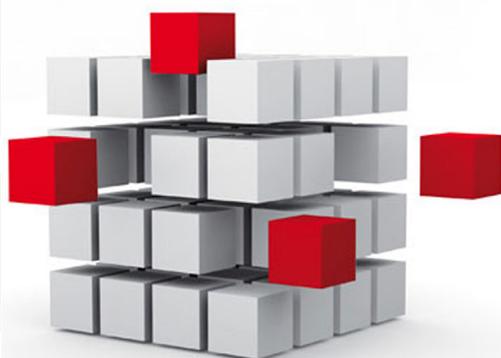


# Functions

Datasheet #89088604



LOYTEC offers a wide range of products for various applications in building automation. Those application-centric products often combine an entire set of different functions on one single device (L-INX Automation Servers, IP-capable L-IOB I/O Modules and Controllers, L-ROC Room Controllers, L-GATE Gateways, L-VIS Touch Panels). This enables a given product to be used for different tasks. For example, the L-GATE as a typical gateway also has the ability to host a graphical user interface to dynamically visualize a site or record historic data in trend logs. L-INX Automation Servers are primarily programmable controllers but can also be used as gateways depending on the available protocols.

We have high quality standards in research, development, and production of our products. In order to offer the same high standards to our customers, the programmable controllers may only be purchased by trained staff of companies that are enrolled in the LOYTEC Competence Partner Program.

For all functions, LOYTEC ensures common workflows for configuration and operation. The workflow for configuration of certain functions is the same, regardless which device

is used. This applies for integration in different communication network technologies, creating schedules, alarm conditions, trend logs, and even for the design of graphical projects. For an efficient workflow the user can – depending on the network technology – create single data points or entire device templates via a network scan or file import. The use of a single configuration tool for a range of product models such as the L-INX Automation Servers, L-IOB I/O Modules, L-IOB I/O Controllers, and L-GATE Gateways, reduces the learning curve notably when working with LOYTEC products.

The combination of different functions on a single device and the common workflows for configuration and operation offer a maximum of flexibility when selecting LOYTEC products for various application requirements. On the following pages we give an overview on the offered functions. For more detailed information on the presented functions please refer to the respective product manuals, which are available for download on our web site. The functions are represented by symbols, which are referred to by the respective product descriptions later in the catalog.

## AST™ Functions

The acronym AST™ stands for the combination of alarming (alarm management), scheduling, and trending (historic data recording) functions, which are available as automation functions on LOYTEC devices (L-INX Automation Servers, IP-capable L-IOB I/O Controllers, L-ROC Room Controllers, L-GATE Gateways, L-VIS Touch Panels). The AST™ functions can therefore be distributed into the field and are available exactly where they are needed in a building automation system. AST™ functions can be seamlessly integrated with the L-WEB building management software. Also graphical user interfaces like LWEB-802/803, the building management system LWEB-900 and the L-VIS Touch Panels provide access to the distributed AST™ functions.

## Alarming (Alarm Management)



On a LOYTEC device it is possible to define alarm conditions for each data point. This can be done independently of the underlying communication technology (CEA-709, BACnet, DALI, M-Bus, Modbus, KNX, etc.) or the underlying, physical data point of a L-IOB I/O Module.

Alarms generated by these alarm conditions are reported to a generic alarm server, which is also independent of the network technology. The alarm server collects alarm records and is the interface for remote access to those local alarms. Alarm records contain information on the alarm source data point, the alarm value, an alarm message, alarm type (off-normal, limit, fault), alarm priority, and alarm state (alarm active, acknowledged, inactive). The alarm message of the record can be user-defined and extended by variable placeholders.

LOYTEC devices with a BACnet interface support BACnet alarms with intrinsic reporting. BACnet alarm servers are mapped to BACnet notification class (NC) objects. Alarm conditions can be defined for analog input, output, and value objects (AI, AO, AV), for binary input, output, and value objects (BI, BO, BV) and for multi-state input, output, and value objects (MSI, MSO, MSV). More than this, alarm records from generic alarm servers can be reported to BACnet alarm servers and can be exposed to notification class objects. This allows the reporting of alarm conditions from other communication technologies to BACnet. Using client mappings, LOYTEC devices can also access remote BACnet notification class objects, for instance to receive alarms from third-party devices.

LOYTEC devices for LonMark Systems (CEA-709) support the transmission of alarms via the LonMark node object's nvoAlarm (SNVT\_alarm) and nvoAlarm\_2 (SNVT\_alarm\_2). This allows other devices that support the LonMark alarm notifier profile to receive alarms sent by LOYTEC devices. The acknowledgement of alarms in the LonMark alarm server is defined in the LonMark specification and works with the RQ\_CLEAR\_ALARM mechanism. Alarms from generic alarm servers can be reported to the LonMark alarm server (mapped to the LonMark node object). This way alarm conditions of data points from other network technologies can be reported to a LonMark System.

Alarms of the different alarm servers can be displayed in LWEB-900, LWEB-802/803, L-VIS Touch Panels or in the device's integrated web interface using the built-in web server.

The alarming feature also includes the recording of alarm transitions in an alarm log on the LOYTEC device. The alarm log works as a ring buffer and its size can be configured. The alarm log can be viewed on the web interface of the LOYTEC device and be exported to a CSV file. The alarm log can also be transmitted as a CSV file e-mail attachment or be downloaded from the device via FTP access.

## Scheduling



Scheduling refers to changing the value of data points on a timely basis using a time schedule. The schedule contains a weekly schedule, exception days (e.g. holidays), and date periods (e.g. vacation time). The scheduling feature works locally on LOYTEC devices and can be enabled depending on an enable data point.

All LOYTEC devices supporting the scheduling function feature a built-in battery-buffered Real Time Clock (RTC). Schedules can change the state of a binary data point or the value of an analog data point. This occurs independently of the underlying communication technology (CEA-709, BACnet, DALI, M-Bus, Modbus, KNX, etc.) or the underlying, physical data point of a L-IOB I/O Module.

Generic schedulers – like generic trends and alarms – can be created, that are neither CEA-709 nor BACnet objects. They are 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.

LOYTEC devices with a BACnet interface use the standardized BACnet schedule and calendar object to map the schedule. A separate BACnet schedule object is created for each schedule. BACnet calendar objects are used for defining exception days. The BACnet schedule object allows scheduling of a single value at a time (multistate, analog, or binary). More than one scheduled value or different data types at a time are not possible. Using the client mapping function, it is possible to access remote BACnet scheduler objects. This allows reading and modifying schedules of third-party devices.

LOYTEC devices for LonMark Systems (CEA-709) support CEA-709 schedulers and CEA-709 calendars via standard LonMark objects. For CEA-709 schedules, more than one data point can be configured, possibly of different data type, for which a set of different values can be scheduled at a time.

Schedules are executed autonomously on LOYTEC devices. The schedules and scheduled values can be viewed and configured in LWEB-900, LWEB-802/803, L-VIS Touch Panels, or on the device's web interface using the built-in web server. The distributed schedules on LOYTEC devices can be managed by the LWEB-900 Building Management System. LWEB-900 allows grouping schedules, building a hierarchical structure, and configuring schedules efficiently.

## Trending (Historic Data Logging)



Generic trend logs are technology-independent and allow the recording of historic data values over time. The recording of data point values occurs at fixed intervals, on a defined change-of-value, or is triggered by a trigger data point. Recording intervals can be aligned to the wall-time. For example, different trend logs with 15 minutes intervals can record synchronously aligned to the top of the hour. For each data point, a change-of-value condition can be defined on the LOYTEC device. Trends operate independently of the underlying communication technology (CEA-709, BACnet, DALI, M-Bus, Modbus, KNX, etc.) or the underlying, physical data point of a L-IOB I/O Module. Trend logs can record local and remote data points of other, distributed devices. The capacity of a trend log and the storage mode (linear or ring buffer) can be configured. Devices that support SD cards or have a USB port also allow the storage of trend log data on external memory. The time of backing up trend logs can be triggered by the user on the LCD display or by defined, automatic trigger conditions.

LOYTEC devices with a BACnet interface can also use BACnet trend log objects for historic data recording. These objects can be accessed over the BACnet network and expose trend data to other BACnet devices and operator workstations (OWS). Each BACnet trend log object can record data for a single data point only. The recorded data point is limited to the BACnet technology, either to a local BACnet object or to a remote BACnet object (configured by a client mapping).

LOYTEC devices for LonMark Systems (CEA-709) use generic trend logs. There exists no LonMark functionality that allows transparent LonMark access to trend log data.

Trend log data of the different trend log objects can be displayed by LWEB-900, LWEB-802/803 and L-VIS. Trend data can be viewed either in a table view or in a trend graph. In addition, the LWEB-900 server allows long-term storage of the historic trend data. For doing so, the recorded data is periodically read out from the device and stored in a database. If no permanent IP connection should exist between the L-WEB server and the respective LOYTEC devices, the devices can be configured to send trend data automatically as an e-mail attachment to the L-WEB server. Trend data can also be exported as a CSV file (via FTP access), or stored to SD card or USB memory, if the device supports it.

For certain applications, historic values of a given base data point, both recent and far into the past, can be of interest. This can be accomplished with historic filters. They allow processing historic values of the base data point according to a filter function. One or more such functions can be defined per base data point. The result of the historic filter is written to "historicFilter" property relations. For each historic filter function, a time period can be defined at which the base value is sampled, e.g., every first of the month at midnight, and how many samples ago. Historic filters can be created for any analog, binary, or multi-state data point. It is not necessary to create a trend log.

# Functions

## Communication

### IoT



The Internet of Things has brought forward an off-spring of devices with Web-based interfaces, such as Multimedia projectors, A/V systems, Smart-TVs, or smart light bulbs. LOYTEC's groundbreaking JavaScript-based IoT integration allows to integrate them all. In short: If you can control it via app, you can integrate it into the building automation system or touch panel interface.

Typical applications are meeting rooms or auditoriums with scene control of lighting and shading, integration of third-party devices, and operation of multi-media equipment by the touch of a single button. Similar products from the consumer sector like a Sonos® audio system, Philips Hue lights or Alexa and friends can be connected to the LOYTEC building control system. Some LOYTEC devices require the L-IOT1 software license.

The IoT function (Node.js) allows connecting the system to almost any cloud service, either for uploading historical data to analytics services, delivering alarm messages to alarm processing services or operating parts of the control system over a cloud service (e.g., scheduling based on Web calendars or booking systems). Processing Internet information such as weather data in forecast-based control is also possible. Finally, the JavaScript kernel also allows implementing serial protocols to non-standard equipment in primary plant control.

Benefits:

- Easy integration of multi-media equipment into the building control system
- Connect consumer products like Sonos®, Philips Hue, Alexa and friends
- Uploading data to cloud services for further processing
- Scheduling based on Web applications (e.g., Google Calendar)
- Implementing custom serial protocols

### E-mail Notification



The integrated e-mail client allows for the transmission of messages based on a timely basis or triggered by events. Message texts can be multi-line and consist of static text and variable placeholders, which are evaluated at the time of transmission and insert values into the text. Furthermore, alarm logs and trend logs can be automatically transmitted as e-mail attachments in CSV file format.

The number of transmitted e-mails can be limited. Using a trigger data point, the e-mail transmission can be invoked on a timely basis or event-based. In case an e-mail could not be delivered, retransmissions are tried every 30 minutes up to 24 times.

### SMS Notification



Together with the LTE-800 interface the transmission of SMS directly from the device becomes possible. SMS can contain configurable text and variable placeholders that resolve to data point content at the time of transmission. SMS can be sent on a timely basis or triggered by events such as alarms. This makes it easy to add an SMS alarm notifier to the device. The transmission of SMS can be limited to burst and long-term transmission rates.

### Ethernet (Ethernet Switch)



Ethernet summarizes a variety of networking technologies, software (protocols) and hardware (cable, hubs, interface cards, etc.) for wired, local area networks (LANs). Originally published in 1983 as the IEEE 802.3 standard, Ethernet has evolved to today's most used LAN technology. As a packet-switched network, Ethernet belongs to the layers 1 and 2 of the ISO/OSI layer model and defines addressing and media access. Ethernet is a common basis for networking protocols such as TCP/IP and UDP/IP and is able to multiplex several application protocols at the same time (e.g. HTTP, FTP, IP-852, BACnet/IP, KNXnet/IP).

LOYTEC devices with an Ethernet interface use 100Base-T (Fast Ethernet) at 100 Mbit/s and an RJ45 jack.

LOYTEC devices featuring two Ethernet ports can either be configured to use the internal switch to interconnect the two ports or every port is configured to work in a separate IP network.

When the Ethernet ports are configured for two separate IP networks, one port can be connected for instance to a WAN (Wide Area Network) with enabled network security (HTTPS) while the second port can be configured to be connected to an insecure network (LAN) where the standard building automation protocols like BACnet/IP, LON/IP, or Modbus TCP are present. These devices also feature firewall functionality of course to isolate particular protocols or services between the ports.

Using the internal switch, a daisy chained line topology of up to 20 devices can be built, which reduces costs for network installation. The IP switch also allows the setup of a redundant Ethernet installation (ring topology), which increases reliability. The redundant Ethernet topology is enabled by the Rapid Spanning Tree Protocol (RSTP), which is supported by most managed switches.

## Network Security and VPN



Integral part of the LOYTEC hardware is a configurable firewall, which can be enabled and configured over the built-in web server, over OPC XML-DA, or OPC UA. The built-in web server is accessed via the secure HTTPS protocol. A pre-installed certificate allows a quick setup and can later be replaced by a locally generated certificate or by a certificate issued by a certification authority. Data communication is encrypted by TLS encryption methods. The use of secure certificates prevents man-in-the-middle attacks. Furthermore, the OPC UA server provides a secure alternative to OPC XML-DA. It uses the installed server certificate and authorizes OPC clients by certificates.

LOYTEC devices can also be operated as part of a virtual private network (VPN) based on the OpenVPN technology. In a VPN setup, the device connects to a VPN server with an authenticated VPN certificate. The VPN provides a secured network channel that can carry any of the IP-based protocols. In combination with a VPN server on a public address, VPN devices can be accessed without having a public address. This provides a secure alternative to NAT forwarding and makes secure access to remote sites very simple. In combination with LWEB-900, setting up a VPN on the device is as easy as entering the LWEB-900 VPN project PIN code. LWEB-900 fully automatically generates the VPN certificates and enrolls the device in its own VPN.

## BACnet



BACnet (Building Automation and Control networks) is a standardized communication protocol for building automation (ISO 16484: Building automation and control systems – Part 5: Data communication protocol). It was developed at the end of the 1980s by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). Communication in the network is modeled on BACnet objects, which are exposed as server objects by a BACnet device. Other BACnet devices connect as clients to those BACnet server objects. The network integration is accomplished by vendor-specific configuration tools.

LOYTEC devices with a BACnet interface expose data via BACnet server objects (binary, analog, multi-state) and communicate through client mappings. Change-of-value (COV) events can trigger the transmission of values. The AST™ functions are available for BACnet scheduler, calendar, trend log, and notification class objects. Devices are connected to the BACnet network over BACnet MS/TP (twisted pair based on RS-485), BACnet/IP or BACnet/SC. BACnet objects are created in the LOYTEC Configurator tool using EDE import, online network scan, or manual creation.

As a default, BACnet objects use the ASCII character encoding on the device. This applies to the properties object name, object description, active/inactive text, state text, etc. Most third-party tools are compatible with this setting. To support international character sets, LOYTEC devices can be switched to use the encodings ISO 8895-1 (good for most Western Europe) or UCS-2 (good for Unicode character sets used in Japan).

All LOYTEC products with the BACnet/IP interface can act as BACnet time masters. It is possible to use the BACnet services TimeSynchronization and UTCTimeSynchronization in order to send out time synchronization events. This happens after a power-on reset of the device, when the system time is changed, or periodically. The system time on IP-based LOYTEC devices can be synchronized via NTP (Network Time Protocol), which allows the LOYTEC device – as a BACnet time master – to synchronize all registered BACnet devices in the network to the NTP time.

LOYTEC BACnet routers and BACnet devices with an integrated router can also function as a BACnet MS/TP slave proxy. A slave proxy answers BACnet Who-Is broadcast requests sent to slave devices on the MS/TP bus on behalf of them with appropriate I-Am packets. This covers the shortcoming of BACnet slave devices, which by definition cannot initiate communication by themselves. Using this feature, it is possible to find MS/TP slave devices in a BACnet network scan, which would not be possible without the slave proxy. LOYTEC BACnet routers, BACnet devices with an integrated router and L-GATE Gateways also have a built-in BACnet broadcast management device (BBMD) for managing BACnet/IP Internetworks that span across IP routers. BACnet models without the router function can register as a foreign device (FD) with other BBMDs.

All models with BACnet routing function can route between BACnet/IP, BACnet/SC and BACnet MS/TP.

The BACnet/SC node on LOYTEC devices provides a secure path for BACnet communication to a BACnet/SC hub. If configured with separate Ethernet ports, BACnet/IP can be operated on the LAN port which is isolated from BACnet/SC on the WAN port. Along with HTTPS this provides an extra layer of protection. Routing between BACnet/IP (LAN) and BACnet/SC (WAN) is possible.

BACnet devices with the BACnet MS/TP interface provide an additional remote MS/TP protocol analyzer. BACnet MS/TP packets are captured and can either be transmitted online to a Wireshark analyzer (sniffer program for analyzing network protocols available free of charge) or stored offline as a capture file on the device. This file can be downloaded over the web interface and opened later in Wireshark.

Other BACnet details such as the BACnet standardized device profile, the supported BIBBs (BACnet Interoperability Building Blocks) and the object properties are specified in the respective PICS (Protocol Implementation Conformance Statement) document. Apart from this, most LOYTEC devices are BTL-certified products that support the BACnet Building Controller (B-BC) profile (see also the related product descriptions).

# Functions

## BACnet Operator Workstation (B-OWS)



A BACnet Operator Workstation is designed to provide an operator with all the information and editing ability needed for managing a system on a daily basis. In addition to viewing and editing selected BACnet object, an Operator Workstation can display trends, schedules, and other specialized objects. It can also display reports and graphics. A BACnet Operator Workstation will notify the operator that an alarm has occurred, lets the operator acknowledge the alarm, provides a summary of alarms, and allows to adjust the alarm thresholds of analog objects.

## CEA-709



By the end of the 1990s, LON (Local Operating Network) was standardized by the Consumer Electronics Association (CEA) under the title "Control Network Protocol" as CEA-709. Today, the CEA-709 protocol is a recognized international communication standard, namely ISO/IEC 14908. LOYTEC is highly experienced in the CEA-709 technology. LOYTEC developed its own technology to make devices talk on CEA-709 networks. LOYTEC technology includes chip sets and also the fully featured ORION Protocol stack which executes the CEA-709 protocol on powerful 32-bit micro controllers. All LOYTEC devices supporting CEA-709 connectivity make use of this powerful technology. Communication Objects (Network Variables) and functional profiles, standardized by LonMark International ([www.LonMark.org](http://www.LonMark.org)), describe the communication interface of a LonMark device. Configuration properties (CPs) allow downloading and modification of device parameters. Network integration is accomplished by a network management tool, which is independent of the hardware manufacturer (e.g. NL220 or LonMaker®) and is used for device installation and creation of bindings between network variables, which are stored in a database. This allows for a clear separation between the application and the communication relations in the network. Configuration tools specific to LonMark nodes integrate as plug-ins into the network management tool and allow for fast and simple device configuration.

LOYTEC devices can be used in LonMark Systems with standard network variable types (SNVT) or user-defined network variable types (UNVT). The NVs can be created as static or dynamic network variables. Additionally, network variables of other LonMark nodes can be brought in via "external NVs", which are polled in a cyclical manner and written explicitly, without allocating and binding static or dynamic NVs on the LOYTEC device. LOYTEC devices also offer direct access to configuration properties of other LonMark nodes (using LonMark file transfer or read memory access methods). Both standard configuration property types (SCPTs) and user-defined configuration property types (UCPTs) are supported. Network variables are created in the Configurator tool (plug-in) by importing from a XIF file, scanning an LNS database, scanning a network online, or by manual creation. The AST™ functions alarming (alarm management) and scheduling are supported by using the respective LonMark profiles. Historic trend data can be logged by generic trend logs, which are technology-independent. Connectivity to the LonMark System is provided via IP-852 (100Base-T Ethernet) or TP/FT-10 channel with twisted pair or power line link. A sub-group of the LOYTEC devices is also LonMark certified (see product details).

## DALI



DALI (Digital Addressable Lighting Interface) is a protocol for lighting control. It is standardized in Annex E of IEC 60929 and in the IEC 62386 standard. DALI is used as a lighting control sub-system for dimming and switching ballasts with a DALI interface. The ballasts can be controlled and queried independently via DALI short addresses. Also DALI groups can be freely assigned for controlling lighting scenes. The bi-directional communication allows DALI ballasts to report operational parameters and errors. Although DALI buttons and DALI multi-sensors are not covered by the DALI standard, they are interoperable depending on the manufacturer. The DALI standard specifies the testing of emergency lighting systems with a DALI interface. In a DALI system, the DALI master controls and queries the DALI devices in a master/slave manner. The multi-master capability also allows multiple DALI masters on the channel.

LOYTEC devices with a DALI interface can be integrated in a DALI network as DALI masters with a constant light controller (CLC) function. The configuration is done via the built-in web interface or for some models via the Configurator tool. AST™ functions for alarming (alarm management), scheduling, and trending (historical data recording) are also supported. As a DALI master, the devices can be installed autonomously. For the integration in building automation systems, the LOYTEC DALI master is equipped either with a BACnet interface or an interface to LonMark Systems.

## DALI-2



The newer DALI-2 standard also covers switches, multi-sensors, bus power supplies, and control systems in addition to luminaires or ECGs. DALI-2 devices must be certified by the Digital Illumination Interface Alliance (DiiA) to be entitled to carry the DALI-2 logo. The DALI-2 certification promises significantly improved interoperability and additional functionality compared to older DALI systems on the market (version 1). LOYTEC recommends to use preferably DALI-2 certified devices. DALI and DALI-2 devices can be used simultaneously within one DALI channel.

## EnOcean



EnOcean is a radio protocol for wireless products in building automation and is defined in the international standard ISO/IEC 14543-3-10. Switches, like sensors with EnOcean technology just need little energy for sending short radio signals. The energy is mainly produced from piezoelectricity during switching (energy harvesting), the energy of solar panels, or Peltier elements. This energy is sufficient for a batteryless, hence maintenance free operation of the sender. The wireless protocol is geared to transfer information energy efficiently yet highly reliable. Frequency bands with regional differences are used. Europe: 868.3 MHz, US/Canada: 902 MHz (also 315 MHz), and Japan: 928 MHz.

For the integration of EnOcean radio switches and sensors into LOYTEC devices with EnOcean support, an EnOcean interface of the LOYTEC product family L-ENO is necessary. The L-ENO interface is simply connected via a USB cable. Also the energy for the EnOcean interface is supplied via USB likewise automatic detection.

## KNX



KNX is a communication protocol for building automation, which has been standardized internationally as ISO/IEC 14543-3 "Home Electronic Systems". KNX is used in the field of home automation and commercial building automation as well. In a KNX network, sensors and actuators are assigned to a set of communication objects. A communication object represents a value of a given type, for instance a temperature, a switch state, or a set point. The communication objects communicate via group addresses. Sensors transmit a message containing the current value to all actuators, which are member of the same group. In order to make devices of different manufacturers interoperable, the communication objects use a pre-defined set of standardized data point types (DPTs). Network integration in a KNX system is accomplished by a vendor-independent installation tool based on a database (ETS – Engineering Tool Software).

LOYTEC devices are integrated into the KNX system by exporting the database of communication objects from the Engineering Tool Software (ETS4/ETS5). ETS projects are imported by the LOYTEC Configurator tool. After the import of the KNX project, an overview of all available KNX data points is displayed. The desired data points for use can be chosen from this list. Later changes to the ETS project can be tracked and synchronized the same way. Once KNX data points have been integrated, they can be used for AST™ functions. The alarming (alarm management) is based on generic alarm servers. Scheduling of KNX data points is done using generic schedulers. Historic trend data of KNX data points can be logged by generic trend logs. The device communicates with the KNX system on KNX TP1 (twisted pair using an external KNX coupler) and on KNXnet/IP (Ethernet).

## M-Bus



The M-Bus (Meter-Bus) is an established European standard (EN 13757-2, EN 13757-3) for remote meter reading. The M-Bus is a serial bus and employs a master/slave architecture. The M-Bus master can request data from several slaves (meters) on the network. The data transfer from master to slave is a voltage-modulated signal. The transfer from slave to master is a current-modulated signal. M-Bus devices can be bus-powered. The maximum number of nodes, which can be powered on the bus, depends on the M-Bus transceiver.

LOYTEC devices with M-Bus support are M-Bus masters and require an external transceiver for the integration of M-Bus meters. M-Bus data points can be created from an online network scan or offline by using M-Bus device templates, which have been previously created. The assignment of primary addresses to the M-Bus devices can be done in the Configurator tool. AST™ functions for alarming (alarm management), scheduling, and trending (historic data recording) also apply to M-Bus data points. Especially the historic data logging and cyclic polling of values is optimized for M-Bus meters.

## Functions

### Modbus (TCP, RTU)



Modbus is an open protocol and a de facto standard in the industry, which is based on a master/slave architecture. It was originally designed at the end of the 1970s for exchanging data between PLCs. Today, Modbus is still a widely used interface for integrating field devices into a system. Modbus devices communicate over a serial interface or over TCP/IP. Modbus TCP specifies communication over TCP/IP and is part of the IEC 61158 standard. Modbus devices use registers for data exchange, which are characterized by register type, address, and length. In addition, data type and byte order need to be specified in order to interpret Modbus data. The configuration is done by vendor-specific tools.

LOYTEC devices featuring a Modbus interface provide either Modbus TCP (Ethernet TCP/IP) or Modbus RTU (Remote Terminal Unit, based on RS-485) connectivity. Certain devices provide Modbus TCP and Modbus RTU at the same time. A Modbus interface can be operated either as a master or as a slave. The supported register types are: Read Discrete Inputs (2), Read Coils (1), Write Coils (5), Read Input Registers (4), Read Holding Registers (3), Write Holding Registers (6). For third-party integration, the vendor's datasheet needs to be consulted in order to manually create a configuration. The Modbus technology does not offer a method for scanning this information online, as it is known from other technologies. For Modbus devices that are online, the manual configuration can however be tested via an online test function. By looking at the extracted values, the respective data points can then be configured accordingly. Modbus device templates can be created, which allows the re-use of Modbus configurations and reduces errors in configuration. AST™ functions for alarming (alarm management), scheduling, and trending (historic data recording) also apply to Modbus data points.

More details on the communication behavior in a Modbus network can be found in the respective product manuals, which are available for download.

### MP-Bus



The MP-Bus controls HVAC actuators for dampers, regulator valves or VAV air volume controls. It is a master/slave bus developed by Belimo®. There are no restrictions with respect to network topology. Permissible topologies include star, ring, tree and mixed configurations. The MP-Bus (multi point bus) consists of three conductors 24 V (AC or DC), GND and the MP data line.

### SMI



The Standard Motor Interface (SMI) is a bus protocol used to control SMI sunblind motors for shading. On closer examination, the SMI is a digital interface with the benefit to parallelize the connection of roller shutters and sun protection drives. Furthermore, the automation controller gets feedback from the drives and the possibility of flexible parameterization. This allows telegrams to be exchanged over the consistent interface, from the controller to the drive and vice versa. SMI drives from different manufacturers are compatible with each other. For drives that operate on mains voltage, the drive and controller are connected by a 5-core cable which both supplies power and transmits data. Distances of even up to 350 m between the controller and drive are possible. Up to 16 drives per SMI channel can be connected. In this way, the hardware expense is reduced significantly in comparison with today's conventional technology, and the drive status can be queried by the sun protection controller.

The roller shutters and sun protection installations with SMI-drives can also be set up for operation without using a controller. The SMI drive has a setup mode. This mode can be activated using simple push buttons. The standard interface is also available for low-voltage drives. This means that interior sun protection installations can also be controlled intelligently and accurately. Low-voltage drives can be recognized by the SMI LoVo symbol.

### OPC XML-DA



OPC is a de facto standard for interoperable communication in the automation industry, which is also often used for data exchange between management level and automation level in building automation. OPC is a set of different specifications and versions, which can be implemented independently of each other.

LOYTEC devices that support OPC have a built-in OPC server following the OPC XML-DA specification. When integrating the different communication technologies (CEA-709, BACnet, DALI, M-Bus, Modbus, KNX, etc.), OPC tags are automatically created without additional engineering effort and exposed via a web services. The OPC server provides data access via web services according to XML-DA, which are available over the same TCP port as the built-in web server. The OPC server exposes simple data points and complex AST™ functions as OPC tags for alarming (alarm management), scheduling, and trending (historic data recording). Since the OPC XML-DA standard does not specify corresponding tags for these functions, the OPC XML-DA server uses groups of OPC tags for exposing AST™ functions. Because web services are built for being routed across the Internet, the built-in OPC XML-DA server uses basic authentication for protection against unauthorized write access. Authentication requires the operator user and the respective password.

The L-WEB System uses OPC XML-DA communication (web services) for data exchange with LOYTEC devices. This allows for a hassle-free communication in the Intranet or Internet across firewalls and NAT routers. Also third-party applications such as SCADA systems can communicate as OPC XML-DA clients over the Intranet or Internet and access the built-in OPC server in a simple and secure way. The embedded OPC servers do not require extra PC hardware and can be distributed in the IP network.

## OPC UA



The OPC server on LOYTEC devices, which support security, also features the OPC UA binary protocol, that exposes the same OPC tags as the OPC XML-DA server.

## CEA-709 Router Function



The CEA-709 router function allows the transparent connection of two LonMark channels in a LonMark System. One of the channels can be a LonMark IP-852 (Ethernet/IP) channel. LOYTEC devices featuring IP-852 routing have a built-in IP-852 configuration server to configure and manage all IP-852 members on the channel.

## BACnet Router Function



The BACnet router function allows the transparent connection of one BACnet/IP channel and one BACnet MS/TP channel. In addition, the router function implements a BACnet Broadcast Management Device (BBMD) and features Foreign Device support. For MS/TP slave devices it acts as a slave proxy.

## Remote Access



LOYTEC devices offer remote access functions, which differ depending on the device model. All device settings can be modified, data point values can be queried, and configuration parameters can be modified. Apart from this, backup and restore of the device configuration is available. The same applies to parameters. Access to AST™ functions for alarming (alarm management), scheduling, and trending (historic data recording) is also supported, including reading out alarm logs and trend logs from the device via file transfer. The devices offer various analysis functions and statistical data for troubleshooting the used communication protocols. Programmable LOYTEC devices also provide online test functions for developing application programs.

## Remote Network Interface (RNI)



The Remote Network Interface (RNI) function is available, if the LOYTEC device is configured to operate on the TP/FT-10 channel. In this mode, the LOYTEC device appears as a LOYTEC network interface and thus enables remote access to the TP/FT-10 channel over an Ethernet/IP connection. The network interface can be used together with LNS-based tools such as NL220 or LonMaker®, or as a native LOYTEC network interface. Furthermore, the RNI offers the “remote LPA” (LOYTEC Protocol Analyzer) feature for remote troubleshooting.

## Wireless Local Area Network (WLAN)



WLAN refers to a local wireless radio network compliant to the common Standard IEEE 802.11. It extends all protocols of the wired Ethernet of corresponding LOYTEC devices to a wireless communication.

For network integration into a WLAN, the corresponding LOYTEC devices need to be connected with an L-WLAN interface via USB. The USB bus supplies the L-WLAN device with energy and enables an automatic detection. It is also possible to connect the LOYTEC device with an existing WLAN Access Point or create a WLAN Access Point.

## Functions

### LTE



The LTE function refers to supporting mobile communication standards for LTE, UMTS/HSPA+ and GSM/GPRS/EDGE. It is approved for:

- Carrier Certification: Deutsche Telekom/Verizon/AT&T/Sprint/U.S. Cellular/Telus/T-Mobile/Rogers\*
- Regulatory Certification: SRRC/NAL/CCC/GCF/CE/FCC/PTCRB/IC/Anatel/IFETEL/KC/NCC/JATE/TELEC/RCM/NBTC/ICASA/IMDA
- Others: WHQL

The corresponding LOYTEC devices require the LTE-800 Interface connected to a USB port, which provides for an easy and simple solution to connect remote sites together via a VPN network and expose defined on-site services. The LTE interface can also be used to send SMS directly. Typical LTE applications include remote management, energy monitoring, site visualization, SMS alarm notification.

\* Under development

### Bluetooth



Bluetooth is a wireless communication technology in the UHF-range from 2.402-2.480 GHz. The IEEE standardized Bluetooth in IEEE 802.15.1, but no longer maintains the standard. Instead, the Bluetooth SIG oversees development, specification, qualification program and protects the trademarks. An important boost came with the introduction of Bluetooth Low Energy (BLE) as a subset of the Bluetooth v4.0 core specification. The entirely new protocol stack for rapid build-up of simple links is aimed at very low power coin-cell applications such as advertising beacons for indoor navigation and asset tracking.

LOYTEC multisensors and LOYTEC controllers with Bluetooth interface use BLE for asset tracking. In addition, LOYTEC multisensors are able to advertise either standard beacons with configurable identifier like iBeacon or EddyStone-UID which allows them to be perfectly integrated in indoor navigation systems. The L-WEB beacon enables secure room operation using the LWEB-App, as it restricts access to LWEB-900 functions to the close vicinity of the L-WEB beacon.

### Bluetooth Mesh



In 2017 the Bluetooth SIG introduced Bluetooth Mesh on top of the Bluetooth v4.2 specification. In difference to classical Bluetooth and BLE, the new technology allows many-to-many communication by using advertising channels only. It is based on a forwarding mechanism (relay-function) and a publish/subscribe method for data exchange. In difference to BLE Bluetooth Mesh is not limited by the direct connection range. In 2023 a reworked version (called "Mesh 1.1") has been released by the Bluetooth SIG adding Mesh Protocol improvements like Directed Forwarding and Remote Provisioning as well as completely new specifications for Mesh Device Firmware Updates and Mesh Network Lighting Control Profiles.

The LOYBT product line is based on Bluetooth SIG qualified mesh and represents a wireless ecosystem for field devices.

## Gateway

### Gateway Function



The gateway functions allow data exchange between all available communication technologies. This is accomplished by using "connections" which connect data points of different technologies with each other. Both "1-to-n" and "m-to-1" connections are supported. Connections can contain simple or complex calculations. Different engineering units of connected data points are automatically converted. Connections can easily be created using templates. They are distinguished into local and global connections. Connections can be created manually or automatically using the Smart Auto-Connect™ feature of the Configurator tool. Especially the automated creation of connections reduces engineering effort and helps preventing configuration errors.

The Smart Auto-Connect™ feature works on a selection of source data points and creates target data points and the respective connections. In principle, Smart Auto-Connect™ can work with all available communication technologies as sources. However, only select technologies can be used as targets. Depending on the availability on the device model, data points can be created for the following technologies: CEA-709 (static NVs), BACnet (server objects), Modbus (slave registers) and user registers. A remarkable feature in this context is the automatic mapping of network variables to BACnet objects according to CEN/TS 15231:2005.

## Local Connection



A “local connection” is used for connecting data points of different networking technologies, which are integrated on a single LOYTEC device.

## Global Connection



“Global connections” provide similar functions as local connections, but can span across an IP network between two or more LOYTEC devices. A global connection creates a data cloud with a system-wide name. Data points which are added to a global connection can send values into the cloud or receive values from the cloud. This is entirely independent from the installation location or the original communication technology.

## L-IOB I/O

L-IOB I/O Modules extend the L-INX Automation Servers, IP-capable L-IOB I/O Controllers, and L-ROC Room Controllers by adding physical inputs and outputs. Models with different I/O configurations and communication interfaces are available. L-IOB I/O Modules with LIOB-Connect can be directly connected in a daisy-chain. Those L-INX Automation Servers and L-ROC Room Controllers that support this feature, automatically detect which I/O modules are connected and map the corresponding data points. All L-INX and L-ROC models provide an additional way for connecting and integrating L-IOB I/O Modules via LIOB-FT (twisted pair) and L-IOB IP (Ethernet). L-IOB IP I/O Controllers are limited to the use of one additional L-IOB IP I/O Module.

## LIOB-Connect



The LIOB-Connect port of a L-INX or L-ROC device allows connecting LIOB-10x Modules and provides a power and communication path without additional cabling. Regardless of the L-IOB type, up to 24 L-IOB I/O Modules are supported. This makes up to 24 LIOB-10x devices possible in a daisy chain. The first four LIOB-10x can be connected directly. Starting with the fifth LIOB-10x, the LIOB-Connect chain needs to be divided into two (or more) segments using LIOB-A4 and LIOB-A5 adapters.

Parameterization of the I/O modules is done by the Configurator software or over the web interface of the L-INX or L-ROC device. All parameter data is stored on the L-INX Automation Server or the L-ROC Room Controller and can be downloaded to the L-IOB Modules again if needed. When replacing a L-IOB Module, it is detected and integrated again automatically.

## LIOB-FT



The LIOB-FT port allows operation of remote LIOB-15x Modules. These are connected by twisted pair cabling of up to 500 m length in free topology or more than 500 m in bus topology. The maximum number of supported LIOB-15x Modules depends on the L-INX Automation Server model, the L-IOB IP I/O Controller model, or the L-ROC Room Controller model.

Parameterization of the I/O Modules is done by the Configurator software or over the web interface of the L-INX, L-IOB IP or L-ROC device. All parameter data is stored on the L-INX Automation Server, the L-IOB IP I/O Controller, or the L-ROC Room Controller and can be downloaded to the L-IOB Modules again when needed. When replacing a L-IOB Module, it is detected and integrated again automatically.

## LIOB-IP



The LIOB-IP port allows operation of remote LIOB-45x and LIOB-55x Modules. These are connected over Ethernet/IP (100Base-T). The maximum number of supported Modules depends on the L-INX Automation Server model, the L-IOB IP I/O Controller model, or the L-ROC Room Controller model. Communication across NAT routers is not supported.

Parameterization of the I/O Modules is done by the Configurator software or over the web interface of the L-INX, L-IOB IP, or L-ROC device. All parameter data is stored on the L-INX Automation Server, the L-IOB IP I/O Controller, or the L-ROC Room Controller and can be downloaded to the L-IOB Modules again if needed. When replacing a L-IOB Module, it is detected and integrated again automatically.

## Local I/Os



All L-IOB I/O Controllers are equipped with local I/Os. The usage of local I/Os is completely transparent to the application. For the device’s logic program, it does not matter if the I/Os are local or remote. Parameterization of the Local I/Os is done by the Configurator software or over the web interface of the L-IOB I/O Controllers.

# Functions

## Programming Functions

### IEC 61499 – L-STUDIO



The application project is created with the graphical programming system L-STUDIO (IEC 61499 standard), which allows programming using function blocks (FBs). In L-STUDIO, the programming environment comprises the entire project, where each controller in the IP network is treated as a computing resource with data points. L-STUDIO deploys the application to the networked controllers and creates the connections between them automatically. Event-oriented execution of the program allows for fast reaction times. As a novel approach to automation we name this "Cloud Control". An arbitrary set of functions can be mapped to a cloud of controllers. The strictly object oriented programming method allows for efficient reuse of previously implemented functions. A variety of debugging and watch functions allows for building-wide troubleshooting during run-time.

### IEC 61131 – L-STUDIO



L-STUDIO has established itself as an integration platform for the L-ROC system for individual room control installations. With the new version L-STUDIO 3.0, LOYTEC is now taking the next step and extending the programming function by a development environment in accordance with the industry standard IEC 61131.

### Mathematical Functions

$$y=f(x)$$

Math objects with user-defined formulas can execute mathematical functions on data points. A math object uses a number of data points as input variables ( $v_1, v_2, \dots, v_n$ ) and calculates a result according to the formula. The result is written as an output to a number of data points. The calculation is executed each time one of the input data points changes its value. A result is calculated only if all inputs have a valid value.

## Device Management

### Backup / Restore



Depending on the device model, there exist several possibilities to backup and restore a device configuration. In principle, all LOYTEC devices with a built-in web server offer the backup and restore function on the web interface. Also the Configurator tools provide this function for their respective device models. When using the L-WEB System, backups of device configuration can be created on a timely basis (e.g. once a day) and restored easily when needed. Devices with SD card support and USB port allow a device backup onto external storage. In this case, the backup and restore function is operated locally on the LCD display. In all cases, the LOYTEC device is restored with all data points, dynamic NVs and bindings, BACnet server objects and client mappings, etc. The device appears again as commissioned and online and is fully functional in the network. In case an LNS-based tool is used, the LNS device needs to be replaced, which can be done at a later time.

### Device Manager



LWEB-900 gives a clear overview of the status of all devices and provides detailed information for each device (e.g. device type, name, IP address, firmware version, configuration file, program file, etc.). A firmware update can be performed for individual devices or groups of devices. A backup feature ensures a regular backup of all relevant device configurations. If a defective device needs to be replaced, the configuration can be easily restored. Depending on the device hardware, the restore operation can be initiated either from the LCD UI of the device or from the LWEB-900 Client.

### Device Configuration



LWEB-900 manages and configures all LOYTEC devices based on a central database. The required device configuration software can be opened directly in LWEB-900 and the configuration files are stored in the data base.

### AKS – Identification Keys



Each data point is uniquely identified by its name and path. With LWEB-900, you can define your own identification key schema and assign identification keys (IK) to each data point. The IK schema can be exported and imported into other LWEB-900 projects.

### SNMP



The built-in SNMP server (Simple Network Management Protocol) provides network management information of a device that can be used by customary IT tools. Via a configurable SNMP agent, status information and statistics with standard MIBs (Management Information Bases), system registers, and all OPC-exposed data points can be read and monitored, and also alarms can be sent.

# Functions

## Visualization / Operate and Monitor

### Local Manual Operation



The LOYTEC device is equipped with a graphical LCD display (128x64) and a jog dial, which can be used for monitoring, testing, and configuration. The backlight is automatically turned off after 30 minutes of jog dial inactivity. Access to the display can be protected by a PIN code. The display can show the current device configuration and allows its modification. All basic settings (IP address, BACnet ID, etc.) can be made on the LCD display.

Apart from configuration, L-INX Automation Servers and L-GATE Gateways with a graphical LCD display allow operating trend data backup to external storage (SD card or USB stick) and backup/restore of the entire device configuration. Also the state of the integrated data points can be displayed and modified. Remote access to the LCD display over an Ethernet/IP connection is made possible by the VNC protocol.

In L-IOB I/O Modules and Controllers, the graphical LCD display allows – apart from modifying the configuration – access to physical I/O data points and parameters. The data point state is displayed as a value and engineering unit, as a status text, or showing dynamic symbols. Inputs and outputs can be switched to manual mode on the display and thus be decoupled from the physical input or the output value from the logic application.

### VNC



The VNC (Virtual Network Computing) service offers password-protected remote access to the LOYTEC device. VNC employs a client-server model. The VNC server is a built-in component of the LOYTEC device. A great variety of free or commercial VNC clients is available on the market for different platforms. Which functions and views are exposed over VNC depends on the device.

### Web Server for Device Configuration



The web interface on LOYTEC devices with a built-in web server provides an alternative to the Configurator tool for the maintenance personnel. It can be used to configure device and communication settings. It also provides extensive statistical information on the used communication protocols for analysis and troubleshooting. Backup and restore can also be operated on the web interface.

LOYTEC devices with an Ethernet/IP interface display data point values and states on the web interface coming from different communication networks or registers. The display contains a data point list, a tree view, and a breadcrumb navigation for fast access to subdirectories. The data point list shows the data point name, direction, type, data point state, the current value, and a description. All values are updated live. Data points can also be modified on the web interface.

On LOYTEC devices with L-WEB support, all available graphical user interfaces are listed on the web interface and can be started with a mouse click. LOYTEC devices with AST™ functions (Alarming, Scheduling, and Trending) offer access to those functions over the web interface.

An alarm summary page displays all currently active alarms of alarm data points, which can also be acknowledged, if configured so. The web interface also provides access to a historical alarm log, which lists alarms and acknowledgements. If an inactive, acknowledged alarm disappears from the alarm summary page, the last transition is stored in the alarm log. The content of the historic alarm log can be exported to a CSV file on the web interface.

The web interface provides a scheduler page, which allows modification of schedules and calendar entries for exception days during runtime. For existing local schedulers, the web interface supports the re-configuration of the scheduled data points. The changes become effective immediately and do not require a reboot of the device. For adding or removing data points to or from a scheduler, no reboot is necessary either.

The trend log configuration page on the web interface allows the reconfiguration of existing trend logs during run-time. This also includes the assignment of new data points. The changes become effective immediately and do not require a reboot of the device. The trended data can be exported into a CSV file over the web interface.

## LWEB-900



The LWEB-900 Building Management System offers a BACnet Operator Workstation capability to integrate BACnet devices via BACnet/IP. In addition most LOYTEC devices can use the OPC XML-DA web service to get connected to LWEB-900. LWEB-900 is a highly flexible and scalable solution which accompanies you from installation and configuration of LOYTEC devices (L-INX Automation Servers, L-IOB I/O Modules and Controllers with IP connectivity, L-ROC Room Controllers, L-GATE Gateways, L-VIS Touch Panels, L-DALI Controllers), all the way to daily operation of the facilities.

## Graphical View



Graphical views are schematics that help to visualize and operate areas of a building. Each graphical view can consist of a large number of dynamic display elements which reflect the current status of the facilities. LWEB-900 provides the graphical view within the LWEB-900 User Interface of the software and additionally offers distributed LWEB-900 clients the same functionality of visualization through web services.

## LWEB-802/803 Visualization



Most LOYTEC devices can manage and store graphical projects (L-WEB projects). These projects can be created without knowledge of any web-based language within the L-VIS/L-WEB configuration tool. Customized graphical pages with dynamic content can be shown either with LWEB-803 on Windows PCs or with LWEB-802 in a standard browser.

## Reporting



LWEB-900 can create reports based on trend logs. Reports can be used, for example, to document the energy consumption in a building. The generation of a report can be triggered in one of the following ways:

Periodically: Reports can be generated daily, weekly, monthly, or yearly.

Event: The change of a data point value can trigger a report.

Manually: A report can be triggered manually by the user.

Reports can be generated in PDF, Excel, or Word format. They can be automatically distributed via e-mail.

## User Management



LWEB-900 provides a separate work environment for each user. A user has to log on to the system and is presented with a perspective tailored to his individual requirements. A perspective defines which windows are open and how they are arranged. In this way, a user can define separate perspectives which are optimized for different tasks and quickly switch between them.

LWEB-900 uses access control lists to define which operations a user can perform on a certain object (e.g. folder, data point, graphical view, parameter view, trend chart). To speed up the access right configuration, access control lists can be inherited from parent to child objects.

## Parameter View



The LWEB-900 parameter view allows configuring operational parameters, which are distributed over multiple devices, efficiently. For example, parameters for room temperature control, light control, or sunblind control can be organized in different parameter views. Each parameter view is a matrix where each cell represents a parameter. Parameters can be organized freely in the matrix depending on space layout and function. In this way, it is possible to e.g. adjust the running periods of sunblinds across many rooms with a few mouse clicks and write the new values reliably into the corresponding automation devices.

# Functions

## Watch View



The LWEB-900 watch view allows observing data point values in real time. Depending on the data point types, the values can also be changed and easily edited within the watch view. You are able to see what is actually going on in the network.

## Integration of Web Cams



LWEB-900 can integrate web cams supporting the ONVIF standard. The local subnet scanning feature detects cameras automatically and reduces configuration effort significantly. The live image of a camera can be added to graphical views. LWEB-900 automatically detects the capabilities of a camera and maps events (e.g. motion detection, people counter information) and commands (e.g. PTZ control) to data points. LWEB-900 does not record videos itself but can command a camera to start recording if an alarm occurs.

## Multi-Site



This feature allows accessing multiple LWEB-900 Servers located at different sites with a single LWEB-900 Client. It is possible to create a common graphical view showing data from the different servers. Devices, alarms, and users can be managed across the sites. To enable this feature the LWEB-900-MS license needs to be installed on each LWEB-900 Server.

## L-STAT



The L-STAT is a room operator panel with a modern, minimalistic look that fits any interior design. It is directly connected to a LOYTEC controller with a Modbus interface such as L-ROC.