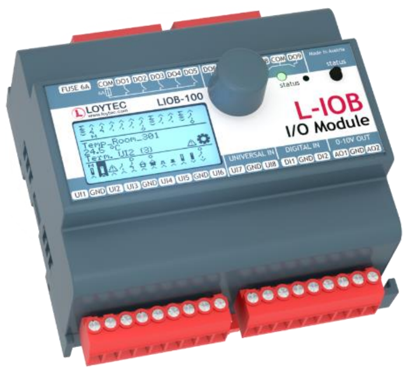
LIOB-10x / x5x

L-IOB™ I/O Module

User Manual

LOYTEC electronics GmbH



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Version 6.4

Document № 88078512

Contents

Abbreviations

AST .... Alarming, Scheduling, Trending
BACnet .... Building Automation and Control Network
CEA-709 .... Protocol standard for LONWORKS networks
CEA-852 .... Protocol standard for CEA-709 over IP networks
COV .... Change-Of-Value
CP....................................... Configuration Property
CS....................................... Configuration Server that manages CEA-852 IP devices
DHCP................................. Dynamic Host Configuration Protocol, RFC 2131, RFC 2132
I/O .... Input/Output
LIOB .... LOYTEC I/O bus
MAC .... Media Access Control
NAT .... Network Address Translation, see Internet RFC 1631
NTC .... Negative Temperature Coefficient (Temperature Sensor)
NV...................................... Network Variable
OPC.................................... Open Process Control
PTC .... Positive Temperature Coefficient (Temperature Sensor)
SCPT.................................. Standard Configuration Property Type
SNVT .... Standard Network Variable Type
UCPT .... User-Defined Configuration Property Type
UI .... User Interface

Additionally, the following abbreviations are used for the L-IOB device modes:

L-INX Mode .... Refers to the LIOB-Connect device mode (LIOB-10x models), the LIOB-FT device mode (LIOB-15x models), and the LIOB-IP device mode (LIOB-45x/55x models). A L-IOB host is needed (e.g. L-INX device).

LONMARK® Mode............ Refers to the LONMARK® and non-ECS device modes (LIOB-15x/45x models). In these modes, the LIOB-15x/45x devices act as independent nodes on a CEA-709 network. A L-IOB host is not needed.

BACnet Mode .... Refers to the BACnet device mode of the LIOB-55x models. In this mode, the LIOB-55x devices act as independent nodes on a BACnet/IP network. A L-IOB host is not needed.

1 Introduction

1.1 Overview

The L-IOB I/O modules LIOB-10x, LIOB-15x, LIOB-45x, and LIOB-55x provide physical inputs and outputs (I/Os) either through a CEA-709 connection, a BACnet/IP connection, or a direct connection to a L-IOB host (e.g. L-INX automation server). The I/Os can e.g. be used as data points in the IEC 61131 program running on the L-IOB host. The L-IOB I/O modules come in different models with different I/O configurations, including analog outputs, digital outputs, digital inputs, and universal inputs, which can be freely configured.

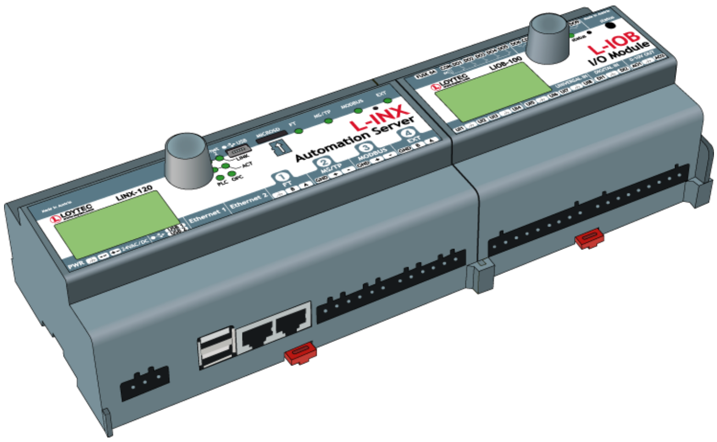


Figure 1: L-IOB installation with L-INX device

The LIOB-10x modules are added to the L-INX automation server using the LIOB-Connect system. An example is shown in Figure 1. To add a L-IOB module to the L-INX device, slide the module from the top to the bottom. The plastic fitting on the side holds the module in place and the gold contacts attach the L-IOB module to the LIOB-Connect bus. The L-IOB modules are powered through the LIOB-Connect bus. Depending on the L-INX device, up to 8 or even 24 L-IOB devices can be stacked up this way in a daisy chain.

The LIOB-15x modules are either connected over the LIOB-FT port of a L-INX device or over any CEA-709 FT network (LONMARK® / Non-ECS device modes). This allows connecting remote I/Os over standard FT cabling.

The LIOB-45x modules are either connected via the LIOB-IP protocol of a L-INX or LIOB-48x/58x device, or over any CEA-852 network (LONMARK® / Non-ECS device modes). In both cases, the physical connection is done via Ethernet/IP. Some models feature a 2-port Ethernet switch.

The LIOB-55x modules are either connected via the LIOB-IP protocol of a L-INX or LIOB-48x/58x device, or over any BACnet/IP network (BACnet device mode). In both cases, the physical connection is done via Ethernet/IP. Some models feature a 2-port Ethernet switch. All LIOB-55x models are BTL-certified B-BC devices.

Whenever a L-INX (or LIOB-48x/58x) device is needed as a L-IOB host, the L-IOB device mode is abbreviated as '**L-INX Mode'**. This covers the LIOB-Connect device mode (LIOB-10x models), the LIOB-FT device mode (LIOB-15x models), and the LIOB-IP device mode (LIOB-45x/55x models). Whenever the L-IOB devices act as independent nodes on a CEA-709 network without the need for a L-IOB host, the L-IOB device mode is abbreviated as '**LONMARK® Mode'**. This covers the LONMARK® and non-ECS device modes (LIOB-15x/45x models). Whenever the L-IOB devices act as independent nodes on a BACnet network without the need for a L-IOB host, the L-IOB device mode is abbreviated as '**BACnet Mode'**. These three abbreviations ('L-INX Mode', 'LONMARK® Mode', and 'BACnet Mode') will be used throughout this entire document, especially in headings, to point out that the following section only applies to this mode. Refer to Section 5.1 for more information about the different L-IOB device modes and Section 6.4 for information on how to setup the device mode in LIOB-15x/45x/55x models.

Initial configuration of the L-IOB modules is accomplished through the L-INX Configurator software. The parameterization of I/Os, self-test, manual modes, override values, etc. can also be operated on the L-IOB's LCD display, the Web UI of a connected L-IOB host, or the LWEB-900 tool.

1.2 Scope

This document covers LIOB-10x, LIOB-15x, LIOB-45x, and LIOB-55x modules with firmware version 6.2 (or higher), the L-INX automation server firmware version 6.2 (or higher) and the L-INX Configurator version 6.2 (or higher).

2 What's New

2.1 New in LIOB-10x/x5x 6.4.0

Localized Web Interface

The entire Web interface of the device has been localized to German, French, and Chinese language. Simply change the language on the LCD display or directly on the Web interface via the new flag symbol on the upper right corner. Changing language is instant and does not require a reboot.

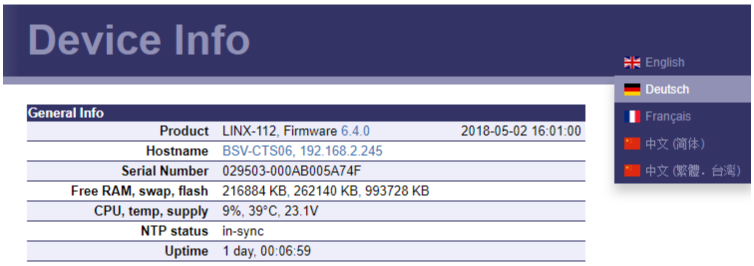


Figure 2: Language selection on the Web interface

Safe Reboot and Auto-Login

Changing IP settings and rebooting could end in a device unreachable, if something was different than expected. The new safe reboot feature helps out by reverting the changes made, if not logged in in on the Web interface within 5 minutes after the reboot. Locking oneself out by entering a mistaken IP address is no longer possible.

Figure 3: Safe reboot screen suggesting new IP address.

Another new feature that helps getting logged in again is the session auto-login. After a device has rebooted the Web interface restores the session and automatically logs in again. Even when changing a static IP address the device tries to connect to the new IP or suggests links for opening the device info page under the new IP address.

Backup before Upgrade

The firmware upgrade feature has been made safer by creating a backup before executing the upgrade. This feature has been added to firmware and Configurator upgrade paths. It is, however, optional and can be turned off by deselecting the check box.

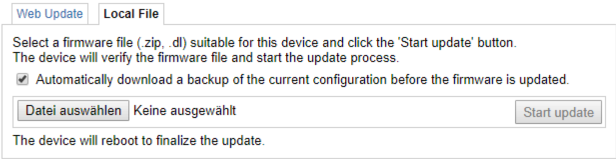


Figure 4: Backup before Upgrade on the Web interface.

Binary Interpretation of Analog Inputs

A simple way to turn an analog universal input (UI) into a digital data point has been added. On the UI select the option **Digital Input** and enter an on/off value hysteresis. A binary data point will be created instead of the analog one.

2.2 New in LIOB-10x/x5x 6.2.0

This section describes the major changes and new features in version 5.0.0. For a full list of changes refer to the Readme file.

New User Manual Structure

The LIOB-10x/x5x User Manual has been split up into three parts: The LIOB-10x/x5x User Manual, which now covers the specific functions of the LIOB-10x/x5x device models. The LINX Configurator User Manual is a common description for using the Configurator software for the L-INX, L-GATE, L-ROC, L-IOB, and L-DALI product line. And the LOYTEC Device User Manual covers hardware, Web interface, LCD display and operating interfaces topics common to all LOYTEC devices.

L-IOB Firmware Upgrade and V2 Models

The L-IOB firmware upgrade has been enhanced by a parallel upgrade mode. This mode is back-ward compatible to existing L-IOB devices and allows parallel upgrade over the network. This means a number of devices receive the firmware upgrade at the same time which greatly improves upgrade time over LIOB-FT. This also applies to the new V2 L-IOB models. The Configurator firmware upgrade dialog has also been extended to allow the assignment of a universal L-IOB firmware ZIP archive to all L-IOB models.

2.3 New in LIOB-10x/x5x 5.0.0

This section describes the major changes and new features in version 5.0.0. For a full list of changes refer to the Readme file.

New L-IOB Models

The new models LIOB-454 and LIOB-554 with a 2-port Ethernet switch and a built-in pressure sensor are supported by the firmware. See Sections 13.6, and 13.7.

2-Port Ethernet Switch Support

The new firmware supports all models with a built-in 2-port Ethernet switch. See Section 11.4.

Duration Mode of Digital Outputs

Digital outputs can be configured in a “Duration” mode. In this mode, the value written to the output is interpreted as a time period, the output shall stay active. When the period ends, the output is automatically switched inactive again. See Section 7.3.5.

Support of State-controlled Occupancy Sensors

The L-IOB now also supports occupancy sensors, which do not generate pulses but rather are only switched to the active state as long as occupancy is detected. See Section 7.3.28.

Simplified Offset Calibration in the LCD UI

The calibrated life value is now shown next to the offset value for simplified calibration in the LCD UI. See Section 7.3.22.

Switching Off Detection of Disconnected Sensors

A new flag is introduced, which allows switching off the detection of disconnected sensors so that every measured value is processed. See Section 7.3.16.

Firmware upgrade via Web Interface

A new firmware upgrade menu on the Web interface allows online checking for firmware updates and upgrading by selecting a local firmware file. All this is possible without starting the Configurator.

BACnet

All LIOB-55x models are now BTL-certified as B-BC devices.

3 Quick-Start Guide

This chapter shows step-by-step instructions on how to configure the L-IOB I/O module for a simple application.

3.1 Quick-Start Guide (L-INX Mode)

Observe that this quick-start guide only covers the LIOB-Connect (LIOB-10x), LIOB-FT (LIOB-15x), and LIOB-IP (LIOB-45x/55x) device modes, see Section 5.1. For this guide, it is assumed that the L-IOB host is a L-INX automation server.

3.1.1 Hardware Installation

Depending on the L-IOB model, the L-IOB I/O modules can either be attached directly to the LIOB-Connect bus, the LIOB-FT bus of the L-INX device, or Ethernet/IP.

For LIOB-10x devices (LIOB-Connect), connect the first L-IOB device to the L-INX by sliding it from top to bottom at the right side of the L-INX (see Figure 1). The plastic fitting on the side holds the module in place and the gold contacts attach the L-IOB module to the LIOB-Connect bus. Connect further L-IOB devices the same way to the last L-IOB device already connected.

3.1.2 Configuration

Configuration of the L-IOB devices is achieved using the L-INX Configurator software, see the corresponding LINX Configurator User Manual [2]. The L-INX Configurator uses a separate tab to configure the L-IOB devices. The L-IOB device configuration can be done offline and is shown in the following steps.

To Configure L-IOB I/Os

1. Add L-IOB devices on the **L-IOB** tab from the supplied L-IOB templates using the **Add Device(s)** button as shown in Figure 5.

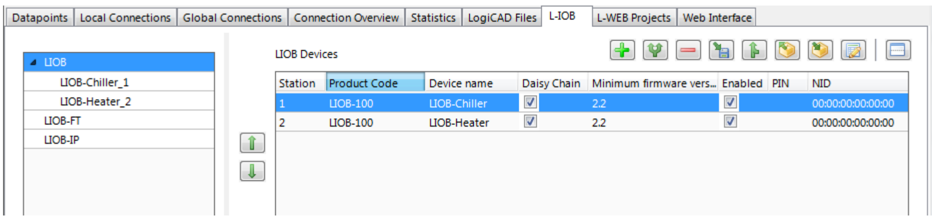


Figure 5: Add L-IOB devices to the LIOB-Connect bus

2. Select a L-IOB device in the tree on the left-hand side and enter names for the I/Os by double-clicking into the **Name** column as shown in Figure 6.

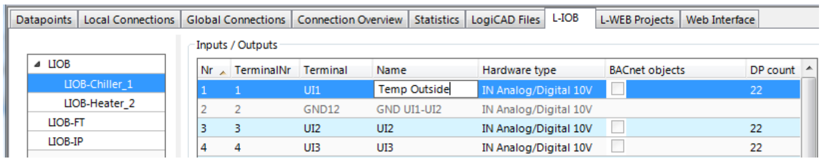


Figure 6: Change I/O names

3. Select an I/O and change the object parameters to configure this I/O. You can multi-select I/Os and change the parameters for all selected I/Os, see Figure 7.

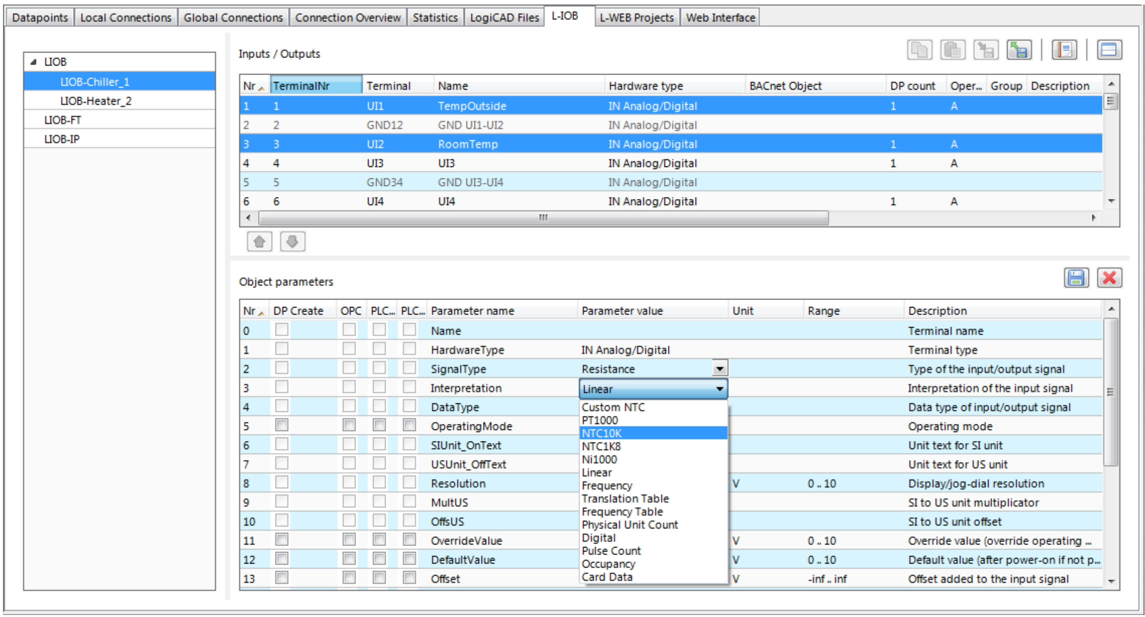


Figure 7: Change L-IOB parameters for the selected I/O(s)

4. On the **Datapoints** tab, the L-IOB data points have been created. These data points can be used, e.g., in the logiCAD IEC61131 program. For physical inputs, the data point Lx_y_zzz_**Input** will be used to read the input value and for physical outputs, the data point Lx_y_zzz_**Output** will be used to set the output value.

5. After downloading the configuration into the L-INX device, the L-IOB inputs and outputs can be checked with the L-INX Web UI. An example is shown in Figure 8.

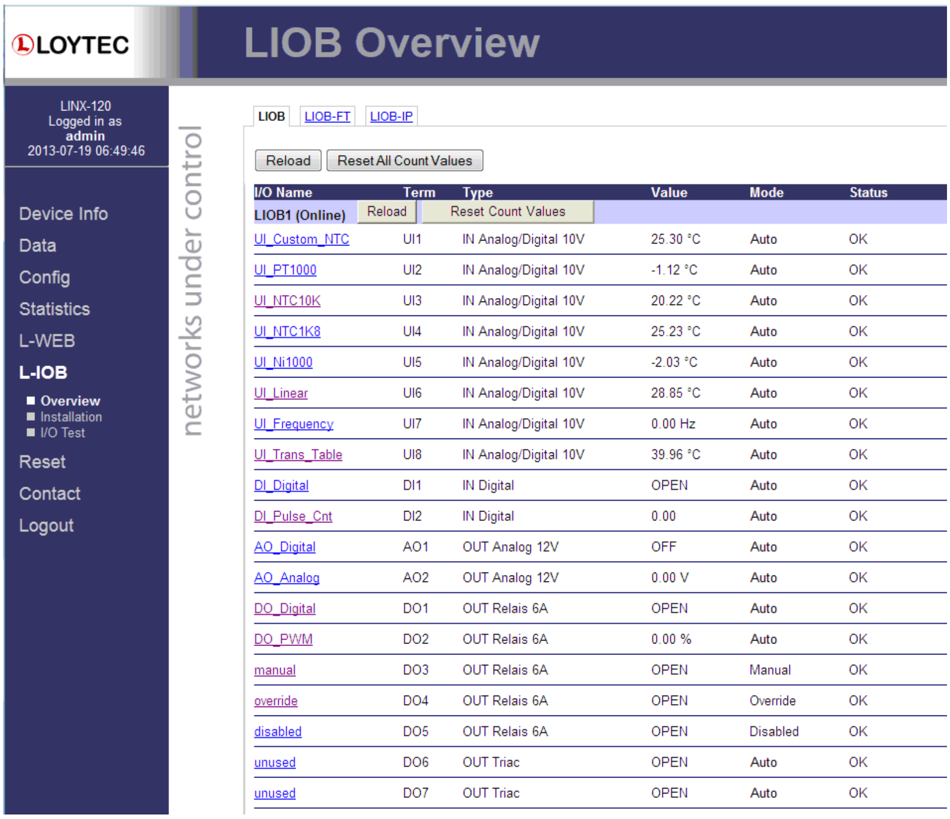


Figure 8: Checking L-IOB inputs and outputs on the Web UI

3.2 Quick-Start Guide (LONMARK® Mode)

Observe that this quick-start guide only covers the LONMARK® device mode of LIOB-15x/45x models, see Section 5.1.

3.2.1 Hardware Installation

A LIOB-15x I/O module in LONMARK® device mode is connected to a CEA-709 network using the FT port of the L-IOB device. A LIOB-45x I/O module in LONMARK® device mode is connected to a CEA-852 network using the Ethernet/IP port of the L-IOB device, see Chapter 5. In both cases, the device must be powered e.g. using an LPOW-2415A power supply.

3.2.2 Commissioning

Use the appropriate L-IOB template of your LNS™ based network management tool (e.g. NL-220™ or LonMaker™) to create and commission a L-IOB device in the database. Once the device is created, the 'Configure' function of the network management tool can be used to invoke the Configurator Software.

3.2.3 Configuration

Configuration of the L-IOB devices is achieved using the L-INX Configurator software, see the corresponding LINX Configurator User Manual [2]. After startup, the Configurator will show the **LIOB Device** tab as depicted in Figure 9.

L-IOB Device | L-IOB I/Os

Device Parameters

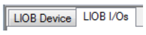
Nr	Parameter name	Parameter value	Description
0	ProductCode	LIOB-150	Product code of L-IOB device
1	DeviceName	LIOB-OG3	Device name
2	PinCode		PIN code (empty or 0 to disable)
3	AlternativeUnit	☐	SI/US unit setting
4	Language	English	Language setting for LCD display
5	GroupInMinSendTime	0	Minimum wait time between updates of digital group input NV (rate limitation)
6	GroupInMaxSendTime	0	Maximum time between updates of digital group input NV (heart beat)
7	GroupOutFBMinSendTime	0	Minimum wait time between updates of digital group output feedback NV (rate limitation)
8	GroupOutFBMaxSendTime	0	Maximum time between updates of digital group output feedback NV (heart beat)

Figure 9: LIOB Device Tab

In the **Device Parameters** table, the device specific configuration properties can be set.

To Configure L-IOB I/Os

1. Select the **LIOB I/Os** tab.

2. The **LIOB I/Os** tab displays the I/Os available on that L-IOB device in the **Inputs / Outputs** list.

   Inputs / Outputs

Nr	TerminalNr	Terminal	Name	Hardware type
1	1	UI1	UI1	IN Analog/Digital
2	2	GND12	GND UI1-UI2	IN Analog/Digital
3	3	UI2	UI2	IN Analog/Digital
4	4	UI3	UI3	IN Analog/Digital

3. To adapt the I/O name, double-click the name in the **Name** column and edit it, e.g., 'RoomTemp'.

Nr	TerminalNr	Terminal	Name	Hardware type
1	1	UI1	RoomTemp	IN Analog/Digital

4. Select (or multi-select) an I/O in the **Inputs/Outputs** list and observe the **Object parameters** list below. These parameters can be used to configure the I/O.

   Object parameters

Nr	Parameter name	Parameter value	Unit	Range	Description
0	Name	RoomTemp			Terminal name
1	HardwareType	IN Analog/Digital			Terminal type
2	SignalType	Voltage 0-10V			Type of the input/output signal

5. Once the L-IOB configuration is finished, it can be downloaded into the connected L-IOB device using **Tools / Download Configuration**.

6. The data points of the L-IOB device are represented as network variables (NVs) and configuration properties (CPs). The NVs can now be polled or bound in the network management tool.

3.3 Quick-Start Guide (BACnet Mode)

Observe that this quick-start guide only covers the BACnet device mode of LIOB-55x models, see Section 5.1.

3.3.1 Hardware Installation

A LIOB-55x I/O module in BACnet device mode is connected to a BACnet/IP network using the Ethernet/IP port of the L-IOB device, see Chapter 5. The device must be powered e.g. using an LPOW-2415A power supply.

3.3.2 BACnet/IP Setup

Before the device can be used in the BACnet/IP network, the initial IP and BACnet setup must be done in the LCD UI (see Section 6.1) or Web UI (see Section Web UI in the LOYTEC Device User Manual [1]).

3.3.3 Configuration

Configuration of the L-IOB devices is achieved using the L-INX Configurator software, see the corresponding LINX Configurator User Manual [2]. After startup of the Configurator, select the **L-IOB** tab as depicted in Figure 9.

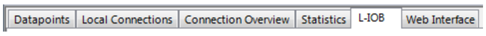
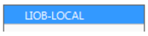


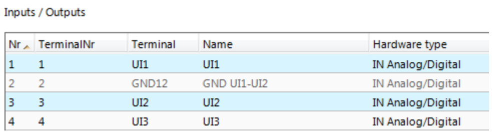
Figure 10: L-IOB Tab

To Configure L-IOB I/Os

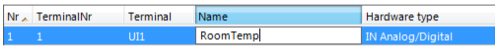
1. Select 'LIOB-LOCAL' at the left side of the **L-IOB** tab.



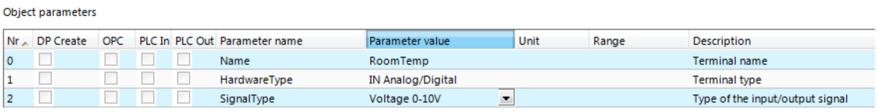
2. The I/Os available on that L-IOB device are displayed in the **Inputs / Outputs** list.



3. To adapt the I/O name, double-click the name in the **Name** column and edit it, e.g., 'RoomTemp'.



4. Select (or multi-select) an I/O in the **Inputs/Outputs** list and observe the **Object parameters** list below. These parameters can be used to configure the I/O.



5. Once the L-IOB configuration is finished, it can be downloaded into the connected L-IOB device using **Tools / Download Configuration**.

6. The data points of the L-IOB device are represented as BACnet input or output server objects of the appropriate type according to the I/O configuration.

4 Hardware Installation

4.1 Enclosure

The enclosure of the product and its terminal layout are shown on the installation sheet found in the product's box.

4.2 Product Label

The product label on the side of the L-IOB I/O module contains the following information (see Figure 11):

- L-IOB order number (e.g.: LIOB-100, LIOB-150, etc.),
- Date Code, which defines the production week and year,
- Serial number with bar-code (SER#),
- Node ID of the device. Models with an Ethernet/IP interface additionally contain the MAC address on the label.

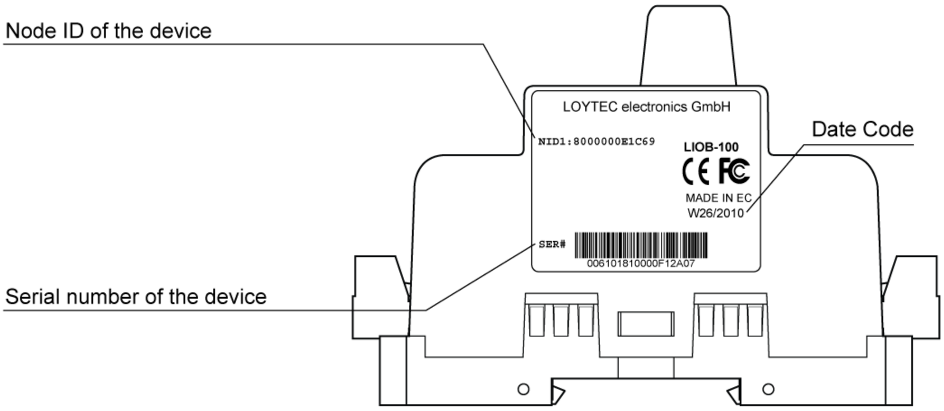


Figure 11: L-IOB product label

Unless stated otherwise, all bar codes are encoded using "Code 128". An additional label is also supplied with the L-IOB for documentation purposes.

4.3 Mounting

All L-IOB devices come prepared for mounting on DIN rails following DIN EN 50 022. The devices can be mounted in any position. However, an installation place with proper airflow must be selected to ensure that the L-IOB's temperature does not exceed the specified range (see Section 13.4).

4.3.1 LIOB-A2

The LIOB-A2 adapter can be used to extend the LIOB-Connect bus and to connect an external power supply. Figure 12 shows the front view of the LIOB-A2.

Figure 12: LIOB-A2 front view

On the “24 VDC INPUT” terminal, a 24 VDC power supply can optionally be connected to supply L-IOB devices with power when not using an L-POW power supply. 3rd party devices (up to 200 mA in total), which also need a 24 VDC power supply, can be connected to the “24 VDC / 200mA OUTPUT”.

At the bottom of the LIOB-A2, a 4-wire cable (“SEL”, “GND”, “A”, “B”) can be connected to extend the LIOB-Connect bus as shown in Figure 13. When the cable is longer than 1 m, it is necessary to terminate the LIOB-Connect bus at the end. This is achieved by using another LIOB-A2 and connecting the “B” with the “TERM” terminal, as shown at the bottom right of Figure 13.

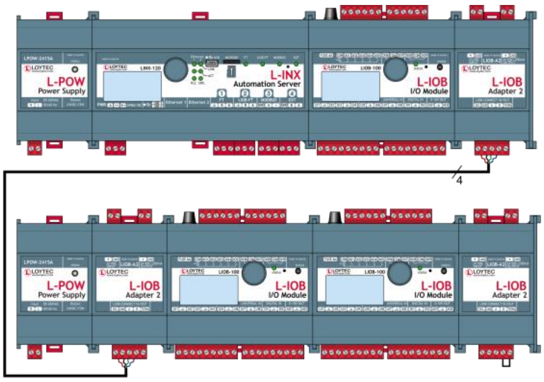


Figure 13: Using the LIOB-A2 adapter to extend the LIOB-Connect bus

More information about LIOB-Connect wiring can be found in Section 4.4.

4.4 Power Supply and Wiring

Please refer to Section 13.3 on how many L-IOB devices can be connected to a L-IOB host. There are six ways of connecting L-IOB devices:

- to the LIOB-Connect port of a L-IOB host (LIOB-10x),
- to the LIOB-FT port of a L-IOB host (LIOB-15x in LIOB-FT device mode),

- to a CEA-709 network (LIOB-15x in LONMARK® or Non-ECS device mode),
- to the LIOB-IP bus of a L-IOB host (LIOB-45x/55x in LIOB-IP device mode),
- to a CEA-852 network (LIOB-45x in LONMARK® or Non-ECS device mode),
- to a BACnet/IP network (LIOB-55x in BACnet device mode).

The LIOB-Connect port of a L-IOB host provides a means for connecting LIOB-10x modules, including power supply and communication, without further cabling needs. The gold contacts at the side of the enclosure attach the modules in a daisy chain. Up to 24 L-IOB devices can be connected to the LIOB-Connect port. The LIOB devices are physically and logically organized in a daisy chain. This means that the L-IOB host is able to automatically enumerate the connected I/O modules to match the order defined in the Configurator.

The LIOB-FT port of a L-IOB host is used to overcome longer distances between the L-IOB host and the L-IOB I/O modules (LIOB-15x models in LIOB-FT device mode). Depending on the L-IOB host, up to 8 or 24 L-IOB devices can be attached over LIOB-FT. The cable type, topology, and length are in accordance with the TP/FT-10 specification. The LIOB-FT modules need additional setup (Station ID), as explained in Chapter 5.

The CEA-709 Network Connection is available for the LIOB-15x models in LONMARK® or Non-ECS device mode. The number of connectable devices, cable type, topology and length follow the TP/FT-10 specification. All rules of CEA-709 / LONMARK® devices regarding network installation, management, and maintenance apply. A L-IOB host is not required.

The LIOB-IP port of a L-IOB host is used to connect L-IOB devices over Ethernet/IP (LIOB-45x/55x models in LIOB-IP device mode). Depending on the L-IOB host, up to 8 or 24 L-IOB devices can be attached over LIOB-IP. The LIOB-IP modules need additional setup (e.g. IP address, Station ID), as explained in Chapter 5.

The CEA-852 Network Connection is available for the LIOB-45x models in LONMARK® or Non-ECS device mode. All rules of CEA-852 / LONMARK® devices regarding network installation, management, and maintenance apply. A L-IOB host is not required.

The BACnet/IP Network Connection is available for the LIOB-55x models in BACnet device mode. All rules of BACnet devices regarding network installation, management, and maintenance apply. A L-IOB host is not required.

Please refer to Section 6.4 for setting up the correct device mode in LIOB-15x/45x/55x models. For using external (non-LOYTEC) power supplies, please refer to Section 11.1. For connecting sensors and actuators to the L-IOB I/Os, please refer to Sections 11.2 and 11.3. The next Sections describe the different power supply and cabling variants in detail, depending on the connection method.

4.4.1 LIOB-Connect without Extension

Up to 4 L-IOB devices can be directly connected to the L-INX device in a physical daisy chain as depicted in Figure 14.

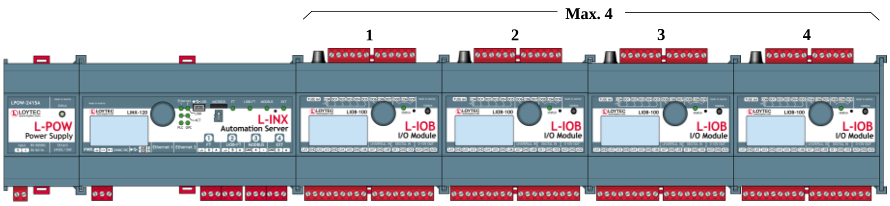


Figure 14: LIOB-Connect Daisy Chain

The LPOW-2415A power supply to the left is equipped with a LIOB-Connect port and can be attached to the L-INX for powering both the L-INX and the L-IOB I/O modules.

4.4.2 LIOB-Connect with Extension

For space considerations or if the power supply is not sufficient for all connected L-IOB devices (more than 4), the LIOB-Connect chain can be split into two (or more) segments of modules using LIOB-A2 adapters and a 4-wire cable (“SEL”, “GND”, “A”, “B”) as depicted in Figure 15.

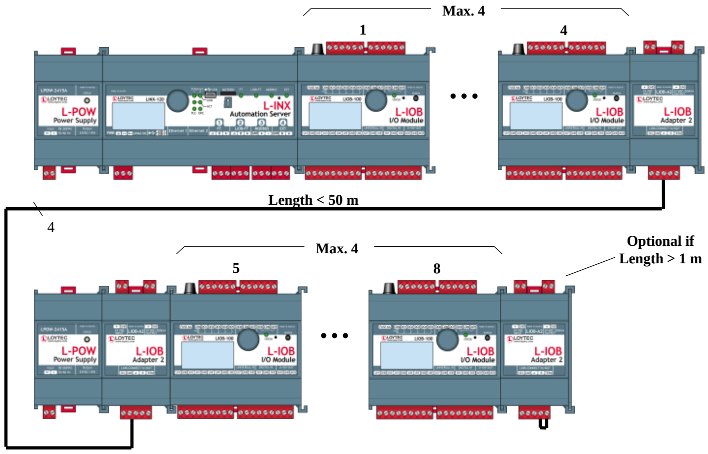


Figure 15: LIOB-Connect Extension

The total length of the extension cable must be smaller than 50 meters. If the length exceeds 1 meter, a LIOB-A2 adapter must be used at the end of the last segment as a termination, with terminals “B” and “TERM” connected, as depicted in the bottom right of Figure 15. Observe that the extension must be done exactly as depicted in Figure 15, even if it is just used for providing sufficient power supply and not to overcome space issues.

4.4.3 LIOB-FT in Free Topology

Figure 16 shows the connection of LIOB-15x modules (LIOB-FT device mode) to the LIOB-FT port of a L-INX device in free topology, which can be used for cable lengths of up to 500 m between any two devices.

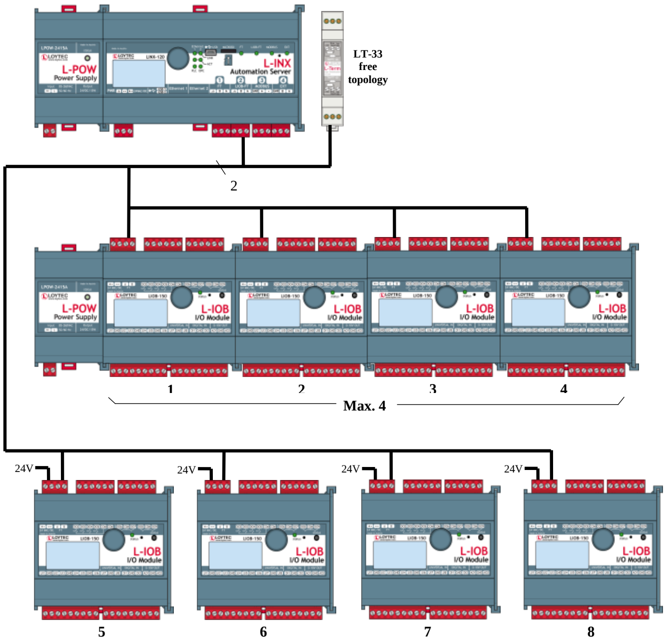


Figure 16: LIOB-FT Free Topology

The L-IOB devices can either be powered by L-POWs (middle part of Figure 16) or other 24 V power supplies (bottom part of Figure 16). The LIOB-FT port of the L-INX (terminals “A” and “B”) must be connected to all LIOB-15x devices. One LT-33 terminator (free topology terminals) must be placed somewhere in the network.

4.4.4 LIOB-FT in Bus Topology

Figure 17 shows the connection of LIOB-15x modules (LIOB-FT device mode) to the LIOB-FT port of a L-INX device in bus topology, which must be used for a cable length of above 500 m. The L-IOB devices can either be powered by L-POWs (middle part of Figure 17) or other 24 V power supplies (bottom part of Figure 17). The LIOB-FT port of the L-INX (terminals “A” and “B”) must be connected to all LIOB-15x devices, forming a physical bus. An LT-33 terminator (bus topology terminals) must be placed at both ends of the bus.

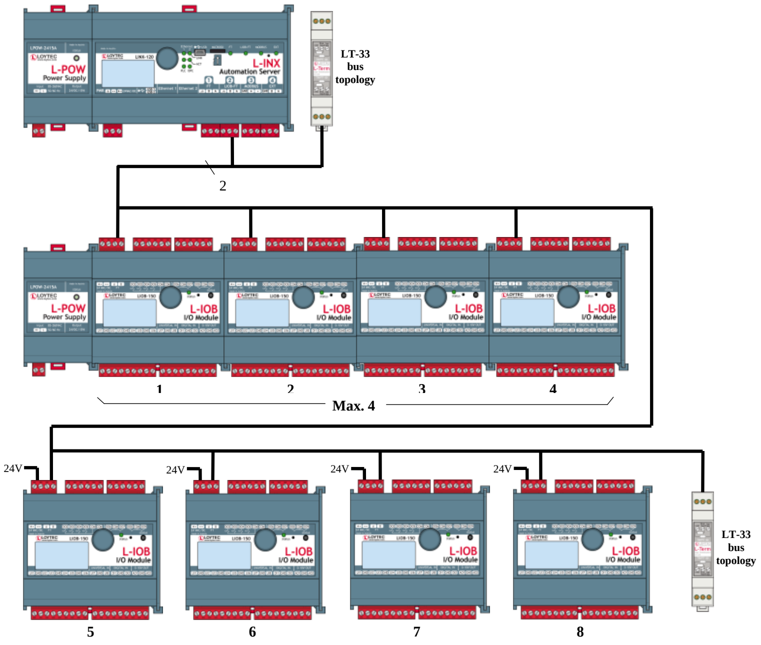


Figure 17: LIOB-FT Bus Topology

4.4.5 CEA-709 Network Connection in Free Topology or Bus Topology

The connection of LIOB-15x devices in LONMARK® or Non-ECS device mode works exactly like in LIOB-FT device mode, refer to Sections 4.4.3 and 4.4.4. The only difference is that instead of the connection to the LIOB-FT port of a L-INX device, the L-IOB devices are directly connected to a CEA-709 network.

4.4.6 LIOB-IP Connection

Figure 18 shows the connection of LIOB-45x/55x modules (LIOB-IP device mode) to a L-INX. Observe that communication over NAT routers is not supported for the LIOB-IP bus. The L-IOB devices can either be powered by L-POWs (middle part of Figure 18) or other 24 V power supplies (bottom part of Figure 18).

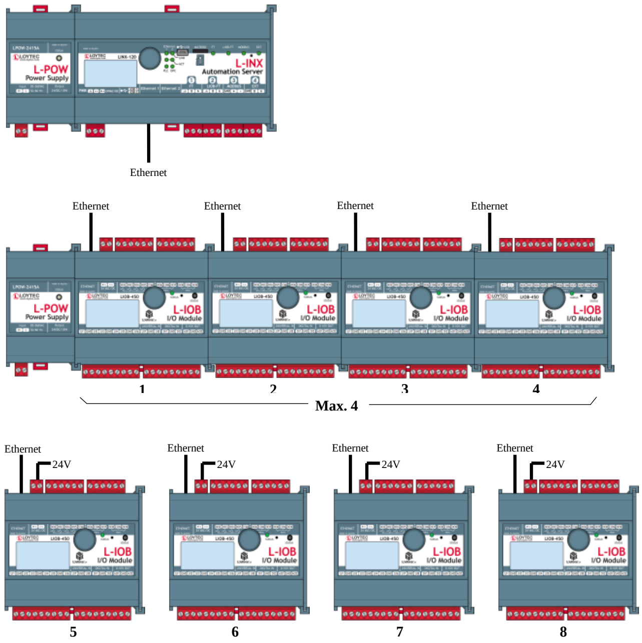


Figure 18: LIOB-IP Connection

4.4.7 CEA-852 Network Connection

The connection of LIOB-45x devices in LONMARK® or Non-ECS device mode works exactly like in LIOB-IP device mode, refer to Section 4.4.6. A L-IOB host is not needed in this case. There could still be e.g. a L-INX device in the network acting as the CEA-852 configuration server though.

4.4.8 BACnet/IP Network Connection

The connection of LIOB-55x devices in BACnet device mode works exactly like in LIOB-IP device mode, refer to Section 4.4.6. A L-IOB host is not needed in this case.

4.5 LED signals

The L-IOB device is equipped with a three-color status LED (see LOYTEC Device User Manual [1]) which indicates the current state of the L-IOB device.

4.5.1 Status LED (L-INX Mode)

The meaning of the LED signals for the LIOB-10x models, the LIOB-15x models in LIOB-FT device mode, and the LIOB-45x/55x models in LIOB-IP device mode is listed in Table 1.

Behavior	Description	Comment
OFF	Unconfigured / Offline	The L-IOB device is either not connected to a L-IOB host or not yet set online.
GREEN	Normal Operation	The L-IOB device is connected to a L-IOB host and online. No I/O is in manual mode.
ORANGE	Manual Mode	At least one I/O is in manual mode.
RED	Error	An error has occurred (e.g. a sensor is disconnected or signals an error).
Flickering	Traffic	Indicates traffic between the L-IOB host and the L-IOB device.
RED flashing at 0.5 Hz	Fallback Override	The primary firmware image is corrupt and the L-IOB has booted the fallback image. In this case, the firmware must be upgraded again.

Table 1: Status LED Patterns in LIOB-Connect / LIOB-FT / LIOB-IP device mode

4.5.2 Status LED (LONMARK® Mode)

The meaning of the LED signals for the LIOB-15x/45x models in LONMARK® or Non-ECS device mode is listed in Table 2.

Behavior	Description	Comment
OFF	Online	The L-IOB device is configured online.
Flickering	Traffic	The L-IOB device receives or transmits NV or CP values.
ORANGE	Manual Mode	At least one I/O is in manual mode.
RED	Error	An error has occurred (e.g. a sensor is disconnected or signals an error).
GREEN flashing at 0.5 Hz	Offline	The L-IOB device is offline.
RED flashing at 0.5 Hz	Fallback Override	The primary firmware image is corrupt and the L-IOB has booted the fallback image. In this case, the firmware must be upgraded again.

Table 2: Status LED Patterns in LONMARK® / Non-ECS device mode

4.5.3 Status LED (BACnet Mode)

The meaning of the LED signals for the LIOB-55x models in BACnet device mode is listed in Table 3.

Behavior	Description	Comment
OFF	No Traffic	No packets are received or transmitted.
Flickering GREEN	Traffic	The L-IOB device receives or transmits packets.
ORANGE	Manual Mode	At least one I/O is in manual mode.
RED	Error	An error has occurred (e.g. a sensor is disconnected).
RED flashing at 0.5 Hz and “LIOB Fallback” shown in LCD UI	Fallback Override	The primary firmware image is corrupt and the L-IOB has booted the fallback image. In this case, the firmware must be upgraded again.

Table 3: Status LED Patterns in BACnet device mode

4.6 Status Button

The L-IOB device is equipped with a status button (see LOYTEC Device User Manual [1]). When pressing the status button shortly during normal operation of the device, a service pin message (LIOB-15x/45x) or I-Am message (LIOB-55x) is sent out, the LCD is reset, and the LCD backlight is switched on.

The status button can also be used to switch the device back to factory default state. Press the button and power-cycle the device. Keep the button pressed until the Status LED illuminates orange permanently. Release the button within five seconds from that time on to reset the device to factory defaults.

5 Device Modes and Installation

After physically installing and connecting the L-IOB devices, they must be configured to be able to communicate with each other resp. with the L-IOB host. The necessary steps depend on the used device mode. The available device modes and resulting installation steps as well as some remarks about device monitoring and replacement are documented in the next sections.

5.1 Device Modes

There are six different device modes available for L-IOB devices which are explained in the following sections. For LIOB-15x/45x/55x models, the device mode can be changed on the LCD Display, see Section 6.4. Observe that the LIOB-Connect / LIOB-FT / LIOB-IP device modes are abbreviated as '**L-INX Mode**', the LONMARK® / Non-ECS device modes are abbreviated as '**LONMARK® Mode**', and the BACnet device mode is abbreviated as '**BACnet Mode**'.

5.1.1 LIOB-Connect Device Mode (LIOB-10x)

This is the only available device mode for LIOB-10x devices. It requires a L-IOB host. The L-IOB devices are directly connected to the host as described in Section 4.4.

5.1.2 LIOB-FT Device Mode (LIOB-15x)

This mode is similar to the LIOB-Connect device mode of LIOB-10x devices. It also requires a L-IOB host. The difference is that the connection between the LIOB host and the L-IOB devices is done over the LIOB-FT port instead of the LIOB-Connect port as explained in Section 4.4.

5.1.3 LIOB-IP Device Mode (LIOB-45x/55x)

This mode is similar to the LIOB-FT device mode of LIOB-15x devices. The only difference is that the connection between the L-IOB host and the L-IOB devices is done over the LIOB-IP bus instead of the LIOB-FT port.

5.1.4 LONMARK® Device Mode (LIOB-15x/45x)

This is the standard device mode for LIOB-15x/45x devices. The L-IOB devices behave as independent nodes on a CEA-709 network. They are LONMARK® certified and support all current CEA-709 technologies such as the Enhanced Command Set (ECS) and a large number of network address table entries (512). A L-IOB host is not needed.

5.1.5 Non-ECS Device Mode (LIOB-15x/45x)

This mode is similar to the LONMARK® Device Mode with the exception that the Enhanced Command Set (ECS) is not supported and thus the L-IOB device only supports 15 address table entries. This mode must be set when using network management tools which do not support ECS.

5.1.6 BACnet Device Mode (LIOB-55x)

This is the standard device mode for LIOB-55x devices. The L-IOB devices behave as independent nodes on a BACnet/IP network. A L-IOB host is not needed.

5.2 Device Installation

Depending on the device mode, device installation works as explained in the following sections.

5.2.1 Device Installation (LIOB-Connect device mode)

Whenever a new configuration is downloaded into a L-INX device (with connected LIOB-10x devices), as well as whenever the user manually scans for devices or starts a configuration run in the L-INX UI, the L-IOB devices are detected, commissioned, and configured. This is done in the following steps:

1. All L-IOB devices directly connected over the LIOB-Connect bus or over a LIOB-A2 adapter using a 4-wire cable (see Section 4.4) are detected. The devices are automatically enumerated according to their position in the physical daisy chain.

2. All devices are configured and set online. At this point, the L-IOB data points are available in the L-INX application.

5.2.2 Device Installation (LIOB-FT/IP device mode)

The first step after hardware installation is to setup the LIOB-FT/IP device mode, since LIOB-15x/45x/55x devices are in LONMARK® or BACnet device mode by default. See Section 6.4 for setting up the LIOB-FT/IP device mode in LIOB-15x/45x devices. See Section 6.1 for setting up the LIOB-IP device mode in LIOB-55x devices.

For LIOB-45x/55x devices in LIOB-IP device mode, the next step is the activation of the LIOB-IP channel in the L-IOB host, see Section LIOB-IP in the LOYTEC Device User Manual [1]. After that, the IP and host setup must be done in all LIOB-45x/55x devices, see Section 6.4.

Note: *Older L-IOB hosts must be upgraded to firmware version 4.8 or higher. After upgrading, the LIOB-IP support must be enabled in the Web-UI of the L-IOB host (menu "L-IOB / Upgrade")*

For both LIOB-15x devices in LIOB-FT device mode and LIOB-45x/55x devices in LIOB-IP device mode, the user must then manually setup a unique Station-ID in each L-IOB device via the LCD UI (see Section 6.4). Alternatively, one can also setup the Node-IDs of all attached L-IOB devices in the L-IOB host's Web UI and start a configuration run (see LOYTEC Device User Manual [1]). In this case, the L-IOB Station-IDs are automatically set by the L-IOB host during the configuration run.

Whenever a new configuration is downloaded into a L-IOB host (with connected LIOB-15x/45x/55x devices), as well as whenever the user manually scans for devices or starts a configuration run in the L-IOB host, the L-IOB devices are detected, commissioned, and configured. This is done in the following steps:

1. All L-IOB devices connected over the LIOB-FT/IP bus are detected. Enumeration is achieved via the Station-ID.

2. All devices are configured and set online. At this point, the L-IOB data points are available in the L-IOB host application.

5.2.3 Device Installation (LONMARK® / Non-ECS device mode)

For LIOB-45x devices in LONMARK® or Non-ECS device mode, the first step after hardware installation and IP setup is to add them to a CEA-852 channel, see Section 6.4.

Both LIOB-15x and LIOB-45x devices in LONMARK® or Non-ECS device mode must then be installed and commissioned like any other CEA-709 / LONMARK® node. Please consult the documentation of your CEA-709 network management tool on how to perform these tasks.

For LNS™ based network management tools, the LOYTEC L-INX Configurator Software acts as an LNS™ plug-in to configure the L-IOB devices. It also installs the needed templates for all LIOB-15x/45x models when it is registered as a plug-in in the network management software. Both off- and online installation of the L-IOB devices is supported.

For Non- LNS™ network management tools, a LOYTEC NIC such as the NIC-USB100 or NIC852 is needed for configuration. The devices must be configured (using the CEA-709 Connection method of the Configurator Software) before installing and commissioning them in the network management tool. Afterwards, the device templates must always be created online from the L-IOB devices if the network management tool does not support changeable network variables. If the network management tool does support changeable network variables, the L-IOB devices can also be created from the corresponding L-IOB XIF files shipped with the L-INX Configurator software (folder ‘XIF’).

5.2.4 Device Installation (BACnet Mode)

Before the device can be used in the BACnet/IP network, the initial IP and BACnet setup must be done in the LCD UI (see Section 6.1) or Web UI (see LOYTEC Device User Manual [1]).

5.3 Device Monitoring and Replacement

5.3.1 Device Monitoring and Replacement (L-INX Mode)

Whenever a L-IOB device loses communication with the L-IOB host, the host automatically detects the missing L-IOB and starts to poll the L-IOB device until it is detected again. Refer to Chapter 9 for more information on L-IOB device replacement.

5.3.2 Device Monitoring and Replacement (LONMARK® Mode)

Device monitoring and replacement works like with any other CEA-709 / LONMARK® node. Please consult the documentation of your CEA-709 network management tool on how to perform these tasks. If a device needs to be physically replaced (e.g. because it is defective), please use the ‘replace’ method of your network management tool. For Non- LNS™ based tools, either download the old configuration in the new device beforehand (using the CEA-709 Connection method of the Configurator Software) or use the restore function of the Configurator if you have a recent backup of the original L-IOB device available.

5.3.3 Device Replacement (BACnet Mode)

For replacing a LIOB-55x device, use the restore function of the Configurator (or LWEB-900 tool) with a recent backup of the original L-IOB device.

6 L-IOB LCD Display

The L-IOB device is equipped with an LCD display and jog dial for monitoring, testing, and configuration purposes. The LCD backlight is automatically switched off after 30 minutes of idle time (no jog dial or status button activity).

6.1 Main Page of LIOB-55x in BACnet Device Mode

The LCD main page of the LIOB-55x I/O modules in BACnet device mode is shown in Figure 19. It is different from the other I/O modules, since it is derived from the main page of the LIOB-58x I/O controller, see [3]. Observe that when in LIOB-IP device mode, the LIOB-55x has the same LCD UI as the LIOB-45x.

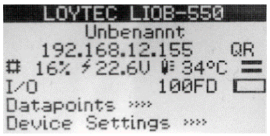


Figure 19: Main Screen of the LIOB-55x LCD in BACnet device mode

The main page displays (from top to bottom) the device name, project name, IP address, QR code menu item (shows QR code of IP address), CPU load, supply voltage, system temperature, language setting (flag symbol), local I/O menu, Ethernet connection status (e.g. “100FD” for single Ethernet devices or “Link12” for dual Ethernet devices), Ethernet traffic indicator, Datapoints menu and Device Settings menu. Observe that some settings require a reboot.

Turn the jog dial to navigate between menu items and press to enter a menu or go into selection mode. When in selection mode, turn the jog dial to alter the value and press again to quit the selection. The **I/O »»** menu is described in Sections 6.2, 6.3, and 6.5. The **Datapoints »»** menu allows browsing through the data points on the device.

The **Device Settings »»** menu allows configuring basic device settings. Navigate e.g. to the **Device Management »»** sub-menu, which is displayed in Figure 20.

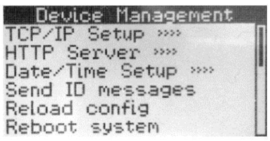


Figure 20: Device Management Menu on the LIOB-55x LCD in BACnet device mode

This menu gives you e.g. the following options for basic device configuration:

- **TCP/IP Setup**: IP Configuration page (IP-Address, etc.).
- **Send ID messages**: send out an I-Am message.

- **Reboot system**: By choosing this item, the device performs a full reboot.
- **Clear DP config**: By choosing this item, the user can clear the device's entire data point configuration.
- **Factory Defaults**: By choosing this item, the user can reset the entire device to its factory default.
- **PIN**: Alter the default PIN to any 4-digit number to protect certain operations on the LCD UI. The user will be prompted to enter the PIN on protected areas.
- **Contrast**: changes the display contrast.
- **Language**: changes the LCD language. Observe that this requires a device reboot.
- **Reset I/O counters**: resets all I/O counters like pulse count values.
- **LIOB-IP Device Mode**: the LIOB-55x device switches to LIOB-IP device mode. Observe that changing the device mode will clear all configuration data except for the basic IP configuration.

6.2 Main Page of LIOB-10x/15x/45x (I/O Overview Page)

The main LCD page of the LIOB-10x/15x/45x models (and LIOB-55x in LIOB-IP device mode) is shown in Figure 21. The LIOB-55x models in BACnet device mode also contain this I/O overview page, but not as the main page. The top and bottom rows show the direction, state, and operating mode (without a letter = Auto, **M** = Manual, **O** = Override, **D** = Disabled) of all I/Os.

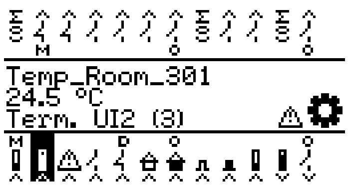


Figure 21: L-IOB LCD Display Main Page

The I/O state is shown as one of the following icons:

- **Switch Icon**: used for I/Os which generate a digital value as well as Inputs in Switch Mode,
- **Bar Icon**: used for I/Os which generate an analog value,
- **Pulse Icon**: used for pulse count inputs,
- **House Icon**: used for occupancy inputs,
- **Exclamation Mark**: shown for disconnected sensors or sensors which indicate an error,
- **Check Icon**: shown for sensors which indicate correct operation,
- **COM Icon**: used for all common terminals of relays and triacs.
- **CD Icon**: used for STId card reader code signals.

- **DT Icon**: used for STId card reader data signals.
- **CK Icon**: used for STId card reader clock signals.

Refer to Section 7.3 for details on I/O types, configuration, and operating modes.

When an I/O is selected, the middle part of the main page shows the I/O name, current value, terminal name, and terminal number. To the right, the device configuration icon (toothed wheel icon, see Section 6.4) and the device state icon is shown. When the device configuration icon is selected, the middle of the main page shows the device name, device state (offline, online, etc.), and station ID. The device state icon shows an exclamation mark if at least one I/O shows an exclamation mark. Otherwise it shows the checked icon to indicate that all I/Os are operating correctly. For LIOB-55x Models in BACnet device mode, the toothed wheel icon is replaced by an exit icon, which is used to exit the I/O overview page.

By turning the jog dial, the user can cycle through all I/Os (resp. to the device configuration icon, see Section 6.4). This can be used to get a quick overview of all I/O states as well as the device state. Observe that the common terminal icons (COM) only show the name and information of that terminal. No further configuration is possible for common terminals.

6.3 Manual / Quick Edit Mode

If the jog dial is pushed shortly on an I/O in manual mode (**M**), the quick edit mode is entered, which allows changing the I/O value by turning the jog dial. By pushing the jog dial shortly again, the quick edit mode is left. When pushing the jog dial shortly on an I/O in auto mode (normal mode without special letter), one can quickly switch to both manual mode *and* quick edit mode by turning to the jog dial. The manual mode (along with the quick edit mode) can be left again by pushing the jog dial for at least one second.

The manual mode can also be setup in the corresponding I/O configuration page (see Section 6.5) or for all I/Os in the device configuration page (see Section 6.4).

If an input is in manual mode, the physical input from the connected sensor is ignored and the user can setup a simulated input value to be used in the L-IOB host application or receiving node. This can be used e.g. to test the behavior of the application in the L-IOB host or receiving node depending on certain input values. If an output is in manual mode, the value coming from the L-IOB host or sending node is ignored and the user can set the value for the actuator connected to the physical output. This can be used to physically test the connected actuator.

It is possible that changing the manual value is restricted via a PIN code. In this case, the user will be requested to enter a pin code before the value can be changed. The pin code only needs to be entered once except when the device is not operated manually for more than 30 minutes.

6.4 Device Information and Configuration (LIOB-10x/15x/45x)

This page is available for the LIOB-10x/15x/45x models as well as the LIOB-55x models in LIOB-IP device mode. If the jog dial is pushed when the device configuration icon (toothed wheel icon to the right) is selected, the L-IOB device information and configuration page is entered, which allows viewing and changing device specific properties. If the jog dial is pushed shortly on a device property, the edit mode is entered, which allows changing the property by turning the jog dial. By pushing the jog dial again, the edit mode is left. Following is a list of all device properties:

- **Remote LCD Access (L-INX Mode)**: here the user can exit the remote LCD access. This option is only available if the L-IOB device is remotely accessed via the L-IOB host's LCD Display, see Section LCD Display in the LOYTEC Device User Manual [1].

- **Pin Code Access**: here the user can explicitly log in and out with PIN code. This option is only available if a PIN code is set for the device.

- **Operating Mode**: here the user can change the operating mode of all I/Os except for disabled I/Os, which can only be changed via the I/O configuration page of that specific I/O.

- **Display Contrast**: here the user can setup the LCD display contrast.

- **DHCP, IP Address/Mask/Gateway (LIOB-45x/55x models)**: here the user can configure the IP settings of the device. Observe that they must be confirmed with 'Save IP Settings' (see below).

- **IP Addr. LIOB Host (LIOB-IP device mode)**: here the user can configure the IP address of the L-IOB host, the L-IOB device in LIOB-IP device mode shall be integrated with. Observe that NAT routers are not supported.

- **Config Server Addr. (LONMARK® Mode of LIOB-45x)**: here the user can configure the IP Address of the CEA-852 Configuration Server, the LIOB-45x device in LONMARK® device mode shall become a member of. All further CEA-852 settings can be made in the L-IOB Web UI.

- **Save IP Settings (LIOB-45x/55x models)**: here the user can confirm the IP settings. A device reboot will be performed automatically.

- **Ethernet Status (LIOB-45x/55x models)**: shows the current Ethernet link status and connection speed.

- **Station ID (L-INX Mode)**: shows the station ID (1-24) within the logical daisy chain of L-IOB devices on this L-IOB bus. For LIOB-FT/IP devices (LIOB-15x/45x/55x models), the user can edit this field to setup the order of L-IOB devices.

- **Configure (LIOB-FT/IP device mode)**: here the user can request a fast device configuration or a complete bus configuration run (for all connected devices) from the L-IOB host. At the end of the configuration process, the L-IOB device will either be set online or an error message will be displayed (e.g. if no configuration is available for the requested station ID or the ID is already taken).

- **Domain Length, Domain, Subnet, Node, Set CEA709 Mode (LONMARK® Mode)**: with these properties, the user can get a LIOB-15x/45x device online on a CEA-709 network without the need for a network management tool.

- **Device Name**: name of the L-IOB device.

- **Product Code**: L-IOB model (e.g. LIOB-100).

- **Device Status**: shows the current status of the L-IOB device (offline, online, in configuration, configured).

- **Firmware Image**: shows if the L-IOB device has booted the primary or fallback image (should always be primary).

- **Firmware Version**: version of L-IOB primary firmware image.

- **Firmware Build**: firmware build timestamp.
- **Serial Number**: serial number of the L-IOB device.
- **Node ID**: world-wide unique node ID of the L-IOB device.
- **CPU Load**: current CPU load on the L-IOB device.
- **System Temperature**: current L-IOB system temperature.
- **Supply Voltage**: current supply voltage of the L-IOB device.
- **Last Fatal Error**: shows the last detected fatal error.
- **Last Reset (L-INX Mode)**: timestamp of last reset resp. power cycle of the L-IOB device. This is only set correctly if the L-IOB device is connected to a L-IOB host.
- **Current Date/Time**: shows the current date and time of the L-IOB. This is only set correctly if the L-IOB device is connected to a L-IOB host or time server.
- **Name of LIOB Host (L-INX Mode)**: shows the name of the L-IOB host (e.g. L-INX device).
- **Host Project File (L-INX Mode)**: shows the file name of the L-IOB host project.
- **Host Project Name (L-INX Mode)**: shows the name of the L-IOB host project.
- **Host Project Date (L-INX Mode)**: shows the creation date and time of the L-IOB host project.
- **Reset Count Values**: here the user can set back all count values (counting inputs and the run hours and energy count of all outputs).
- **Reset Device**: here the user can reset the device or set back the device to factory defaults. Observe that in the latter case, the device mode might change too.
- **Device Mode (LIOB-15x/45x/55x models)**: here the user can change the device mode of a LIOB-15x/45x/55x device between LONMARK®, Non-ECS, LIOB-FT/IP, and BACnet (LIOB-55x). Observe that changing the device mode will clear all configuration data except for the basic IP configuration.
- **Model Number (LONMARK® Mode)**: shows the model number (last byte of the Program ID) and version number of the corresponding XIF file.
- **Language**: here the user can setup the language (English or German) of the LCD display.

It is possible that changing the device configuration is restricted via a PIN code. In this case, the user will be requested to enter a pin code before a value can be changed. The pin code only needs to be entered once except when the device is not operated manually for more than 30 minutes or the user logs out explicitly.

6.5 I/O Configuration

If the jog dial is pushed for at least one second on any I/O, the configuration page for that I/O is entered, which allows viewing and changing configuration properties of the I/O. The properties which can be changed are enclosed by angle brackets (“<”, “>”). By turning the jog dial, the user can cycle through the configuration properties. If the jog dial is pushed shortly on a property, the edit mode is entered, which allows changing the property by turning the jog dial. By pushing the jog dial again, the edit mode is left.

It is possible that changing properties is restricted via a PIN code. In this case, the user will be requested to enter a pin code before a value can be changed. The pin code only needs to be entered once except when the device is not operated manually for more than 30 minutes.

To leave the configuration page, the user must turn the jog dial until the title line (I/O name) is selected and then push the jog dial. Alternatively, the jog dial can also be pushed anywhere on the page for at least 1 second.

Observe that depending on the hardware type, signal type, and interpretation of an I/O, the list of configuration properties varies. Refer to Section 7.3 for detailed information on the different configuration properties. In addition to the configuration properties described there, for some I/Os, a “RawValue” property will be displayed. It shows the physical measured value for inputs (e.g. the resistance of an NTC) resp. the physical value for outputs (e.g. the actual voltage for analog outputs). Note that this information can be used for debugging sensors or actuators but is not available in the form of data points on the LIOB host.

For counting inputs, two additional configuration options are available: ‘Pulse Count Reset’ and ‘Count Start Value’. Using ‘Pulse Count Reset’, the counter can either be reset to 0 or to the value set in ‘Count Start Value’.

7 Concepts

This chapter describes the basic concepts behind the configuration and data points of L-IOB devices. These concepts apply to the L-IOB part of the Configurator software (LINX Configurator User Manual [2]), the L-IOB host Web UI (LOYTEC Device User Manual [1]), the L-IOB Web UI (LOYTEC Device User Manual [1]), the L-IOB host LCD UI (LOYTEC Device User Manual [1]), and the L-IOB LCD UI (Chapter 6). Observe that not all properties and data points will be available in all configuration instances. Some properties e.g. can only be seen or setup at configuration time, others only at run time.

7.1 Technology-Independent Data Points (BACnet Mode)

The LIOB-55x I/O modules in BACnet Mode support internal, technology independent data points as well as other advanced features such as alarming, scheduling, and trending (AST) similar to the LIOB I/O controllers. Since the main purpose of LIOB I/O modules is to directly expose I/Os to the control network (CEA-852 or BACnet/IP), these function will usually not be required. For more information on technology independent data points and AST, please refer to the LINX Configurator User Manual [2].

7.2 Bus and Device Configuration

Each L-IOB device has certain configuration properties which are global to the whole bus (LIOB-Connect or LIOB-FT/IP device modes) or one device. The following sections describe these properties.

7.2.1 Index of first Device not in Daisy Chain (LIOB-Connect device mode)

This is a property which is only available for the LIOB-Connect port. It is only required if the LIOB-Connect bus is extended with a 3-wire cable (without select signal) instead of a 4-wire cable. In this case the property specifies the first device after the 3-wire cable

7.2.2 Station ID (L-INX Mode)

Each L-IOB device is assigned a station ID (1-24), unique to the L-IOB bus. The station ID represents the position of the L-IOB device in the L-IOB host configuration. In case of LIOB-Connect, it also represents the physical position in the daisy chain, see Chapter 5.

7.2.3 Minimum Firmware Version (L-INX Mode)

This property can be used to specify a minimum for the required firmware version of the connected L-IOB devices, e.g. to enable advanced functions in the Configurator which are only available from a certain L-IOB firmware version on.

7.2.4 Enabled (L-INX Mode)

The enabled flag can be used to disable certain L-IOB devices which are part of a common L-IOB host project but not part of a certain L-IOB host installation where this project shall be used. One could e.g. create a common L-IOB host project for 10 rooms where in some rooms, one or more L-IOB devices (resp. their data points) are not needed. In this case, the unneeded L-IOB devices can be disabled and the corresponding L-IOB units do not have to be physically installed.

7.2.5 Product Code

The product code is the model name of the L-IOB device, e.g. “LIOB-100”

7.2.6 Device Name

The device name is the user defined name of the L-IOB device.

7.2.7 PIN

The PIN code can be used to restrict manual access to the L-IOB LCD UI (See Chapter 6). Values can only be changed after the user enters the pin code using the jog dial of the L-IOB device.

7.2.8 Alternative Unit

This is a flag which is set if this device shows US units (instead of SI units).

7.2.9 Language

This is the language setting of the L-IOB LCD Display (English or German).

7.2.10 Group I/O Min/Max Send Times (LONMARK® Mode)

These are parameters to setup a minimum wait time and maximum time between updates of the digital group network variables in LONMARK® Mode.

7.2.11 NID

The NID (worldwide unique Node ID of each L-IOB device) is a standard requirement for each CEA-709 device. In L-INX Mode, it is used by the L-IOB host to detect L-IOB devices after a reboot and also to automatically enumerate L-IOB devices.

7.2.12 Translation Tables

Translation tables are used to translate a physical input value (resistance, voltage, current, or frequency) to the actual value, the sensor is supposed to measure (e.g. temperature). The configuration of translation tables is explained in the LINX Configurator User Manual [2].

7.3 I/O Configuration

Each I/O in a L-IOB device has certain configuration properties which are specific to that I/O. Not all listed properties are available for all I/Os, dependent on the hardware type and certain other configuration properties. The following sections describe the I/O properties and their dependencies.

7.3.1 Name

The name property is available for all I/Os. It is the user defined name of the I/O (e.g.: ‘Temperature1’).

7.3.2 HardwareType

The hardware type property is available for all I/Os. The following hardware types are available (dependent on the L-IOB model):

- **IN Analog/Digital**: universal analog/digital input (UI) which can be configured to measure resistance, voltage, or current (with or without internal shunt). Observe that this hardware type is also used for the internal pressure sensor (e.g. ‘PRESS’ in LIOB-154). In this case, 0V refers to 0Pa (Pascal) and 10V to 500Pa.

- **IN Digital**: digital S0 input (DI).
- **OUT Analog**: analog 0-10 V output (AO).
- **OUT Relay 6A**: digital 6 A relay output (DO).
- **OUT Relay 16A**: digital 16 A relay output (DO).
- **OUT Triac**: digital 1 A triac output (DO).

This hardware type property can not be configured of course. Refer to Section 13.1 for a detailed specification of the different I/O hardware types.

7.3.3 SignalType

The signal type property is available for I/Os of hardware type “IN Analog/Digital”. The following signal types can be configured:

- **Resistance**: measures resistance of about 1 kΩ to 100 kΩ. A value bigger than 500 kΩ is detected as a disconnected sensor (except if NoValCorr flag is set, see Section 7.3.16).
- **Voltage 0-10V**: measures voltage from 0 to 10 V.
- **Voltage 2-10V**: measures voltage from 2 to 10 V. A value smaller than 1.75 V is detected as a disconnected sensor (except if NoValCorr flag is set, see Section 7.3.16).
- **Current 4-20mA ext. Shunt**: measures current from 4 to 20 mA. A value smaller than 3.5 mA is detected as a disconnected sensor (except if NoValCorr flag is set, see Section 7.3.16). An external shunt of 249 Ω must be used for correct measurement.
- **Current 4-20mA int. Shunt**: measures current from 4 to 20 mA. A value smaller than 3.5 mA is detected as a disconnected sensor (except if NoValCorr flag is set, see Section 7.3.16). No external shunt is required. This setting is only available on some universal inputs which have an internal shunt, see Section 13.4. Observe that changing the signal type to this setting may result in changing the setting on other universal inputs too. In this case, a Configurator message will inform the user of the changes.

7.3.4 Interpretation

The interpretation property is available for all I/Os. Depending on the hardware type and signal type, the following interpretations can be configured:

- **CustomNTC**: This interpretation is only available for universal inputs (hardware type “IN Analog/Digital”) with signal type “Resistance”. It is used for connecting a custom NTC temperature sensor to the input. The parameters of the NTC can be setup as described in Section 7.3.27.
- **PT1000**: This interpretation is only available for universal inputs (hardware type “IN Analog/Digital”) with signal type “Resistance”. It is used for connecting a PT1000 temperature sensor to the input.
- **NTC10K**: This interpretation is only available for universal inputs (hardware type “IN Analog/Digital”) with signal type “Resistance”. It is used for connecting an NTC10K temperature sensor to the input.

- **NTC1K8**: This interpretation is only available for universal inputs (hardware type “IN Analog/Digital”) with signal type “Resistance”. It is used for connecting an NTC1K8 temperature sensor to the input.

- **Ni1000**: This interpretation is only available for universal inputs (hardware type “IN Analog/Digital”) with signal type “Resistance”. It is used for connecting an Ni1000 temperature sensor to the input.

- **Linear**: This interpretation is only available for universal inputs (hardware type “IN Analog/Digital”). It is used to perform a linear transformation from a physical input value (resistance, voltage, or current, see Section 7.3.3) to the actual value, the sensor is supposed to measure (e.g. temperature, see Section 7.3.5). The input range is specified by the signal type:

    - Resistance: 0 … 10 kΩ
    - Voltage 0-10V: 0 … 10 V
    - Voltage 2-10V: 2 … 10 V
    - Current 4-20mA ext. Shunt: 4 … 20 mA
    - Current 4-20mA int. Shunt: 4 … 20 mA

  The output range is specified by MinValue and MaxValue, see Section 7.3.23. In case of signal type “Voltage 2-10V” e.g. a measured value of 2 V would be transformed into MinValue and a measured value of 10 V would be transformed into MaxValue.

- **Frequency**: This interpretation is available for all inputs. It is used to measure the frequency of the digital input resp. universal input in digital mode. The period used for measurement is specified by the MinSendTime parameter, see Section 7.3.25.

- **Translation Table**: This interpretation is only available for universal inputs (hardware type “IN Analog/Digital”). It is used to perform a transformation from a physical input value (resistance, voltage, or current, see Section 7.3.3) to the actual value, the sensor is supposed to measure (e.g. temperature, see Section 7.3.5) using a transformation table. The table can be selected with TransTable, see Section 7.3.26. The tables can be setup for each L-IOB device.

- **Frequency Table**: This interpretation is available for all inputs. It is used to perform a transformation from a frequency value (measured as described above) to the actual value, the sensor is supposed to measure (e.g. velocity, see Section 7.3.5) using a transformation table. The table can be selected with TransTable, see Section 7.3.26. The tables can be setup for each L-IOB device.

- **Physical Unit Count**: This interpretation is available for all inputs. It is used to count in a certain physical unit. The unit is setup with DataType and SIUnit_OnText, see Sections 7.3.5 and 7.3.18. The increment for each pulse is setup using the Resolution property, see Section 7.3.19.

- **Digital**: This interpretation is available for all I/Os. In case of an analog output, the off and on output values are specified with OffValue and OnValue, see Section 7.3.30.

- **Pulse Count**: This interpretation is available for all inputs. It is used to count pulses of the digital input or universal input in digital mode. It is also used for connecting the code signal of STId card readers, see Section 7.5. Like in the “Physical Unit Count” interpretation, a unit and an increment can be setup for calculating a value of a certain physical unit. However, in case of the “Pulse Count” interpretation, this calculation is only used for display on the L-IOB LCD UI. The data point remains a 32-bit counter.

- **Occupancy**: This interpretation is available for all inputs. See Section 7.3.28 for details.

- **Switch Mode (LONMARK® Mode)**: This interpretation is available for all inputs (restricted to LIOB-15x/45x in LONMARK® or Non-ECS device mode). See Section 7.4 for details.

- **Clock**: This interpretation is available for all interrupt-capable inputs. It is used for connecting the clock signal of STId card readers, see Section 7.5.

- **Card Data**: This interpretation is available for all inputs. It is used for connecting the data signal of STId card readers, see Section 7.5.

- **Analog**: This interpretation is only available for analog outputs (hardware type “OUT Analog”). It is used to output a voltage between 0 and 12 V. In case of using data type “Percentage” (see Section 7.3.5), the output value (in percent) coming from the L-IOB host is scaled using the MinValue and MaxValue properties (see Section 7.3.23). An output value of 50% would e.g. translate into an actual voltage of just in the middle between MinValue and MaxValue, an output value of 100% would translate into a voltage of MaxValue. Note that an output value of 0% is still always translated into 0V. As soon as the output value is slightly raised above 0% however, the voltage jumps to MinValue.

- **PWM**: This interpretation is available for all outputs. It is used to generate a pulse width modulated output signal. The period is setup with PWMPeriod, see Section 7.3.31. In case of an analog output, the off and on output values are specified with OffValue and OnValue, see Section 7.3.30. The output value (in percent) coming from the L-IOB host is scaled using the MinValue and MaxValue properties (see Section 7.3.23). An output value of 50% would e.g. translate into an actual pulse width of just in the middle between MinValue and MaxValue, an output value of 100% would translate into a pulse width of MaxValue. Note that an output value of 0% is still always translated into zero pulse width (always off). As soon as the output value is slightly raised above 0% however, the pulse width jumps to MinValue. This scaling is typically used to correctly control slow actuators like heating valves. If a valve e.g. requires a pre-heating time of 1 min, using a PWM period of 10 min, the MinValue can be set to 10% to compensate the pre-heating time. For further information on optimal control of your actuator in PWM mode, please refer to the corresponding data sheet. When the output value (coming from the L-IOB host) changes during a PWM period, the new value will be applied in the current period if possible. If the value decreases, the physical output will be switched off earlier, or immediately, if the newly defined point in time has already elapsed. If the value increases, the physical output will be switched off later, if it was still switched on when the value changes. Otherwise, the new value will be applied starting with the next period. When a PWM output is in manual operating mode (see Section 7.3.11), a new period is started immediately whenever the manual value is changed.

- **Fading**: This interpretation is available for all analog outputs. It is equal to the “Analog” interpretation except for the behavior on a value change. The output is not immediately set to the new value but instead a slow fading from the current value to the new value is performed. The transition time used for fading from the current value to the new value (fading time) is setup in the property DeadTime, see Section 7.3.7. Since this time is constant, the transition speed depends on the difference between current and new value.

- **Ramping**: This interpretation is available for all analog outputs. It is equal to the “Fading” interpretation except that the DeadTime property (see Section 7.3.7) specifies the time it takes to ramp from the minimum value to the maximum value (ramping time). This way, the transition speed between current and new value is always equal, independent of the difference between the two values.

7.3.5 DataType

The data type property is available for all inputs with interpretation “Linear”, “Translation Table”, “Frequency Table”, “Physical Unit Count”, “Digital”, “Occupancy”, and “Switch Mode”, as well as for outputs with interpretation “Digital”, “Analog”, “Fading”, or “Ramping”. It specifies the physical quantity of the I/O. For outputs with interpretation “Digital”, the data type can be chosen between “Switch” and “Duration”. In case of “Duration”, the output has the following characteristics:

- If a positive output value is written, it is interpreted as a period (in [ms]) in which the output shall be switched on. After that period, the output is automatically switched off again. The feedback value of the output is initially set to the given period and stays there until the output is switched off. After that, the feedback value is set to 0.
- If 0 is written to the output value, the output is switched off immediately.
- If a negative output value is written, the output is switched on permanently.

7.3.6 SNVT

The SNVT (Standard Network Variable Type) is available for all I/Os on a LIOB-15x/45x model in LONMARK® or Non-ECS device mode. Depending on the interpretation, different SNVTs will be available for selection. The SNVT determines the type of all changeable network variables and configuration properties of the I/O.

7.3.7 DeadTime for Fading and Ramping

For interpretation “Fading”, the DeadTime property specifies the fading time from the current value to the new value. For interpretation “Ramping”, the DeadTime property specifies the ramping time from the minimum to the maximum value (independent of current and new value).

7.3.8 IOFunc, GroupNumber, and DeadTime for Interlocked Mode

The IO function, group number, and dead time properties are available for all digital outputs. If **IOFunc** is set to “Interlocked”, the **GroupNumber** property can be used to form different interlocked groups. Further, for each interlocked output, the data type can be chosen between “Switch” and “Duration”. The digital outputs belonging to one interlocked group have the following characteristics:

- Data Type “Switch”:
  - If “true” is written to the output value, the output is switched on permanently.
  - If “false” is written to the output value, the output is switched off immediately.
- Data Type “Duration”:
  - If a positive output value is written, it is interpreted as a period (in [ms]) in which the output shall be switched on. After that period, the output is automatically switched off again. The feedback value of the output is initially set to the given period and stays there until the output is switched off. After that, the feedback value is set to 0.
  - If 0 is written to the output value, the output is switched off immediately.
  - If a negative output value is written, the output is switched on permanently.

- Whenever an output is switched on (as described above), it is checked before if another output in the same interlocked group is already switched on. In this case, the other output is switched off immediately. Then, for a period setup with **DeadTime**, all outputs of the group remain off. After that, finally the new output is switched on (either for a certain period of permanently).

The interlocked mechanism can be used e.g. for sunblind motors where it must be ensured that the up and down motors are never active at the same time.

7.3.9 IOFunc, GroupNumber, and SubGroupNumber for Switch Mode

The IO function, group number, and sub group number properties are available for all inputs with interpretation “Switch Mode” (only available for LONMARK® / Non-ECS device mode). If **IOFunc** is set to “2-Switch-Group”, the **GroupNumber** property can be used to form different two-input groups. With the **SubGroupNumber** property, the two inputs must be assigned to either the function “Switch 1” or “Switch 2”. Refer to Section 7.4 for more information on the switch mode.

7.3.10 IOFunc, GroupNumber, and SubGroupNumber for Card Reader Mode

The IO function, group number, and sub group number properties are available for all inputs used for connecting the signals of an STId card reader, see Section 7.5.

7.3.11 OperatingMode, OverrideValue, and DefaultValue

The operating mode property is available for all I/Os. For inputs, the **OperatingMode** property has the following meaning:

- **Disabled**: The physical input is disabled and the data point is set to **DefaultValue**. This can be used to disable unused inputs.

- **Auto**: The input measures the value from the connected sensor.

- **Override**: The physical input is disabled and the data point is set to **OverrideValue**.

- **Manual**: The physical input is disabled and the data point is set by the user on the L-IOB LCD UI (see Chapter 6) or L-IOB host Web UI (see LOYTEC Device User Manual [1]). This can be used to simulate input values for the connected node(s) or the L-IOB host. Observe that this function is available in the L-IOB host Web UI works even if the corresponding L-IOB device is not physically present yet.

The **DefaultValue** is also used for inputs, when no sensor value has yet been read from the physical input or a sensor error is detected. For outputs, the **OperatingMode** property has the following meaning:

- **Disabled**: The output value is ignored in the L-IOB device and the physical output (as well as the feedback value) is set to **DefaultValue**.

- **Auto**: The physical output (and feedback value) is set as requested by the output value set from the network or L-IOB host (L-INX mode).

- **Override**: The output value is ignored in the L-IOB device and the physical output (as well as the feedback value) is set to **OverrideValue**. This can be used e.g. for providing a constant supply voltage to a sensor.

- **Manual**: The output value is ignored in the L-IOB device and the physical output (as well as the feedback value) is set by the user on the LIOB LCD UI (see Chapter 6). This can be used to test actuators.

The **DefaultValue** is also used for outputs when no output value has yet been received by the L-IOB device resp. after a reboot, if the persistent flag is not set (see Section 7.3.12).

7.3.12 Persistent Flag

The persistent flag is available for all outputs. It specifies the behavior of the L-IOB outputs after a power cycle of the L-IOB device or when the L-IOB device loses connection to the L-IOB host. If it is set, the output is set to the last stored value in the mentioned scenarios. If it is cleared, the output is set to the DefaultValue (see Section 7.3.11). Since the output values are only stored in the L-IOB device approx. every 20 minutes, it is possible that even in the first case, the output value temporarily changes.

7.3.13 Invert Flag

The invert flag is available for all I/Os in digital/PWM mode or where the input is used to count pulses or detect occupancy. In the first case, the invert flag is used to invert the input or output. In the second case, the flag specifies whether the pulse shall be detected at the positive or negative edge. For occupancy detection, the flag specifies the occupied state of the sensor. Observe that if the SignalType is set to “Resistance” (see Section 7.3.3), the Invert flag is set by default. This is because the ON / OCCUPIED state usually refers to a low resistance value (“CLOSED” contact) whereas the OFF / UNOCCUPIED state usually refers to a high resistance value (“OPEN” contact).

7.3.14 AnaInvert Flag

The analog invert flag is available for all voltage or current inputs with interpretation “Linear” or “Translation Table” (see Section 7.3.4) and for all outputs with interpretation “Analog”, “Fading”, or “Ramping”. It inverts the analog range between the MinValue and the MaxValue. For a 0-10V sensor with linear interpretation e.g., 0V would result in a live value of MaxValue and 10V results in the MinValue.

7.3.15 Sqrt Flag

The square root flag is available for all voltage, current, or pressure inputs with interpretation “Linear” or “Translation Table” (see Section 7.3.4). It performs a square root operation on the signal range. The formulas for the different sensor signal types are listed below:

- 0-10V Sensor or Pressure Sensor: $Usqrt = \sqrt{U * 10V}$
- 2-10V Sensor: $Usqrt = 2V + \sqrt{(U - 2V) * 8V}$
- 4-20mA Sensor: $Isqrt = 4mA + \sqrt{(I - 4mA) * 16mA}$

Values below the signal range (below 0V, 2V, or 4mA) are not converted. The *Usqrt* or *Isqrt* value is then used instead of the *U* or *I* value for further calculation (linear transformation or translation table). The square root flag can be used e.g. to easily calculate a flow value instead of a differential pressure.

7.3.16 NoValCorr Flag

The NoValCorr flag is available for all inputs with signal type “Resistance”, “Voltage 2-10V”, “Current 4-20mA ext. Shunt”, or “Current 4-20mA int. Shunt” and interpretation “CustomNTC”, “PT1000”, “NTC10K”, “NTC1K8”, “Ni1000”, “Linear”, or “Translation Table”. If it is set, the detection of disconnected sensors is switched off and every measured value is processed, see also Section 7.3.3.

7.3.17 PulseTime Flag

The pulse time flag is available for all inputs with interpretation “Pulse Count” or “Physical Unit Count” (see Section 7.3.4). It activates the pulse time data point. Note that by setting this flag, additional traffic is generated.

7.3.18 SIUnit_OnText and USUnit_OffText

The SI unit / on text and US unit / off text properties are available for all I/Os. In case of analog values, the **SIUnit_OnText** property specifies the unit in SI mode, in case of digital values, it specifies the ON text (shown when the digital I/O is active). In case of analog values, the **USUnit_OffText** property specifies the unit in US mode, in case of digital values, it specifies the OFF text (shown when the digital I/O is inactive). Using the Configurator (**Project Settings**), the user can choose between SI and US units.

7.3.19 Resolution

The resolution property is available for all I/Os with an analog data type. It specifies the resolution of the value display in the L-IOB LCD UI as well as the step width for the L-IOB jog dial when manually setting an analog value or property of that I/O. For the interpretations “Physical Unit Count” and “Pulse Count”, it also specifies the increment for each pulse, see Section 7.3.4.

7.3.20 MultUS and OffsUS

The US Multiplier and Offset properties are available for all I/Os with an analog data type and are calculated automatically. Using the Configurator, the user can choose between SI and US units. In case of US units, the I/O values displayed in the L-IOB host Web UI and L-IOB LCD UI are converted using these properties (ValueUS = ValueSI * MultUS + OffsUS). The US unit is setup in the USUnit_OffText property, see Section 7.3.18. Observe that the properties setup in the Configurator as well as the connected data points will still always carry SI units.

7.3.21 DisplayOnSymbol and DisplayOffSymbol

The display on/off symbol properties are available for inputs with Interpretation “Digital” (see Section 7.3.4). They are used to specify the display of the two digital states ON and OFF. For both these states, the following symbols can be chosen:

- **OPEN**: open switch symbol
- **CLOSED**: closed switch symbol
- **OK**: check symbol
- **ERROR**: exclamation mark symbol

7.3.22 Offset

The offset property is available for inputs with an analog data type. It is added at the end of the calculation to the (already processed) value. This way, e.g. temperature sensors can be calibrated in each room without changing the common application. Observe that in the LCD UI, the resulting input value will be displayed next to the offset value to simplify calibration.

7.3.23 MinValue and MaxValue

The minimum and maximum value properties are available for all I/Os with an analog data type (except for Interpretation “Physical Unit Count”) as well as for inputs with interpretation “Digital”, “Occupancy, or “Switch Mode”. They are used for:

- scaling inputs with interpretation “Linear” (see Section 7.3.4),

- scaling outputs with interpretation “Analog”, “PWM”, “Fading”, or “Ramping (see Section 7.3.4),
- scaling the bar icon in the L-IOB LCD UI (see Section 6.2),
- setting the active and inactive values of the SNVT_occupancy for digital or occupancy inputs (LONMARK® / Non-ECS device mode only),
- limiting the dimming values in Switch Mode (LONMARK® / Non-ECS device mode only, see Section 7.4).

7.3.24 COV and MaxSendTime

The **C**hange-**O**f-**V**alue property is available for all inputs with an analog data type. It is used to specify a minimum delta value required to trigger a data point update. If the input value only changes within a range of –**COV** to +**COV**, no update is generated. In any case, after **MaxSendTime** an update is generated to be sure to get the latest value at least at some point in time. If COV is set to 0, every input value change generates an update of the attached data point.

Observe that the **MaxSendTime** property is available for all I/Os (analog and digital) to act as a heartbeat function. For outputs, it is applied both on the output value (heartbeat *to* L-IOB device) and feedback value (heartbeat *from* L-IOB device). Whenever an update is sent from a L-IOB device to the host because of a max send time, the connected data point in the host (input or feedback value) is updated too, even if there is no value change. In cases where this behavior is not desired, the “Analog Point COV Increment” or “Only notify on COV” property of the corresponding host data point must be set.

7.3.25 MinSendTime

The minimum send time property is available for all I/Os. It specifies the minimum time that has to pass before a new update of an input or output feedback value is generated. If MinSendTime is set to 0, all changes of the inputs or output feedbacks immediately generate updates. For inputs with interpretation “Frequency” or “Frequency Table” (see Section 7.3.4), the MinSendTime property also specifies the period used for frequency measurement. For inputs with interpretation “Switch Mode”, the MinSendTime property specifies the repeat time for the long push events, see Section 7.4.

7.3.26 TransTable

The translation table property is available for all inputs with interpretation “Translation Table” or “Frequency Table” (see Section 7.3.4). It specifies the translation table which shall be used for the translation. The configuration of translation tables are explained in the LINX Configurator User Manual [2].

7.3.27 NTC_Rn, NTC_Tn, and NTC_B

The Rn, Tn, and B properties are available for inputs with interpretation “Custom NTC” (see Section 7.3.4). Tn is specified in degree Celsius. Rn is the resistance of the NTC temperature sensor at the temperature Tn. The temperature value is calculated using the formula:

T = B * (Tn + 273.16 degC) / (B + ln(R / Rn) * (Tn + 273.16 degC)) – 273.16 degC.

T is the calculated temperature in degree Celsius and R is the measured resistance of the NTC temperature sensor.

7.3.28 HoldTime and DebounceTime

These properties are available for all inputs where the Interpretation is set to “Occupancy” or “Switch Mode”. The HoldTime is also available for the data signal of STId card readers, see Section 7.5. The DebounceTime is also available for inputs with interpretation “Digital”.

In interpretation “Occupancy”, the occupied state is detected using a sensor which becomes active (e.g. closes a contact) or creates pulses whenever the room is occupied. These states are converted to an occupancy value in the following way:

- When the occupied state (or a pulse) is detected, the value changes to OCCUPIED and stays there for at least the **HoldTime**.
- As long as the sensor stays in the occupied state or whenever new pulses are detected during the **HoldTime**, the timer for the **HoldTime** is started again.
- When the sensor stays in the unoccupied state until the **HoldTime** exceeds, the state goes back to UNOCCUPIED.
- From this moment on, all pulses from the sensor are ignored for as long as the **DebounceTime** lasts. This is useful e.g. when light is switched off due to detecting the UNOCCUPIED state which leads to new pulses of the sensor and in turn leads to switching on the light again. To break this loop, the debounce time is used.

In case of interpretation “Switch Mode”, the **HoldTime** specifies the time to distinguish between short and long pushes. The **DebounceTime** is used to distinguish between a combined push or two consecutive pushes of a 2-switch group.

In case of interpretation “Digital”, the **DebounceTime** is used for spike suppression. It specifies the maximum duration of an unwanted spike to be suppressed.

7.3.29 EventGroup Modes and Values

The EventGroupXyzModes (e.g. **EventGroup1ShortPushMode**) and EventGroupXyzValues (e.g. **EventGroup1ShortPushValue**) are available for Inputs with Interpretation “Switch Mode” (LONMARK® / Non-ECS device mode only). Refer to Section 7.4 for more information.

7.3.30 OffValue and OnValue

The off and on value properties are available for analog outputs in digital mode. They specify the physical values (voltages) to be output for the OFF (inactive) and ON (active) state.

7.3.31 PWMPeriod

The PWM period property specifies the period (in seconds) for outputs with Interpretation “PWM” (Pulse Width Modulation), see Section 7.3.4.

7.3.32 NominalPower

The nominal power property is available for all outputs. It specifies the nominal resp. average expected power consumption of the device or appliance (e.g. lamp) connected to the output. For digital outputs it specifies the average power when the output is activated (e.g. relay closed), for analog outputs it specifies the average power when the output is set to 10 V. The nominal power property is used to calculate the energy count data point of the output.

7.4 Switch Mode (LONMARK® Mode)

This chapter only applies to LIOB-15x/45x models in LONMARK® or Non-ECS device mode.

The switch mode is available for all inputs as an interpretation option, see Section 7.3.4. It implements a configurable switch function with an optional secondary input and an additional feedback input network variable ‘nviInSwitchFb’ of type SNVT_switch (available for each input). An input in switch mode basically acts as a digital input with some additional functions described in the following sections.

7.4.1 General Function

Whenever the state of an input in switch mode changes (a connected button or switch is pressed, released, or switched), the live value network variable updates its value according to the configuration properties described below. The type of the live value NV is determined by the **DataType** property (see Section 7.3.5) and can be set to Switch (SNVT_switch), Scene (SNVT_scene), or Setting (SNVT_setting). The following configuration properties are available for each input in switch mode:

- EventGroup1ShortPushMode / EventGroup1ShortPushValue,
- EventGroup1ShortReleaseMode / EventGroup1ShortReleaseValue,
- EventGroup1LongPushMode / EventGroup1LongPushValue,
- EventGroup1LongReleaseMode / EventGroup1LongReleaseValue,
- EventGroup2ShortPushMode / EventGroup2ShortPushValue,
- EventGroup2ShortReleaseMode / EventGroup2ShortReleaseValue,
- EventGroup2LongPushMode / EventGroup2LongPushValue,
- EventGroup2LongReleaseMode / EventGroup2LongReleaseValue,

Whether EventGroup1 or EventGroup2 is active is either determined by toggling between them with one input (whenever the input becomes inactive) or explicitly, by using two inputs (see Section 7.4.2). The flow chart of the switch mode is depicted in Figure 22.

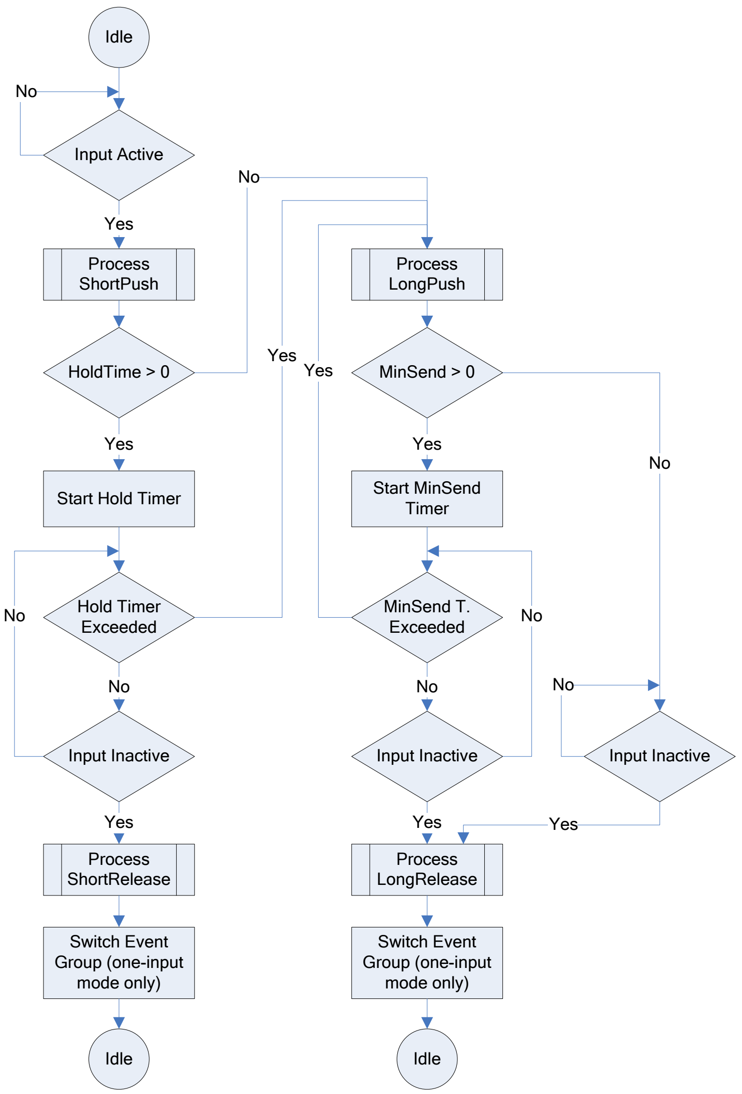


Figure 22: Switch Mode Flow Chart

The event ShortPush is fired when the input becomes active. ShortRelease is fired when the input becomes inactive again before the **HoldTime** (see Section 7.3.28). LongPush is fired when the input is still active after **HoldTime**. If the **MinSendTime** (see Section 7.3.25) is greater than 0 for the input, the LongPush event is fired consecutively with a period of **MinSendTime** as long as the input stays active. If the input becomes inactive again after **HoldTime**, LongRelease is fired. For each event, a Mode and a Value property is available as listed above. The Value properties determine the values which shall be sent out when the corresponding events occur. They therefore always have the same type as the live value network variable of the input. The Mode properties determine the modes and conditions under which the Values are sent out. They are enumerations which define the following modes:

- **Disabled**: No value is sent out if the event occurs. If all modes of EventGroup2 are set to disabled, the EventGroup2 is disabled completely (no switching between event groups).

- **Set**: The value is sent out as specified.

- **Set if Feedback State is 0**: Same as ‘Set’ but only if the feedback .state member is 0. If not, the event group is switched and the corresponding Mode/Value properties of the other event group are processed instead.

- **Set if Feedback State is 1**: Same as 'Set' but only if the feedback .state member is 1. If not, the event group is switched and the corresponding Mode/Value properties of the other event group are processed instead.

- **Increment** (SNVT_switch only): The last value of the feedback .value member (when the feedback .state member was > 0) is increased by the .value member of the corresponding configuration property (EventGroupXyzValue) and sent with the .state member specified in the corresponding configuration property. The sent .value member is not increased above the .value member of the MaxValue property (see Section 7.3.23).

- **Increment if Feedback State is 0** (SNVT_switch only): Same as 'Increment' but only if the feedback .state member is 0. If not, the event group is switched and the corresponding Mode/Value properties of the other event group are processed instead.

- **Increment if Feedback State is 1** (SNVT_switch only): Same as 'Increment' but only if the feedback .state member is 1. If not, the event group is switched and the corresponding Mode/Value properties of the other event group are processed instead.

- **Decrement** (SNVT_switch only): The last value of the feedback .value member (when the feedback .state member was > 0) is decreased by the .value member of the corresponding configuration property (EventGroupXyzValue) and sent with the .state member specified in the corresponding configuration property. The sent .value member is not decreased below the .value member of the MinValue property (see Section 7.3.23).

- **Decrement if Feedback State is 0** (SNVT_switch only): Same as 'Decrement' but only if the feedback .state member is 0. If not, the event group is switched and the corresponding Mode/Value properties of the other event group are processed instead.

- **Decrement if Feedback State is 1** (SNVT_switch only): Same as 'Decrement' but only if the feedback .state member is 1. If not, the event group is switched and the corresponding Mode/Value properties of the other event group are processed instead.

- **Set State** (SNVT_switch only): The last value of the feedback .value member (when the feedback .state member was > 0) is sent with the .state member specified in the corresponding configuration property (EventGroupXyzValue). It is made sure that the sent .value member stays between the .value members of the MinValue and MaxValue properties (see Section 7.3.23).

- **Set State if Feedback State is 0** (SNVT_switch only): Same as 'Set State' but only if the feedback .state member is 0. If not, the event group is switched and the corresponding Mode/Value properties of the other event group are processed instead.

- **Set State if Feedback State is 1** (SNVT_switch only): Same as 'Set State' but only if the feedback .state member is 1. If not, the event group is switched and the corresponding Mode/Value properties of the other event group are processed instead.

- **Set Value and Set Feedback State to 0** (SNVT_scene / SNVT_setting only): The value is sent out as specified and the feedback .state member is internally set to 0.

- **Set Value and Set Feedback State to 1** (SNVT_scene / SNVT_setting only): The value is sent out as specified and the feedback .state member is internally set to 1.

- **Set Value and Set Feedback State to 0 if Feedback State is 1** (SNVT_scene / SNVT_setting only): Same as 'Set Value and Set Feedback State to 0' but only if the feedback .state member is 1. If not, the event group is switched and the corresponding Mode/Value properties of the other event group are processed instead.

- **Set Value and Set Feedback State to 1 if Feedback State is 0** (SNVT_scene / SNVT_setting only): Same as 'Set Value and Set Feedback State to 1' but only if the feedback .state member is 0. If not, the event group is switched and the corresponding Mode/Value properties of the other event group are processed instead.

When using the conditional modes (… if Feedback State is 0/1), it must be made sure that the feedback network variable of the input always represents the current state of the object which shall be controlled. There are three possible ways to achieve that:

- The object which is controlled (e.g. a light) delivers a SNVT_switch network variable, which can be bound to the feedback network variable ('nviInSwitchFb') of the input.

- A turn-around binding between the live value ('nvoInValue') and the feedback network variable ('nviInSwitchFb') of the input is created. This is only possible if the **DataType** of the input is set to Switch (SNVT_switch).

- The feedback .state member is internally controlled using the 'Set Value and Set Feedback State to …' modes. This is only possible if the **DataType** of the input is set to Scene (SNVT_scene) or Setting (SNVT_setting).

7.4.2 Two-Input Mode

Two inputs can be grouped together using the **IOFunc**, **GroupNumber**, and **SubGroupNumber** properties (see Section 7.3.9). Each event group is permanently assigned to a specific input and there is no back and forth between the two event groups. EventGroup1 is assigned to the input with the **SubGroupNumber** 'Switch 1' and EventGroup2 is assigned to the input with the **SubGroupNumber** 'Switch 2'. The **GroupNumber** property must be the same for both inputs.

In this case, both event groups described in Section 7.4.1 are defined in the first input object ('Switch 1'). The two free event groups (in combination with the **HoldTime** and **MinSendTime**) of the second input are used to define the behavior when both inputs become active 'at the same time', meaning within the **DebounceTime** (see Section 7.3.28). The release events are fired when at least one input becomes inactive again. Both inputs must become inactive again before any new event is fired after that. The live value and feedback network variables of both inputs are fully functional. Between the two feedback network variables, the latest received value always wins.

7.4.3 Examples

The following sections present some typical examples of using the switch mode. All examples can be found as I/O object template files in the folder 'LIOB\objects' of the L-INX Configurator Software. Since the switch mode is available both for universal and digital inputs, there are two versions of each example file: 'UI_xyz.xml' and 'DI_xyz.xml'. The example files using the two-input mode are named 'xyz_1.xml' and 'xyz_2.xml'. If several two-input ('two_button') examples are used within one L-IOB device, the **GroupNumber** properties must be changed so that each 2-Switch-Group has a unique group number.

7.4.3.1 Simple Switch

This example is implemented in the following I/O object template files:

- UI_simple_switch.xml (universal input)
- DI_simple_switch.xml (digital input)

The following properties are changed (from the default values) in this example:

- **DataType** = Switch (SNVT_switch, members: value / state)

- **EventGroup1ShortPushMode** = Set
- **EventGroup1ShortPushValue** = 100 / 1
- **EventGroup1LongReleaseMode** = Set
- **EventGroup1LongReleaseValue** = 0 / 0

When the input is activated (switched on), 100/1 is sent out. When the input is deactivated, (switched off), 0/0 is sent out. Observe that the **HoldTime** is set to 0 to prevent the ShortRelease event from occurring.

7.4.3.2 One-Button Toggle

This example is implemented in the following I/O object template files:

- UI_one_button_toggle.xml (universal input)
- DI_one_button_toggle.xml (digital input)

The following properties are changed (from the default values) in this example:

- **DataType** = Switch (SNVT_switch, members: value / state)
- **EventGroup1ShortPushMode** = Set if Feedback State is 0
- **EventGroup1ShortPushValue** = 100 / 1
- **EventGroup2ShortPushMode** = Set if Feedback State is 1
- **EventGroup2ShortPushValue** = 0 / 0

When the input is activated (button is pressed) and the feedback .state member is 0, 100/1 is sent out. If the feedback .state member is 1, 0/0 is sent out. It does not matter in which event group the input is currently in, since the conditional modes always make sure that the live value toggles. Observe that for this example, a turnaround network variable binding from the live value (‘nvoInValue’) to the feedback (‘nviInSwitchFb’) of the input object must be created.

7.4.3.3 One-Button Dimming

This example is implemented in the following I/O object template files:

- UI_one_button_dimming.xml (universal input)
- DI_one_button_dimming.xml (digital input)

The following properties are changed (from the default values) in this example:

- **DataType** = Switch (SNVT_switch, members: value / state)
- **MinValue** = 10 / 1
- **MaxValue** = 100 / 1
- **MinSendTime** = 0.2s
- **HoldTime** = 1s
- **EventGroup1ShortReleaseMode** = Set State if Feedback State is 0
- **EventGroup1ShortReleaseValue** = 0 / 1
- **EventGroup1LongPushMode** = Increment
- **EventGroup1LongPushValue** = 1 / 1
- **EventGroup2ShortReleaseMode** = Set if Feedback State is 1
- **EventGroup2ShortReleaseValue** = 0 / 0

- **EventGroup2LongPushMode** = Decrement
- **EventGroup2LongPushValue** = 1 / 1

When the input is activated shortly (button is pressed shortly) and the feedback .state member is 0, the last feedback .value member (when the .state member was > 0) is sent out along with the .state member 1 (light is switched on). Using the 'Set State …' mode ensures that the last dimming value is restored. When the input is activated shortly (button is pressed shortly) and the feedback .state member is 1, 0/0 is sent out (light is switched off). If the input is activated for longer than 1s (HoldTime), the light is switched on and the .value member is incremented or decremented by 1 each 0.2s (MinSendTime). Using the MinValue property, it is made sure that the light level never goes below 10% as long as it is switched on. Observe that for this example, a turnaround network variable binding from the live value ('nvoInValue') to the feedback ('nviInSwitchFb') of the input object must be created.

7.4.3.4 Rocker Switch

This example is implemented in the following I/O object template files:

- UI_rocker_switch_1.xml / UI_rocker_switch_2.xml (universal inputs)
- DI_rocker_switch_1.xml / DI_rocker_switch_2.xml (digital inputs)

This example uses two inputs in a 2-Switch-Group. For the first input, the following properties are changed (from the default values) in this example:

- **DataType** = Switch (SNVT_switch, members: value / state)
- **IOFunc** = 2-Switch-Group
- **GroupNumber** = X (must be the same as for second input)
- **SubGroupNumber** = Switch 1
- **EventGroup1ShortPushMode** = Set
- **EventGroup1ShortPushValue** = 100 / 1
- **EventGroup2ShortPushMode** = Set
- **EventGroup2ShortPushValue** = 0 / 0

For the second input, the following properties are changed (from the default values) in this example:

- **DataType** = Switch (SNVT_switch, members: value / state)
- **IOFunc** = 2-Switch-Group
- **GroupNumber** = X (must be the same as for first input)
- **SubGroupNumber** = Switch 2

When the first input is activated (rocker switch up), 100/1 is sent out. When the second input is activated (rocker switch down), 0/0 is sent out.

7.4.3.5 Two-Button Dimming

This example is implemented in the following I/O object template files:

- UI_two_button_dimming_1.xml / UI_two_button_dimming_2.xml (universal inputs)
- DI_two_button_dimming_1.xml / DI_two_button_dimming_2.xml (digital inputs)

This example uses two inputs in a 2-Switch-Group. For the first input, the following properties are changed (from the default values) in this example:

- **DataType** = Switch (SNVT_switch, members: value / state)

- **IOFunc** = 2-Switch-Group
- **GroupNumber** = X (must be the same as for second input)
- **SubGroupNumber** = Switch 1
- **MinValue** = 10 / 1
- **MaxValue** = 100 / 1
- **MinSendTime** = 0.2s
- **HoldTime** = 1s
- **DebounceTime** = 0.1s
- **EventGroup1ShortReleaseMode** = Set State
- **EventGroup1ShortReleaseValue** = 0 / 1
- **EventGroup1LongPushMode** = Increment
- **EventGroup1LongPushValue** = 1 / 1
- **EventGroup2ShortReleaseMode** = Set
- **EventGroup2ShortReleaseValue** = 0 / 0
- **EventGroup2LongPushMode** = Decrement
- **EventGroup2LongPushValue** = 1 / 1

For the second input, the following properties are changed (from the default values) in this example:

- **DataType** = Switch (SNVT_switch, members: value / state)
- **IOFunc** = 2-Switch-Group
- **GroupNumber** = X (must be the same as for first input)
- **SubGroupNumber** = Switch 2
- **HoldTime** = 3s
- **DebounceTime** = 0.1s
- **EventGroup1ShortReleaseMode** = Set
- **EventGroup1ShortReleaseValue** = 100 / 1
- **EventGroup1LongPushMode** = Set
- **EventGroup1LongPushValue** = 0 / -1

The first input is configured and works exactly like the input in the one-button dimming example (Section 7.4.3.3) except for the conditional modes. A condition is not needed here since the event groups are explicitly mapped to the two inputs. Additionally, the properties of the second input are configured to setup the operation for pressing both buttons at the same time (resp. within the DebounceTime of 0.1s). If both buttons are pressed shortly, the light is fully switched on to 100%. If both buttons are pressed for longer than 3s (HoldTime of second input), the .state member is set to -1 which could be used to release control of the light. Observe that for this example, a turnaround network variable binding from the live value (‘nvoInValue’) to the feedback (‘nviInSwitchFb’) of the input object must still be created to be sure the dimming value is restored correctly.

7.4.3.6 Two-Button Sunblinds

This example is implemented in the following I/O object template files:

- UI_two_button_sunblinds_1.xml / UI_two_button_sunblinds_2.xml (universal inputs)

- DI_two_button_sunblinds_1.xml / DI_two_button_sunblinds_2.xml (digital inputs)

This example uses two inputs in a 2-Switch-Group. For the first input, the following properties are changed (from the default values) in this example:

- **DataType** = Setting (SNVT_setting, members: function / setting / rotation)
- **IOFunc** = 2-Switch-Group
- **GroupNumber** = X (must be the same as for second input)
- **SubGroupNumber** = Switch 1
- **HoldTime** = 3s
- **DebounceTime** = 0.1s
- **EventGroup1ShortPushMode** = Set
- **EventGroup1ShortPushValue** = SET_UP / 0 / 0
- **EventGroup1ShortReleaseMode** = Set
- **EventGroup1ShortReleaseValue** = SET_STOP / 0 / 0
- **EventGroup1LongPushMode** = Set
- **EventGroup1LongPushValue** = SET_STATE / 100 / 0
- **EventGroup2ShortPushMode** = Set
- **EventGroup2ShortPushValue** = SET_DOWN / 0 / 0
- **EventGroup2ShortReleaseMode** = Set
- **EventGroup2ShortReleaseValue** = SET_STOP / 0 / 0
- **EventGroup2LongPushMode** = Set
- **EventGroup2LongPushValue** = SET_STATE / 0 / 0

For the second input, the following properties are changed (from the default values) in this example:

- **DataType** = Setting (SNVT_setting, members: function / setting / rotation)
- **IOFunc** = 2-Switch-Group
- **GroupNumber** = X (must be the same as for first input)
- **SubGroupNumber** = Switch 2
- **DebounceTime** = 0.1s
- **EventGroup1ShortPushMode** = Set
- **EventGroup1ShortPushValue** = SET_NUL / 0 / 0

When the first input is activated shortly (button pressed for less than HoldTime = 3s), the sunblinds go up for as long as the button is pressed (SET_UP). When it is released, the sunblinds stop (SET_STOP). When the second input is activated shortly (button pressed for less than HoldTime = 3s), the sunblinds go down for as long as the button is pressed (SET_DOWN). When it is released, the sunblinds stop (SET_STOP). When the first button is pressed for longer than 3s, the sunblinds go all the way up (SET_STATE) except if it is pressed shortly again. When the second button is pressed for longer than 3s, the sunblinds go all the way down (SET_STATE) except if it is pressed shortly again. If both buttons are pressed at the same time (resp. within the DebounceTime of 0.1s), control of the sunblinds is released (SET_NUL).

7.5 STId Card Reader Mode

The L-IOB devices support STId card readers running the ISO2 protocol. Refer to Section 13.4 and the following sections for information on which L-IOB models support STId card readers. The card readers have three signals which must be connected to inputs on the L-IOB device, as explained in the following sections.

7.5.1 Code Signal

The code signal of the card reader must be connected to a universal or digital input of the L-IOB device. The following properties must be set for that input:

- SignalType (if universal input): “Voltage 0-10V”.
- Interpretation: “Pulse Count”.
- IOFunc: “Cardreader ISO2”.
- GroupNumber: must be equal for all three signals of one card reader.
- SubGroupNumber: will automatically be set to “Code”.
- Invert: checked if signal is low active, check data sheet of card reader.

In its live value, this L-IOB input will represent the number of codes read from the card reader.

7.5.2 Data Signal

The data signal of the card reader must be connected to a universal or digital input of the L-IOB device. The following properties must be set for that input:

- SignalType (if universal input): “Voltage 0-10V”.
- Interpretation: “Card Data”.
- IOFunc: will automatically be set to “Cardreader ISO2”.
- GroupNumber: must be equal for all three signals of one card reader.
- SubGroupNumber: will automatically be set to “Data”.
- Invert: depends on implementation of card reader, check data sheet.
- HoldTime: specifies the time, a new code remains in the L-IOB data point. After this time, the data point is set back to “0xBF …”, which means “not available”. If the HoldTime is set to 0, the last read value remains until a new value is read.

In its live value, this L-IOB input will represent the read code in a 20-byte array (40 decimal digits). In LONMARK® mode, the SNVT_magcard (86) is used.

7.5.3 Clock Signal

The clock signal of the card reader must be connected to a interrupt-capable universal or digital input of the L-IOB device. The corresponding interpretation “Clock” will only be available in the Configurator software, if the input is interrupt-capable. The following properties must be set for that input:

- SignalType (if universal input): “Voltage 0-10V”.

- Interpretation: “Clock”.
- IOFunc: will automatically be set to “Cardreader ISO2”.
- GroupNumber: must be equal for all three signals of one card reader.
- SubGroupNumber: will automatically be set to “Clock”.
- Invert: checked if signal is low active, check data sheet of card reader.

The live value of that L-IOB input will not deliver any useful data.

7.6 Data Points (L-INX Mode)

This section describes the data points available in a L-IOB host which has L-IOB devices connected to the LIOB-Connect bus (LIOB-10x models), LIOB-FT bus (LIOB-15x models in LIOB-FT device mode), or LIOB-IP bus (LIOB-45x/55x models in LIOB-IP device mode). For each I/O, the most basic data points are created automatically (input value, output value, feedback). In the Configurator, the user can choose to create lots of additional data points on the L-IOB bus level, device level, and I/O level.

As soon as communication between the L-IOB host and its connected L-IOB devices is established, the corresponding data points are available for the application running on the L-IOB host. Observe that some L-IOB data points are read-only (e.g. ProductCode) and some are write-only (e.g. PinCode). For data points which can be read and written, value data points will be created on the L-IOB host.

7.6.1 Bus specific Data Points

The bus specific data point names are preceded with the L-IOB bus number, e.g. ‘L1_**FirstNonDCIndex**’.

- **FirstNonDCIndex**: see Section 7.2.1.
- **MaxDeviceCount**: maximum number of L-IOB devices on this L-IOB bus (8 or 24).

7.6.2 Device specific Data Points

The device specific data point names are preceded with the L-IOB bus number and L-IOB station ID, e.g. ‘L1_2_**ProductCode**’.

- **ProductCode**: see Section 7.2.5.
- **DeviceName**: see Section 7.2.6.
- **NID**: see Section 7.2.11.
- **StationID**: see Section 7.2.1.
- **PinCode**: see Section 7.2.5.
- **ErrorMask**: Contains the last error code of this L-IOB device:
    - 0 … OK (no error)
    - 23 … Wrong L-IOB device type
    - 25 … Firmware version too low

  - 28 … Address mismatch (device not correctly commissioned)
  - 43 … Device is unconfigured
  - 49 … Device needs configuration run
  - 51 … Station ID mismatch
  - 71 … LIOB-10x device on wrong position in daisy chain

- **CfgExists**: flag is set if configuration for this device exists (always set).
- **Enabled**: flag is set if this device is enabled.
- **Online**: flag is set if this device is online.
- **NotDetected**: flag is set if this device could not be detected.
- **EnableUpgrade**: flag is set if firmware upgrade is allowed for this device.
- **AlternativeUnit**: flag is set if this device shows US units (instead of SI units).
- **ManualMode**: flag is set if at least one I/O is in manual mode.
- **FMWVersion**: firmware version of this device.
- **FMWTimestamp**: firmware build time stamp (date and time) of this device.
- **Serial**: serial number of this device.
- **LastRebootTimestamp**: date and time of last reboot of this device.
- **SystemTemp**: current system temperature of the device.
- **SystemVoltage**: current supply voltage of this device.
- **CPULoad**: current CPU load of this device.

7.6.3 I/O specific Data Points for Inputs

The I/O specific data point names are preceded with the L-IOB bus number, L-IOB station ID, and I/O terminal name, e.g. ‘L1_2_UI5_**Input**’.

- **Input**: current value of the input as measured and interpreted by the L-IOB device, if the operating mode is set to “Auto”. This data point will go offline if the L-IOB device is detected offline by the L-IOB host. It will go out-of-service, if the sensor is detected disconnected by the L-IOB device. If the operating mode is set to a mode different than “Auto”, the input value will be set to the corresponding manual, override, or default value, see Section 7.3.11.

- **IOStatus**: current status of input. This data point will go from “OK” to “Disconnected”, if the sensor is disconnected.

- **PulseTime**: time between the last two pulses for signal interpretation “Pulse Count” or “Physical Unit Count” (see Section 7.3.4). This can be used to quickly detect a change of the derivative of the physical value, e.g. a change of the electric power if the measured physical value is electric energy. Note that the PulseTime data point must be activated via the PulseTime flag, see Section 7.3.14.

- **OperatingMode**: see Section 7.3.11.

- **OverrideValue**: see Section 7.3.11.
- **DefaultValue**: see Section 7.3.11.
- **Offset**: see Section 7.3.22.
- **MinValue**: see Section 7.3.23.
- **MaxValue**: see Section 7.3.23.
- **HoldTime**: see Section 7.3.28.
- **DebounceTime**: see Section 7.3.28.
- **PulseCountInit**: when this data point is written, the pulse count is reset to the written value. This applies to inputs with Interpretation “Pulse Count” or “Physical Unit Count”, see Section 7.3.4.

7.6.4 I/O specific Data Points for Outputs

The I/O specific data point names are preceded with the L-IOB bus number, L-IOB station ID, and I/O terminal name, e.g. “L1_1_DO4_**Output**”.

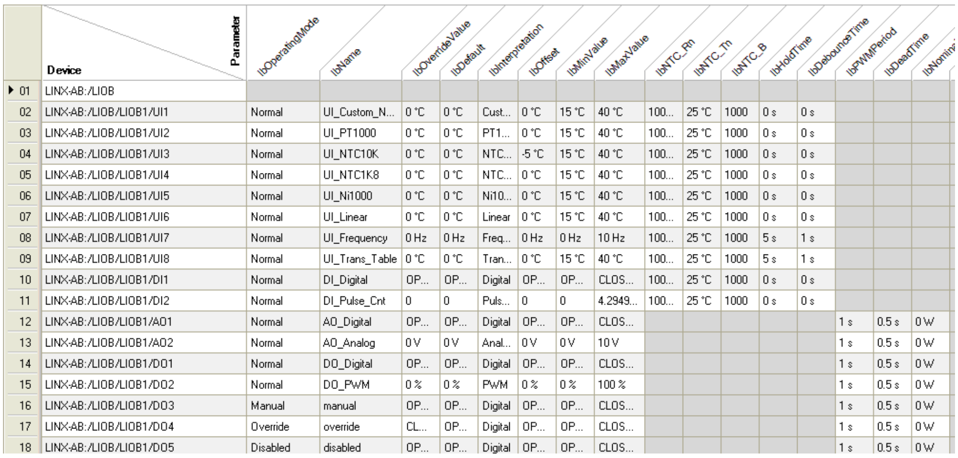
- **Output**: current value of the output as set by the L-IOB host application. This data point will go offline if the L-IOB device is detected offline by the L-IOB host.
- **Feedback**: the feedback data point will always be set to the current physical value of the output. See Section 7.3.11 for details.
- **IOStatus**: current status of output. This data point always has the value “OK”.
- **RunHours**: total time the digital output was switched on.
- **EnergyCount**: energy consumption of the device or appliance (e.g. lamp) connected to the output, see also Section 7.3.32.
- **SwitchCycles**: Number of switching cycles of the digital output. This is useful for estimating the expected remaining life time of a relay. Observe that this data point is never reset, not even by a reset to factory defaults, see Section 4.5.3.
- **OperatingMode**: see Section 7.3.11.
- **OverrideValue**: see Section 7.3.11.
- **DefaultValue**: see Section 7.3.11.
- **Offset**: see Section 7.3.22.
- **MinValue**: see Section 7.3.23.
- **MaxValue**: see Section 7.3.23.
- **PWMPeriod**: see Section 7.3.31.
- **RunHoursInit**: when this data point is written, the RunHours data point is reset to the written value.

- **EnergyCntInit**: when this data point is written, the EnergyCount data point is reset to the written value.

- **NominalPower**: see Section 7.3.32.

7.6.5 Parameters

Some bus, device, and I/O specific configuration properties are available as parameters. The parameter data points are exported via a parameter file, which contains the entire set of current parameter values including meta-information for external tools to display parameter data in a human-readable way. The LWEB-900 parameter view (see Figure 23) can process such parameter data points and manage them for a large number of devices. L-IOB parameters can easily be set for multiple L-IOB host devices in a system without having to change the L-IOB host project for each L-IOB host in the Configurator. For more information on how to manage parameters on your devices please refer to the LWEB-900 manual.



	Device / Parameter	lbOperatingMode	lbName	lbOverrideValue	lbDefault	lbInterpretation	lbOffset	lbMinValue	lbMaxValue	lbNTC_Rn	lbNTC_Tn	lbNTC_B	lbHoldTime	lbDebounceTime	lbPWMPeriod	lbDeadTime	lbNomin
01	LINX-AB:/LIOB																
02	LINX-AB:/LIOB/LIOB1/UI1	Normal	UI_Custom_N...	0 °C	0 °C	Cust...	0 °C	15 °C	40 °C	100...	25 °C	1000	0 s	0 s			
03	LINX-AB:/LIOB/LIOB1/UI2	Normal	UI_PT1000	0 °C	0 °C	PT1...	0 °C	15 °C	40 °C	100...	25 °C	1000	0 s	0 s			
04	LINX-AB:/LIOB/LIOB1/UI3	Normal	UI_NTC10K	0 °C	0 °C	NTC...	-5 °C	15 °C	40 °C	100...	25 °C	1000	0 s	0 s			
05	LINX-AB:/LIOB/LIOB1/UI4	Normal	UI_NTC1K8	0 °C	0 °C	NTC...	0 °C	15 °C	40 °C	100...	25 °C	1000	0 s	0 s			
06	LINX-AB:/LIOB/LIOB1/UI5	Normal	UI_Ni1000	0 °C	0 °C	Ni10...	0 °C	15 °C	40 °C	100...	25 °C	1000	0 s	0 s			
07	LINX-AB:/LIOB/LIOB1/UI6	Normal	UI_Linear	0 °C	0 °C	Linear	0 °C	15 °C	40 °C	100...	25 °C	1000	0 s	0 s			
08	LINX-AB:/LIOB/LIOB1/UI7	Normal	UI_Frequency	0 Hz	0 Hz	Freq...	0 Hz	0 Hz	10 Hz	100...	25 °C	1000	5 s	1 s			
09	LINX-AB:/LIOB/LIOB1/UI8	Normal	UI_Trans_Table	0 °C	0 °C	Tran...	0 °C	15 °C	40 °C	100...	25 °C	1000	5 s	1 s			
10	LINX-AB:/LIOB/LIOB1/DI1	Normal	DI_Digital	OP...	OP...	Digital	OP...	OP...	CLOS...	100...	25 °C	1000	0 s	0 s			
11	LINX-AB:/LIOB/LIOB1/DI2	Normal	DI_Pulse_Cnt	0	0	Puls...	0	0	4.2949...	100...	25 °C	1000	0 s	0 s			
12	LINX-AB:/LIOB/LIOB1/AO1	Normal	AO_Digital	OP...	OP...	Digital	OP...	OP...	CLOS...						1 s	0.5 s	0 W
13	LINX-AB:/LIOB/LIOB1/AO2	Normal	AO_Analog	0 V	0 V	Anal...	0 V	0 V	10 V						1 s	0.5 s	0 W
14	LINX-AB:/LIOB/LIOB1/DO1	Normal	DO_Digital	OP...	OP...	Digital	OP...	OP...	CLOS...						1 s	0.5 s	0 W
15	LINX-AB:/LIOB/LIOB1/DO2	Normal	DO_PWM	0 %	0 %	PWM	0 %	0 %	100 %						1 s	0.5 s	0 W
16	LINX-AB:/LIOB/LIOB1/DO3	Manual	manual	OP...	OP...	Digital	OP...	OP...	CLOS...						1 s	0.5 s	0 W
17	LINX-AB:/LIOB/LIOB1/DO4	Override	override	CL...	OP...	Digital	OP...	OP...	CLOS...						1 s	0.5 s	0 W
18	LINX-AB:/LIOB/LIOB1/DO5	Disabled	disabled	OP...	OP...	Digital	OP...	OP...	CLOS...						1 s	0.5 s	0 W

Figure 23: LWEB-900 Parameter View

When changing parameters on the device or via the LWEB-900 parameter view, they are out of sync with their default values in the configuration. As a default it assumed that parameters are managed by LWEB-900 and the Configurator does not download and overwrite parameter values to the device.

The project settings can be changed to have the Configurator manage parameters (see LINX Configurator User Manual [2]). In this mode the Configurator provides a mechanism to resolve this conflict and to merge those changed parameters back into the configuration. This is accomplished in the parameter merge dialog when uploading or downloading the configuration (see Figure 24). The user can select a resolution in the drop-down box. The arrow indicates in which direction the parameter values shall be copied: Copy value from device to default value, write default value to the device or NONE to leave configuration and value on device separate.

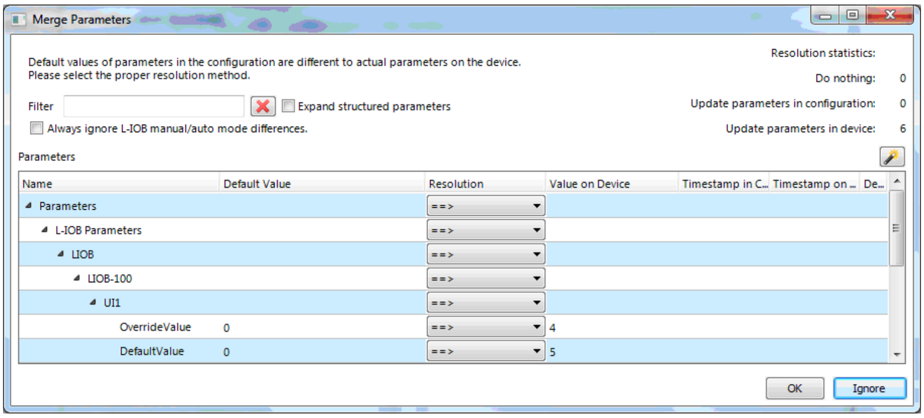


Figure 24: Parameter merge dialog.

When selecting a resolution on single parameters it affects only those parameters. When selecting a resolution on a folder it affects all data points under this folder. Click on **Ignore** to skip the parameter merge process.

L-IOB parameters are not managed by LWEB-900 and the Configurator always tries to merge L-IOB parameters that have been changed on the device. Frequent changes made to manual/auto mode can be ignored by checking **Always ignore L-IOB manual/auto mode differences**.

7.7 Data Points (LONMARK® Mode)

This section describes the network data points provided by a LIOB-15x or LIOB-45x device in LONMARK® or Non-ECS device mode. Since the L-IOB device acts as a common CEA-709 node in these device modes, the data points are represented as network variables (NVs) and configuration properties (CPs). These NVs and CPs are organized in functional blocks which form the CEA-709 interface of the node. All CPs are implemented as files (CPT, CPC, CPV files) and configured in the L-INX Configurator Software. The description in the following sections provides documentation of the CPs just for the sake of completeness, it is not meant to suggest manual CP setup (without the Configurator Software).

7.7.1 Device Global Configuration Properties

The L-IOB device has some device global configuration properties not mapped to a functional block:

- **UCPTioDeviceExt** (structure): This CP is reserved for future use.
- **UCPTioPinCode** (unsigned): This CP represents the PIN code of the L-IOB device, see Section 7.2.7.
- **UCPTmsText** (array of structures): This CP is reserved for future use.
- **UCPTtermDescr** (array of structures): This CP contains the names and numbers of all terminals.
- **UCPTtransTbl** (array of structures): This CP contains the translation tables of the L-IOB device, see Section 7.2.12.

7.7.2 Node Object (UFPTnodeObject, FPT Key #0)

The L-IOB device provides a node object conforming to the LONMARK® guidelines. The functional block type for the node object is derived from the Standard Functional Profile Template **SFPTnodeObject** (FPT Key #0) and was extended to the Template

UFPTnodeObject. The essential NVs and CPs of the functional profile are depicted in Figure 25.

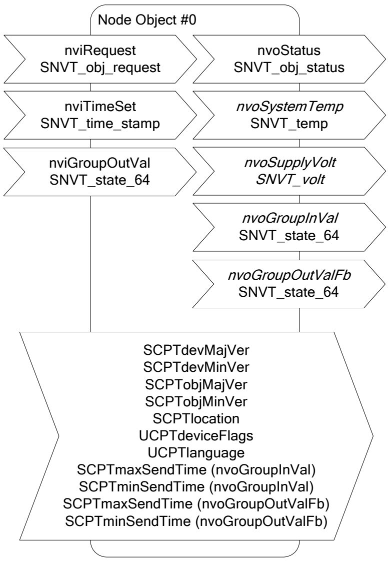


Figure 25: Node Object

- **nviRequest** (SNVT_obj_request) **/ nvoStatus** (SNVT_obj_status): The Node Object accepts the following commands via nviRequest: RQ_NORMAL, RQ_UPDATE_STATUS, RQ_REPORT_MASK, RQ_ENABLE, RQ_DISABLED, RQ_RMV_OVERRIDE, RQ_REMOTE_CTRL, RQ_MANUAL_CTRL, RQ_OVERRIDE.
- **SCPTlocation** (*SNVT_str_asc*): This CP represents the name of the device, see Section 7.2.6.
- **UCPTdeviceFlags** (*unsigned quad*): This CP allows setting some device specific flags:
    - UCPT_DEVICE_FLAGS_US (0x00200000): for displaying US units instead of SI units in the L-IOB LCD Display, see Section 7.2.8.
    - UCPT_DEVICE_FLAGS_SET_ACC (0x10000000): this flag must be set to be able to set back counter values (energy count, run hours, and live values for interpretation ‘physical unit count’ or ‘pulse count’). During normal operation, it must be reset to ensure that commissioning the device does not automatically set back the counter values.
- **UCPTlanguage** (*enumeration type*): This CP allows setting the language in the L-IOB LCD Display:
    - UCPT_LANGUAGE_UNDEF (0): default language / leave language as is,
    - UCPT_LANGUAGE_ENG (1): English,
    - UCPT_LANGUAGE_GER (2): German,
- **nviTimeSet** (*SNVT_time_stamp*): When writing to this NV, the system time is set. The time value is interpreted as local time.
- **nvoSystemTemp** (*SNVT_temp*): This NV can be used to poll the system temperature of the device. It does not send updates and must be polled.
- **nvoSupplyVolt** (*SNVT_volt*): This NV can be used to poll the supply voltage of the device. It does not send updates and must be polled.
- **nvoGroupInVal** (*SNVT_state_64*): This NV combines the binary values of all inputs with interpretation ‘digital’ or ‘occupancy’. The mapping of its bits is documented in

Section 7.7.4. The NV has mapped a SCPTmaxSendTime and a SCPTminSendTime CP, see Section 7.2.10.

- **nviGroupOutVal** (*SNVT_state_64*): This NV allows setting all outputs with interpretation 'digital' at once. The corresponding bits for outputs with other interpretations are ignored. The mapping is documented in Section 7.7.4.
- **nvoGroupOutValFb** (*SNVT_state_64*): This NV combines the binary feedback values of all outputs with interpretation 'digital'. The mapping is documented in Section 7.7.4. The NV has mapped a SCPTmaxSendTime and a SCPTminSendTime CP, see Section 7.2.10.

7.7.3 Common Terminal Object (UFPTcomTerm, FPT Key #20013)

These functional blocks contain CPs of the common terminals of digital outputs for documentation and display in the L-IOB LCD only. They are configured via the L-INX Configurator Software.

7.7.4 Input / Output / Group Mapping

The different LIOB-15x and LIOB-45x Models contain different numbers of input and output functional blocks. When downloading a L-IOB configuration over LNS with the Configurator, these functional blocks will receive display names in the format "TerminalName_IOname" (e.g. "UI1_Temp1") for easy identification in the LNS network management tool. However, the corresponding program name is independent from the I/O name, e.g. "Input[0]" for the functional block of the first input. The following tables show the mapping between the functional blocks and the terminal names (as printed on the L-IOB enclosure) as well as the mapping to the digital group NVs.

LIOB-150 / LIOB-450		
Terminal Name	**Functional Block (Program Name)**	**Digital Group NV mapping**
UI1	Input[0]	nvoGroupInVal.bit0
UI2	Input[1]	nvoGroupInVal.bit1
UI3	Input[2]	nvoGroupInVal.bit2
UI4	Input[3]	nvoGroupInVal.bit3
UI5	Input[4]	nvoGroupInVal.bit4
UI6	Input[5]	nvoGroupInVal.bit5
UI7	Input[6]	nvoGroupInVal.bit6
UI8	Input[7]	nvoGroupInVal.bit7
DI1	Input[8]	nvoGroupInVal.bit8
DI2	Input[9]	nvoGroupInVal.bit9
AO1	Output[0]	nviGroupOutVal.bit0 / nvoGroupOutValFb.bit0
AO2	Output[1]	nviGroupOutVal.bit1 / nvoGroupOutValFb.bit1
DO2	Output[2]	nviGroupOutVal.bit2 / nvoGroupOutValFb.bit2
DO3	Output[3]	nviGroupOutVal.bit3 / nvoGroupOutValFb.bit3
DO4	Output[4]	nviGroupOutVal.bit4 / nvoGroupOutValFb.bit4
DO5	Output[5]	nviGroupOutVal.bit5 / nvoGroupOutValFb.bit5
DO6	Output[6]	nviGroupOutVal.bit6 / nvoGroupOutValFb.bit6
DO7	Output[7]	nviGroupOutVal.bit7 / nvoGroupOutValFb.bit7
DO8	Output[8]	nviGroupOutVal.bit8 / nvoGroupOutValFb.bit8

LIOB-150 / LIOB-450		
Terminal Name	**Functional Block (Program Name)**	**Digital Group NV mapping**
DO9	Output[9]	nviGroupOutVal.bit9 / nvoGroupOutValFb.bit9

Table 4: LIOB-150/450 Object Mapping

LIOB-151 / LIOB-451		
Terminal Name	**Functional Block (Program Name)**	**Digital Group NV mapping**
UI1	Input[0]	nvoGroupInVal.bit0
UI2	Input[1]	nvoGroupInVal.bit1
UI3	Input[2]	nvoGroupInVal.bit2
UI4	Input[3]	nvoGroupInVal.bit3
UI5	Input[4]	nvoGroupInVal.bit4
UI6	Input[5]	nvoGroupInVal.bit5
UI7	Input[6]	nvoGroupInVal.bit6
UI8	Input[7]	nvoGroupInVal.bit7
DI5	Input[8]	nvoGroupInVal.bit8
DI6	Input[9]	nvoGroupInVal.bit9
DI7	Input[10]	nvoGroupInVal.bit10
DI8	Input[11]	nvoGroupInVal.bit11
DI9	Input[12]	nvoGroupInVal.bit12
DI10	Input[13]	nvoGroupInVal.bit13
DI11	Input[14]	nvoGroupInVal.bit14
DI12	Input[15]	nvoGroupInVal.bit15
DI13	Input[16]	nvoGroupInVal.bit16
DI14	Input[17]	nvoGroupInVal.bit17
DI15	Input[18]	nvoGroupInVal.bit18
DI16	Input[19]	nvoGroupInVal.bit19

Table 5: LIOB-151/451 Object Mapping

LIOB-152 / LIOB-452		
Terminal Name	**Functional Block (Program Name)**	**Digital Group NV mapping**
UI1	Input[0]	nvoGroupInVal.bit0
UI2	Input[1]	nvoGroupInVal.bit1
UI3	Input[2]	nvoGroupInVal.bit2
UI4	Input[3]	nvoGroupInVal.bit3
UI5	Input[4]	nvoGroupInVal.bit4
UI6	Input[5]	nvoGroupInVal.bit5
AO1	Output[0]	nviGroupOutVal.bit0 / nvoGroupOutValFb.bit0

LIOB-152 / LIOB-452		
Terminal Name	**Functional Block (Program Name)**	**Digital Group NV mapping**
AO2	Output[1]	nviGroupOutVal.bit1 / nvoGroupOutValFb.bit1
AO3	Output[2]	nviGroupOutVal.bit2 / nvoGroupOutValFb.bit2
AO4	Output[3]	nviGroupOutVal.bit3 / nvoGroupOutValFb.bit3
AO5	Output[4]	nviGroupOutVal.bit4 / nvoGroupOutValFb.bit4
AO6	Output[5]	nviGroupOutVal.bit5 / nvoGroupOutValFb.bit5
DO1	Output[6]	nviGroupOutVal.bit6 / nvoGroupOutValFb.bit6
DO2	Output[7]	nviGroupOutVal.bit7 / nvoGroupOutValFb.bit7
DO3	Output[8]	nviGroupOutVal.bit8 / nvoGroupOutValFb.bit8
DO4	Output[9]	nviGroupOutVal.bit9 / nvoGroupOutValFb.bit9
DO5	Output[10]	nviGroupOutVal.bit10 / nvoGroupOutValFb.bit10
DO6	Output[11]	nviGroupOutVal.bit11 / nvoGroupOutValFb.bit11
DO7	Output[12]	nviGroupOutVal.bit12 / nvoGroupOutValFb.bit12
DO8	Output[13]	nviGroupOutVal.bit13 / nvoGroupOutValFb.bit13

Table 6: LIOB-152/452 Object Mapping

LIOB-153 / LIOB-453		
Terminal Name	**Functional Block (Program Name)**	**Digital Group NV mapping**
UI1	Input[0]	nvoGroupInVal.bit0
UI2	Input[1]	nvoGroupInVal.bit1
UI3	Input[2]	nvoGroupInVal.bit2
UI4	Input[3]	nvoGroupInVal.bit3
UI5	Input[4]	nvoGroupInVal.bit4
UI6	Input[5]	nvoGroupInVal.bit5
AO1	Output[0]	nviGroupOutVal.bit0 / nvoGroupOutValFb.bit0
AO2	Output[1]	nviGroupOutVal.bit1 / nvoGroupOutValFb.bit1
AO3	Output[2]	nviGroupOutVal.bit2 / nvoGroupOutValFb.bit2
AO4	Output[3]	nviGroupOutVal.bit3 / nvoGroupOutValFb.bit3
AO5	Output[4]	nviGroupOutVal.bit4 / nvoGroupOutValFb.bit4
AO6	Output[5]	nviGroupOutVal.bit5 / nvoGroupOutValFb.bit5
DO1	Output[6]	nviGroupOutVal.bit6 / nvoGroupOutValFb.bit6
DO2	Output[7]	nviGroupOutVal.bit7 / nvoGroupOutValFb.bit7
DO3	Output[8]	nviGroupOutVal.bit8 / nvoGroupOutValFb.bit8
DO4	Output[9]	nviGroupOutVal.bit9 / nvoGroupOutValFb.bit9
DO5	Output[10]	nviGroupOutVal.bit10 / nvoGroupOutValFb.bit10

Table 7: LIOB-153/453 Object Mapping

LIOB-154		
Terminal Name	**Functional Block (Program Name)**	**Digital Group NV mapping**
UI1	Input[0]	nvoGroupInVal.bit0
UI2	Input[1]	nvoGroupInVal.bit1
UI3	Input[2]	nvoGroupInVal.bit2
UI4	Input[3]	nvoGroupInVal.bit3
UI5	Input[4]	nvoGroupInVal.bit4
UI6	Input[5]	nvoGroupInVal.bit5
UI7	Input[6]	nvoGroupInVal.bit6
PRESS	Input[7]	nvoGroupInVal.bit7
AO1	Output[0]	nviGroupOutVal.bit0 / nvoGroupOutValFb.bit0
AO2	Output[1]	nviGroupOutVal.bit1 / nvoGroupOutValFb.bit1
AO3	Output[2]	nviGroupOutVal.bit2 / nvoGroupOutValFb.bit2
AO4	Output[3]	nviGroupOutVal.bit3 / nvoGroupOutValFb.bit3
DO1	Output[4]	nviGroupOutVal.bit4 / nvoGroupOutValFb.bit4
DO2	Output[5]	nviGroupOutVal.bit5 / nvoGroupOutValFb.bit5
DO3	Output[6]	nviGroupOutVal.bit6 / nvoGroupOutValFb.bit6
DO4	Output[7]	nviGroupOutVal.bit7 / nvoGroupOutValFb.bit7
DO5	Output[8]	nviGroupOutVal.bit8 / nvoGroupOutValFb.bit8
DO6	Output[9]	nviGroupOutVal.bit9 / nvoGroupOutValFb.bit9
DO7	Output[10]	nviGroupOutVal.bit10 / nvoGroupOutValFb.bit10

Table 8: LIOB-154 Object Mapping

7.7.5 Input Object (UFPTopenLoopSensor, FPT Key #1)

The functional block type for inputs is derived from the Standard Functional Profile Template **SFPTopenLoopSensor** (FPT Key #1) and was extended to the Template **UFPTopenLoopSensor**. The functional profile is depicted in Figure 26.

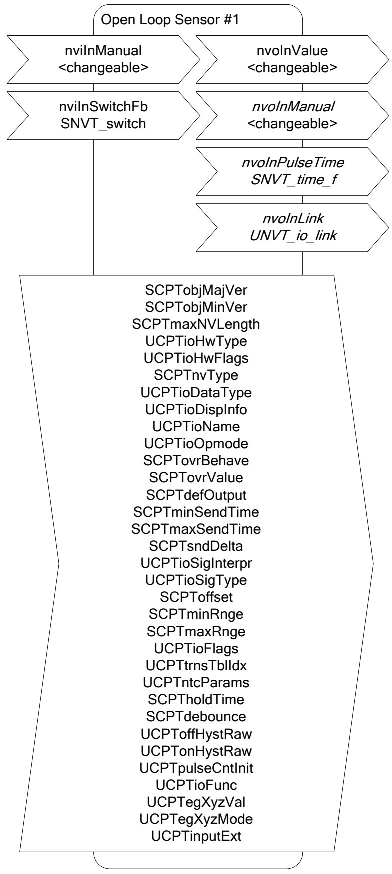


Figure 26: Input Object (Open Loop Sensor)

7.7.5.1 Input Network Variables

- **nviInManual** (*changeable*): If this NV is written, the value of the input in manual mode is set. The type of the NV is determined by the SCPTnvType CP, see Section 7.7.5.4.
- **nviInSwitchFb** (*SNVT_switch*): This NV provides feedback for the switch mode, see Section 7.4.

7.7.5.2 Output Network Variables

- **nvoInValue** (*changeable*): This is the main value of the input. It represents the currently measured value of the input (in auto mode). The type of the NV is determined by the SCPTnvType CP, see Section 7.7.5.4.
- **nvoInManual** (*changeable*): This NV is updated whenever the value of the input in manual mode is changed on the L-IOB LCD Display. The type of the NV is determined by the SCPTnvType CP, see Section 7.7.5.4.
- **nvoInPulseTime** (*SNVT_time_f*): This NV represents the time between the last two pulses for signal interpretation “Pulse Count” or “Physical Unit Count” (see Section 7.3.4). This can be used to quickly detect a change of the derivative of the physical value, e.g. a change of the electric power if the measured physical value is electric energy. Note that the PulseTime NV must be activated via the PulseTime flag, see Section 7.3.14.
- **nvoInLink** (*UNVT_io_link*): This NV is only used internally by the Configurator software and is not required during normal operation.

7.7.5.3 Read-Only Configuration Properties

- **SCPTobjMajVer**: major version of object.
- **SCPTobjMinVer**: minor version of object.
- **SCPTmaxNVLength**: maximum length of changeable type NVs (4).
- **UCPTioHwType**: hardware type of physical input, see Section 7.3.2.
- **UCPTioHwFlags**: hardware flags reserved for future use.

7.7.5.4 Read/Write Configuration Properties

- **SCPTnvType**: specifies the type of the changeable NVs, see Section 7.3.6.
- **UCPTioDataType**: specifies the high-level data type of the input, see Section 7.3.5.
- **UCPTioDispInfo**: specifies the unit texts for analog inputs or the active/inactive texts for digital inputs (Section 7.3.18), the resolution (Section 7.3.19), alternative unit multiplicator and offset (Section 7.3.20), as well as the display on/off symbols (Section 7.3.21).
- **UCPTioName**: specifies the name of the input, see Section 7.3.1.
- **UCPTioOpmode**: specifies the operating mode, see Section 7.3.11.
- **SCPTovrBehave**: specifies the override behavior. This is set by the Configurator software so that in override mode, the override value (SCPTovrValue) is used.
- **SCPTovrValue**: specifies the override value, see Section 7.3.11.
- **SCPTdefOutput**: specifies the default value, see Section 7.3.11.
- **SCPTminSendTime**: specifies the minimum send time, see Section 7.3.25.
- **SCPTmaxSendTime**: specifies the maximum send time, see Section 7.3.24.
- **SCPTsndDelta**: specifies the change-of-value property, see Section 7.3.24.
- **UCPTioSigInterpr**: specifies the interpretation, see Section 7.3.4.
- **UCPTioSigType**: specifies the signal type, see Section 7.3.3.
- **SCPToffset**: specifies the offset, see Section 7.3.22.
- **SCPTminRnge**: specifies the minimum value, see Section 7.3.23.
- **SCPTmaxRnge**: specifies the maximum value, see Section 7.3.23.
- **UCPTioFlags**: specifies the invert flag (Section 7.3.13) and the pulse time flag (Section 7.3.14).
- **UCPTtrnsTblIdx**: specifies the index of the translation table, see Section 7.3.26.
- **UCPTntcParams**: specifies the custom NTC parameters, see Section 7.3.27.
- **SCPTholdTime**: specifies the hold time, see Section 7.3.28.
- **SCPTdebounce**: specifies the debounce time, see Section 7.3.28.
- **UCPToffHystRaw**: reserved for future use.
- **UCPTonHystRaw**: reserved for future use.
- **UCPTpulseCntInit**: initializes the pulse count for interpretation ‘physical unit count’ and ‘pulse count’. The UCPT_DEVICE_FLAGS_SET_ACC flag must be set in order to perform this operation, see Section 7.7.2.
- **UCPTioFunc**: specifies the I/O function, group number, and sub group number, see Section 7.3.9.

- **UCPTegXyzVal**: these eight configuration properties specify the values to be sent out when the corresponding events occur in switch mode, see Section 7.4.
- **UCPTegXyzMode**: these eight configuration properties specify the modes for sending out values when the corresponding events occur in switch mode, see Section 7.4.
- **UCPTinputExt**: reserved for future use.

7.7.6 Output Object (UFPTclosedLoopActuator, FPT Key #4)

The functional block type for outputs is derived from the Standard Functional Profile Template **SFPTclosedLoopActuator** (FPT Key #4) and was extended to the Template **UFPTclosedLoopActuator**. The functional profile is depicted in Figure 27.

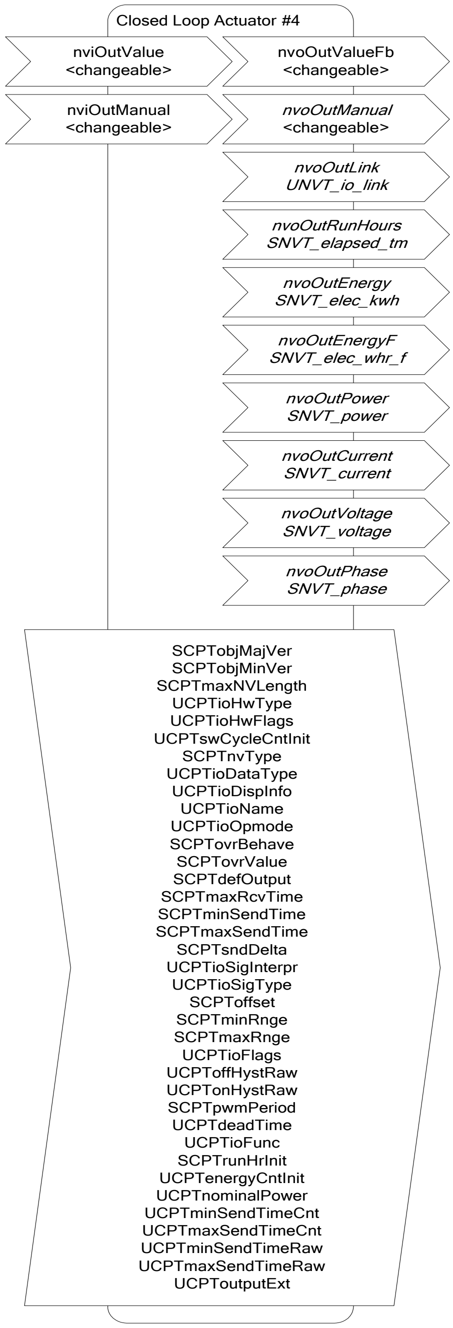


Figure 27: Output Object (Closed Loop Actuator)

7.7.6.1 Input Network Variables

- **nviOutValue** (*changeable*): This is the main live value of the output. If it is written, the output changes its physical value accordingly (in auto mode). The type of the NV is determined by the SCPTnvType CP, see Section 7.7.6.4.
- **nviOutManual** (*changeable*): If this NV is written, the value of the output in manual mode is set. The type of the NV is determined by the SCPTnvType CP, see Section 7.7.6.4.

7.7.6.2 Output Network Variables

- **nvoOutValueFb** (*changeable*): This is the feedback value of the output. It always represents the current physical value of the output. See Section 7.3.11 for details. The type of the NV is determined by the SCPTnvType CP, see Section 7.7.6.4.
- **nvoOutManual** (*changeable*): This NV is updated whenever the value of the output in manual mode is changed on the L-IOB LCD Display. The type of the NV is determined by the SCPTnvType CP, see Section 7.7.6.4.
- **nvoOutLink** (*UNVT_io_link*): This NV is only used internally by the Configurator software and is not required during normal operation.
- **nvoOutRunHours** (*SNVT_elapsed_tm*): This NV represents the total time the digital output was switched on.
- **nvoOutEnergy** (*SNVT_elec_kwh*): This NV represents the energy consumption of the device or appliance (e.g. lamp) connected to the output, see also Section 7.3.32.
- **nvoOutEnergyF** (*SNVT_elec_whr_f*): same as nvoOutEnergy but using a float type SNVT.
- **nvoOutPower** (*SNVT_power*): reserved for future use.
- **nvoOutCurrent** (*SNVT_current*): reserved for future use.
- **nvoOutVoltage** (*SNVT_voltage*): reserved for future use.
- **nvoOutPhase** (*SNVT_phase*): reserved for future use.

7.7.6.3 Read-Only Configuration Properties

- **SCPTobjMajVer**: major version of object.
- **SCPTobjMinVer**: minor version of object.
- **SCPTmaxNVLength**: maximum length of changeable type NVs (4).
- **UCPTioHwType**: hardware type of physical output, see Section 7.3.2.
- **UCPTioHwFlags**: hardware flags reserved for future use.
- **UCPTswCycleCntInit:** number of switching cycles of the digital output. This CP is useful for estimating the expected remaining life time of a relay. Observe that this data is never reset, not even by a reset to factory defaults, see Section 4.5.3.

7.7.6.4 Read/Write Configuration Properties

- **SCPTnvType**: specifies the type of the changeable NVs, see Section 7.3.6.
- **UCPTioDataType**: specifies the high-level data type of the output, see Section 7.3.5.
- **UCPTioDispInfo**: specifies the unit texts for analog outputs or the active/inactive texts for digital outputs (Section 7.3.18), the resolution (Section 7.3.19), alternative unit multiplicator and offset (Section 7.3.20).
- **UCPTioName**: specifies the name of the output, see Section 7.3.1.
- **UCPTioOpmode**: specifies the operating mode, see Section 7.3.11.

- **SCPTovrBehave**: specifies the override behavior. This is set by the Configurator software so that in override mode, the override value (SCPTovrValue) is used.
- **SCPTovrValue**: specifies the override value, see Section 7.3.11.
- **SCPTdefOutput**: specifies the default value, see Section 7.3.11.
- **SCPTmaxRcvTime**: specifies the maximum receive time. If no NV update on the main live value is received within this time, the output is set to the default value.
- **SCPTminSendTime**: specifies the minimum send time for the feedback value, see Section 7.3.25.
- **SCPTmaxSendTime**: specifies the maximum send time for the feedback value, see Section 7.3.24.
- **SCPTsndDelta**: specifies the change-of-value property for the feedback value, see Section 7.3.24.
- **UCPTioSigInterpr**: specifies the interpretation, see Section 7.3.4.
- **UCPTioSigType**: specifies the signal type, see Section 7.3.3.
- **SCPToffset**: reserved for future use.
- **SCPTminRnge**: specifies the minimum value, see Section 7.3.23.
- **SCPTmaxRnge**: specifies the maximum value, see Section 7.3.23.
- **UCPTioFlags**: specifies the persistent flag (Section 7.3.12) and the invert flag (Section 7.3.13).
- **UCPToffHystRaw**: specifies the off value, see Section 7.3.30.
- **UCPTonHystRaw**: specifies the on value, see Section 7.3.30.
- **SCPTpwmPeriod**: specifies the PWM period, see Section 7.3.31.
- **UCPTdeadTime**: specifies the dead time, see Section 7.3.8.
- **UCPTioFunc**: specifies the I/O function and group number, see Section 7.3.8.
- **SCPTrunHrInit**: initializes the run hours of the digital output. The UCPT_DEVICE_FLAGS_SET_ACC flag must be set in order to perform this operation, see Section 7.7.2.
- **UCPTenergyCntInit**: initializes the energy count of the output. The UCPT_DEVICE_FLAGS_SET_ACC flag must be set in order to perform this operation, see Section 7.7.2.
- **UCPTnominalPower**: specifies the nominal power, see Section 7.3.32.
- **UCPTminSendTimeCnt**: specifies the minimum send time for the run hours and energy count values. This CP is set to 10min by default.
- **UCPTmaxSendTimeCnt**: specifies the maximum send time for the run hours and energy count values. This CP is set to 0 (disabled) by default.
- **UCPTminSendTimeRaw**: reserved for future use.
- **UCPTmaxSendTimeRaw**: reserved for future use.
- **UCPToutputExt**: reserved for future use.

7.8 Data Points (BACnet Mode)

This section describes the network data points provided by a LIOB-55x in BACnet device mode. Since the L-IOB device acts as a common BACnet node in this device mode, the data points are represented as native BACnet server objects.

7.8.1 BACnet Technology

Data points in the BACnet technology are known as BACnet objects. They have a specific type (e.g. analog input or binary output) and a set of properties, which describe the data point more closely. The actual value is stored in the "Present_Value".

On the device, there exist two classes of BACnet data points:

- **BACnet server objects** (SO): These BACnet objects configured by the Configurator software to be allocated *locally* on the device. These objects can be accessed by the BACnet building control system or operating workstations. They support COV subscriptions to deliver value changes in an event-driven way.

- **BACnet client mappings** (CM): For certain applications, it is necessary that the device acts as a BACnet client. This functionality can be configured by activating a *client mapping*. Client mappings can be of the type *Poll*, *COV*, *Write*, or *Auto*. This specifies how the BACnet client accesses other BACnet objects on the BACnet network. The *Auto* method determines the best way (poll, COV, or write) to talk with other server objects. *Poll* is used for objects that need to read data from other BACnet objects in a periodic manner. *COV* is used to subscribe for COV at other BACnet objects in order to get updates in an event-driven fashion. *Write* is used to send updates to other BACnet objects. On LIOB-55x devices, it is possible to add client mappings to the automatically created native I/O server objects.

The direction of BACnet server objects deserves a closer look. The direction specified for data points in the Configurator software always refers to the network view of the communication. The definition of input and output objects in BACnet, however, refers to the process view, which is opposite to the network. Therefore, a BACnet analog input (AI) object is modeled as an analog output data point. The direction of client mappings naturally refers to the network communication. Therefore, a write client mapping is represented as an analog output data point.

In BACnet, commandable objects can be written with values at a certain priority. The value with the highest priority is in effect. When revoking a written value, the NULL value is written. This takes back the value. When all written values are withdrawn, the Relinquish_Default value is in effect.

The default value feature of a data point is mapped to the Relinquish_Default property for commandable objects. For BACnet objects, which are not commandable, the Present_Value is initialized with the specified default value.

7.8.2 Native BACnet Objects for I/Os

On LIOB-55x devices in BACnet Mode, the L-IOB I/Os are directly exposed to BACnet server objects. Each L-IOB I/O object is represented by one BACnet object. All relevant I/O configuration properties are mapped to corresponding BACnet properties and reflect actual input/output values, I/O status, override/manual values, operating mode, inversion and adhere to all prescribed BACnet functions.

For L-IOB devices, which are connected to a L-IOB host (L-INX or LIOB-48x/58x) via the LIOB-Connect or LIOB-FT/IP bus (L-INX Mode), the native BACnet objects can also optionally be created on the L-IOB host. The option can be switched for each I/O in the Configurator Software.

The type of the created BACnet server object depends on the type of the live value I/O data point. If e.g. a universal input (UI) is used for measuring an analog value, the type of the live value (**Input** data point) will be Double and thus, an Analog Input (AI) BACnet object will be created. Table 9 shows all possible native BACnet object types for I/Os.

I/O	I/O Live Value Type	BACnet Object	Feedback Object
DI/UI	Double	Analog Input (AI) or Accumulator	-
DI/UI	Boolean	Binary Input (BI)	-
DI/UI	LIOB/MagCard	Analog Input (AI)	-
AO/DO	Double	Analog Output (AO)	Analog Input (AI)
AO/DO	Boolean	Binary Output (BO)	-

Table 9: Native BACnet object types for I/Os

For an AO object, an additional AI object is generated as the feedback value object. For BO objects, a separate feedback object is not required, since a feedback value is already included in the BACnet BO object.

For the STId Card Reader mode (see Section 7.5), the I/O live value type of the Card Data input is an array of 40 nibbles which contains the last read Card ID in BCD encoding (LIOB/MagCard). In this case, the first n BCD digits that form a number which can be displayed by a BACnet float are written to the Present_Value of the created BACnet AI object. An ASCII version of the entire BCD code is written to the Description property of the BACnet object.

For the “Pulse Count” interpretation of inputs (see Section 7.3.4), it is possible to choose between an analog input or an accumulator object in the Configurator. The main difference is that accumulator objects can precisely represent 32-bit meter data while analog objects suffer from a loss of resolution.

When using native BACnet objects for L-IOB outputs, the BACnet priority array concept is used in the I/O operating mode ‘Auto’ for determining the physical output value. Other I/O operating modes (‘Override’, ‘Manual’, ‘Disabled’, see Section 7.3.11) bypass the BACnet priority array. The physical value is determined by the override value or manual value in this case. The following L-IOB live value and configuration property data points, which can be changed at run-time, are exposed to BACnet properties:

- **Input**: For L-IOB inputs in ‘Auto’ mode, the input value is written to the Present_Value property of the BACnet input object. When switching from another operating mode to ‘Auto’, the current input value is also written.
- **Output**: The Present_Value of the BACnet object is written to the physical output in ‘Auto’ mode.
- **OperatingMode**:
    - **Auto**: The BACnet object is in normal operation as described above. Out_of_service and OVERRIDDEN flags of the BACnet object are cleared.
    - **Override (Input)**: The BACnet input object is set to out-of-service. The Present_Value no longer reflects the physical L-IOB input value. The L-IOB override value is coupled to the Present_Value and vice-versa. Writing the Out_Of_Service property over the BACnet network can turn the ‘Override’ mode on or off (except if in ‘Manual’ or ‘Disabled’ mode).
    - **Override (Output)**: The BACnet output object is set to out-of-service. The Present_Value no longer writes to the L-IOB output value. The L-IOB override value is coupled to priority slot ‘1’ and vice-versa. It is removed from priority slot ‘1’ when returning to ‘Auto’ mode. Writing the Out_Of_Service property

over the BACnet network can turn the 'Override' mode on or off (except if in 'Manual' or 'Disabled' mode).

   - **Manual**: The BACnet object is set OVERRIDDEN. The Present_Value reflects the manual value and is decoupled from the L-IOB input value (input) or Priority_Array (output). Out_Of_Service is not set. The Out_Of_Service, Present_Value, and Reliability properties are made read-only and can no longer be written over BACnet. This mode cannot be modified over the BACnet network.
   - **Disabled**: The BACnet object is set out-of-service, the OVERRIDDEN flag is set, and the reliability is set to 'no fault detected'. The Out_Of_Service, Present_Value, and Reliability properties are made read-only and can no longer be written over BACnet. This mode cannot be modified over the BACnet network.

- **OverrideValue**: In 'Override' mode this value is written to the Present_Value of the BACnet object at priority '1'. When entering 'Override' mode, the current override value is written. When leaving 'Override' mode, NULL is written at priority '1' for output objects and nothing is done for input objects. For input objects in 'Override' mode, the override value is updated by the Present_Value when written over BACnet.
- **ManualValue**: In 'Manual' mode, the L-IOB manual value is written to the Present_Value property of the BACnet object. The Present_Value cannot be written over BACnet in 'Manual' mode.
- **DefaultValue**: The L-IOB default value is written to the Relinquish_Default property of the BACnet object and vice-versa, if it exists.
- **Invert**: This L-IOB parameter is written to the Polarity property of BACnet BO and BI objects and vice-versa.
- **IOStatus**: The I/O status is reflected in the Reliability property of the BACnet object:
   - NO_FAULT_DETECTED: If the I/O does not report any error.
   - NO_OUTPUT/NO_SENSOR: If an output or sensor failure is detected.
   - COMMUNICATION_ERROR: If the L-IOB host reports a communication error.
   - UNRELIABLE_OTHER: For all other problems.
- **Feedback**: For L-IOB outputs in digital mode, the feedback value is written to the Feedback_Value property of the BACnet BO object. For L-IOB outputs in analog mode, the feedback value is written to the dedicated BACnet AI feedback object.
- **MinValue, MaxValue, Resolution**: For analog BACnet objects and BACnet Accumulator objects, these L-IOB configuration properties are written to the corresponding BACnet properties when they change. For a BACnet Accumulator object, the L-IOB Resolution is mapped to the BACnet Scale property. The BACnet properties are read-only from the BACnet network.
- **I/O Name and Description**: Initially, the BACnet server object name and description are both set to e.g. 'L1_1_UI1' (for UI1). In the Configurator, the BACnet server object name and description can later be modified manually or synchronized with the current I/O name and description.
- **PulseCountInit**: If the BACnet object type is Accumulator and this L-IOB configuration property is written (to reset the pulse counter), the value is also written to the Value_Set property of the BACnet Accumulator object and vice versa.

7.9 Default Configuration

Every L-IOB device is shipped with a default I/O configuration, which can be used right away. This configuration is the same in every device mode (see Section 5.1) and is dependent on the hardware type (see Section 7.3.2) of the corresponding I/O:

- **Universal Inputs (UI)**: measure voltage between 0V and 10V. The interpretation is 'Linear' with MinValue 0V and MaxValue 10V. Network variables of type SNVT_volt_f are used in LONMARK® Mode.

- **Digital Inputs (DI)**: act as switch inputs. The interpretation is 'Digital'. Network variables of type SNVT_switch are used in LONMARK® Mode.

- **Pressure Sensors (PRESS)**: measure pressure between 0Pa and 500Pa (Pascal). The interpretation is 'Linear' with MinValue 0Pa and MaxValue 500Pa. Network variables of type SNVT_press_f are used in LONMARK® Mode.

- **Analog Outputs (AO)**: deliver a voltage between 0V and 10V according to the given percentage level. The interpretation is 'Analog' with MinValue 0V and MaxValue 10V. Network variables of type SNVT_lev_percent are used in LONMARK® Mode.

- **Digital Outputs (DO)**: relays or triacs close when the given value goes active and open when the value goes inactive. The interpretation is 'Digital'. Network variables of type SNVT_switch are used in LONMARK® Mode.

Observe that LIOB-55x devices in BACnet Mode need an initial configuration from the Configurator software to be accessible over the BACnet/IP network.

8 L-IOB Firmware Update

The L-IOB firmware supports remote upgrade over the L-IOB bus. To guarantee that the L-IOB is not destroyed due to a failed firmware update, the L-IOB firmware consists of two images:

1. fallback image,
2. primary image.

The fallback image cannot be changed. Thus, if the update of the primary image fails or the image is destroyed by some other means, the fallback image is booted and allows reinstalling a valid primary image.

When the L-IOB device boots up with the fallback image, the status LED is flashing red.

8.1 Firmware Update using the Configurator

Refer to Section Firmware Update in the LINX Configurator User Manual [2] for information on how to upgrade the L-IOB firmware using the Configurator Software.

8.2 Firmware Update using LWEB-900

Refer to the user manual of LWEB-900 for information on how to upgrade the L-IOB firmware using this tool.

8.3 Firmware Update via the Web Interface (LIOB-45x/55x)

The device’s firmware can also be upgraded using the Web interface. This option can be found in the **Config** menu under the **Firmware** item. For more details see the LOYTEC Device User Manual [1].

9 L-IOB Device Replacement

A defective L-IOB device can easily be replaced with a new device of the same type without the need for any configuration changes.

9.1 L-IOB Device Replacement (L-INX Mode)

9.1.1 LIOB-Connect Device Replacement with L-INX Power-Cycle

This Section only applies to LIOB-10x devices. If a L-INX power cycle is acceptable, the L-IOB replacement on the LIOB-Connect bus can be performed without access to the L-INX Web UI or LCD UI using the following steps:

1. Switch off power of the L-INX device hosting the L-IOB device to be replaced.
2. Replace the L-IOB device with a new device of the same model.
3. Switch on power of the L-INX device again.
4. After a few minutes, all L-IOB devices including the replaced device will be online again.

In case not all L-IOB devices come online, check the status of the L-IOB devices in the L-INX Web UI or L-INX LCD UI.

9.1.2 LIOB-Connect Device Replacement without L-INX Power-Cycle

This Section only applies to LIOB-10x devices. If a L-INX power cycle is not acceptable, the L-IOB replacement on the LIOB-Connect bus can be performed using the following steps:

1. Replace the L-IOB device with a new device of the same model. Observe that this means that all L-IOB devices after the replaced one will reboot.
2. Go to the **LIOB / Installation** page of the L-INX Web UI and click **Save Settings** or go to the **Device Settings / LIOB** page of the L-INX LCD UI and click **Configure LIOBs**.
3. The L-IOB devices will be configured as shown in the L-INX Web UI or LCD UI. At the end of the configuration run, all L-IOB devices including the replaced device will be online again.

In case not all L-IOB devices come online, check the status of the L-IOB devices in the L-INX Web UI or LCD UI.

9.1.3 LIOB-FT/IP Device Replacement

This Section only applies to LIOB-15x devices in LIOB-FT device mode and LIOB-45x/55x devices in LIOB-IP device mode. The L-IOB replacement on the LIOB-FT/IP bus can be performed using the following steps:

1. Replace the L-IOB device with a new device of the same model and set the device to LIOB-FT resp. LIOB-IP device mode (see Section 5.1).

2. For LIOB-45x/55x devices, at first the IP and host configuration must be done (see Section 5.2.2).

3. In the L-IOB LCD interface, setup the station ID of the new device as it was configured in the replaced device (see Section 5.2.2).

4. In the L-IOB LCD interface, request a device configuration from the L-IOB host (also see Section 6.4).

5. After a short time, all L-IOB devices including the replaced device will be online again.

In case not all L-IOB devices come online, check the status of the L-IOB devices in the L-IOB host Web UI or L-IOB host LCD UI.

9.2 L-IOB Device Replacement (LONMARK® Mode)

LIOB-15x/45x devices in LONMARK® or Non-ECS device mode can simply be replaced using the 'replace' method of the used network management tool. Alternatively, a backup of the old device can be created and restored into the new device using the LOYTEC NIC connection, see LINX Configurator User Manual [2].

9.3 L-IOB Device Replacement (BACnet Mode)

LIOB-55x devices in BACnet device mode can simply be replaced using the backup/restore function. This can either be done using the Web UI or the Configurator Software (menu **Tools** / **Backup Device Configuration** and **Tools** / **Restore Device Configuration**).

10 Troubleshooting

10.1 Technical Support

LOYTEC offers free telephone and e-mail support for the L-IOB 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 / Europe

e-mail : ***support@loytec.com***
Web : ***http://www.loytec.com***
tel : ***+43 (1) 4020805-100***
fax : ***+43 (1) 4020805-99***

or

LOYTEC Americas Inc.
N27W23957 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***

11 Application Notes

11.1 External Power Supply (not using LPOW-2415A)

When using a non-LOYTEC power supply (see Figure 28), the following rules must be complied with:

- Consistent polarity must be maintained when connecting LOYTEC I/O controllers and modules to the transformer. That is, the '– ~' terminal of each I/O controller and each I/O module must be connected to the same terminal on the secondary side of the transformer.
- The I/O controllers and modules are half-wave rectified. Connecting two half-wave rectified devices to the same transformer without maintaining polarity will cause short circuit.
- The GND terminals of the I/O controller or module are internally wired to the '– ~' terminal. Therefore, if powering I/O controllers and modules with the same transformer, it is again essential to maintain polarity. Failure to do so will result in short circuit and/or damaged device.
- If the transformer output must be grounded, connect the '– ~' terminal to earth ground.

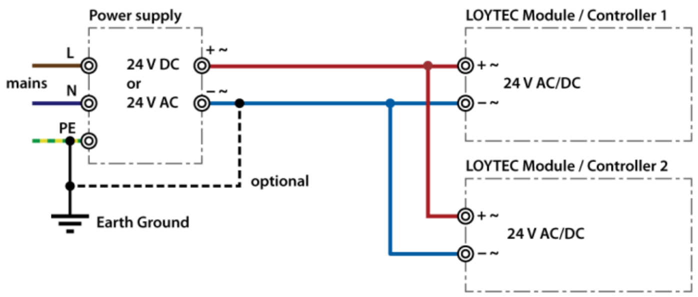


Figure 28: External power supply

11.2 Physical Connection of Inputs

11.2.1 Connection of Switches

On- or off-switches can either be connected to the DIs (Digital Inputs) or to the UIs (Universal Inputs) in digital interpretation.

11.2.1.1 Switch connected to a DI

A switch can be directly connected to a digital input as shown in Figure 29.

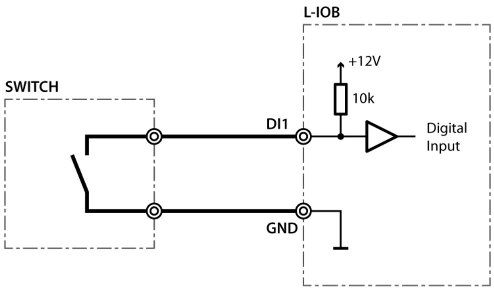


Figure 29: Switch connected to DI

The digital inputs (DI) recognize the following digital signals according to the connected resistance (switch):

Resistance of Switch	**Status**
< 6.8 kΩ	Closed Switch
> 10 kΩ	Open Switch

11.2.1.2 Switch connected to a UI

A switch can be directly connected to a universal input with signal type resistance as shown in Figure 30.

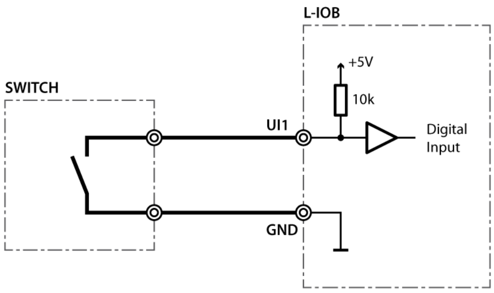


Figure 30: Switch connected to UI

UIs recognize the following digital signals according to the input resistance (switch):

Resistance Switch	**Status**
< 1.9 kΩ	Closed Switch
> 6.7 kΩ	Open Switch

11.2.2 Connection of S0 Pulse Devices (Meters)

S0 pulse meters must be connected to digital inputs (DI) as shown in Figure 31.

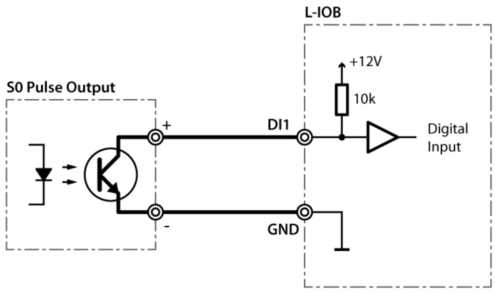


Figure 31: S0 pulse meter connected to DI

11.2.3 Connection of Voltage Sources to Universal Inputs

The Universal Input (UI) provides voltage measurement both if used as an analog or digital input. The signal type must be configured to ‘Voltage 0-10V’ or ‘Voltage 2-10V’ in both cases.

11.2.3.1 Voltage Source connected to UI with Analog Interpretation

Figure 32 shows the connection of a voltage source to a universal input in analog mode.

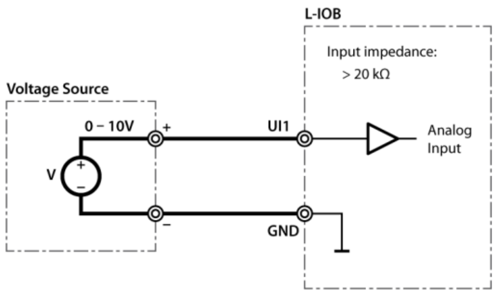


Figure 32: Voltage source on UI in analog mode

11.2.3.2 Voltage Source connected to UI with Digital Interpretation

Figure 33 shows the connection of a voltage source to a universal input in digital mode. In this case, the voltage source acts as a switch with the depicted low and high levels.

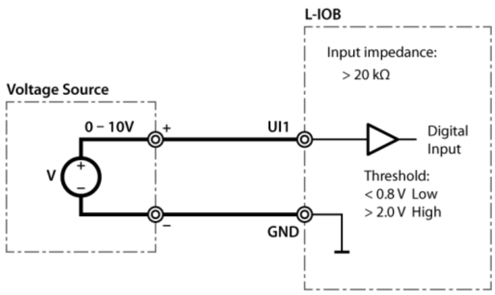


Figure 33: Voltage source on UI in digital mode

11.2.4 Connection of 4-20mA Transmitters to Universal Inputs

11.2.4.1 4-20mA Transmitter connected to UI with Internal Shunt

Some universal inputs have an internal shunt which can be activated (in pairs with another UI) in the Configurator software (signal type ‘Current 4-20mA int. Shunt’). Which UIs are equipped with shunts is documented in Section 13.4 and the following Sections. Figure 34 shows the connection of a 4-20mA transmitter to a universal input with internal shunt.

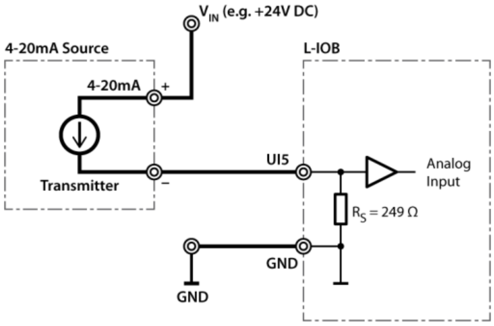


Figure 34: 4-20mA transmitter with internal shunt on UI

11.2.4.2 4-20mA Transmitter connected to UI with External Shunt

On universal inputs, which do not have an internal shunt, an external shunt must be used as shown in Figure 35. The signal type must be set to ‘Current 4-20mA’ in the Configurator software.

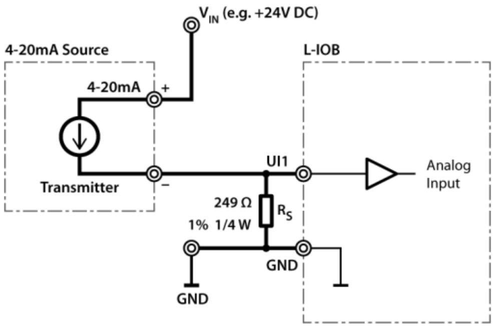


Figure 35: 4-20mA transmitter with external shunt on UI

11.2.5 Connection of Resistive Sensors

Figure 36 shows the connection of resistive sensors to the universal inputs with a temperature sensor as an example. Sensors in the resistance range of 1 kΩ to 100 kΩ can be measured. The signal type must be set to ‘Resistance’ in the Configurator software.

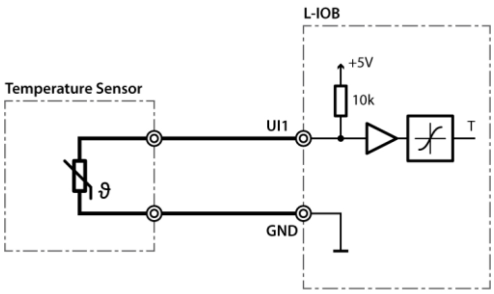


Figure 36: Temperature measurement on UI

11.2.6 Connection of STId Card Readers

Figure 37 shows the connection of an STId card reader to three L-IOB inputs (UIs or DIs). Observe that the clock signal must be connected to an interrupt-capable input of the L-IOB device. More information on STId card readers can be found in Section 7.5.

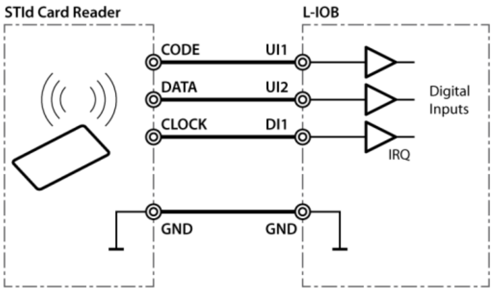


Figure 37: STId card reader

11.3 Physical Connection of Outputs

11.3.1 6A Relays on LIOB-100 (Built-in Fuse)

The LIOB-100 has a built-in fuse, rated with T 6.3A (time-lag), as shown in Figure 38.

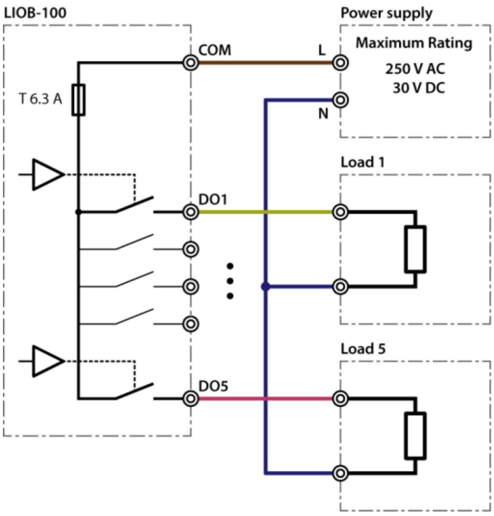


Figure 38: LIOB-100 6A relays

11.3.2 6A Relays with One External Fuse

The total current of all used 6A relays must be restricted to 6A, if more than two relays share a common (COM) terminal. The wiring shown in Figure 39 can be used for all L-IOB models with common terminals (and without a built-in fuse).

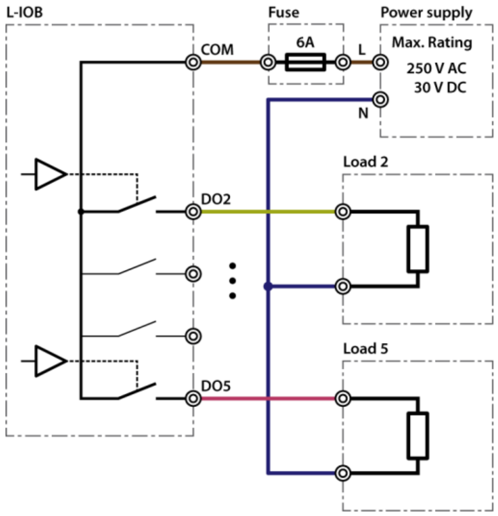


Figure 39: 6A relays with one external fuse

11.3.3 6A Relays on LIOB-xx2 using Separate Fuses

Figure 40 shows the wiring of the 6A relays for the LIOB-102/152/452/552 models using separate fuses. In this case, two relays share one common terminal (COM).

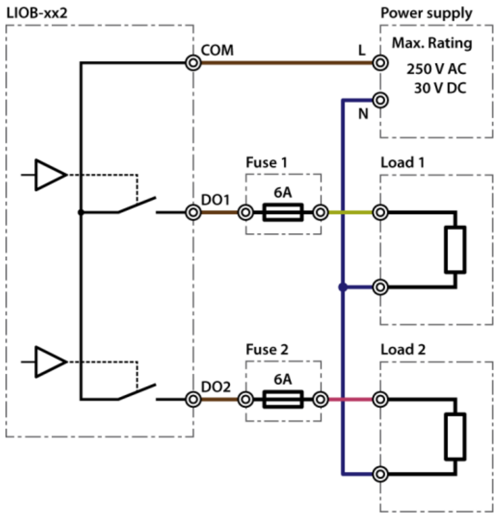


Figure 40: LIOB-102/152/452/552 6A relays

11.3.4 16A and 6A Relays on LIOB-xx3

The 16A and 6A relays on the LIOB-103/153/453/553 models all have two separate terminals per relay. There are no common (COM) terminals. This means that a 16A (or 6A) fuse must be wired to one of the two terminals of each relay, as shown in Figure 41.

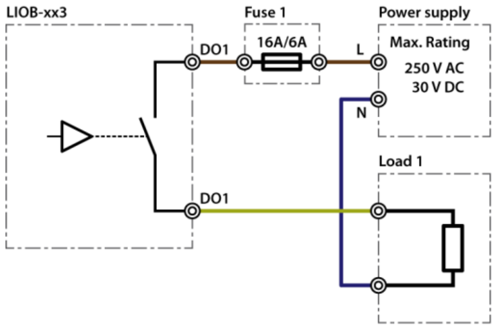


Figure 41: LIOB-103/153/453/553 16A/6A relays

11.3.5 External Relays and Inductive Loads

When controlling an external relay or inductive load using a L-IOB relay, either an integrated suppressor circuit must be used for the inductor, or a free-wheeling diode, a varistor, RC circuit, etc. must be installed to suppress voltage peaks and sparking due to switching off inductive circuits. It is recommended to use diodes that are part of the 1N400x family and to place them close to the relay, as shown in Figure 42. Figure 43 shows the connection of a 230V relay with a varistor.

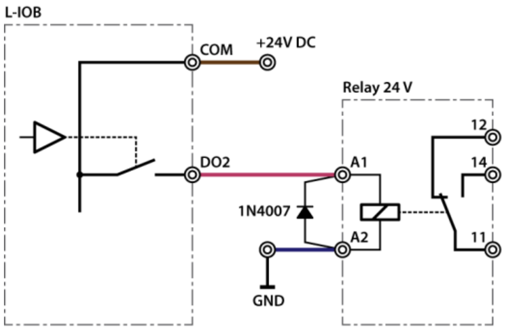


Figure 42: Suppressor circuit with free-wheeling diode

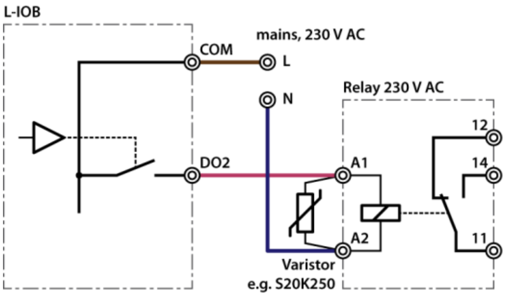


Figure 43: Suppressor circuit with varistor

11.3.6 Triacs

Figure 44 shows the wiring of the 0.5A Triac Outputs.

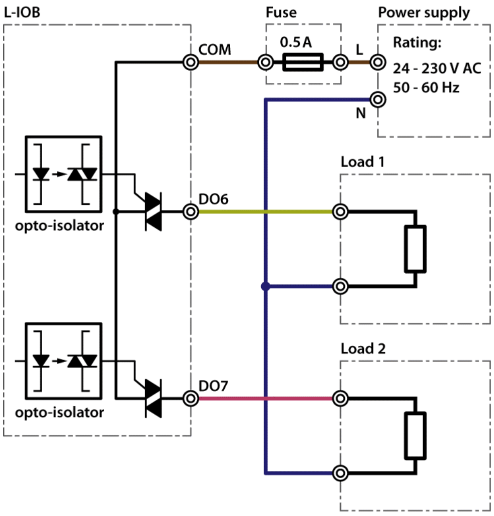


Figure 44: 0.5A Triacs

11.3.7 Analog Outputs

Figure 45 shows the wiring of the analog outputs (AO). Observe that the analog outputs are labeled '0-10V OUT' but are in fact capable of delivering over 11V.

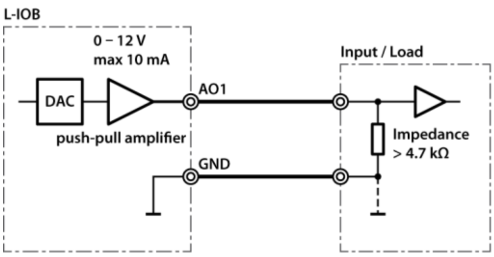


Figure 45: Analog outputs

The input impedance of the connected load must be greater than or equal to 4.7 kΩ for linear output.

11.4 Redundant Ethernet (LIOB-45x/55x)

11.4.1 Ethernet Cabling Options

Some L-IOB models are equipped with two Ethernet ports, which are connected to an internal Ethernet switch. This allows for advanced cabling options to reduce cabling costs or to increase network resilience. For this discussion, the term *upstream* is used to designate the direction towards the network, which the devices are connected to. Likewise, the term *downstream* is used to designate devices more distant to the network which the devices are connected to.

Redundant cabling options are enabled by the Rapid Spanning Tree Protocol (RSTP) which is implemented in most managed switches. Please note, that this is a feature of the switch, not of the L-IOB device, so that LOYTEC cannot give a guarantee that this will work with a particular switch model. In no case redundant cabling options will work with unmanaged switches. The older Spanning Tree Protocol (STP) should not be used for this type of application, as it converges too slowly.

Star topology: In the most basic setup, a device is connected to an Ethernet switch with one cable. This is called a star cabling because all devices are connected to a common upstream device. In this setup, the cable and the switch are single point of failures.

Chain topology: Because the L-IOB device itself acts as an Ethernet switch, this device can be connected to a chain. This is a special form of the star topology. Its advantage is the reduced cabling costs. The disadvantage is the connection loss to downstream devices when an upstream device is powered-off, reset or removed. Also, the Ethernet bandwidth (100 MBit/s) is shared among all members of the chain. The last device has one unused Ethernet port, as it is not allowed to create Ethernet loops without STP. The recommended maximum number of daisy-chained devices is 20.

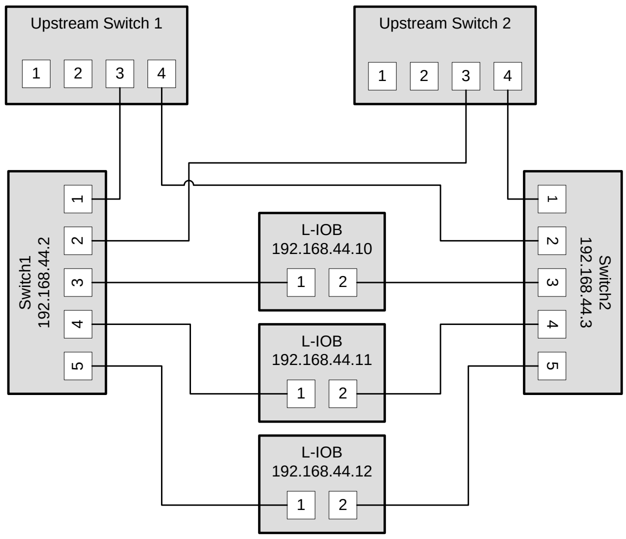


Figure 46: Fully redundant Ethernet topology

Fully redundant topology: Both Ethernet ports are connected to a different upstream switch. Thus, a single cable or upstream switch problem can be tolerated. This topology requires RSTP. In Figure 46, the L-IOB devices with IP addresses 192.168.44.10 to 192.168.44.12 are connected in this way. This connection scheme increases switch and cabling costs, but increases network resilience. Note that the upstream network is connected via the lowest-numbered ports. If this is not possible, the ports need to be configured to the lowest STP port priority value (which is the highest priority).

Ring topology: In this setup, the devices are connected in a chain and each end of the chain is connected to a different upstream switch. This topology requires RSTP. If a single device is powered off, the RSTP will automatically recalculate the spanning tree so that all other devices in the chain are reachable. Only if two devices are power-off at the same time, the devices between them will not have an Ethernet connection. In Figure 47, the L-IOB devices with IP addresses from 192.168.44.10 to 192.168.44.12 are connected in this way. The recommended maximum number of daisy-chained devices is 20.

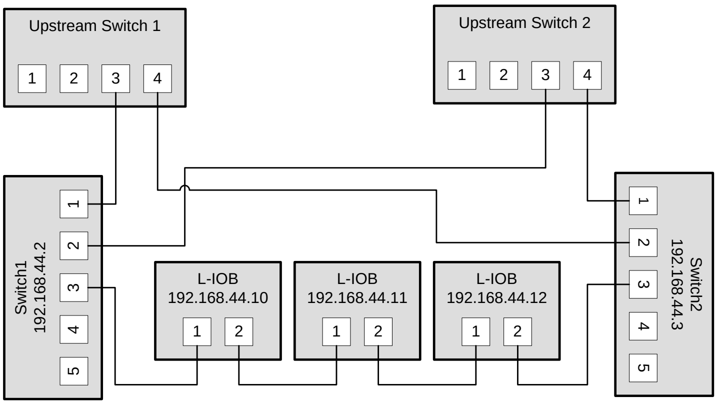


Figure 47: Ring Ethernet topology

11.4.2 Upstream Options

In case of redundant switches, there are two possible upstream topologies:

Single upstream connection: Switch1 (or Switch2, but not both) is connected to the upstream network while Switch2 only provides a redundant path to the LOYTEC devices. The redundant path is created by a direct Ethernet cable between Switch1 and Switch2 which needs to be plugged into a lower-numbered port than the L-IOB devices are connected to. If this is not possible, the STP port priority for the cross-connection cable needs to be set to a low value. The RSTP domain should be restricted to Switch1 and Switch2. This can be done by enabling a BPDU filter on the port on Upstream Switch 1. This will block all RSTP packets to enter the upstream network. A sample setup for this topology is shown in Figure 48.

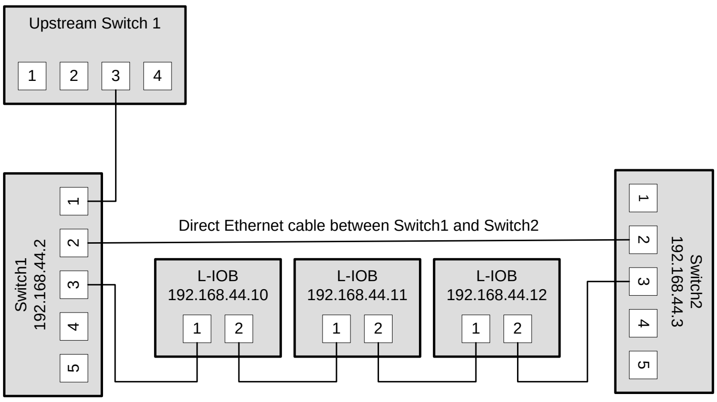


Figure 48: Single upstream connection.

Redundant upstream connection: Switch1 and Switch2 are both connected to the upstream network, either to two ports on the same switch or to two redundant upstream switches. In this case, RSTP is needed to ensure a loop-free topology between the upstream switches, Switch1 and Switch2, so the RSTP domain includes the upstream network and the chained L-IOB devices. The configuration of Switch1 and Switch2 need to ensure that they are not selected as the root bridge. If possible device communication should be bound to a separate VLAN and MSTP (Multiple Spanning Tree Protocol) should be employed to isolate the spanning tree operations. This topology is shown in Figure 46.

11.4.3 Preconditions

For the fully redundant and ring topology, the following preconditions have to be met:

- The upstream switches have to support the Rapid Spanning Tree Protocol (RSTP), as defined in IEEE 802.1w.
- The upstream switches have to provide a broadcast storm filter.
- Two distinct switches are required for each end of the device chain.
- Both upstream switches are connected to the same Ethernet network.

11.4.4 Switch Settings

The switches which connect the devices to the network need the following settings. Note that these are only recommendations or starting points. Each network with redundant connections needs testing and verification to prevent network loops.

- The STP bridge must be enabled.
- The STP bridge priority should be set to the minimum (61440), so that these switches are not elected as root bridges.
- The bridge mode should match the upstream bridge modes, preferable 802.1s or 802.1w.

If the upstream network uses RSTP, the timing parameters of the upstream networks must be used. Else the timing parameters should be set to minimum values for fast convergence:

- Bridge max age time: 6 seconds
- Hello time: 1 seconds
- Forward delay: 4 seconds
- All ports connected to Ethernet rings have to be configured as NON-EDGE ports, so that the RSTP can detect loops
- The switches should be configured to block broadcast storms. A recommended rate is 5% or 3000 packets/seconds.

The upstream switches need the following configuration:

- If a single upstream connection is used, the connected port on the upstream switch should have BPDU filtering enabled.
- If redundant upstream connections are used, the connected ports on the upstream switches should have a BPDU root guard enabled.

11.4.5 Testing

When the switches are configured and the devices are connected, the following tests are recommended. These tests are important to confirm that the STP changes due to topology changes to not interfere with the rest of the network.

- Check that no broadcast storms are sent into the upstream network by capturing traffic between Switch1, Switch2 and the Upstream switch. This test should be done continuously, especially during switch and device power cycles.
- Check that all devices can be reached (ICMP ping).

Execute these tests for these conditions:

- Power up all switches and devices. Wait until all devices are up, then test.
- Power-off Switch1. Wait approx. 10 seconds, then test.
- Power-on Switch2, power-off Switch1. Wait until Switch2 has booted, then test.
- Power-on Switch1. Wait until Switch1 has booted, then test.
- Reboot all L-IOB devices. Wait until the devices have booted, then test.
- Remove a single Ethernet cable. Wait approx. 10 seconds, then test. This test should be repeated for different cables. Make sure that at least the following connections are tested:
    - The connection between Switch1 and the L-IOB device directly connected to Switch1.
    - The connection between Switch2 and the L-IOB device directly connected to Switch2.
    - A connection in the middle of the chain, which is not connected directly to either Switch1 or Switch2.

11.4.6 Example switch configuration

The following example shows the configuration commands for Switch1, Switch2 and the upstream switch (HP Procurve syntax) in the setup shown in Figure 46.

Upstream switches:

```
config
spanning-tree
spanning-tree priority 8
spanning-tree 3,4 root-guard
spanning-tree hello-time 1
spanning-tree forward-delay 4
spanning-tree maximum-age 6
exit
```

Switch1 and Switch2:

```
config
spanning-tree
spanning-tree priority 15
spanning-tree 1,2 port-priority 0
spanning-tree 3-5 port-priority 8
spanning-tree hello-time 1
spanning-tree forward-delay 4
spanning-tree maximum-age 6
exit
```

12 Security Hardening Guide

This guide contains security-relevant information for operating the LIOB-45x/55x models on IT networks. The information refers to the firmware version and the instructions found in the previous chapters of this User Manual.

12.1 Installation Instructions

Install the device over the Web interface:

- Set up the basic device functions and protocol settings as described in Section 3.3.
- Disable the FTP, and Telnet servers in the IP port configuration as described in the LOYTEC Device User Manual [1].

12.2 Firmware

The device is equipped with one piece of software. This is the firmware image and its related firmware version. The firmware is distributed as a downloadable file. The device can be upgraded by placing the firmware image onto the device using the procedure described in Chapter 8.

12.3 Ports

This Section lists all ports, which may be used by the device. The ports are default settings for their respective services. If not stated otherwise, the ports can be changed.

Required Ports:

- 80 tcp: This port is opened by the Web server. The port can be changed.
- 1628 udp/tcp: This is the data exchange port for CEA-852 (LON over IP). It is required for the primary function of the device to exchange control network data between devices over the IP network. Each device needs this port open. The port can be changed in case of the LONMARK® mode (see Section 5.1).
- 47808 udp (LIOB-55x): This is the data exchange port for BACnet/IP. It is required for the primary function of the device to exchange control network data between routers over the IP network. Each device needs this port open. The port can be changed.

Optional ports not necessary for the primary product function. They can be disabled as described in the installation instructions in Section 12.1:

- 21 tcp: This port is opened by the FTP server. The port can be changed and disabled.
- 23 tcp: This port is opened by the Telnet server. The port can be changed and disabled.
- 5900 tcp: This port is opened by the VNC server, if it is enabled. This port is disabled by default. The port can be changed.

12.4 Services

Required services:

- CEA-852 (LON over IP): Primary function of the device. This service is in accordance with the standard ANSI/CEA-852-B.
- BACnet/IP (LIOB-55x): Primary function of the device. This service is in accordance with the standard ANSI/ASHRAE 135-2010.
- OPC XML-DA (LIOB-55x): This Web service provides access to data points over the OPC XML-DA standard.

Optional services not necessary for the primary product function. They can be disabled as described in the installation instructions in Section 12.1:

- HTTP: Web server. It provides a Web-based configuration UI. The Web UI can be disabled after setting up the device.
- FTP and Telnet: The FTP and Telnet server is used for connection to the device by the Configurator for configuration, firmware upgrade, and access to the log file. These services must be enabled during device configuration.
- VNC: The VNC server can be used for remote access to the LCD display on devices that have it. The service is disabled by default.

12.5 Logging and Auditing

The device contains a log file, which can be read out over FTP or the Web server. This log contains information when the device started and when crucial communication errors occur. Other information such user log-on are not logged as they are not part of the primary services of this device.

Logged events:

- Time of the last power-on reset of the device.
- Time and version of the last firmware upgrade.
- Time when the device was reset to factory defaults.
- Commission of the CEA-709 node.
- Static errors in the device and I/O configuration.
- System overload situations as one-time log messages since last power-on.
- Crucial communication errors as they occur.

13 Specifications

13.1 I/O Specification

13.1.1 UI - Universal Input

UIs are universal inputs for four different input types. They have an input voltage range of 0V to 10V, and can withstand up to 30V. The UIs correspond to class 1 with a relative accuracy of +/-1% (of measured value) between 1V and 10V, and an absolute accuracy of +/-10mV between 0V and 1V. The ADC resolution is 16 bits. Galvanically isolated sensors resp. switches must be connected. Universal inputs can be configured as:

- **Binary Input (Digital Input):** input impedance > 20kΩ, sampling period 10ms.
    - In voltage mode, the threshold values are < 0.8V for low level and > 2V for high level.
    - In resistance mode, the threshold values are < 1.9kΩ for low level and > 6.7kΩ for high level.

    Between the threshold values, the resulting level of the UI is not defined.

- **Voltage Metering 0-10V**: input impedance > 20kΩ, sampling period < 1s.
- **Current Loop 4-20mA**: input impedance 249Ω, sampling period < 1s. An internal shunt of 249Ω is available for some universal inputs. Otherwise, an external resistor of 249Ω must be used as a shunt.
- **Resistance Measurement**: input impedance 10kΩ, sampling period < 1s. Resistors in the range of 1kΩ to 100kΩ can be measured.

The average sampling period *p* of analog inputs depends on the number of active (non-disabled) universal inputs *n* that are configured in analog mode. The formula for *p* is:

$$p = n * 125ms$$

This means if e.g. only two UIs are configured as analog inputs, a new sample is taken every 250ms (on average) for each of the two inputs. The UIs configured as digital inputs are unaffected (sampling period always 10ms) by this formula.

For measuring room temperature LOYTEC suggests using NTC10k sensors. Because of their steep resistance characteristics around typical space temperature values no calibration is required and measurements have sufficient accuracy.

Because of the flat resistance characteristics of PT1000 and Ni1000 sensors the accuracy of space temperature measurements is lower. Therefore, PT1000 and Ni1000 sensors require calibration on the LCD display of the device.

13.1.2 DI - Digital Input, Counter Input (S0-Pulse)

DIs are fast binary inputs, which can also be used as counter inputs (S0). They follow the S0 specification for electric meters and have a sampling period of 10ms. They change state at a load of 195Ω between the DI terminal and GND. Galvanically isolated sensors resp. switches must be connected.

13.1.3 AO - Analog Output

AOs are analog outputs with a signal range of 0V to 10V (up to 12V), a resolution of 10 bits, and a maximum output current of 10mA (short circuit proof). The accuracy over the whole range is +/-100mV.

13.1.4 DO - Digital Output

The following digital outputs are available:

- Relay 6A Output: Switching capacity 6A, 250VAC resp. 30VDC. Max in-rush current 6A, max. 600W (resistive) @ 250VAC.
- Relay 10A Output: Switching capacity 10A, 250VAC resp. 30VDC. Max in-rush current 10A, max. 1600W (resistive) @ 250VAC.
- Relay 16A Output: Switching capacity 16A, 250VAC resp. 30VDC. Max in-rush current 80A, max. 2000W (resistive) @ 250VAC.
- TRIAC Output: Switching capacity 0.5A, 24 to 230VAC. No external relays must be connected.

When switching higher loads than specified an interface relay must be used. When connecting an external interface relay to a L-IOB relay, a quenching circuit like a varistor or RC element must be used.

13.1.5 PRESS - Pressure Sensor

These inputs represent differential pressure sensors which measure pressures from 0 - 500 Pascal. They are equipped with two 3/16” (4.8 mm) hose connectors.

13.2 Internal Translation Tables

The L-IOB devices offer fixed internal translation tables for easy configuration of some temperature sensors. The xin/xout values of these tables are listed in Table 10.

xout: Temp. [°C]	xin: Resistance [Ω]			
	PT1000	NTC10K	NTC1K8	Ni1000
-30	882.2	176680	24500	842
-20	921.6	96970	14000	893
-10	960.9	55300	8400	946
0	1000.0	32650	5200	1000
10	1039.0	19900	3330	1056
20	1077.9	12490	2200	1112
25	1097.4	10000	1800	1141
30	1116.7	8060	1480	1171

xout: Temp. [°C]	xin: Resistance [Ω]			
	PT1000	NTC10K	NTC1K8	Ni1000
40	1155.4	5320	1040	1230
50	1194.0	3600	740	1291
60	1232.4	2490	540	1353
70	1270.0	1750	402	1417
80	1308.9	1260	306	1483
90	1347.0	920	240	1549
100	1385.0	680	187	1618
120	1460.6	390	118	1760

Table 10: Internal translation table values

13.3 Maximum Number of L-IOB Devices per L-IOB Host

Table 11 specifies the maximum number of L-IOB devices per L-IOB bus as well as the maximum total number of L-IOB devices per L-IOB host.

L-IOB Host	L-IOB Devices on LIOB-Connect Bus	L-IOB Devices on LIOB-FT Bus	L-IOB Devices on LIOB-IP Bus	L-IOB Devices Total
LINX-10x/11x/20x/21x	-	8	8	8
LINX-12x/22x/15x	24	24	24	24
LROC-10x	24	24	24	24
LROC-40x	-	-	2	2
LIOB-48x/580..584	-	-	1	1
LIOB-586/588/589	1	-	1	1
LIOB-AIR	-	-	1	1

Table 11: L-IOB devices per L-IOB Host

After the first four L-IOB devices, which can be directly connected to the L-IOB host, each additional (local) group of up to four L-IOB devices requires a separate power supply (e.g. LPOW-2415A). In case of LIOB-Connect, each group additionally requires two LIOB-A2 adapters and an extension cable between the two adapters.

13.4 Specification for LIOB-10x Models

Dimensions [mm]	107 x 100 x 75 (L x W x H)			
Operating Temperature (ambient)	0°C to +50°C			
Storage Temperature	-10°C to +85°C			
Humidity (non condensing) operating / storage	10 to 90 % RH			
Environmental Protection	IP 40 (enclosure); IP 20 (screw terminals)			
Power Supply	24 VDC ±10 %, powered over LIOB-Connect			
Installation	DIN rail mounting (EN 50 022), attachable or connected with a 4-wire cable, max. 50 m			
Interface	1 x LIOB-Connect			
Types	LIOB-100	LIOB-101	LIOB-102	LIOB-103
Power Consumption [W]	1.7 / 2.6 (all Relays on)	1.7	1.7 / 2.7	1.7 / 2.5
Universal Input (UI)	8	8	6	6
Digital Input (DI)	2	16	-	-
Analog Output (AO)	2	-	6	6
Digital Output (DO)	9 (5 x Relay, 4 x Triac)	-	8 (8 x Relay)	5 (5 x Relay)
Digital output specification	Relay: 6 A Triac: 0.5 A @ 24-230 VAC	-	Relay: 6 A	Relay: 16 A
Internal shunt available for current measurement	UI5 & UI6, UI7 & UI8	UI5 & UI6, UI7 & UI8	UI3 & UI4, UI5 & UI6	UI3 & UI4, UI5 & UI6
Supported STId card readers	3	2	-	-

13.5 Specification for LIOB-15x Models

Dimensions [mm]	107 x 100 x 75 (L x W x H)				
Operating Temperature (ambient)	0°C to +50°C				
Storage Temperature	-10°C to +85°C				
Humidity (non condensing) operating / storage	10 to 90 % RH				
Environmental Protection	IP 40 (enclosure); IP 20 (screw terminals)				
Power Supply	24 VDC / 24 VAC ±10 %				
Installation	DIN rail mounting (EN 50 022)				
Interface	1 x CEA-709/FT or LIOB-FT (configurable)				
Types	LIOB-150	LIOB-151	LIOB-152	LIOB-153	LIOB-154
Power Consumption [W]	1.7 / 2.6 (all Relays on)	1.7	1.7 / 2.7	1.7 / 2.5	1.7 / 2.5
Universal Input (UI)	8	8	6	6	7 + 1 x Pressure Sensor
Digital Input (DI)	2	12	-	-	-
Analog Output (AO)	2	-	6	6	4
Digital Output (DO)	8 (4 x Relay, 4 x Triac)	-	8 (8 x Relay)	5 (4 x Relay 16 A, 1 x Relay 6 A)	7 (5 x Relay, 2 x Triac)
Digital output specification	Relay: 6 A Triac: 0.5 A @ 24-230 VAC	-	Relay: 6 A	Relay: 16 A and 6 A	Relay: 6 A Triac: 0.5 A @ 24-230 VAC
Internal shunt available for current measurement	UI5 & UI6, UI7 & UI8	UI5 & UI6, UI7 & UI8	UI3 & UI4, UI5 & UI6	UI3 & UI4, UI5 & UI6	UI5 & UI6, UI7
Supported STId card readers	3	2	-	-	1

13.6 Specification for LIOB-45x Models

Dimensions [mm]	107 x 100 x 75 (L x W x H)				
Operating Temperature (ambient)	0°C to +50°C				
Storage Temperature	-10°C to +85°C				
Humidity (non condensing) operating / storage	10 to 90 % RH				
Environmental Protection	IP 40 (enclosure); IP 20 (screw terminals)				
Power Supply	24 VDC / 24 VAC ±10 %				
Installation	DIN rail mounting (EN 50 022)				
Interface	1 x IP-852 or LIOB-IP (configurable)				
Types	LIOB-450	LIOB-451	LIOB-452	LIOB-453	LIOB-454
Power Consumption [W]	1.7 / 2.6 (all Relays on)	1.7	1.7 / 2.7	1.7 / 2.5	1.7 / 2.7
Universal Input (UI)	8	8	6	6	7
Digital Input (DI)	2	12	-	-	-
Analog Output (AO)	2	-	6	6	4
Digital Output (DO)	8 (4 x Relay, 4 x Triac)	-	8 (8 x Relay)	5 (4 x Relay 16 A, 1 x Relay 6 A)	7 (5 x Relay, 2 x Triac)
Digital output specification	Relay: 6 A Triac: 0.5 A @ 24-230 VAC	-	Relay: 6 A	Relay: 16 A and 6 A	Relay: 6 A Triac: 0.5 A @ 24-230 VAC
Internal shunt available for current measurement	UI5 & UI6, UI7 & UI8	UI5 & UI6, UI7 & UI8	UI3 & UI4, UI5 & UI6	UI3 & UI4, UI5 & UI6	UI5 & UI6, UI7
Supported STId card readers	3	2	-	-	1

13.7 Specification for LIOB-55x Models

Dimensions [mm]	107 x 100 x 75 (L x W x H)				
Operating Temperature (ambient)	0°C to +50°C				
Storage Temperature	-10°C to +85°C				
Humidity (non condensing) operating / storage	10 to 90 % RH				
Environmental Protection	IP 40 (enclosure); IP 20 (screw terminals)				
Power Supply	24 VDC / 24 VAC ±10 %				
Installation	DIN rail mounting (EN 50 022)				
Interface	1 x BACnet/IP or LIOB-IP (configurable)				
Types	LIOB-550	LIOB-551	LIOB-552	LIOB-553	LIOB-554
Power Consumption [W]	1.7 / 2.6 (all Relays on)	1.7	1.7 / 2.7	1.7 / 2.5	1.7 / 2.7
Universal Input (UI)	8	8	6	6	7
Digital Input (DI)	2	12	-	-	-
Analog Output (AO)	2	-	6	6	4
Digital Output (DO)	8 (4 x Relay, 4 x Triac)	-	8 (8 x Relay)	5 (4 x Relay 16 A, 1 x Relay 6 A)	7 (5 x Relay, 2 x Triac)
Digital output specification	Relay: 6 A Triac: 0.5 A @ 24-230 VAC	-	Relay: 6 A	Relay: 16 A and 6 A	Relay: 6 A Triac: 0.5 A @ 24-230 VAC
Internal shunt available for current measurement	UI5 & UI6, UI7 & UI8	UI5 & UI6, UI7 & UI8	UI3 & UI4, UI5 & UI6	UI3 & UI4, UI5 & UI6	UI5 & UI6, UI7
Supported STId card readers	3	2	-	-	1

14 References

[1] LOYTEC Device User Manual, LOYTEC electronics GmbH, Document № 88086502, April 2017.

[2] LINX Configurator User Manual, LOYTEC electronics GmbH, Document № 88086702, April 2017.

[3] LIOB-x8x User Manual, LOYTEC electronics GmbH, Document № 88080308, April 2017.

15 Revision History

Date	Version	Author	Description
2017-04-24	6.2	STS	Re-organized User Manual structure, branched out common parts into LOYTEC Device User Manual and LINX Configurator User Manual. Section 13.1.4 specification for DO updated.
2018-05-15	6.4	STS	Section 13.1.1 Added specification for temperature sensors.