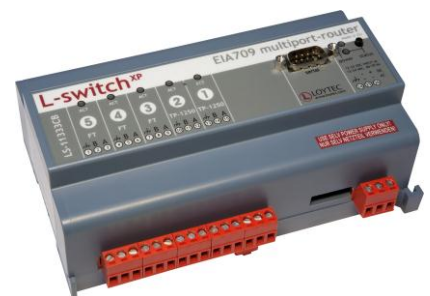# L-Switch XP

CEA-709 Router

User Manual

LOYTEC electronics GmbH

Contact

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Version 6.0

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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
BOOTP	Bootstrap Protocol, RFC 1497
CEA-709	Protocol standard for LONWORKS networks
CEA-852	Protocol standard for tunneling CEA-709 packets over IP channels
CN	Control Network
CR	Channel Routing
CS	Configuration Server that manages CEA-852 IP devices
DHCP	Dynamic Host Configuration Protocol, RFC 2131, RFC 2132
DIF, DIFE	Data Information Field, Data Information Field Extension
DNS	Domain Name Server, RFC 1034
DST	Daylight Saving Time
GMT	Greenwich Mean Time
IP	Internet Protocol
IP-852	logical IP channel that tunnels CEA-709 packets according CEA-852
LSD Tool	LOYTEC System Diagnostics Tool
MAC	Media Access Control
MD5	Message Digest 5, a secure hash function, see Internet RFC 1321
NAT	Network Address Translation, see Internet RFC 1631
NV	Network Variable
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
SL	Send List
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
XML	eXtensible Markup Language

1 Introduction

1.1 Overview

The L-Switch XP is a high performance fully plug-and-play network infrastructure component for CEA-709 networks. It is the first device that allows building fully manageable CEA-709 networks. It is also a cost effective alternative to currently available CEA-709 routers. The L-Switch XP provides up to **five** communication ports and it switches packets between these ports. Its unique architecture very much supports structured wiring in CEA-709 networks by reducing the number of necessary routing devices.

The Plug & Play installation capability of the L-Switch XP allows connection of the L-Switch XP to the network without any further configuration. The smart switching software automatically detects the bit-rates of the connected channels, learns the configuration of the network (domains, subnet/node addresses, group addresses) and forwards the packets between the different ports (see Section 4.1.1). Optionally, the L-Switch XP can be configured via the network.

In addition to the Plug & Play switch mode the L-Switch XP can be operated as a standard configured CEA-709 router. In this operating mode the L-Switch XP is compatible to any standard CEA-709 router and must be commissioned using LonMaker or some other network management tool for CEA-709 networks.

As an additional feature, the L-Switch XP permanently collects statistic information from the attached network channels (channel load, CRC errors, forwarding statistics, etc.). Using this data the L-Switch XP software is able to detect problems on these channels (overload, connections problems, etc.) and warns the system operator via LEDs (see Section 5.4). An intuitive user interface allows fast and easy network troubleshooting without any additional analysis tools and deep system knowledge.

The LSD Tool can be used for a more detailed view of the collected statistics data. See Section 9 for more information on this powerful system diagnostics tool.

The L-Switch XP is used for:

- Isolation of local network traffic

- Structuring networks (structured wiring)

- Signal regeneration

- Noise suppression

- Extending channels in their physical dimension and/or number of nodes

- Connecting channels with different communication media types e.g. power-line and FT

- Network monitoring and network management

1.2 Scope

This document covers L-Switch XP devices with firmware version 6.0. See Section 10 for differences between the different L-Switch XP firmware versions. Older versions of the product labled L-Switch (without XP) are not covered by this document.

2 Quick-Start Guide

2.1 Enclosure

2.1.1 L-Switch XP multi-port

The L-Switch XP multi-port enclosure is 9 TE (1 TE = 17.5 mm) wide for DIN rail mounting, following DIN 43 880 (see Figure 1).
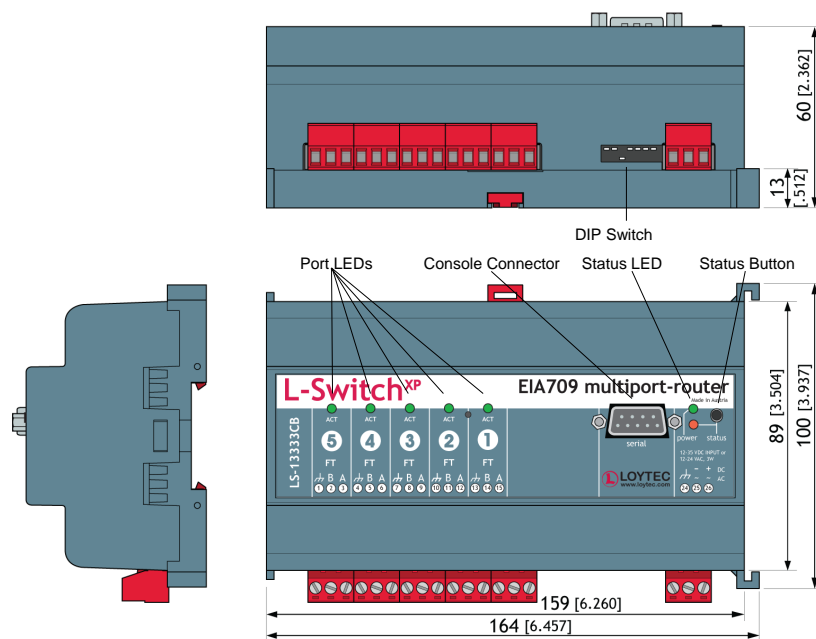
Figure 1: L-Switch XP multi-port enclosure (dimensions in mm [inch])

2.1.2 L-Switch XP 2-port

The L-Switch XP 2-port enclosure is 6 TE (1 TE = 17.5 mm) wide for DIN rail mounting, following DIN 43 880 (see Figure 2).
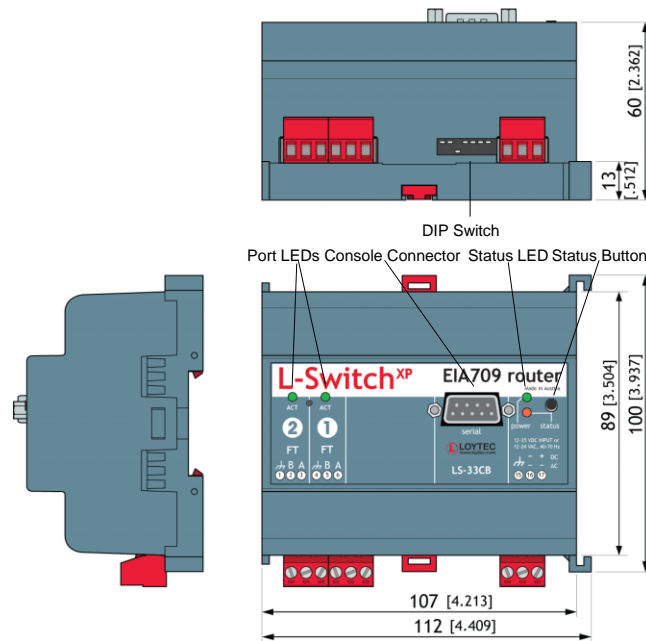
Figure 2: L-Switch XP 2-port enclosure (dimensions in mm [inch]) product label

2.2 Product Label

The product label on the right side of the L-Switch XP contains the following information (see Figure 1):

- L-Switch XP order number with bar-code (e.g. LS-13333CB)

- Serial number with bar-code (SER#)

- Unique node ID of each port (NIDx)

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

Internally the 3-Port (LS-xxx00CB) and the 5-Port (LS-xxxxxCB) version of the L-Switch XP use up to 5 individual routers which are connected over a TP/XP-1250 backbone (see Figure 3 and Figure 4).

On the attached label, only the external NIDs (number 1-3 or 1-5) are printed. Since the NIDs are organized in a continuous number block, the internal NIDs can be derived by incrementing the numbers printed on the label (number 4-6 or 6-10, see Figure 5 and Figure 6).
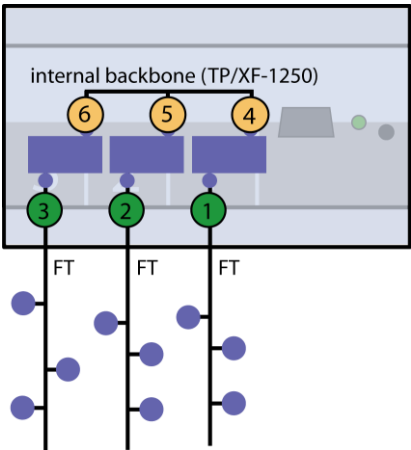
Figure 3: Internal assignment of NIDs on LS-xxx00CB.

Figure 4: Example of internal NID order on LS-xxx00CB.
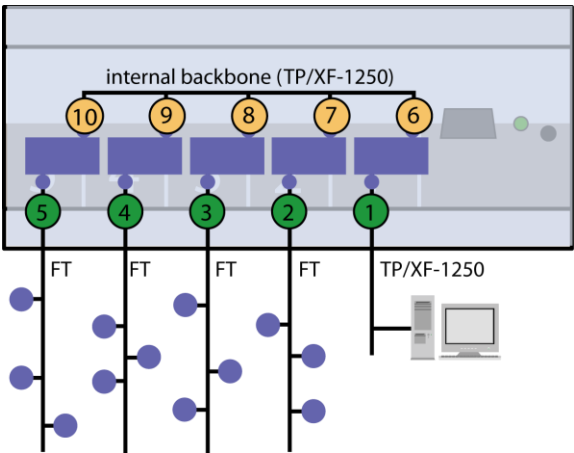
Figure 5: Internal assignment of NIDs on LS-xxxxxCB.

Figure 6: Example of internal NID order on LS-xxxxxCB.

2.3 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 L-Switch XP temperature does not exceed the specified range (see Section 11).

2.4 DIP Switch Setting

The L-Switch XP uses 7 switches to select the mode of operation. The DIP switch assignment is shown in Table 1. For details see Chapter 4.

DIP Switch #	Function	Factory Default
1, 2	ON, ON: L-Switch XP switch mode ON, OFF: L-Switch XP repeater mode OFF, ON: L-Switch XP subnet learning OFF, OFF: Configured CEA-709 router	ON, ON
3	Bit-rate auto detection On/Off (RS-485 version only)	ON
4	Must be OFF	OFF
5	Must be OFF	OFF
6	Must be OFF	OFF
7	Must be OFF	OFF

Table 1: DIP switch settings for L-Switch XP

2.5 Power Supply

The L-Switch XP can either be DC or AC powered (Table 2 to Table 3).

Terminal	Function	Note
24	Earth Ground	
25, 26	Power Inputs	12-35 VDC or 12-24 VAC ± 10%

Table 2: Power Terminals for L-Switch XP multi-port LS-xxxxxCB

Terminal	Function	Note
15	Earth Ground	
16, 17	Power Inputs	12-35 VDC or 12-24 VAC ± 10%

Table 3: Power Terminals for L-Switch XP 2-port LS-xxCB

Important: **Do not ground the power supply wire on terminal 26 (LS-xxxxxCB) or terminal 17 (LS-xxCB) as shown in Figure 7!**

LOYTEC recommends using its LPOW-2415B power supply with the L-Switch XP.

2.6 Connecting Diagrams

The L-Switch XP provides screw terminals to connect to the network as well as to the power supply. The screw terminals can be used for wires having a maximum thickness of 1.5 mm^2/AWG12.

2.6.1 LS-33CB (2-Port)

Terminal	Function
1	Earth Ground
2, 3	CEA-709 A, B of FT-10 Channel Port 2
4	Earth Ground
5, 6	CEA-709 A, B of FT-10 Channel Port 1
15	Earth Ground
16, 17	Power Supply (do not connect terminal 17 to earth ground)

Table 4: L-Switch XP Terminals LS-33CB

2.6.2 LS-13CB (2-Port)

Terminal	Function
1	Earth Ground
2, 3	CEA-709 A, B of FT-10 Channel Port 2
4	Earth Ground
5, 6	CEA-709 A, B of TP-1250 Channel Port 1
15	Earth Ground
16, 17	Power Supply (do not connect terminal 17 to earth ground)

Table 5: L-Switch XP Terminals LS-13CB

2.6.3 LS-11CB (2-Port)

Terminal	Function
1	Earth Ground
2, 3	CEA-709 A, B of TP-1250 Channel Port 2
4	Earth Ground
5, 6	CEA-709 A, B of TP-1250 Channel Port 1
15	Earth Ground
16, 17	Power Supply (do not connect terminal 17 to earth ground)

Table 6: L-Switch XP Terminals LS-11CB

2.6.4 LS-13300CB (3-Port)

Terminal	Function
1-6	NC
7	Earth Ground
8, 9	CEA-709 A, B of FT-10 Channel Port 3
10	Earth Ground
11, 12	CEA-709 A, B of FT-10 Channel Port 2
13	Earth Ground
14, 15	CEA-709 A, B of TP-1250 Channel Port 1
24	Earth Ground
25, 26	Power Supply (do not connect terminal 26 to earth ground)

Table 7: L-Switch XP Terminals LS-13300CB

2.6.5 LS-33300CB (3-Port)

Terminal	Function
1-6	NC
7	Earth Ground
8, 9	CEA-709 A, B of FT-10 Channel Port 3
10	Earth Ground
11, 12	CEA-709 A, B of FT-10 Channel Port 2
13	Earth Ground
14, 15	CEA-709 A, B of FT-10 Channel Port 1
24	Earth Ground
25, 26	Power Supply (do not connect terminal 26 to earth ground)

Table 8: L-Switch XP Terminals LS-33300CB

2.6.6 LS-13333CB (5-Port)

Terminal	Function
1	Earth Ground
2, 3	CEA-709 A, B of FT-10 Channel Port 5
4	Earth Ground
5, 6	CEA-709 A, B of FT-10 Channel Port 4
7	Earth Ground
8, 9	CEA-709 A, B of FT-10 Channel Port 3
10	Earth Ground
11, 12	CEA-709 A, B of FT-10 Channel Port 2
13	Earth Ground
14, 15	CEA-709 A, B of TP-1250 Channel Port 1
24	Earth Ground
25, 26	Power Supply (do not connect terminal 26 to earth ground)

Table 9: L-Switch XP Terminals LS-13333CB

2.6.7 LS-11333CB (5-Port)

Terminal	Function
1	Earth Ground
2, 3	CEA-709 A, B of FT-10 Channel Port 5
4	Earth Ground
5, 6	CEA-709 A, B of FT-10 Channel Port 4
7	Earth Ground
8, 9	CEA-709 A, B of FT-10 Channel Port 3
10	Earth Ground
11, 12	CEA-709 A, B of TP-1250 Channel Port 2
13	Earth Ground
14, 15	CEA-709 A, B of TP-1250 Channel Port 1
24	Earth Ground
25, 26	Power Supply (do not connect terminal 26 to earth ground)

Table 10: L-Switch XP Terminals LS-11333CB

2.7 Wiring

Every network segment connected to the L-Switch XP needs to be terminated according to the rules found in the specification of the transceiver (see Chapter 3).

Important: *All used and unused ports must be properly terminated. LOYTEC recommends the use of the LOYTEC L-Term series network terminators (LT-13 or LT-33 respectively). For unused ports, it is recommended to use a 100 Ohm 0.25 W resistor between terminals A and B as termination.*

Important: *When using shielded network cables, only one side of the cable should be connected to earth ground. Thus, the shield must be connected to earth ground either at the L-Switch XP terminals or somewhere else in the network!*
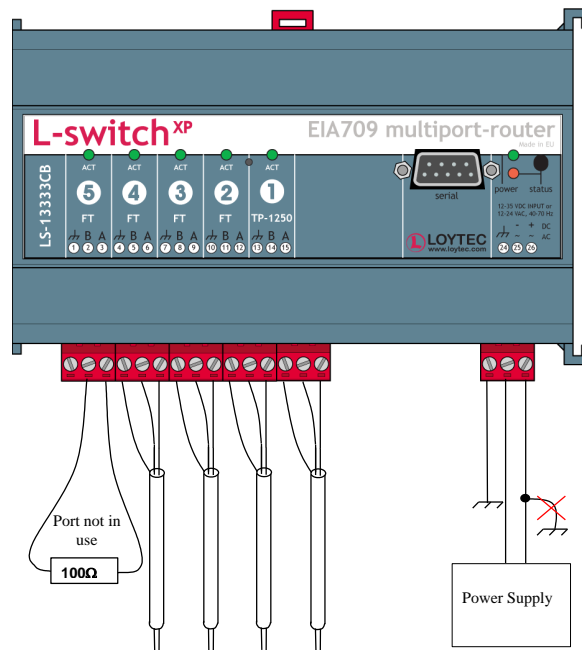
Figure 7: Connecting the L-Switch XP (LS-13333CB)

Figure 7 shows an L-Switch XP where Port 5 is not used.

3 Network Media

3.1 TP-1250

The TP-1250 uses transformers for galvanic isolation. The topology of a TP-1250 network is a bus. Thus, both ends of the bus cable need to be terminated. LOYTEC recommends using its L-TERM network terminators for network termination (LT-13). Figure 8 shows an example.
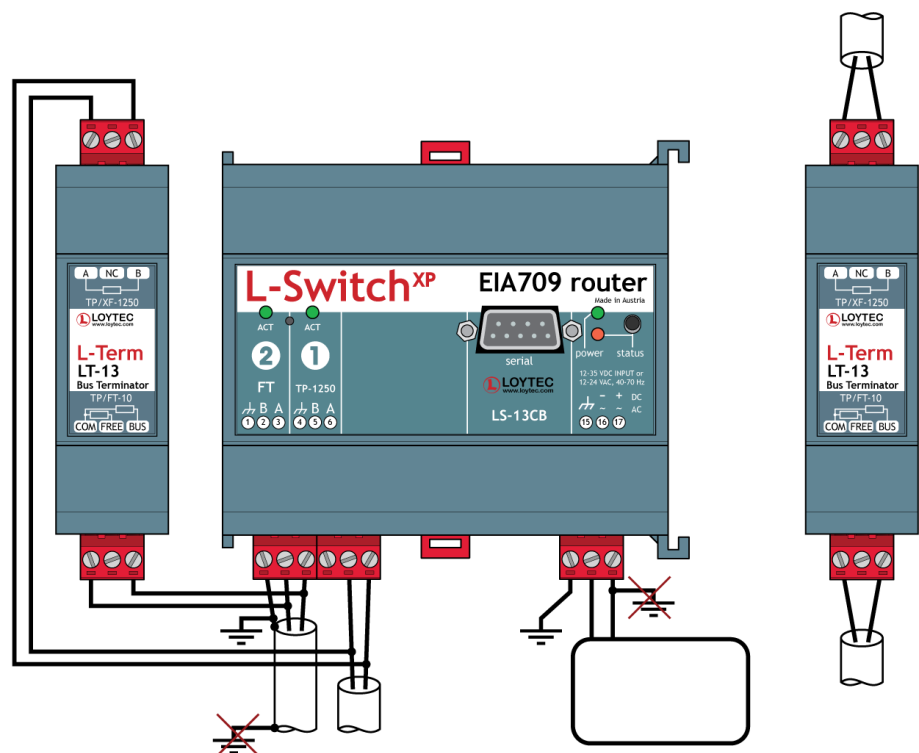
Figure 8: TP-1250 and FT-10 Network Termination

If the collision-less backbone mode (recommended, default behavior) is disabled, the L-Switch XP TP-1250 ports are fully compatible to the parameters specified by LONMARK for this channel (TP/XF-1250). If the collision-less backbone mode is enabled, proprietary channel parameters are used. In this case no Neuron Chip based nodes or other nodes with standard TP-1250 communication parameters are permitted on the same channel.

3.2 FT-10

The L-Switch XP FT-10 ports are fully compatible to the parameters specified by LONMARK for this channel. FT-10 ports can also be used on Link Power (LP-10) channels. However, the L-Switch XP does not provide the power supply for Link Power channels.

When using the Free Topology Segment feature of the FT-10, only one termination is required and can be placed anywhere on the free topology segment. In a double terminated bus topology, two terminations are required. These terminations need to be placed at each end of the bus.

LOYTEC recommends using its L-TERM network terminators (LT-13, LT-33 or LT-03) for network termination (see Figure 9).
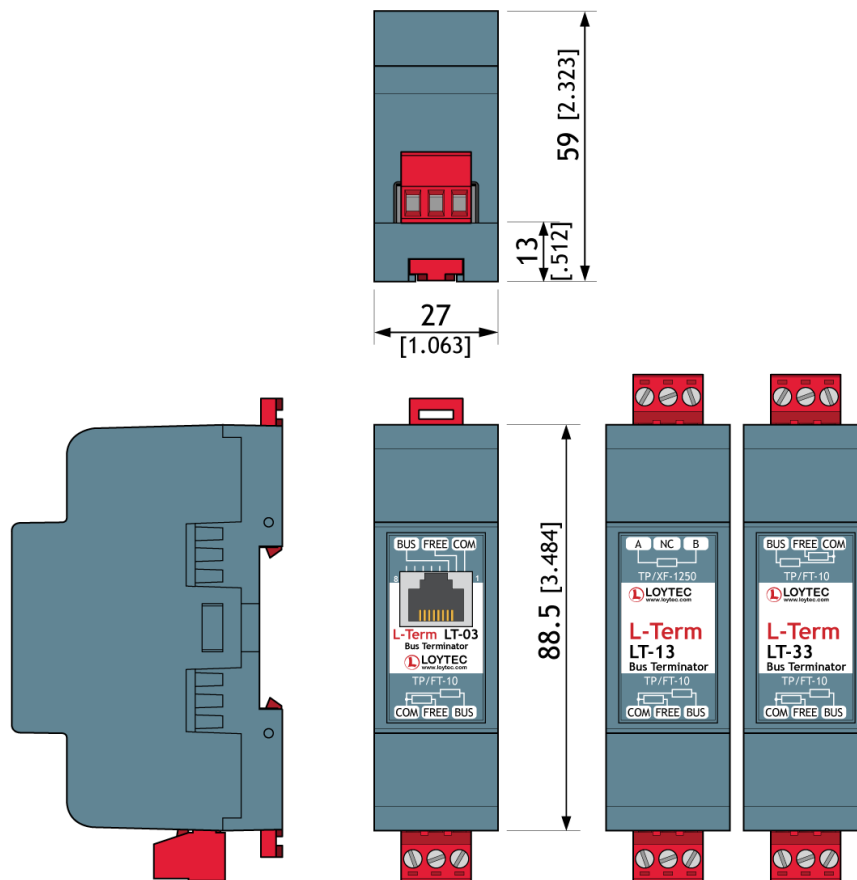
Figure 9: FT-10 Network Termination.

3.3 RS-485

The L-Switch XP RS-485 ports are fully compatible with the parameters specified by TIA/EIA RS-485 for this channel. A maximum of 32 L-Switch XP RS-485 ports can be connected to one channel.

The RS-485 ports support bit-rates between 300 kbps and 2.5 Mbps. When using bit-rate auto-detection (see Section 4.2) the L-Switch XP checks for the following bit-rates: 0.61 kbps, 1.221 kbps, 2.441 kbps, 4.883 kbps, 9.766 kbps, 19.531 kbps, 39.0625 kbps, 78.125 kbps, 156.25 kbps, 312.5 kbps, 625 kbps, 1,250 kbps and 2,500 kbps. Standard Neuron Chip compatible channel parameters with a channel priority of 4, but no node priority are

used with these bit-rates. If bit-rate auto-detection is switched off, the channel parameters for the LONMARK TP-RS485-39 channel (39 kbps) are used.

RS-485 can only be used in a bus configuration and must be terminated on both ends. The maximum stub length between the main bus and a single node is 0.3 m.

LOYTEC recommends using its L-TERM network terminators (LT-04 or LT-B4) for network termination (see Figure 10).
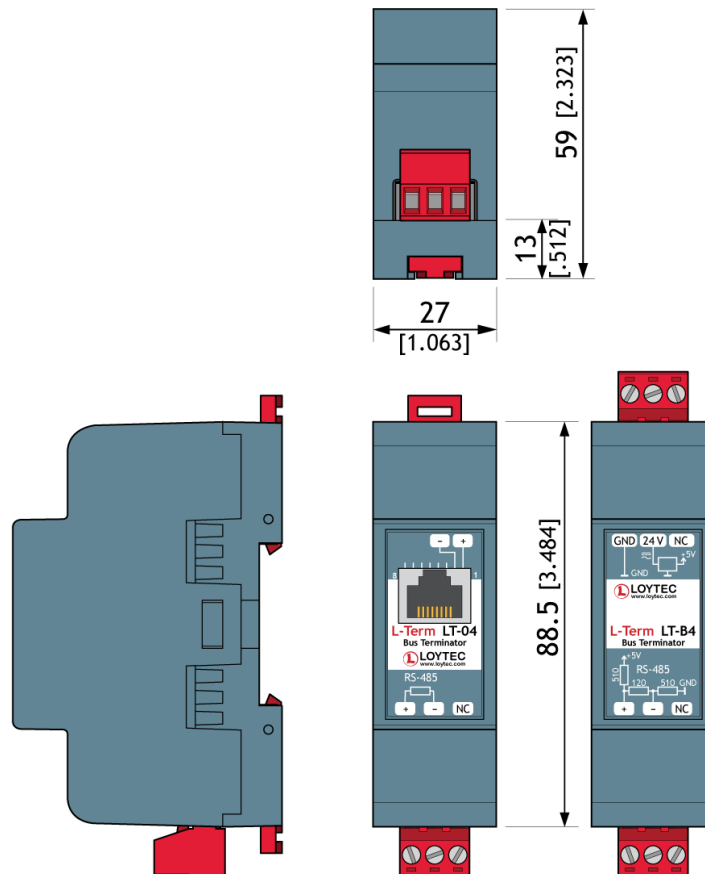
Figure 10: RS-485 Network Termination.

4 Operating Modes

4.1 Message Forwarding Modes

The L-Switch XP supports three different operating methods defining how packets are routed between its ports: Smart switch mode, repeater mode and the configured CEA-709 router mode. The operation mode can be selected via the DIP switch settings of DIP switch 1 and 2 or via the console menu.

Important:	***Whenever the forwarding mode of the L-Switch XP is changed using the DIP switch a reset to factory defaults is recommended!***

4.1.1 Smart Switch Mode

The L-Switch XP can be configured to act as a self-learning switch in an CEA-709 network. In this operation mode the L-Switch XP decides based on the destination address of a message, to which port(s) the message has to be forwarded or whether it has to be forwarded at all. Thus, it isolates local network traffic (e.g. in case of heavy loaded networks). This is the default operating mode for the L-Switch XP.

Figure 11 shows the proper DIP switch setting to put the L-Switch XP into learning switch mode. This DIP switch setting is the factory default setting.
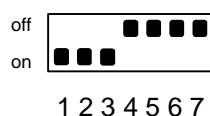
Figure 11: DIP switch setting for learning switch mode (factory default)

Important:	***This smart switch routing algorithm does not support any kind of network loops!***

Important:	***Whenever a network is reconfigured, it is recommended to clear the forwarding tables in the L-Switch XP by pressing the status button for at least 20 seconds (see Section 5.5).***

4.1.1.1 Domain Learning

The L-Switch XP supports learning of up to 4 Domains.

Note:	*All messages, which are received on an unknown domain are forwarded to all ports!*

4.1.1.2 Subnet/Node Learning

The subnet/node learning algorithm supports segmentation of the network traffic on a subnet/node basis. Thus, the user does NOT need to take care of any subnets spanning multiple physical channels. Even when a node is moved from one channel to another, the L-Switch XP keeps track and modifies its forwarding tables accordingly.

Note:	*All messages with a destination subnet/node address not yet learned are forwarded to all ports!*

4.1.1.3 Group Learning

The L-Switch XP supports group learning. Groups can span multiple L-Switch XP ports.

Note:	*Group learning only works for messages using acknowledged or request/response service.*

Note:	*All messages with a destination group address not yet learned are forwarded to all ports!*

4.1.1.4 Broadcast Address Learning

The L-Switch XP has no learning strategy for broadcast addresses.

As a result, all subnet or domain wide broadcasts are forwarded to all ports[1].

4.1.1.5 Unique Node ID Address Learning

The L-Switch XP has no learning strategy for unique node ID addresses.

Node ID addressed messages are forwarded to all ports.

4.1.2 Repeater Mode

The L-Switch XP can be configured to operate in a repeater mode, where all messages are forwarded to all ports regardless of the address format.

To put the L-Switch XP into repeater mode the following steps need to be performed:

1. Set the L-Switch XP into repeater mode (switch OFF subnet/node learning and group learning) by setting DIP switches 1 and 2 in the appropriate position (see Figure 12).

2. The forwarding tables must be reset by pressing the status button for at least 20 seconds (see Section 5.5).

Figure 12 shows the proper DIP switch settings for repeater mode, assuming all other DIP switches remain in the factory default position.
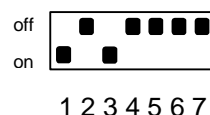
Figure 12: DIP switch settings to enable repeater mode for an L-Switch XP

---

[1] Firmware versions 2.0 and up allow to disable subnet broadcast flooding. Please contact LOYTEC support if you need to enable this feature!

4.1.3 Configured Router Mode

In this operating mode the L-Switch XP acts like a standard CEA-709 compatible router, which can be configured with standard network management tools like LonMaker or NL-220. This operating mode is compatible with any other standard CEA-709 router.

Figure 13 shows the proper DIP-switch settings for CEA-709 compatible router mode, assuming all other DIP-switches remain in the factory default position.
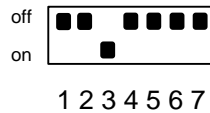
Figure 13: OFF-OFF: DIP-switch settings for configured router mode.

Standard CEA-709 routers allow 4 different operating modes, which must be configured via a network management tool (e.g. LonMaker): configured router, learning router, bridge and repeater. Since the learning algorithm in the smart switch operating mode (see Section 4.1.1) is superior to the learning router mode of a standard CEA-709 router, the learning router mode is not supported by the L-Switch XP.

Further, note that the repeater mode of the standard CEA-709 router differs from the L-Switch XP repeater mode (see Section 4.1.2). While the L-Switch XP repeater mode is transparent and does not require any additional configuration, the repeater mode of the standard CEA-709 router must be configured using a network management tool and thus requires commissioning.

4.2 Bit-Rate Auto-Detection

The L-Switch XP supports bit-rate auto-detection on RS-485 channels. The factory default DIP switch setting enables bit-rate auto-detection on all RS-485 ports. Figure 14 shows the DIP switch settings to disable bit-rate auto-detection, assuming all other DIP switches remain in the factory default position.
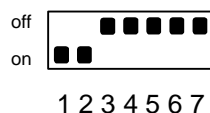
Figure 14: DIP switch settings to disable bit-rate auto-detection

Alternatively the bit-rate auto-detection can be enabled/disabled on a per port basis via the console menu (see Section 5.3.4). Further the console menu allows restarting the bit-rate auto-detection on selected ports.

While the port is auto-detecting the corresponding port LED is flashing orange.

4.3 Network Buffers

The L-Switch XP can handle packets from the network with a maximum length of 256 bytes. There is no explicit limit in the network buffer counts.

5 User Interface

5.1 Status Button

The L-Switch XP is equipped with a status button (see Figure 1). When pressing the status button shortly during normal operation of the L-Switch XP, it sends a "Service Pin Message" on every port. Note, that every L-Switch XP port has its own unique node ID ("Neuron ID").

Pressing the status button longer than 2 seconds will allow you to select the port to sends out the "Service Pin Message" message: The port LED of the currently selected port will light up orange. After 2 seconds the next available port will be selected. When the status button is released the "Service Pin Message" is sent out on the currently selected port.

If the L-Switch XP is operated in smart switch mode (see Section 4.1.1) or repeater mode (see Section 4.1.2) pressing the status button for more than 20 seconds resets the switching tables (see Section 5.5).

5.2 LED Signals

5.2.1 Status LED

The L-Switch XP is equipped with a two-color status LED (green and red, see Figure 1).

When power is applied to the L-Switch XP, the status LED is green. During boot-up the status LED is used to signal error conditions (red).

5.2.2 Port LEDs

Each port on the L-Switch XP has a three color LED (green, red and orange, see Figure 1). Table 11 shows the port different LED patterns and their meaning.

Behavior	Description	Comment
GREEN flashing fast	Traffic	
GREEN flashing at 1 Hz	Port unconfigured	Configured CEA-709 router mode only (see Section 4.1.3)
RED permanent	Port damaged	
RED flashing fast	Traffic with high amount of errors (see Section 5.4)	
RED flashing at 1 Hz (all ports)	Firmware image corrupt Please upload new firmware	
ORANGE permanent	Port disabled	e.g. using LSD Tool (see Section 9)
ORANGE flashing fast	Traffic on port configured as management port	e.g. using LSD Tool (see Section 9)
ORANGE flashing at 1 Hz	Bit-rate auto-detection	RS-485 ports only
ORANGE permanent (all ports)	Status button pressed for more than 20 seconds Switching tables will be reset once button is released	Only if L-IP operated in smart switch mode or repeater mode

Table 11: Port LED patterns

5.3 Console

The L-Switch XP is equipped with a serial interface to

- display the results of the self test

- allow advanced configuration via a console menu

- upgrade the L-Switch XP firmware

To use the serial interface the console connector (see Figure 1 and Figure 2) of the L-Switch XP can be connected to the RS-232 port of a PC. For this connection a PC a standard null-modem-cable with full handshaking must be used. Now, the PC can communicate with the L-Switch XP using a standard terminal program with the communication settings set to 38,400 bps / 8 data bits / no parity / 1 stop bit.

5.3.1 Self Test

Whenever the L-Switch XP comes out of reset it performs a self test. If the self test passed successfully, all port LEDs successively turn green for 0.5 seconds. If a failure occurs during self test, the status LED is flashing red and the L-Switch XP is reset.

The console output of a successful boot sequence on an L-Switch XP with 5 ports on the console reads as follows:

```
LOYTEC electronics GmbH
www.loytec.com


Testing Board ID (4)                                    Passed
Testing RAM                                             Passed
Testing boot loader                                     Passed
Testing fallback image                                  Passed
Testing primary image                                   Passed
Testing Flash                                           Passed

Loading primary image                                   Passed

Bootloader version 2
L-Switch/L-IP Primary Image loading...
Firmware version 6.0.0

Type bootshell to enter the boot shell...

Mounting file system                                    Passed
Detecting CEA-709 port 1 (XF/TP-1250)                   Passed
Detecting CEA-709 port 2 (FT)                           Passed
Detecting CEA-709 port 3 (FT)                           Passed
Detecting CEA-709 port 4 (FT)                           Passed
Detecting CEA-709 port 5 (FT)                           Passed
Starting CEA-709 networking                             Passed

L-Switch XP(c)
LOYTEC electronics GmbH
Mon Sep 10 08:11:41 2012 - V6.0.0
```

Figure 15: Console messages during the boot phase

The duration of a successful boot sequence of an L-Switch XP with 5 ports is typically 10 seconds.

5.3.2 Device Main Menu

After booting the L-Switch XP displays the following console menu:

```
Device Main Menu
================

[1]   Show device information
[2]   Serial firmware upgrade
[3]   System configuration
[4]   CEA-709 configuration
[8]   Reset configuration (factory defaults)
[9]   Device statistics

[0]   Reset device

Please choose:
```

Figure 16: Device main menu

The menu items are described below:

1 - Show device information

This menu item shows information on the L-Switch XP and the current firmware. The output should look like what is shown in Figure 17.

```
Device Information
==================

Product:       L-Switch XP
Product code:  LS-13333CB
Firmware:      L-Switch/L-IP Primary Image
Version:       6.0.0
Build date:    Mon Sep 10 08:11:41 2012
Serial number: 007810-8000000951F4
Free memory:   11744K
Free flash:    6089K
RTEMS heap:    876K
CPU load:      0.0%
System temp:   33.0C
Supply volt:   23.8V

CEA-709 router unique node IDs
==============================

Port 1        : 80 00 00 09 51 F4 | 80 00 00 09 51 F9 (Online)
Port 2        : 80 00 00 09 51 F5 | 80 00 00 09 51 FA (Online)
Port 3        : 80 00 00 09 51 F6 | 80 00 00 09 51 FB (Online)
Port 4        : 80 00 00 09 51 F7 | 80 00 00 09 51 FC (Online)
Port 5        : 80 00 00 09 51 F8 | 80 00 00 09 51 FD (Online)
```

Figure 17: Device information

2 - Serial firmware upgrade

This menu item allows updating the L-Switch XP firmware via the serial interface (console). See Section 7.2 for detailed instructions.

Note: *If you select this option accidentally you can return to the main menu by sending a break signal. In case your terminal program does not offer an option to send a break signal the device has to be reset to return to the main menu.*

---

3 - System configuration

Select this menu item to change system configuration settings. See Section 5.3.3 for details.

4 - CEA-709 configuration

Select this menu item to change the CEA-709 configuration settings. See Section 5.3.4 for details.

8 - Reset configuration (factory defaults)

This menu item resets the L-Switch XP to factory defaults. See Section 5.5 for details on how to load factory defaults by pressing the status button and Section 5.3.6 on how to load factory defaults through the console menu.

0 - Reset device

This menu item resets the L-Switch XP.

5.3.3 System Configuration Menu

The system configuration menu allows setting basic device configuration options.

```
System Configuration Menu
=========================

[1]   Configure date/time : Mon Sep 10 09:34:29 2012 (UTC+00:00)
[2]   Configure earth pos : 48:13:14 N 16:20:05 E 200 m
[3]   Remote configuration: disabled

[q]   Quit without saving
[x]   Exit and save

Please choose:
```

Figure 18: System Configuration Menu

1 – Configure date/time

This menu option allows setting the battery powered on-board real-time clock.

2 - Configure earth pos

This menu option allows configuring the longitude, latitude and elevation of the device.

3- Remote configuration

This menu option allows enabling/disabling the remote configuration functionality of the device (e.g. by the LOYTEC L-WEB system).

5.3.4 CEA-709 Configuration Menu

This menu allows changing the CEA-709 transceiver configuration, enabling the collision-less backbone mode for TP-1250 transceivers, enabling bit-rate auto-detection for RS-485 transceivers, and configuring the CEA-709 router mode.

```
CEA-709 Configuration Menu
==========================

[1]   Port 1                : XF/TP-1250 (1250 kBit)
      Port 2                : FT
      Port 3                : FT
      Port 4                : FT
      Port 5                : FT

[r]   Router configuration  : Configured Router (DIP)

[q]   Quit without saving
[x]   Exit and save

Please choose:
```

Figure 19 CEA-709 configuration menu.

1 to 5 - Change transceiver configuration for Port 1 – 5

This menu item allows setting the default transceiver configuration for port 1 to 5 if there are different possible transceiver configurations.

For TP-1250 transceivers it is possible to set the transceiver settings to collision-less backbone mode. Please contact LOYTEC if you think you might need this feature!

For RS-485 transceivers it is possible to manually set the bit-rate or choose bit-rate auto-detection. If auto-detection is enabled the detected bit-rate is shown. See Section 4.2 for an in-depth discussion of this feature.

9 - Bit-rate auto-detection configuration source (only if RS-485 port is present)

This menu item allows to set what decision element should be used to enable or disable the bit-rate auto-detection. If [1] DIP Switch is selected the value set on the DIP switch (see

Table 1) is used to enable or disable the bit-rate auto-detection. If [2] Manual is selected the setting made with Option 1 – 5 is used to enable or disable the bit-rate auto-detection.

r - Router configuration

This menu item opens the CEA-709 router configuration menu as described in Section 5.3.5.

5.3.5 CEA-709 Router Configuration Menu

This menu allows configuring the CEA-709 router mode.

```
CEA-709 Router/Switch Menu
==========================

[1]   Router mode                : Smart Switch
[2]   Subnet/node learning       : subnet/node
[3]   Group learning             : enabled
[5]   Block unknown domains      : disabled
[6]   Switch reset w. status button : enabled

[q]   Quit without saving
[x]   Exit and save

Please choose:
```
Figure 20 CEA-709 router configuration menu.

1 - Router Mode

The router mode menu allows setting the principal operating mode of the L-Switch XP routing core. Normally the operating mode of the routing core is set with the DIP switches 1 and 2 but can be overridden in this menu.

```
Set router mode
===============

[1]   Enable Configured Router Mode
[2]   Enable Smart Switch Mode
[3]   Set router configuration according to DIP switch

Please choose:
```
Figure 21 Router mode configuration menu

2 - Subnet/node learning

This menu option allows selecting the subnet/node learning mode (see Figure 22).

```
Set subnet/node learning mode
=============================

[1]   Subnet/node learning
[2]   Subnet learning
[3]   Disable
[4]   Set router configuration according to DIP switch

Please choose:
```
Figure 22 Selecting subnet/node learning mode

If subnet/node learning is selected the L-Switch XP will learn based on subnet/node addresses (see Section 4.1.1.2). Subnet broadcasts are flooded. This mode is plug&play.

If subnet learning is selected the L-Switch XP will learn based on subnets. Subnet broadcasts are only forwarded to ports, which contain nodes with that subnet. Subnet learning should be enabled if group overloading is used in the case that more than 256 group addresses are needed. Subnet learning is not plug&play. Please use LonMaker, NL-220, or other network management tools to ensure that one subnet address is only used behind one L-Switch XP port. This can be achieved by using our L-Switch XP LonMaker

shapes or by placing phantom routers in e.g. NL-220. Please contact LOYTEC support if you think you need this feature!

If the mode is changed via the console menu, it cannot changed via the corresponding DIP switch anymore (see Section 2.4). Choose "[4] Set router configuration according to DIP switch", to return control to the DIP switch.

3 - Group learning

This menu option allows enabling or disabling learning of group addresses (see Section 4.1.1.3).

5 – Block unknown domains

The L-Switch XP will learn up to four domains. If your network contains more than four domains please contact LOYTEC support for advice!

6 – Factory reset w. status button

In case the L-Switch XP is in the mode repeater or smart switch, pressing the status button longer than 20 seconds resets the switching tables (see Section 5.1). This function can be disabled using this menu option.

5.3.6 Reset configuration (load factory defaults)

This menu item allows resetting the device into its factory default state. The following menu appears.

```
Reset Configuration Menu
========================

[1]  Reset everything to factory defaults
[2]  Reset switch configuration to factory defaults
[3]  Reset all passwords

[q]  Quit

Please choose:
```

Figure 23 Reset to factory defaults menu.

1 – Reset everything to factory defaults

Pressing "1" resets the complete device to factory defaults (including error log etc.).

2 – Reset switch configuration to factory defaults

Pressing "2" performs a reset identical to pressing the status button longer than 20 seconds (see Section 5.5). Use this menu item if you are moving CEA-709 network nodes between different CEA-709 channels.

5.4 Network Diagnostics

The L-Switch XP provides simple network diagnostics via its port LEDs:

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

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

A port overload condition occurs if

- the average bandwidth utilization of this port was higher than 70% or

- the collisions 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 L-Switch XP was not able to process all available messages.

For a deeper analysis of the reason of 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 (see Section 9).

5.5 Reseting the switching tables

If the L-Switch XP is in smart switch mode (see Section 4.1.1) or repeater mode (see Section 4.1.2) the status button needs to be pressed for at least 20 seconds, in order to reset the switching tables. Resetting the switching tables means:

- Clearing the group forwarding, the subnet/node forwarding and the router domain table.

- Clearing the L-Switch XP status and statistic data.

- Resetting the L-Switch XP back to unconfigured state.

All this is done when the button is released. Afterwards a reset is performed to let the changes take effect. Once the button is held down for more than 20 seconds all port LEDs are switched to orange and stay orange until the button is released and the L-Switch XP is reset. This indicates that the switching tables were reset.

Alternatively to holding down the status button the switching tables can be reset by selecting the menu item "Reset to factory defaults" in the console menu (see Section 5.3.6).

Important: ***If the L-Switch XP is operated in smart switch mode (see Section 4.1.1) and is moved from one location to another or if major changes to the configuration of the network are made, it is recommended to reset the L-Switch XP configuration to factory defaults.***

Important: ***Wait at least 30 seconds after power-up of the L-Switch XP before pressing the Status Button to ensure that the L-Switch XP has booted properly!***

Important: ***If the L-Switch XP is manually configured it is recommended to disable the option to reset the L-Switch XP back to factory defaults via the status button to prevent users from accidentally clearing the configuration! This can be done via the console using the corresponding menu option in the CEA-709 router configuration submenu (see Section 5.3.5)!***

---

6 The L-Switch XP in a Network

The L-Switch XP is based on LOYTEC's powerful L-Core™ and L-Chip™ technology. It is designed to be very robust and reliable in high bandwidth applications.

6.1 L-Switch XP as Smart Switch

In this operation mode the L-Switch XP behaves completely transparent in a network. To put it simple: It installs like a repeater, but works like a router.

Installing and operating the L-Switch XP is plug and play when using the factory default settings, which have

- Subnet/node learning enabled,

- Group learning enabled,

- Bit-rate auto detection enabled, and

- Collision-less backbone mode for TP-1250 ports disabled.

After connecting the network cables, the L-Switch XP can be powered up and it will start its switching application.

When using a standard binding tool (e.g. LonMaker) bindings between nodes connected to different ports can be done without considering the L-Switch XP. Further, an L-Switch XP can be added anywhere to an already configured network without reconfiguring the nodes in the network.

Optionally the L-Switch XP can be configured as a repeater. If configured as repeater this does not have any impact on the routing algorithm of the L-Switch XP in smart switch mode.

In case the L-Switch XP has to be visible in an LNS base binding tool (e.g. LonMaker) LOYTEC provides LonMaker shapes for the different L-Switch XP models (e.g. for documentation purposes). Please refer to application note AN006E "L-Switch XP and LNS" (see Section 9) for details.

The smart switch mode is the default operation mode for all L-Switch XP models.

6.2 L-Switch XP as Configured CEA-709 Router

The L-Switch XP is designed to be compatible with standard CEA-709 routers, if operated as configured CEA-709 router. Thus, it requires commissioning via a network management tool (e.g. LonMaker) like any standard CEA-709 router to be fully functional.

Note: *When shipped the L-Switch XP comes configured in smart switch mode. To use it as CEA-709 compatible router changing the DIP-switches is required (see Section 2.4).*

The L-Switch XP 2-Port can be installed with any network management tool like any other standard CEA-709 router.

The L-Switch XP multi-port versions (3 to 5 ports) contain multiple standard CEA-709 routers − one for each port − and one internal TP-1250 backbone. The internal TP-1250 is neither visible nor accessible.
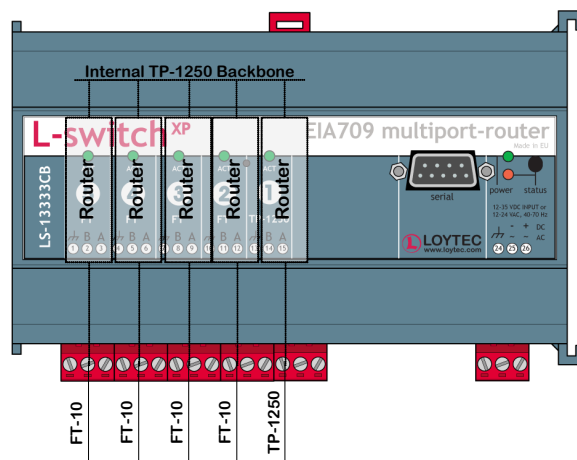

Figure 24: Internal structure of a 5-Port L-Switch XP in configured CEA-709 router mode.

Each router must be commissioned separately. The port LEDs of unconfigured routers are flashing green with a frequency of 1 Hz (once per second).

Pressing the status button longer than 2 seconds will allow you to select the port to sends out the "Service Pin Message" message: The port LED of the currently selected port will light up orange. After 2 seconds the next available port will be selected. When the status button is released the "Service Pin Message" is sent out on the currently selected port/router.

If an LNS based installation tool (e.g. LonMaker) is used, detailed instructions can be found in application note AN006E "L-Switch XP and LNS" (see Section 9).

6.3 Wink action

When receiving a wink network management message all the port LEDs light up orange one after the other back and forth three times ("scanner light"). At the end of this cycle the port LED on which the wink command was received lights up three times.

7 Updating the L-Switch XP Firmware

The L-Switch XP firmware supports remote upgrade over the network and the serial console.

To guarantee that the L-Switch XP cannot be destroyed due to a failed firmware update the L-Switch XP firmware consists of two images:

- Fall-back image

- L-Switch XP application image

The fall-back image is write protected in flash memory and provides everything needed to talk to the L-Switch XP platform over the network. The L-Switch XP application image is designed to be updated over the network whenever there is a need to do so.

The fall-back image makes sure that the L-Switch XP comes up in a status where the maintenance software can at least talk to the L-Switch XP platform and can download a new L-Switch XP application image.

When the L-Switch XP boots up with the fall-back image, all port LEDs are flashing red. In this state it does not forward any messages.

7.1 Firmware Update via the Network

Basically firmware downloads can be performed on every L-Switch XP port. However, since the L-Switch XP is not based on a Neuron Chip a new firmware image cannot be downloaded with a standard tool. Rather, a designated tool, the LSD Tool (see Section 9), must be used. See the LSD Tool documentation for details on how to download a new L-Switch XP firmware via the network.

7.2 Firmware Update via the Console

To download the firmware via the console the L-Switch XP must be connected to the RS-232 port of a PC via its console interface as described in Section 5.3. You will need the LOYTEC serial upgrade tool (LSU Tool), which can be downloaded from our homepage at www.loytec.com.

Please make sure that the L-Switch XP console shows the main menu otherwise navigate to the main menu or simply reset the L-Switch XP.

Double click on the *.dlc file that comes with the new firmware package. This should start the LSU Tool and load the firmware image referenced in the dlc file. Please note that the dlc file and the dl file must be stored in the same folder. The start window of the LSU tool is shown in Figure 25.
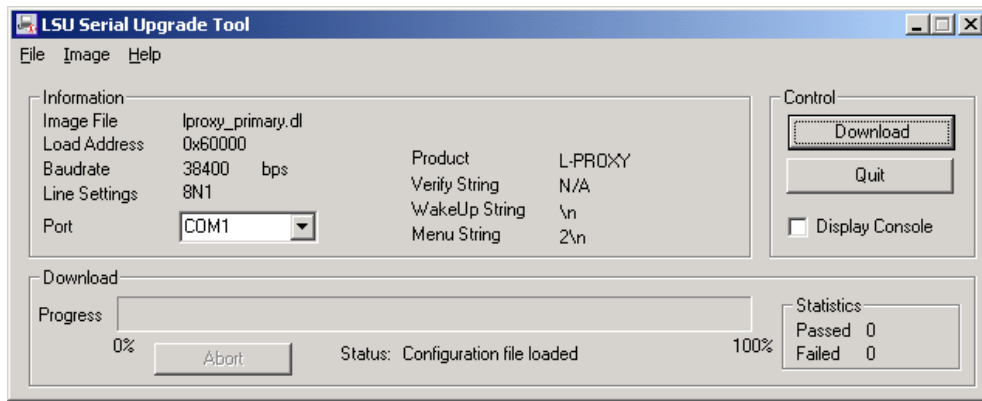
Figure 25: LSU Serial Upgrade Tool in idle mode.

If the L-Switch XP is not connected to COM1 you can change the port to COM1, COM2, COM3, or COM4. Make sure that the product shown under "Product" matches the device you are upgrading. Note, that Figure 25 and Figure 26 do not necessarily show the proper product.

Press "Download" to start the download. A progress bar as shown in Figure 26 can be seen.

Figure 26: Progress bar during firmware download.

If the upgrade is successful the following window appears (Figure 27).

Figure 27: Successful firmware upgrade.

Double check that the new firmware is executed by selecting 1 and pressing Enter in the console window. This will bring up the device information, which shows the current firmware version.

8 Troubleshooting

8.1 TP-1250 port does not work

Problem

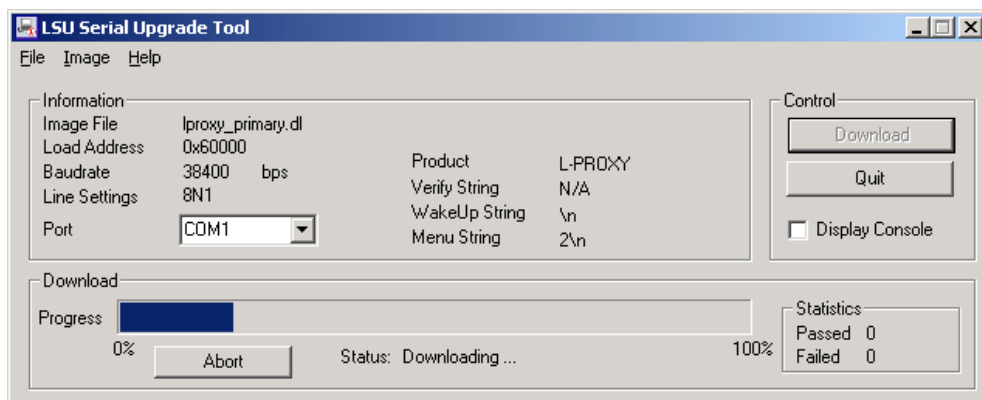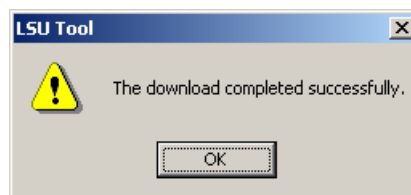Messages are not forwarded to or from the TP-1250 port(s). All other ports work properly.

Explanation

This problem might be due to mixing collision-less backbone mode and standard backbone mode devices on one channel.

Solution

If the TP-1250 channel is used in collision-less backbone mode make sure all devices on the network have collision-less backbone mode enabled, only L-Switch XP devices are connected to this backbone and every L-Switch XP has a unique station ID set.

If the TP-1250 channel is used in standard backbone mode make sure that all L-Switch XP devices have the collision-less backbone mode disabled.

8.2 One or more port LEDs are flashing red

Problem

One or more port LEDs are flashing red whenever there is traffic on the channel (instead of green).

Explanation

The L-Switch XP has built-in network analysis functionality (see Section 5.4): Whenever it detects a potential problem on one port, the corresponding activity LED will change its color to red.

Solution

Most likely this behavior is due to a wiring problem. Check the wiring and termination of the network connected to the affected port. If this does not solve your problem use a protocol analyzer (e.g. LOYTEC's LPA) and/or a network diagnostics tool (e.g. LOYTEC's LSD Tool or Echelon's Nodeutil) to find the source of the problem.

8.3 All port LEDs are flashing red

Problem

All port LEDs are flashing red at a rate of approx. once per second and the L-Switch XP does not forward any messages.

Explanation

Somehow the primary image was destroyed and the fall-back image was booted (see Section 7). This image does not support forwarding of messages. It only allows downloading a new firmware.

Solution

If this problem occurs because a firmware update was attempted (and failed somehow), simply retry downloading the new firmware image.

If no firmware update was attempted, please contact LOYTEC support (see Section 8.6).

8.4 LonMaker cannot commission node

Problem

When adding a new node to a LonMaker project, LonMaker receives the service ping message from that node, but is unable to commission it.

Explanation

This problem might be due to badly configured TP-1250 port.

Solution

See Section 8.1.

8.5 All LEDs light up orange about every second

Problem

All LEDs of my L-Switch XP (port & status LEDs) light up orange every second or so and it does not forward any messages.

Explanation

Probably the power supply is too weak and the L-Switch XP reboots again and again.

Solution

Try to use a power supply following the specifications in the user manual.

If the problem persists contact LOYTEC support (see Section 8.6).

8.6 Technical Support

LOYTEC offers free telephone and e-mail support for our L-Switch XP 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

email :	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

email:	support@loytec-americas.com
web:	http://www.loytec-americas.com
tel:	*+1/262/278 4370*
fax:	*+1/262/408 5238*

9 Application Notes

Please refer to the application notes listed in Table 12 for further information on using the L-Switch XP in different application scenarios.

Application Note	Topic
AN002E LSD Tool	How to use the enhanced statistic features of the L-Switch XP with the LOYTEC system diagnostics tool (LSD tool)
AN006E L-Switch XP and LNS	How to use the L-Switch XP with LonMaker and other network management tools
AN004E Backbone Mode	Further information on how to best utilize the high-speed collision-less backbone mode of the L-Switch XP
AN005E L-Switch XP with L-IP Backbone	How to best utilize the L-Switch XP together with L-IPs

Table 12: L-Switch XP related application notes.

10 L-Switch XP Firmware Versions

Table 13 shows the most important features available only in certain firmware versions depending on the firmware version. The L-Switch XP can be used with firmware versions 3.0 and up.

Firmware Version/ Features	1.0	1.2 Final 1	2.0	3.0/3.1	4.2	6.0
Console Menu (configuration & firmware update)	-	√	√	√	√	√
Aging mechanism	-	√	√	√	√	√
Execute Wink NM command	-	√	√	√	√	√
Management port	-	√	√	√	√	√
Password protection	-	√	√	√	√	√
Full LSD 2.0 support	-	-	√	√	√	√
L-Switch XP support	-	-	-	√	√	√
Commission in smart switch mode					√	√

Table 13: Available features depending on firmware version

11 Specification

11.1 LS-xxxxxCB and LS-xxCB

Operating Voltage: .... 12-35 V DC or 12-24 V AC ±10%

Power Consumption: .... typ. 3 W

In rush current:... up to 1100 mA @ 24 VAC

Operating Temperature (ambient): .... 0°C to + 50°C

Storage Temperature: .... -10°C to +85°C

Humidity (non condensing) operating: .... 10 to 90% RH @ 50°C

Humidity (non condensing) storage:............... 90% RH @ 50°C

Enclosure: .... Installation enclosure 9 TE (L-Switch XP Multi-port) resp. 6 TE (L-Switch XP 2-Port), DIN 43 880

Environmental Protection: .... IP 40 (enclosure); IP 20 (screw terminals)

Installation: .... DIN rail mounting (EN 50 022) or wall mounting

12 Revision History

Date	Version	Author	Description
31-12-2001	1.0	JB	Initial revision V1.0
12-02-2002	1.1	JB	Updated supply voltage range from 9-22 V AC to 9-24 V AC (production lot 2) Added installation instructions on ferrite
10-06-2002	1.2	JB	Updated L-Switch XP product label Added recommended power supplies Added connecting diagrams for LS-33300C and LS-33000C Added description of console menu Updated information on network diagnostics Added description of Wink command Added information on firmware update Added information on LSD Tool Added application note on L-Switch XP LonMaker shapes Updated application note on L-Switch XP backbone mode Added application note on using L-Switch XP devices with CEA-709/IP Routers Added firmware feature list
	2.0	DL, JB	Updated cover sheet Updates for Firmware version 2.0 (specifically Console Menu, Network Variables, and Firmware Update) Moved applications notes into separate documents Added documentation of L-Switch XP 2-port version
15-09-2003	2.0	DL, JB	Release version 2.0
23-01-2004	3.0	JB	Release version 3.0
28-04-2004	3.1	JB	Release version 3.1
07-02-2006	4.4	JB	Updated for firmware version 4.4 Updated for LS-xxxxxCB and LS-xxCB
10-09-2012	6.0	JB	Updated for firmware version 6.0 Remove information on legacy L-Switch products Updated to new manual design Minor corrections