ±10 %



CAUTION

Specification for 24VAC Transformers

IEC: safety transformers according to IEC 61558 with double insulation, designed for 100% duty cycle to supply SELV or PELV circuits.

U.S.: Class 2 circuits according to UL 5085-3.

For efficiency reasons, the power drawn from the transformer should be at least 50% of the nominal load.

The nominal power of the transformer must be at least 25 VA. Using a transformer of smaller size, the ratio of open circuit voltage to voltage at full load becomes unfavorable (> + 20%).



CAUTION

Specification for 24VDC Power Supplies

Power supplies must be designed for 100% duty cycle to supply SELV or PELV circuits.

U.S.: Class 2 circuits according to UL 5085-3.

For efficiency reasons, the power drawn from the power supply should be at least 50% of the nominal load.



CAUTION

Protection of the 24VAC Supply Voltage

Transformers must be protected on the secondary circuit, according to the transformer dimensions and the effective load of all connected devices:

Always protect the 24VAC conductor (system potential),

Additionally protect the conductor ⊥ (system zero) where required.



CAUTION

Protection of the 24VDC Supply Voltage

24 VDC power supplies must be short-circuit proof or have an internal micro fuse.

Local regulations must be observed.



CAUTION

Protection of Mains Voltage

Transformers/24VDC power supplies must be protected on the primary circuit using a control cabinet fuse.



CAUTION

Power over Ethernet (PoE)

LPAD-7 Touch Panels require a PoE Class 1 power supply (max. 12W), which must be compliant to IEEE 802.3at-2009.

For the power supply of the PoE switches observe the manufacturer's specifications.



CAUTION

Device Installation/Removal in De-Energized State Only

Ensure that power supply is switched off before starting to install or uninstall LOYTEC devices. Do NOT connect or disconnect equipment with the power switched on, unless instructed otherwise. Do NOT assemble or disassemble devices with power switched on, unless instructed otherwise.



CAUTION

Power supply protection

When installing LOYTEC devices, ensure that the power source is adequately protected by means of a suitably-rated fuse or thermal circuit breaker.



CAUTION

Power supply voltage

Do not connect a voltage supply greater than the specified maximum rating. Refer to product label and/or datasheet for the correct voltage.



CAUTION

DALI is FELV (Functional Extra Low Voltage)

A DALI-line is treated to be FELV. Since it is non-SELV the relevant installation regulations for low voltage apply.



ATTENTION

DALI wiring

A DALI-line may be installed within the same cable or as single conductors within the same tube as mains supply. The DALI-line is either limited to a maximum length of 300 m using a minimum cross-section of 1.5 mm^2 (AWG15) or it must be ensured that the voltage drop on the DALI-line does not exceed 2 V.



CAUTION

Attention to External Voltages

Any kind of introduction or spreading of dangerous voltages onto the low-voltage circuits of the system (e.g. due to incorrect wiring) must be avoided at any circumstance and represents an immediate life danger or can lead to the entire or partial destruction of the building automation system.

3 Bluetooth Low Energy (BLE)

3.1 Introduction

Bluetooth Low Energy is a technology for short range radio transmission of small data packages. It operates in the license-free ISM band between 2.402 and 2.480 GHz. It may interact and be disturbed by other technologies using this frequency range like WLAN or radio emitting sources like microwave-ovens.

Bluetooth Low Energy has been introduced in the Bluetooth 4.0 specification in 2010. By defining transmit and receive timeslots for a dedicated connection between two devices, the energy-consumption for radio-communication has been dramatically reduced since the radio has to be turned on only during these slots. While the Generic Access Profile (GAP) controls connections and advertising in Bluetooth, the Generic Attribute Profile (GATT) defines the way how BLE-devices transfer data back and forth by services and characteristics.

Bluetooth Low Energy (BLE) enables several features, the most important ones are mentioned here:

- Beaconing: advertising of Bluetooth beacons that can be used as identifiers
- Connections: services are used to provide device specific data
- Asset Tracking: scanning for available Bluetooth beacons and determine a location based on the RSSI

Nevertheless, BLE is still a point-to-point (connection) or point-to-multipoint (broadcast) communication.

3.1.1 Bluetooth Mesh Basics

In 2017 the Bluetooth SIG introduced Bluetooth Mesh on top of the Bluetooth 4.2 specification. It allows many-to-many connections by using advertising channels only. It is based on the introduction of a forwarding-mechanism (relay-function) and a publish/subscribe method for data exchange.

LOYTEC supports Bluetooth SIG qualified mesh only.

Note:	***This means proprietary Bluetooth Mesh solutions such as Casambi, BlueRange, Wirepas, CSRmesh, Mindtree, MeshTek, Estimote, etc. are not supported!***

The basic concepts to allow multipoint-to-multipoint communication in BLE-based systems are simple:

- Use of **advertising channels 37, 38 & 39** only (any device can listen). A further advantage of these channels is that they do not interfere with WLAN-channels 1, 6 and 11.

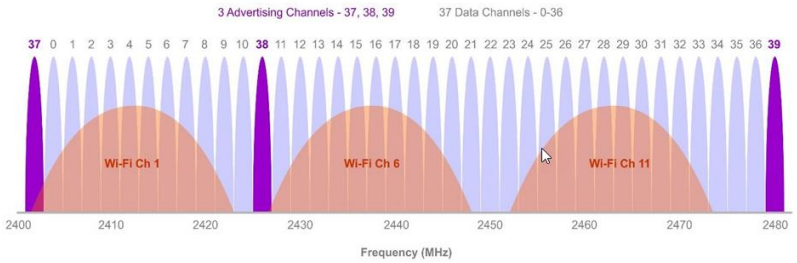


Figure 1: BLE and Wi-Fi Channels.

- **Managed Flooding** approach, which means that any message in the network can be forwarded multiple times (defined by the TTL-parameter). The target device is subscribed to the target address. Most important methods and parameters:
  - TTL (Time To Live, Number of Hops).
  - Message Cache (Withdraw messages that have already been received).
  - Publish/Subscribe (Process only messages you are subscribed to).

- Each node (device in the mesh network) comes with a set of the following device capabilities and features, none of them is mandatory, but finally all are required in different situations:
  - **Relay Feature**: capability of forwarding mesh-messages based on network key and TTL.
  - **Proxy Feature**: service to access the mesh-network via a GATT-connection, typically via a mobile device.
  - **Low-Power Feature**: required for battery powered devices, so that they can be inactive most of the time to save energy.
  - **Friend Feature**: required for support of devices with Low-Power feature. A friend has the capability to store configuration commands for a Low-Power device when it is in sleep mode.

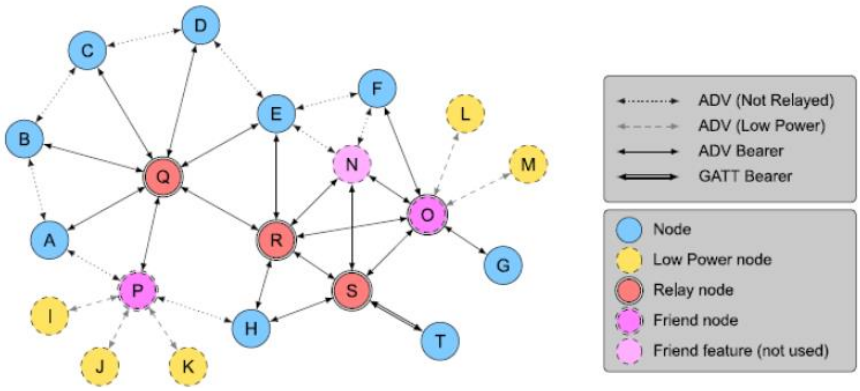


Figure 2: Bluetooth Mesh ecosystem with all features

- **Security is mandatory** in Bluetooth Mesh and is provided by the following methods:
  - Multi-level encryption (network key, application key, device key).
  - Key refresh procedure.
  - Replay protection (IV index, sequence number).
  - Trashcan protection (node blacklisting).
  - Authentication during provisioning (out of band).

- The **application** in Bluetooth Mesh ecosystems is built on so called **models**. Each model describes a set of features represented by states and interacted with a defined command set. There are mandatory models (so called foundation models, which are

used to setup the mesh network and the basic functions) and optional application specific models (some generic, sensor or lighting specific) as well as vendor models.

In the latest version of the specification several useful features have been introduced, LOYTEC Devices already support Remote Provisioning and the mandatory set of requirements defined in the Networked Lighting Control Profiles (NLC).

For a more detailed description on Bluetooth Mesh operation, models and profiles refer to Bluetooth SIG Mesh Protocol[1] v 1.1 [2], the Mesh Model v1.1 specification [3] and the NLC Profiles [4] – [9].

3.1.2 Bluetooth Mesh Network Limitations

There are several limitations in a Bluetooth Mesh network that must be considered:

- Maximum number of nodes in a network is limited by the maximum number of elements which is 16384.
- Maximum number of group addresses is 16384 (of which 4096 are reserved).
- Forwarding is limited by the TTL-parameter (Time to Live), the theoretical maximum is 126 hops.
- The size of message cache affects the efficiency of relaying (suppression of circular relaying).
- Sequence Number & IV–index are not a limitation per se, but can result in unprovisioned devices (after a device has been offline for more than 48 weeks it may happen that the device cannot be recovered and has to be reprovisioned)
- Length of Subscription List – this parameter limits the number of addresses a device can listen to (or groups a device can be a member of).
- The CRPL parameter defines the length of the list of element addresses which are processed by a node (thus the parameter limits the number of nodes a node can interact with).
- The latency in a Bluetooth Mesh network is heavily depending on mesh size and payload as well as on message size (segmented and unsegmented messages).
- Turning unprovisioned mesh beacons into a node by a provisioning process requires a direct connection and is limiting the range between provisioner and mesh device unless there are nodes in the system which support remote provisioning (introduced by Bluetooth SIG in Mesh version 1.1).

3.2 Thyra Config app

The Thyra Config app is a mobile application (iOS/Android) that serves as a visual front end for the commissioning, configuration and maintenance of LOYTEC LOYBT devices. It does not implement device-specific logic itself; instead, it manages projects and establishes secure connections to devices via Bluetooth Low Energy and secured GATT connections. The actual set of configurable parameters, special functions, and displayed properties is defined by each device rather than by the app (see Self-Describing Devices below).

[1] previously called Mesh Profile

The app provides the following functionality for every supported device:

- Firmware update
- Configuration backup and restore
- A base set of device parameters (see Table 1)
- Device-specific parameters and special functions (e.g., light calibration, button teach-in)
- The base set of parameters common to all LOYBT devices is listed in Table 1.

Note: *The firmware installed on a device defines which parameters and special functions are exposed. Feature availability therefore depends on the device type and its firmware version.*

3.2.1 Projects and PIN Protection

The app allows the user to maintain multiple projects. A project is a container for the devices belonging to a single installation or customer and is protected by a PIN.

Devices are associated with a project using this PIN (the device is said to be linked). Once a device has been linked to a project:

- It can no longer be accessed without the correct PIN.
- It cannot be accessed from within a project that uses a different PIN.

This ensures that a commissioned installation is protected against unauthorized access and that devices belonging to one project cannot be modified from another.

Note: *The PIN is the credential that grants configuration access to the linked devices of a project. Because access is tied to the PIN rather than to a specific installation of the app, the PIN alone is sufficient to recover the devices of a project — e.g., on a new device or after reinstalling the app, entering the correct PIN restores full access to all previously linked devices. The PIN should therefore be stored safely; without it, linked devices can no longer be configured and can only be reset to factory default via the device-specific reset procedure.*

3.2.2 Secured Connection

Configuration access to a linked device is protected cryptographically. A key derived from the project PIN is exchanged with the device during linking, and on every subsequent connection the device verifies that the app holds the correct key before granting access. All configuration traffic runs over a secured GATT connection.

As a result, only an instance of the app that holds the correct PIN is granted configuration access to the device.

3.2.3 Unlinked Devices

A device that has not been linked to a project can still be connected to without a PIN. In this unlinked state, the app provides restricted access only:

- **Default device properties** can be accessed (e.g. device type, firmware/hardware revision, serial number).
- A **firmware update** can be carried out.

Note: *No configuration parameters can be read or written while a device is unlinked. Full configuration access requires linking the device to a project.*

3.2.4 Enabling and Disabling the App

Access to a device through the Thyra Config app can be enabled or disabled via the **Generic OnOff Server** in the first element (Primary) of the device's model composition.

When an unlinked device is provisioned into a mesh network, it automatically disables app access. This prevents an unprotected configuration interface from remaining available on a device that is already managed within a mesh network.

To use the Thyra Config app on such a device, app access must first be re-enabled by setting the Generic OnOff Server in the first element to *on*.

3.2.5 Self-Describing Devices

The properties, parameters, and special functions shown in the app are described by the device itself. When the app connects, it reads this description from the device and builds the corresponding user interface dynamically.

This means that new device types and newly added features become available in the app without requiring an app update — support is delivered through the device firmware.

Group / Property	Access	Details
Device Information		
Device Name	Read/Write	max. 28 characters
Device Type	Read	e.g. LOYBT-TEMP1, LOYBT-MS2, LOYBT-RT1, LOYBT-PP20A …
Firmware Version	Read	
Firmware Build Timestamp	Read	
Serial Number	Read	
Hardware Revision	Read	
Production Date	Read	
Bluetooth Mesh UUID	Read	
Uptime	Read	unit: s
Operation Time	Read	unit: s
Maintenance		
Wink Device	Action	triggers attention/identification
Remove from Mesh	Action	removes the device from the mesh network

Group / Property	Access	Details
Factory Default	Action	resets device to factory default

Table 1: Thyra Config app - default device properties

4 LOYTEC Controllers with Bluetooth Mesh Interface

4.1 Overview

Various LOYTEC controllers provide a SIG-compliant Bluetooth Mesh interface. The feature set of the application controller is perfectly suited to support all features of ballasts and input devices of the LOYBT product portfolio. Besides of the gateway function to the building management, the controller allows commissioning, device configuration, firmware update etc. A LOYTEC controller with programmable logic and data point interface is the heart of a LOYTEC Bluetooth Mesh system. For a detailed description refer to the LOYTEC Device User Manual [1].

LOYTEC controllers with a SIG-compliant Bluetooth Mesh interface are:

- LPAD7-30G2/30G3, Touch Panel
- LPAD7-31G2/31G3, Programmable Touch Panel
- LPAD7-41G2/42G3, Programmable Touch Panel with microphone
- LROC-800, Programmable Room Controller

5 LOYBT - Input Devices

5.1 Overview

LOYTEC provides different types of input devices with a Bluetooth Mesh interface. This chapter deals with the characteristics of those devices.

5.2 LOYTEC LOYBT-TEMPx Battery Powered Environmental Sensor

This section covers common operations on LOYBT-TEMPx devices with firmware version 1.6.0.

5.2.1 Device Description

The LOYBT-TEMPx Bluetooth sensor is a battery powered sensor for measuring environmental properties like room temperature and relative humidity. It is based on the Bluetooth SIG qualified mesh stack (declaration-ID: D060851, reference-design: 154767, Bluetooth 5.1). It acts as low-power node in a Bluetooth Mesh network and publishes sensor data on change of value as well as periodically. In addition, the sensor also reports its battery status.

The device allows to perform temperature and humidity measurements at the location of your choice.

The type LOYBT-TEMP2 additionally offers presence detection based on an integrated vibration sensor. Vacant and occupied workspaces can be determined if the sensor is placed properly, e.g. by being mounted on the backside of a chair.

Due to the energy-saving operation of Low-Power nodes the device is sleeping most of the time.

The enclosure contains 3 holes on the front side. The sensor, a service-button (in the center) and a status-LED (see also Figure 3) are located behind these holes.

The service button has a central function for commissioning and waking up the device for any desired interaction. The status LED gives feedback about the current state during device interaction.

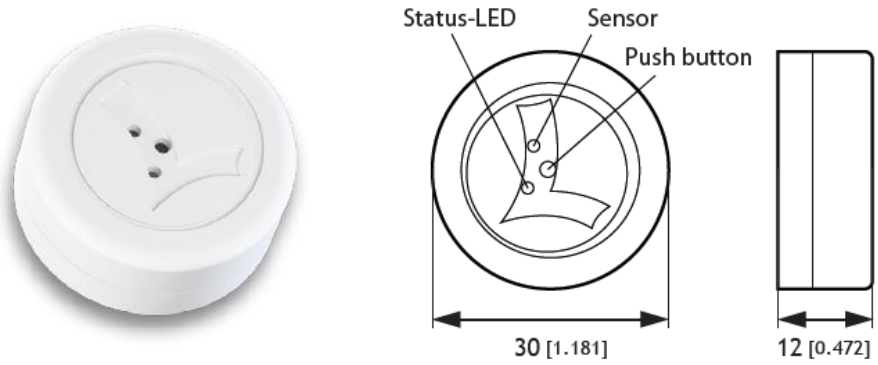


Figure 3: LOYBT-TEMPx environmental sensor

Service-Button

A short button press wakes up the device and initiates different actions dependent on the current state of the device:

- If the LOYBT-TEMPx is unprovisioned, the provisioning process is initiated.
- If the LOYBT-TEMPx is provisioned, the device starts a publication sequence that contains additional data like firmware version and build timestamp. At the beginning of the wake-up period the friendship is terminated, the device can listen to standard mesh messages (node-reset, firmware-update initialization etc.). Before the device finally goes to sleep again, friendship relation is tried to be reestablished.

A long button press (15 seconds) resets the device to factory default (and removes the device from the mesh network). The unprovisioned state is finally indicated by the Status LED (Blinking 3 times).

During DFU-mode (special mode for transferring firmware image via a connection) a 5 second button press will abort this process and bring the device back in mesh operation.

Status LED

The LOYBT-TEMPx provides a red status-LED. The behavior of this LED is as follows:

- Blinking 3 times on power-up if unprovisioned
- Blinking 3 times if device gets unprovisioned (e.g., after device reset)
- Blinking 1 time on power-up if provisioned
- Blinking 1 time after wake-up caused by a button press
- Indicating provisioning/configuration state if attention timer feature is used (continues blinking)[2]
- Indicating a firmware update procedure (continues short flash blinking, 5 seconds interval)

[2] Using the attention timer will result in blinking at any time, but the LOYBT-TEMPx has to be awake to receive the command.

Battery

A CR2032 lithium battery is used as power supply for the LOYBT-TEMPx. To ensure a long battery lifetime, the device is in sleep mode most of the time. Depending on the state it wakes up in different intervals for various actions. The expected lifetime is shown in Table 2. The lifetime calculation is only valid if cadence in sensor setup server and periodic publishing are not used (not configured). This way the sensor is publishing sensor data only at a predefined interval of 5 minutes or if the temperature changes more than 0.5°C since the last reported measurement. Additional publications would reduce the battery lifetime.

Device State	Current Consumption	Expected Battery Lifetime[3]
Unprovisioned	3 µA	> 2 years
provisioned, in friendship	4.5 µA	> 1.3 years
Provisioned, not in friendship	6.4 µA	> 1 year

Table 2: LOYBT-TEMPx battery lifetime.

Models and Sensor Properties

The model composition for the LOYBT-TEMPx is shown in Table 3.

Model number	Model name	Element	Comment
0x0000	Configuration Server	Primary	Network Configuration
0x0002	Health Server	Primary	Status Report
0x1000	Generic OnOff Server	Primary	LED
0x100C	Generic Battery Server	Primary	Battery Status
0x1100	Generic Sensor Server	Primary	Temperature, Humidity, Occupancy
0x1101	Generic Sensor Setup Server	Primary	Temperature, Humidity, Occupancy
0x0AA00001	LOYTEC Device Server	Primary	Device Extension

Table 3: LOYBT-TEMPx composition data.

Recommendation: *Due to the Low-Power behavior of the device cadence and publication interval for sensor data shall not be configured. Instead, the internal mechanism shall be used, only the publication address must be configured[4].*

[3] The calculation of the lifetime considers an efficiency of 30% of the CR2032 (220mAh) battery, the efficiency includes self-discharge and a high safety margin to ensure that the current peaks during wake-up can still be provided by an already discharged battery.

[4] LOYTEC controllers are following this recommendation and configure the publication address only.

The properties provided by the sensor server are listed in Table 4.

Message Type	Property-ID	Property Name	Characteristic[5]
Sensor Status (0x52)	0x0075	Precise Present Ambient Temperature	Temperature
Sensor Status (0x52)	0x0076	Present Ambient Relative Humidity	Humidity
Sensor Status (0x52)	0x004D	Presence Detected (LOYBT-TEMP2 only)	Boolean

Table 4: LOYBT-TEMPx message types and properties[6].

The properties provided by the generic battery server[7] are listed in Table 5.

Message Type	Property Name
Generic Battery Status (0x8224)	Generic Battery Level
Generic Battery Status (0x8224)	Generic Battery Flags

Table 5: LOYBT-TEMPx message types and properties.

Provisioning and Configuration[8]

The provisioning and the configuration of the device is different to normal mesh nodes due to the LOYBT-TEMPx Low-Power feature. Manual interaction is required to wake-up the device. Additionally, the device will be awake only for a defined amount of time before it goes to sleep again (typically 30 seconds). This time-window can be used for provisioning and configuration of the LOYBT-TEMPx. To provision the LOYBT-TEMPx successfully the provision algorithm has to align with the following constraints:

- Initiate the provisioning by pressing the button on the device (device wake up).
- Afterwards the device is emitting an unprovisioned beacon (30 seconds window).
- The provisioner can now scan for the device and add it to the mesh-network.
- Once the device is provisioned, another 30 seconds window allows for device configuration. This period can be used to configure device publications (typically for the sensor server and battery server models). The attention timer can also be used by the provisioner to indicate this state via feedback LED.
- After the configuration window is finished the device tries to establish friendship and goes to sleep.

[5] Characteristics according to GATT Specification Supplement v4 [10].

[6] Properties according Mesh Device Properties v2 Specification [11].

[7] According to Mesh Model v1.1 Specification [3].

[8] When using the Bluetooth Mesh commissioning page on a suitable LOYTEC controller the required actions are reduced to a single press for device wakeup, everything else will be done automatically. For details refer to the Bluetooth chapter in the LOYTEC Device User Manual [1].

Operation in a Bluetooth Mesh network

The sensor is waking up every minute for measurements (temperature, humidity, battery voltage). If the temperature has changed more than 0.5°C since the last sensor data publication the new values are reported immediately. Otherwise, the sensor data is reported once every 5 minutes (this periodic publication also includes presence in case of a LOYBT-TEMP2). The reported battery level is an average over the last 10 minutes whereas reported temperature and humidity are actual values.

For the LOYBT-TEMP2 an additional wake up triggered by an occupancy event (vibration) can occur. A status change (vacant -> occupied) is reported immediately by a sensor status message via the PRESENCE DETECTED property. The status gets vacant again if no movement has been detected for a full period of two consecutive periodic reports.

On a button press event, the device wakes up and disables friendship. Afterwards it publishes the sensor data and additional vendor specific properties (firmware version and build timestamp). A 5 second window begins at this point, which allows to interact with the device (e.g., remove it from mesh, change configuration etc.). At the end of this window the device tries to establish friendship again and goes to sleep.

5.2.2 Intended Use

The LOYBT-TEMPx environmental sensor is a battery powered Low-Power device for integration in SIG-compliant Bluetooth Mesh ecosystems. After adding the sensor to a mesh-ecosystem the device can be placed at the location of your choice (even outside the range of a friend-device).

It provides temperature, rel. humidity and battery status periodically every 5 minutes. In addition, it publishes sensor data on change of temperature value of at least 0.5°C since last publication.

Additionally, the LOYBT-TEMP2 can be used to detect vacant and occupied workspaces.

Operating conditions are temperatures from 0 °C to 50 °C and relative humidity from 10 % to 90 % (non-condensing). The protection degree of the housing is IP20.

5.2.3 Installation Instructions

- The device is suitable for wall mounting, either with a screw or adhesive tape.
- Follow the safety instructions (see chapter 2).
- Press the button on the device to initiate Provisioning and Device Configuration.
- Once the device is provisioned either wait at least 5 minutes or press the button again to get sensor data.
- The device can be placed anywhere in the range of the mesh-system. For long battery life a mounting position near a device supporting the friend-feature is recommended.

5.3 LOYTEC LOYBT-MSx(-B) Multi-Sensor

5.3.1 Device Description

The LOYBT-MSx is a multi-sensor based on the Bluetooth SIG qualified mesh stack (Declaration-ID: Design number (DN) Q301729, contains qualified designs: 239299 (controller subsystem Bluetooth 5.4), 239354 (host subsystem Bluetooth 5.4) and 226841 (Mesh Protocol 1.1, Mesh Model 1.1 and NLC-Profiles 1.0).

The LOYBT-MSx series represents a generation of wirelessly integrated LOYTEC multi-sensors. They perform motion/presence detection, illuminance, temperature and humidity measurements, provide digital inputs, support the L-RC1 remote control and feature a Bluetooth Mesh to DALI gateway.



Figure 4: LOYBT-MS2 and LOYBT-MS2-B multi-sensor for office applications.



Figure 5: LOYBT-MS3 and LOYBT-MS3-B multi-sensor.



Figure 6: LOYBT-MS4 multi-sensor with flat lens.

The multi-sensors are powered either via a DC-power supply (12V or 24V, e.g. LOY-POW2404) or a DALI power supply (e.g. LDALI-PWR1). If a DALI power supply is used

additional DALI ballasts can be connected to the DALI-line and be controlled via the gateway function of the sensor. The current consumption is typically 6 mA (15mA max.).

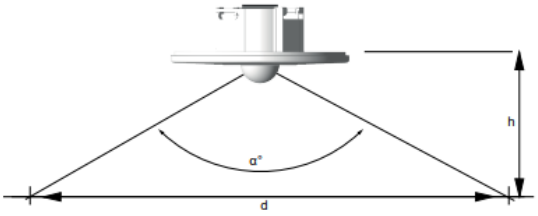
Note:	*The DC-power supply shall not provide currents of more than 1A.*

Occupancy Detection - PIR

The LOYBT-MSx performs motion detection with a high-resolution PIR sensor.

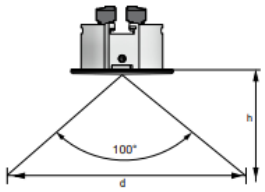
The LOYBT MS2/MS3 presence detection zone diameter of 10.8 m at 3 m mounting height is ideal to cover a typical office room or an area in an open office space. Due to the wide detection range the sensor type is also well suited for high bay applications with mounting heights of up to 12 m.

The LOYBT-MS4 provides a flat lens and the presence detection zone diameter is 7 m at 3 m mounting height. It is suitable for mounting heights of up to 5 m.



Mounting Height / Coverage LOYBT-MS2/MS3

h [m]	d [m]	A [m²]	α[°]
1.5	5.4	23	122
2.0	7.2	41	122
2.5	9.0	64	122
2.7	9.7	75	122
3.0	10.8	92	122
3.5	12.6	125	122
4.0	14.4	164	122
4.5	16.2	207	122
5.0	18.0	256	122
6.0	18.0	256	112
8.0	18.0	256	96.7
10.0	18.0	256	84
12.0	18.0	256	73.6



Mounting Height / Coverage LOYBT-MS4

h [m]	d [m]	A [m²]	α[°]
1.5	3.6	10.0	100
2.0	4.8	17.8	100
2.5	6.0	27.9	100
2.7	6.4	32.5	100
3.0	7.2	40.2	100
3.5	8.3	54.7	100
4.0	9.5	71.4	100
4.5	10.7	90.3	100
5.0	11.9	111.5	100

Figure 7: LOYBT-MSx multi-sensor PIR detection range

Occupancy Detection - Acoustic

Beside the PIR sensor the LOYBT-MSx provides acoustic presence detection. This feature is disabled by default. The sensitivity can be adjusted separately for both detection methods.

Both methods are combined to generate a single occupancy signal which is represented via the PRESENCE DETECTED property of a sensor server model.

Illuminance Measurement

The LOYBT-MSx allows to measure lux levels in the range of 0 – 4000 lux.

The measured values are represented by the PRESENT AMBIENT LIGHT LEVEL property of a separate sensor server instance.

Note: *The illuminance sensor is reporting approximately the same value as a lux meter when placed at the same position. Nevertheless, the spectral distribution of the light source may result in different values when comparing the reported measurements with those of a lux-meter.*

Note: *Since the light sensor is never placed exactly on the position at which the illuminance must be measured (the sensor is mounted in the ceiling whereas a minimum illuminance is defined for the workspace below), a calibration routine is required to identify the relationship between sensor and illuminance measurements on the target position. The LOYTEC controllers provide such a calibration routine (refer to [1]).*

Temperature and Humidity Measurement

In addition to occupancy and lux measurement, the LOYBT-MSx comes with integrated temperature and humidity sensors. In room automation applications, the additional sensor values can be used to calculate the current dew point. The sensor can perform temperature measurements in the range from -5 °C to 60 °C with a resolution of 0.1 °C and an accuracy of ±0.2 °C. The relative humidity (0 % to 100 %) is provided with a resolution of 0.5 % and an accuracy of ±2.2 % (@25 °C between 20 % and 80 % R.H.).

The values are represented by the PRECISE AMBIENT TEMPERATURE and PRESENT AMBIENT RELATIVE HUMIDITY properties of a separate sensor server instance.

Digital Inputs

On the back of the sensor, there is a connector for three digital inputs, allowing to connect conventional switches and push-buttons, window contacts, dew point sensor, etc.

The wire length connected to the digital inputs shall be below 10 m.

The values of input are represented via the LOYTEC DIIR vendor model.

Infrared Receiver

An integrated infrared receiver is designed to work with the L-RC1 infrared remote control, which is available as optional accessory (see Figure 8). The L-RC1 is an infrared remote control, optimized for room automation applications. It allows the control of the room's light, sun blinds and HVAC system.



Figure 8: L-RC1 infrared remote control for LOYBT-MSx.

Table 6 lists all button-instances of the LOYBT-MSx and the corresponding inputs.

DALI-Instance Number	Type	Input	Description
04	Digital Input	DI1	DI1 on back of LOYBT-MSx-BT
05	Digital Input	DI2	DI2 on back of LOYBT-MSx-BT
06	Digital Input	DI3	DI3 on back of LOYBT-MSx-BT
07	Button	IR-Remote Cmd 1	CH1
08	Button	IR-Remote Cmd 2	CH2
09	Button	IR-Remote Cmd 3	Sunblind UP
10	Button	IR-Remote Cmd 4	Sunblind AUTO
11	Button	IR-Remote Cmd 5	Sunblind DOWN
12	Button	IR-Remote Cmd 6	Lights UP
13	Button	IR-Remote Cmd 7	Lights AUTO
14	Button	IR-Remote Cmd 8	Lights DOWN
15	Button	IR-Remote Cmd 9	Scene A
16	Button	IR-Remote Cmd 10	Scene B
17	Button	IR-Remote Cmd 11	Scene C
18	Button	IR-Remote Cmd 12	A/C
19	Button	IR-Remote Cmd 13	Temp +
20	Button	IR-Remote Cmd 14	Temp -
21	Button	IR-Remote Cmd 15	Fan AUTO
22	Button	IR-Remote Cmd 16	Fan UP
23	Button	IR-Remote Cmd 17	Occupied
24	Button	IR-Remote Cmd 18	Vacant

Table 6: Mapping of Button/Input-Instances of LOYBT-MSx.

The remote control is represented via the LOYTEC DIIR vendor model.

Remote Bluetooth Button Switch Feature

As mentioned in [1] LOYTEC controllers with Bluetooth also support the integration of the EnOcean Bluetooth Switch PTM215B/PTM216B modules. Since those modules are communicating via common Bluetooth beacons instead of mesh-messages the range of emitted messages is limited to 1 hop. The LOYBT-MSx is capable of recognizing those messages and forward them to a LOYTEC controller via mesh. As a result, the button module

based on PTM215B/PTM216B can be located inside the direct radio range of any LOYBT-MSx or LOYTEC-controller.

Asset Tracking and Beaconing

The LOYBT-MSx series can scan for Bluetooth-beacons. A maximum of 32 active beacons (Eddystone UID+TLM or iBeacon) can be managed by the device. The asset data can be queried via a vendor model and is available on data point level on the controller. The asset data contains parameters like identifiers and RSSI-values. For more information refer to [1].

Moreover, the LOYBT-MSx supports beaconing for various frame formats (iBeacon, Eddystone-UID beacon or the LOYTEC-specific LWEB-beacon), each of which can be individually configured.

- iBeacon and Eddystone-UID beacon can be used for indoor localization and indoor navigation systems.
- The LWEB beacon offers access to LWEB-802 views via the LWEB app on a mobile device (iOS/Android) and thus provides access to room control and monitoring functions.

The beacon parameters are available as datapoints on LOYTEC-controllers. For more information refer to [1].

Bluetooth Mesh to DALI Gateway Feature

In addition to the sensor functionality the LOYBT-MSx can act as a gateway to a DALI-subsystem. If the device is supplied by a DALI power supply (e.g. LDALI-PWR1), DALI-ballasts connected to this DALI-line can be controlled via Bluetooth Mesh ecosystem.

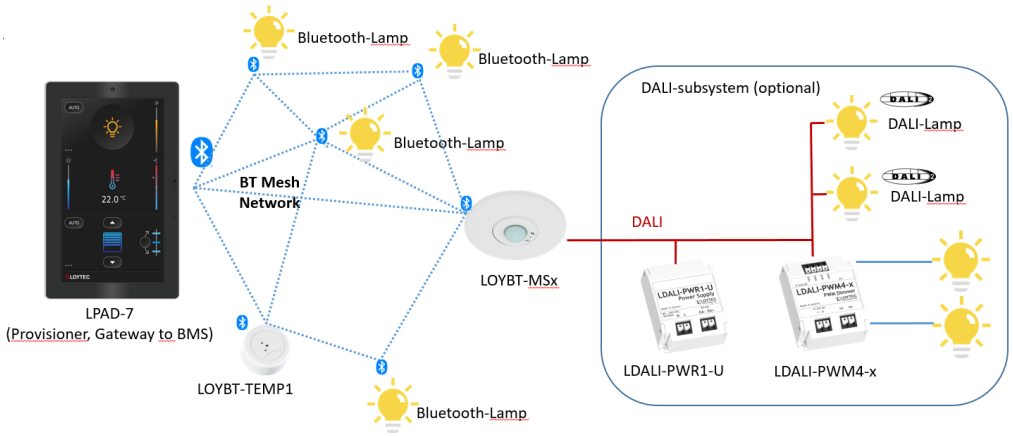


Figure 9: LOYBT-MSx acting as Bluetooth Mesh to DALI interface.

The integration of DALI ballasts into Bluetooth Mesh networks allows (re)use of proven DALI-luminaires and -technology as well as existing installations to be retrofitted easily.

Up to 16 DALI-ballasts can be integrated with the help of the gateway. They can be separated in up to 4 groups, which are exposed to the Bluetooth Mesh ecosystem as individually accessible Bluetooth Mesh luminaires. From a DALI-perspective dimmable and tunable white capable ballasts are supported.

Note: *The grouping of the DALI-ballasts to DALI groups 1-4 is performed via a vendor model, which is accessed by LOYTEC controllers during assignment of DALI-ballasts to lamp actuators on the commissioning page of the WebUI (refer to [1]).*

Status LED

The LOYBT-MSx provides a red status-LED. The behavior of this LED is as follows:

- Blinking if motion is detected if device is unprovisioned (check basic functionality and support for sensor head adjustment during installation)
- Blinking if attention timer is set (e.g. WINK-action via WebUI)
- Blinking 3 times on power-up if unprovisioned
- Blinking 3 times if device gets unprovisioned
- Blinking 1 time on power-up if provisioned

Models

The model composition for the LOYBT-MSx is shown in Table 7.

Model number	Model name	Element	Comment
0x0000	Configuration Server	Primary (0)	Network Configuration
0x0002	Health Server	Primary (0)	Status Report
0x0004	Remote Provisioning Server	Primary (0)	Range Extension
0x1000	Generic OnOff Server	Primary (0)	Loytec Config App enable/disable
0x1011	Generic Admin Property Server	Primary (0)	Device Property Report
0x1012	Generic Manufacturer Property Server	Primary (0)	Device Property Report
0x1013	Generic User Property Server	Primary (0)	Device Property Report
0x0AA00001	LOYTEC Device Server	Primary (0)	Device Extension
0x0AA00003	LOYTEC DFU Data Transfer Server	Primary (0)	Transfer Firmware Image
0x0AA00005	LOYTEC Asset Tracking Server	Primary (0)	Asset Tracking
0x0AA00007	LOYTEC Beacon Server	Primary (0)	Beacon Configuration
0x0AA00009	LOYTEC Remote Button Switch Server	Primary (0)	Bluetooth Button Switch for PTM215/216B
0x0AA0000B	LOYTEC Property Server	Primary (0)	Loytec Properties
0x0AA01007	LOYTEC DALI Gateway Server	Primary (0)	DALI-Gateway Configuration
0x1100	Sensor Server	Sec. (1)	Occupancy
0x1101	Sensor Setup Server	Sec. (1)	Occupancy
0x1100	Sensor Server	Sec. (2)	Illuminance

Model number	Model name	Element	Comment
0x1101	Sensor Setup Server	Sec. (2)	Illuminance
0x1100	Sensor Server	Sec. (3)	Temperature, Humidity
0x1101	Sensor Setup Server	Sec. (3)	Temperature, Humidity
0x1000	Generic OnOff Server	Sec. (4)	control LED for occupancy indication
0x0AA01001	LOYTEC DIIR Server	Sec. (4)	Digital Inputs, Infrared (Remote Control)
0x0002	Health Server	Sec. (5,7,9,11)	DALI-Gateway (G1, G2, G3, G4)
0x1000	Generic OnOff Server	Sec. (5,7,9,11)	DALI-Gateway (G1, G2, G3, G4)
0x1002	Generic Level Server	Sec. (5,7,9,11)	DALI-Gateway (G1, G2, G3, G4)
0x1004	Generic Default Transition Time Server	Sec. (5,7,9,11)	DALI-Gateway (G1, G2, G3, G4)
0x1006	Generic Power OnOff Server	Sec. (5,7,9,11)	DALI-Gateway (G1, G2, G3, G4)
0x1007	Generic Power OnOff Setup Server	Sec. (5,7,9,11)	DALI-Gateway (G1, G2, G3, G4)
0x1300	Light Lightness Server	Sec. (5,7,9,11)	DALI-Gateway (G1, G2, G3, G4)
0x1301	Light Lightness Setup Server	Sec. (5,7,9,11)	DALI-Gateway (G1, G2, G3, G4)
0x1303	Light CTL Server	Sec. (5,7,9,11)	DALI-Gateway (G1, G2, G3, G4)
0x1304	Light CTL Setup Server	Sec. (5,7,9,11)	DALI-Gateway (G1, G2, G3, G4)
0x1002	Generic Level Server	Sec. (6,8,10,12)	DALI-Gateway (G1, G2, G3, G4) – color temperature
0x1306	Light CTL Temperature Server	Sec. (6,8,10,12)	DALI-Gateway (G1, G2, G3, G4) – color temperature

Table 7: LOYBT-MSx composition data.

Properties of Sensor Server and Generic Property Server

The properties provided by the sensor servers are listed in Table 8.

Message Type	Property ID	Property Name	Characteristic[9]
Sensor Status (0x52)	0x004D	Presence Detected	Boolean
Sensor Status (0x52)	0x0069	Time Since Presence Detected	Time Second 16
Sensor Status (0x52)	0x004E	Present Ambient Light Level	Illuminance
Sensor Status (0x52)	0x0075	Precise Present Ambient Temperature	Temperature
Sensor Status (0x52)	0x0076	Present Ambient Relative Humidity device property	Humidity

Table 8: LOYBT-MSx message types and properties[10].

The properties provided by the property servers are listed in Table 9.

Message Type	Property ID	Property Name	Characteristic[11]
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x000B	Device Country of Origin	Country Code
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x000E	Device Firmware Revision	Fixed String 8
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x0010	Device Hardware Revision	Fixed String 16
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x0011	Device Manufacturer Name	Fixed String 36
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x0012	Device Model Number	Fixed String 24
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or	0x0019	Device Serial Number	Fixed String 16

[9] Characteristics according to GATT Specification Supplement v4 [10].

[10] Properties according Mesh Device Properties v2 Specification [11].

[11] Characteristics according to GATT Specification Supplement v4 [10].

Message Type	Property ID	Property Name	Characteristic[11]
Generic Manufacturer Property Status (0x46)			
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x0013	Device Operating Temperature Range Specification	Temperature Range
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x0017	Device Runtime Since Turn On	Time Hour 24

Table 9: LOYBT-MSx property server message types and properties[12].

Provisioning, Configuration and Operation Behavior

The provisioning and the configuration of the device is identical with the handling of any other regular mesh node. Ensure that publications are configured for each of the sensor models. Furthermore, the cadence for occupancy must be setup properly to get event notifications.

Afterwards the sensor will report the sensor readings either periodically (illuminance, temperature, humidity) or event based (presence).

On power-up the sensor is automatically identifying the power supply and in case of a DALI power supply a DALI-scan is performed. All connected DALI ballasts are identified, already addressed devices keep unchanged, whereas unaddressed ballasts get a DALI address. As long as there are no DALI-groups in use all addressed devices are assigned automatically to DALI group 1 and can be controlled via the first lamp actuator (represented by the elements 5&6 of the model composition)[13]. This allows out of the box control of DALI-ballasts.

Hint: *A third-party tool can be used for scanning, addressing and grouping (DALI group 1-4, DALI group 0 is not used). On power-up the multi-sensor will automatically find the preconfigured devices.*

Hint: *To reset the database of DALI-devices in the multi-sensor either the sensor or the DALI-database (via WebUI of a LOYTEC-controller) must be reset[14].*

[12] Properties according Mesh Device Properties v2 Specification [11].

[13] If there are already DALI-groups in use newly addressed devices are not assigned to any group, so that already configured groups keep unchanged.

[14] A LOYTEC controller offers simplified configuration on the WebUI (see also [1]).

Configuration via the Thyra Config app

The following datapoints can be configured in the Thyra Config app

Name	Access	Note
Acoustic sensitivity	Read/Write	0% disables the acoustic sensor

Table 10: LOYBT-MSx Thyra Config - device specific parameters

Reset to factory default:

There are 3 ways to reset the LOYBT-MSx:

- Remove the device from the mesh (with the help of the provisioner)
- Connect the inputs DI2 and DI3 as shown in Figure 10 and power-up the device

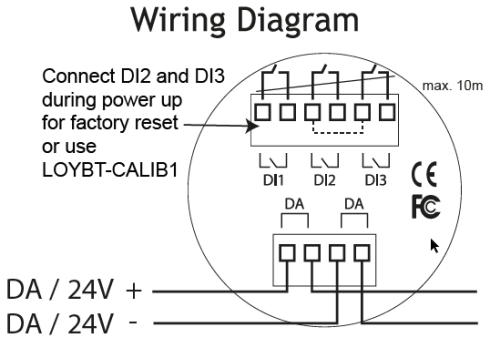


Figure 10: Wiring diagram and info about factory reset.

- As alternative the mobile app Thyra Config can be used (if the access has been activated on the device).

5.3.2 Intended Use

The LOYTEC LOYBT-MSx is intended to be used as environment sensor for room automation in a Bluetooth Mesh lighting control system. The sensor provides information about presence, illuminance, temperature and humidity as well as support for other building automation related features like digital inputs for window contacts, room control via IR remote control or a Bluetooth Mesh to DALI gateway.

The sensors are intended to be used on a ceiling or in suspended ceilings. The LOYBT-MS2 can be mounted in-wall in standard flush-mounted boxes, spring snap in false ceilings and on-wall with a surface mounting box, available as an accessory. The LOYBT-MS3 and LOYBT-MS4 are designed to be used with spring snaps in suspended ceilings.



Figure 11: LOYBT-MSx mounting options.

Operating conditions are temperatures from 0 °C to 50 °C and relative humidity from 10 % to 90 % (non-condensing). The protection degree of the housing is IP20.

5.3.3 Installation Instructions

- The LOYBT-MS2 can be mounted in-wall in standard flush-mounted boxes, on-wall with a surface mounting box, or spring snap in false ceilings
- The LOYBT-MS3/MS4 is intended to be mounted in false ceilings.
- Follow the safety instructions (see chapter 2).
- For different mounting options (in-wall, on-wall, spring) refer to the installation sheet.
- Use cable tie to ensure proper strain relief (see Figure 12).

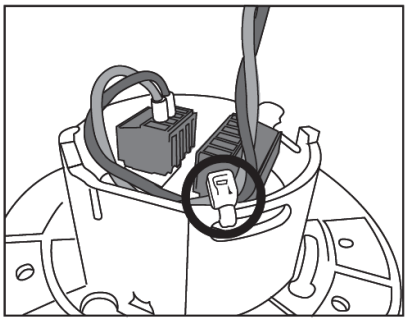


Figure 12: LOYBT-MS2/LOYBT-MS4 strain relief.

- Adjust the tilt angle of the sensor head for better coverage of the detection area.
- Use indicator (red LED) for verification of motion detection (before device commissioning).

5.4 LOYTEC LOYUNO-L UNOlite Indoor Air Quality Sensor

5.4.1 Device Description

The LOYUNO-L represents the pinnacle of indoor air quality monitoring, purposefully designed for effortless integration with BAS/BMS systems. The advanced instrument detects and analyzes a wide range of indoor air quality factors including Ultra-fine, Fine and Standard Suspended Particulates (PM1, PM2.5 and PM10), Carbon Dioxide (CO2), Total Volatile Organic Compounds (TVOC), while also monitoring Temperature and Humidity levels.

LOYUNO-L ensures accurate data, serving as a vital component in achieving LEED green or WELL certification of your building. Rigorously tested and certified for its precise sensing capabilities in detecting PM2.5, CO2, and TVOC, the LOYUNO-L meets the stringent standards set by WELL v2.

The LOYUNO-L comes equipped with Bluetooth Mesh capabilities (declaration-ID: D051757, Bluetooth 5.1), seamlessly integrating in LOYTEC Bluetooth Mesh ecosystems. In addition, the LOYUNO-L also provides a Modbus RTU and BACnet MS/TP interface for BMS integration, which makes it well-suited for both new construction projects and retrofitting BAS/BMS systems.



Figure 13: LOYUNO-L for indoor air quality monitoring.

The LOYUNO-L is either powered by a DC-power supply (12V-24V DC / 24V AC) via V+/V- terminals or by a 12V/1A dc power adapter via the DC charger input. The maximum power consumption is 6 W.

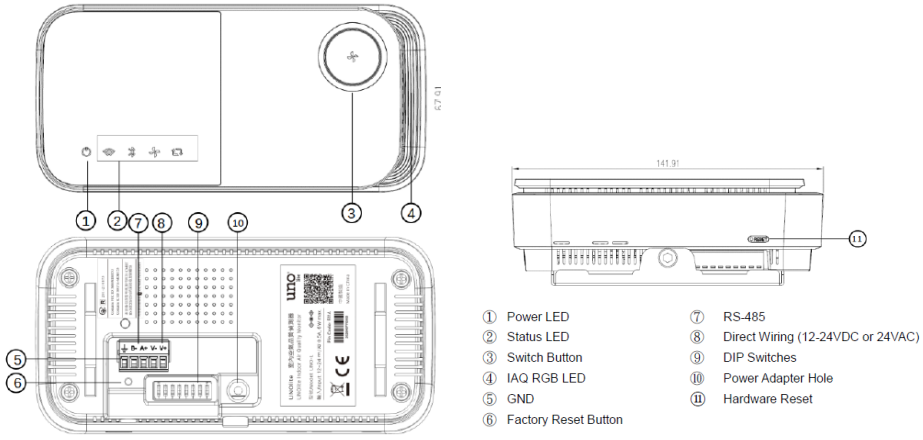


Figure 14: LOYUNO-L functional description.

Air Quality Measurement

The LOYUNO-L evaluates particulate matter concentration for different particle sizes:

PM1 in the range from 0-1000µg/m^3 with an accuracy of ± (5 µg/m^3 + 20%) in the range of 0-100µg/m^3 and ±10% in the range of 100-1000µg/m^3 is reported via the proprietary property MASS CONCENTRATION PM1.0 (0x00C0) of the sensor model.

PM2.5 in the range from 0-1000µg/m^3 with an accuracy of ± (5 µg/m^3 + 20%) in the range of 0-100µg/m^3 and ±10% in the range of 100-1000µg/m^3 is reported via the proprietary property MASS CONCENTRATION PM2.5 (0x00C1) of the sensor model.

PM10 in the range from 0-1000µg/m^3 with an accuracy of ± (5 µg/m^3 + 20%) in the range of 0-100µg/m^3 and ±25% in the range of 100-1000µg/m^3 is reported via the proprietary property MASS CONCENTRATION PM10 (0x00C2) of the sensor model.

Moreover, it is capable to measure:

CO2 in the range from 400-5000ppm with an accuracy of ± (50ppm + 5%) is reported via the property PRESENT AMBIENT CO2 CONCENTRATION (0x0077) of the sensor model.

TVOC in the range for 0-30000ppb with an accuracy of ±15% is reported via property PRESENT AMBIENT VOC CONCENTRATION (0x0078) of the sensor model.

Temperature and Humidity Measurement

In addition to air quality analysis, the LOYUNO-L comes with integrated temperature and humidity sensors. The sensor can perform temperature measurements in the range from 0 °C to 50 °C with an accuracy of ±1 °C (@25°C and 50 % R.H.). The relative humidity (10 % to 80 %) is provided with an accuracy of ±10 % (@25 °C and 50 % R.H.).

The temperature values are represented by the PRESENT INDOOR AMBIENT TEMPERATURE (0x0056) and PRECISE PRESENT AMBIENT TEMPERATURE (0x0075) properties, whereas the humidity is represented by the PRESENT INDOOR RELATIVE HUMIDITY (0x00A7) and PRESENT AMBIENT HUMIDITY (0x0076) properties, each of which is implemented in separate sensor server instances.

LED Indication

The IAQ-RGB LED (number 4 in Figure 14) is used to indicate different states and can be turned on with the switch button on the front (number 3 in Figure 14):

Indication	Description
Breathing Light BLUE	Device is booting
Breathing Light GREEN	Indoor Air Quality is GOOD
Breathing Light YELLOW	Indoor Air Quality is MODERATE
Breathing Light RED	Indoor Air Quality is UNHEALTHY
Breathing Light PURPLE	Indoor Air Quality is VERY UNHEALTHY
Steady OFF	IAQ-RGB LED turned off via switch button

Table 11: LOYUNO-L RGB-LED description.

Status LED Indication:

Indicator	Behavior	Description
Power	Steady Off	Device is not powered correctly.
Power	Steady On	Device is powered.
BLE	Steady Off	No BLE connection.
BLE	Steady On	In BLE connection.
BLE	Flash Rapidly	In BLE binding process.
Wi-Fi	Steady Off / On	Wi-Fi not used on this device type.
Equipment	Reserved	Reserved
Filter Status	Reserved	Reserved

Table 12: LOYUNO-L status LED description.

During factory reset all LEDs flash rapidly.

If the attention timer is set (BT-mesh operation) the Status-LEDs are running a light sequence.

Models and Sensor Properties

The model composition for the LOYUNO-L is shown in Table 13.

Model number	Model name	Element	Comment
0x0000	Configuration Server	Primary (0)	Network Configuration
0x0002	Health Server	Primary (0)	Status Report
0x1102	Sensor Client	Primary (0)	
0x1100	Sensor Server	Sec (1)	CO2
0x1101	Sensor Setup Server	Sec (1)	CO2
0x1100	Sensor Server	Sec (2)	Indoor Temperature
0x1101	Sensor Setup Server	Sec (2)	Indoor Temperature
0x1100	Sensor Server	Sec (3)	Indoor Rel. Humidity
0x1101	Sensor Setup Server	Sec (3)	Indoor Rel. Humidity
0x1100	Sensor Server	Sec (4)	VOC
0x1101	Sensor Setup Server	Sec (4)	VOC
0x1100	Sensor Server	Sec (5)	PM1.0

Model number	Model name	Element	Comment
0x1101	Sensor Setup Server	Sec (5)	PM1.0
0x1100	Sensor Server	Sec (6)	PM2.5
0x1101	Sensor Setup Server	Sec (6)	PM2.5
0x1100	Sensor Server	Sec (7)	PM10
0x1101	Sensor Setup Server	Sec (7)	PM10
0x1100	Sensor Server	Sec (8)	-
0x1101	Sensor Setup Server	Sec (8)	-
0x1100	Sensor Server	Sec (9)	Temperature
0x1101	Sensor Setup Server	Sec (9)	Temperature

Table 13: LOYUNO-L composition data.

The properties provided by the sensor servers are listed in Table 14.

Message Type	Property-ID	Property Name	Characteristic[15]
Sensor Status (0x52)	0x0056	Present Indoor Ambient Temperature	Temperature 8
Sensor Status (0x52)	0x0075	Precise Present Ambient Temperature	Temperature
Sensor Status (0x52)	0x0076	Present Ambient Relative Humidity	Humidity
Sensor Status (0x52)	0x0077	Present Ambient CO2 Concentration	CO2 Concentration
Sensor Status (0x52)	0x0078	Present Ambient VOC Concentration	VOC Concentration
Sensor Status (0x52)	0x00A7	Present Indoor Relative Humidity	Humidity
Sensor Status (0x52)	0x00C0	Mass concentration PM 1.0	-
Sensor Status (0x52)	0x00C1	Mass concentration PM 2.5	-
Sensor Status (0x52)	0x00C2	Mass concentration PM 10	-

Table 14: LOYUNO-L sensor server message types and properties[16].

[15] Characteristics according to GATT Specification Supplement v4 [10].

[16] Properties according Mesh Device Properties v2 Specification [11].

Provisioning, Configuration and Operation Behavior

The provisioning and the configuration of the device is identical to the handling of any other regular mesh node. When setting up the publication intervals consider the internal sensor refresh rate of 10 seconds. Ensure that publications are configured for each of the sensor models.

Afterwards the device will report the sensor readings periodically.

Factory Reset:

After booting, press the button for factory reset on the backside of the device three times within 2 seconds (see Figure 14). It is recommended to use a paper clip to press the button. This will trigger a factory reset. Next, all values will be reset and the following action will take place:

- Turn the device in unprovisioned state

Additionally (not BT-mesh related) the following values will be restored to default:

- Modbus baud rate
- BACnet saved mac address
- CO2 auto baseline calibration is ON
- Sensor calibration settings

Hardware Reset:

Pushing the button on the bottom of the device will trigger a power cycle (see Figure 14). It is recommended to use a paper clip to press the button.

Note: *Integration via Modbus, BACnet is not part of this manual. For more detailed information for Modbus refer to [12], for BACnet refer to [13].*

5.4.2 Intended Use

The LOYUNO-L is intended to be used as air quality sensor. It can be integrated in a BMS/BAS via BACnet MSTP, ModBus RTU and Bluetooth Mesh. The sensor provides information about Ultra-fine, Fine and Standard Suspended Particulates (PM1, PM2.5 and PM10), Carbon Dioxide (CO2), Total Volatile Organic Compounds (TVOC), temperature and humidity.

The sensors are intended to be wall mounted indoor at a height between 0.8 m and 1.5m. With the help of the included mounting kits, it can be mounted on standard junction boxes of various regions (US, EMEA, China).

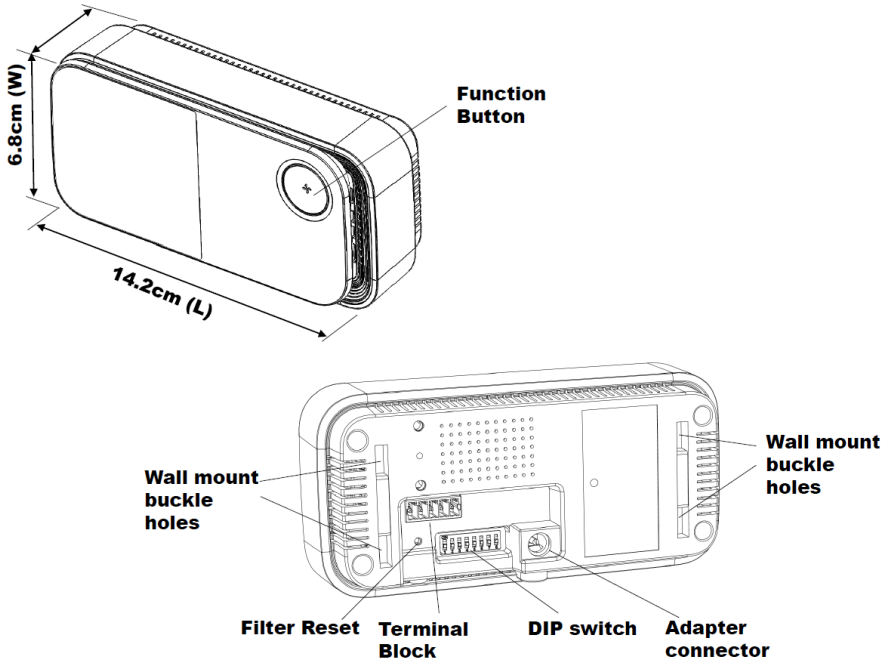


Figure 15: LOYUNO-L mechanical and electrical connections.

Operating conditions are temperatures from 0 °C to 50 °C and relative humidity from 10 % to 90 % (non-condensing). The protection degree of the housing is IP20.

5.4.3 Installation Instructions

- The LOYUNO-L is intended to be mounted on-wall with the help of a mounting kit (included).
- Locate the LOYUNO-L
  - At least 5 meters away from operable windows, doors, and diffusers.
  - The optimal installation height is 0.8m to 1.5m from the ground.
  - Air is drawn into the LOYUNO-L from the lower side and there is natural air exchange on each side, it is vital that neither side of the device is covered. Any changes in airflow may affect the readings and accuracy.
  - Avoid direct sunlight.
  - Keep away from air-conditioning outlet.
  - Keep away from light heat source.
  - Keep away from fire and cooking areas.
- Follow the safety instructions (see chapter 2).
- Select suitable wall mount frame to meet different junction
  - Small Wall Mount frame (Delta Part No.: 3487312702), to be installed with 1 Gang Embedded Junction Box
  - Large Wall Mount frame (Delta Part No.: 3994041800), to be installed with 2 Gang Embedded Junction Box
  - Large Wall Mount frame cover can be mounted directly on a junction box

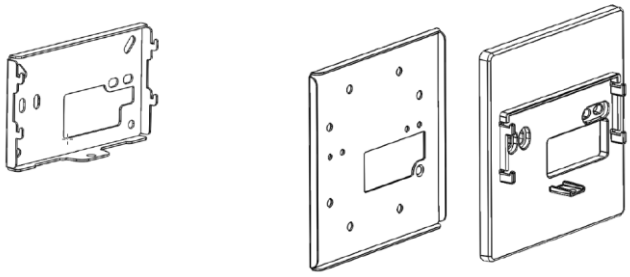


Figure 16: LOYUNO-L wall mount frames.

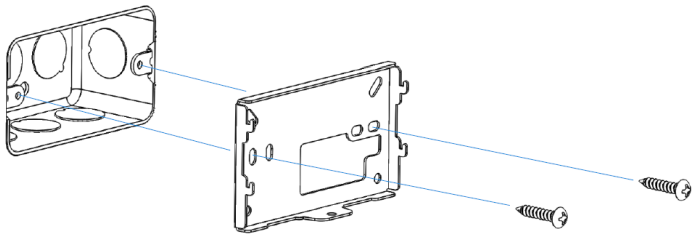


Figure 17: Install small Wall Mount frame with 1gang embedded junction box.

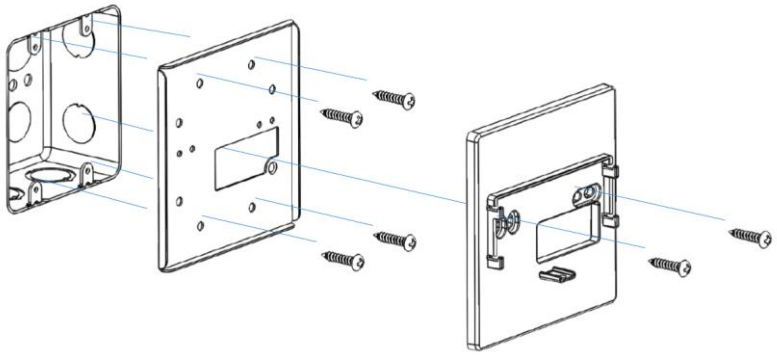


Figure 18: Install LOYUNO-L with large wall mount kit and 2 gang embedded junction box.

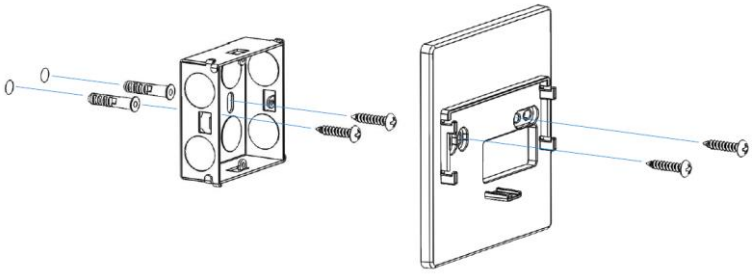


Figure 19: Install LOYUNO-L with large wall mount cover with junction box.

.

- Arrange Power Lines
  - Insert wire cables to terminal plug and insert terminal plug
    Or
  - DC power plug to LOYUNO-L

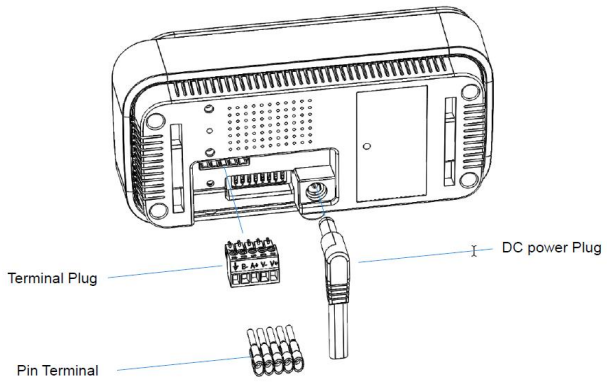


Figure 20: Connect Terminal Plug or DC Power Plug.

- Mount LOYUNO-L on four buckles of the wall mount fixture and fix the device with a M4 screw using a Hex screw-driver

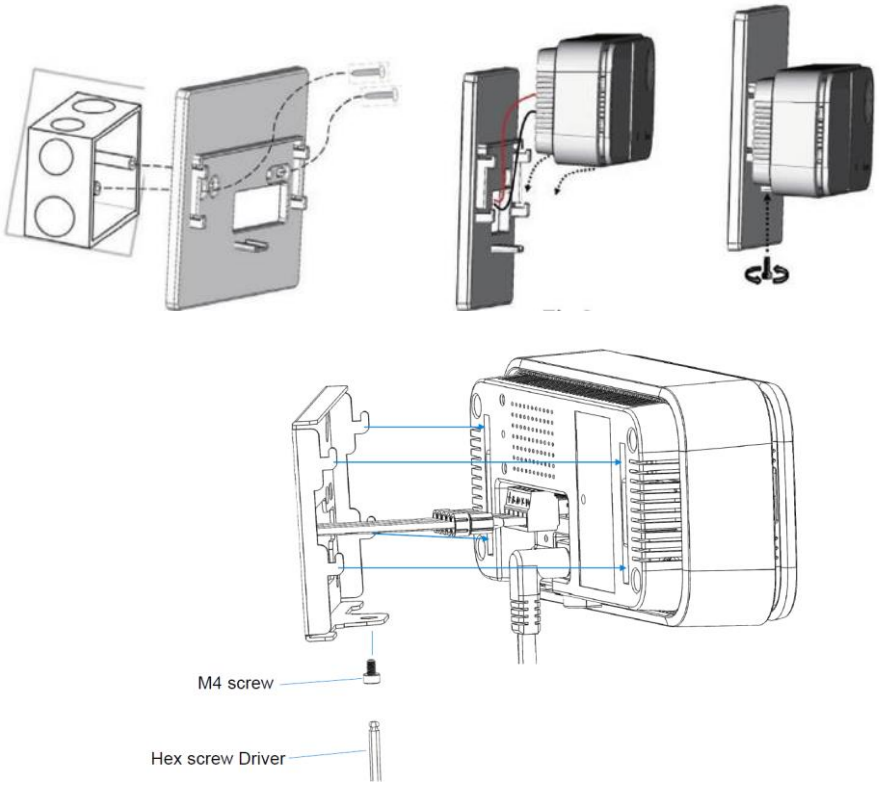


Figure 21: Mount on four buckles and fix LOYUNO-L with M4 screw.

6 LOYBT - Actuators

6.1 Overview

LOYTEC provides different types of actuators with a Bluetooth Mesh interface. This chapter deals with the characteristics of those devices.

6.2 LOYTEC LOYBT-SBM1 Sunblind Module

6.2.1 Device Description

The LOYBT-SBM1 sunblind module is a compact actuator for the control of sun blinds in a Bluetooth Mesh ecosystem. It is based on the Bluetooth SIG qualified mesh stack (Declaration-ID: Design number (DN) Q301729, contains qualified designs: 239299 (controller subsystem Bluetooth 5.4), 239354 (host subsystem Bluetooth 5.4) and 226841 (Mesh Protocol 1.1, Mesh Model 1.1 and NLC-Profiles 1.0).

The device is mains powered and comes with 2 built-in relay contacts, which are suitable to switch currents of up to 6A at 250V AC.

For sunblind control the module uses a vendor server model, which provides a command set that contains direction and duration information for the blinds connected to the relay outputs. This allows LOYTEC controllers with Bluetooth Mesh interface to control sun blinds wirelessly.

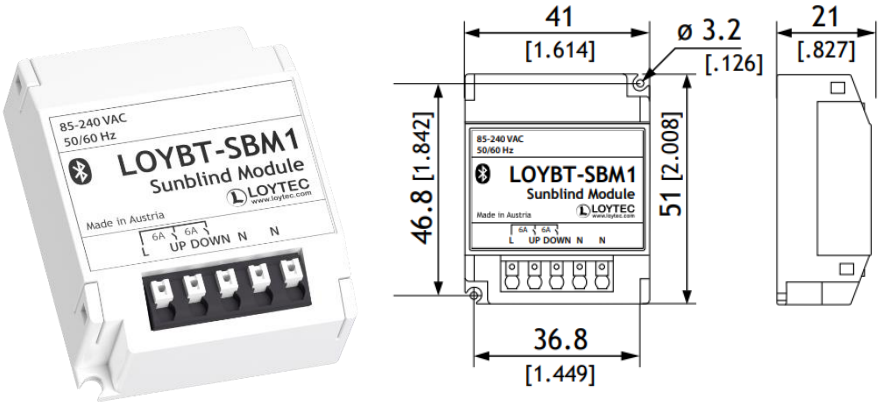


Figure 22: LOYBT-SBM1 sunblind module

The LOYBT-SBM1 is suited to control a single sunblind-motor, which is controlled by switching mains voltage to separate inputs for moving up and down (Figure 23).

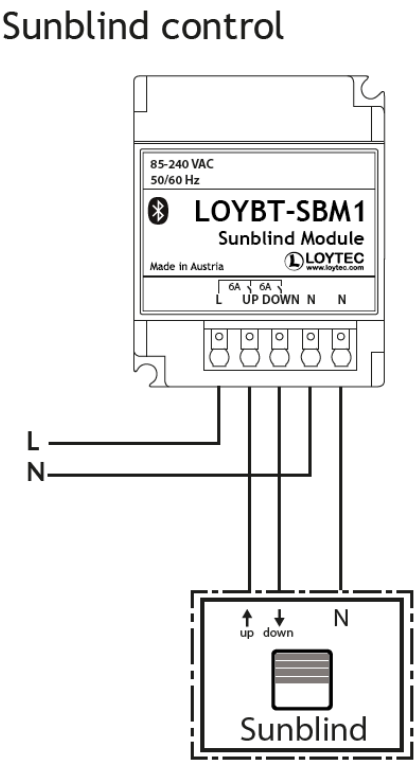


Figure 23: LOYBT-SBM1 module for control of a single sunblind motor

Note: *Sunblind control is supported via vendor models only.*

Reset-Button

A reset button on the backside of the device (operated by a proper tool or needle) allows to reset the device to factory default, which means the device is in an unprovisioned state afterwards.

Note: *Use a proper insulated tool for reset operation.*

Models

The model composition for the LOYBT-SBM1 is shown in Table 15.

Model number	Model name	Element	Comment
0x0000	Configuration Server	Primary(0)	Network Configuration
0x0002	Health Server	Primary(0)	
0x0004	Remote Provisioning Server	Primary(0)	Range Extension
0x1011	Generic Admin Property Server	Primary(0)	Device Property Report

Model number	Model name	Element	Comment
0x1000	Generic OnOff Server	Primary(0)	Loytec Config App enable/disable
0x1012	Generic Manufacturer Property Server	Primary(0)	Device Property Report
0x1013	Generic User Property Server	Primary(0)	Device Property Report
0x0AA00001	LOYTEC Device Server	Primary(0)	Device Extension
0x0AA00003	LOYTEC DFU Data Transfer Server	Primary(0)	Transfer Firmware Image
0x0AA00009	LOYTEC Remote Button Switch Server	Primary(0)	Bluetooth Button Switch for PTM215/216B
0x0AA0000B	LOYTEC Property Server	Primary (0)	Loytec Properties
0x0AA01005	LOYTEC SB Server	Primary(0)	Sunblind Control
0x1002	Generic Level Server	Sec. (1)	Sunblind Position
0x1002	Generic Level Server	Sec. (2)	Sunblind Rotation

Table 15: LOYBT-SBM1 composition data.

Properties of Generic Property Server

The properties provided by the property server are listed in Table 16.

Message Type	Property ID	Property Name	Characteristic[17]
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x000B	Device Country of Origin	Country Code
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x000E	Device Firmware Revision	Fixed String 8
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x0010	Device Hardware Revision	Fixed String 16
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x0011	Device Manufacturer Name	Fixed String 36
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x0012	Device Model Number	Fixed String 24

[17] Characteristics according to GATT Specification Supplement v4 [10].

Message Type	Property ID	Property Name	Characteristic[17]
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x0019	Device Serial Number	Fixed String 16
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x0013	Device Operating Temperature Range Specification	Temperature Range
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x0017	Device Runtime Since Turn On	Time Hour 24

Table 16: LOYBT-SBM1 message types and properties[18].

Messages in the Position - Generic Level Server

Message Type	Description
Generic Level Get (0x82 0x05), Generic Level Status (0x82 0x08)	Reports on the current absolute position (entire range is mapped to 0-100%)
Generic Level Set (0x82 0x06), Generic Level Set Unacknowledged (0x82 0x07)	Starts an absolute movement to the desired position (entire range is mapped to 0-100%)
Generic Delta Set (0x82 0x09), Generic Delta Set Unacknowledged (0x82 0x0A)	Start a relative movement including rotation for 1/6 of the rotation time or 200 ms if no rotation time is set
Generic Move Set (0x82 0x0B), Generic Move Set Unacknowledged (0x82 0x0C)	Starts an absolute movement, which is only stopped by a Generic Move Set with the value 0 or any other Set-Command to this Generic Level Server

Table 17: LOYBT-SBM1 Position – Generic Level Server Opcodes

Messages in the Rotation - Generic Level Server

Message Type	Description
Generic Level Get (0x82 0x05), Generic Level Status (0x82 0x08)	Reports on the current absolute rotation (entire range is mapped to Min Angle – Max Angle)
Generic Level Set (0x82 0x06), Generic Level Set Unacknowledged (0x82 0x07)	Starts an absolute rotational movement (entire range is mapped to Min Angle – Max Angle)
Generic Delta Set (0x82 0x09), Generic Delta Set Unacknowledged (0x82 0x0A)	Start a relative rotational movement (entire range is mapped to Min Angle – Max Angle)

[18] Properties according Mesh Device Properties v2 Specification [11].

Message Type	Description
Generic Move Set (0x82 0x0B), Generic Move Set Unacknowledged (0x82 0x0C)	Starts an absolute rotational movement towards the Min Angle or Max Angle, which is only stopped by a Generic Move Set with the value 0 or any other Set-Command to this Generic Level Server

Table 18: LOYBT-SBM1 Rotation – Generic Level Server Opcodes

Provisioning, Configuration and Operation Behavior

The provisioning and the configuration of the device is identical with the handling of any other regular mesh node.

A Bluetooth enabled LOYTEC controller is needed to access the LOYTEC SB server model, which is required for sunblind control.

Configuration via "Thyra Config" app

The following datapoints can be configured in the Thyra Config app

Name	Access	Note
Open Time	Read/Write	Required for absolute position movements
Close Time	Read/Write	Required for absolute position movements
Rotation Time	Read/Write	Required for absolute rotation movements
Min Angle	Read/Write	Measured relative from horizontal position
Max Angle	Read/Write	Measured relative from horizontal position
Power On Position	Read/Write	Applied after power cycle
Start Initialization Run	Action	Measures Open and Close Time

Table 19: LOYBT-SBM Thyra Config - device specific parameters

Third party integration via Generic Level Servers

We recommend the following workflow:

1. Commission the LOYBT-SBM1 with the "Thyra Config" app
2. Use the Position Generic Level Server in Element 1 together with a Bluetooth Mesh Switch in Sunblind mode, which sends Generic Move Set Commands on a Long press and Generic Delta Set commands on a short press for direct control
3. Use the Generic Level Set in both Position and Rotation Generic Level Servers for overrides and automated control

Reset to factory default:

There are 3 ways to reset the LOYBT-SBM1:

- Remove the device from the mesh (with the help of the provisioner)
- Press the reset button on the backside of the device for at least 10 seconds.
- As alternative the mobile app “Thyra Config” can be used (if the access has been activated on the device).

6.2.2 Intended Use

The LOYTEC LOYBT-SBM1 is intended to be used as actuator for sunblind control in a Bluetooth Mesh system. The device allows to control a single sunblind motor.

The device is intended to be installed in a distribution box.

Operating conditions are temperatures from 0 °C to 50 °C and relative humidity from 10 % to 90 % (non-condensing). The protection degree of the housing is IP20.

6.2.3 Installation Instructions

- The device is suitable for installation in a distribution box.
- Follow the safety instructions (see chapter 2).
- For wiring refer to the installation sheet or Figure 23.

6.3 LOYTEC LOYBT-IO1 I/O-Module

6.3.1 Device Description

The LOYBT-IO1 is a compact I/O module operated in a Bluetooth Mesh ecosystem. It is based on the Bluetooth SIG qualified mesh stack (Declaration-ID: Design number (DN) Q301729, contains qualified designs: 239299 (controller subsystem Bluetooth 5.4), 239354 (host subsystem Bluetooth 5.4) and 226841 (Mesh Protocol 1.1, Mesh Model 1.1 and NLC-Profiles 1.0).

The device is either mains powered (85-240 V AC) or supplied via a 24V AC / 24 V DC SELV-circuit. It comes with 12 universal I/Os and 6 digital outputs (4x Relay, 2x TRIAC).

The LOYBT-IO1 integrates perfectly into the LOYBT product line. Bluetooth Mesh enabled LOYTEC controllers allow individual configuration of all I/Os (tailored to the respective application) via datapoints that are mapped to commands and properties of vendor models for each I/O.

Note: *Configuration and control of the I/Os is supported via vendor models only.*

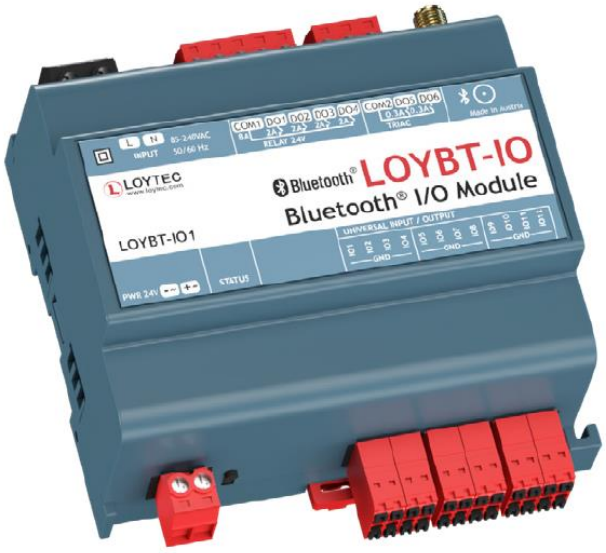


Figure 24: LOYBT-IO1 I/O-module.

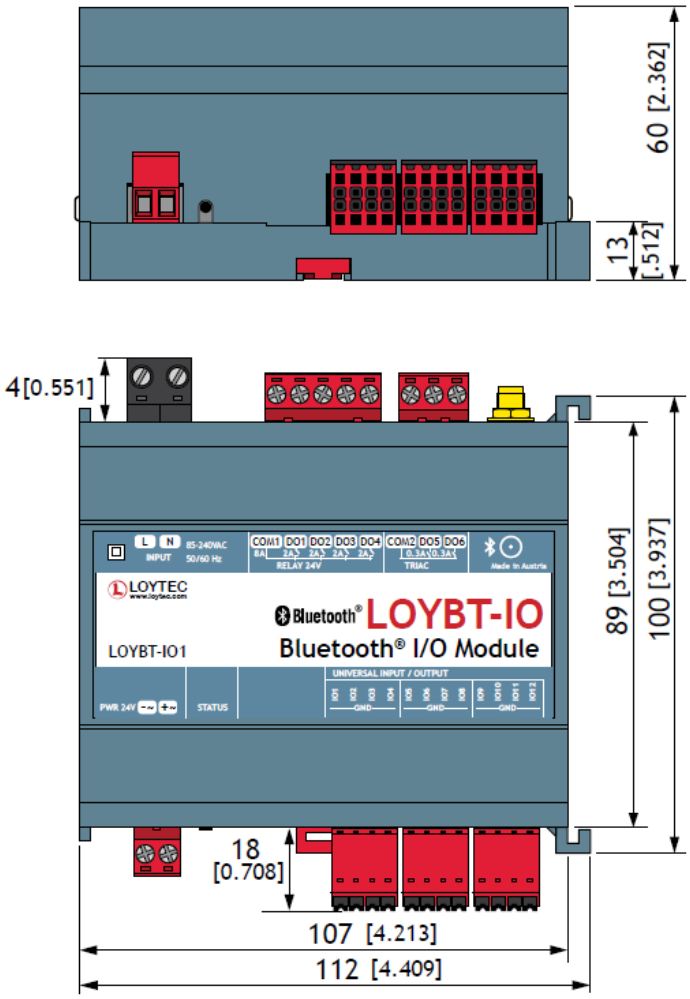


Figure 25: LOYBT-IO1 I/O-module dimensions.

Reset-Button

A reset button on the bottom of the device allows to reset the device to factory default, which means the device is in an unprovisioned state afterwards.

LED-Indicator

The LOYBT-IO1 provides a multicolor status-LED. The behavior of this LED is as follows:

- Blinking if attention timer is set (e.g. WINK-action via WebUI)
- Blinking 3 times on power-up if unprovisioned
- Blinking 3 times if device gets unprovisioned
- Blinking 1 time on power-up if provisioned
- Continuous green during normal operation

Models

The model composition for the LOYBT-IO1 is shown in Table 20.

Model number	Model name	Element	Comment
0x0000	Configuration Server	Primary(0)	Network Configuration
0x0002	Health Server	Primary(0)	
0x0004	Remote Provisioning Server	Primary(0)	Range Extension
0x1000	Generic OnOff Server	Primary(0)	Loytec Config App enable/disable
0x1011	Generic Admin Property Server	Primary(0)	Device Property Report
0x1012	Generic Manufacturer Property Server	Primary(0)	Device Property Report
0x1013	Generic User Property Server	Primary(0)	Device Property Report
0x0AA00001	LOYTEC Device Server	Primary(0)	Device Extension
0x0AA00003	LOYTEC DFU Data Transfer Server	Primary(0)	Transfer Firmware Image
0x0AA0000B	LOYTEC Property Server	Primary(0)	Loytec Properties
0x0AA01003	LOYTEC LIOB Server	Sec (1-18)	I/O Parameters and Control

Table 20: LOYBT-IO1 composition data.

Properties of Generic Property Server

The properties provided by the property server are listed in Table 21.

Message Type	Property ID	Property Name	Characteristic[19]
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x000B	Device Country of Origin	Country Code
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x000E	Device Firmware Revision	Fixed String 8
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x0010	Device Hardware Revision	Fixed String 16
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x0011	Device Manufacturer Name	Fixed String 36
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x0012	Device Model Number	Fixed String 24

[19] Characteristics according to GATT Specification Supplement v4 [10].

Message Type	Property ID	Property Name	Characteristic[19]
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x0019	Device Serial Number	Fixed String 16
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x0013	Device Operating Temperature Range Specification	Temperature Range
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x0017	Device Runtime Since Turn On	Time Hour 24

Table 21: LOYBT-IO1 message types and properties[20].

Provisioning, Configuration and Operation Behavior

The provisioning and the configuration of the device is identical to the handling of any other regular mesh node.

A Bluetooth enabled LOYTEC controller is needed to access the LOYTEC LIOB server model, which is required for configuration and control of the I/Os. In case of lost communication to the host controller the device enters a fail-safe state. In this state all outputs are set to their default value. The failsafe state is reflected by the error code 0x29 (Device Dropped Warning) published by the health model.

Reset to factory default:

There are 3 ways to reset the LOYBT-IO1:

- Remove the device from the mesh (with the help of the provisioner).
- Press the button on the bottom of the device for at least 10 seconds.
- As alternative the mobile app “Thyra Config” can be used (if the access has been activated on the device).

6.3.2 Intended Use

The LOYTEC LOYBT-IO1 is intended to be used as I/O-module in a Bluetooth Mesh system. The devices allow control of 6 digital outputs (2 TRIACS, 4 Relays) and 12 universal I/Os.

The device is intended for din-rail mounting in a distribution box or switching cabinet. If the mounting location is within a metal enclosure the external antenna has to be placed outside of this metal enclosure.

Operating conditions are temperatures from 0 °C to 50 °C and relative humidity from 10 % to 90 % (non-condensing). The protection degree of the housing is IP40, the terminals are IP20.

[20] Properties according Mesh Device Properties v2 Specification [11].

6.3.3 Installation Instructions

- The device is suitable for installation in a distribution box or switching cabinet.
- Follow the safety instructions (see chapter 2).
- Follow the guidelines in the installation sheet.
- Do not connect GND and 24V Minus.
- Connect the external antenna to ensure proper Bluetooth connectivity.

6.4 LOYTEC RT1 – Radiator Valve

6.4.1 Device Description

The LOYBT-RT1 radiator valve is an actuator for the control of radiators in a Bluetooth Mesh ecosystem. It is based on the Bluetooth SIG qualified mesh stack (Declaration-ID: Design number (DN) Q301729, contains qualified designs: 239299 (controller subsystem Bluetooth 5.4), 239354 (host subsystem Bluetooth 5.4) and 226841 (Mesh Protocol 1.1, Mesh Model 1.1). It is a Low-Power device based on the friendship feature to configure and maintain Low-Power nodes inside a mesh network.

The device is powered by a battery pack with 3.6 Volt. Unless otherwise stated in the datasheet, the battery charge is 8500 mAh.



Figure 26: LOYBT-RT1



Figure 27: LOYBT-RT1 Battery Pack

The basic modes for the RT1 are as follows. Settings will be explained in more detail afterwards.

Mode	Usage	Setting
Internal Heating	Standard mode. Uses internal temperature sensor to determine regulating variable. The heating setpoint is used.	Setpoint via generic user property/ Loytec model
External Heating	Regulating variable is determined through external temperature sensor and temperature setpoint. The heating setpoint is used.	Setpoint via generic user property/ Loytec model. Sensor shall be set via sensor server, a value of 0 will reset to internal temperature.
Internal Energy Saving	When changed to this mode energy saving setpoint will be used to determine regulating variable, used for vacant present regulation.	Alternative setpoint via Loytec model.

Mode	Usage	Setting
External Energy Saving	Regulating variable is determined through external temperature sensor and energy saving temperature setpoint.	Alternative setpoint via Loytec model. Sensor shall be set via sensor server, a value of 0 will reset to internal temperature.
Position	Position mode is used to directly control the position of the valve. If not in friendship for a period of more than 2hrs and no other signal is received the device will do a fallback to the internal heating mode.	Generic level server

For **Internal Heating** control, configure the setpoint by using the **Desired Ambient Temperature** property in the Generic Property Server model. To use an external sensor, switch the device to **External Heating** mode by writing a temperature value to the Sensor Client. For **Position** mode, control the valve position through the Generic Level Server. Modes are set automatically if the corresponding value is changed (e.g. if device is in the internal temperature mode and receives a level through the Generic Level Server the device will change to the position mode).

Set-Button

A double button press is used to wake up the device so that it can be added to or removed from the Bluetooth Mesh network. If the device is already part of a network it will wake up for 5 minutes, otherwise the device will send its unprovisioned device beacon for 2 minutes.

A long press (>3s) is used to initiate the adaptation process described in detail in the included installation sheet and in the installation instructions (chapter 6.4.3).

One short press (< 1s) with a following long press (> 5s) resets value of the internal battery level calculation and shall be pressed if a new battery has been inserted as described in the installation instructions (chapter 6.4.3).

Reset-Button

A short button press turns on the indication LEDs of the device representing the current state of the device.

For a factory reset, hold the button for > 10 seconds. Afterwards, the device is unprovisioned, set to the default internal heating mode (temperature setting of 8 °C), and will repeat the adaptation phase.

LED-Indicators

The Setup-LED signals the state of the setup sequence consisting of the adaptation process used to determine the valve position boundaries. The color orange indicates that a process is still in action, green indicates a successful adaptation and red an unsuccessful one.

The Network-LED indicates the mesh state where red indicates an unprovisioned device, orange a provisioned device which is not in friendship and a green LED a device which is in a mesh network and is in friendship.

The Status-LED is only set on special errors and indicates firmware updates with orange.

General LED indications:

	LED 1	LED 2	LED 3
RED	Adaptation error	Device unprovisioned	--
RED BLINK	--	Device provisioned and awake	--
ORANGE	Device ready to mount	Device provisioned not in friendship	Update in progress
ORANGE BLINK	Device in adaptation	--	--
GREEN	Adaptation successful	Provisioned and in friendship	--
GREEN BLINK	--	Provisioning to a network	--

Additionally, to the general LED indications there is a special state shown below

	LED 1	LED 2	LED 3
HOST FMW UPDATE	ORANGE	GREEN	ORANGE

Provisioning, Configuration and Behavior

The LOYBT-RT1 operates as a battery powered Low-Power Node (LPN). The device is in deep sleep most of the time and per default it operates in internal heating mode with a temperature setpoint of 8 °C. This shall act as an out of the box anti-freezing protection if installed with the intent of provisioning it later.

For provisioning double-press the SET push button to activate the device. Once it is awake (and unprovisioned), the node advertises its unprovisioned-device beacon for 2 minutes. If no provisioning link is established within this period, the radio is shut down and the device returns to deep sleep.

After successful provisioning, the node remains idle for 1 minute before entering Friendship procedures. This delay guarantees that network keys and settings are fully stored to non-volatile memory. The node then initiates the Bluetooth Mesh Friend Request procedure and searches for a Friend node in its radio range. Once a Friend is selected, the LOYBT-RT1 polls the Friends queue every 2 minutes. The Friend buffers any mesh messages addressed to the LOYBT-RT1 and delivers them during these poll transactions, ensuring reliable delivery while the Low-Power node remains in its Low-Power state.

To unprovision the device, perform a double button press followed by the removal sequence from the provisioner or reset the device.

Note: *A friend is required for proper operation of the LOYBT-RT1. Without friendship relation, messages to the LOYBT-RT1, like reference value for temperature, position or the measurements of an external temperature sensor, are not stored and queued while the radiator valve is sleeping and cannot be polled later.*

Battery

The battery pack consists of a main lithium component that holds 8500 mAh of charge with 3.6 V and an additional rechargeable capacitor acting as a buffer for current peaks to ensure maximum battery lifetime. The device is at sleep most of the time and only wakes up for periodic publishing or for a friendship poll if in friendship. The device’s battery lifetime is

highly dependent on the frequency of valve actuation. A single full valve cycle (i.e., opening from 0 % → 100 % → 0 %) consumes conservatively (below) 0.75 mAh.

To illustrate the impact of actuation frequency:

Performing one full drive per hour results in about 6570 mAh/year

Performing one full drive per day results in about 275 mAh/year.

When designing the system logic, minimize unnecessary valve operations to maximize device lifetime.

Without any additional movement:

Device State	**Current Consumption**	**Expected Battery Lifetime[21]**
Unprovisioned	7.5 µA	> 10 years
provisioned, in friendship	18 µA	>10 years
Provisioned, in friendship, 1 full cycle per day (open/close)	50 µA	>10 years
Provisioned, in friendship, 5 full cycles per day (open/close)	175uA	>4 years

Note: *The estimation of battery lifetime heavily depends on the valve movement. Since the internal regulator performs only small position increments of the valve, it is hard to make accurate predictions. Typically, the accumulated overall movement should be below 2-3 full cycles per day which corresponds to an expected battery lifetime of 8 years (assuming an 80% battery efficiency).*

[21] The calculation of the lifetime considers an efficiency of 80% of the battery pack (8500 mAh), the efficiency includes self-discharge and a high safety margin.

Models

The model composition for the LOYBT-RT1 is shown in Table 22.

Model number	Model name	Element	Comment
0x0000	Configuration Server	Primary (0)	Network Configuration
0x0002	Health Server	Primary (0)	Status Report
0x0004	Remote Provisioning Server	Primary (0)	--
0x1000	Generic OnOff Server	Primary (0)	Loytec Config App enable/disable
0x1013	Generic User Property Server	Primary (0)	Set Reference Temperature
0x1012	Generic Manufacturer Property Server	Primary (0)	--
0x1011	Generic Admin Property	Primary (0)	--
0x100C	Generic Battery Server	Primary (0)	Battery Status
0x0AA00001	LOYTEC Device Server	Primary (0)	Device Extension
0x0AA00003	Loytec DFU Server	Primary (0)	DFU
0x1002	Generic Level Server	Sec (1)	Set Level of Valve
0x1100	Sensor Server	Sec (1)	Get Valve Temperature
0x1101	Sensor Setup Server	Sec (1)	
0x1102	Sensor Client	Sec (1)	Bind External Temperature Sensor

Table 22: LOYBT-RT1 composition data.

Properties of Generic Property Server

The properties provided by the user property server are listed in Table 23: LOYBT-RT1 user property server.

Message Type	Property ID	Property Name	Characteristic[22]
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x000B	Device Country of Origin	Country Code
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x000E	Device Firmware Revision	Fixed String 8
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x0010	Device Hardware Revision	Fixed String 16
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x0011	Device Manufacturer Name	Fixed String 36
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x0012	Device Model Number	Fixed String 24
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x0019	Device Serial Number	Fixed String 16
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x0013	Device Operating Temperature Range Specification	Temperature Range
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x0017	Device Runtime Since Turn On	Time Hour 24
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x000B	Device Country of Origin	Country Code
Generic User Property Set (0x4C)	0x0071	Desired Ambient Temperature	Temperature 8

Table 23: LOYBT-RT1 user property server

[22] Characteristics according to GATT Specification Supplement v4 [10].

Properties of Sensor Client

The properties used by the sensor client are listed in Table 24.

Message Type	Property ID	Property Name	Characteristic[23]
Sensor Status (0x52)	0x004F	Present Ambient Temperature	Temperature 8

Table 24: LOYBT-RT1 sensor client.

Properties of Sensor Server

The properties provided by the sensor server are listed in Table 25.

Message Type	Property ID	Property Name	Characteristic[24]
Sensor Status (0x52)	0x0075	Precise Present Ambient Temperature	Temperature

Table 25: LOYBT-RT1 sensor server.

Properties of Generic Level Server

The properties provided by the generic level server are listed in Table 26.

Message Type	Property ID	Property Name	Characteristic[25]
Generic Level (0x82)	0x07	Generic Level Set Unacknowledged	Generic Level state

Table 26: LOYBT-RT1 generic level server.

6.4.2 Intended Use

The LOYTEC LOYBT-RT1 is designed as a radiator actuator, enabling automatic control within a Bluetooth Mesh network. It can be controlled either with the **internal temperature sensor**, with an **external sensor** or with **position control**.

To control the LOYBT-RT1 with the **internal temperature** sensor the refence temperature value has to be provided via the **Desired Ambient Temperature** (Property ID 0x0071, Generic

[23] Characteristics according to GATT Specification Supplement v4 [10].

[24] Characteristics according to GATT Specification Supplement v4 [10].

[25] Characteristics according to GATT Specification Supplement v4 [10].

Property Server), whereas the internal temperature is exposed via the **Precise Present Ambient Temperature** (Property ID 0x0075, Sensor Server)

To control the LOYBT-RT1 with an **external temperature** sensor write the reference value to the **Desired Ambient Temperature** (ID 0x0071, Generic Property Server) and bind an external sensor server, which is publishing the **Present Ambient Temperature** (ID=0x004F), to the Sensor Client. If intended to go back to the internal temperature write 0 to the Present Ambient Temperature property of the sensor client.

To use **Position control**, write to the generic level server. The valve will return to internal heating mode if nothing is received for 2 hours meaning no friendship has been established.

The device is intended to be directly installed on a radiator. Be aware that an adapter might be needed as there are different valve variations.

Operating conditions are temperatures from 0 °C to 50 °C and relative humidity from 10 % to 90 % (non-condensing). The protection degree is IP20.

6.4.3 Installation Instructions

Mounting

1. Take the device out of the box and plug in the battery.
2. Preparation run will start (first LED blinks orange).
3. Wait till the preparation for the initial run is finished (first LED shines orange).
4. Tighten the RT1 firmly on the radiator valve without the use of tools (check if an adapter is needed).
5. Wait until the init run (indicated by the first light flashing orange) has been finished.
6. The process is finished when the first LED shines green. If it shines red press the set button for more than 3 seconds and repeat from step 2. If it does not work a second time push in the pin of the radiator in case it got stuck. Then try again.

Battery Change

1. Change the battery.
2. Short press the set button so you can see the indication lights.
3. Long press the set button (>5s).

6.5 LOYTEC LOYBT-LEDDRV

6.5.1 Device Description

The LOYBT-LEDDRV is a 2 channel LED-driver with 2 constant current outputs for tunable white capable light sources. The LOYBT-LEDDRV is available with different output currents (900mA, 600mA, 400mA, other values on request). It is based on a Bluetooth SIG qualified mesh stack (Declaration-ID: Design number (DN) Q301729, contains qualified designs: 239299 (controller subsystem Bluetooth 5.4), 239354 (host subsystem Bluetooth 5.4) and 226841 (Mesh Protocol 1.1, Mesh Model 1.1 and NLC-Profiles 1.0).) In addition, the device comes with a DALI-interface, which allows alternative usage and integration in a DALI-lighting system.



Figure 28: LOYBT-LEDDRV tunable white LED-driver.

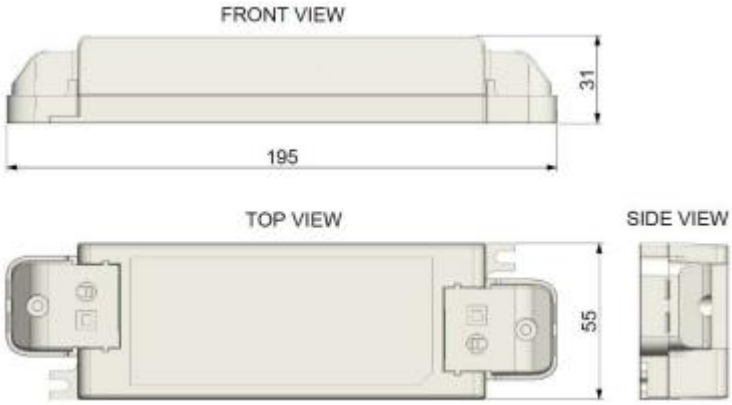


Figure 29: LOYBT-LEDDRV module dimensions [mm].

The device is mains powered. The rated input voltage range is 220-240VAC. The device can also be operated at DC-voltages from 176V to 280V DC for up to 8 hours, which is suitable for usage in central battery emergency systems.

The rated power is 35.1W. The networked standby power is 0.3W. Flicker free dimming is available in the range from 0.1% to 100%. The driver comes with protection mechanisms for overload, over temperature and short circuit.

Models

The model composition for the LOYBT-LEDDRV is shown in Table 27.

Model number	Model name	Element	Comment
0x0000	Configuration Server	Primary(0)	Network Configuration
0x0002	Health Server	Primary(0)	
0x0004	Remote Provisioning Server	Primary(0)	Range Extension
0x1000	Generic OnOff Server	Primary(0)	Loytec Config App enable/disable
0x1011	Generic Admin Property Server	Primary(0)	Device Property Report
0x1012	Generic Manufacturer Property Server	Primary(0)	Device Property Report
0x1013	Generic User Property Server	Primary(0)	Device Property Report
0x1100	Sensor Server	Primary(0)	Energy Reporting
0x1101	Sensor Setup Server	Primary(0)	Energy Reporting
0x0AA00001	LOYTEC Device Server	Primary(0)	Device Extension
0x0AA00003	LOYTEC DFU Data Transfer Server	Primary(0)	Transfer Firmware Image
0x0AA00009	LOYTEC Remote Button Switch Server	Primary(0)	Bluetooth Button Switch for PTM215/216B
0x0AA0000B	LOYTEC Property Server	Primary(0)	Loytec Properties
0x1000	Generic OnOff Server	Sec. (1)	Luminaire On/Off
0x1002	Generic Level Server	Sec. (1)	Luminaire Level
0x1004	Generic DTT Server	Sec. (1)	Luminaire Transition Time
0x1006	Generic Power OnOff Server	Sec. (1)	Luminaire Power On Behavior
0x1007	Generic Power OnOff Setup Server	Sec. (1)	Luminaire Power On Behavior

Model number	Model name	Element	Comment
0x1300	Light Lightness Server	Sec. (1)	Luminaire Lightness
0x1301	Light Lightness Setup Server	Sec. (1)	Luminaire Lightness
0x1303	Light CTL Server	Sec. (1)	Luminaire CTL
0x1304	Light CTL Setup Server	Sec. (1)	Luminaire CTL
0x1002	Generic Level Server	Sec. (2)	Luminaire Color Temperature
0x1306	Light CTL Temperature Server	Sec. (2)	Luminaire Color Temperature

Table 27: LOYBT-LEDDRV composition data.

Properties of Sensor Server

The properties provided by the sensor server are listed in Table 28.

Message Type	Property ID	Property Name	Characteristic[26]
Sensor Status (0x52)	0x0052	Present Device Input Power	Country Code
Sensor Status (0x52)	0x006A	Total Device Energy Use	Fixed String 8

Table 28: LOYBT-LEDDRV composition data.

Properties of Generic Property Server

The properties provided by the property server are listed in Table 29.

Message Type	Property ID	Property Name	Characteristic[27]
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x000B	Device Country of Origin	Country Code
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x000E	Device Firmware Revision	Fixed String 8
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x0010	Device Hardware Revision	Fixed String 16

[26] Characteristics according to GATT Specification Supplement v4 [10].

[27] Characteristics according to GATT Specification Supplement v4 [10].

Message Type	Property ID	Property Name	Characteristic[27]
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x0011	Device Manufacturer Name	Fixed String 36
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x0012	Device Model Number	Fixed String 24
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x0019	Device Serial Number	Fixed String 16
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x0013	Device Operating Temperature Range Specification	Temperature Range
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x0017	Device Runtime Since Turn On	Time Hour 24

Table 29: LOYBT-LEDDRV message types and properties[28].

Provisioning, Configuration and Operation Behavior

The provisioning and the configuration of the device is identical with the handling of any other regular mesh node.

Configuration via "Thyra Config" app

Reset to factory default:

There are 3 ways to reset the LOYBT-LEDDRV:

- Remove the device from the mesh (with the help of the provisioner)
- A reset can be enforced by applying a short circuit on both outputs when turning the device on.
- As alternative the mobile app "Thyra Config" can be used (if the access has been activated on the device).

6.5.2 Intended Use

The LOYTEC LOYBT-LEDDRV is intended to be used as led driver for tunable white light sources in a Bluetooth Mesh system. The device offers a programmable constant current range from 100mA-900mA. LOYTEC offers sets with LED panels and downlights with correctly preprogrammed current.

[28] Properties according Mesh Device Properties v2 Specification [11].

The device is intended to be used in false ceilings and is also suitable for luminaire integration (independent control gear).

Operating conditions are temperatures from 0 °C to 50 °C and relative humidity from 10 % to 90 % (non-condensing). The protection degree of the housing is IP20.

6.5.3 Installation Instructions

- The device is for use in indoor led lighting
- Suitable for installation in false ceilings and for integration in class II light fixtures.
- Follow the safety instructions (see chapter 2).
- The maximum cable length between LED-driver and light source is 30cm.
- The push-in terminals are suitable for wire diameters of 0.2-1.5mm^2 (24AWG-16AWG)
- Check the terminal description in Figure 30.

Wiring Description:

Maximum cable length: 30cm (between driver and LED module)

Terminal-types: Push-Terminal



Input / Output Push-in Clamp Connector							
Function	No	Name	Connector color	Wire Color	Wire Diameter	Strip Length	Condition
Control	1	DA	Orange	N/A	0.2 ... 1.5 mm^2 [24...16AWG]	8.5 ... 9.5 mm	DALI Input
Control	2	DA	Orange	N/A	0.2 ... 1.5 mm^2 [24...16AWG]	8.5 ... 9.5 mm	DALI Input
Input	3	Line	Brown	N/A	0.2 ... 1.5 mm^2 [24...16AWG]	8.5 ... 9.5 mm	AC Input
-	4	N/C	Yellow	N/A	0.2 ... 1.5 mm^2 [24...16AWG]	8.5 ... 9.5 mm	-
Input	5	Neutral	Blue	N/A	0.2 ... 1.5 mm^2 [24...16AWG]	8.5 ... 9.5 mm	AC Input
LED OUTPUT	6	V2-	Green	Green	0.2 ... 1.5 mm^2 [24...16AWG]	8.5 ... 9.5 mm	Cold White
LED OUTPUT	7	V2+	White	White	0.2 ... 1.5 mm^2 [24...16AWG]	8.5 ... 9.5 mm	Cold White
LED OUTPUT	8	V1-	Black	Black	0.2 ... 1.5 mm^2 [24...16AWG]	8.5 ... 9.5 mm	Warm White
LED OUTPUT	9	V1+	Red	Red	0.2 ... 1.5 mm^2 [24...16AWG]	8.5 ... 9.5 mm	Warm White

Figure 30: LOYBT-LEDDRV: terminals and wiring.

6.6 LOYTEC LOYBT-PP20A / LOYBT-PP20A-EM

6.6.1 Device Description

The LOYBT-PP20A and LOYBT-20A-EM are zone controllers for connected luminaires or plug loads. The LOYBT-PP20A-EM is designed to be used in emergency circuits, i.e. it is supplied by emergency power. For detection of the normal power a sniffer is used. In case of a normal supply outage the device overrides the dim level on the outputs to a predefined emergency level, which can be configured in the range from 30% - 100%, and the relay is switched on. Applications for both types are shown in Figure 31 and Figure 32.

The LOYBT-PP20A/PP20A-EM is mains powered (100-277 V AC) and comes with 0-10V control outputs for 2 lightbands, that can be controlled independently. Each of them can sink currents of up to 50mA. An integrated energy measurement records the power transported over the switched relay output. The DALI-output with integrated DALI power supply of 50mA input devices allows to connect DALI input devices like sensors and button-modules. Based on the events received from these input devices the zone controller acts accordingly to the configured mode and controls the luminaires of the 2 lightbands. The autonomous zone can be integrated into a Bluetooth Mesh network which adds a wide range of central features like scheduling, trending, alarming, circadian daylight, energy monitoring etc. to the zone.

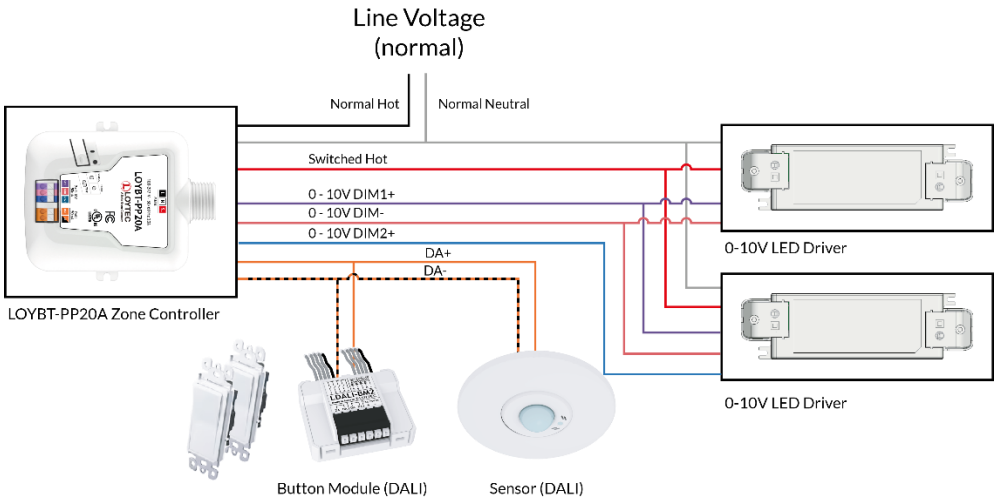


Figure 31: LOYBT-PP20A zone controller application.

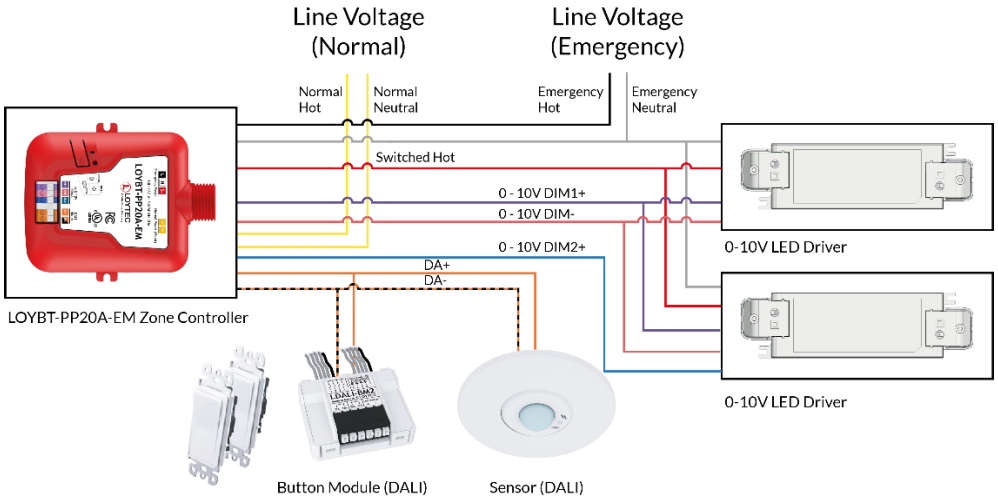


Figure 32: LOYBT-PP20A-EM zone controller application for emergency circuits.

Modes of Operation

The zone controller can be operated in different ways:

1. **Standalone:**
   It can be operated standalone, i.e. the operation behavior is either preconfigured in production or can be set/adapted via a secured Bluetooth connection.

2. **Networked:**
   It can be integrated in a Bluetooth Mesh ecosystem. It is based on the Bluetooth SIG qualified mesh stack (Declaration-ID: Design number (DN) Q301729, contains qualified designs: 239299 (controller subsystem Bluetooth 5.4), 239354 (host subsystem Bluetooth 5.4) and 226841 (Mesh Protocol 1.1, Mesh Model 1.1 and NLC-Profiles 1.0)).

   After adding the LOYBT-PP20A/LOYBT-PP20A-EM to a Bluetooth Mesh system it can either be configured as zone controller using the same features set provided in standalone operation or all models can be configured and used in an individual manner (e.g. for direct control of the lightbands).

Installation Test and Emergency Function Test

For test purposes the output level of the 0-10V luminaires can be controlled by the test button on the device. Additionally, the emergency behavior can be simulated via the button.

Button behavior in normal mode (LED continuous green):

- Short Press: alternating on/off
- Long Press: dimming

The LOYBT-PP20A-EM also supports emergency test mode. Switching between normal mode and emergency test mode can be performed by a double press.

Button behavior in emergency test mode (LED continuous orange):

- Short Press: Start/Stop simulation of missing sniffer voltage

A missing sniffer voltage (real or simulated) is always indicated by an orange blinking LED.

Reset-Button

A reset button on the front of the device (proper tool needed, e.g. paperclip) allows to reset the device to factory default, which means the device is in an unprovisioned state / factory default state afterwards.

LED-Indicator

The LOYBT-PP20A / LOYBT-PP20A-EM provides a multicolor status-LED. The behavior of this LED is as follows:

- Blinking green if attention timer is set.
- Blinking green 3 times on power-up if unprovisioned.
- Blinking green 3 times if device gets unprovisioned.
- Blinking green 1 time on power-up if provisioned.
- Continuous green during normal operation.
- Blinking orange in emergency operation, real or simulated (LOYBT-PP20A-EM only).
- Continuous orange in emergency test mode (LOYBT-PP20A-EM only).
- Blinking green 3 times after reset-button triggered reset to factory default

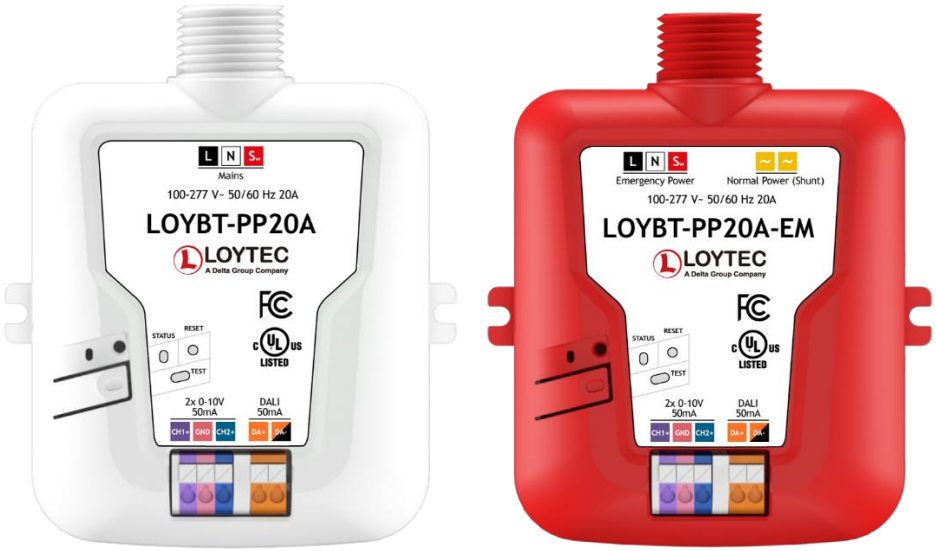


Figure 33: LOYBT-PP20A and LOYBT-PP20A-EM modules.

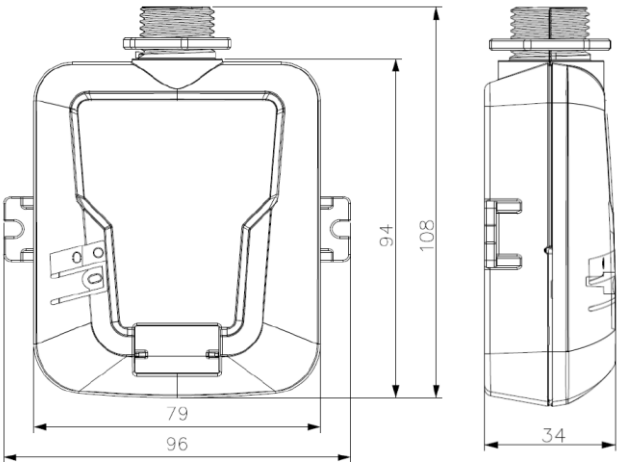


Figure 34: LOYBT-PP20A module dimensions.

Models

The model composition for the LOYBT-PP20A is shown in Table 30.

Model number	Model name	Element	Comment
0x0000	Configuration Server	Primary (0)	Network Configuration
0x0001	Configuration Client	Primary (0)	Standalone Application
0x0002	Health Server	Primary (0)	Status Report
0x0004	Remote Provisioning Server	Primary (0)	Range Extension
0x1011	Generic Admin Property Server	Primary (0)	Device Property Report
0x1012	Generic Manufacturer Property Server	Primary (0)	Device Property Report

Model number	Model name	Element	Comment
0x1013	Generic User Property Server	Primary (0)	Device Property Report
0x1100	Sensor Server	Primary (0)	Energy, Occupancy, Illuminance
0x1101	Sensor Setup Server	Primary (0)	Energy, Occupancy, Illuminance
0x1000	Generic OnOff Server	Primary (0)	Loytec Config App enable/disable
0x0AA00001	LOYTEC Device Server	Primary (0)	Device Extension
0x0AA00003	LOYTEC DFU Data Transfer Server	Primary (0)	Transfer Firmware Image
0x0AA00009	LOYTEC Remote Button Switch Server	Primary (0)	Bluetooth Button Switch for PTM215/216B
0x0AA0000B	LOYTEC Property Server	Primary (0)	Loytec Properties
0x0AA01007	LOYTEC DALI Gateway Server	Primary (0)	DALI-Gateway Configuration
0x1100	Sensor Server	Sec. (1)	Occupancy
0x1101	Sensor Setup Server	Sec. (1)	Occupancy
0x1100	Sensor Server	Sec. (2)	Illuminance
0x1101	Sensor Setup Server	Sec. (2)	Illuminance
0x1000	Generic OnOff Server	Sec. (3)	control LED for occupancy indication
0x1001	Generic OnOff Client	Sec. (3)	DALI-Button / Rocker
0x1003	Generic Level Client	Sec. (3)	DALI-Button / Rocker
0x0AA01001	LOYTEC DIIR Server	Sec. (3)	DALI-Buttons
0x1002	Generic Level Server	Sec. (4)	Virtual Lamp Zone
0x1000	Generic OnOff Server	Sec. (4)	Virtual Lamp Zone
0x1004	Generic Default Transition Time Server	Sec. (4)	Virtual Lamp Zone
0x1006	Generic Power OnOff Server	Sec. (4)	Virtual Lamp Zone
0x1007	Generic Power OnOff Setup Server	Sec. (4)	Virtual Lamp Zone
0x1300	Light Lightness Server	Sec. (4)	Virtual Lamp Zone
0x1301	Light Lightness Setup Server	Sec. (4)	Virtual Lamp Zone
0x1303	Light CTL Server	Sec. (4)	Virtual Lamp Zone

Model number	Model name	Element	Comment
0x1304	Light CTL Setup Server	Sec. (4)	Virtual Lamp Zone
0x1003	Generic Level Client	Sec. (4)	Virtual Lamp Zone Extension
0x1002	Generic Level Server	Sec. (5)	Virtual Lamp Zone (color Temperature)
0x1306	Light CTL Temperature Server	Sec. (5)	Virtual Lamp Zone
0x1000	Generic OnOff Server	Sec. (5)	Lighting Controller
0x130F	Light LC Server	Sec. (5)	Lighting Controller
0x1310	Licht LC Setup Server	Sec. (5)	Lighting Controller
0x0AA0100B	LOYTEC Zone Controller Server	Sec. (5)	Zone Controller
0x0AA01009	LOYTEC Light Zone Controller Server	Sec. (5)	Light Zone Controller
0x1000	Generic OnOff Server	Sec. (6,9)	Lightband Coupler
0x0AA0100D	LOYTEC Lightness Coupler Server	Sec. (6,9)	Lightband Coupler
0x0AA0000B	LOYTEC Property Server	Sec. (6,9)	Lightband related properties
0x1002	Generic Level Server	Sec. (7,10)	Lightband 1/2
0x1000	Generic OnOff Server	Sec. (7,10)	Lightband 1/2
0x1004	Generic Default Transition Time Server	Sec. (7,10)	Lightband 1/2
0x1006	Generic Power OnOff Server	Sec. (7,10)	Lightband 1/2
0x1007	Generic Power OnOff Setup Server	Sec. (7,10)	Lightband 1/2
0x1300	Light Lightness Server	Sec. (7,10)	Lightband 1/2
0x1301	Light Lightness Setup Server	Sec. (7,10)	Lightband 1/2
0x1303	Light CTL Server	Sec. (7,10)	Lightband 1/2
0x1304	Light CTL Setup Server	Sec. (7,10)	Lightband 1/2
0x1003	Generic Level Client	Sec. (7,10)	Lightband 1/2 Extension
0x1002	Generic Level Server	Sec. (8,11)	Lightband 1/2
0x1306	Light CTL Temperature Server	Sec. (8,11)	Lightband 1/2
0x1000	Generic OnOff Server	Sec. (8,11)	Lightband Coupler

Model number	Model name	Element	Comment
0x0AA0100F	LOYTEC Color Temperature Coupler Server	Sec. (8,11)	Lightband Coupler

Table 30: LOYBT-PP20A / LOYBT-PP20A-EM composition data.

Properties of Sensor Server and Generic Property Server

The properties provided by the sensor servers are listed in Table 31.

Message Type	Property ID	Property Name	Characteristic[29]
Sensor Status (0x52)	0x004D	Presence Detected	Boolean
Sensor Status (0x52)	0x004E	Present Ambient Light Level	Illuminance
Sensor Status (0x52)	0x0075	Precise Present Ambient Temperature	Temperature
Sensor Status (0x52)	0x0052	Present Device Input Power	Country Code
Sensor Status (0x52)	0x006A	Total Device Energy Use	Fixed String 8

Table 31: LOYBT-PP20A / LOYBT-PP20A-EM message types and properties[30].

The properties provided by the property servers are listed in Table 32.

Message Type	Property ID	Property Name	Characteristic[31]
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x000B	Device Country of Origin	Country Code
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x000E	Device Firmware Revision	Fixed String 8
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x0010	Device Hardware Revision	Fixed String 16

[29] Characteristics according to GATT Specification Supplement v4 [10].

[30] Properties according Mesh Device Properties v2 Specification [11].

[31] Characteristics according to GATT Specification Supplement v4 [10].

Message Type	Property ID	Property Name	Characteristic[31]
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x0011	Device Manufacturer Name	Fixed String 36
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x0012	Device Model Number	Fixed String 24
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x0019	Device Serial Number	Fixed String 16
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x0013	Device Operating Temperature Range Specification	Temperature Range
Generic User Property Status (0x4E), Generic Admin Property Status (0x4A) or Generic Manufacturer Property Status (0x46)	0x0017	Device Runtime Since Turn On	Time Hour 24

Table 32: LOYBT-PP20A / LOYBT-PP20A-EM property server message types and properties[32].

Mesh Operation: Provisioning, Configuration and Operation Behavior

The provisioning and the configuration of the device is identical with the handling of any other regular mesh node. Ensure that publications and subscriptions are configured for each of the models.

If the lightbands shall be controlled by the lightness controller, the lightness coupling mechanism must be activated, i.e. the OnOff-servers in element 6/9 must be turned on to connect lightband 1/2.

Hint: *On LOYTEC-controllers with Bluetooth Mesh interface a specific template for zone controllers provides a rich set of datapoints that offers full access and configuration options to setup the device as self-contained application. Furthermore, reports of important figures are automatically mapped to datapoints, making them available in the building management system.*

Configuration via "Thyra Config" app

The available configuration parameters can be seen in Table 33. Additionally, the "Thyra Config" app allows for:

1. Lux Calibration of the connected LDALI-MSx using a configuration wizard (only available if an LDALI-MSx is connected)
2. Teach-in of energy harvesting BLE buttons of type enocean ptm 215b/216b

[32] Properties according Mesh Device Properties v2 Specification [11].

Zone Control		
Name	**Access**	**Note**
Zone Name	Read/Write	Designates the zone the device belongs to (max. 32 characters)
Standalone Operation	Read/Write	Activates the self-contained zone application on the device
Networked Operation	Read	Only shown if the device is integrated in a networked solution
Prepare for Integration in Networked Solution	Action	Disables standalone operation without resetting associated parameters
Emergency Light Level (LOYBT-PP20A-EM only)	Read/Write	Light level in case of emergency operation (30 – 100 %)
Lighting Controller		
Name	**Access**	**Note**
Enabled	Read/Write	Activates the internal lighting controller
Profile	Read/Write	Manual, Vacancy, Occupancy or Daylight Harvesting; determines which of the following parameters are available
On Level	Read/Write	Light level in active state; not available in Daylight Harvesting profile
Setpoint	Read/Write	Illuminance setpoint (0 – 4000 lx); Daylight Harvesting profile only
On Level Min	Read/Write	Minimum light level in active state; Daylight Harvesting profile only
Hold Time	Read/Write	Time the active state is maintained after the last detected presence (0 – 600 min); not available in Manual profile
Prolong Level	Read/Write	Light level after the hold time has elapsed; not available in Manual profile
Off Level	Read/Write	Light level after the prolong phase has elapsed

Table 33: LOYBT-PP20A(-EM) Thyra Config - device specific parameters

Reset to factory default:

There are 3 ways to reset the LOYBT-PP20A:

- Remove the device from the mesh (with the help of the provisioner)
- A reset can be enforced by pressing the reset button for at least 10 seconds.
- As alternative the mobile app “Thyra Config” can be used (if the access has been activated on the device).

Standalone Operation: Device Setup via App

For standalone operation the “Thyra Config” mobile app is used to setup the device. The app connects via secure BLE-connection to the device and allows to setup the zone controller parameters as defined in the installed device firmware. The settings provided via the app represent only a subset of the available capabilities, but offer a good balance between functionality and user-friendliness. For more details on setting up a zone controller on the app refer to the “THYRA Lighting Solution” application guide [14].

6.6.2 Intended Use

The LOYTEC LOYBT-PP20A/LOYBT-PP20-EM is intended to be used as zone controller for lighting applications. It can be operated standalone or networked in a Bluetooth Mesh network. It offers supply and control options for the wired ecosystem and exposes data to mesh network as needed.

It provides a relay with power measurements for the switched output. It is suitable for the control of Electronic Ballasts, CFLs, LED and LED lamps or the equivalent. The relay is capable for loads of up to 5540VA @277VAC. In addition, the two 0-10V outputs allow to control 2 groups of luminaires with 0-10V interface independently. Together with the relay option also older 0-10V drivers, which do not support DIM TO OFF can be used.

Operating conditions are temperatures from 0 °C to 50 °C and relative humidity from 10 % to 90 % (non-condensing). The protection degree of the housing is IP20.

6.6.3 Installation Instructions

- The LOYBT-PP20A/LOYBT-PP20A-EM is suitable for installation on a junction or marshaling box using the conduit nut (1/2” knockout) or with mounting screws on wall or ceiling.
- It is suitable for use in air handling spaces (UL2043 listed for plenum applications), the maximum ambient air temperature is 50°C (122°F).
- Follow the safety instructions (see chapter 2).
- Follow the guidelines in the installation sheet.
- For supply connections, use 12AWG or larger wires rated for at least 75°C (167°F).
- The device is suitable for Class1 and Class2 wiring.
    - Class 1 installations require wire with insulation that is rated for the voltage carried (most wiring has 600V rated insulation) and must be installed in conduit or a protective cable assembly. The 0-10V and DALI low voltage control wires run along with the line voltage wires in the same conduit.

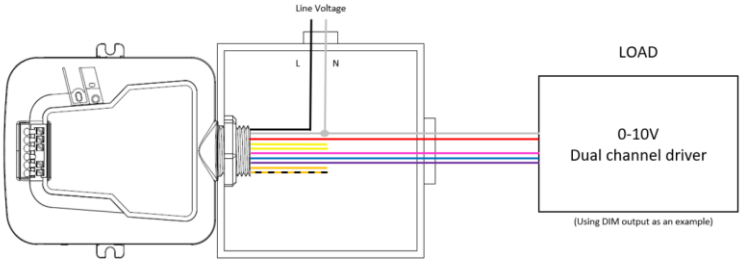


Figure 35: Class 1 installation

- In Class-2 installations the 0-10V and DALI low voltage wired run separately in another conduit. A Class-2 wiring may be installed free within the wall or ceiling without line voltage rated insulation or protection of conduit or a cable assembly.

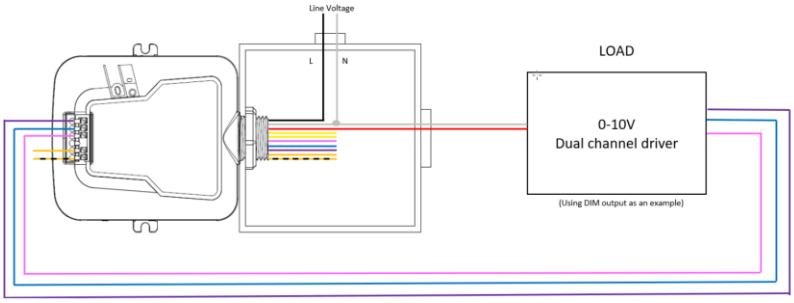


Figure 36: Class 2 installation

- Class 2 wiring shall use Class 1 rated conductors and be routed separately.
- In accordance with Item I of NEC article 725.136, conductors of Class 2 circuits shall be reliably maintained from conductors of Class 1 electric light and power by minimum 50mm (2 inch) by barrier, restricted routing or similar means.

- Provided recommended minimum space for wiring compartment, the minimum spacing is 700cm^3.
- Use wire nuts on all unused wires inside the installation box.

7 Troubleshooting

7.1 Technical Support

LOYTEC offers free telephone and e-mail support for the LOYBT product series. If none of the above descriptions solves your specific problem please contact us at the following address:

LOYTEC electronics GmbH
Blumengasse 35
A-1170 Vienna
Austria

E-Mail: ***support@loytec.com***
Web: ***http://www.loytec.com***
Tel: ***+43/1/4020805-100***
Fax: ***+43/1/4020805-99***

Or

LOYTEC Americas Inc.
N27 W23957 Paul Road
Suite 103
Pewaukee, WI 53072
USA

E-Mail : ***support@loytec-americas.com***
Web : ***http://www.loytec-americas.com***
Tel : ***+1 (512) 402 5319***
Fax : ***+1 (262) 408 5238***

8 References

[1] LOYTEC Device User Manual 8.2, LOYTEC electronics GmbH, Document № 88086512, December 2023.

[2] Mesh Protocol 1.1 Specification, Bluetooth SIG, 2023.

[3] Mesh Model 1.1 Specification, Bluetooth SIG, 2023.

[4] Ambient Sensor NLC Profile 1.0, Bluetooth SIG, 2023.

[5] Basic Lightness Controller NLC Profile 1.0, Bluetooth SIG, 2023.

[6] Basic Scene Selector NLC Profile 1.0, Bluetooth SIG, 2023.

[7] Dimming Control NLC Profile 1.0, Bluetooth SIG, 2023.

[8] Energy Monitor NLC Profile 1.0, Bluetooth SIG, 2023.

[9] Occupancy Sensor NLC Profile 1.0, Bluetooth SIG, 2023.

[10] GATT Specification Supplement v4 (GSS v4), Bluetooth SIG, 2021

[11] Mesh Device Properties v2 Specification, Bluetooth SIG, 2020

[12] UNOlite Modbus User Guide V0.6

[13] UNOlite BACnet User Guide V0.4

[14] Thyralite Lighting Solution Application Guide 1.0, LOYTEC electronics GmbH, Document № 88098801, January 2026.

9 Revision History

Date	Version	Author	Description
2023-06-30	1.2.0	UR	Initial revision. Moved from chapter 15 of the LOYTEC Device Manual and refined device description.
2024-01-30	1.4.0	UR	Add Info about LOYBT-TEMP2 in LOYBT-TEMPx chapter.
2024-03-31	1.4.2	UR	Add chapter about LOYBT-MSx. Add chapter about LOYUNO-L.
2024-09-30	2.0.0	UR	Update chapter about LOYBT-MSx. Update information on battery lifetime of LOYBT-TEMPx. Add chapter about LOYBT-SBM1.
2025-04-30	2.2.0	UR	Add info about current firmware version of LOYBT-TEMPx. Update chapter about LOYBT-MSx. Add Asset Tracking and Beaconing. Add chapter about LOYBT-IO1. Update property tables of LOYBT-MSx and LOYBT-SBM1.
2025-12-15	2.4.0	UR	Added chapter about LOYBT-RT1. Add chapter about LOYBT-LEDDRV. Add chapter about LOYBT-PP20A/LOYBT-PP20A-EM.
2026-04-20	2.4.4	IV	Updated model-compositions of all devices
2026-08-04	2.6.0	IV	Added chapter about the “Thyra Config” app Added section about LOYBT-MSx “Thyra Config” properties Added section about LOYBT-SBM level servers and third-party integration and “Thyra Config” properties Added section about LOYBT-PP20A “Thyra Config” properties and “Thyra Config” specific wizards