L-INX/L-GATE

L-INX™ Automation Server

L-GATE™ Universal Gateway

User Manual

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Version 8.4

Document № 88073032

Contents

Abbreviations

100Base-T .... 100 Mbps Ethernet network with RJ-45 plug
Aggregation......................... Collection of several CEA-709 packets into a single CEA-852 packet
AST .... Alarming, Scheduling, Trending
BACnet .... Building Automation and Control Network
BBMD................................. BACnet Broadcast Management Device
BDT .... Broadcast Distribution Table
BOOTP .... Bootstrap Protocol, RFC 1497
CA .... Certification Authority
CEA-709 .... Protocol standard for LONWORKS networks
CEA-852 .... Protocol standard for tunneling CEA-709 packets over IP channels
CN .... Control Network
COV .... change-of-value
CR .... Channel Routing
CS....................................... Configuration Server that manages CEA-852 IP devices
DA .... Data Access (Web service)
DHCP.................................. Dynamic Host Configuration Protocol, RFC 2131, RFC 2132
DIF, DIFE .... Data Information Field, Data Information Field Extension
DL .... Data Logger (Web service)
DNS .... Domain Name Server, RFC 1034
DST .... Daylight Saving Time
EEP .... EnOcean Equipment Profile
GMT................................... Greenwich Mean Time
IP .... Internet Protocol
IP-852................................. logical IP channel that tunnels CEA-709 packets according CEA-852
LAN .... Local Area Network
LSD Tool .... LOYTEC System Diagnostics Tool
MAC .... Media Access Control
MD5 .... Message Digest 5, a secure hash function, see Internet RFC 1321
M-Bus .... Meter-Bus (Standards EN 13757-2, EN 13757-3)
MIB .... Management Information Base
MS/TP .... Master/Slave Token Passing (this is a BACnet data link layer)
NAT .... Network Address Translation, see Internet RFC 1631
NV....................................... Network Variable
OPC.................................... Open Process Control
OPC UA .... OPC Unified Architecture
PEM .... Privacy Enhanced Mail
PLC .... Programmable Logic Controller
RNI..................................... Remote Network Interface
RSTP .... Rapid Spanning Tree Protocol (Standard IEEE 802.1D-2004)
RTT .... Round-Trip Time
RTU .... Remote Terminal Unit
SCPT .... Standard Configuration Property Type

SSH.................................... Secure Shell
SL .... Send List
SMTP .... Simple Mail Transfer Protocol
SNMP .... Simple Network Management Protocol
SNTP .... Simple Network Time Protocol
SSL .... Secure Socket Layer
STP .... Spanning Tree Protocol (Standard IEEE 802.1D)
TLS..................................... Transport Layer Security
UCPT.................................. User-defined Configuration Property Type
UI.. User Interface
UNVT................................. User-defined Network Variable Type
UTC.................................... Universal Time Coordinated
VIF, VIFE........................... Value Information Field, Value Information Field Extension
WLAN .... Wireless LAN
XML .... eXtensible Markup Language

1 Introduction

1.1 Overview

The L-INX product family consists of high performance, reliable and secure network infrastructure components that implement an embedded automation server. The different models of the L-INX family contain a number of components and network technologies. As protocols on the control network side, the L-INX implements access to BACnet, CEA-709, KNX, Modbus, and M-Bus. The BACnet models are BTL-certified B-BC devices.

The L-GATE product family is intended for use as universal gateways. They provide a similar user interface and set of protocols as the L-INX family. The L-GATE provides data access to a defined set of data points, which are mapped from one control network technology to another control network technology. In particular, the CEA-709/BACnet Gateway (LGATE-902) implements mappings between a set of CEA-709 network variables (NVs) and a set of standard BACnet server objects. Which NVs are mapped to BACnet objects can be configured by an LNS plug-in or stand-alone configuration software. The LGATE-902 is equipped with a 100-BaseT Ethernet port (IP), an FT-10 port (CEA-709), and an RS-485 port (MS/TP). The device is fully compliant with ANSI/CEA-709 and ENV14908, ANSI/ASHRAE-135-2004 and ISO 16484. The LGATE-95X extends the 902 model with a number of additional protocol ports and supports more data points for the gateway.

Data from the supported network technologies are available as data points in the automation server. Those data points are freely configurable via configuration software, which provides a fast and easy way to configure the L-INX and L-GATE using online network scans, import/export features or device templates. Data points between different network technologies can be connected to each other for data transfer between those network technologies (gateway). Data points are also subject to alarming, trending and scheduling (AST) functions of the automation server. The usage of math objects allows basic calculations and the built-in E-mail client allows the L-INX and L-GATE to transmit e-mails on certain conditions. Generated alarms can be configured to send e-mails to predefined addresses. Alarms can also be stored in a historical *alarm log.* Trended data collected by the device and is available in CSV format and through a dedicated Web service.

An embedded OPC server exposes a defined set of data points as OPC tags. It implements the OPC XML-DA standard OPC XML-DA 1.01, which lets OPC clients access the data points via Web services. For secure OPC communication some L-INX models add an OPC UA server. Which native data points are exposed to OPC can also be configured by the configuration software. AST objects such as schedules are exposed as a set of OPC tags. Using the supplied L-WEB designer, users can easily generate a Web-based visualization for the L-INX.

Only the L-INX family contains a freely programmable controller that can operate on all L-INX data points. The controller application is developed using the provided IEC-61131 compliant design tool.

The L-INX and the L-GATE permanently collect statistical information from the attached network channels (OPC connections, FT traffic, MS/TP token passing, Ethernet traffic, etc.). Using this data, the device is able to detect problems on these channels (overload, lost tokens, connection problems, etc.) and warns the system operator via LEDs (see Section 6.4). An intuitive user interface allows fast and easy network troubleshooting without any additional analysis tools or deep system knowledge. For troubleshooting Ethernet protocols a local and remote Wireshark packet capture can be configured (see Section 10.2).

The built-in Web server allows convenient device configuration through a standard Web browser such as the Internet Explorer or Firefox. The Web interface also provides statistics information for system installation and network troubleshooting. Some devices also have an LCD display, which provides a quick way to configure basic settings of the device via a jog dial. Also available on some L-INX models are ports for SD card memory and a USB peripheral bus.

Some L-INX and L-GATE models are also equipped with a 2-port Ethernet Switch/Hub. In switched mode an Ethernet daisy chain can be built, which reduces cabling effort. The two Ethernet connectors can also be configured to work as two isolated IP interfaces. This can be used to safely connect a local building network while keeping it isolated from WAN access, that exposes some aspects using secure services. By using the external L-WLAN adapter, the device also provides a WLAN interface, which can link to an existing access point, set up its own access point or work in a wireless mesh network.

The L-INX is used for:

- Exposing data of control network devices from different technologies (CEA-709, BACnet, KNX, Modbus, M-Bus) to data points in the automation server,
- Directly connecting I/Os to data points in the automation server,
- exposing data points to OPC tags,
- visualization of data points with the supplied LOYTEC L-WEB software,
- visualization of data points in an OPC XML-DA, UA SCADA package,
- Room control, plant control running IEC61131 programs on data points,
- automatic meter reading applications via M-Bus and Modbus,
- meter gateway to BACnet using pulse counters or M-Bus and Modbus meters,
- browsing data points on the Web interface or LCD display,
- basic automation functions on data points (alarming, trending, scheduling),
- logging alarms,
- sending e-mails on alarms, trend logs, or scheduled events.

The L-GATE is used for:

- Connecting data points between any supported control networks (CEA-709, BACnet, KNX, Modbus, M-Bus) using the universal gateway function,
- browsing data points on the Web interface or LCD display,
- exposing data points to OPC tags,
- basic automation functions on data points (alarming, trending, scheduling),
- logging alarms,
- sending e-mails on alarms, trend logs, or scheduled events,
- gateway for ANSI/CEA-709 network variables (NVs) and configuration properties (CPs),
- gateway for standard (SNVT, SCPT) and user-defined (UNVT, UCPT) types.

1.2 CEA-709.1

L-INX automation server models that have CEA-709 and all L-GATE models are equipped with an FT port (CEA-709) and a 100Base-T Ethernet port (CEA-852). CEA-709 L-INX models come with a router option or an RNI option. L-INX models with the router option contain a CEA-709 router between the FT and the IP-852 channel, which can be configured like an L-IP. It includes a configuration server (CS) to manage the IP-852 channel. The L-INX models without the router option contain a remote network interface (RNI) instead of the router for remote network access. Please refer to Table 1 to learn, which device models have CEA-709 and the router option.

The CEA-709 L-INX and L-GATE device is fully compliant with ANSI/CEA-709, ANSI/CEA-852-A, EN 14908. The CEA-709 node, that is going to be commissioned in the network, is always connected to the FT port of the device.

The function of the CEA-709 node is to expose CEA-709 network variables (NVs) and configuration properties (CPs) to data points in the automation server or the gateway. The configuration software can be run as LNS plug-in or stand-alone. The CEA-709 data points can be bound in the CEA-709 network as NVs or operated as “external NVs”. External NVs are polled or explicitly written to without allocating static or dynamic NVs on the device. In this case, address information is supplied by the configuration software by importing e.g., a CSV file. User-defined network variable types (UNVTs) can be used as dynamic or external NVs. Configuration properties (CPs) on other devices can be accessed through file transfer. To transfer CPs, the device supports both the LONMARK file transfer and the read memory access method. For CPs, the standard SCPTs and user-defined UCPTs are supported. All those CEA-709 data points can be exposed to the automation server or the gateway.

The CEA-709 L-INX with the router option possesses a router between the CEA-852 interface (IP-852) and the FT interface. The CEA-852 interface can be used to connect the L-INX to an IP-based high-speed backbone. The L-INX’s router can be used as a standard CEA-709 configured router or it can be used as a self-learning plug&play router based on the high-performance, well-proven routing core from our L-Switch plug&play multi-port router devices (“smart switch mode”). The self-learning router doesn’t need a network management tool for configuration but is a true plug&play and easy to use IP infrastructure component. For a detailed description of the CEA-709 router’s usage refer to the L-IP User Manual [8].

The L-GATE and the CEA-709 L-INX without the router option can be configured to run either on the CEA-852 interface (IP-852 mode) or on the FT interface (FT mode). In the FT mode, the device provides a remote network interface (RNI), which appears like a LOYTEC NIC-IP is intended to be used together with the LOYTEC NIC software [3]. The RNI can be utilized for remote access and configuration as well as trouble-shooting with the remote LPA. Please consult our product literature for the LPA-IP to learn more about this IP-based CEA-709 protocol analyzer.

The CEA-709 technology in the L-INX and L-GATE allows for:

- Exposing CEA-709 network variables (NVs) and configuration properties (CPs) as data points to the automation server or gateway,
- supporting standard (SNVT, SCPT) and user-defined (UNVT, UCPT) types,
- scheduling CEA-709 network variables,
- generating alarms over the LONMARK node object,
- CEA-709 PC applications (as a CEA-709 network interface),
- remote LPA functionality,
- communicating on CEA-709 with either FT or IP-852 (IP channel on the Intranet/Internet),

- connecting an FT channel to a high-performance backbone using existing IP infra-structure,
- operating as a configuration server for IP-852 devices with the router option.

1.3 BACnet

L-INX automation server models that have BACnet and all L-GATE models are BTL-certified products that implement the B-BC profile. They are equipped with an MS/TP port and a 100Base-T Ethernet port (BACnet/IP and/or BACnet/SC). The MS/TP port supports remote Wireshark packet capture for troubleshooting. BACnet L-INX models with the router option also contain a BACnet router between the MS/TP and the BACnet/IP and BACnet/SC ports, which can be configured like an LIP-ME20X. The router models also include a BACnet broadcast management device (BBMD) to manage BACnet/IP internetworks, which span across IP routers. BACnet models without the router can register as a foreign device (FD) with other BBMDs. The device is fully compliant with ANSI/ASHRAE 135-2020 (Rev 1.16) and ISO 16484-5. Please refer to Table 1 to learn, which device models have BACnet and the router option.

The BACnet L-INX and the L-GATE expose BACnet server objects and client mappings to data points of the automation server or the gateway. For client mappings, the BACnet address information is supplied by the configuration software by importing e.g., a CSV file or by performing an online network scan.

The BACnet L-INX and L-GATE models also support the LOYTEC Alarming, Scheduling and Trending (AST) features in native BACnet objects. The device provides BACnet scheduler/calendar objects, which can directly schedule BACnet server objects, remote BACnet objects or non-BACnet registers. For alarm conditions the device supports the intrinsic reporting method of BACnet objects. Trend logs can be uploaded from the device via the native BACnet read range.

The BACnet L-INX with the router option possesses a BACnet router between the BACnet/IP port, the BACnet/SC port, and the MS/TP port. This router can be operated and configured like the LIP-ME20X from LOYTEC. The BACnet/IP or BACnet/SC interface can be used to connect the L-INX to an IP-based high-speed backbone. The L-INX also can act as a BBMD for a BACnet/IP network. For a detailed description of the BACnet router's usage refer to the LIP-ME20X User Manual [9].

A BACnet L-INX without the router option and the L-GATE can be configured to run either on the BACnet/IP or on the BACnet/SC or on the MS/TP interface. In BACnet/IP mode, the L-INX can be configured as a foreign device in another BBMD. The BACnet L-INX without the router option does not provide the BBMD functionality itself. The L-GATE can also be configured to be a BBMD. Please refer to Table 1 to learn, which models can be configured as a BBMD.

The BACnet technology in the L-INX and L-GATE allows for:

- Using the device as a BTL-certified B-BC,
- exposing local BACnet server objects (analog, binary, multi-state) and remote objects (client mappings) to data points,
- scheduling any data point from native BACnet schedule and calendar objects,
- trending any data point to native BACnet trend log objects,
- generating native BACnet alarms on any data point,
- communicating with either MS/TP, BACnet/IP, or BACnet/SC,
- connecting an MS/TP network to a high-performance backbone using existing IP infra-structure,

- operation as a BBMD for a BACnet/IP network with the router option,
- troubleshoot the MS/TP network with Wireshark remote packet capture (see Section 10.2),
- distributing NTP time into the BACnet network as BACnet time master.

1.4 M-Bus

In addition to the basic network technologies all models except the LGATE-900 support the M-Bus interface according to the standards EN 13757-2 and EN 13757-3. To get access to the M-Bus network, an external M-Bus interface such as the L-MBUS by LOYTEC must be attached to the device. On devices with a serial port, the M-Bus interface is connected to the serial connector. In this case the user needs to turn M-Bus support on and off via a DIP switch. On devices without a serial port, the L-MBUS interface must be used and is connected to the extension port (EXT).

Through the M-Bus interface the L-INX can be used to scan the attached M-Bus network for devices, pull M-Bus data points into a configuration, connect those data points to other technologies and expose M-Bus data points to the automation server. All AST functions can be used directly on M-Bus data points. Especially trending data and polling for data on M-Bus devices has been optimized for automatic meter reading applications.

For debugging purposes a protocol analyzer is included in the firmware and can be operated via the Web-UI and the configuration software. For more information on how to set up the device for using M-Bus, configuring and using M-Bus data points, refer to the M-Bus Chapter in the LINX Configurator User Manual [2].

1.5 Modbus

In addition to the basic network technologies the all models support the Modbus RTU and the Modbus TCP interface. To get access to the Modbus network, the appropriate interfaces have to be activated either in the Web UI or in the configuration software. Modbus RTU is operated with 8N1. A Modbus port can either be operated as Modbus master or Modbus slave.

On some BACnet L-INX models, the Modbus RTU and BACnet MS/TP protocols share the same port. On those models, Modbus RTU can only be used, if BACnet MS/TP is disabled. Please refer to Table 1 to learn, which BACnet L-INX models have this restriction.

Using the LRS232-802 interface extends a LOYTEC device by two RS-232 ports over the USB connector. Modbus ASCII or RTU can be operated on those RS-232 extension ports where RS-232 cennectivity is required.

Through the Modbus interface the device can be used to data points to other technologies, and expose Modbus data points to OPC tags. All AST functions can be used directly on Modbus data points. Especially trending data and polling for data on Modbus devices has been optimized for automatic meter reading applications.

For debugging purposes a protocol analyzer is included in the firmware and can be operated via the Web UI and the configuration software. For more information on how to set up the device for using Modbus, configuring and using Modbus data points, refer to the Modbus Chapter in the LINX Configurator User Manual [2].

1.6 KNX

In addition to the basic network technologies, some L-INX and L-GATE models can be connected to KNX networks (see Section 1.12). To gain access to a KNX TP1 network, the LKNX-300 interface has to be attached to the device for TP1 networks. All KNX-capable models support KNXnet/IP directly with their Ethernet interface.

The KNX interface allows creating KNX data points which can be used with the AST functions, the OPC server and also the PLC on the L-INX models. The device configuration can be imported from an ETS database export.

For more information on how to set up the device for using KNX, configuring and using KNX data points, refer to the KNX Chapter in the LINX Configurator User Manual [2].

1.7 EnOcean

In addition to the basic network technologies, some L-INX and L-GATE models can integrate EnOcean wireless devices (see Section 1.12). To gain access to an EnOcean network, the LENO-800 interface has to be attached via one of the USB ports USB 1 or USB 2.

The EnOcean interface is represented in the Configurator as a technology folder. EnOcean devices are created from device templates and provide data points, which can be used with the AST functions, the OPC server and also the PLC on the L-INX models.

For debugging purposes a protocol analyzer is included in the firmware and can be operated via the Web UI. For more information on how to set up the device for using EnOcean, configuring and using EnOcean data points, refer to the EnOcean Chapter in the LINX Configurator User Manual [2].

1.8 SMI

In addition to the basic network technologies, some L-INX and L-GATE models can be connected to SMI networks (see Section 1.12). To get access to the SMI network, the LSMI-800 interface has to be attached to the EXT port of the device (for one SMI channel), or the LSMI-804 interface to the USB port (for four SMI channels). LOYTEC devices support SMI 3.0 BF (basic format).

The SMI interface is represented in the Configurator as a technology folder. SMI devices are created from device templates and provide data points, which can be used with the AST functions, the OPC server and also the PLC on the L-INX models.

For debugging purposes a protocol analyzer is included in the firmware and can be operated via the Web UI. For more information on how to set up the device for using SMI, configuring and using SMI data points, refer to the SMI Chapter in the LINX Configurator User Manual [2].

1.9 MP-Bus

In addition to the basic network technologies, some L-INX and L-GATE models can be connected to MP-Bus networks (see Section 1.12). To get access to the MP-Bus network, the LMPBUS-804 interface has to be attached to the built-in USB ports USB 1 and USB 2. Up to two LMPBUS-804 interfaces can be operated at the same time, covering a maximum of 8 MP-Bus channels. External USB hubs are not supported.

The MP-Bus interface is represented in the Configurator as a technology folder. MP-Bus devices are created from device templates and provide data points, which can be used with the AST functions, the OPC server and also the PLC on the L-INX models.

For debugging purposes a protocol analyzer is included in the firmware and can be operated via the Web UI. For more information on how to set up the device for using MP-Bus, configuring and using MP-Bus data points, refer to the MP-Bus Chapter in the LINX Configurator User Manual [2].

1.10 L-IOB

The L-INX automation server models allow connecting physical I/Os to the device via the L-IOB I/O modules (see Table 1). On some models those modules can be stacked up directly to the L-INX using the LIOB-Connect feature (see Section 1.12). The connected I/O modules are automatically identified and coupled as data points into the L-INX automation server. All L-INX models also support easy integration of L-IOB I/O modules over FT cabling using the LIOB-FT feature, or over Ethernet using the LIOB-IP feature.

L-IOB modules are available with digital inputs and outputs, analog inputs and outputs and universal inputs that are configurable. Some models are also available with a differential pressure sensor.

The I/O modules can be parameterized over the configuration software or the Web UI. All parameterization data is stored on the L-INX and can be reloaded to the LIOB modules when needed. The exchange of modules is detected automatically. For more information on how to setup and use L-IOB I/Os please refer to the L-IOB I/O module user manual [7].

1.11 Scripting

Select programmable L-INX and L-GATE models provide a JavaScript-based scripting engine (see Table 1 and Table 2). On some of them, a license (L-IOT1) needs to be purchased to enable the feature. The script engine allows users to implement custom protocols using RESTful APIs, JSON, Web services for IoT integration into the LOYTEC data point model. The dpal-js API gives JavaScript modules access to the data point server. Script modules are embedded into and deployed along with the data point configuration.

The Web interface of the LOYTEC device offers an overview of installed script modules and allows starting scripts in debug mode. The debug mode implements the inspector interface of Google Chrome to debug JavaScript on the device. For more information read the new Scripting Chapter in the LINX Configurator User Manual [2].

Node-RED™ is also available on LOYTEC devices with script support. The Node-RED™ editor is fully integrated in the Web interface. With Node-RED™ it is a simple task to use published nodes and palettes for various tasks, such as REST APIs, MQTT, circadian light, etc. There is also a built-in LOYTEC palette that provides nodes for reading and writing data points on the device. This combination makes it easy to integrate various IoT components on the LOYTEC device.

1.12 L-INX and L-GATE Models

This Section provides an overview of the different L-INX and L-GATE models in Table 1 and Table 2. This table identifies the different features of those models. Models that possess a certain feature have a check mark (✓) in the respective column. If a feature is not available in the particular model, the column is left blank.

L-INX models with the router option have a CEA-709 router or a BACnet router, respectively. The LINX-151 has both a CEA-709 router between FT and IP and a BACnet router between MS/TP and IP.

On L-INX models without the router option and on all L-GATE models, certain ports can only be used alternatively. On models with CEA-709 this means either as CEA-709 FT or as CEA-852 IP (see note 1 in Table 1 and Table 2). On models with BACnet this means either as BACnet MS/TP or as BACnet IP (see note 2 in Table 1 and Table 2). Some BACnet models have a restriction on Modbus RTU and BACnet MS/TP as they share the same port. On those models Modbus RTU can only be used, if BACnet MS/TP is disabled (see note 3 in Table 1 and Table 2).

The LGATE-951 has two EXT ports and therefore can operate M-Bus and KNX TP1 at the same time, while the LGATE-950 can use etiher M-Bus or KNX TP1. The LGATE-952 has two RS-485 and three EXT ports.

Features \ Model	LINX-102	LINX-103	LINX-112	LINX-113	LINX-120	LINX-121	LINX-150	LINX-151	LINX-153	LINX-154
CEA-709 Router		✓		✓		✓		✓	✓	
CEA-709 RNI	✓		✓		✓		✓		✓	
CEA-709 (FT)	✓[1]	✓	✓[1]	✓	✓[1]	✓	✓[1]	✓	✓	
CEA-852 (IP)	✓[1]	✓	✓[1]	✓	✓[1]	✓	✓[1]	✓	✓	✓
BACnet Router								✓	✓	✓
BACnet MS/TP							✓[2]	✓	✓	✓
BACnet IP and SC							✓[2]	✓	✓	✓
BBMD								✓	✓	✓
Modbus RTU	✓	✓	✓	✓	✓	✓	✓[3]	✓[3]	✓	✓
Modbus IP	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M-Bus	✓[4]	✓[4]	✓[4]	✓[4]	✓[4]	✓[4]	✓[4]	✓[4]	✓[4]	
SMI	✓[4]	✓[4]	✓[4]	✓[4]	✓[4]	✓[4]	✓[4]	✓[4]	✓[4]	
KNX TP1	✓[4]	✓[4]	✓[4]	✓[4]	✓[4]	✓[4]	✓[4]	✓[4]	✓[4]	
KNX IP	✓	✓	✓	✓	✓	✓	✓	✓	✓	
EnOcean	✓[5]	✓[5]	✓[5]	✓[5]	✓[5]	✓[5]	✓[5]	✓[5]	✓[5]	
MP-Bus (8 channels)	✓[5]	✓[5]	✓[5]	✓[5]	✓[5]	✓[5]	✓[5]	✓[5]	✓[5]	
LRS232-802	✓	✓	✓	✓					✓	✓
OPC XML-DA	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
OPC UA	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
OPC Client	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SNMP	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
PLC (L-LOGICAD)			✓	✓	✓	✓	✓	✓	✓[6]	✓[6]
PLC (L-STUDIO)			✓[6]	✓[6]					✓	✓
LIOB Connect	✓	✓	✓	✓	✓	✓	✓	✓	✓	
LIOB FT + IP	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
LCD Display	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SD Card					✓	✓	✓	✓		
USB	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Ethernet Switch/Hub	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
WLAN, LTE	✓[5]	✓[5]	✓[5]	✓[5]	✓[5]	✓[5]	✓[5]	✓[5]	✓[5]	✓[5]
SSH, HTTPS, Firewall	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Script Support	✓[6]	✓[6]	✓	✓					✓	✓

[1] This model can be configured to have either FT or IP active for CEA-709.

[2] This model can be configured to have either MS/TP or IP or SC active for BACnet.

[3] Modbus RTU can only be used, if BACnet MS/TP is not active on this model.

[4] M-Bus, SMI and KNX TP1 can be used alternatively only on this model. To operate these protocols an expansion module is needed and must be ordered separately. LSMI-804 can be connected independently.

[5] To operate these protocols an expansion module is needed and must be ordered separately.

[6] These models require a separate license that needs to be purchased to use this feature. Note, that for devices since production week 50/2023 (A64 models) the L-LOGICAD license is no longer available.

Table 1: Available features in different L-INX and L-GATE models.

Features \ Model	LINX-202	LINX-203	LINX-212	LINX-213	LINX-215	LINX-220	LINX-221	LGATE-902	LGATE-950	LGATE-951	LGATE-952
CEA-709 Router					✓						
CEA-709 RNI					✓			✓	✓	✓	✓
CEA-709 (FT)					✓			✓[1]	✓[1]	✓[1]	✓[1]
CEA-852 (IP)					✓			✓[1]	✓[1]	✓[1]	✓[1]
BACnet Router		✓		✓	✓	✓	✓				
BACnet MS/TP	✓[2]	✓	✓[2]	✓	✓	✓	✓	✓[2]	✓[2]	✓[2]	✓[2]
BACnet IP and SC	✓[2]	✓	✓[2]	✓	✓	✓	✓	✓[2]	✓[2]	✓[2]	✓[2]
BBMD		✓		✓	✓	✓	✓	✓	✓	✓	✓
Modbus RTU	✓[3]	✓[3]	✓[3]	✓[3]	✓	✓	✓	✓[3]	✓	✓[3]	✓
Modbus IP	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M-Bus	✓[4]	✓[4]	✓[4]	✓[4]	✓[4]	✓[4]	✓[4]	✓[4]	✓[4]	✓[4]	✓[4]
SMI	✓[4]	✓[4]	✓[4]	✓[4]	✓[4]	✓[4]	✓[4]	✓[4]	✓[4]	✓[4]	✓[4]
KNX TP1	✓[4]	✓[4]	✓[4]	✓[4]	✓[4]	✓[4]	✓[4]	✓[4]	✓[4]	✓[4]	✓[4]
KNX IP	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
EnOcean	✓[5]	✓[5]	✓[5]	✓[5]	✓[5]	✓[5]	✓[5]	✓[5]	✓[5]	✓[5]	✓[5]
MP-Bus (8 channels)	✓[5]	✓[5]	✓[5]	✓[5]	✓[5]	✓[5]	✓[5]	✓[5]	✓[5]	✓[5]	✓[5]
LRS232-802	✓	✓	✓	✓	✓			✓			✓
OPC XML-DA	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
OPC UA	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
OPC Client	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SNMP	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
PLC (L-LOGICAD)			✓	✓	✓[6]	✓	✓				
PLC (L-STUDIO)			✓[6]	✓[6]	✓						
LIOB Connect	✓	✓	✓	✓	✓	✓	✓				
LIOB FT + IP	✓	✓	✓	✓	✓	✓	✓				
LCD Display	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SD Card						✓	✓		✓	✓	
USB	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Ethernet Switch/Hub	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
WLAN, LTE	✓[5]	✓[5]	✓[5]	✓[5]	✓[5]	✓[5]	✓[5]	✓[5]	✓[5]	✓[5]	✓[5]
SSH, HTTPS, Firewall	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Script Support	✓[6]	✓[6]	✓	✓	✓			✓			✓

[1] This model can be configured to have either FT or IP active for CEA-709.

[2] This model can be configured to have either MS/TP or IP or SC active for BACnet.

[3] Modbus RTU can only be used, if BACnet MS/TP is not active on this model.

[4] M-Bus, SMI and KNX TP1 can be used alternatively only on this model. To operate these protocols an expansion module is needed and must be ordered separately. LSMI-804 can be connected independently.

[5] To operate these protocols an expansion module is needed and must be ordered separately.

[6] These models require a separate license that needs to be purchased to use this feature. Note, that for devices since production week 50/2023 (A64 models) the L-LOGICAD license is no longer available.

Table 2: Available features in different L-INX and L-GATE models (continued).

1.13 Scope

This document covers L-INX and L-GATE devices with firmware version 8.4 and describes specific functions of those device models. Basic device operations are covered in the LOYTEC Device User Manual [1] and data point configuration is covered by the L-INX Configurator User Manual [2]. The usage of logiCAD itself is beyond the scope of this manual. Please refer to the logiCAD online help in case of additional questions.

2 Disclaimer Cyber Security

LOYTEC offers a portfolio of products, solutions and systems with cyber security functions that enable the secure operation of devices, systems and networks in the field of building automation and control technology. To ensure that devices, systems, and networks are always protected against online threats, a holistic security concept is required that is implemented using the latest technology and is being kept up-to-date. The LOYTEC portfolio is only one component of such an overall concept.

The customer is responsible for preventing unauthorized access to the devices, systems and networks. These should only be connected to a network or the Internet if adequate security measures are in place (e.g. firewalls, separate networks) and a connection is required for operation. In addition, LOYTEC's recommendations for securing devices in the Security Hardening Guide (Chapter 12) must be followed. For additional information, please contact your support person at LOYTEC or visit our website.

LOYTEC is constantly working on improving the existing products in order to follow the latest cyber security standards. Therefore, LOYTEC strongly recommends installing updates as soon as they become available and always using the latest software versions. LOYTEC explicitly points out that using older versions or refraining from updates increases the risk of online security threats.

3 Safety Instructions

ATTENTION

General Safety Instructions

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

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

ATTENTION

Country-specific Safety Regulations

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

CAUTION

Electrical Safety

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

CAUTION

IEC (SELV, PELV) (world-wide)

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

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

CAUTION

NEC (North America)

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

CAUTION

Device Safety

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

ATTENTION

Installation Personnel

Only qualified staff may carry out electrical installations.

CAUTION

Installation according to Safety Class II

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

The following requirements apply:

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

ATTENTION

Environment Conditions

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

CAUTION

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

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

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

CAUTION

Functional Earth ⏚

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

CAUTION

Operating Voltage 24V AC/DC

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

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

CAUTION

Specification for 24VAC Transformers

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

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

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

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

CAUTION

Specification for 24VDC Power Supplies

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

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

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

CAUTION

Protection of the 24VAC Supply Voltage

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

Always protect the 24VAC conductor (system potential),

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

CAUTION

Protection of the 24VDC Supply Voltage

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

Local regulations must be observed.

CAUTION

Protection of Mains Voltage

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

CAUTION

Power over Ethernet (PoE)

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

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

CAUTION

Device Installation/Removal in De-Energized State Only

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

CAUTION

Power Supply Protection

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

CAUTION

Power Supply Voltage

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

CAUTION

DALI is FELV (Functional Extra Low Voltage)

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

ATTENTION

DALI Wiring

A DALI-line may be installed within the same cable or as single conductors within the same tube as mains supply. The DALI-line is either limited to a maximum length of 300 m using a minimum cross-section of 1.5 mm2 (AWG15) or it must be ensured that the voltage drop on the DALI-line does not exceed 2 V.

CAUTION

Attention to External Voltages

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

4 What's New in L-INX/L-GATE

4.1 New in L-INX/L-GATE 8.4.0

Enhanced Account Security and View Role

The built-in user accounts (admin, operator, guest) can be disabled to prevent attacks on those well-known accounts. The admin account can only be disabled, if a custom user account with the superadmin role is created instead. For all accounts, the default settings enforce the use of strong passwords.

The new "view" role has been added that allows a user to view configuration settings only. A view user cannot change any configuration settings.

Responsive Web UI

The Web UI on LOYTEC devices has been enhanced for display on smaller screens such as mobile devices or handhelds. The menu structure collapses in order to save space. Some pages also provide a responsive display to enhance user experience on smaller displays, such as the data point page or Bluetooth commission page.

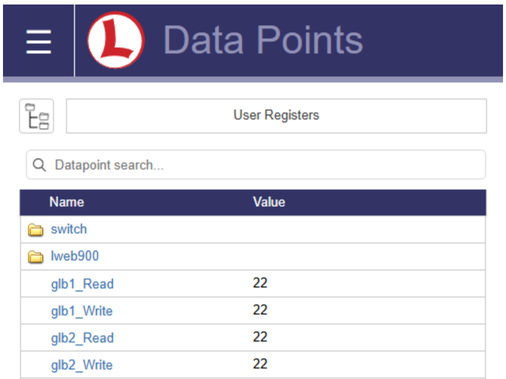


Figure 1: Responsive Web UI on the data point page.

Support placeholder %{folder_descr} in Data Point Description

A new placeholder has been introduced that can be used in data point descriptions. The %{folder_descr} is expanded to the actual description text set on the parent folder. This can be used to create unique descriptions in CAT instances.

Increased BACnet Limits

The limit of BACnet server objects has been extended to allow a larger limit for server objects generated by the L-STUDIO logic application. While the general-purpose limit remains the same, server objects created by L-STUDIO for the PLC in CAT instances are counted on top until the higher limit is reached. This new limit is noted as "incl. PLC" in the tables of Section 13.2.

Also, the limit of the BACnet description property has been increased to hold up to 255 characters.

BACnet/SC Node Improvements

The LOYTEC BACnet/SC node has been extended to improve troubleshooting and compatibility with third-party hubs. The node now supports uploading a CA certificate chain. While not required by the standard, this feature gives extra flexibility with certain PKI implementations.

The BACnet/SC node also supports a Wireshark interface, that can be enabled for troubleshooting the encrypted traffic. On the network, IPv6 is supported for hub connections.

Support new BT Mesh Device Templates

The Bluetooth Mesh technology now supports a flexible concept for generalized device templates. Using the new BT mesh templates requires the use of firmware 8.4.0 or above. As a benefit, new device templates can be created without requiring firmware update. This allows creation of tailored templates for specific use cases in various projects.

Also new templates exist for LOYBT-MSx that support configuration of LOYTEC beacons and the DALI gateway feature by simple assignment of DALI control gear to lamp actuator objects on the Web UI.

Discovery of Devices via loytec.local

Unconfigured LOYTEC devices starting with firmware 8.4.0 can now be easily found without knowing the IP address by simply calling the Web page ‘loytec.local’. The search is implemented as an mDNS discovery on the local network. A device finder page is displayed that provides links to all devices found.

Configuration of an Internet Failover Interface

LOYTEC devices can support multiple paths to reach the Internet. For example, Ethernet and an attached LTE-800 interface. For such scenarios, a failover interface can be selected. This failover interface is used as the default route to the Internet, if the primary interface lost Internet connection. This can be configured on the IP Host tab.

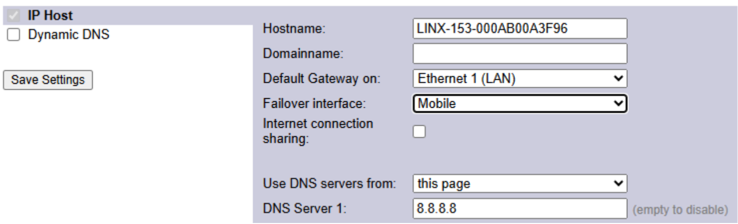


Figure 2: Configuration of an Internet failover interface.

Site-to-Site VPN

This special VPN option has been added to make the LOYTEC device a VPN router between sites. While route to local subnet allows access from the VPN to a local node via TCP or request/response, a site-to-site VPN routes all traffic from local nodes into the VPN. That makes local nodes on network A directly talk to local nodes on network B, where networks A and B are connected via the VPN.

To use this feature, a number of pre-conditions must be met that are not controlled by the LOYTEC device: 1) The OpenVPN server must allocate and push all respective and unique subnets that exist in the site-to-site VPN. 2) Each node on the local network must use a gateway address that directs all non-local traffic to the VPN router. The VPN router delivers the traffic to the VPN.

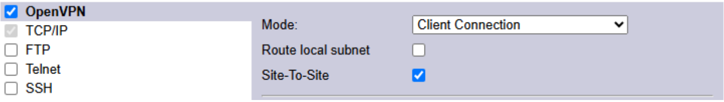


Figure 3: Enabling the site-to-site VPN router.

4.2 New in L-INX/L-GATE 8.2.0

L-LOGICAD Licence Discontinued on L-INX

For new L-INX devices since production week 50/2023 (A64 models) the L-LOGICAD run-time license is no longer available. PLC programs need to be migrated to run on the L-STUDIO 61131 run-time instead. Upgrading older L-INX controllers to firmware 8.2.0 does not remove an already installed L-LOGICAD license and it can still be used.

New generic trend mode “Interval+COV”

Generic trends now offer a new trending mode: Interval+COV. This is a combination of periodic logging and COV trends. Data records are recorded when the COV condition is met and in a periodic fashion.

New historic filter “Current Value”

Historic filters can be configured to use an offset correction data point. In order to process the current value including offset correction, the “Current value” filter item was added. This item contains the offset-corrected value of the underlying data point. It can be used, for example, to trend an offset-corrected meter value after replacing a meter.

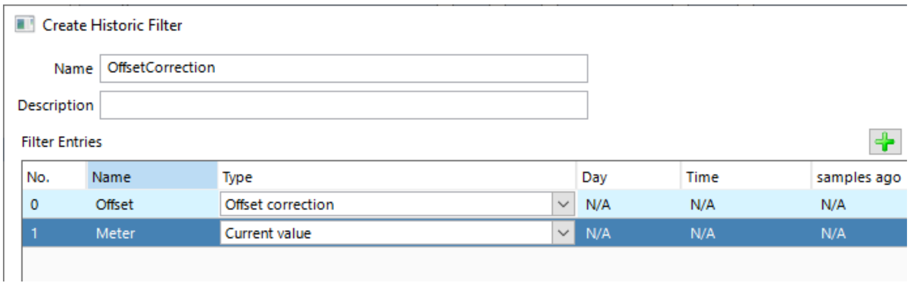


Figure 4: Current value filter item for offset-corrected historic filters.

Edit BACnet Priority Array on Web UI

The detailed data point Web UI for BACnet objects now offers an editor for the priority array of the underlying BACnet object. The editor allows editing each priority slot, including a clear option to withdraw a slot.

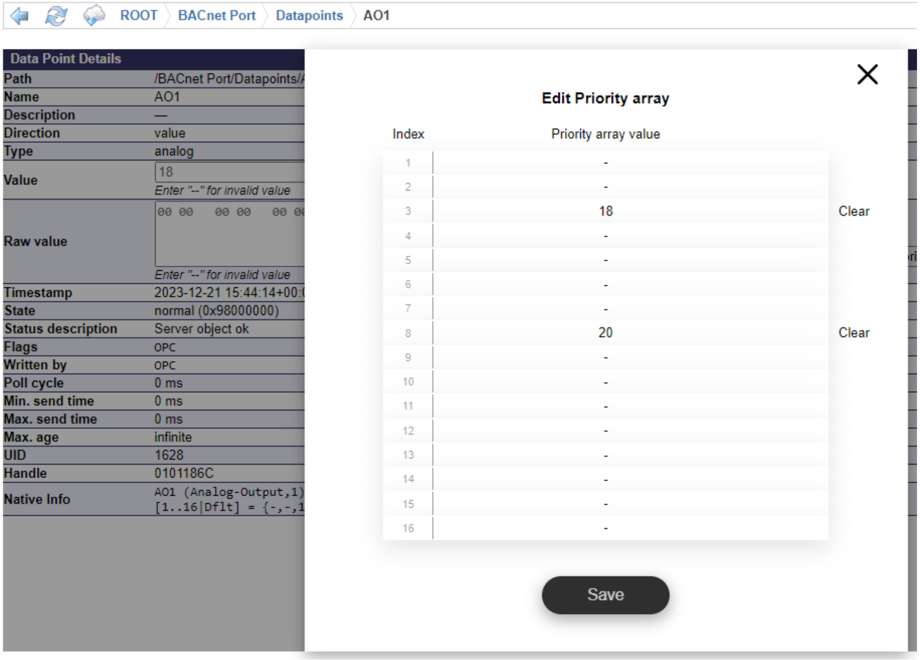


Figure 5: BACnet priority array editor on the data point Web UI.

4.3 New in L-INX/L-GATE 8.0.0

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

New iCalendar Schedulers

LOYTEC devices support a new scheduler object class that is based on iCalendar events. This scheduler class can be selected as an alternative to the generic scheduler class. It supports extended features such as events that span over midnight or last for several days, flexible recurrence patterns known from Outlook, and booking information. The Web interface has been extended to display an event view of the scheduler. External iCalendar data sources can be imported by using a calendar URL, which allows pulling in data from published Outlook or Google calendars.

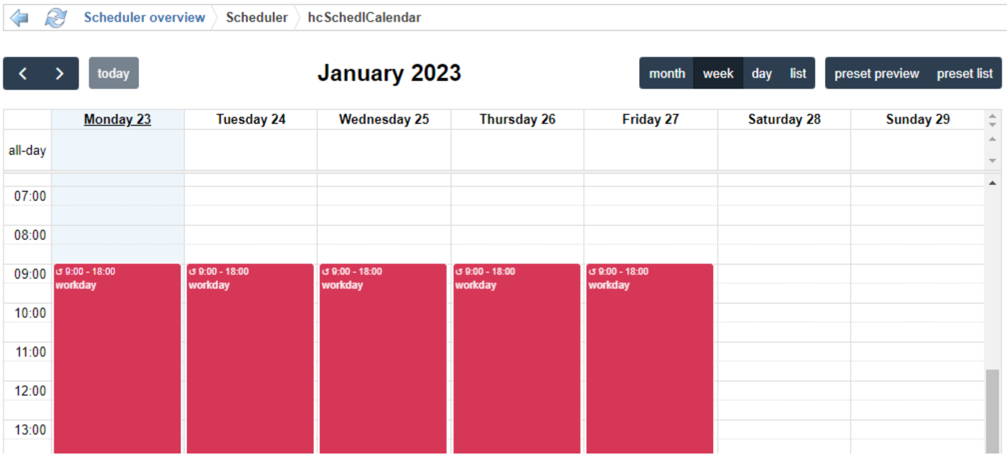


Figure 6: New iCalendar scheduler view on the Web interface.

The new currentEvent, upcomingEvent and upcomingTime data points can be used to display booking information of a meeting room, while the known timeToNext and nextEvent data points allow optimum start algorithms on the controller.

Edge Trigger Mode

Trends and alarms can be based on trigger conditions. There are two new trigger modes available: rising edge and falling edge. These can be used to trigger a recording, if the trigger data point changes from inactive to active (rising) or from active to inactive (falling).

Folder Component Placeholder for Alarm Messages

In addition to the full data point path, individual folder components of the path can now be addressed using the %{f*N*} placeholder, where *N* refers to the *N*-th folder part above the data point. For example on the data point "/User Registers/Building2/Floor3/Room101/temp" the placeholder %{f1} expands to "Room101" and %{f2} to "Floor3". This way, individual compositions of the folder components can be assembled to form the alarm message.

New WLAN Configuration Tabs and System Registers

The WLAN configuration of the port configuration has been re-modelled to better match the client and access point (AP) use cases. The tabs are now labelled **WLAN Client** and **WLAN Access Point**. These tabs are restricted to settings that apply to their respective use.

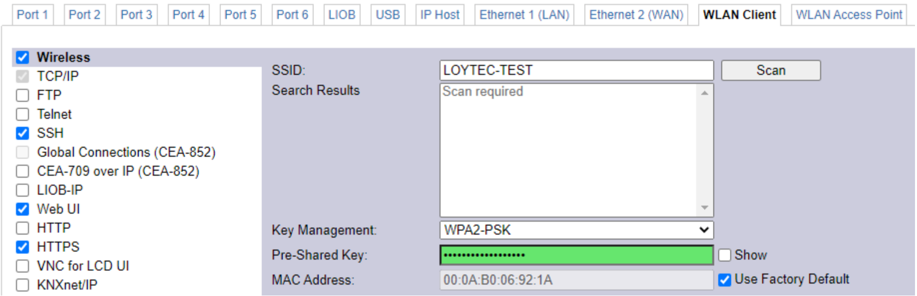


Figure 7: New WLAN configuration tabs

The system registers have also been moved to sub-folders named WLAN Client and WLAN Access Point. Setting SSID, Key and writing the new Enable system register under either port allows enabling the client or AP, respectively.

BACnet/SC

LOYTEC devices support the BACnet/SC node function. This allows LOYTEC devices to register with BACnet/SC hubs and be integrated in BACnet/SC networks, thus benefitting from increased security including TLS encryption and authentication. On devices with a BACnet router, BACnet/SC can be enabled in addition to or as a replacement of BACnet/IP. Devices without the BACnet routing function can enable either BACnet/SC or BACnet/IP.

The internal device certificate can be used out-of-the-box, and CA-signed operational certificates can be installed as needed. When BACnet/SC and BACnet/IP and/or MS/TP are enabled, the device acts as a router between those interfaces. It is also possible to run BACnet/SC on a separate network than BACnet/IP.

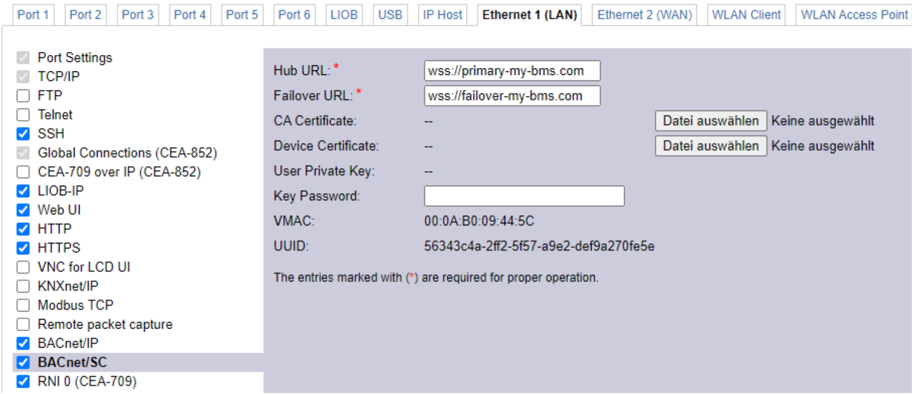


Figure 8: BACnet/SC configuration on Ethernet

Node-RED™ 3.0 and AST for Scripts

The scripting support on LOYTEC devices has been improved by supporting Node-RED™ 3.0. This includes new editor UI features. The underlying node.js has been updated to 18.7. This allows up-to-date palettes and script packages to work on LOYTEC devices.

The API available for node.js scripts has been extended to fully support alarm summaries, alarm acknowledgement, reading and writing schedules, as well as flexible access to historic data in trend logs.

4.4 New in L-INX/L-GATE 7.6.0

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

New Structure for System Registers

The system registers have been re-organized under a folder structure. The old system register locations are available for back-ward compatibility. A new system register “Time Zone Name” has been added that allows configuration of the time zone offset and DST settings according to the timezone database. Writing a valid time zone name to that register sets the new timezone information, e.g., “CET” for Central European Time.

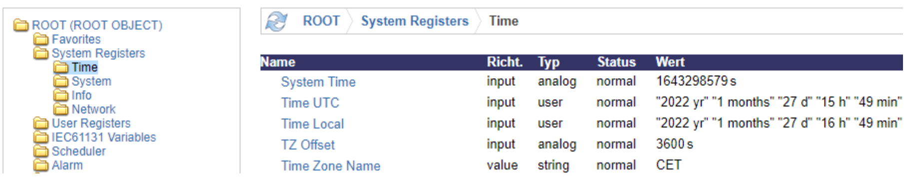


Figure 9: New system register layout.

WiFi Enterprise

To further increase security in a WiFi network, IT departments support the 802.1X authentication method on WiFi also known as WiFi Enterprise. LOYTEC devices can enable WiFi Enterprise in the WiFi settings by selecting WPA2-ENTERPRISE key management. The authentication methods Protected EAP (PEAP), Tunneled TLS (TTLS) and EAP-TLS (using certificates) are supported.

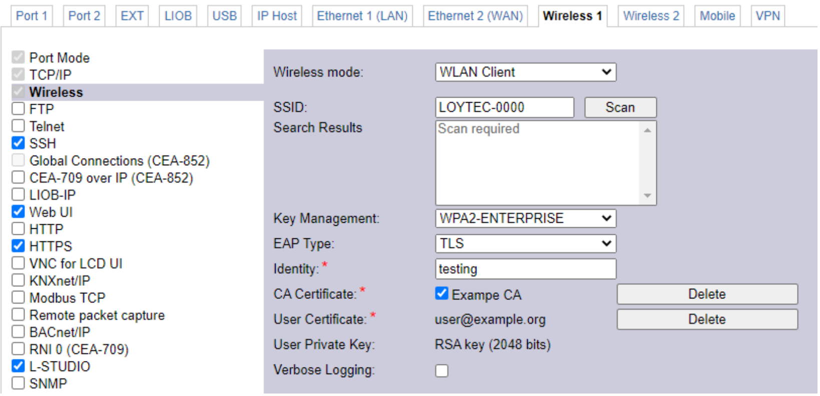


Figure 10: Configure WiFi Enterprise

Historic Filters

A new filter item type has been added to historic filters: The Offset Correction item. This item allows correcting the underlying meter value by a given offset. That offset will be added to the measured value before the value is processed by other historic filters. After replacing a meter, the offset correction can be used to maintain continuous consumption.

In addition, historic filter items can now be written to on the Web interface to set historic values. For example, it is now possible to set the value of Jan 1 or any other historic value. On the details page, all historic filter values can be exported to a CSV file. That file can be imported on other historic filter data points allowing the simple transfer of historic values.

Node-RED™ 2.0

The scripting support on LOYTEC devices has been improved by supporting Node-RED™ 2.0. This includes new editor UI features. A new safe mode allows debugging problems in third-party packages.

BTL Testplan 16 Certified

The BACnet certification of all BACnet models has been updated to comply with protocol revision 16. All new device models are now BTL certified. New BACnet features in that release include

- Support Fault_Type and Fault_Parameters in the Event Enrollment object,
- Fault_High_Limit and Fault_Low_Limit properties,
- Support extended “jumbo” MS/TP frames.

4.5 New in L-INX/L-GATE 7.4.0

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

New Menu Structure on Web UI

The menu structure on the Web UI has been redesigned to be more intuitive and group frequent actions together. New top-level menus help keeping the menus organized into typical tasks, such as statistics, data viewing, commissioning, configuration, programming, security, and maintenance.

User Management on the Device

LOYTEC devices now provide a simple user management to create users and passwords on the go. Users can be assigned roles, such as ‘admin’, ‘operator’ or ‘lweb’ roles. Users having the ‘lweb’ role are limited to using LWEB-802/803 visualization projects only and have no other device operation capabilities.

The Web UI on the device allows creating, deleting and modifying users and assigning roles. As an example, an additional admin user can be created who is allowed to configure the device without knowing the master admin password. This user account can easily be disabled again.

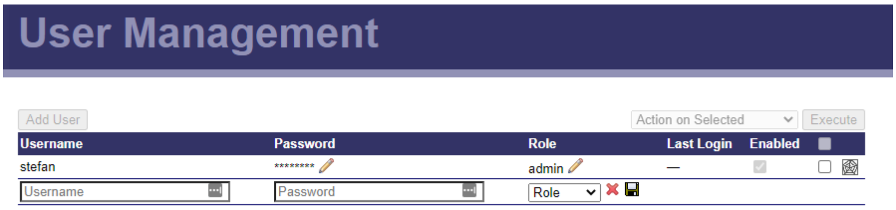


Figure 11: User management on the device.

Support for LRS232-802

The new LRS232-802 interface supports two RS-232 ports and is connected to the device’s USB port. LOYTEC devices that support the LRS232-802 can be configured to run Modbus ASCII on it or a custom RS-232 serial protocol implemented by a script module. The protocol settings can be found on port tabs under the USB port.

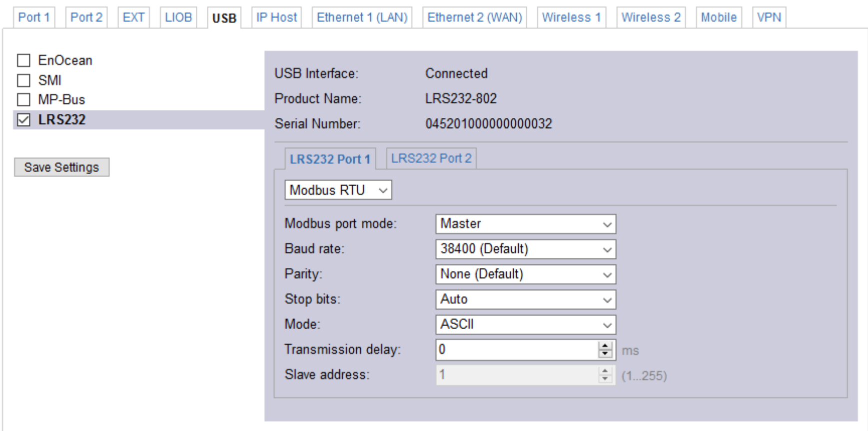


Figure 12: Configure Modbus ASCII on LRS232-802.

Late Linkage of L-IOB Native BACnet Objects

A new feature now allows linking existing BACnet objects as L-IOB native BACnet objects for a given L-IOB I/O as an alternative to the automatic creation of native BACnet objects. This feature is beneficial when using library components with a collection of BACnet objects, that need to be linked to actual I/O configurations when instantiating the library components. This can be easily done on the L-IOB tab by choosing a BACnet object to serve as the native object for an I/O.

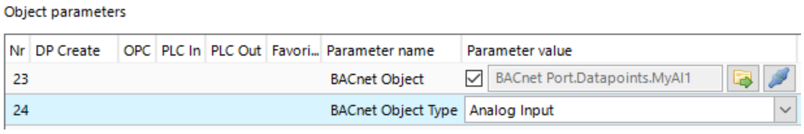


Figure 13: Link an existing BACnet object as a native BACnet object for an I/O.

BACnet Features for AMEV AS-B Profile and Protocol Rev 1.15

The BACnet implementation now supports additional features to comply with the AMEV AS-B profile. This includes:

- Additional properties for the Loop object,
- new properties for intrinsic reporting, including event and reliability inhibition, alarm message texts config, time delay normal,
- External Notification-B (AE-N-E-B) in the Event_Enrollment object,
- Minimum_On/Off_Time properties for commandable binary objects,
- Min/Max_Pres_Value properties for Analog Value objects,
- Current_Command_Priority for all commandable objects.

Alarming

Both BACnet and generic alarms now support an option to define a different delay for the to-normal transition. Simply select the Time delay normal option and set a delay in the alarm condition dialog. On BACnet, intrinsic reporting and algorithmic reporting facilitate the property Time_Delay_Normal to carry this value. Also, the layout of the alarm dialog has been reorganized to better group the settings by the different alarm transitions.

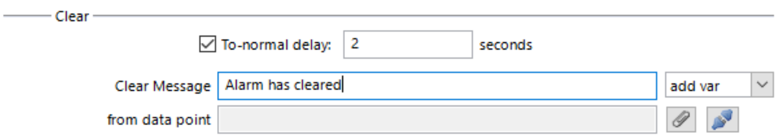


Figure 14: Option to define a different to-normal delay.

New L-IOB Features

Data points for L-IOB terminal name and description have been added. These allow modification via the data point interface. The I/O description can now also be changed on the L-IOB Web page.

Operating mode "manual disable". This new L-IOB operating mode can be selected to manually disable a terminal. The setting persists an L-STUDIO deploy and cannot be changed over the network until the terminal is manually enabled again.

Spike suppression on pulse counter inputs allows filtering short signal spikes. This feature can be used to de-bounce a contact connected to a pulse counter input.

Network Port Authentication

To further increase security in a network installation, IT departments support the 802.1X port authentication method. This standard requires a device to authenticate its port on the network switch, before traffic into the network is allowed.

LOYTEC devices can enable 802.1X port authentication in the port mode settings. The authentication methods Protected EAP (PEAP), Tunneled TLS (TTLS) and EAP-TLS (using certificates) are supported.

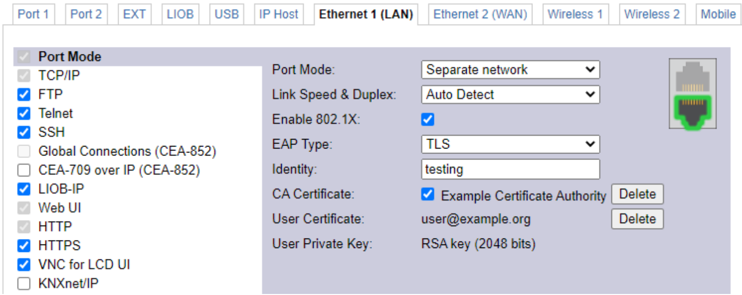


Figure 15: Configure 802.1X port authentication

4.6 New in L-INX/L-GATE 7.2.0

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

Support for LTE

LOYTEC devices now support the LTE-800 mobile interface. This interface is connected via the USB port and offers LTE/UMTS/GSM mobile network access. A SIM card from your provider needs to be inserted and the LOYTEC device is ready on the mobile network. A **Mobile** tab has been added to the port configuration interface for configuring the LTE-800. Simply enable Mobile Network, enter your APN data and select which protocols shall be run on LTE.

New system registers offer mobile communication statistics such as Bytes transferred or SMS sent. The VPN client is also ready to be used on the LTE mobile network.

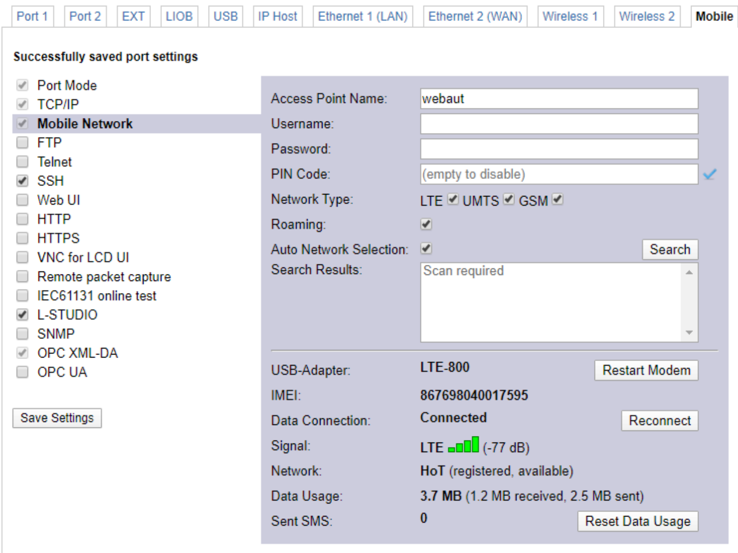


Figure 16: LTE-800 mobile configuration

Internet Connection Sharing

Combined with an LTE-800 mobile interface a LOYTEC device can act as a NAT router to share the mobile Internet connection with other devices on the LAN. For doing so, the **Internet connection sharing** feature can be enabled on the **IP Host** tab, where the default router interface is selected. Other devices on the LAN need to specify the IP address of the LOYTEC device offering connection sharing as their default gateway. This way, local devices can use NTP, VPN client or other Internet services.

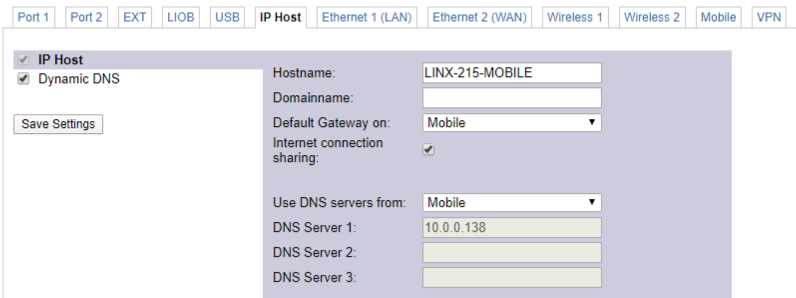


Figure 17: Internet connection sharing

Dynamic DNS

LOYTEC devices can now make use of a dynamic DNS service to register a public DNS name. This makes the device reachable over a public IP address that can change over time, for instance an LTE-800 mobile interface using a public IP address assigned by the mobile carrier. A number of dynamic DNS providers are preconfigured and can be selected on the **IP Host** tab of the port configuration as shown in Figure 18.

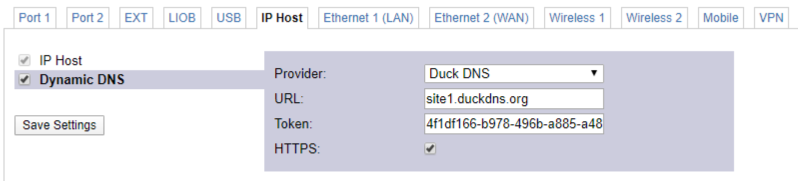


Figure 18: Dynamic DNS Settings

Secure Building Automation Protocols using VPN

This firmware version enhances flexibility and control over which building automation protocols are directly available on the VPN. A separate **VPN** tab has been added to the port configuration that allows configuring IP-based control protocols to be running directly on the VPN client. This effectively secures otherwise unsecured automation protocols such as BACnet/IP, Modbus TCP, KNXnet/IP or CEA-852. When running on the VPN interface, the protocols are assigned the VPN's IP address and as a protocol node, the LOYTEC device is also reachable over multi-NAT access networks, such as LTE.

For example, simply set up the CEA-852 configuration server on the VPN interface and add all other CEA-852 clients on the same VPN. The same can be done for BACnet/IP. Each node establishes a secure channel to the OpenVPN server hub, which routes the traffic between the communicating peer nodes. No unencrypted traffic will ever be transmitted.

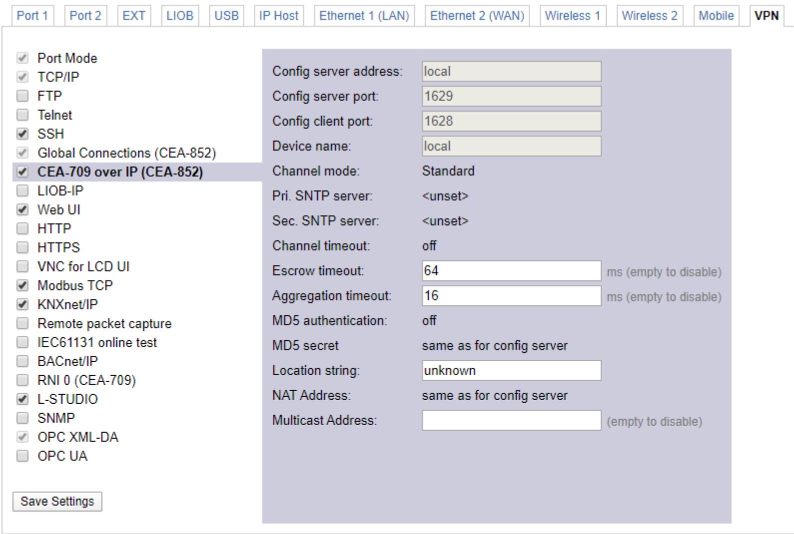


Figure 19: VPN tab on the port configuration interface.

SMS Delivery

The new SMS template message type can be used to configure SMS transmission just like E-Mail templates for E-Mail transmission. SMS can be triggered and contain arbitrary variable text and placeholders. One application is SMS alarm delivery.

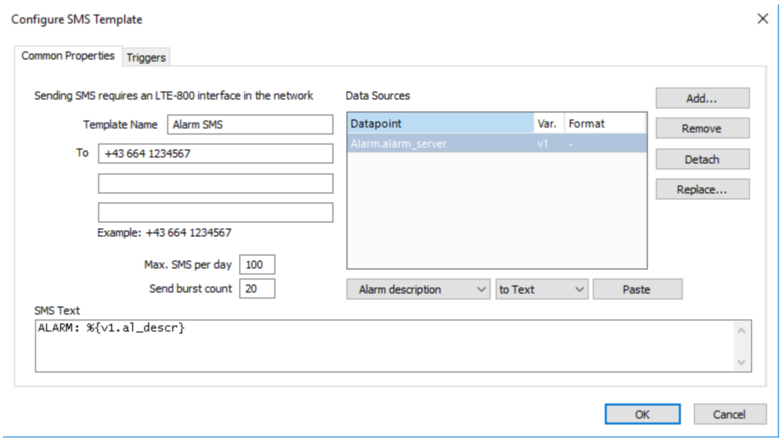


Figure 20: SMS template configuration.

SMS can be sent using a locally attached LTE-800 mobile interface or over the network using another LOYTEC device acting as an SMS proxy for its LTE-800 mobile interface. SMS proxy mode can be configured in the new SMS configuration menu on the Web UI. As a result, only one LTE-800 is required to offer SMS service for an entire local network.

Node-RED™ Integration

LOYTEC devices that support the scripting feature now also natively integrate the Node-RED™ run-time. The Web interface provides a configuration menu to open the Node-RED™ editor UI. As a default, the run-time is not executing and needs to be enabled. Once enabled, the run-time automatically starts the configured flows. An example is shown in Figure 21.

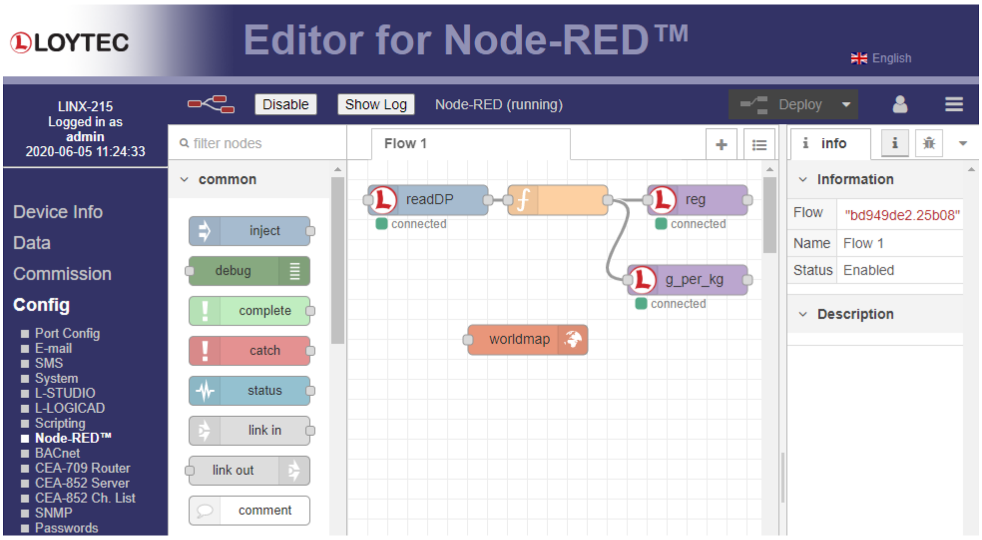


Figure 21: Node-RED™ editor UI on the device.

The user can access data points on the device using the pre-installed 'readDP' and 'writeDP' palette items. Custom palette items can also be installed, like the 'worldmap'. The editor UI is also accessible on a stand-alone Web browser page under the '/nodered' device URL.

Parameter and Default Values

A new *Parameter Value* property has been introduced in the data point configuration that tracks the current parameter value on the device. This is in addition to the *Default Value* property. When uploading parameter values from the device into the configuration, the parameter value property is updated where selected so in the parameter merge dialog. The default value property remains unaffected by a parameter upload. This way it is possible to track current parameter values while still keeping their original default values. When desired, parameter values can be reset to their default values.

Name	Value	Description
Datapoint Path	User Registers.param1	Path to the data point in the hierarchy
Datapoint Type	Double	Class type of the data point
Default Value	☑ 10	Default value when starting up
Parameter	☑	Make available as a parameter
Parameter Value	21	Effective parameter value
Persistent	☑	Make the data point value persistent over power-on resets

Figure 22: The new Parameter Value property.

New universal IN/OUT Analog/Digital L-IOB Terminal Type

With the introduction of the LIOB-110/LIOB-590 models, a new L-IOB I/O terminal hardware type has been introduced: a universally configurable IN/OUT Analog/Digital terminal. The signal type of this terminal determines whether it is an input (measure resistance, current, voltage) or an output (drive 0-10V voltage output). Within its signal type class, the known signal interpretations can be configured (e.g. PT1000, linear, translation table).

IPv6

LOYTEC devices now support IPv6 using stateless address autoconfiguration (SLAAC) or having a configured, fixed IPv6 address. The IPv6 feature is available on all Ethernet and WLAN ports. With SLAAC no further configuration (except the required IPv6 router equipment) is required. The static IPv6 address can be configured on the TCP/IP settings on the port configuration.

Protocols that support IPv6 are the Web interface, SSH, HTTPS, NTP and BACnet/IPv6. Additional IPv6 statistics have been added to the IP statistics pages for troubleshooting.

BACnet Dynamic Object Creation and Event Enrollment

New BACnet protocol features have been added to LOYTEC devices. First, dynamic object creation is now supported for Trend_Log, Scheduler, Calendar, Notification_Class objects. This means that a BACnet OWS can dynamically create and delete those objects during run-time. No reserved BACnet objects are required in the data point configuration.

Second, algorithmic reporting has been implemented in the Event_Enrollment object. This object can be created and configured by a BACnet OWS to dynamically add and remove alarm conditions on any BACnet object in the device.

In combination with IPv6 support, the BACnet protocol can be configured to run on the BACnet/IPv6 data link. Simply choose IPv6 in the BACnet/IP protocol configuration.

4.7 New in L-INX/L-GATE 7.0.0

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

Support two LMPBUS-804

Up to two LMPBUS-804 interfaces can now be connected to the built-in USB ports of the LOYTEC device. This increases the maximum number for supported MP-Bus channels from 4 to 8. Note, that no external USB hubs are supported. The LMPBUS-804 interfaces need to be directly attached to the two built-in USB ports.

Alarming

The data point alarming brings two new features for alarm messages: First, the new placeholders %{bacName}, %{bacDescr} have been added. These expand to the native BACnet server object name and description. Since these may be updated by an OWS at run-time, alarm messages will now reflect those updates when using the new placeholders.

Another change to alarmed data points are new property relation data points for alarm message texts: msgNormal, msgOffnormal, msgHigh, msgLow, and msgFault. The content of these property data point overwrite the pre-configured alarm messages and can be changed at run-time. This allows easy configuration of alarm messages by linking to common string data points that are parameters. For example, all temperature alarms may lnk their msgHigh property relation to the string parameter msgTempHigh configured to a local text such as “Temperature %{name} exceeds %{hi}”.

VPN

LOYTEC devices support joining a virtual private network (VPN). This feature is based on the widely-used and open-protocol OpenVPN technology. An OpenVPN configuration file (.ovpn) can be installed on the Web interface and makes the LOYTEC device a VPN client and dial into the OpenVPN server defined by that file. Any standard OpenVPN configuration file can be used, which is auto-login, i.e. does not require entering a password when connecting. After having registered, the LOYTEC device can be reached via its VPN address.

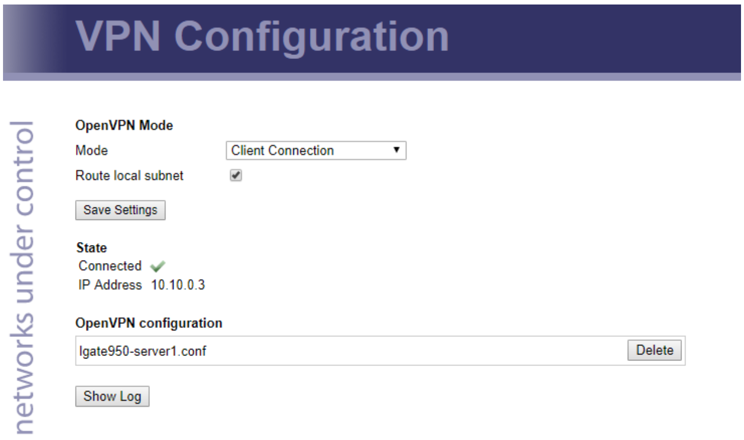


Figure 23: VPN client configuration on the Web interface

Setting up a VPN client on the LOYTEC device may solve NAT router issues, because no port forwarding rules need to be configured. The device dials out to the OpenVPN server running on a public IP and establishes the VPN channel. This VPN channel provides a secure connection for building automation protocols, such as BACnet/IP, Modbus TCP or CEA-852. Being part of a VPN the LOYTEC device is also reachable over multi-NAT access networks, such as LTE.

An alternative method is to enable simple server mode on the LOYTEC device. In this mode, the device provides an OpenVPN server and allows downloading a client configuration file from the Web interface. This file can be installed on any OpenVPN client and allows that client connect to the LOYTEC device over the secure VPN channel. Only one client may connect at a time.

Data Point Web UI

The LOYTEC device is now tracking information on the source of a written value for each data point. This information is shown on the data point details Web UI next to the modification timestamp and can be used for troubleshooting, for example, whether a value was modified over the Web UI or is written by a local connection.

Timestamp	2019-03-27 16:21:43+00:00 written by Web UI
State	normal (0x98000000)
Status description	—
Flags	DEFAULT_VALUE OPC

Figure 24: Write source info on the data point Web interface

Make protocol logs more verbose

LOYTEC devices have been improved to decode protocol logs of its supported technologies to be displayed in a more verbose manner. This makes it easier for Modbus, M-Bus, MP-Bus, SMI, DALI, EnOcean to analyze communication problems with other third-party devices. Simply click the Protocol Analyzer link on the statistics Web page of the respective protocol.

EnOcean over L-STAT

L-STAT devices with EnOcean capability can now be used by LOYTEC devices as remote EnOcean antennas like a LENO-800 interface. This EnOcean over Modbus feature expands the air coverage of EnOcean in a multi-room setup. An EnOcean repeater setup that is cumbersome and difficult to troubleshoot is no longer needed. Simply add EnOcean L-STATs to extend the wireless reach of the LOYTEC device.

BACnet for Japan

This software release includes some minor changes to improve BACnet interoperability in Japan. First, a new client mapping mode was added: COV unsolicited + poll. In this mode the client map not only accepts updates via unsolicited broadcast messages but also actively polls the remote devices. Second, any kind of UnconfirmedEventNotification broadcast (event or alarm) can be used to receive value updates. Third, also status flags of client mappings are updated by event/COV notifications that include status flags.

Support Custom Serial Port in JavaScript

A new API has been added that allows using the serial port on a LOYTEC device in JavaScript. This feature can be used to implement custom serial protocols. The port Web interface offers a choice to select such a custom serial implementation based on meta data provided by the JavaScript module. An example for such custom protocol support is DMX, which is distributed as an add-on script resource.

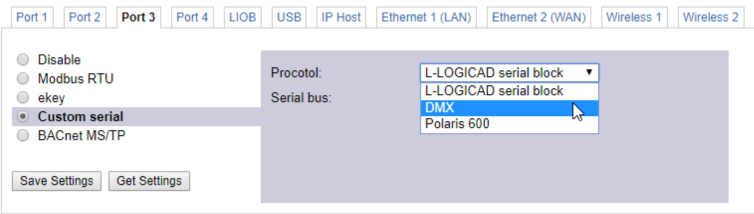


Figure 25: New Web interface to select custom serial protocols.

Other scripting features added to this release are defining debug filter keywords on the Web interface, enabling and disabling scripts, and a new system API to allow firewall ports on the LOYTEC device.

4.8 New in L-INX/L-GATE 6.4.0

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

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.

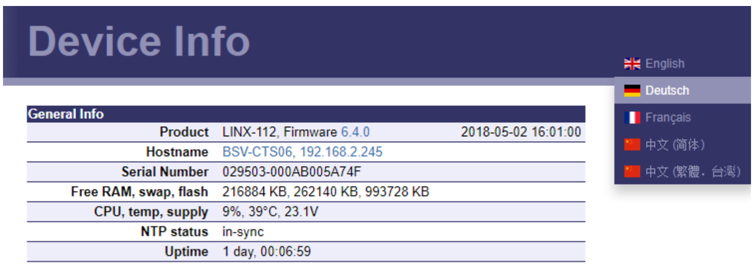


Figure 26: Language selection on the Web interface

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 27: 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.

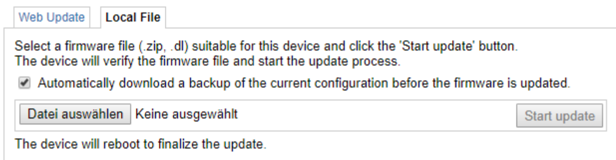


Figure 28: Backup before Upgrade on the Web interface.

Multiple M-Bus Ports

LOYTEC devices with multiple EXT ports now support operating an LMBUS-20/80 interface on each port in parallel. This way the total number of M-Bus devices managed by the LOYTEC device can be increased by using several LMBUS-20/80 interfaces. The commission Web interface supports EXT port assignment and moving M-Bus devices from one EXT port to another.

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.

Support Custom Protocols and IoT by Scripting

New models of programmable L-INX and L-GATE devices now include a JavaSript-based scripting engine. This engine allows users to implement their own protocol support for the IoT world using RESTful APIs, JSON or Web services. The LOYTEC data point server allows integrating data points into the scripting language using the dpal-js API. The script modules can be embedded into and deployed along with the data point configuration.

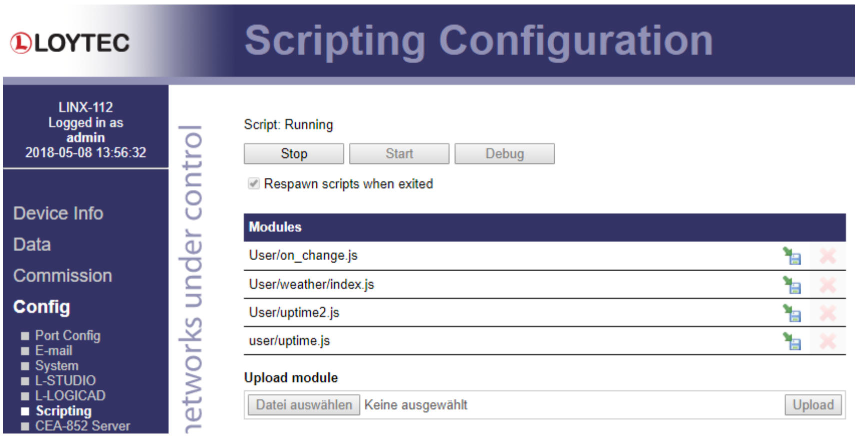


Figure 29: Web interface for scripting engine

The Web interface of the device offers an overview of installed script modules and allows starting scripts in debug mode. Use the Google Chrome inspector to debug JavaScript on the device. For more information read the new Scripting Chapter in the LINX Configurator User Manual [2].

4.9 New in L-INX/L-GATE 6.3.0

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

KNX

The KNX implementation has been reworked. The new version lowers average CPU load and increases performance.

4.10 New in L-INX/L-GATE 6.2.0

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

New Models

The L-INX automation server family has been extended by two new programmable all-rounder models. The new LINX-215 combines the functionality of all LINX-11x, 21x. It provides both router and RNI functionality, which can be configured as needed. The LINX-153 as the larger sibling combines the functionality of the bigger L-INX models LINX-12x, 15x, 22x and also provides a configurable router/RNI. The new LINX-154 model has been designed to accommodate a maximum number of Modbus RTU and/or BACnet MS/TP devices on its four RS-485 ports.

L-STUDIO 3.0 with 61131 Run-Time

New L-INX and L-IOB controller models are now embedded into the L-STUDIO workflow using a 61131 program run-time environment. This new environment combines both advantages, the well-known 61131 programming workflow and the powerful mechanisms of L-STUDIO for mass-engineering LOYTEC controllers. Support for the previously used logiCAD run-time and programming tool is also continued for existing products.

LMPBUS-804

The LMPBUS-804 interface is supported. This is a four-channel MP-Bus interface connected to the USB port of the LOYTEC device. The PPX addressing mode is now also supported for MP-Bus as well as an MP-Bus scan engine. For more information on MP-Bus read the respective Chapters in the Device User Manual [1] and the LINX Configurator User Manual [2].

LCD Interface

The user interface on the LCD display has been extended by a firmware upgrade menu. This menu allows installing a new firmware image from an attached USB memory stick. This is beneficial for WLAN-only devices. When plugging in a USB memory stick, a menu pops up (Figure 30) on the LCD interface that shows selected quick options, including firmware upgrade and backup.

Figure 30: LCD pop-up menu for USB storage

BACnet Features

A new BACnet client mapping type has been added: The COV unsolicited type. This new read mapping type, a client mapping will accept broadcast COV updates without subscription.

A new type of BACnet favorites has been added, which offer BACnet-related options such as adding BACnet properties. When linking a BACnet favorite to a BACnet server object, the respective BACnet property data points are added and linked to the link target.

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.

Web UI

The data point details page on the Web UI provides write usage information. This information can now be used to determine by which objects a certain data point is being written to. The Web UI design has also been reworked according to the latest security standards, now suggesting usage of strong passwords.

4.11 New in L-INX/L-GATE 6.1.0

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

LSMI-804

The LSMI-804 interface is supported. This is a four-channel SMI interface connected to the USB port of the LOYTEC device. It also contains four relays for SMI channel power-on functionality. This saves energy while the SMI bus is idle. For more information on SMI read the respective Chapters in the Device User Manual [1] and the LINX Configurator User Manual [2].

Selective Backup and Restore

The backup and restore interface on the Web interface has been extended by content options. It is now possible to decide whether a created backup shall contains passwords, IP settings or historical data (trend logs, alarm logs). Also when restoring a backup archive it can be selected whether password and IP settings shall be accepted from the backup or not. This makes it easier to replicate devices without scarifying the IP configuration and password settings. An example is shown in Figure 31.

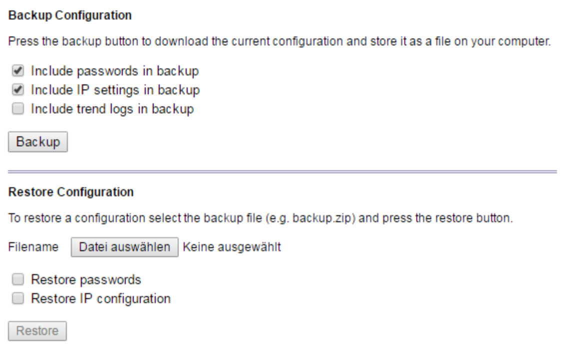


Figure 31: Backup and restore options on the Web UI.

L-STAT Configuration Backup

The Modbus commission Web UI has been extended to better support L-STAT devices. Now it is possible to upload one or more L-STAT backup files and save them on disk. Those L-STAT backup files can also be restored to L-STAT devices. The regular device backup now includes all L-STAT device backups as well.

Advanced WLAN Mesh Configuration

The WLAN Mesh configuration has been enhanced by a graphical floorplan editor as well as an online monitor of inter-link communication quality. This tool allows not only easier setup of a Mesh network but also simple troubleshooting by identifying radio bottleneck between Mesh points (see Figure 32).

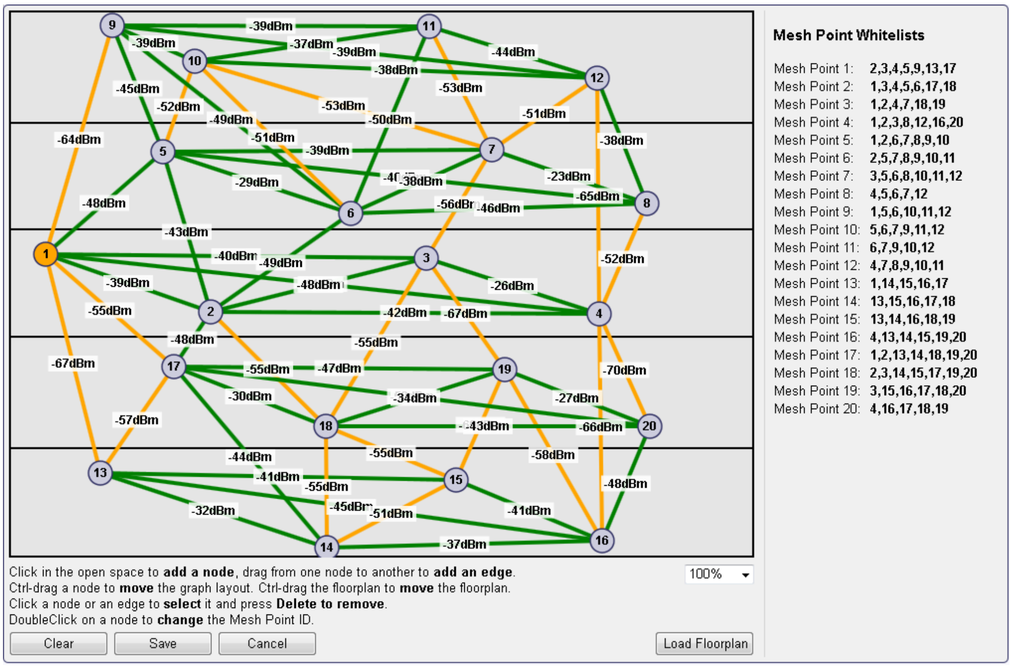


Figure 32: Mesh floorplan and online link quality monitor

Flexible Column Layout in Configurator

The Configurator now supports a flexible column layout in the data point list. It is possible to modify the column arrangement and add/remove columns as needed. This provides for better overview in situations where the default column layout misses important information. The new **Configure Columns** dialog makes this possible.

Incremental Data Point Scan

The data point scanning engine of the Configurator has been extended to mark data points already used on the device and data points found in new scans. The last two columns **Used on Device** and **Last Scan** of Figure 33 show an example and can be used to sort the list. This way the data point configuration can be easily adapted to incremental changes of the scanned devices.

Datapoint Name	No.	Dire...	Remote NV	Type	Remote Device	Func. Block	Used...	Last Scan
nvo00temp	1	In	nvo00temp	SNVT_temp	tn50	Ctrl	✓	Already scanned
nvi01temp	2	Out	nvi01temp	SNVT_temp	tn50	Ctrl	✓	Already scanned
nvo02lux	3	In	nvo02lux	SNVT_lux	tn50	Ctrl	✓	Already scanned
nvi03lux	4	Out	nvi03lux	SNVT_lux	tn50	Ctrl	✓	Already scanned
nvo04lev_percent	5	In	nvo04lev_percent	SNVT_lev_percent	tn50	Ctrl	✓	Already scanned
nvi05lev_percent	6	Out	nvi05lev_percent	SNVT_lev_percent	tn50	Ctrl		Already scanned
nvo06temp_f	7	In	nvo06temp_f	SNVT_temp_f	tn50	Ctrl		Already scanned
nvi07temp_f	8	Out	nvi07temp_f	SNVT_temp_f	tn50	Ctrl		Already scanned
nvo08switch	9	In	nvo08switch	SNVT_switch	tn50	Ctrl		Already scanned
nvi09switch	10	Out	nvi09switch	SNVT_switch	tn50	Ctrl		New
nvo10motor_state	11	In	nvo10motor_state	SNVT_motor_state	tn50	Ctrl		New
nvi11motor_state	12	Out	nvi11motor_state	SNVT_motor_state	tn50	Ctrl		New

Figure 33: Example of an incremental data point scan

LCD Interface

The user interface on the LCD display has been localized for the Chinese simplified and traditional language sets. The language can be selected from the main page and is switched immediately without a device reboot.

Another feature on the LCD display is the option to rotate the display 180 degrees. This is a useful setting, if the device is mounted upside down.

EnOcean VLD Profile Support

EnOcean devices that require variable-length data (VLD) profiles are now fully supported. The respective device templates are provided by LOYTEC. In addition to new profiles, the teach-in process on the Web interface has been improved by dialog wizards that guide through bi-directional teach-in and assignment of transmission IDs.

4.12 New in L-INX/L-GATE 6.0.0

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

New User Manual Structure

The L-INX/L-GATE User Manual has been split up into three parts: The L-INX/L-GATE User Manual, which now covers the specific functions of the L-INX and L-GATE 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.

New Models and Combined Firmware

The new LROC-400 room controller models are now supported by the device firmware and in the LINX Configurator. The different device firmware images for LROC-10x, LIOB-AIR, and LROC-400 have been integrated in one image for all L-ROC, L-INX, LIOB-AIR and L-GATE models.

SMI

A new protocol is now supported: SMI for controlling sunblinds over the Standardized Motor Interface. All LOYTEC devices with an EXT port can now be extended by the L-SMI interface and connect to an SMI bus. The LINX Configurator provides SMI device templates, which can be commissioned on the device Web interface. The Web interface supports manual address assignment, scanning for SMI devices and calibration. For more information on SMI read the respective Chapters in the Device User Manual [1] and the LINX Configurator User Manual [2].

Flexible CSV Import/Export

The entire CSV import/export engine of the LINX Configurator has been revisited. Previously special export options with fixed columns for CEA-709, Modbus, etc. have been replaced by a general CSV engine that is able to configure columns for any set of data point properties. Default property sets have been added, which can be modified by the user and saved for later use. The new CSV import/export allows modifying existing data point properties by batch edit in Excel or creating new data points. The property sets can be viewed and modifed in a comfortable export editor (see Figure 34). The new engine also integrates CSV data point templates. Learn more about this flexible import/export mechanism in the LINX Configurator User Manual [2].

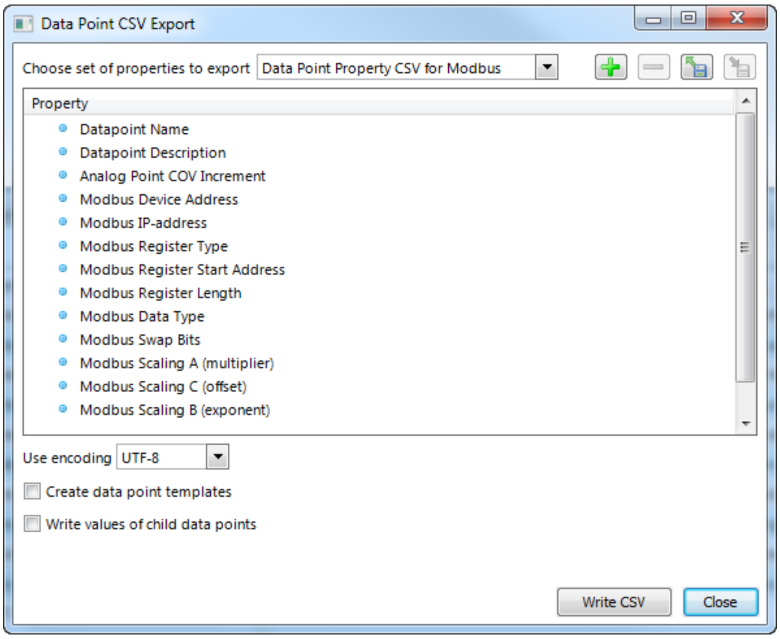


Figure 34: CSV export dialog with configurable columns.

Override Function for Data Points

The data point model in LOYTEC devices has been extended with a manual override function. On the Web interface and on the LCD display data point values can be overridden to manual values. If an override value is set, the running control logic no longer affects the data point value, neither does network communication. The override value is in effect until it is removed again by the user.

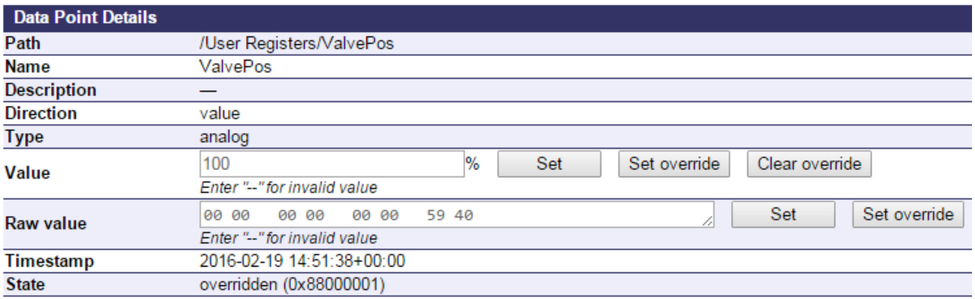


Figure 35: Overriding a data point on the Web interface.

WLAN Mesh Configuration

The Mesh Point mode has been extended by a whitelist function. This allows configuration of a Mesh network with up to 32 nodes. The whitelist contains all mesh point IDs that may contact each other. In order to make configuration of the mesh network easier, the Quick Wireless Setup has been added, which allows a first mesh setup in only a few steps. For optimizing the whitelist the Web interface offers a graphical editor, which makes changes quick and simple. On device models with an LCD display the wireless setup can also be completed using the jog dial. For more information on how to set up a Mesh network please refer to the respective Sections of the LOYTEC Device User Manual [1].

Alarm Messages

The length of alarm messages has been extended to 250. This increased length comes in combination with a new %{path} variable placeholder that can identify the data point path in alarm messages. This is beneficial for mass-engineering alarm conditions on data points that have the same name but are located in different path locations. Alarm logs have also been updated to support the new maximum legnth. BACnet now supports the Event Message Texts property of an alarmed object, which allows retrieving the messages also after a reboot of an alarm client. And analog alarm conditions have been extended to specify a high limit and a low limit alarm message.

Trend Logs

The generic trend logs have been extended to support recording string values. These trends can be operated as polled, COV or triggered. These trend logs can be beneficial to record arbitrary messages The string recording is currently limited to generic trend logs only.

New E-Mail Placeholders

E-Mail configuration has become even more flexible by adding new variable placeholders. The variable placeholders can be augmented by name, description and path specifiers that expand to the respective information in the e-mail. A new date format specifier allows for readable timestamps and the %{last_timestamp} variable expands to the time the last e-mail was transmitted.

BTL Testplan 12 Certified

The BACnet certification of all BACnet models has been updated to comply with protocol revision 12. All new device models are now BTL certified.

4.13 New in L-INX/L-GATE 5.3.0

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

New L-INX and L-GATE Models

The new L-INX and L-GATE models in the small enclosure are now supported. Equipped with dual Ethernet, a built-in firewall and LCD display, these new models serve as a plug-in replacement for the older devices. Existing data point configurations and device backups can be used without modification. Only logiCAD programs need to be re-compiled for the new hardware resource. In addition, the new models also support L-IOB connect, wireless technologies and KNX.

Extended Support for U.S. Units

An extended support for U.S. units has been built into LOYTEC devices. A device can now be configured to run either in the SI or the U.S. unit system by defining SI and U.S. units per data point as shown in Figure 36. When configured for U.S. units, all data points and L-IOB I/Os process values in the respective U.S. units. This includes the Web UI, the OPC server, the parameter file, global connections, and logiCAD programs. Also the Configurator displays values in U.S. units and conversions are done automatically. A device can even be switched from one unit system to the other. In this case all persistent parameters are reset to their default values in the chosen unit system. A system register shows the currently running unit system. This makes it easy to entirely engineer a device in U.S. units or build devices that can be configured for either European or U.S. markets and meet local requirements at the same time. For more information on units please refer to the LINX Configurator User Manual [2].

Figure 36: Configuration of SI and U.S. units on a data point

OPC Client

L-INX and L-GATE devices are extended by their own OPC client technology. Using the OPC client you are able to integrate other LOYTEC devices simply by importing the data point configuration of their OPC servers. This way an L-DALI device can be added to a L-INX configuration in a few steps. The OPC client can also take advantage of the commission later feature by using the Web UI in order to assign OPC server URLs at the time of device commissioning. Even the base path to imported OPC tags can be replaced. This way sub-configurations can be imported to save OPC client tags and be re-assigned later. Learn more about the OPC client function in the LINX Configurator User Manual [2].

Forward Delay in Connections

For applications that require staggered start/stop and randomization, the device implements a configurable forward delay in local and global connections. All receive data point items can be configured with a delay. A received value is written to the data point after the delay expires. The delay can be a fixed time or a time interval, in which the actual delay is randomized. With a resolution of 0.1 seconds the total delay can be up to 100 minutes. Learn more about forward delay in the LINX Configurator User Manual [2].

Auto-Generate and Connect

The auto-connect feature has been extended:

- Support %{folder_descr} as a placeholder in auto-generate templates. This evaluates the description property of the parent folder.

- Generate into existing connections. Epecially when auto-generating the same source data points to different technologies, the same connections are used. This makes it easier to manage auto-generated local connections.

Enhanced Structure Support on the Web UI

The display of data point structures has been improved on the Web UI. The data point listing shows a textual short version of the structured value instead of a hexadecimal Byte buffer. Also CEA-709 structures of NVs without sub-data points are displayed and can be edited.

Project Documentation

A new feature on the device is a Web UI for creating and viewing project documentation on the device. The documentation editor requires admin rights and allows storing files on the device or creating documentation links as URLs. Both items can be viewed by guest users. Examples include storing cabling plans as PDF or adding links to a Web site containing manuals, plans or other useful project documentation. Consult the LOYTEC Device User Manual [1] to learn more about project documentation on the device.

LWEB-802 Application on Device

The L-INX and L-GATE device now come with a pre-installed version of the LWEB-802 application. This enables out-of-the-box L-WEB applications on sites without Internet access. An enhanced Web UI also allows installing a specific version of the LWEB-802 application, which overrides the pre-installed one. As a default, the Internet version is still available. To learn more on how to configure the L-WEB application refer to the LOYTEC Device User Manual [1].

BACnet

All previously extended BACnet features and new features have been BTL-certified in the 5.X firmware series. New features include:

- BACnet object names can be made writeable. With this new option the user can create data point configurations with generic object names and assign location-specific names later in his OWS.
- BACnet simple value objects are now supported. The user can create Large Analog Value, Signed Integer Value, Unsigned Integer Value, Character String Value and Octet String Value objects as needed. Also auto-connect supports these new object types.
- For Trend Log objects, the properties Notify_Type, Event_Enable, Notification_Class can be pre-configured in the data point configuration.

User-defined Serial Protocols in logiCAD

A new logiCAD service block has been introduced, which allows implementation of generic serial protocols. The 'SerialComm' service block can receive and transmit strings from and to a serial port using start frame and end frame delimiting characters. A logical bus number is assigned to the service block, which can be selected as a custom serial protocol on the port configuration Web UI as shown in Figure 37. Please read Section 8.6.10 to learn more about using the 'SerialComm' block.

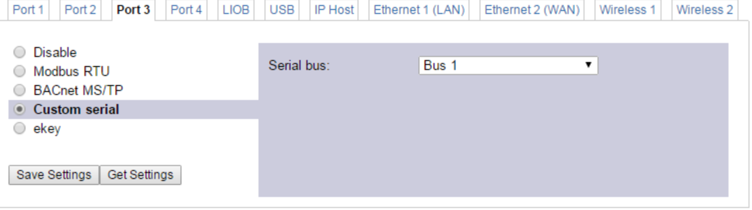


Figure 37: Selecting a custom logiCAD serial protocol.

Data Point Creation from CSV Lists

The Configurator implements a new data point template CSV import feature, which can be used by external tools to generate a list of data points. Each line in this CSV references a data point template file that describes all properties of the data point. The CSV supplies name, description and path of the data point to be created. Additionally, data points can be automatically scheduled and trended. Learn more about data point templates in the LINX Configurator User Manual [2].

KNX Protocol Analyzer

Devices that support the KNX protocol now have a built-in protocol analyzer. It can be accessed through the KNX statistics Web interface and allows starting, stopping and storing protocol logs on any of the KNX interfaces. Protocol logs can be loaded from the device and stored on the PC either in CSV or in XML format. The XML format can be opened in the ETS protocol viewer. Learn more about the KNX protocol analyzer in the KNX Chapter of the LOYTEC Device User Manual [1].

ekey Fingerprint Readers

LOYTEC devices can now be used to build applications with biometric access control (fingerprints). The ekey fingerprint reader devices can be attached to the RS-485 port. Users and fingers can be enrolled and grant or deny access when swiping the finger over a reader. User groups can be implemented and distributed over reader devices. Learn more about ekey fingerprint reader support in the ekey Chapter of the LOYTEC Device User Manual [1].

4.14 New in L-INX/L-GATE 5.1.0

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

Dual-Ethernet with Separate Networks

L-INX and L-GATE models with two Ethernet interfaces can now be configured to work with separate and isolated IP networks. For example, one Ethernet interface can be accessed over HTTPS from a WAN connected to Ethernet 2 while the building network services are running locally on the LAN connected to Ethernet 1. For configuration the device provides separate Ethernet tabs in the port configuration, which allow selecting the offered services on each interface. The example in Figure 38 shows a WAN interface with HTTPS and OPC UA only, while BACnet/IP or CEA-709 over IP are still bound to Ethernet 1 (LAN). Another use case for this feature is operating a gateway between otherwise entirely isolated building networks, e.g. BACnet/IP on Ethernet 1 and KNXnet/IP on Ethernet 2.

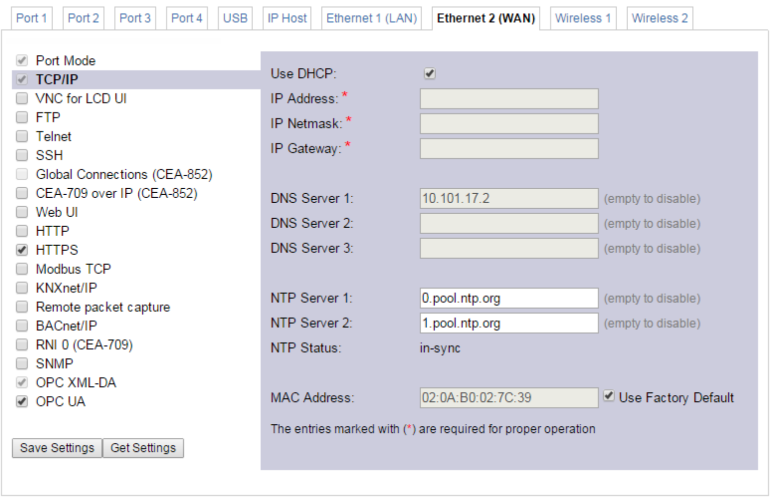


Figure 38: New Ethernet 2 (WAN) tab

WLAN Interface

In combination with the external LWLAN-800 interface, the device provides new interface tabs for wireless IP networks. Similar to the second Ethernet interface, one can choose which protocols are available on the wireless network. The wireless interface can be configured as a WLAN client, access point or mesh node. Using the latter, a wireless mesh network of LOYTEC devices can be built. Please refer to the LOYTEC Device User Manual [1] to learn more about the WLAN interface.

EnOcean

The EnOcean technology is now supported by the L-INX and L-GATE devices. Together with the external LENO-800 interface, EnOcean sensors and actuators can be easily integrated. LENO-800 interfaces are available for European, U.S. and Japanese frequency bands. Data point configurations for the EnOcean technology are built using EnOcean device templates. The actual assignment of physical devices is done later in the teach-in process over the Web UI. For more information on the EnOcean technology please refer to EnOcean Chapter of the LOYTEC Device User Manual [1].

SNMP

For accessing vital operational data in standard IT equipment, L-INX and L-GATE devices offer an SNMP management base (MIB). All system registers and OPC-exposed data points are available in that MIB. The MIB file can be downloaded from the device and imported in the SNMP management tool. Alarms on the device can be exposed as SNMP traps. For more information on configuring and using SNMP with a LOYTEC device please refer to the LOYTEC Device User Manual [1].

Online Commissioning

The Web interface of the device now provides an online commissioning tool for the respective networking technologies. Using this tool, data point configurations can be created based on placeholder devices, which are marked to be commissioned later. The necessary addressing information can be assigned later on the Web interface by scanning for devices online or be entered manually. Device replacement is also possible in the commissioning Web interface without the need to edit devices in the data point configuration. For more information on the commissioning Web UI please refer to the LOYTEC Device User Manual [1].

Favorites

Enhancements for using favorites include engineering units, active/inactive texts, multi-state texts and value persistency for unlinked favorites. A new feature are structured favorites. For example, the structure of a SNVT_switch may now be created as a favorite. The top-level part of a structured favorite can be linked to a structured data point of the same type. Alternatively, the individual member elements of a structured favorite can be linked to other, individual data points. This way, one is able to create a structured favorite, that can be linked directly to a matching SNVT or to separate BACnet objects..

Web Interface

The Web interface of the device offers a number of new features:

- A new device info page provides a quick overview of all relevant operational parameters, such as CPU load, active protocols, time synchronization and many more.

- The trend log configuration on the Web UI now also provides a preview tab, which shows a chart of the trend log data. The trend chart allows zoom, scrolling and hiding specific data curves, as shown in Figure 39.

Figure 39: New trend chart on the Web UI

Scheduler

The scheduler objects have been extended by the following new features:

- Color support in BACnet and generic schedulers allows consistent assignment and display of preset colors in L-WEB, L-VIS and the Configurator scheduler UIs.
- Event auto-prune removes passed events, if the capacity of exception events in a scheduler gets low.
- The scheduler default for LONMARK and generic schedulers is extended by a "silent" mode. In this mode the scheduler becomes inactive as soon as the last event is withdrawn. This mode can be used in event-driven scheduler models.
- Generic schedulers allow specifying an existing value preset as the schedule default. LONMARK and BACnet schedulers try identifying a matching preset name from the schedule default value.

5000 BACnet Client Maps and Dynamic Polling

The number of BACnet client mappings on the L-INX has been increased to 5000. This has become possible with the use of strict on-demand dynamic polling on the device. This means any data point configured for polling (client mappings, external NVs, Modbus, etc.) will start polling only when it is actually used, i.e. displayed on L-WEB, the data point Web interface or used by a trend log. This reduces the required network bandwidth.

1000 Trended Data Points in LINX-12x/15x/22x/LGATE-95x

The bigger L-INX and L-GATE devices now allow a total of 1000 trended data points distributed among the 512 trend logs. This limit can be exploited when trending two or more data points in a generic trend log.

Alarm Server Ack-All Data Point

Alarm servers now provide a special ackAll property data point. When writing TRUE on that data point all currently active alarms on the alarm server are acknowledged.

Format Strings in E-Mails

Data point variables used in e-mail templates can now use format strings to specify their numeric appearance in the e-mail text.

Output NVs with Integrated Feedback

Output network variables (NVs) are used to send updates to remote nodes. In order to poll back the actual value of the remote variable, a feedback data point had to be created for the output NV. Now changing the direction on the NV from output to value, an integrated feedback function is activated without the need for an extra data point. This becomes especially useful in data point templates.

Modbus and M-Bus Templates

Modbus and M-Bus device templates offer some new features that boost productivity:

- Templates can now contain definitions of pollgroups and other type resources used by Modbus data points.
- Templates can now store a folder hierarchy.

4.15 New in L-INX/L-GATE 5.0.0

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

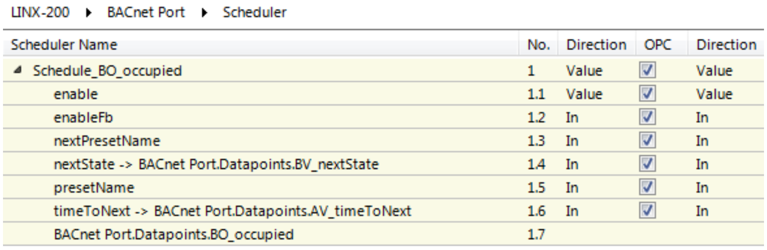
Generic Scheduler

Generic schedulers – like generic trends and alarms – can now be created, that are neither CEA-709 nor BACnet objects. Generic schedulers appear next to the generic alarm folder and are ready-to-use on any device. This is beneficial for creating technology-independent applications. Generic schedulers can write to any technology as well as data point favorites and are the ideal solution, if configured via LWEB-900 only. For more information on creating generic schedulers refer to the LINX Configurator User Manual [2].

Optimum Start for Schedulers

Up to now, optimum start was limited to using a SNVT_tod_event in a CEA-709 scheduler. Now all schedulers (including BACnet and generic schedulers) support timeToNext and nextState data points for implementing optimum start algorithms also for those technologies. Schedulers are extended by property relations, which offer the time to the next state in minutes and the next state in data points. Also, the enable, enableFb (feedback), and presetName information is available as property relations.

The BACnet scheduler object also has custom properties that expose time to next state and next state to BACnet. If standard BACnet objects are required, the property relations can be linked to any matching BACnet server object as shown in Figure 40 (BV_nextState, AV_timeToNext).


LINX-200 ▸ BACnet Port ▸ Scheduler

Scheduler Name	No.	Direction	OPC	Direction
◢ Schedule_BO_occupied	1	Value	☑	Value
enable	1.1	Value	☑	Value
enableFb	1.2	In	☑	In
nextPresetName	1.3	In	☑	In
nextState -> BACnet Port.Datapoints.BV_nextState	1.4	In	☑	In
presetName	1.5	In	☑	In
timeToNext -> BACnet Port.Datapoints.AV_timeToNext	1.6	In	☑	In
BACnet Port.Datapoints.BO_occupied	1.7			

Figure 40: BACnet scheduler with next state data points.

Favorites

Favorites have been vastly extended to be compatible with all uses that were previously only possible for regular data points. Favorites can now be trended, can have an alarm condition (reporting to a generic alarm server), and be scheduled. Historic filters can be applied to favorites. Favorites can also be used in e-mail templates, math objects and connections like any other data point. Furthermore, it is possible to link favorites to property relations and vice versa, e.g. link a favorite directly to a historic filter data point.

Historic Filters

Historic filters have been extended by a generic delta calculation between any of the defined filter items or the current value. This way, it is no longer necessary to create a separate math object to calculate the consumption of the previous month. Also, a definition for “last day of month” has been added to the monthly period.

256 Trend Logs on LINX-10x/11x/20x/21x/LGATE-900

The smaller L-INX and L-GATE devices are now extended from 100 trend logs to 256 trend logs at a total of 256 trended data points. This is beneficial for native BACnet trend logs, which allow only one data point per trend log object. The increase comes at the cost of available log rate, which is reduced from 121,050 to 60,525 records per hour, once more than 100 trend log objects are created. This is, however, still sufficient for 256 energy trends at 1 minute log interval each.

Web Interface

The Web interface of the device offers a number of new features:

- Live update of values in the data point list. This allows monitoring values without repeated pressing of reload. Data point structures can be expanded or collapsed for better overview.
- Breadcrumb navigation has been added to the data point list. This gives faster access to sub-folders.
- 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.
- The trend overview page displays current trend log states and provides controls for easy trend data upload in CSV format.

Data Point Polling

The receive timeout on input and value data points has been generalized. A receive timeout can now be defined on all technologies for input and value data points. Writing updates to those data points from any source (e.g. a global connection) resets the receive timeout.

Background polling can be enabled in the project settings, which allows a slow polling of all data points even if no pollcycle or dynamic polling has been activated on those data points..

OPC UA Server

The OPC server on the devices, which support security, has been extended by an OPC UA server. This supports the OPC UA binary protocol and exposes the same OPC tags as the well-known OPC XML-DA server. In addition OPC UA offers superior security features as well as slimmer data transfers. For more information on the OPC UA server please refer to the LOYTEC Device User Manual [1].

BACnet

All previously extended BACnet features and new features have been BTL-certified in the 5.X firmware series. New features include:

- Intrinsic alarming for the Accumulator object.
- Option to keep OWS settings in BACnet properties also after a new configuration has been downloaded.
- BACnet naming rules can now freely define how data point names are constructed out of scanned BACnet information.

Conversion to Value Data Points

Firmware versions since 4.9.0 support value data points. The default behavior of the Configurator can be controlled in the project settings. This defines whether new value data points or the old "_Read/_Write" data point combinations shall be created. When using templates in L-WEB or L-VIS it is often an all-or-nothing approach, a mixture is not practical.

For making the transition in old projects to value data points, the Configurator now offers a conversion tool. Multi-select old read/write data points and choose the item **Convert to value** from the data point context menu. This converts the selected data points to the new value data points, leaving the IDs, default values and data point usages intact.

Application Objects

Application objects such as math objects, e-mail templates, and alarm logs can now be organized in folders. Copy and paste of application objects between Configurators has been improved. Math objects now allow single constants and single variable assignments, such as "=5" or "=v1". Input variables can be configured to trigger a new calculation or not.

Configurator Usability

The folder tree of the data point manager has been brought to state-of-the-art user concepts such as multi-select, drag-and-drop of folders, moving folders, deleting multiple folders and their contents. A name filter can be applied to quickly find folders in the folder tree.

The property tab has been extended by a property name filter. This makes it easy to find the desired property by typing a sub-string of its name in the filter. For a detailed description on the data point properties refer to the LINX Configurator User Manual [2].

Data point link navigation has been made easy by using a **Go to data point** context menu and speed button everywhere data point references are displayed. A data point usage report dialog shows all references to the selected data point and allows jumping to selected objects.

The new **PLC conflicts** tab shows all PLC write conflicts with other write usage of data points such as math objects, connection receivers, etc., while editing the project. This allows finding problems prior to the configuration download. The conflicts tab also provides easy navigation to data points listed as problematic. For more information refer to Section 8.4.7.

Modbus and M-Bus Templates

Modbus and M-Bus device templates offer some new features that boost productivity:

- Allow setting the device name when storing the template in a file.
- Naming rules for created data points when used on device.
- Configure naming rules for the automatic naming of Modbus devices (e.g. with or without device address).
- Templates include all OPC and PLC settings.
- Imported device templates are also stored in the device configuration. They are now also available after loading a configuration out of the device, not only from the disk file.

5 Quick-Start Guide

This chapter shows step-by-step instructions on how to configure the L-INX for a simple OPC server application with a logiCAD program and using basic I/Os in L-IOB modules. For the L-GATE it gives an example of how to quickly map CEA-709 network variables to BACnet objects in the gateway.

5.1 Hardware Installation

Connect power (12-35 VDC or 12-24 VAC), the CEA-709 and/or MS/TP network, and the Ethernet cable to the ports, which are labeled respectively, as shown in Figure 41. More detailed instructions are shown in Chapter 6.

Important:	*Do not connect terminal PWR Supply + with Earth-ground!*

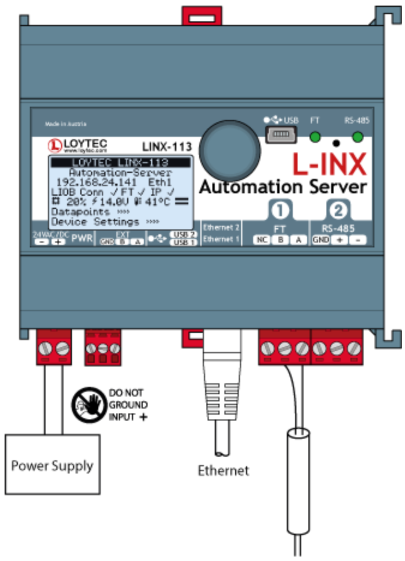


Figure 41: Basic Hardware Installation.

If the L-INX device is connected to a BACnet MS/TP network, the MS/TP network segment must be properly terminated with an LT-04 network terminator connected at each of the two ends of the segment media.

5.2 Configuration of the Device

The device can be configured via LCD display or via the Web interface. To configure the device, the following steps have to be performed:

1. Setup IP configuration (see Sections 5.2.1 and 5.2.2).

2. Setup basic BACnet configuration (see Section 5.2.3).

3. Setup the OPC configuration (see Section 5.3).

Note: *This setup procedure assumes the use of the IP interface.*

5.2.1 IP Configuration via the Web Interface

LOYTEC devices are shipped with DHCP and will acquire an IP address as soon as they are connected to the network. To use a static IP you can use the Web interface to configure the client device. In a Web browser enter the IP address of the device which can be read on the LCD display. Note that your PC must be attached to the same subnet as the device. For devices with a default IP address choose the setup on the LCD display.

To Configure a Static IP

1. Open your Web browser and type in the IP address shown on the LCD display or type in ‘loytec.local’. As a first step you will be asked to enter passwords for the administrator and operator accounts before proceeding. Only strong passwords are accepted.

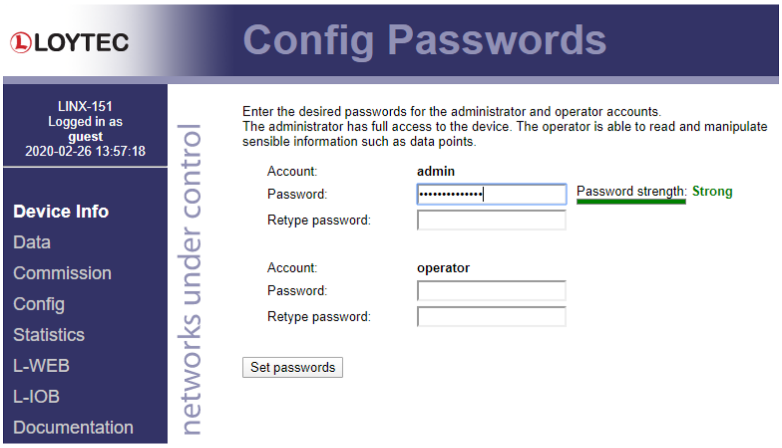


Figure 42: Enter passwords for admin and operator accounts.

2. Then click on the **Config** menu. Click on **Port Config** and change to the tab **Ethernet**. The TCP/IP settings are selected as shown in Figure 43. Enter the IP address, the IP netmask, and IP gateway for this device.

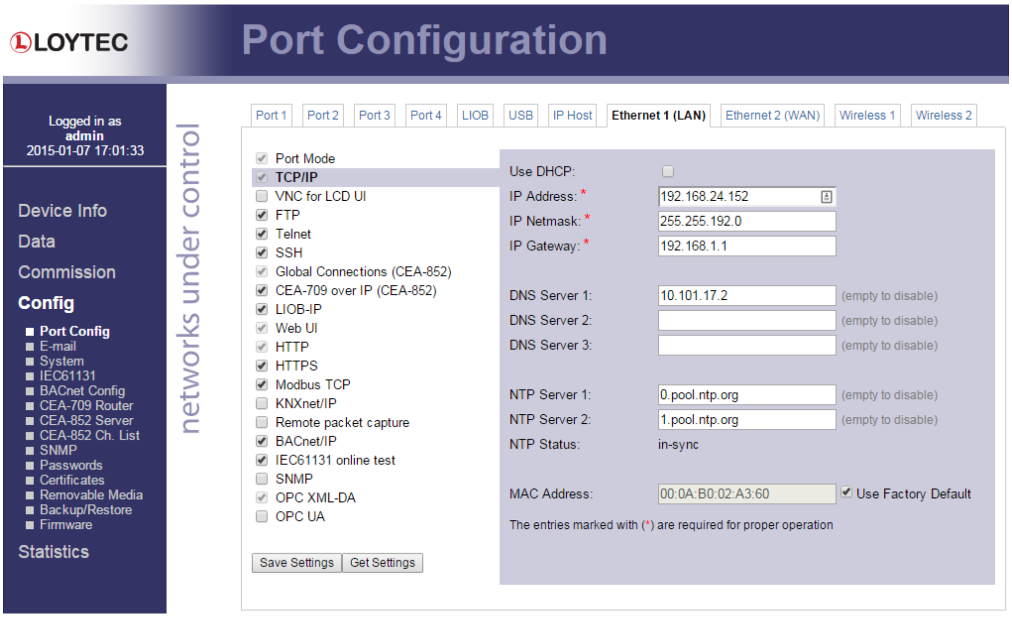


Figure 43: Enter IP address and gateway.

3. Press **Save Settings** and then reset the device by selecting **Reset** in the highlighted text. This changes the IP settings of the device.

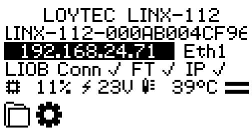
5.2.2 IP Configuration via the LCD Display

Device models with an LCD display can also be configured to their basic settings through jog dial navigation on the LCD UI. 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. Some input fields provide acceleration. This means turning faster changes the value in larger increments.

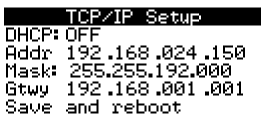
To Set the IP Address on the LCD Display

1. On the LCD main screen set the desired language. Navigate to the language icon, press the button and choose the desired language.

2. Navigate to the IP address on the main screen and press the button.



3. There navigate to the needed input fields, press and change the value. Press again to set the value. Continue to the next field.



4. Finally navigate to **Save and reboot** and press.

5. Acknowledge the reboot and the device reboots with the new IP address.

5.2.3 BACnet Configuration

To configure the BACnet interface, at least the Device ID and the Device Name must be configured (see Figure 44).

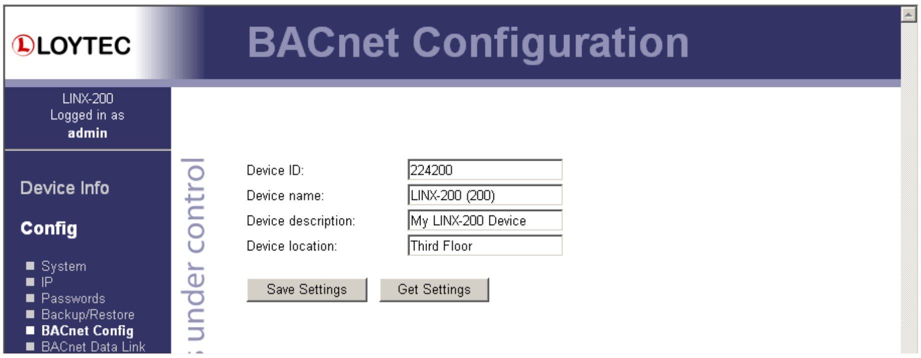


Figure 44: BACnet Device Configuration.

The device ID corresponds to the instance number of the BACnet device object. It must be a unique ID on the BACnet internetwork. Also the Device Name must be a unique name on the BACnet internetwork.

By default the BACnet/IP data link layer is used. If the device shall be used with the BACnet MS/TP data link layer, please refer to the LOYTEC Device User Manual [1] for further information.

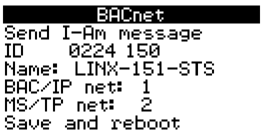
On devices with an LCD display, the BACnet device ID can also be configured over the LCD UI.

To Configure the BACnet Device ID over the LCD Display

1. On the LCD main screen navigate to **Device Settings** »».

2. Then navigate to the menu **BACnet** »».

3. In that menu navigate to the **ID** input for entering the device ID. The field is split into two controls, one for the thousands and one for singles, to simplify entering big numbers.



4. After the device ID has been entered the device name is automatically assembled using that device ID, if no other name has been configured on the Web UI.

5. On a BACnet router navigate to the **BAC/IP Net** menu item and enter the BACnet network ID of the BACnet/IP network. Then choose the appropriate **MS/TP Net** number for each available MS/TP port. To disable the router port, scroll down till **off** appears.

6. To let the changes take effect, the device needs to be rebooted. For doing this now you may select the menu item **Save and reboot**.

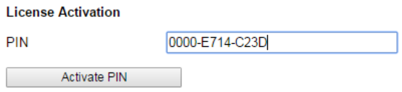
5.2.4 License Activation

On the L-INX devices certain features must be activated by entering a license PIN code on the Web interface or the LCD UI. This license PIN code is entered only once and remains on the device for its lifetime.

To Activate a License on the Web UI

1. Go to the menu **Config → License**.

2. Enter the 12-digit license PIN code and click on **Activate PIN**.



3. The list of activated features now lists the PIN code and activated license.

4. Finally, reboot the device to start the activated feature.

5.2.5 LWEB-900 VPN Enrollment

The **VPN Setup** menu allows configuring the LWEB-900 VPN connection. In the setup menu, enter the 9-digit LWEB-900 project PIN code and optional device PIN code. In order to connect this device to LWEB-900 choose **Register Device** as shown in Figure 45.

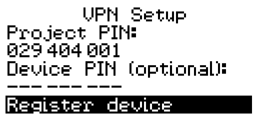


Figure 45: Device VPN enrollment in LWEB-900

5.3 Getting Started with the L-INX Configurator

Before setting up a gateway, a working IEC61131 program or creating an L-WEB visualization, the data points of the L-INX automation server or the L-GATE need to be set up. These can be data points of L-IOB I/Os, network variables, BACnet objects, and other available technologies. Before executing the steps below, install the L-INX Configurator Software from the 'setup.exe'. This file can be downloaded from www.loytec.com.

To Start a Configurator Project

1. Start the L-INX Configurator software by selecting Windows **Start → Programs → LOYTEC LINX Configurator → LOYTEC LINX Configurator**. The application starts up and displays the data point manager screen as shown in Figure 46.

2. When the device is online, connect to the device by clicking on the **Connect to device** speed button as indicated by the red rectangle in Figure 46.

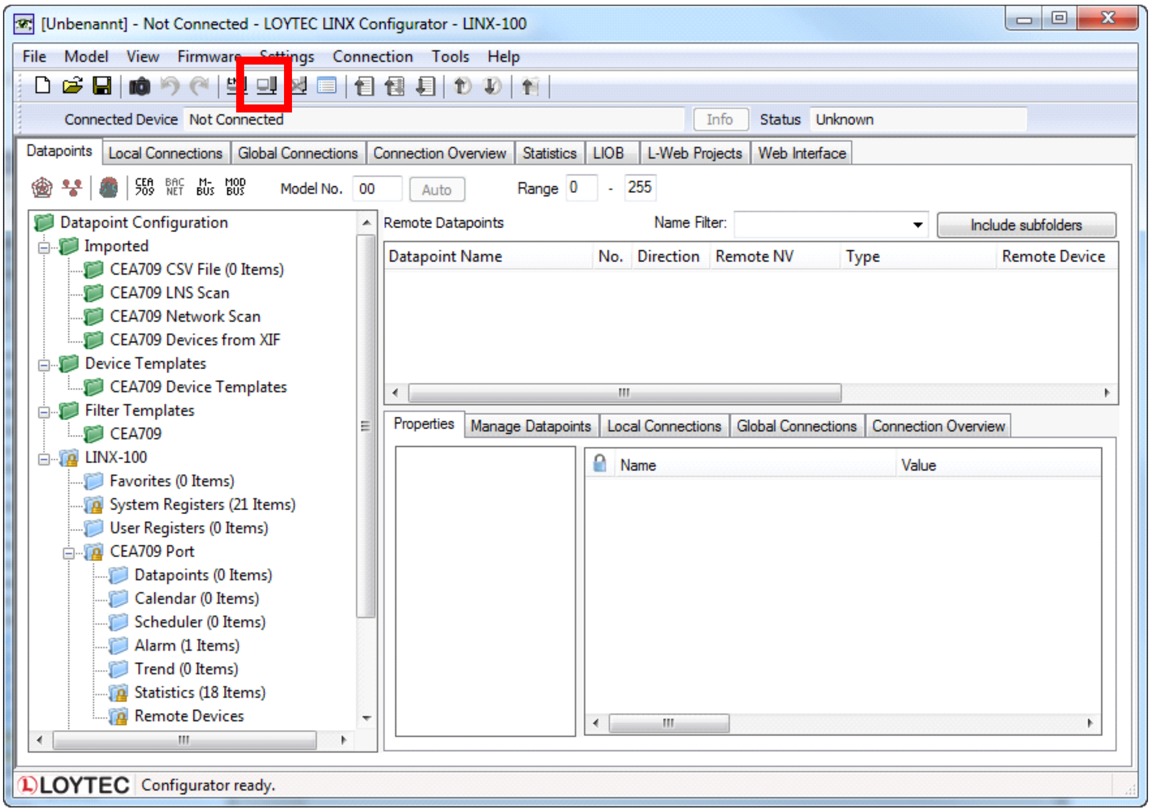


Figure 46: L-INX Configurator main screen.

3. For detailed information on how to create data points out of the network please refer to the LINX Configurator User Manual [2].

5.4 Getting Started with the Gateway

The L-GATE and L-INX devices can be used as a gateway between any of the supported network technologies. This example gets you started with the gateway and shows how to map CEA-709 network variables from an LNS database to BACnet. The installer of the L-INX Configurator has already registered the L-INX Configurator as an LNS plug-in. This quick-start assumes LonMaker TE as the LNS tool.

To Configure a Gateway

1. Open a new LNS database or open an existing LNS database. In the latter case you need to register the L-INX Configurator as an LNS plug-in in that database.

2. Add your LONMARK devices to the LNS database.

3. Add a new device using the device template for the L-GATE (e.g. ‘LOYTEC LGATE-950 FT-10’) or L-INX (e.g. ‘LOYTEC LINX-150 FT-10’) and commission the device.

4. Right-click on the added device template and select **Configure …** This opens the L-INX Configurator as an LNS plug-in.

5. Click on the **Datapoints** tab of the main window.

6. Click on the button  **Scan channel**. This scans in all NVs on all devices connected to the CEA-709 channel of the device.

7. After the scan has completed, the folder **LNS Database Scan** is populated with the found NVs as shown in Figure 47.

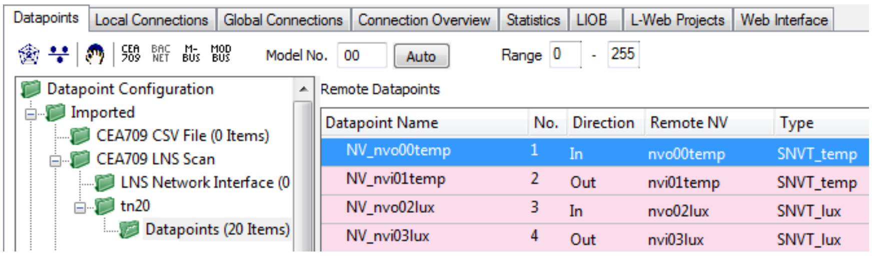


Figure 47: Result of an NV scan in LNS.

8. Select the scanned NVs for use in the gateway and click on the button **Use on Device** in the tool bar.

9. The data points are created as dynamic NVs under the **Datapoints** folder of the **CEA-709 Port** folder.

10. Select the NVs under the port folder, which shall be mapped to BACnet. Click on the speed button **Generate and connect selected** in the tool bar.

11. The generated BACnet objects appear in the **Datapoints** folder under the **BACnet Port** folder as shown in Figure 47. These objects are also automatically connected to the respective NVs.

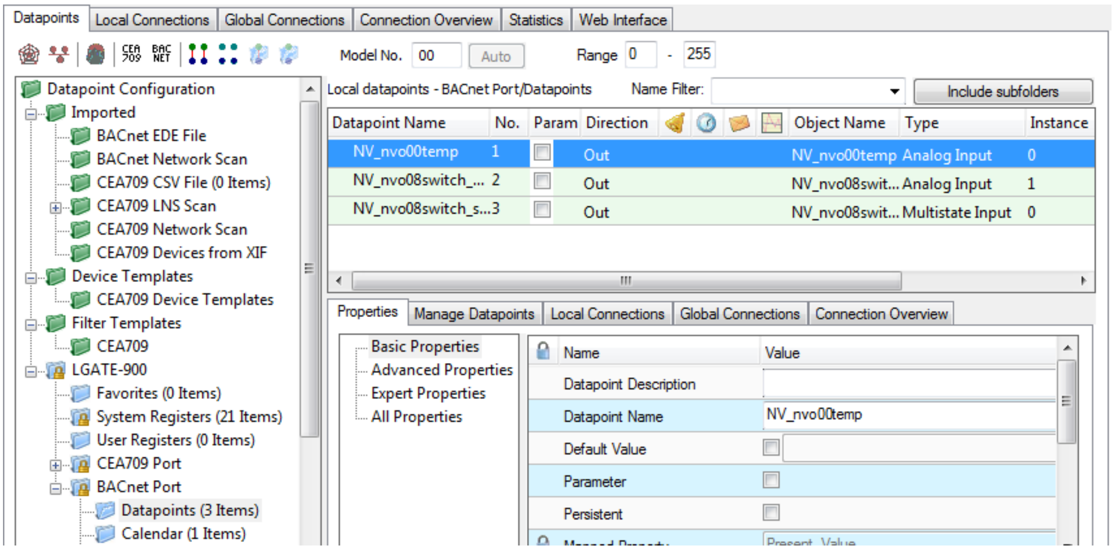


Figure 48: Auto-created BACnet Points in the BACnet Folder

12. Then download the configuration into the device by clicking the **Download Configuration** speed button.

13. After the reboot of the device value changes in the NVs are propagated to the connected BACnet objects and vice versa.

5.5 Configuration of the L-IOB I/O Modules

The L-IOB I/O modules can be attached either directly to the LIOB Connect bus or to the LIOB-FT bus with standard TP/FT-10 wiring rules. Please visit the L-IOB I/O Module User Manual [7] for detailed hardware installation and terminal configuration instructions.

The L-INX Configurator uses a separate tab to configure the L-IOB devices. The L-IOB device configuration can be done off-line and is shown in the following steps.

To Configure L-IOB I/Os

1. Add L-IOB devices on the **LIOB** tab from the supplied L-IOB templates using the **Add Device(s)** button as shown in Figure 49.

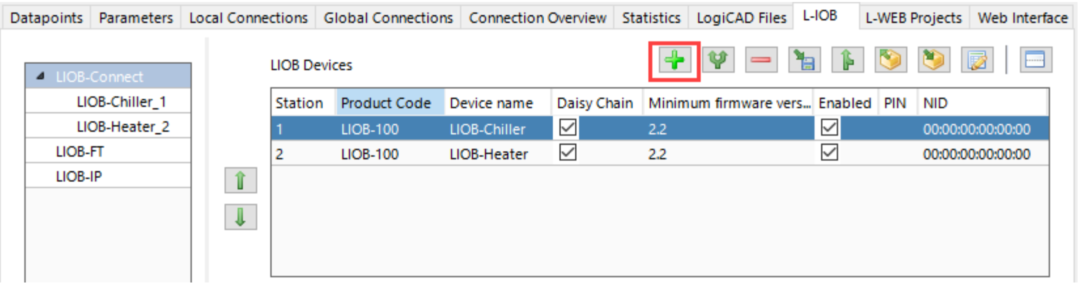


Figure 49: Add L-IOB devices to the LIOB Connect bus.

2. Select a L-IOB device in the tree on the left-hand side and enter names for the terminals by double-clicking into the **Name** column as shown in Figure 50.

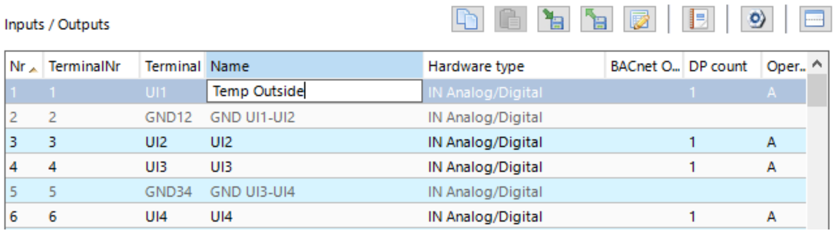


Figure 50: Change L-IOB terminal names for your installation.

3. Select a terminal and change the object parameters to configure this terminal. You can multi-select terminals and change the parameters for all selected terminals as shown in Figure 51.

4. After setting all parameters, click on the **Commit member changes** button to accept the changes.

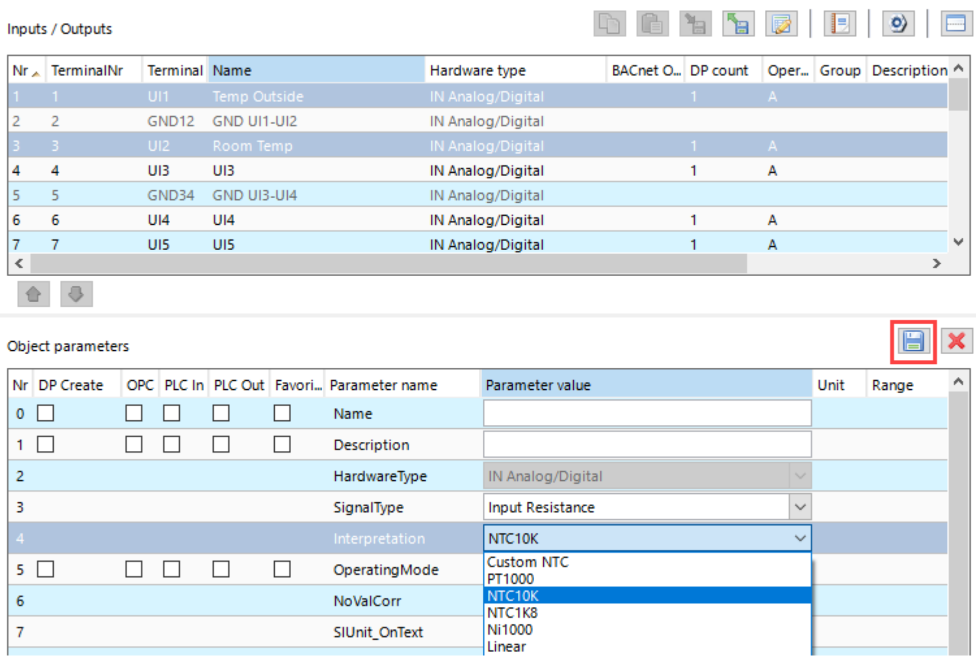


Figure 51: Change L-IOB parameters for the selected terminal(s).

5. On the **Datapoints** tab the data points for the LIOB terminals have been created. These data points can be used, e.g., in the IEC 61131 program. For terminal inputs the data point L1_x_UIy_**Input_Read** will be used to read an input terminal and for terminal outputs the data point L1_x_DOy_**Output_Write** will be used to set an output terminal.

6. After downloading the L-INX configuration into the L-INX device, the L-IOB input and output terminals can be tested with the L-INX Web UI. An example is shown in Figure 52.

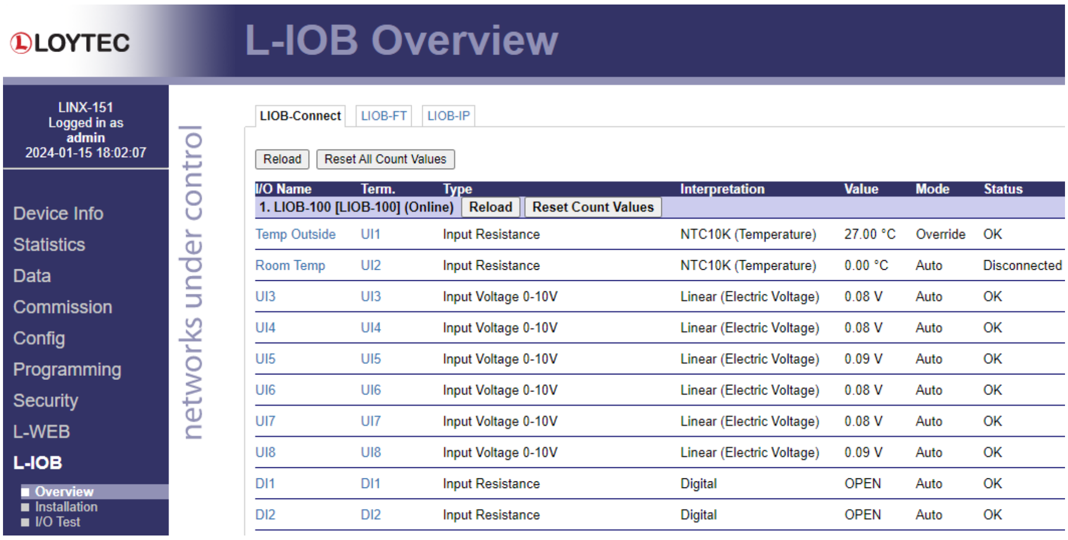


Figure 52: Test L-IOB inputs and outputs on the Web UI.

5.6 Getting started with L-STUDIO

L-STUDIO is the LOYTEC solution for integrated development of PLC programming, data point configuration, visualization and cross-device communication between resources in the runtime. L-STUDIO is used to engineer the entire system, not only single controllers. To fully support integrated cross-cmmunication, the L-STUDIO runtime requires IP-based communication.

For developing IEC61131 programs with L-STUDIO the following components must be installed:

1. L-STUDIO setup package. This package installs the L-STUDIO software, which is needed to design PLC programs for the L-INX device.

2. L-INX Configurator. This software is required to configure the L-INX device to provide the necessary data points to the PLC and integrate the device into the network.

3. L-VIS Configurator. This software is required to create graphics for the CAT (composite automation type). The CAT combines data points, PLC logic, and graphics in one component.

4. L-STUDIO runtime license installed on the LOYTEC controller device. Most L-INX devices come with a pre-installed license (see Section 1.12).

The basic components in an L-STUDIO 61131 solution are:

- 61131 program CAT: This contains the functions blocks, data points and sub-function blocks that implement the PLC logic. Logic in the 61131 program CATs is executed on a cyclic basis.
- 61499 CAT: This composite block instantiates one ore more 61131 program CATs and creates the cyclic trigger signal for those blocks.
- Device CAT: This represents a type for the controller equipment on which 61499 CATs can be instantiated. On the device CAT, L-IOB I/Os can be links to favorites that have been generated out of the 61131 CATs.
- Device Resource: This is the physical representation of the controller equipment.

This quick-start guide walks you through the basic steps to create a first simple PLC program in L-STUDIO 61131. For a thorough discussion of the components needed in an L-STUDIO 61131 application the LTRAIN-LSTUDIO training course must be attended. The training material goes into more detail on how to use LOYTEC library components and instantiate CATs for visualization.

To Start an L-STUDIO Project with a 61131 program

1. After installing the necessary software components start the L-STUDIO application from the Windows start menu.

2. Create a new solution in menu **File → New → Solution…** and enter a name as shown in Figure 53.

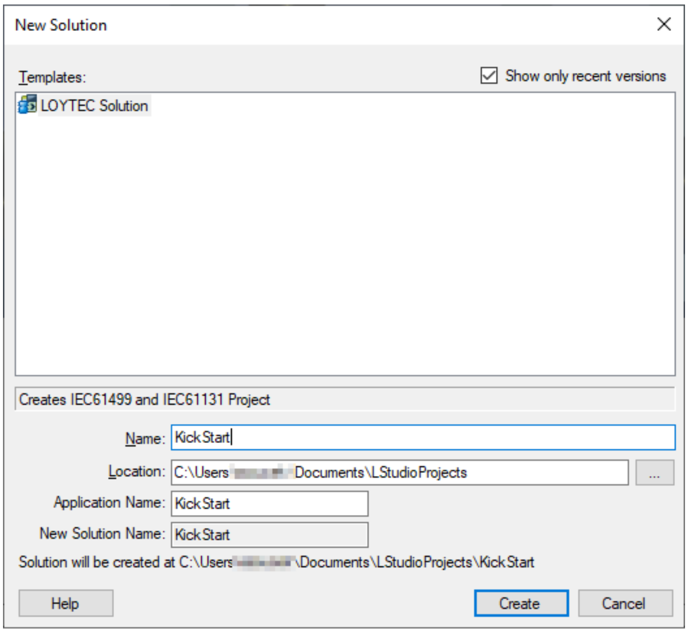


Figure 53: Create a new L-STUDIO solution

3. This create a blank solution named ‘KickStart’ as shown in Figure 54

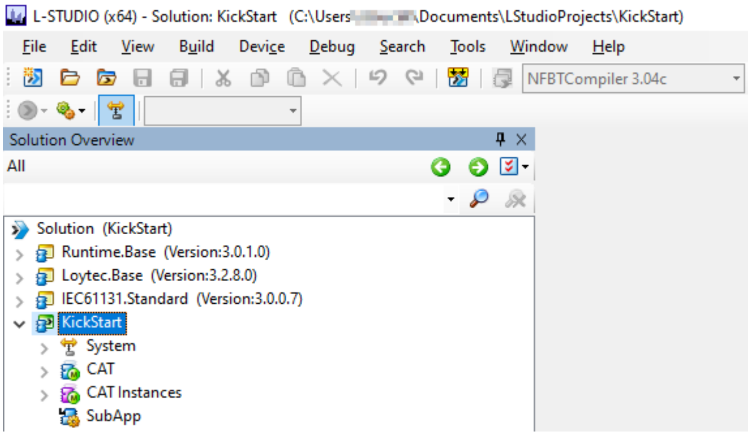


Figure 54: Blank L-STUDIO solution.

4. Create a 61131 program CAT: In the ‘KickStart’ solution tree, select **CAT → Application**. Then right-click and choose **New Item**. Select IEC61131 CAT, enter a name, and select **Program** as implementation and **Continuous Function Chart**. Then click **Finish** as shown in Figure 55.

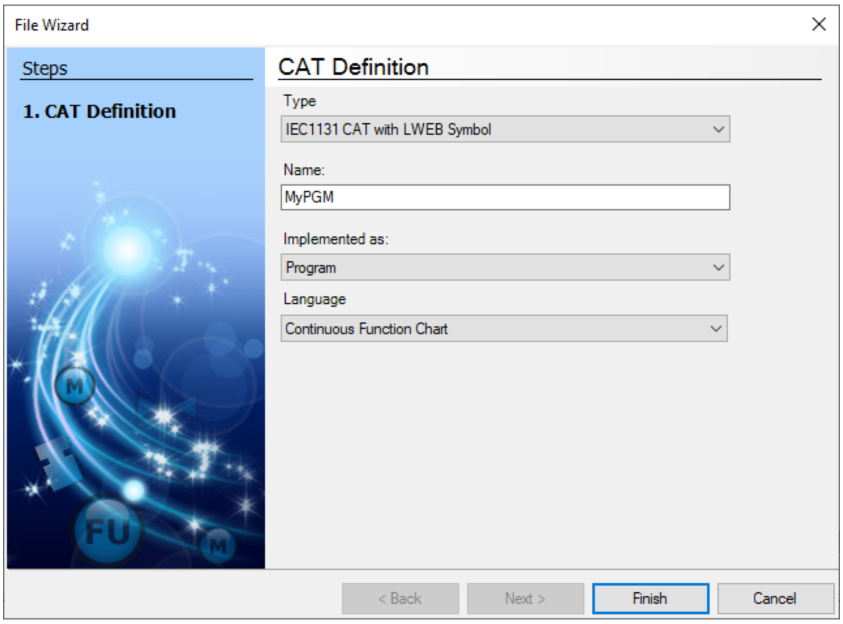


Figure 55: Create a 61131 program CAT.

5. Open 'MyPGM' and go to the **Configurator** tab. This opens the Configurator for this IEC 61131 program. Create data points as needed, e.g., reg1, reg2, reg_sum. Set **PLC in** on reg1 and reg2 and set **PLC out** on reg_sum as shown in Figure 56. Click on **Save** in the toolbar.

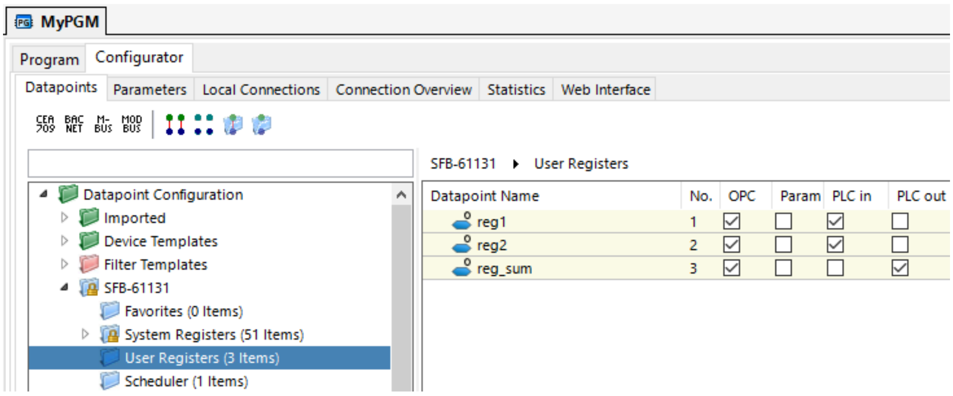


Figure 56: Setting PLC in and out on data points in the Configurator

6. Change to the **Program** tab. The created PLC data points show up in the VAR list as shown in Figure 57.

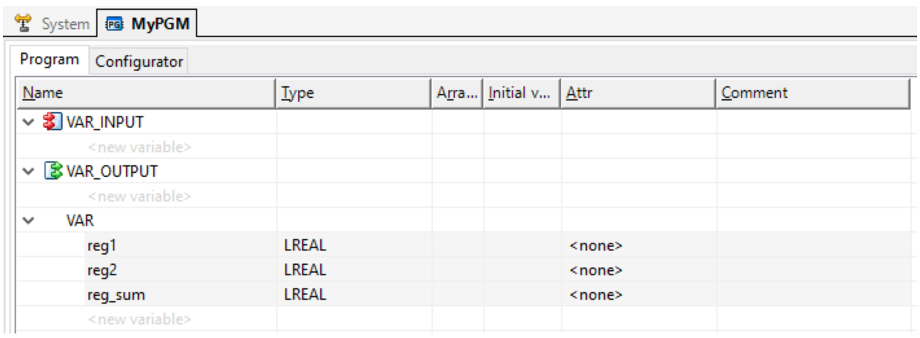


Figure 57: VAR list in the program CAT.

7. In the drawing area below create an 'ADD' function block by Ctrl+W and typing 'ADD'. Right-click on IN1 and select **Add Internal Var**. Type 'reg1' as the VAR name and save. Do the same for IN2 and reg2, and ADD and reg_sum as shown in Figure 58.

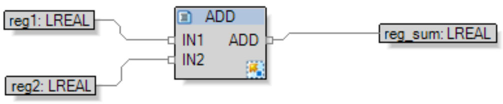


Figure 58: Create simple logic in the 61131 program.

8. Click **Save** in the toolbar. This creates a first simple 61131 program. It can be extended by 61131 function blocks.

9. The program CAT is really a 61499 CAT with the TASKIN event as the only input event. It is the "bridge" between the IEC 61499 (outside) and IEC 61131 (inside) programming. It allows to combine IEC 61499 and IEC 61131 functionality in a single device.

10. To embed the program block into the 61499 runtime, create a normal CAT: In the 'KickStart' solution tree, select **CAT → Application**. Then right-click and choose **New Item**. Select **Normal CAT** and type in a name. Then click **Finish** as shown in Figure 59.

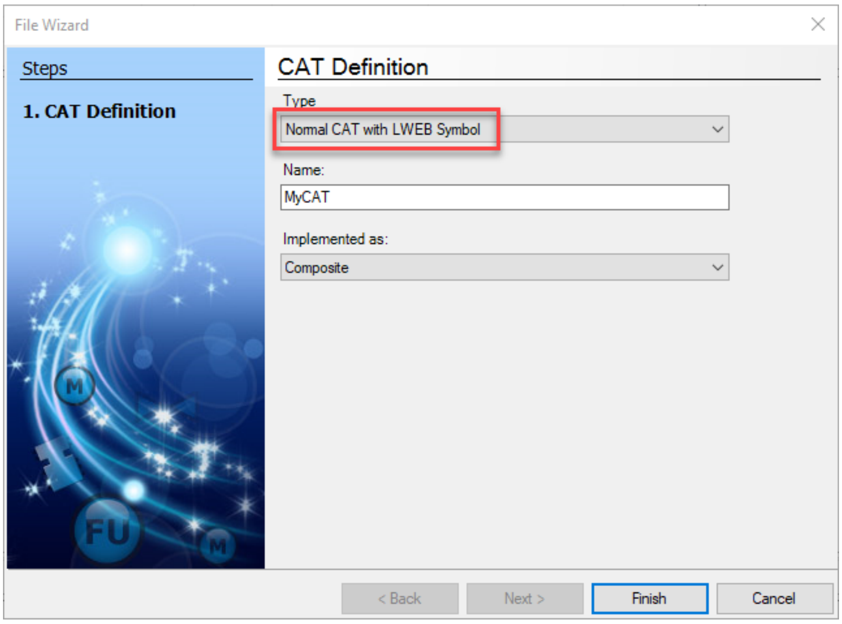


Figure 59: Create a 61499 CAT to embed the 61131 program.

11. Now create a clock signal for IEC61131 programs: Open the new CAT 'MyCAT' and select the **Composite** tab.

12. Create the E_RESTART and E_CYCLE function blocks: This can be done by Ctrl+W and typing E_RESTART as the new element type. That opens a drop-down list as you type. Choose the E_RESTART item and hit Enter. This creates the E_RESTART function block. Repeat this for the E_CYCLE block.

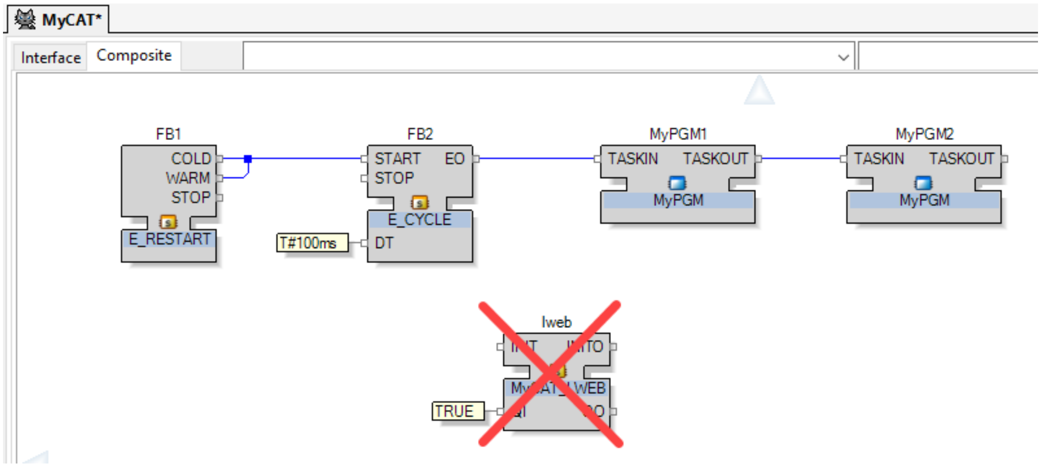


Figure 60: Embed the 61131 program in a 61499 CAT.

13. Connect the COLD and WARM Restart outputs to the START input by drag-and-drop between the function blocks as shown in Figure 60.

14. Right-click on the DT input of the E_CYCLE block, choose **Add Constant** and set it to 'T#100ms'.

15. Delete the lweb block. That block is used only in native 61499 applications and is not used in 61131.

16. Drag and drop the 'MyPGM' block from the solution tree onto the 'MyCAT' composite tab. This creates a program instance. Then connect the EO output to the TASKIN of the program block. Multiple instance of a program are possible. In this case connect the TASKOUT to TASKIN of the next instance.

17. As a next step it is necessary to create a device type. In the 'KickStart' solution tree, select **CAT → Application**. Then right-click and choose **New Item**. Select Device CAT, enter a name and choose the device model, e.g. LINX-153, as shown in Figure 61.

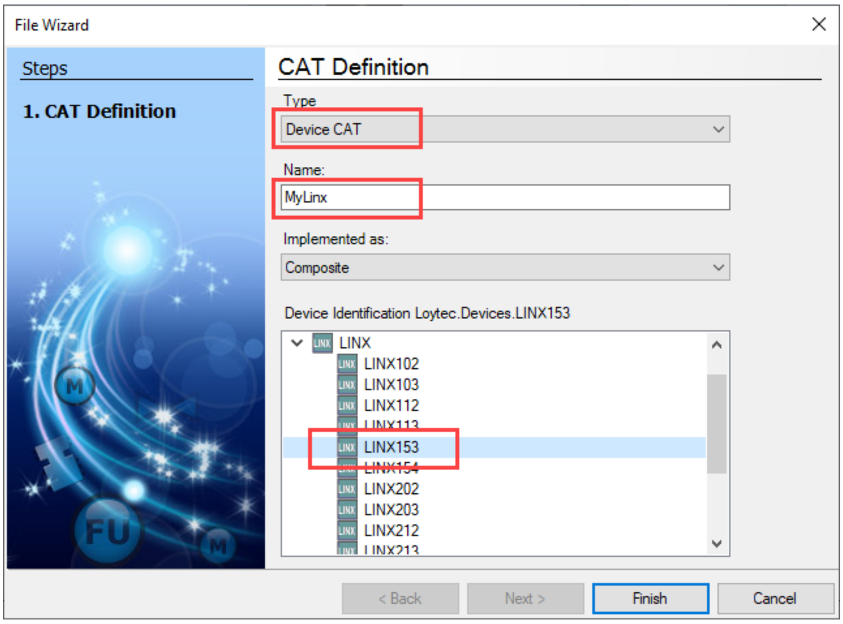


Figure 61: Create a new device CAT.

18. Open the device ‘MyLinx’ and go to the **Composite** tab. Drag the ‘MyCAT’ from the solution tree onto the composite tab to create a CAT instance (see Figure 62). You may also delete the ‘lweb’ block as it is not needed.

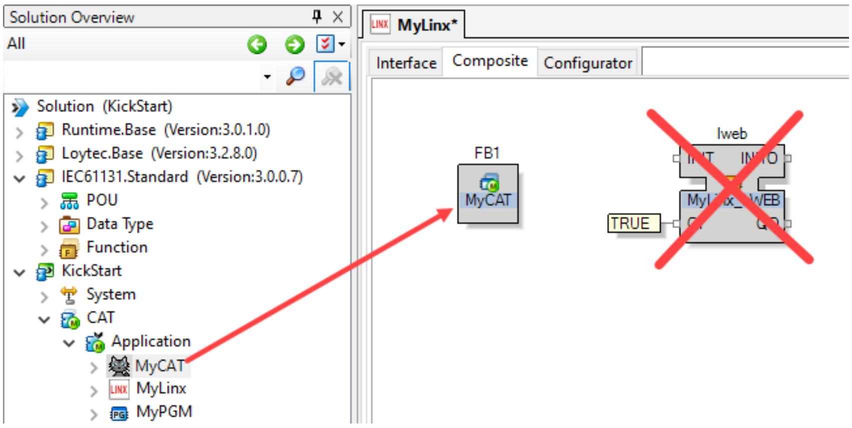


Figure 62: Create a CAT instance within the device CAT.

19. Finally create a device instance. Open the System in the toolbar. Then select the **Network** tab. Drag the ‘MyLinx’ device from the solution tree onto the network tab and assign a name to the device instance as shown in Figure 63.

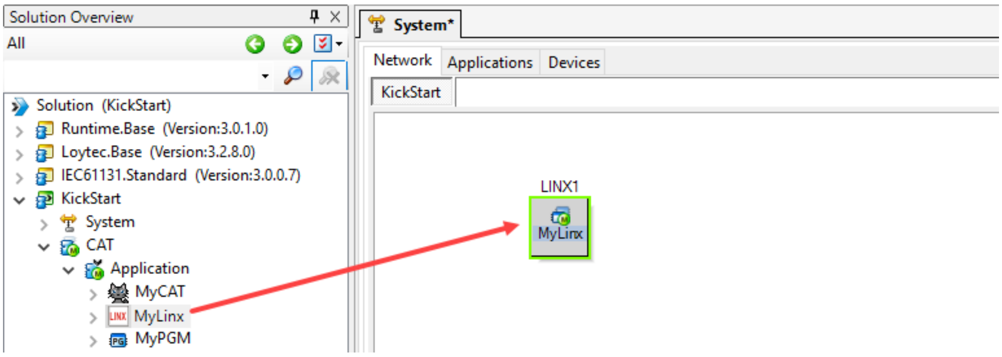


Figure 63: Create a device instance.

20. Select the **Devices** tab. Then click on the **Device** dropdown and choose **Device CATs…** in order to create the device resources (see Figure 64).

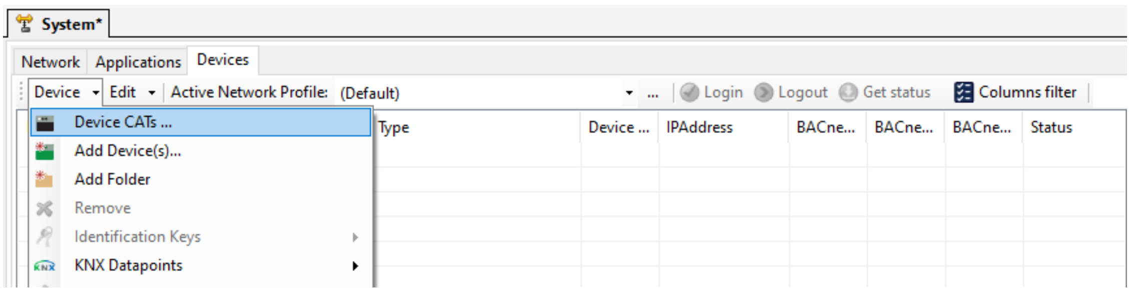


Figure 64: Create device resources in the system.

21. In the list, select all devices that apply and click **Create Devices** (see Figure 65).

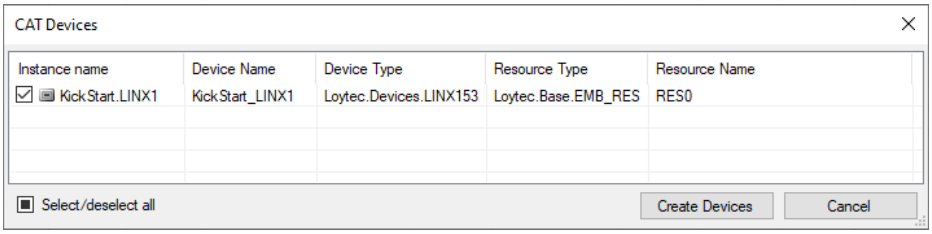


Figure 65: Select devices to be created.

22. Edit the IP address, login credentials for the device as shown in Figure 66. Then click **Save** in the toolbar.

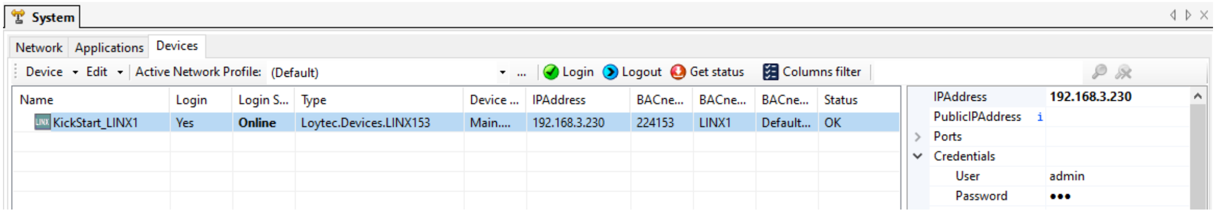


Figure 66: Enter IP address and credentials for the device resource.

23. To test click on the **Get status** button as shown in Figure 67. The **Status** column should now show **OK**.

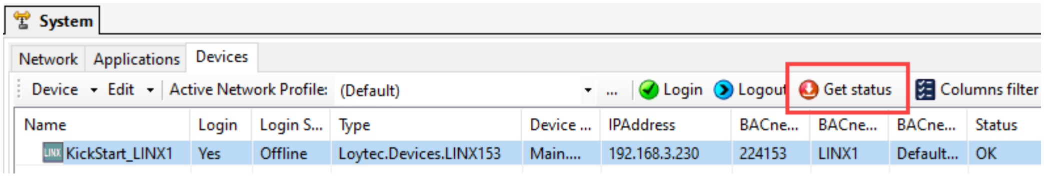


Figure 67: Test connection to the device resource.

24. Deploy the application: Right-click on the device. In the context menu, choose **Deploy → Deploy**. The program is compiled and then deployed onto the device.

25. The device will reboot and come up with the new program. Open the Web UI on the device and verify the add function as shown in Figure 68. Note, that two folders have been generated for the two 61131 program instances (MyPGM1, MyPGM2).

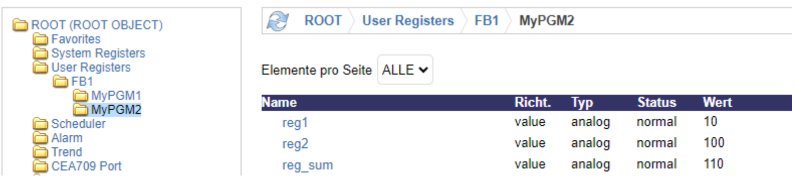


Figure 68: Resulting data points on the device.

5.7 Getting started with logiCAD

For developing IEC61131 programs with logiCAD the following components must be installed:

1. L-logiCAD setup package. This package installs the logiCAD software, which is needed to design PLC programs for the L-INX device.

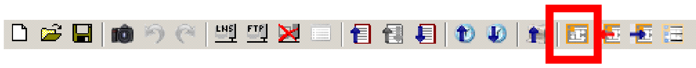
2. L-INX Configurator. This software is required to configure the L-INX device to provide the necessary data points to the PLC and integrate the device into the network.

3. logiCAD license for using logiCAD on the PC. The license is available as a softlock version or as a hardlock version with a USB dongle. On virtual machines it is mandatory to use the hardlock license.

A detailed guide on how to install the software components described above and upgrade of an older license can be found in Section 8.2.

To Start a logiCAD Project

1. After installing the necessary software components start logiCAD from the L-INX Configurator by clicking the **Start LogiCAD** speed button.



2. The project wizard starts automatically as shown in Figure 69.

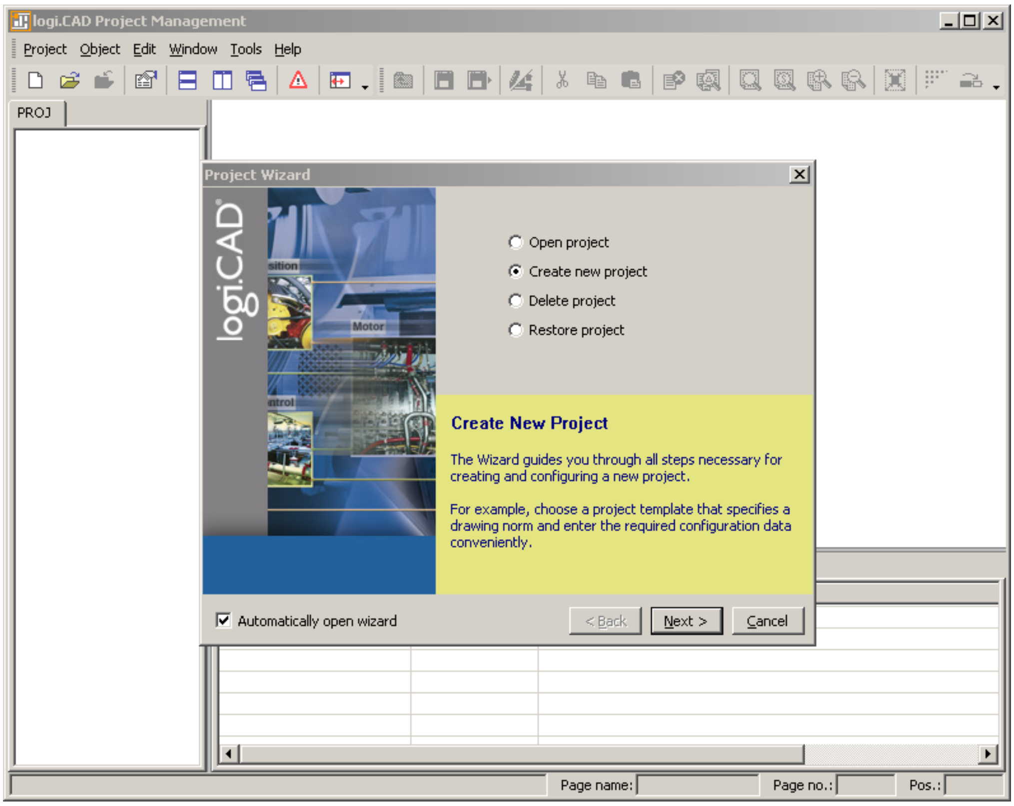


Figure 69: logiCAD project wizard

3. Select Create new project and press **Next**.

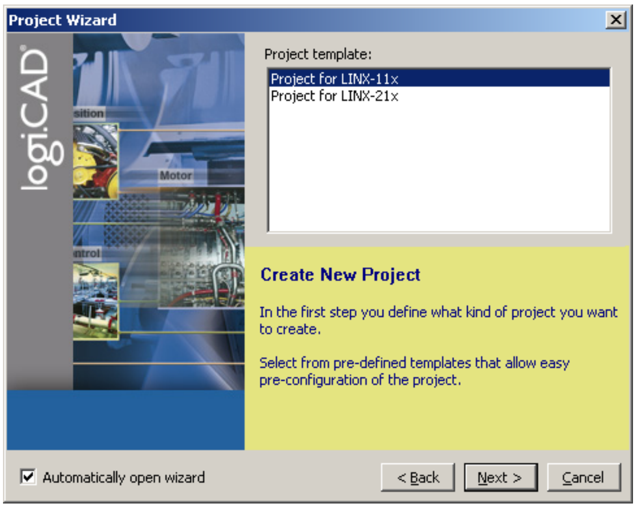


Figure 70: Available project templates

4. Select the project template for the L-INX device (e.g., LINX-11x or LINX-12x).

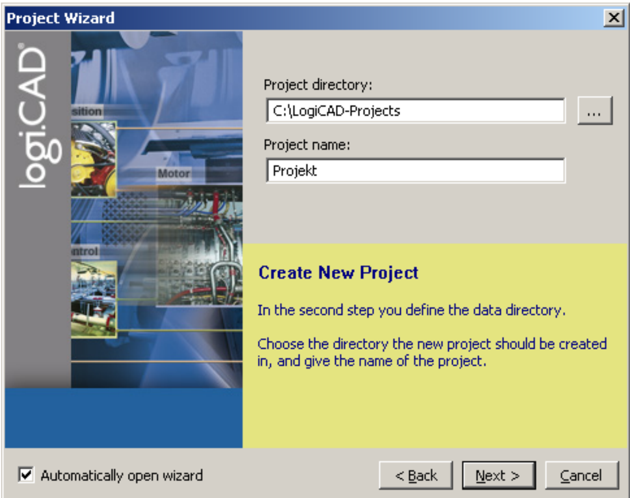


Figure 71: Project name and path

5. Specify the name of the project and the path where to store the project files, see Figure 71.

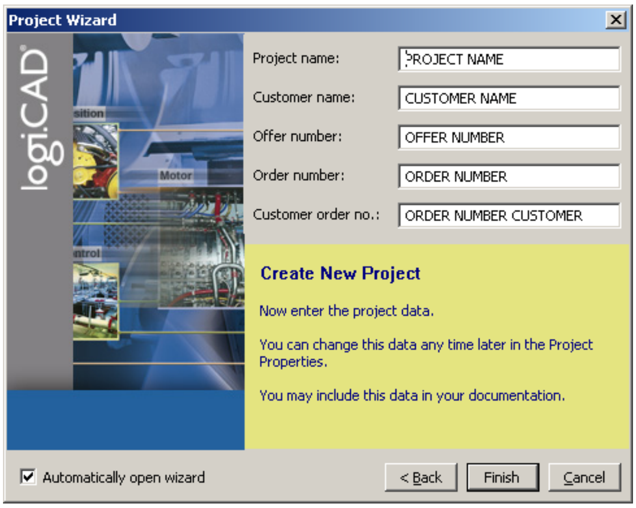


Figure 72: Additional information

6. After specifying additional information the new project is created by pressing the **Finish** button.

7. As shown in Figure 73 below, expand the tree element **Functionplans** and double click **Plan_1** in order to start editing the plan.

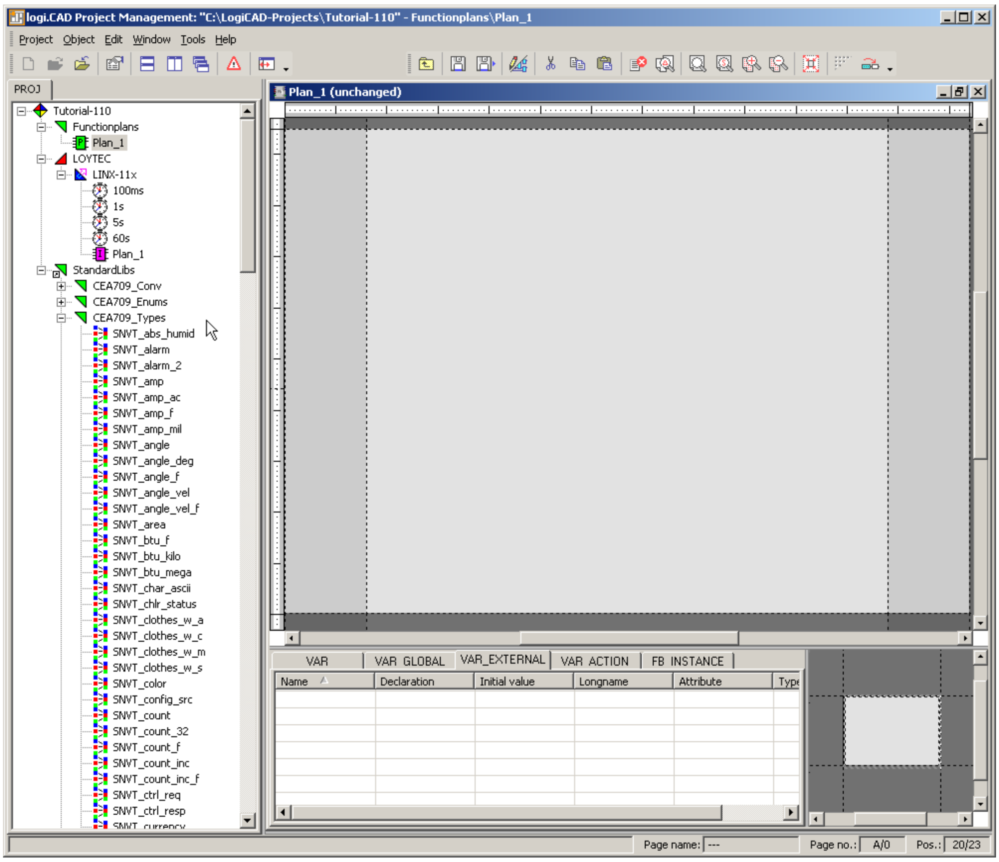
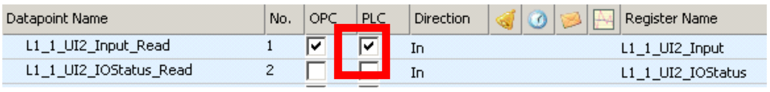


Figure 73: Edit Plan_1

8. In the new LogiCAD project there are no external variables yet. To expose data points from the L-INX to the logic program, activate the **PLC** check box of the corresponding data points in the Configurator, e.g., the L-IOB I/Os of the universal input or any other

data point such as a network variable, user register or BACnet object.



9. When you have completed selecting the PLC data points, click the **Export variables to LogiCAD** speed button while LogiCAD is running.

10. The data points now appear as variables in LogiCAD in a folder under the device folder. The folder is named specific to the technology of the data points, e.g. LIOB for all L-IOB I/Os that are exposed as a PLC variable. An example is shown in Figure 74.

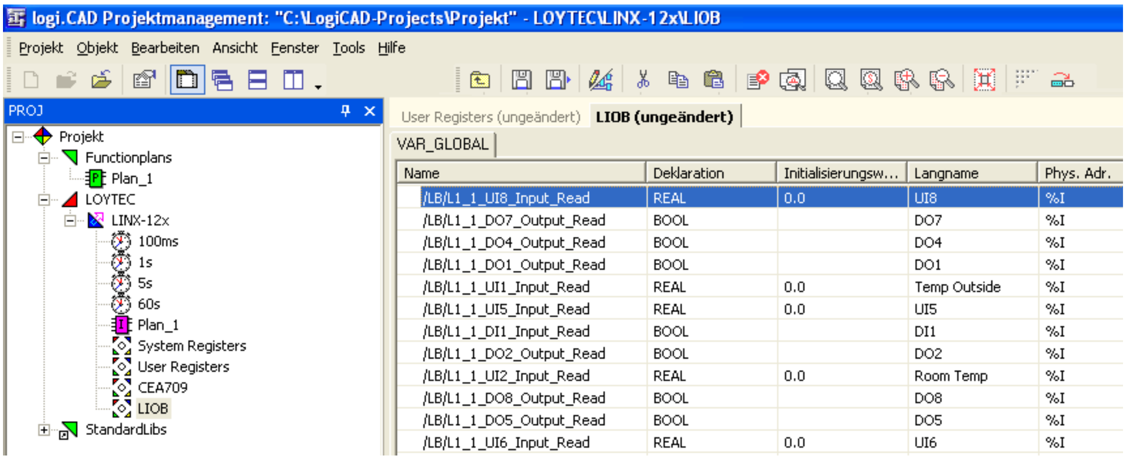


Figure 74: Exposed PLC data points appear in LogiCAD

11. Now the logic can be developed on the function plan.

12. For later debugging, it is good practice to add online test fields to the drawing, to display the current value of the signals during online test. To do this, right-click on the value output of the left function block and select **Create OLT Field** from the context menu, as shown in Figure 75.

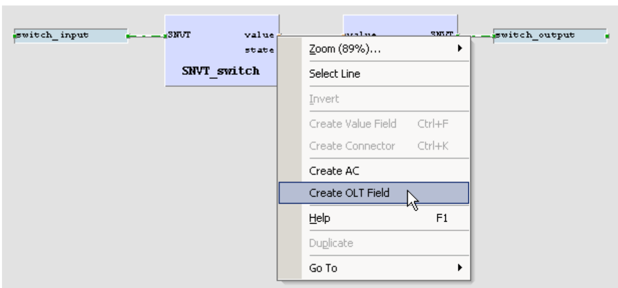


Figure 75: Create online test fields

13. Place the fields above and below the drawing as shown in Figure 76, then press the **Save** button to save your changes.

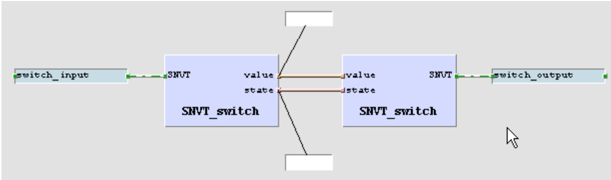


Figure 76: Online Test fields

14. Finally, open the context menu of the **LINX-11x** device again and select **Code Generation**. In the dialog, press the button **Start** to start the code generation process. On success, the code generation window reports Errors=0 and Warnings=1.

15. Close the window by pressing the **OK** button. Now the compiled IEC61131 program can be downloaded to the device. Right-click the tree element **LINX-11x** and select **Download** from the context menu. A connection dialog will appear and ask for the type of connection and additional information.

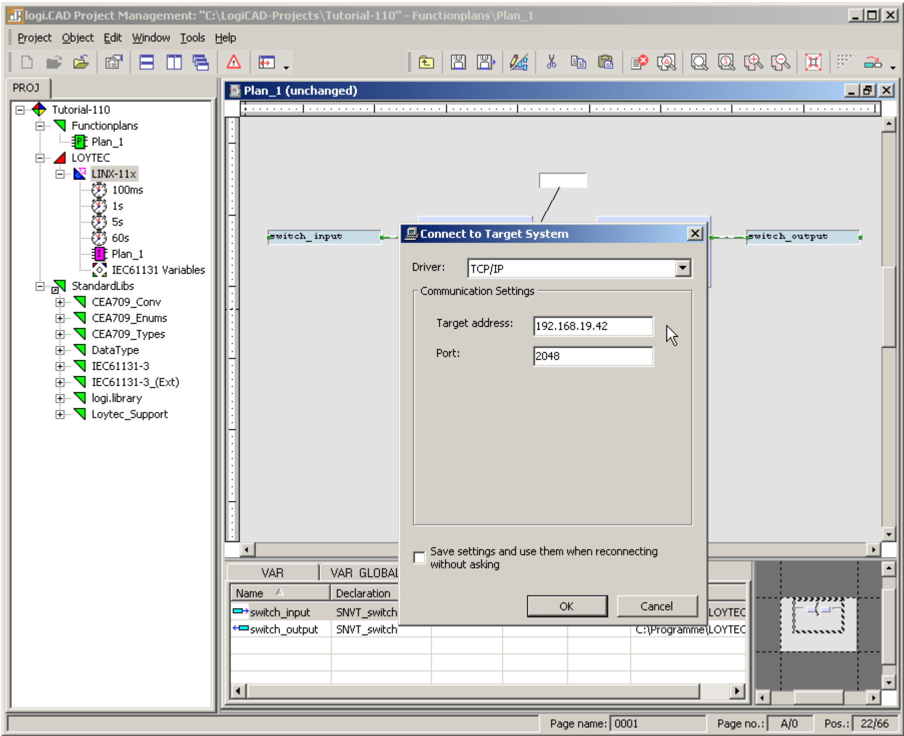


Figure 77: IEC61131 program download

16. Select the TCP/IP communication driver and enter the target address as configured in Section 5.2. Start the download process by pressing the **OK** button.

17. After the download completed check the PLC LED. If it is steady green, the logic is not yet running. Reboot the L-INX to start the IEC61131 program.

5.8 Connect with an OPC XML-DA Client

After the configuration has been downloaded to the L-INX it is ready to serve OPC XML-DA clients. All data points with the **OPC** check box activated will be exposed. Connect to the L-INX using the URL

http://192.168.24.99/DA,

given that 192.168.24.99 is the IP address of the device. Note, that by default, writing to OPC tags needs basic HTTP authentication using the password for the operator user. This is 'operator' by default.

5.9 Reset to Factory Defaults

In case the password of the device or the PIN code of the LCD UI has been forgotten you may need to reset the device back to factory defaults to gain access again. On the L-INX models 10X, 11X, 20X, 21X press the service button and power-cycle the device. On the L-INX models with the jog dial press the jog dial and power-cycle the device. Keep the button/jog dial pressed until the port LEDs illuminate orange permanently. Release the button/jog dial within five seconds from that time on to reset the device to factory defaults.

6 Hardware Installation

6.1 Enclosure

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

6.2 Product Label

The product label on the side of the L-INX/L-GATE contains the following information (for an example see Figure 78):

- L-INX order number with bar-code (e.g. LINX-112, LGATE-950),
- serial number with bar-code (Ser#).

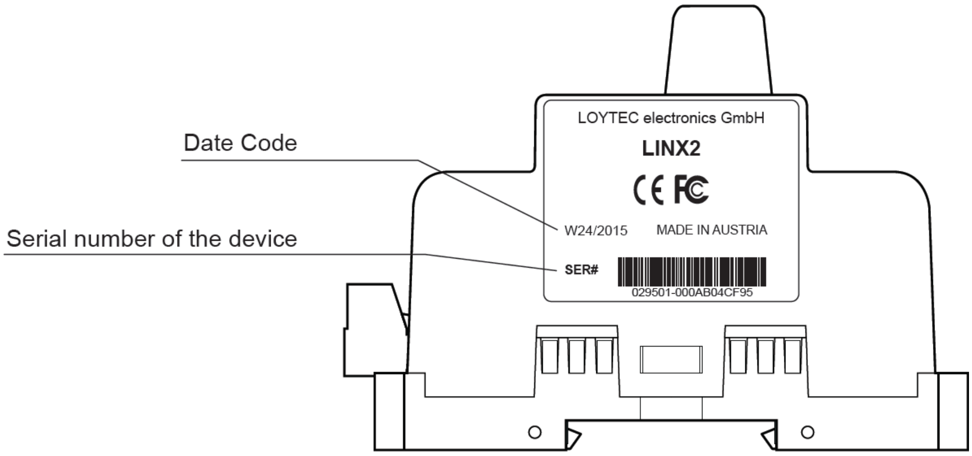


Figure 78: Example product label.

Unless stated otherwise, all bar codes are encoded using "Code 128". An additional label is also supplied with the device for documentation purposes. The specific contents of the product label are shown on the installation sheet found in the product's box.

6.3 Mounting

The device comes prepared for mounting on DIN rails following DIN EN 50 022. The device can be mounted in any position. However, an installation place with proper airflow must be selected to ensure that the device's temperature does not exceed the specified range (see Chapter 13).

6.4 LED signals

Available LEDs and their location on the respective device model can be found on the product's installation sheet. The installation sheet can be found in the product's box.

6.4.1 OPC LED

The OPC Server LED illuminates green when at least one OPC client is connected to the OPC server. The LED flickers on OPC XML-DA traffic activity.

6.4.2 PLC LED

The PLC LED indicates the state of the IEC61131 kernel and the IEC61131 program (see product installation sheet). Table 3 shows the different LED patterns and their meaning.

Behavior	Description	Comment
GREEN permanent	The IEC61131 program has been stopped	The IEC61131 kernel is running, there is an IEC61131 program, but the program execution was stopped.
GREEN flashing slow at 1 Hz	Normal condition, IEC61131 program running	The IEC61131 kernel and program were successfully loaded. The IEC61131 program is executed.
GREEN flashing fast in an on-on-pause pattern	I/O driver disabled	The I/O driver is disabled, that is that no updates from or the IEC61131 program were handled.
GREEN flashing fast	CPU overload	CPU load exceeded 80%. Modify the PLC program to reduce CPU load in order to guarantee normal system operation (for example, reduce the cycle time of the program).
OFF	No IEC61131 program	No IEC61131 orogram is loaded or a problem occurred while starting the IEC61131 kernel.

Table 3: PLC LED Patterns

6.4.3 FT Activity LED

The FT port on the device has a three-color LED (green, red, and orange, see product installation sheet). Table 4 shows different LED patterns of the port and their meaning.

Behavior	Description	Comment
GREEN flashing fast	Traffic	
GREEN flashing at 1Hz	The OPC node or LINX-101's router port is unconfigured	On the LINX-101 this LED only stops flashing if both, node and router, are commissioned.
RED permanent	Port damaged	
RED flashing fast	Traffic with high amount of errors	
RED flashing at 1 Hz (all ports)	Firmware image corrupt	Please upload new firmware.
ORANGE permanent	Port disabled	e.g., using LSD Tool
ORANGE flashing fast	Traffic on port configured as management port	e.g., using LSD Tool

Table 4: CEA-709 Activity LED Patterns.

6.4.4 MSTP Activity LED

The MS/TP port has a three-color MSTP Activity LED (see product installation sheet). Table 5 shows the different LED patterns of the port and their meaning. A permanent color reflects a state. Flicker is for 25 ms when there is activity on the MS/TP data link layer.

Behavior	Description	Comment
GREEN permanently, flicker off	Multi-Master, token ok, flicker when traffic	Normal condition on a multi-master MS/TP network.
ORANGE flicker	Sole master, flicker when traffic	Normal condition on a single-master MS/TP network.
RED permanent, flicker GREEN	Token lost state, flicker when transmit attempt	Cable might be broken.
RED flash fast	Transmission or receive errors	This indicates bad cabling.

Table 5: MS/TP Activity LED Patterns.

6.4.5 Modbus LED

The Modbus LED is a three-color LED. Table 6 shows the different LED patterns of the port and their meaning. Flicker is for 25 ms when there is activity on the bus.

Behavior	Description	Comment
GREEN flicker	Traffic, transmission successful	Normal condition.
RED flicker	Traffic, transmission unsusccesful	Device not responding or other network error.

Table 6: Modbus Activity LED Patterns.

6.4.6 EXT LED

The EXT port has a three-color LED (see product installation sheet), which displays link and traffic information on the protocol enabled on the port (M-Bus or KNX TP1). Table 7 shows the different LED patterns of the port and their meaning. A permanent color reflects a state. Flicker is for 25 ms when there is activity on the attached network. The LGATE-951/952 and the LINX-153 have more than one EXT port that all conform to the described behavior.

Behavior	Description	Comment
GREEN permanently, flicker off	LKNX-300 attached, flicker when traffic	Normal condition on a KNX TP1 network.
GREEN flash fast	M-Bus traffic	Normal condition on an M-Bus network.
RED permanent	LKNX-300 not attached, no KNX bus power or port damaged	Check if cabling to LKNX-300 is bad.
RED flash fast	M-Bus transmission or receive errors	This indicates bad cabling. Check if L-MBUS is connected. Check if M-Bus devices are operational.

Table 7: EXT port LED Patterns.

6.4.7 Ethernet Link LED

The Ethernet Link LED lights up green whenever an Ethernet cable is plugged-in and a physical connection with a switch, hub, or PC can be established.

6.4.8 Ethernet Activity LED

The Ethernet Activity LED lights up green for 6 ms whenever a packet is transmitted or received or when a collision is detected on the network cable.

6.4.9 BBMD LED

This LED is available on LGATE-95X only. The BBMD LED is permanent green if BBMD is enabled. Otherwise, it is off.

6.4.10 Wink Action

If the CEA-709 device receives a wink command on any of its network ports, it shows a blink pattern on the CNIP and the CEA-709 activity LEDs. The CEA-709 activity and the CNIP LED turn green/orange/red (each 0.15 s). This pattern is repeated six times. After that, the CNIP LED flashes orange six times if the wink command was received on the IP channel or the CEA-709 activity LED flashes orange six times if the wink command was received on the CEA-709 channel. After that the device's LEDs resume their normal behavior.

6.4.11 Network Diagnostics

The CEA-709 device provides simple network diagnostics via its CEA-709 activity LED:

If the LED does not light up at all, this port is not connected to any network segment or the connected network segment currently shows no traffic.

If the LED is flashing green, the network segment connected to this port is ok.

If the LED is flashing red, a potential problem exists on the network segment connected to this port. This state is referred to as overload condition.

A port overload condition occurs if

- the average bandwidth utilization of this port was higher than 70 %, or
- the collision rate was higher than 5 %, or
- more than 15 % CRC errors have occurred on a port with a power-line transceiver, or more than 5 % on a port with a transceiver other than power-line, or
- the device was not able to process all available messages.

For a deeper analysis of the reason for the overload condition, it is recommended to use a protocol analyzer (e.g., LOYTEC's LPA) or a similar tool. The exact reason of the overload condition can also be determined with the LSD Tool.

6.5 Wiring

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

7 Concepts

7.1 Universal Gateway

The operating principle of a universal gateway is to connect data points of one network technology to data points of another technology. This is the primary function of the L-GATE product family. Gateway function are, however, also available in the L-INX family.

Data points in the CEA-709 network are known as network variables (NVs). Data points in the BACnet technology are known as BACnet server 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". For more information on the mentioned technologies refer to the LINX Configurator User Manual [2].

The typical task in configuring the universal gateway consists of the following steps:

1. Selecting the data points of the network to be mapped (e.g., select the NVs in the CEA-709 network nodes or create new NVs)

2. Select or create matching counterparts of the other technology (e.g., create matching BACnet objects)

3. Create connections between the data points (e.g. connect NVs and BACnet objects).

The connection is the central part of the gateway functionality. It defines, which data points are mapped to which data points. Refer to the Connections Section in the LINX Configurator User Manual [2] for more information.

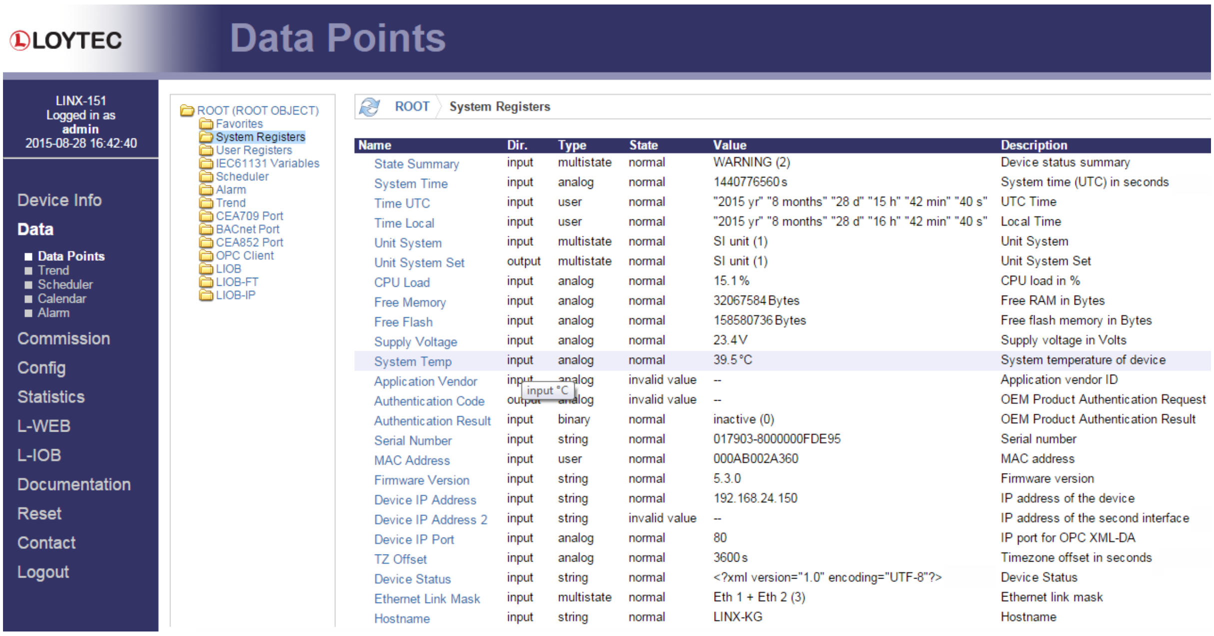
7.2 Data Point Configuration

Data points are part of the fundamental device concept to model process data. A data point is the basic input/output element on the device. Each data point has a value, a data type, a direction, and a set of meta-data describing the value in a semantic context. Each data point also has a name and a description. The entire set of data points is organized in a hierarchy using a folder structure. Folders can be created as needed and have a folder name and description.

The direction of a data point is defined as the "network view" of the data flow. This means, an input data point obtains data from the network. An output data point sends data to the network. This is an important convention to remember as different technologies may define other direction semantics. If a data point can both receive and send data on the network, its direction is set to value, indicating no explicit network data flow.

The device provides a Web interface for displaying and modifying data point values (see Figure 79). Data points that are structures contain their structure members as sub-data points beneath them. Data point values are typically written by the controller or by the network. For testing purposes the values can also be manually overridden (Set Override). More information on the data point Web interface can be found in the LOYTEC Device User

Manual [1]. For a comprehensive description of the data point configuration on the device please refer to the LINX Configurator User Manual [2].



Name	Dir.	Type	State	Value	Description
State Summary	input	multistate	normal	WARNING (2)	Device status summary
System Time	input	analog	normal	1440776560 s	System time (UTC) in seconds
Time UTC	input	user	normal	"2015 yr" "8 months" "28 d" "15 h" "42 min" "40 s"	UTC Time
Time Local	input	user	normal	"2015 yr" "8 months" "28 d" "16 h" "42 min" "40 s"	Local Time
Unit System	input	multistate	normal	SI unit (1)	Unit System
Unit System Set	output	multistate	normal	SI unit (1)	Unit System Set
CPU Load	input	analog	normal	15.1 %	CPU load in %
Free Memory	input	analog	normal	32067584 Bytes	Free RAM in Bytes
Free Flash	input	analog	normal	158580736 Bytes	Free flash memory in Bytes
Supply Voltage	input	analog	normal	23.4 V	Supply voltage in Volts
System Temp	input	analog	normal	39.5 °C	System temperature of device
Application Vendor	input	analog	invalid value	--	Application vendor ID
Authentication Code	output	analog	invalid value	--	OEM Product Authentication Request
Authentication Result	input	binary	normal	inactive (0)	OEM Product Authentication Result
Serial Number	input	string	normal	017903-8000000FDE95	Serial number
MAC Address	input	user	normal	000AB002A360	MAC address
Firmware Version	input	string	normal	5.3.0	Firmware version
Device IP Address	input	string	normal	192.168.24.150	IP address of the device
Device IP Address 2	input	string	invalid value	--	IP address of the second interface
Device IP Port	input	analog	normal	80	IP port for OPC XML-DA
TZ Offset	input	analog	normal	3600 s	Timezone offset in seconds
Device Status	input	string	normal	<?xml version="1.0" encoding="UTF-8"?>	Device Status
Ethernet Link Mask	input	multistate	normal	Eth 1 + Eth 2 (3)	Ethernet link mask
Hostname	input	string	normal	LINX-KG	Hostname

Figure 79: Data points on the Web interface.

7.3 IEC61131 Variables

IEC61131 variables are dedicated data points used to exchange data with the L-LOGICAD IEC61131 program. These variables are represented in the data point configuration as register data points and can be connected to other data points, e.g. to CEA-709 NV points, via data point connections.

Another way to use data points in a 61131 program is to set the PLC in and PLC out flags on the respective data points.

In contrast to CEA-709 or BACnet variables, IEC61131 variables are always represented as single data point. In case of scalar values (representing CEA-709 scalar or enumeration types) one of the following basic data types might be used:

- **Double**: A register of base type *double* is represented by an *analog* data point. It can hold any scalar value. No specific scaling factors apply.
- **Signed Integer**: A register of base type *signed integer* is represented by a *multi-state* data point. This register can hold a set of discrete states, each identified by a signed stats ID.
- **Boolean**: A register of base type *boolean* is represented by a *binary* data point. This register can hold a Boolean value.

Structured IEC61131 variables, representing for example structured NVs, or customer defined IEC61131 structures, are stored as user type:

- **User**: A *user* data point contains un-interpreted, user-defined data. The data is stored as a byte array. A user data point does not include any other meta-data. This type of data point also serves as a container for otherwise structured data points and represents the entire data structure. User data points can only be connected to other user data points of the same data length.

8 IEC 61131 – L-LOGICAD

To design the IEC61131 program which should run on the L-INX device, the graphical programming tool logiCAD is required. The tool allows creating IEC61131 programs using various IEC61131 programming languages. It offers additional features downloading and debugging of the created program.

In addition to logiCAD, the L-INX Configurator necessary to create an appropriate data point configuration in the automation server. The usage of logiCAD itself is beyond the scope of this manual. Please refer to the logiCAD online help in case of additional questions.

8.1 Overview

The PLC in the L-INX device is intended to perform IEC61131 programs operating on IEC61131 data points. The operating principle is to connect IEC61131 data points to data points derived from CEA-709, BACnet or LIOB network. Figure 80 depicts the usage of data points for IEC61131 programs at the example of using CEA-709 network variables.

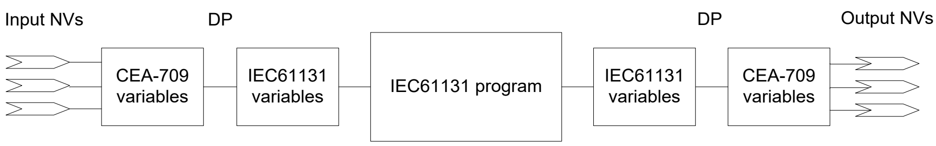


Figure 80 Usage of data points.

Alternatively, data points can also be directly exposed as IEC61131 variables. The data points provide a PLC check box for this purpose. In this use case, not special IEC61131 data points are created and no connections are necessary.

In order to run a logiCAD PLC program on a L-INX controller, the L-LOGICAD license must be installed on the controller device. Note, that for newer devices as of production week 50/2023 (A64 models) the L-LOGICAD license is no longer available. The following sections on logiCAD are therefore describing a legacy technology for L-INX controllers. For new projects, PLC programs need to be migrated to the L-STUDIO 61131 run-time.

8.2 Installing logiCAD

For developing IEC61131 programs with logiCAD the following components must be installed:

1. L-logiCAD setup package. This package installs the logiCAD software, which is needed to design PLC programs for the L-INX device.

2. L-INX Configurator. This software is required to configure the L-INX device to provide the necessary data points to the PLC and integrate the device into the network.

3. logiCAD license for using logiCAD on the PC. The license is available as a softlock version or as a hardlock version with a USB dongle. On virtual machines it is mandatory to use the hardlock license. How to obtain and install the license is described in this Section.

The L-logiCAD installer installs the IEC61131 programming environment logiCAD and all L-INX related software packages. These packages include the template project for the LINX, the required software to build IEC61131 programs for the L-INX device, and required extensions to interface to CEA-709 networks. Follow the instructions of the installer to install logiCAD for the L-INX.

The language for the logiCAD user interfaces can be set to German or English using the administration folder of the logiCAD control center. The logiCAD control center can be started from the Windows start menu.

8.2.1 Softlock License

The license to run a copy of logiCAD on any PC is based on a softlock license. In case the original softlock license file was generated for an older L-logiCAD version, the software will request an update signature key for the new L-logiCAD installation. This signature key can be found in the file 'logicad_Readme.txt' that is located in the installation directory of the L-logiCAD software.

To obtain and install a new license start logiCAD. The product activation dialog will appear as shown in Figure 81. In this dialog press the button **Download Softlock License.**

Important! ***When using Windows7 start logiCAD as administrator in order to allow the script read the computer number code. If there are x's in the code, the code was not read by the script.***

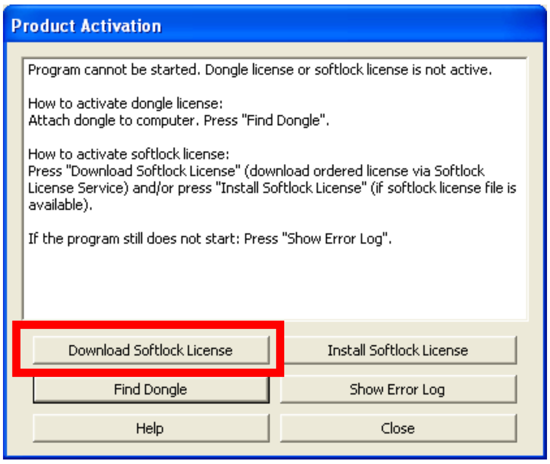


Figure 81: logiCAD Product Activation

Enter the license data provided with the product information on the Web site form as shown in Figure 82. Fill in the **SL-number** and **Licensing Code** from your L-LOGICAD registration form and click on **Download License File**. Save the license file on your computer or have it e-mailed to you.

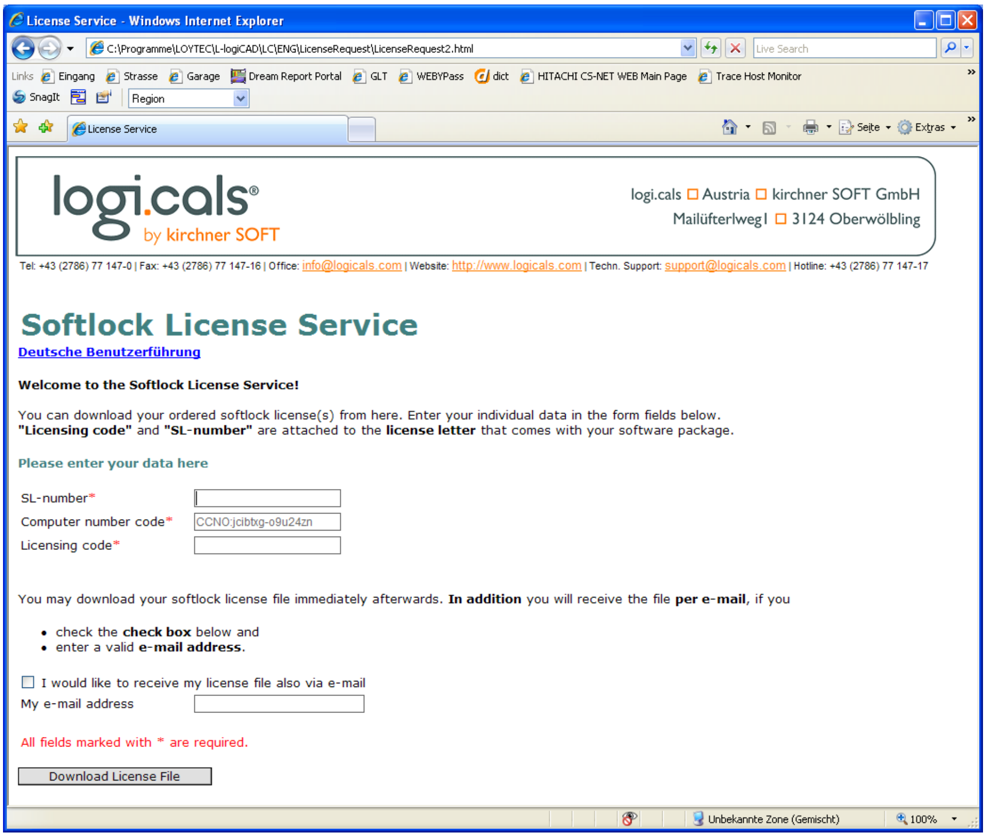


Figure 82: logiCAD softlock license Web form.

Then install the license using the **Install Softlock License** button in the product activation dialog as indicated in Figure 83.

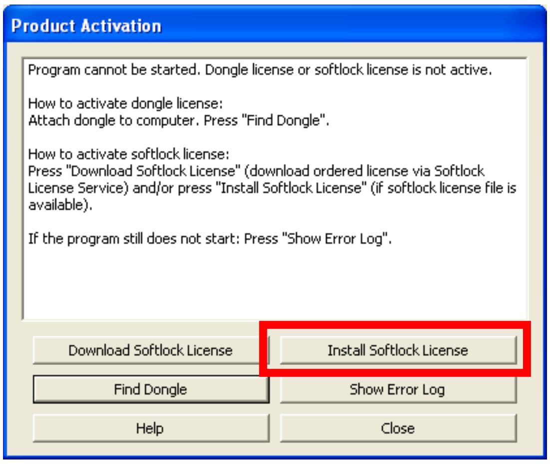


Figure 83: logiCAD softlock installation.

A file requestor dialog opens. Locate the downloaded license file (logicad.lf) and click **Open**. Finally click **Close** in the product activation dialog and start logiCAD again. The softlock license is now activated.

8.2.2 Hardlock License

The hardlock license is needed to run a copy of logiCAD in a virtual machine on the PC. It needs to be puchased separately as L-LODICAD-USB and is distributed as a USB hardlock key of type ‘CodeMeter’. If no driver for this type of hardlock is already installed on the PC, install the hardlock driver provided on the LOYTEC website. It can be found in Support →

Download and the product selection for L-LOGICAD. After the driver installation has completed, plug in the USB key. It must be recognized as a mass storage device (the details on it show the location 'CodeMeter-Stick'). When starting logiCAD it recognizes the hardlock automatically.

If the driver installation failed, or the USB key was not detected or connected, the window shown in Figure 84 will be shown when logiCAD is started. In this case plug in the hardlock stick, wait for Windows to recognize it and then click **Find Dongle**.

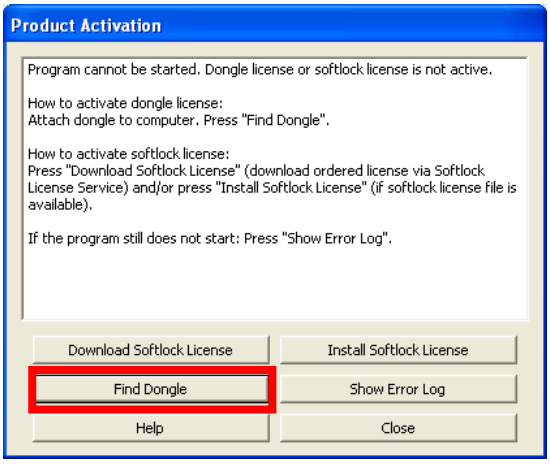


Figure 84: logiCAD Product Activation with Hardlock

Note: *logiCAD checks frequently if the USB key is present. When unplugging the USB key, even if logiCAD was successfully started, all major features are automatically disabled. But there is no additional message for the user!*

8.3 IEC61131 Project Files

In the L-INX Configurator select the **LogiCAD Files** tab to attach an IEC61131 program and a logiCAD project to the L-INX project. The tab is shown in Figure 85.

If there is an IEC61131 program attached to the project, every time a new configuration is downloaded to the device, the L-INX Configurator asks, if the attached program should be downloaded as well. This way, no logiCAD is required to download a suitable IEC61131 program in a separate step. The project designed in the L-INX Configurator can hold all necessary information to set up a running device:

- IEC61131 data point configuration,
- Data point configuration in the LINX,
- Required connections,
- IEC61131 program.

The logiCAD project directory can also be attached to the L-INX configuration file, in order to include the logiCAD project sources from which the program was compiled.

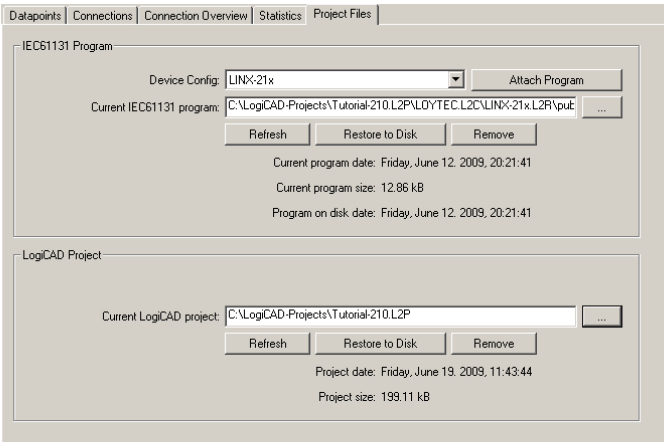


Figure 85: IEC61131 Project Files.

To attach an IEC61131 program or a logiCAD project select the file/folder to attach. The selected data will be attached automatically the project. It can be restored to disk by pressing the **Restore to Disk** button. During the development process the attached data may change several times. To update the attached data, located on the before provided path, press the **Refresh** button.

Every time a logiCAD project is successfully compiled, the file MBRTCode.so, the compiled IEC61131 program, is copied to the *public* directory of the device resource for which the program was compiled. Select this file to attach it to the project of the Configurator. Note that the time and date of the file indicates the time of the last code generation. If logiCAD is not able to build a new program, the old file will not be deleted.

The project will be scanned for device resources and the available devices will be listed in the dropdown box called **Device Config**. Select the desired device and press the button **Attach Program** to automatically attach the correct MBRTCode.so file.

8.4 Working with logiCAD

This section provides all necessary background information how to use the L-INX with logiCAD. For using the L-INX with logiCAD, a predefined project template for the L-INX must be used. Hence, when creating a new project, select the project template “Project for LINX-110”, see Figure 86. For additional information how to create, delete and manage projects please refer to the logiCAD online help.

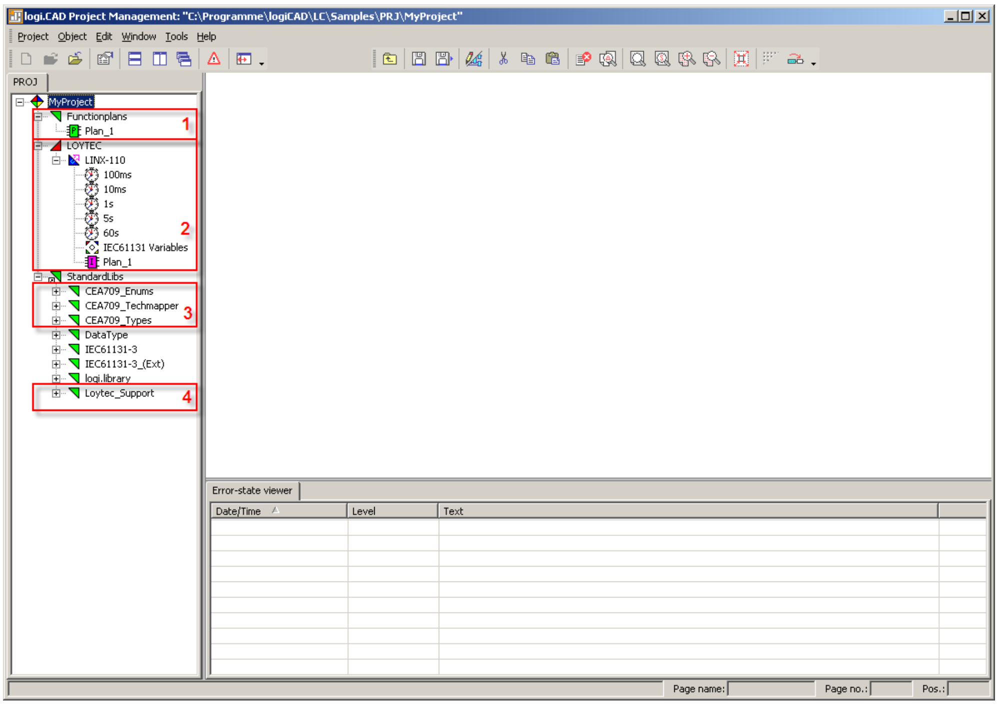


Figure 86: L-INX specific extensions

Figure 86 shows the standard project for the L-INX including all LINX-specific extensions for logiCAD. It shows the structure window showing the project structure on the left, an empty working area top right and the **Error-state viewer** on the bottom right side.

The structure window offers interfaces to the following features:

1. The folder **Functionplans** holds all the program types created within logiCAD. 'Plan_1' is the default plan to start with.

2. The folder **LOYTEC/LINX-110** represents the LINX-110 device. The folder **LOYTEC** represents a configuration containing one LINX-110 resource; please refer to the logiCAD online help for details. To run a program, located in the folder **Functionplans**, a program instance of the corresponding function plan must be created. In the standard LINX-110 template a program instance of the 'Plan_1' is already defined. To be able to transfer IEC61131 variables from the L-INX device to the IEC61131 program a global variables object within the **LINX-110** folder is required, see Section 8.4.1 for details.

3. LogiCAD operates on variable types standardized in the IEC61131 standard. Look for "Elementary and Generic Data Types" within the logiCAD online help to get information about the available data types. For those L-INX devices, which are intended to operate on structured NVs, appropriate type definitions for the NVs are required. These definitions are inside the folder **CEA-709_Types**. Additional NVs must be converted to data types that can be processed by logiCAD. Therefore *Technology Converters* are supplied with the L-INX project, which perform this conversion. See Section 8.4.3 for details.

4. For designing programs that support the force update functionality (see Section 8.6.1), or designing user-defined *Technology Mapper* (see Section 8.6.2) additional function blocks are required. These blocks are located within the **Loytec_Support** directory.

All LINX-specific add-ons are provided using function blocks. Hence, in the following, all samples are based on designs using function blocks.

8.4.1 Managing Variables

On a function plan, three basic types of variables may be created using the tabs shown below the function plan sheet:

- **VAR:** Variables created on this tab will be visible only to the logic designed on this group of sheets. It will not be accessible to any other programs or to any function blocks which are used in this program. It is similar to a 'static' variable declaration in a C code function.

- **VAR GLOBAL:** Variables declared here will be accessible to the entire program, including any function blocks which are called by the program. Function blocks which need to reference this variable need to have a suitable declaration of an external variable (see next point). This declaration is similar to a 'static' declaration of a C variable outside a function, which will be visible to all functions inside the C code module, but not visible to other modules.

- **VAR EXTERNAL:** Variables declared in this list will be treated as open references to a global variable which exists somewhere in the scope of the device on which the program will be executed. This means that a global variable needs to be declared on the device resource, which will be available to all programs running on the device. If the physical address parameter of the variable is set to %I, %O, or %M, the variable will be handed down to the I/O driver of the L-INX for processing. If a suitable IEC61131 variable exists in the data point configuration of the device, its value will be forwarded by the I/O driver between the PLC variable and the data point. If no physical address is set, the variable will only be visible to the PLC programs but not to the I/O driver, which may be used to exchange data between PLC tasks.

The basic data flow between the CEA709 network (or BACnet and other technologies) and the PLC program is depicted in Figure 87.

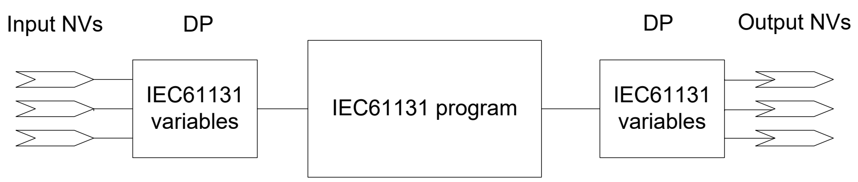


Figure 87: Connecting IEC61131 variables

The place where global variables are created on the device is shown in Figure 88.

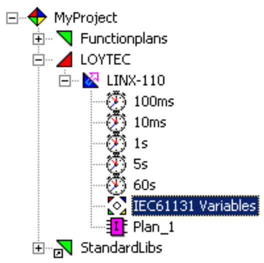


Figure 88: Global Variables Object

When starting a new project, no global variables object is available; it must be created before compiling the IEC61131 application. The global variables object is created automatically by the LINX Configurator when exporting variables to logiCAD.

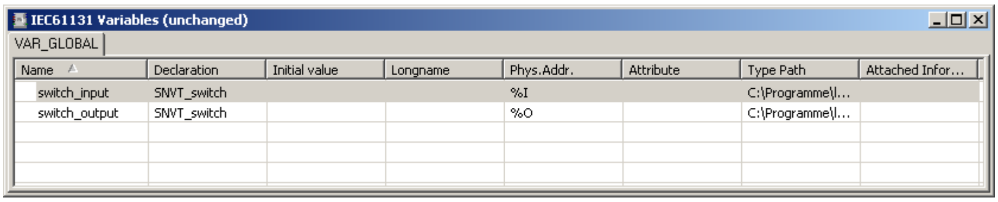


Figure 89: Variables defined in global variables object

Figure 89 shows the contents of a sample global variables object. As shown a global variable is defined by the fields **name**, **declaration** and **phys.addr.**:

- **Name:** The name of a global variable must be unique. The name is used from the IO driver to identify the global variable and from the L-INX Configurator to generate the corresponding IEC61131 data points.

- **Declaration:** Here the type of the global variable is defined.

- **Phys.Addr.:** The IO driver needs to know the data flow direction to be able to update variables. The direction is defined by adding %I for an input variable, %O for an output variable and %M for a marker (input and output). If the address is empty, the I/O driver will not handle the variable, but it may still be used by the tasks running on the device.

Important: ***Only ASCII characters can be used for naming the global variables.***

8.4.2 Build and Download the IEC61131 Program

IEC61131 programs, designed using logiCAD, must be cross compiled in order to run on the L-INX device. The prerequisite to compile an IEC61131 program are as follows:

- A program instance with associated program type

- A corresponding global variables object

Right click on the LINX-110 resource, see Figure 88, and select Code Generation. Please refer to the logiCAD online help for the meaning of the options. Take care about the option breakpoint support, see section 8.4.5 for details.

After successfully finished code generation, the IEC61131 application can be downloaded to the LINX-110. Right click on the LINX-110 resource and select download.

The IEC61131 program can be downloaded to the LINX-110 device via TCP/IP, CEA-709 and RS232:

- **TCP/IP:** Enter the IP address of the LINX-110 device. Do not change the default communication port (2048). This is the easiest and fastest way to connect to the device.

- **CEA-709**: Select the network interface to use and fill out all other fields, see Figure 90. Alternatively, select the network interface and press Auto-detect via Service-Pin. Then press the service pin on the LINX-110 device. Note that this connection method requires an installed LOYTEC network interface.

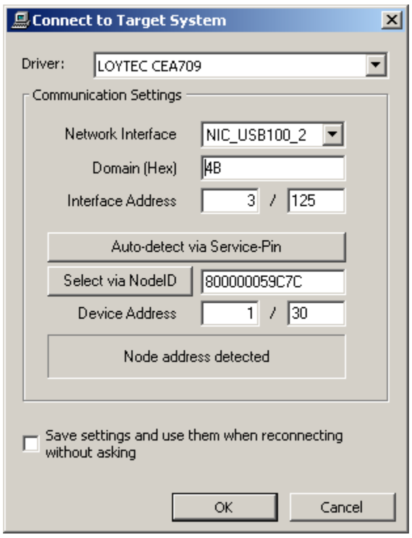


Figure 90: Connect via CEA-709

Important:	***To be able to communicate with the LINX-110 device via CEA709 the LINX-110 must be commissioned.***

- **RS232:** To connect via RS232 select LOYTEC RS232 as Driver and LOYTEC as transmission protocol. All other values are set correctly per default.

8.4.3 Usage of NVs, Technology Converters

To used CEA-709 variables the content of the NVs must be converted to IEC61131 compliant data types. Look for “Elementary and Generic Data Types” within the logiCAD online help to get information about the available data types. Technology Converters are used to perform the transformation from CEA-709 data types to IEC61131 data types. All Technology Converters are summarized in the subfolder CEA709_Conv located in the StandardLibs folder.

Depending on the type of the NV there are three different ways to use the NV within IEC61131 programs:

- Simple NVs that hold only one scalar value, e.g. SNVT_amp:

  Those kinds on NVs are represented as IEC61131 REAL values within logiCAD. There is no additional conversion necessary. Figure 102 shows an example program for scalar data types.

- Simple NVs based on an enumeration, e.g. SNVT_date_day:

  The active identifier of the enumeration is represented as Boolean value. When using NVs based on enumerations, Enumeration Converters are used to identify the current state. There are two kinds of Enumeration Converters. First, the Enumeration Converters that convert the enumeration types to Boolean types, grouped in the folder **Convert from CEA709_Enums**. Second, the Enumeration Converters that converts several Boolean inputs to an enumeration type, grouped in the folder **Convert to CEA709_Enums**.

- Structured NVs that consists of a number of fields, e.g. SNVT_switch:

  On structured NVs two tasks must be performed by the Technology Converters. First the structure of the NV is mapped to IEC61131 conform data types. Second, if necessary scaling factors are applied. Similar to the Enumeration Converters, the Technology Converters are split up into two subfolders. The first one, which converts the NV into IEC61131 compliant data types, is located in the folder **From_CEA709_Types**. Technology Converters to set up NVs based on IEC61131 data types are grouped in the folder **To_CEA709_Types**.

Figure 91 shows the three possibilities how to use NVs within an IEC61131 program.

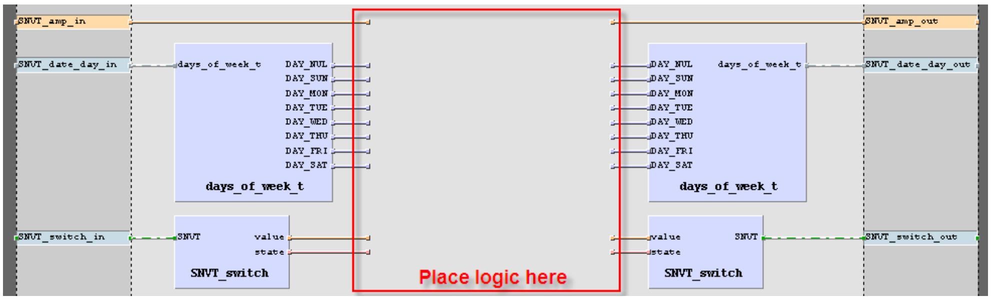


Figure 91: Usage of NVs

If a structured NV comprises enumerations types, these enumerations are not split up by the Technology Converter. To get the value of the enumeration, connect an Enumeration Converter to the corresponding output of the Technology Converter.

For every Technology Converter and Enumeration Converter an online help window, displaying the interface description is available. Select the Technology Converter and press F1 to get the interface description.

8.4.4 IEC61131 Program Cycle Time

IEC61131 programs are performed in a periodical manner. IEC61131 tasks are used do control the execution of an IEC61131 program. As shown in Figure 88 several default tasks are defined within the template project. Right click on the clock symbol and select properties to change the cycle time of the task.

As described in section 8.4 a program instance is required to execute the IEC61131 program. The cycle time of the IEC61131 program is controlled by the task assigned to the program instance. In order to change the cycle time right click on the program instance and select properties. In the upcoming window the task assignment for the selected program type can be changed, see Figure 92.

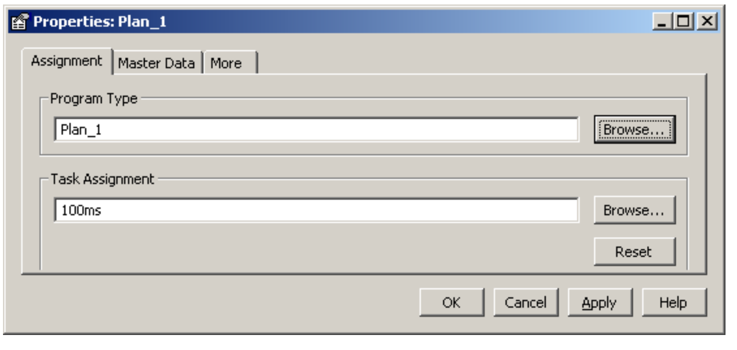


Figure 92: Task assignment

Please take care when defining names for the tasks. The names displayed in the project view are symbolic names, they do not correspond to the settings for the cycle time, even if the L-INX template project use the configured cycle time as task name.

8.4.5 CPU Overload

Several conditions affect the CPU utilization of the IEC61131 program. As a result it is not possible to predict the system load caused by the IEC61131 program. E.g. the following parameters are of particular importance when designing IEC61131 programs:

- Number of inputs and outputs handled by the I/O driver.
- Complexity of the logic in the running IEC61131 program.
- Number of simultaneously running program instances on one L-INX.
- Cycle time of IEC61131 programs.
- logiCAD breakpoint support and force-able code enabled or disabled

The developer of the IEC61131 program is able to check the current system load within the Web UI. To get a rough estimate of the CPU load investigate the PLC-LED. Every time, the system load increases 80% for a certain period of time, the PLC-LED switches to red until the system load goes below 80%.

In case of CPU overload, the IEC61131 program may not be able to finish its work within the defined cycle time. Adapt the program in order to reduce the total system load below 80%. Here are a few tips to keep the CPU load down:

- Increase the cycle time, so that the task may finish in time before the next cycle start is scheduled. The PLC kernel will always schedule the next run at an absolute time, no matter how long the previous run took, in order to compensate for irregular execution times and keep a steady cycle time if possible.
- Reduce the number of I/O variables, to reduce the load caused by exchanging data between the PLC program and the data points of the automation server.
- Reduce the number of independent tasks and try to place as much functionality as possible into one task. Every running task will call the I/O driver for new inputs and outputs independently, therefore two tasks running at a 1s cycle time each will cause twice the I/O load of one task running at 1s cycle time.
- Take special care about the complexity of function blocks which are used a lot. Bad performance of one such block may dramatically increase CPU load if it needs to be calculated several hundred times in one cycle.
- Try to disable breakpoint support and force-able code when generating code for the target, to get the most efficient PLC code out of your logic.
- For complex designs, it may be possible to add a state machine using SFC elements and enable/disable large parts of the logic based on the current state of operation.
- Whenever a function does not need to calculate new output values under certain conditions, use the built-in EN input of the block to disable execution and thus reduce the required CPU time, instead of adding your own ‘Enable’ input which causes the logic to ‘behave’ as if it would be disabled, while it is actually calculated every cycle. This is similar to power saving methods used in modern electronic devices. Parts which are not required are put into a low power mode instead of keeping them running in an unproductive state.

8.4.6 I/O Driver Settings

Before starting the IEC61131 program, the device performs a check on all defined global variables, which are marked %I, %O, or %M in the physical address parameter. For all variables, which cannot be loaded, because the corresponding data points cannot be located on the device, the I/O driver reports a warning in the system log and shows a listing on the Web interface.

Since IEC61131 program and the data point configuration are downloaded separately, it may be possible that the IEC61131 program does not match the currently active data point interface. In this case it could be dangerous to write values onto those potentially wrong data points. The fact that there are any variables that could not be loaded is taken as an indication for a configuration mismatch. The **I/O Check** feature disables the I/O driver of the IEC61131 kernel automatically in this situation. This setting is enabled by default in a new configuration. In the rare case that it is intended to have missing data points, this feature can be disabled in the Configurator. In the system settings de-select the I/O check (see Figure 93). If the I/O driver is disabled, it can be temporarily enabled again on the Web interface until the next reboot.

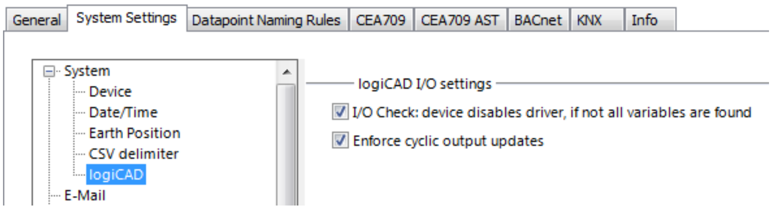


Figure 93: System settings for logiCAD I/O settings.

The project setting **Enforce cyclic output update** enables a cyclic update of output data points, which will ensure that those output data points will contain the calculated value after each cycle. This is the default setting. It can be disabled, if the output data point shall be written only if the calculated value changes. In this mode the output data point can be modified over the Web UI for debugging reasons until the IEC61131 program calculates a new value. This mode can also be used to implement an event-style output operation.

8.4.7 PLC Conflicts

PLC output variables are cyclically updating the respective data points, which are configured as PLC out. If those data points are also written to by other objects (e.g. output of a math object, receiver in a connection) this will not have the desired effect. Also favorites that are PLC out and linked to a PLC out data point will result in two different PLC output variables writing to one and the same data point.

The **PLC Conflicts** tab provides information for detecting such write conflicts on PLC out data points. The tab shows a list of PLC write conflicts and the writing objects, which are in conflict with a PLC out data point. Each reported conflict line can be selected. By clicking the **Go to data point** button  the Configurator navigates to the conflicting object.

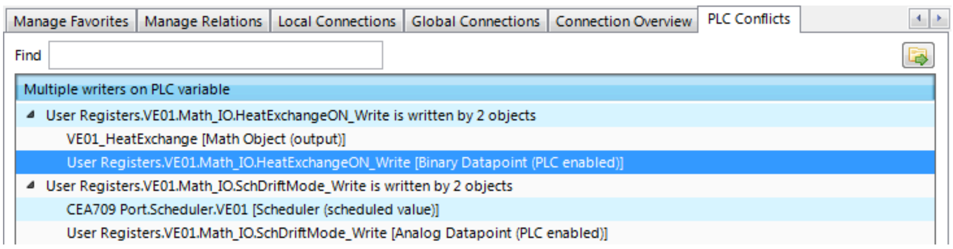


Figure 94: PLC conflicts tab.

An example is shown in Figure 94. The user register ‘HeatExchangeON_Write’ is written to by the PLC, because it is PLC out. But the register is also an output in the math object ‘VE01_HeatExchange’. To resolve the conflict, either remove the register from the math object or remove the PLC out check box from the user register. For doing the latter, select the conflict line reporting the register and select **Go to data point**. Then uncheck PLC out on the data point.

8.5 Workflows for the L-INX

8.5.1 Starting with Data Points

This workflow is based on defining data points used for the IEC61131 program in the L-INX Configurator and then export them to logiCAD. Figure 95 presents the basic steps of this workflow. To follow the steps refer to the quick-start description of Section 5.7. Refer to the LINX Configurator User Manual [2] about additional information how to gather information from the network.

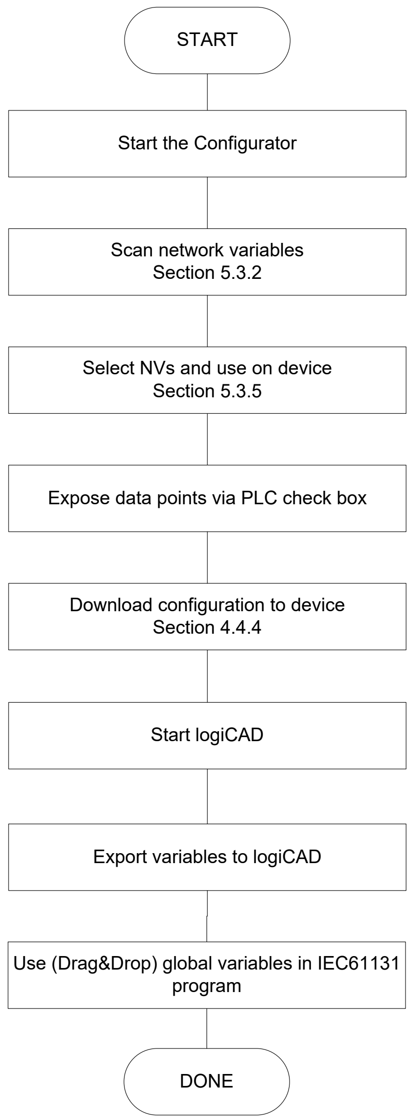


Figure 95: Start with network based information

It is assumed that there are already network data points (CEA-709, BACnet, L-IOB, etc.) available. Clicking the Export variables to logiCAD button in the Configurator creates the IEC61131 variables in logiCAD. The following rules are applied in this process:

- The name of the global variables object is derived from the technology base folder (e.g. CEA709, User Registers, etc.). If there is no matching global variables object one is created. If there is already a suitable global variables object, the existing variables are saved.

- There is already a suitable global variables object: If there is an old and new variable with identical name, the type of the variable is checked. In case of a type mismatch of the old and new variable, the old one is discarded and the new one is imported. Additional a warning is printed on the **Error-state viewer**.

- The name of the global variables object represents the folder name in the L-INX Configurator.

After exporting the data points as global variables to logiCAD, they can be used in the Functionplan 'Plan_1'. To open the respective global variables folder double-click on it. To use the imported variables simply drag and drop the required global variable on to the Functionplan, see Figure 96. The external variables (see Section 8.5.2) are automatically created when adding the global variable to the Functionplan.

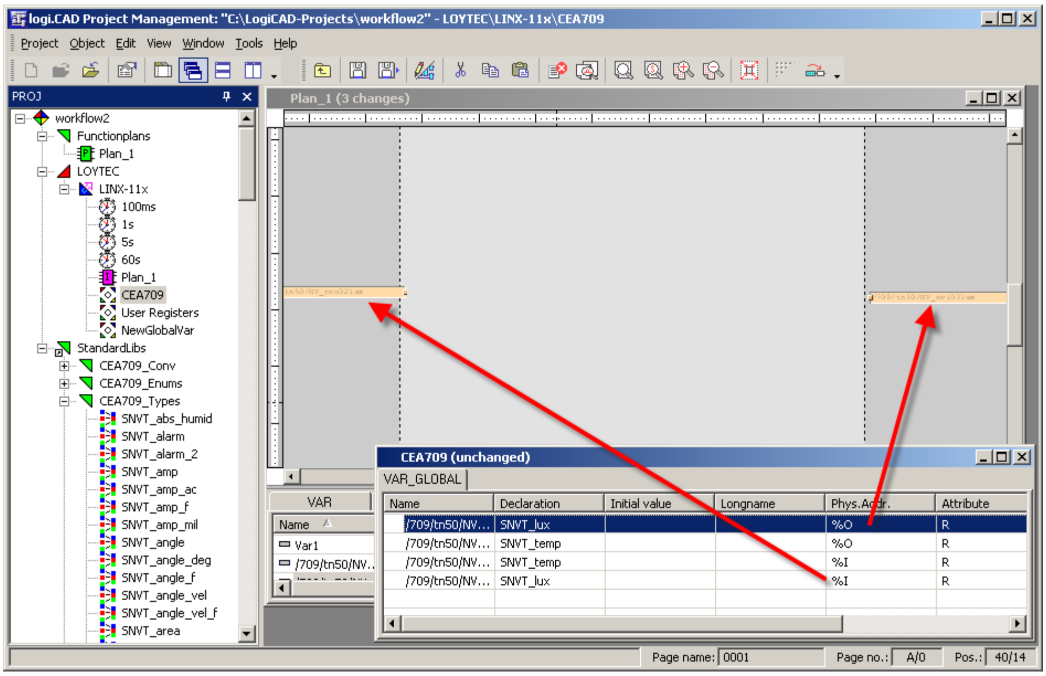


Figure 96: Adding global variables to Functionplans

After adding function blocks that perform the expected work, the IEC61131 program is ready to compile and download (see Section 8.4.2).

8.5.2 Starting with logiCAD

This section introduces a workflow how to develop a new IEC61131 program from scratch using logiCAD. Figure 97 shows the necessary steps to perform. For starting a new logiCAD project refer to the quick-start of Section 5.7.

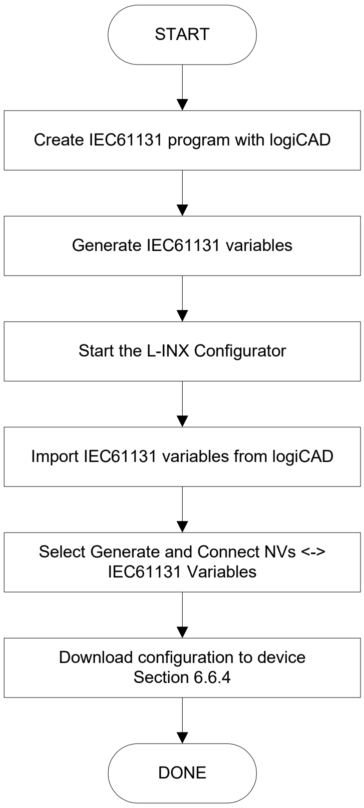


Figure 97: Starting with logiCAD

After creating a new project for a L-INX resource and opening the Functionplan Plan_1 an empty input area is shown, similar to Figure 98.

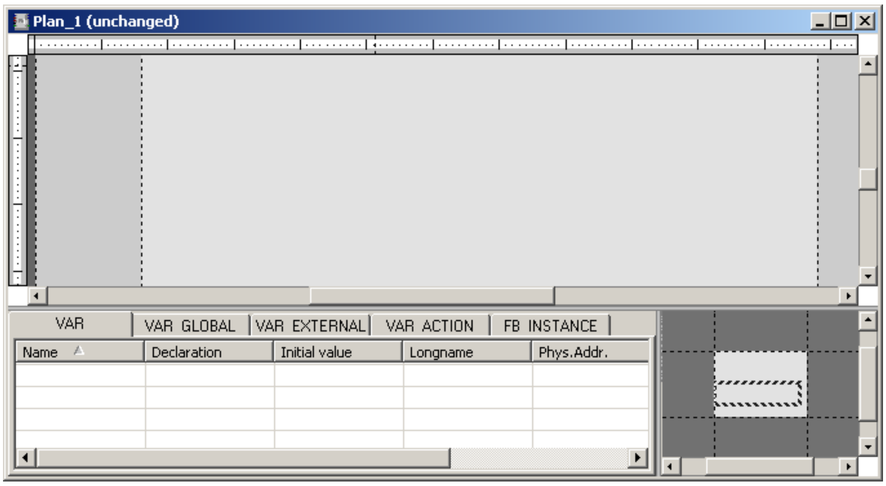


Figure 98: Start new function plan

The dark grey areas on the left and right side are intended to place the input and output variables, the light grey area is used to place the functional blocks.

As described above, global variables are used to interface IEC61131 data points on the LINX-110 device. As assumed for the current workflow, the IEC61131 data points are created on information based on the global variables exported from logiCAD. Hence, for designing the program, external variables are used during the design phase. To create a new variable select the **VAR_EXTERNAL** tab, right click in the declaration area and select **New**, as shown in Figure 99.

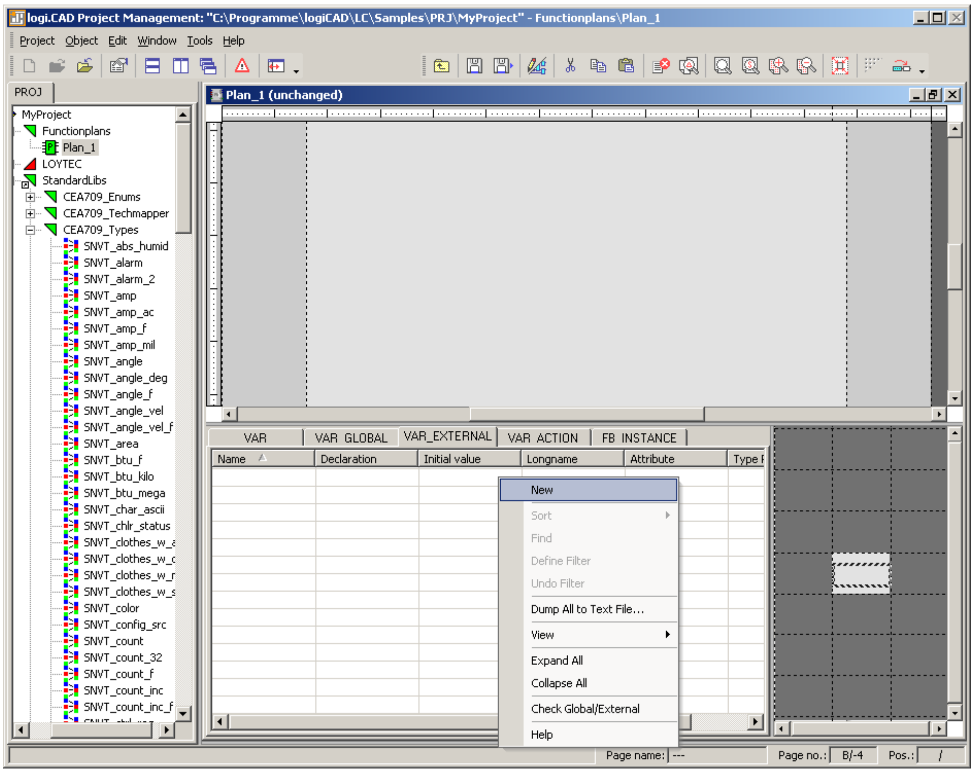


Figure 99: New external variable

In the upcoming dialog the name and the type declaration of the variable must be specified. The type declaration can be done directly by prompting the type into the declaration field, by selecting the type from the pull-down menu or by drag-and-drop of a specific type from the project tree, see Figure 100. Finally, the new variable is added by pressing the **Add** button.

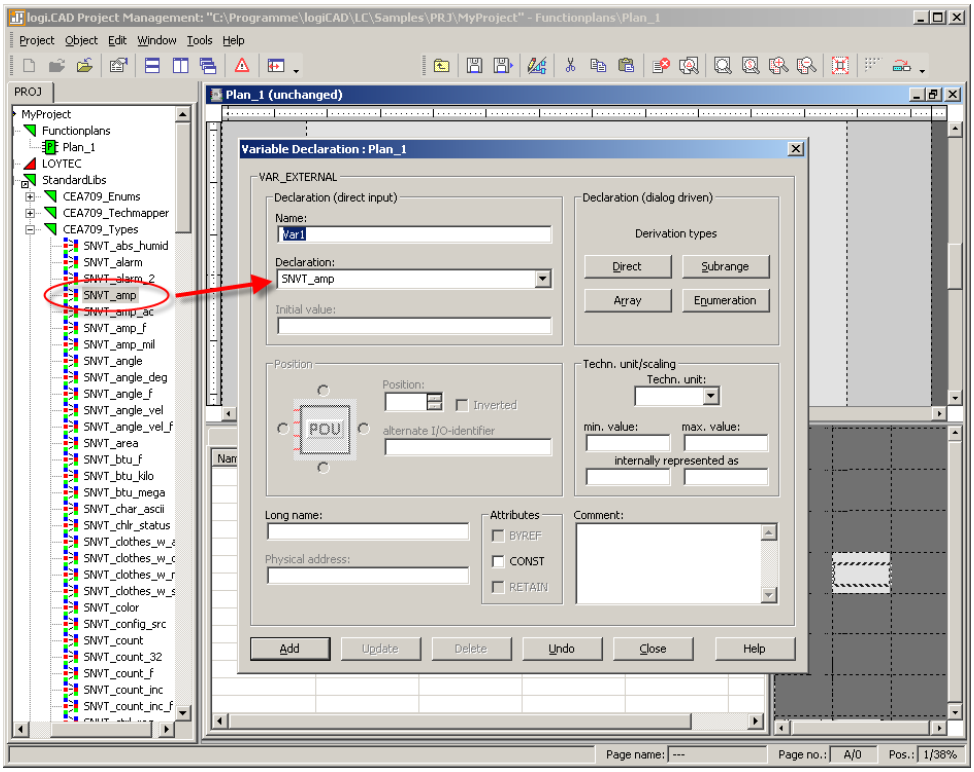


Figure 100: External variable type declaration

The created variable is added to the declaration area and placed to the drawing area by drag-and-drop. At this time the direction of the external variable is not defined, it can be used as input as well as output variable.

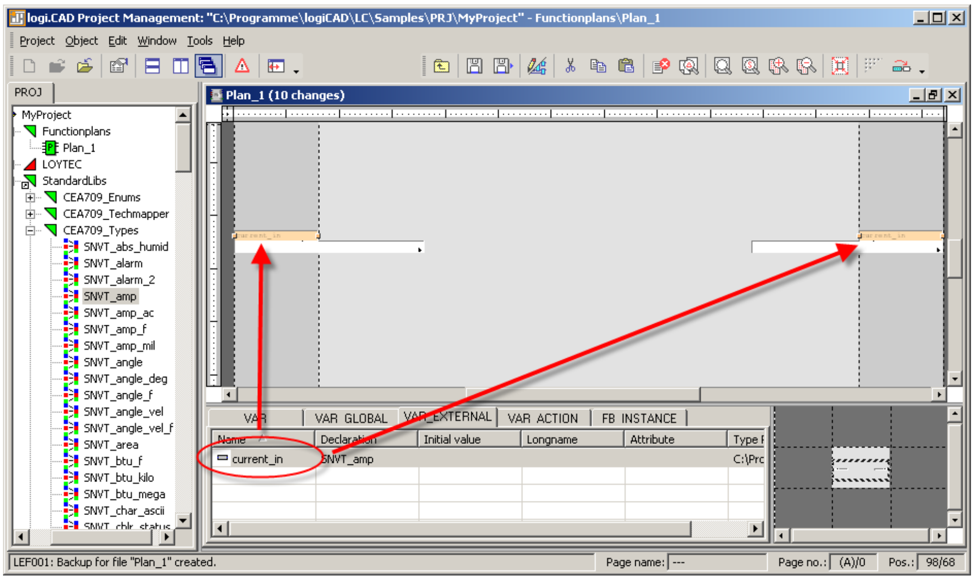


Figure 101: Drag-and-drop external variable to drawing area

Please take care to use an external variable only as input OR output. After adding the external variables to the drawing area, add function blocks to perform the desired actions, see Figure 102 for a sample configuration.

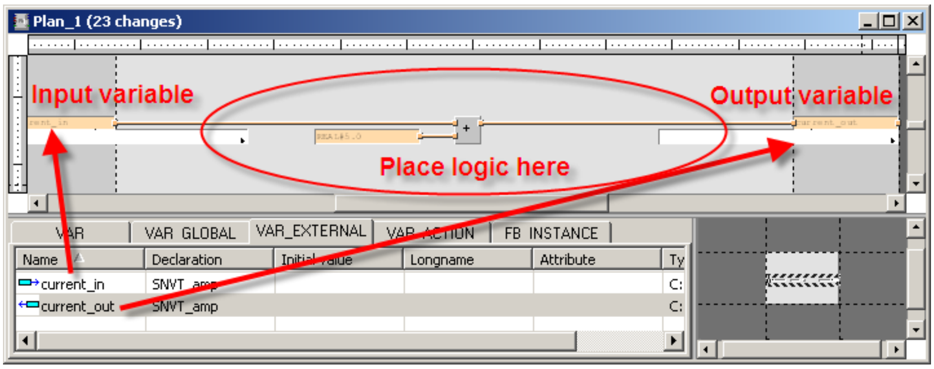


Figure 102: Use external variables

The Functionplan ‘Plan_1’ represents now a simple program. It adds a defined value to the value of the input variable and sends the result to the output variable.

Add all expected functionality to the ‘Plan_1’ or use different Functionplans to split up the expected functionality into smaller pieces. But take care about the name and type declaration of external variables when using more than one Functionplan. All external variables with the same name refer to the same global variable.

After adding all functionality, global variables matching the requirements of the defined external variables, must be generated. A tool automatically performs the process of generating the global variables object and the required global variables.

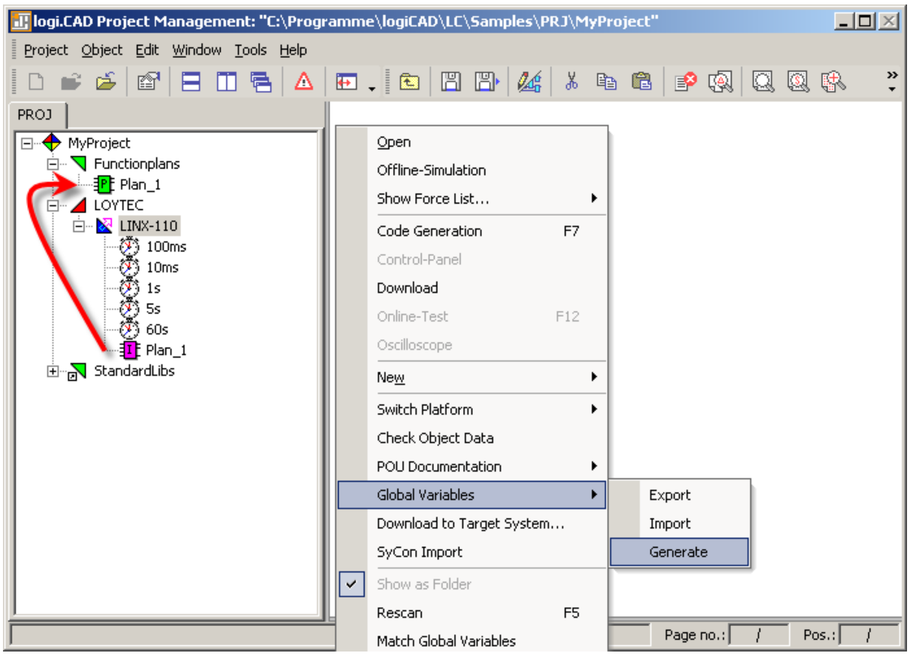


Figure 103: Auto-create global variables

To start the creation of global variables, based on external variables, **Save** all changes, then right click the L-INX device and select **Global Variables → Generate**. Then the selected L-INX resource is parsed and every program instance found is checked for external variables. In Figure 103 the type instance Plan_1 refers to the Functionplan ‘Plan_1’, as defined in Figure 102. If there are more Functionplans than the predefined ‘Plan_1’ appropriate program instances for these plans must be added to the resource before creating the global variables. Anyway, only Functionplans referred from program instances are executed.

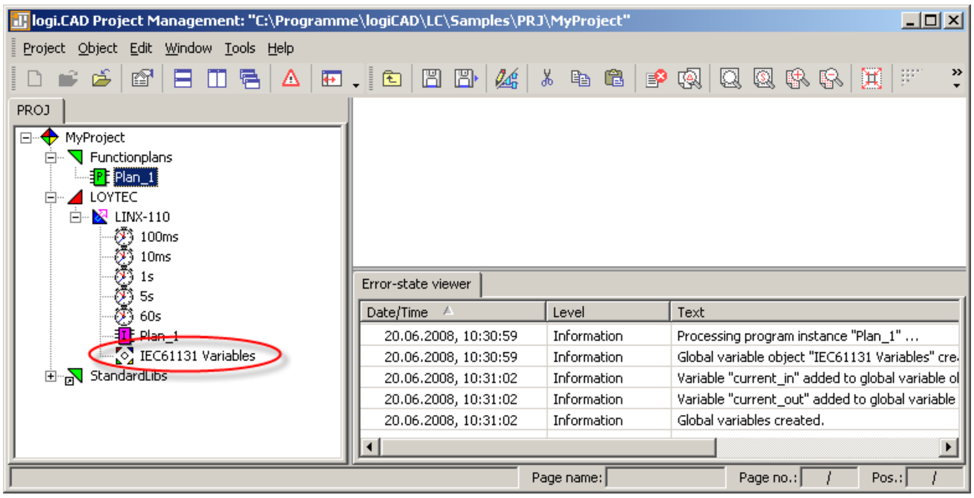


Figure 104: Created global variables object

Now there is a global variables object called IEC61131 Variables available, containing all global representations of the external variables defined before. The **Error-state viewer** reports all processed program instances and added variables, see Figure 104 for details.

The global variables are crated based on the following rules:

- The direction of the variable is determined based on the graphical representation, shown in Figure 105.

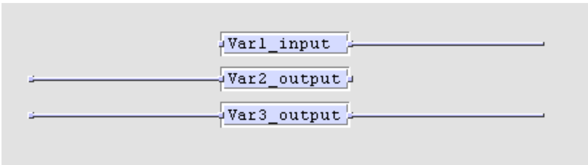


Figure 105: Direction of global variables

  Every external variable connected on the right terminal results in a global input variable. External variables connected on the left terminal or on both sides results in a global output variable. Variables connected on both sides can either be used for the force update feature (see section 8.6.1) or as marker (see section 8.6.4). As the tool can not distinguish between these two possibilities, per default a global output variable is created.

- If there is already a global variables object, only new variables are added. In case of external variables using the same name as an already existing global variable, the new definition is used and a warning is printed in the **Error-state viewer**.

- In case of two Functionplans, each referring to a global variable with the same name but a different type, the creation process is stopped and an error is printed in the **Error-state viewer**.

Now the IEC61131 program is ready to compile and download, refer to section 8.4.2 for details.

Based on the above created global variables corresponding IEC61131 data points are created on the L-INX. For doing so, start the L-INX Configurator and click the speed button **Import variables from logiCAD**. Data points are created in the **IEC61131 Variables** folder.

The Configurator reports the results of the import. For the import process the following rules are applied:

- New variables are added
- Variables with same name and type are ignored
- If there are variables with the same name but different type or direction, the variable to import is ignored and a warning is added to the import log.

The name of the folder to import the new variables corresponds to the name of the global variables object. Figure 106 shows the result of the import process.

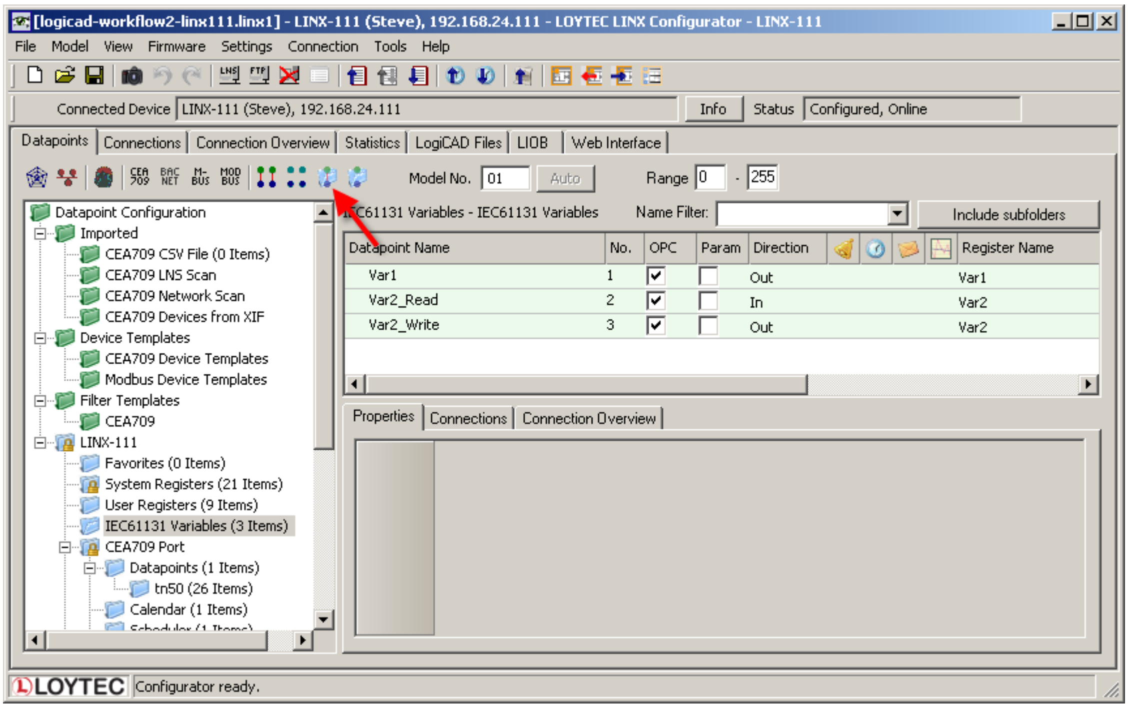


Figure 106: Connect IEC61131 variables

To create the appropriate network data points for all imported IEC61131 variables select the **IEC61131 Variables** folder and press the button **Generate and Connect Network <-> IEC61131 variable from folder**. Check the log output for errors and finally download the configuration to the L-INX device.

After rebooting the L-INX device the IEC61131 program is up and running. Check the PLC LED for potential overload.

8.5.3 Pre-compiled IEC61131 Program

In opposite to the last two chapters it is assumed that there are already some components finished, hence starting up from scratch is not suitable. Second, there is the possibility to have an already defined IEC61131 program or an already fixed network interface.

Starting with an already precompiled IEC61131 program results in a similar workflow as presented in Section 8.5.1. The difference is that all logiCAD related tasks are missing. As the IEC61131 program is compiled, the name of the IEC61131 data points is already fixed. The definitions for the data points must be available either in form of a CSV file to import to the L-INX Configurator or as part of a L-INX Configurator project. If the network interface for the L-INX was not already defined, the L-INX Configurator can be used to generate and connect the needed data points.

Additionally, there is the possibility that also the network data points are already fixed or that a given, user-defined interface is necessary. Then the developer has to connect the IEC61131 data points to the corresponding network data points by himself.

Finally, after downloading the configuration and rebooting the L-INX, the IEC61131 program can be downloaded to the L-INX via the Web UI or the L-INX Configurator. After a final reboot the L-INX loads and executes the IEC61131 program.

8.6 Additional Features

8.6.1 Force Update Functionality

Per default the IEC61131 program only sends updates on changed output values. Every program cycle the input values are fetched, the IEC61131 program is executed and the calculated values are sent to the output driver. If the old values are identically with the new one no updates are sent to the IEC61131 data points. As a result no update is sent to the network.

For some applications, e.g. for a scene controller, it is necessary to send an update on request. E.g. every time the input value is updated, the output value is forwarded to the network, regardless if the value of the output value was changed or not.

For implementing this feature, special vendor blocks are available. First it is necessary to check if there was an update on a selected input within the last execution cycle of the running IEC61131 program. That functionality is offered by the function block **Update Notify** located in the StandardLibs→Loytec_Support folder. Second, an output must be forced to send an update even if the value was not changed. The function block Force Update is used for that functionality, it is located in the StandardLibs→Loytec_Support.

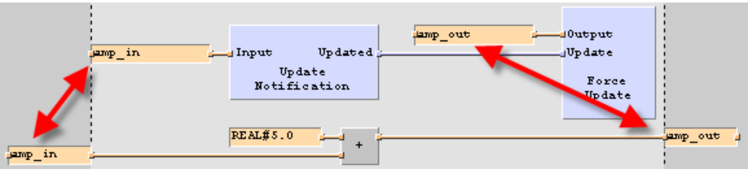


Figure 107: Force update

Figure 107 depicts how to use the force update functionality. Besides of the part of the IEC61131 program that defines the calculations to perform (lower half of Figure 107), additional logic for the force update functionality is required. The global input variable that is monitored for changes is connected to the Update Notification function block. As a result, the Boolean output 'Updated' is set to TRUE for one program cycle, if the value of the connected variable has been updated since the last cycle start. To force the I/O driver send out an update, the global output variable, which shall be updated, is connected to 'Output' of the Force Update block. Hence, every time the 'Update' input of the Force Update block is TRUE, the connected global output variable sends out an update at the end of the program cycle.

Important: ***Every global variable connected to the update notification or force update block must be connected via the right-hand side terminal!***

8.6.2 Using UNVT variables

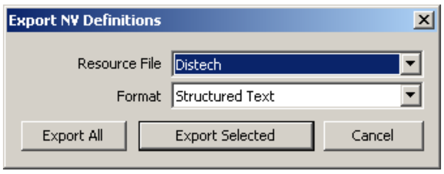
Similar to the predefined CEA709 data types and the technology converter functions, user-defined network variable data types can be used. The L-INX Configurator supports the developer to generate the type definitions needed for UNVTs and enumerations based on resources files. LONMARK

To generate type definitionf for UNVTs in logiCAD

1. Start the L-INX Configurator.

2. Select the menu Tools → Export NV Resource File….

3. Select the resource file to be exported. Select structured text as format and export the file to a location of your choice by clicking **Export Selected**.



4. To import the created type definition file into logiCAD, add a new library to the project. Right-click on the created library and select **Export/Import → Start ST-Import**.

5. Select the file to be imported and check the **Error-state viewer** for the results of the import process.

Using the newly created data types, suitable technology converter function blocks can be created. For each UNVT type, create a normal function block to convert an input of the UNVT type to a number of standard IEC61131 data types and vice versa. You may look at the technology converter blocks for SNVT types which are provided by LOYTEC, to get ideas how to implement your own converter functions.

8.6.3 Create Your Own Data Type

For special applications, custom IEC61131 compliant data types may be created by the user, which do not correspond to any CEA709 network type but should still be available as a data point on the L-INX automation server, in order to access the data point value from the Web interface or over XML as a parameter. Further, such data points can also be made persistent, which makes variables of such custom data types persistent.

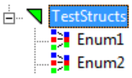
Most of the IEC61131 data types may be used as global variables on the device and the L-INX Configurator will be able to create a suitable register data point for the IEC61131 data type. Supported data types include custom enumeration types (a multi-state register with the required states will be created automatically), strings (a string data point with a maximum length of 128 characters will be built), structures and simple arrays.

If such structured variables shall be mapped to a data point, which shall only be persistent to store the structure but no access to its elements are required in the data point interface create a suitable register data point during the IEC61131 variable import. In this case the data size of custom structures cannot be determined automatically, so the L-INX Configurator does not know how to create a suitable user data point. As a workaround, the type name must contain the desired size of the data point in bytes, for example: MyStructuredType(UT16) will tell the L-INX Configurator to create an IEC61131 register of type ‘user’ with a length of 16 bytes, to hold the data for the IEC61131 structure defined in the logiCAD program.

As an alternative, structures and arrays the logiCAD type definitions can be exported to the Configurator using structured text. The Configurator builds custom structured data point types in the logiCAD category out of the structured text definitions. In this case, the exact data size of a user register is determined by the structured data type. Structure members of the logiCAD types are represented as a tree of sub-data points. logiCAD arrays (like ARRAY [1..16] OF INT) are represented as a series of single data points where each data point represents one array element. Note, that the array in logiCAD can still be access by index.

To Use logiCAD Types in User Registers

1. In logiCAD right-click on the library with the types that shall be exported and select **Export code…**.



2. In the export dialog choose '.ST' as the export configuration, select the option single file and choose a target file (see Figure 108). Then click **Export**, which creates the structured text file.

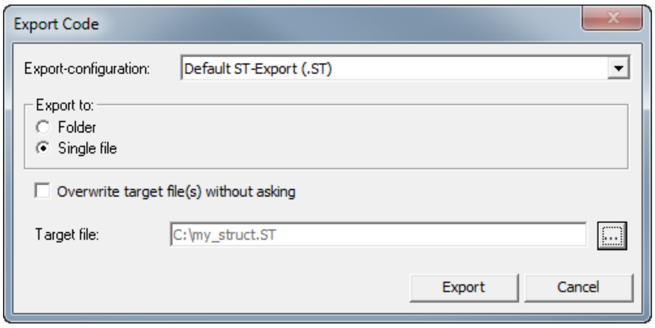


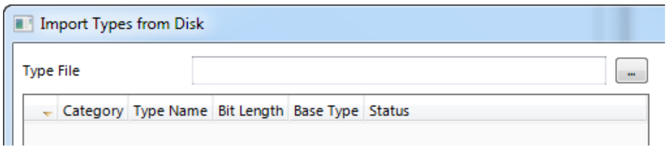
Figure 108: Export logiCAD types as structured text.

3. In the Configurator go to the menu **Tools → Manage Structured Types**.

4. In the dialog choose the type **Category** 'logiCAD'.

5. Click the speed button **Load types from disk** .

6. In the dialog **Import Types from Disk** click on .

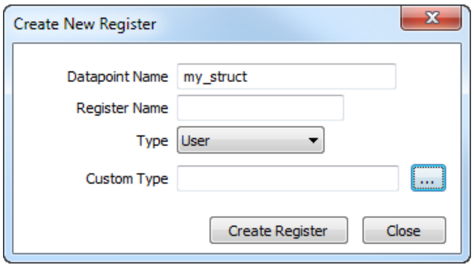


7. In the file selector dialog, choose the file type Structured Text '.ST' and open the previously exported file.

8. The available types in the structured text file appear on the left-hand side of the dialog. Transfer all listed types to the Configurator by clicking . Alternatively select specific types and click . Then click **Close**.

9. In the **Manage Structured Types** dialog, the imported logiCAD types are now listed. Click **Close**.

10. Now you are able to create a structured user register. For **Custom Type** choose one of the imported logiCAD structure types.



8.6.4 Using Persistent Data Points and Markers

Persistent data points are data points on the device that hold their value even after power loss. In the IEC61131 program there is no difference in handling global variables connected to persistent data points or to non-persistent data points. When using global variables on the device resource that shall retain their values after a reboot, the respective data points need to be configured with the persistent flag in the L-INX Configurator.

Global input variables marked as persistent, supply the IEC61131 program every time with the last received, valid data, even after a power failure. To enable this behavior, set the respective input data points persistent in the L-INX Configurator and download the data point configuration to the device.

Global variables declared as marker can be used as input and output variable in IEC61131 programs. LogiCAD is not able to distinguish markers from global output variables used in combination with the force update feature, see Figure 107. As a result it is not possible to create a global variables object holding markers automatically. The procedure as described in Section 8.5.1 is not able to decide when to create an output variable or a marker. Markers must be created manually by adding them to the global variables object and setting the physical address to %M.

8.6.5 Using Retain Variables

Retain variables can be used to maintain certain states or parameters of a program over a reboot in those variables, which cannot be kept in persistent data points. Typically, input variables (%I) will be marked as retain variables. For doing so check the **RETAIN** attribute in the variable declaration when creating or editing a variable as shown in Figure 109.

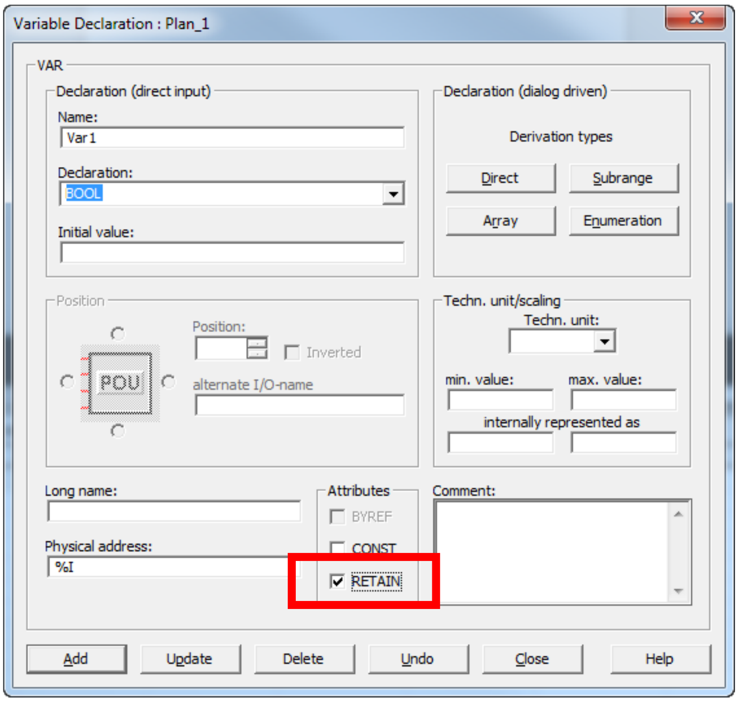


Figure 109: Declaring a retain variable.

The retain attribute should be used in global variables and local variables on function plan only. Global variables on the device resource are managed by the I/O driver and must not use the retain attribute. Instead data point persistency (see Section 8.6.4) must be used for those variables. Furthermore, it is not recommended to mark local variables in function blocks as retain variables.

The contents of retain variables are written to Flash storage every 5 minutes and when shutting down the device. This provides good compromise between write granularity for normal operation and ensuring Flash life-time. If the contents shall be written explicitly at a defined time, use the **RetainCtl** function block located in the **logi.library/Data** folder. Connect the store input (S) and set this input TRUE for one cycle to trigger writing retain data. Make sure to set the input back to FALSE after this cycle to avoid multiple consecutive writes.

8.6.6 L-INX System Registers, System Time

L-INX system registers, such as the system time or the CPU load, can be used within IEC61131 programs. Therefore, for each system input variable, a global input variable of type UDINT may be created within the IEC61131 program. Then, connections to the appropriate system registers are created manually with the L-INX Configurator.

To use the system time within the IEC61131 program, connect the AtoDT converter (located in the StandardLibs->IEC61131-3_ (EXT) folder) to the global input variable that receives the system time.

8.6.7 Code Protection

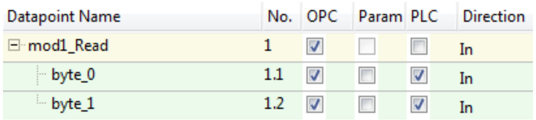
There are 4 data points used for code protection. These data points, in combination with an adapted IEC61131 program, can be used to protect your 61131-Program Intellectual Property. Please contact LOYTEC sales for further information.

8.6.8 Using Structured Data Point Members

Some network technologies provide structured data points. Their types are defined by the network technology and are available in the Configurator. Those structure types can either be used in logiCAD by implementing a technology converter (see Section 8.4.3) or by exposing the sub-data points of the respective structures.

To Use Sub-Data Points in logiCAD

1. In the Configurator, expand the structured data point and expose the desired sub-data points of its structure members to the PLC.



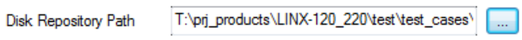
2. Export the variables to logiCAD. The exposed structure members appear for example as '/UR/mod1_Read.byte_0' in the 'User Registers' global variables block.

3. Export the types for the respective type category in the menu **Tools → Manage Structured Types…** . This opens the structured types management dialog.

4. Choose the type **Category**, e.g. 'Modbus'.

5. Click the speed button Save to disk .

6. In the dialog **Export Type to Disk** choose a **Disk Repository Path** and select the extension '.ST' for structured text.

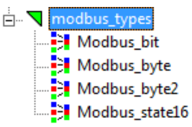


7. Copy all listed types to the disk repository by clicking . Alternatively select specific types and click . Then click **Save** and exit the dialog.

8. In logiCAD create a new library folder, e.g. 'modbus_types'.

9. Right-click on that new library and select **Export/Import → Start ST Import**. In the file dialog choose the previously exported structured text file.

10. The type definitions are now available in the new library.



8.6.9 BACnet Server Objects

BACnet server objects provide additional functionality compared to other network technologies. The most important tasks in an IEC61131 program are:

- Reading sensor data from BACnet input objects,
- writing to commandable BACnet objects with a priority,
- revoking values from commandable BACnet objects,
- handling objects when out of service.

The default data flow direction for a commandable BACnet object (e.g. AO) is input to the PLC (%I). This means its value is commanded over the BACnet network and the logic processes the resulting value. The default for non-commandable BACnet objects (e.g. AI) is output (%O). This means the logic writes the value, which is read out of the object over the BACnet network. With this type of variables the BACnet objects are treated as variables of the IEC61131 program.

When exposing local I/O to BACnet server objects, the BACnet objects represent the I/O values and the IEC61131 program behaves like a user from the network on those objects. Typically sensor values are connected to BACnet input objects (e.g. AI). To read the sensor value the PLC needs an input variable. Since the default data point direction is output, a separate access data point for the PLC must be created. For doing so, use the **Add/Remove BACnet properties** option from the context menu of the data point list and create a read data point for the Present_Value. Figure 110 shows an example, where the PLC uses the input '/BAC/AI2.Present_Value_Read' to get the sensor values from AI2.

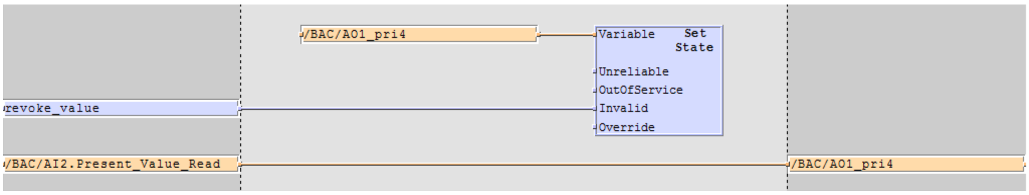


Figure 110: PLC with BACnet objects.

BACnet output objects (e.g. AO) are connected to actuator I/Os. On those BACnet objects the PLC behaves like a user from the network and needs to write and revoke values at certain priority slots. For writing with a certain priority to a commandable object, a priority write data point needs to be created (see LINX Configurator User Manual [2], Section BACnet Configuration, Write and Read with Priority). This data point is configured with a BACnet write priority in the Configurator and used as an output in the PLC. The example in Figure 110 writes with priority '4' to AO1 over '/BAC/AO1_pri4'.

To revoke values in commandable server objects, the **SetValueState** function block must be used. It is located in the **Loytec_Support/Service** folder. The I/O variable of the controlled BACnet object is connected to the **Variable** input of the function block. A Boolean signal needs to be connected to the **Invalid** input. When this input changes to TRUE, the value is revoked at the respective priority slot. When it remains TRUE in the next cycle the service function block is idle. Figure 110 shows an example, how to revoke a value in 'AO1' at priority slot '4'.

With the out-of-service feature BACnet server objects can be decoupled from the senor and actuator I/O equipment. When taken out of service, the I/O variables of the PLC are then decoupled from the network. The input variable Present_Value_Read of an AI no longer tracks the sensor value but reflects the value set in the AI from a BACnet OWS. This holds true for all non-commandable BACnet objects. Writing to the priority output variable of an AO only updates the priority array but no longer drives the actuator. This holds true for all commandable BACnet objects.

The out-of-service state is reflected in the data point status and can be accessed with the **ValueState** function block. This function block reads the value state and is used in a similar fashion as the **SetValueState** function block.

8.6.10 Custom Serial Protocols

A logiCAD program can implement simple custom serial protocols using the **SerialComm** function block. The logic program assigns the Baud rate settings for the protocol as well as a logical *bus number*. This bus number can be selected on the port configuration Web UI in order to activate the custom serial protocol on that port.

Custom serial protocols with the following communication properties can be supported:

- ASCII protocol: The serial communication block works with strings that are transmitted and received.
- Line-Oriented: Each command and reply is modeled as a text line. The line can be terminated by any combination of CR and LF.
- Start/End Character: If not line-oriented, a start and end character can be specified to detect start and end of a frame. The end character must be escaped in the frame content.
- Master/Slave: The serial communication block is a master, which sends requests over the serial port and expects slave(s) to respond. The serial communication block can also implement a slave, which receives requests and creates responses.
- Addressing Information: If the serial protocol has more than one slave, each request must have address information, which selects a specific slave. Especially for RS-485 bus communication address information is required. Since frames sent out are also received, they need to be filtered out by address.

To start the implementation of a custom serial protocol use the function block **SerialComm** located in the StandardLibs→Loytec_Support→Service folder. Add a bus number and communication settings as a string (e.g., „38400-8N1-X") as shown in Figure 111. Best practice for an implementation is to use an SFC-based state machine. All necessary input and output signals are available on this function block. The minimum number of states is Idle, Rx, Tx. For a full specification of this block use the F1 help.

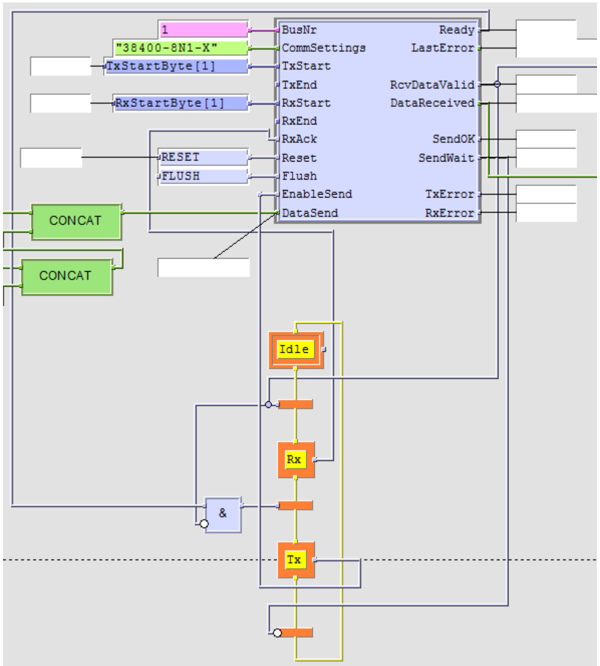


Figure 111: Example for the SerialComm block.

String processing may build commands from data point values and extract data from responses, which are written to data points. The data points should be user registers that are organized into a separate sub-folder for the custom serial protocol.

9 Firmware Update

The L-INX and L-GATE firmware support remote upgrade over the network and the serial console.

To guarantee that the device is not destroyed due to a failed firmware update, the firmware consists of two images:

1. The fallback image,
2. the 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 device boots up with the fallback image, the all port LEDs are flashing red.

Newer devices do not have a dedicated fallback image anymore. Instead, they keep the last working firmware image as a backup. If a firmware upgrade fails or renders the device unsuable in any other way, the last working firmware image is re-installed.

The firmware image is distributed in a firmware ZIP archive that applies to all L-INX and L-GATE models.

9.1 Firmware Update via the Configurator

The primary image can be updated using the Configurator. For this purpose, it is recommended to have the device connected to the Ethernet and to have a valid IP configuration (see Section 5.2). The Configurator must be installed as described in the LINX Configurator User Manual [2].

To Update the Firmware using the Configurator

1. Start the Configurator from the Windows Start menu: **Start → Programs → LOYTEC LINX Configurator → LOYTEC LINX Configurator**.
2. Select the menu: **Connection → Connect to device**. This opens the device connection dialog as shown in Figure 112.

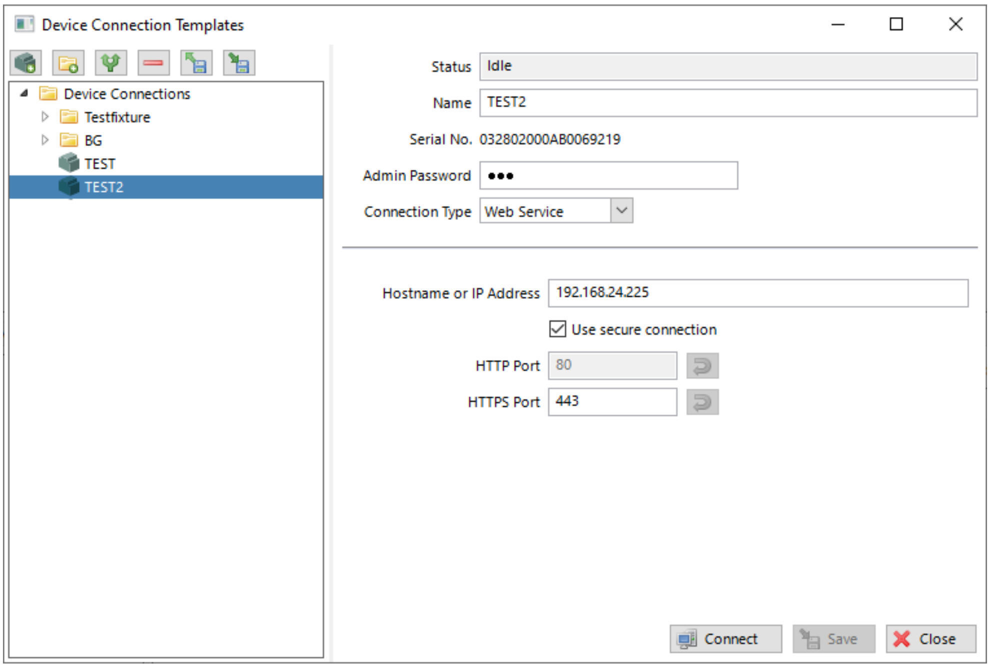


Figure 112: Device connection dialog.

3. In the connection dialog, enter the IP address of the device as well as the admin user's password. The password can be changed via the Web interface.

4. If the device uses other port settings than the standard settings or the device is operated behind a NAT router, adapt the HTTP(S) port accordingly.

5. Click on **Connect**.

Note: *Alternatively, one can also connect via LNS. A firmware upgrade over an FT-10 channel, however, needs a lot more time to complete than over IP.*

6. Optionally, check for updates by selecting the menu **Help → Check for updates …**. This function checks for new firmware and Configurator versions.

7. Select the menu: **Firmware → Update …**

8. This opens the **Firmware Update** dialog as shown in Figure 113. Click on the button and select the firmware image.

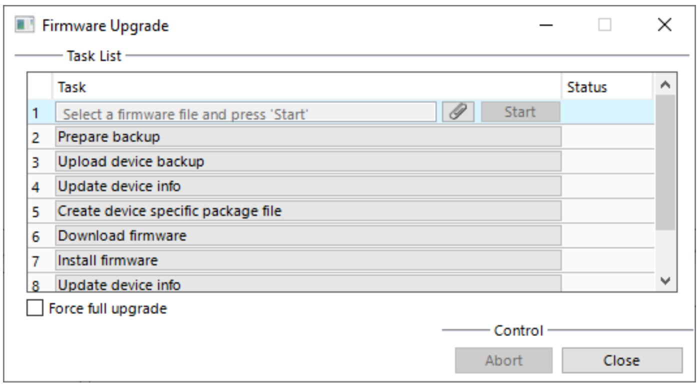


Figure 113: Firmware Update dialog of the Configurator.

9. Click on **Start** and observe the download progress.

10. When the download is complete, a dialog appears. Click **OK**.

11. In the Firmware Update dialog, click **Close**.

12. The device's firmware has now been successfully upgraded.

9.2 Firmware Update via the Web Interface

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 refer to the LOYTEC Device User Manual [1].

9.3 Firmware Update via the USB Port

The device's firmware can be upgraded using a USB memory stick. The LCD display provides a menu to select and perform the upgrade. Select **Device Management »» USB Storage »» Firmware Update** and choose the firmware file. For more details refer to the LOYTEC Device User Manual [1].

10 Troubleshooting

10.1 Technical Support

LOYTEC offers free telephone and e-mail support for the L-INX 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.
N27 W23957 Paul Road
Suite 103
Pewaukee, WI 53072
USA

e-mail: ***support@loytec-americas.com***
Web: ***http://www.loytec-americas.com***
tel: ***+1 (512) 402 5319***
fax: ***+1 (262) 408 5238***

10.2 Packet Capture

Please refer to the Troubleshooting Chapter in the LOYTEC Device User Manual [1] to learn more about packet capture on the LOYTEC device.

11 Application Notes

11.1 The LSD Tool

Please refer to application note “AN002E LSD Tool” for further information about the LOYTEC system diagnostics tool for the LINX-10X.

11.2 Use of Static, Dynamic, and External NVs on a Device

Please refer to application note “AN009E Changing Device Interface in LNS” for more information on the static NV interface, XIF files, device templates and the use of static, dynamic, and external NVs on LOYTEC gateway products.

12 Security Hardening Guide

This guide contains security-relevant information for operating the product 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 5.2. When connecting over the Web UI use https:// in the URL.
- Set a secure password for the admin and operator accounts.
- Disable the HTTP, FTP, and Telnet servers in the IP port configuration as described in the LOYTEC Device User Manual [1]. Note, that FTP and Telnet are disabled in factory defaults as of firmware 7.0.0.
- Create a new HTTPS server certificate as described in the LOYTEC Device User Manual [1].
- Set a password for the “guest” user to protect information of the device info page from unwanted disclosure.

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 9. The device firmware is signed by LOYTEC and its signature integrity is verified before the upgrade is allowed.

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:

- 443 tcp: This port is opened by the Web server and the OPC XML-DA server. It offers secure communication. Make sure the L-STUDIO deploy method is set to “loytechttps” and the Configurator as well as other clients use secure connection.
- 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 routers over the IP network. Each device needs this port open. The port can be changed.

- 1629 udp/tcp: This is the configuration server port of CEA-852. Exactly one device in the system needs this port open. Other devices register with the configuration server to form the IP-852 channel list. The port can be changed.
- 47808 udp: 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.
- 22 tcp: This port is opened by the SSH 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.
- 80 tcp: This port is opened by the Web server and the OPC XML-DA server. It should be disabled and HTTPS (port 443) be used instead. The port can be changed.
- 161 tcp: This port is opened by the SNMP server. This port is disabled by default. The port can be changed.
- 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.
- 502 tcp: This port is opened, if Modbus TCP is configured in slave mode. This port is disabled by default. The port can be changed.
- 3671 udp: This port is opened by KNXnet/IP, if KNX is enabled on the Ethernet interface. This port is disabled by default. The port can be changed.
- 1630 udp/tcp: This port is used by the CEA-709 RNI and for the remote LPA. The port can be changed and disabled.
- 2048 tcp: This port is opened by the logiCAD online test. It cannot be changed. The service can be disabled but the port will remain open.
- 16028/16029 udp: These ports are opened for LIOB-IP on the device. These ports cannot be changed. They can be disabled.
- 2002 tcp: This port is opened by the Wireshark protocol analyzer front-end. This port is disabled by default. The port can be changed.
- 4840 tcp: This port is opened by the OPC UA server. This port is disabled by default. The port can be changed.
- 5353 udp: This port is open for finding the device using mDNS names such as loytec.local. This port can be disabled.
- 61000-62299 udp: This port range is used for IEC-61499 cross-communication between controllers. The ports are assigned automatically by the L-STUDIO programming tool.

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: Primary function of the device. This service is in accordance with the standard ANSI/ASHRAE 135-2010.
- OPC XML-DA: 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:

- mDNS: This service is used for finding the device via multicast DNS in order to establish initial communication. This allows using DNS names such as loytec.local in the Web browser. This service can be disabled.
- HTTP: Web server. It provides a Web-based configuration UI. The Web UI can be disabled after setting up the device. The Web service is also used for the Configurator connection for configuration, firmware upgrade, and access to the log file.
- HTTPS: Secure Web server. It provides a Web-based configuration UI using HTTPS. It is also used for a secure Configurator connection.
- SSH: SSH server. It provides secure access to the device console menu over the network.
- 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. On devices without SSH 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.
- Modbus TCP: A Modbus TCP server is running when Modbus TCP is operated in slave mode. In all other cases this service is not needed.
- KNXnet/IP: A KNXnet/IP server is running if KNX is enabled on the Ethernet port. In all other cases this service is not needed.
- RNI: This service provides the remote network interface (RNI) function. It is also used by the remote LPA feature. If these features are not needed the service can be disabled.
- logiCAD online test: This service is used by the L-logiCAD programming tool for online debugging of IEC61131 programs. It is enabled by default on L-INX devices that have the IEC61131 logic kernel. The service can be disabled.
- LIOB-IP: This service is used by the L-IOB host function to operate LIOB-IP I/O modules. This service is enabled by default on all L-INX devices. The service can be disabled.
- OPC UA: This secure service provides access to data points over the OPC UA standard. The service is disabled by default.
- SNMP: SNMP server. It provides network management information on the device used by standard IT tools. The service is disabled by default.
- Wireshark front-end: The Wireshark protocol analyzer may connect to this service and retrieve online protocol analyzer logs. The service is disabled by default.
- IEC-61499: This service is used by the IEC 61499 runtime for cross-communication between controllers.

12.5 Upgrade Key Strength

The secure services (HTTPS, SSH) rely on certificates to authenticate the device against the connecting client. This is key to prevent man-in-the-middle attacks. The device comes with pre-installed server certificates. It is recommended to upgrade the pre-installed certificate to an individual server-certificate and use stronger key length.

- Server certificate (for HTTPS, OPC UA): Follow the instructions in the LOYTEC Device User Manual [1] Section 3.2.29 Certificate Management on how to upgrade the pre-installed X.509 server certificate to a custom, self-signed or CA-signed certificate with stronger key length.

- SSH key upgrade: If SSH is enabled it is recommended to upgrade the SSH key length. Refer to the LOYTEC Device User Manual [1] Section 3.2.28 SSH Server Config on how to upgrade your RSA key to 2048 bits.

12.6 Logging and Auditing

The device contains a log file, which can be read out over SSH 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 LOYTEC device.
- Time and version of the last firmware upgrade.
- Time when the device configuration has been cleared or the device was reset to factory defaults.
- Commission of the CEA-709 node/router.
- Static errors in the device and data point configuration.
- System overload situations as one-time log messages since last power-on.
- Crucial communication errors as they occur.
- Logins and login failures.
- Failed firmware upgrade attempts.

12.7 Network Access

Network access can be protected by using 802.1X port authentication (as of firmware 7.4.0) using EAP-TLS, PEAP, or TTLS. Unused Ethernet ports can be disabled.

12.8 Password Protection

Devices provide separate administrative (admin) and operative (operator) user accounts. Passwords are not stored, only a strong cryptographic hash (salted SHA256) thereof. Device login is protected by a login trap that blocks logins for 10 seconds after ten consecutive failed login attempts using different passwords to protect against brute-force password attacks. Initial password setting is enforced to use strong passwords. Without setting the initial password, the device functionality is locked down. Passwords can be up to 64 characters long and contain any printable UTF-8 character.

To protect usage of the admin password, the admin user can create additional user accounts with an admin role. Those additional user accounts can be disabled as needed. Usernames can be up to 32 characters. The built-in user accounts can be disabled, if custom user accounts with those roles have been created.

12.9 Encryption-At-Rest

Client credentials required for operation (e.g., E-Mail client) are stored in encrypted storage using AES256-CBC with nonce. The secret encryption key is bound to the device and cannot be accessed or read out of the device. Credentials can be exported or imported encrypted by a project password and PBKDF-2.

12.10 Information Policy

LOYTEC follows a policy for reporting, documenting an informing about potential security vulnerabilities and advisories:

1) The LOYTEC Web site offers a mailing list subscription to receive security-related information in a timely manner.
2) The LOYTEC Web site provides an interface to report any potential security vulnerabilities related to LOYTEC products. Incident reports can also be sent to security@loytec.com. A response will be sent with a trackable identifier.
3) LOYTEC commits to providing security fixes for zero-day exploits within 96 hours after their discovery. All other security-related fixes will be made available in the next firmware patch within 30 days.

13 Specifications

13.1 Physical Specifications

13.1.1 LINX-102/103/112/113/202/203/212/213/215 and LGATE-902

Operating Voltage	12 – 35 VDC or 12 – 24 VAC ±10 %
Power Consumption	typ. 2.5 W
In rush current	up to 950 mA @ 24 VAC
Operating Temperature (ambient)	0°C to +50°C
Storage Temperature	–10°C to +60°C
Humidity (non condensing) operating	10 to 90 % RH
Humidity (non condensing) storage	10 to 90 % RH
Enclosure	Installation enclosure 107 mm wide, DIN 43 880
Environmental Protection	IP 40 (enclosure); IP 20 (screw terminals)
Installation	DIN rail mounting (EN 50 022) or wall mounting

13.1.2 LINX-12X/15X/22X, LGATE-95X

Operating Voltage	24 VDC or 24 VAC ±10 %
Power Consumption	typ. 2.5 W
In rush current	up to 950 mA @ 24 VAC
Operating Temperature (ambient)	0°C to +50°C
Storage Temperature	–10°C to +60°C
Humidity (non condensing) operating	10 to 90 % RH
Humidity (non condensing) storage	10 to 90 % RH
Enclosure	Installation enclosure 159 mm wide, DIN 43 880
Environmental Protection	IP 40 (enclosure); IP 20 (screw terminals)
Installation	DIN rail mounting (EN 50 022) or wall mounting

13.2 Resource Limits

13.2.1 L-INX Models

Table 8 and Table 9 specify the resource limits of the different L-INX models.

The BACnet object limit for general-purpose server objects refers to BACnet objects created manually that are typically used in gateway configurations. A second, higher BACnet object limit includes auto-created by L-STUDIO that are typically used in a PLC application.

The terminal limit in the following tables defines the maximum number of usable L-IOB terminals on connected L-IOB I/O modules.

Model / Limits	102/103	112/113	120/121	150/151	153	154
Total number of data points	10,000	10,000	30,000	30,000	30,000	30,000
OPC Tags	2,000	2,000	10,000	10,000	10,000	10,000
User Registers	2,000	2,000	2,000	2,000	10,000	10,000
NVs (static, dynamic)	1,000	1,000	2,000	2,000	2,000	2,000
External NVs	1,000	1,000	2,000	2,000	2,000	2,000
Alias NVs (ECS and legacy mode)	1,000	1,000	2,000	2,000	2,000	2,000
Address table entries/legacy	512/ 15	1000/ 15	1,000/ 15	1,000/ 15	1,000/ 15	1,000/ 15
LONMARK Calendar objects	1 (25 calendar patterns)					
LONMARK Scheduler objects	100 (max. AST configuration size 384KB, 64 data points per scheduler)					
LONMARK Alarm Servers	1	1	1	1	1	1
BACnet objects (analog, binary, multi-state) general purpose	n/a	n/a	n/a	1,000	2,000	2,000
BACnet objects (incl. PLC)					6,000	
BACnet client mappings	n/a	n/a	n/a	5,000	5,000	5,000
BACnet scheduler objects	n/a	n/a	n/a	100	100	100
BACnet calendar objects	n/a	n/a	n/a	25	25	25
BACnet notification classes	n/a	n/a	n/a	32	32	32
BDT max recommended	n/a	n/a	n/a	100	100	100
Foreign devices max	n/a	n/a	n/a	256	256	256
KNX Communication Objects (per interface)	250	250	1000	1000	1000	n/a
Trend Logs	256	256	512	512	512	512
Total trended data points	256	256	1000	1000	2000	2000
Total aggregated size	200MB	200MB	60MB	60MB	200MB	200MB
E-mail templates	100	100	100	100	100	100
Math objects	100	100	100	100	100	100
Alarm Logs	10	10	10	10	10	10
Modbus data points	2,000	2,000	2,000	2,000	2,000	5,000
M-Bus data points	1,000	1,000	1,000	1,000	1,000	n/a
EnOcean data points	250	250	1,000	1,000	1,000	n/a
SMI devices (per port)	16	16	16	16	16	n/a
Connections (local)	1,000	1,000	2,000	2,000	2,000	2,000
Connections (global)	250	250	250	250	250	250
L-WEB Clients (concurrent)	32	32	32	32	32	32
L-IOB Modules	8	8	24	24	24	24
Terminal limit	200	200	600	600	600	600
LWLAN-800 AP+Mesh max clients	7	7	7	7	7	7

Table 8: Resource limits of different L-INX models

Model / Limits	202/203	212/213	215	220/221
Total number of data points	10,000	10,000	10,000	30,000
OPC Tags	2,000	2,000	5,000	10,000
User Registers	2,000	2,000	5,000	2,000
NVs (static, dynamic)	n/a	n/a	1,000	n/a
External NVs	n/a	n/a	1,000	n/a
Alias NVs (ECS and legacy mode)	n/a	n/a	1,000	n/a
Address table entries/legacy	n/a	n/a	1000/15	n/a
LONMARK Calendar objects	n/a	n/a	1 (25)	n/a
LONMARK Scheduler objects	n/a	n/a	100	n/a
LONMARK Alarm Servers	n/a	n/a	1	n/a
BACnet objects (analog, binary, multi-state)	750	750	750	1,000
BACnet objects (incl. PLC)			2000	
BACnet client mappings	750	750	750	5,000
BACnet scheduler objects	100	100	100	100
BACnet calendar objects	25	25	25	25
BACnet notification classes	32	32	32	32
BDT max recommended	100	100	100	100
Foreign devices max	256	256	256	256
KNX Communication Objects (per interface)	250	250	250	1000
Trend Logs	256	256	256	512
Total trended data points	256	256	256	1000
Total aggregated size	200MB	200MB	200MB	60MB
E-mail templates	100	100	100	100
Math objects	100	100	100	100
Alarm Logs	10	10	10	10
Modbus data points	2,000	2,000	2,000	2,000
M-Bus data points	1,000	1,000	1,000	1,000
EnOcean data points	250	250	250	1,000
SMI devices (per port)	16	16	16	16
Connections (local)	1,000	1,000	1,000	2,000
Connections (global)	250	250	250	250
L-WEB Clients (concurrent)	32	32	32	32
L-IOB Modules	8	8	8	24
Terminal limit	200	200	320	600
LWLAN-800 AP+Mesh max clients	7	7	7	7

Table 9: Resource limits of different L-INX models (cntd.)

13.2.2 L-GATE Models

Table 10 specifies the resource limits of the different L-GATE models.

Model / Limits	902	950/951	952
Total number of data points	10,000	30,000	30,000
OPC Tags	2,000	5,000	5,000
User Registers	1,000	2,000	2,000
NVs (static, dynamic)	1,000	2,000	2,000
External NVs	1,000	2,000	2,000
Alias NVs (ECS and legacy mode)	1,000	2,000	2,000
Address table entries/legacy	512/15	1,000/15	1,000/15
LONMARK Calendar objects	1 (25 calendar patterns)		
LONMARK Scheduler objects	100 (max. AST configuration size 384KB, 64 data points per scheduler)		
LONMARK Alarm Servers	1	1	1
BACnet objects (analog, binary, multi-state)	2,000	1,000	2,000
BACnet client mappings	750	1,000	1,000
BACnet scheduler objects	100	100	100
BACnet calendar objects	25	25	25
BACnet notification classes	32	32	32
BDT max recommended	100	100	100
Foreign devices max	256	256	256
KNX Communication Objects (per interface)	250	1000	1000
Trend Logs	256	512	512
Total trended data points	256	1,000	2,000
Total aggregated size	200MB	60MB	200MB
E-mail templates	100	100	100
Math objects	100	100	100
Alarm Logs	10	10	10
Modbus data points	250	2,000	2,000
M-Bus data points	250	1,000	1,000
EnOcean data points	250	1,000	1,000
SMI devices (per port)	16	16	16
Connections (local)	1,000	2,000	2,000
Connections (global)	250	250	250
L-WEB Clients (concurrent)	32	32	32
L-IOB Modules	n/a	n/a	n/a
LWLAN-800 AP+Mesh max clients	7	7	7

Table 10: Resource limits of different L-GATE models

13.3 Removable Media

13.3.1 LINX-12X/15X/22X, LGATE-950/951

SD Card	microSD form factor, max 8GB, standard density or SDHC (no SDXC), optionally with or without partition table, uses first primary partition

13.4 FCC Warning

This device has been tested and found to comply with limits for a Class B digital device, pursuant to Part 2 and 15 of FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates and radiates radio frequency energy and, if not installed and used in accordance with the user's manual, it may cause interference in which case users will be required to correct interference at their own expenses.

13.5 CE Warning

This is a Class B product. In a domestic environment, this product may cause radio interference in which case the user may be required to take adequate measures.

14 References

[1] LOYTEC Device User Manual 8.4, LOYTEC electronics GmbH, Document № 88086513, July 2025.

[2] LINX Configurator User Manual 8.4, LOYTEC electronics GmbH, Document № 88086712, July 2025.

[3] NIC User Manual 4.2, LOYTEC electronics GmbH, Document № 88067217, April 2013.

[4] LWEB-802/803 User Manual 4.6, LOYTEC electronics GmbH, Document № 88074225, April 2023.

[5] LWEB-900 User Manual 4.0.1, LOYTEC electronics GmbH, Document № 88081510, September 2022.

[6] L-VIS User Manual 8.0, LOYTEC electronics GmbH, Document № 88068527, June 2023.

[7] L-IOB I/O Module User Manual 8.4, LOYTEC electronics GmbH, Document № 88078518, July 2025.

[8] L-IP User Manual 8.4, LOYTEC electronics GmbH, Document № 88065918, June 2025.

[9] LIP-ME20x User Manual 8.4, LOYTEC electronics GmbH, Document № 88073514, July 2025.

15 Revision History

Date	Version	Author	Description
2016-03-23	6.0	STS	Re-organized User Manual structure, branched out common parts into LOYTEC Device User Manual and LINX Configurator User Manual.
2016-10-19	6.1	STS	Added new device models. Added license activation.
2017-04-24	6.2	STS	Added new device models.
2017-12-20	6.3	STS	Updated for firmware 6.3.0.
2018-05-15	6.4	STS	Updated for firmware 6.4.0. Limit changes for L-INX models.
2019-05-15	7.0	STS	Updated for firmware 7.0.0.
2020-04-30	7.2	STS	Updated for firmware 7.2.0. Removed old models LINX-100/101/110/111/200/201/210/211 and LGATE-900. Documented LWLAN-800 client limitation.
2021-01-29	7.4	STS	Updated for firmware 7.4.0. Documented LRS232-802 usage. Updated Chapter 12 Security Hardening Guide.
2022-01-30	7.6	STS	Updated for firmware 7.6.0. Section 5.2.5 LWEB-900 VPN Enrollmen. Updated Chapter 12 Security Hardening Guide.
2023-02-28	8.0	STS	Updated for firmware 8.0.0. Documented BACnet/SC availability.
2023-12-30	8.2	STS	Updated for firmware 8.2.0. Documented that L-LOGICAD license is discontinued. Updated Section 5.5. Added Section 5.6 Getting started with L-STUDIO.
2025-07-30	8.4	STS	Updated for firmware 8.4.0. Section 5.2.1: Added ‘loytec.local’ method to find devices. Updated Chapter 12 Security Hardening Guide. Section 13.2.1: Documented new limit for auto-generated PLC BACnet server objects. Documented terminal limit.