Operating Instructions

LION Infrastucture components

SAFE Power Supplies SIL2
800101, 800103

Power Supplies, non-safe
800111, 800113

Line Coupler SIL0
800102

Version 04

LUTZE TRANSPORTATION
powered by Amphenol

Lütze Transportation GmbH reserves the right to make changes to its products in the interest of further technical development. These changes are not necessarily documented in each individual case.

These operating instructions are an integral part of the device and contain important information on safety and operation. Read the operating instructions before use in order to rule out possible dangers and to ensure proper use.

These operating instructions and the information they contain have been compiled with due care. However, Lütze Transportation accepts no liability for printing or other errors or any resulting damage.

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For the sole purpose of better readability, gender-specific spelling and multiple designations are not used. All personal designations should nevertheless be regarded as gender-neutral.

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Table of contents

1 Introduction

This document is part of the LION Infrastructure modules.
It contains important information about handling and safety. It is an integral part of the LION product family. Additionally, it contains special safety information on safety integrity.

Part no.	Type	Description
	LION SAFE Power Supplies SIL2	
800101	LION-SAFE-PS-24V-110V-72W-LUE	LION SAFE Power Supply SIL2; Input: DC 24V-110V; Output: DC 24V/3A; Galvanic insulation
800103	LION-SAFE-PS-24V-110V-36W-LUE	LION SAFE Power Supply SIL2; Input: DC 24V-110V; Output: DC 24V/1,5A; Galvanic insulation
	LION Power Supplies, non-safe	
800111	LION-PS-24V-110V-72W-LUE	Power Supply, non-safe; Input: DC 24V-110V; Output: DC 24V/3A; Galvanic insulation
800113	LION-PS-24V-110V-36W-LUE	Power Supply, non-safe; Input: DC 24V-110V; Output: DC 24V/1,5A; Galvanic insulation
	LION Line Coupler	
800102	LION-LC-M12-LUE	Line-Coupler, SIL0

To avoid hazardous situations, these instructions must be read and understood before installing, operating, maintaining or dismantling the device.
NOTICE This applies to every person who is getting in touch with the product. Trained personnel and experts, especially qualified persons who have worked with similar products before, have to read and understand this document as well.

CAUTION

Risk of injury and damage to equipment caused by failure to read and observe the operating instructions.

The instructions contain important information on safety, commissioning, operation, maintenance and disposal of the corresponding device.

Before installation or use, carefully read these instructions in order to rule out possible dangers and damage and to guarantee correct use.

NOTICE

Always keep the document ready at hand
This applies until the product is disposed of. In cases of sale, rental or disposal, pass the instructions on to the authorized person.

These instructions and further information is available on the website of the Lütze Transportation GmbH:
www.luetze-transportation.com
Search for the **part number**, or the product name „**LION...**“.

2 General information

2.1 Symbol description

2.1.1 Safety messages

This document contains safety information, which is characterized by a signal word in combination with a specific color to indicate the warning level. The information highlights possible dangers and gives instructions on how to avoid them.

DANGER	**Indicates a dangerous situation that leads to death or serious injuries if not observed.**
WARNING	**Indicates a dangerous situation that can lead to death or serious injuries if not observed.**
CAUTION	**Indicates a dangerous situation that can lead to slight or moderate injuries if not observed.**
NOTICE	**Indicates a situation that could damage the product or the environment. This notice does not apply to personal injuries.**

2.1.2 Handling notes

You will also find icons that indicate important information and action steps:

	**Indicates technically important information to operate the device safely.**
	**Indicates the use of tools.**

2.2 Special notes

SIL relevant	LION-XXX	**Important information on correct use in a safety-relevant environment.** These notes are marked with an ID, for example LION-001.
ASSESS-MENT REPORT	SRAC XX	**Safety-related application condition**. Reference to a safety-relevant application condition from the assessment report. These references are marked with an ID, for example SRAC 01.

2.3 Copyright

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General data, text, images, and drawings are copyrighted and subject to industrial property rights. Contravention will be prosecuted. The named brands and product names in this document are trademarks or registered trademarks owned by the respective titleholder.

2.4 Disclaim of liability

This document was written in consideration of the applied standards, regulations and the current state of technology.
The content‘s accuracy has been verified. Discrepancies are not excluded. For these discrepancies, we disclaim liability. Applicable changes and additional information will be in the next version of this document.

The following causes are not covered by the Lütze Transportation GmbH's liability policy:

- Nonobservance of this document
- Untrained and unqualified employees
- Non-conventional use
- Non-approved reconstructions and functional modifications of the product
- Using non-original or non-admitted parts or equipment

2.5 Standards

SIL relevant	LION-005	The safety-related automation system LION (Lütze Input Output Network) has been independently appraised by TÜV Süd Rail GmbH (Assesment Report FW8257G) in accordance with the standards EN 50128, EN 50129, EN 50155, EN 50159, EN 50121-3-2, and EN 50124-1 regularly certified. The system integrator can refer to this report and the certificate for the approval of this component. **Reports and certificates can be requested by Lütze Transportation GmbH.**

NOTICE	**See also the standards in the respective data sheets.**

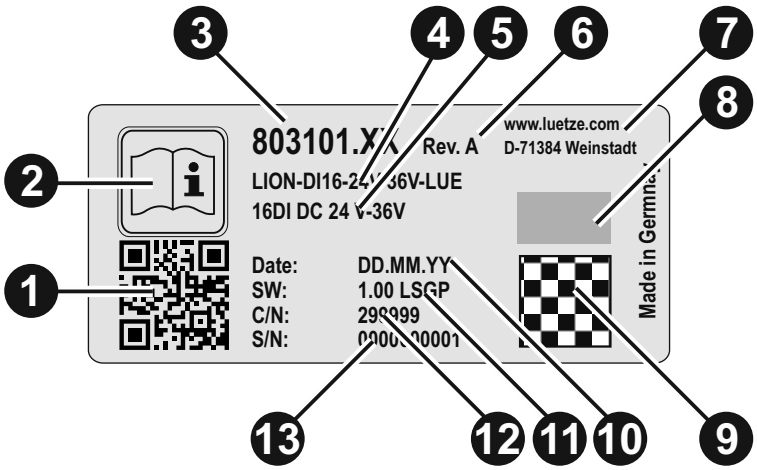
2.6 Labeling

SIL relevant

LION-029 **Identification of the modules.**
The product label contains important information for identification and verification with the system configuration.

Observe the adhesive labels.

- Keep them readable.
- In case of a malfunction, the part number and the serial number might be needed.



The label contains the following information as an example:

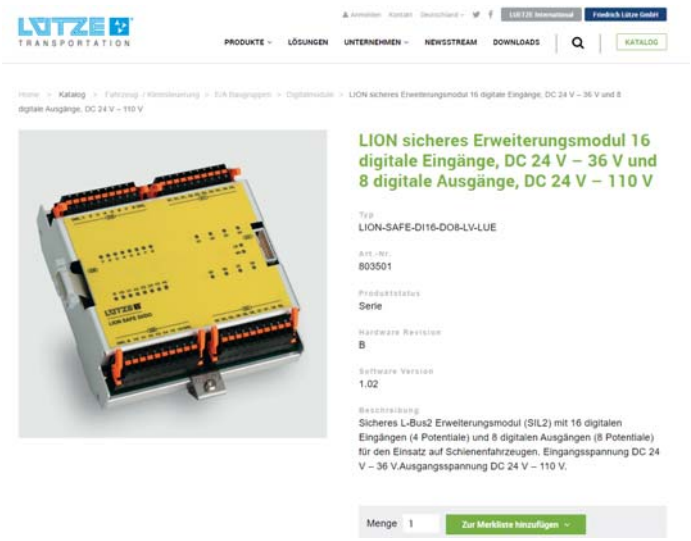
1. The QR code refers to the product information on the homepage
2. Symbol for: first read the operating instructions
3. **Part number***
4. Type (assembly designation/module designation)
5. Module description
6. **Hardware revision***
7. Company name/address
8. Approvals
9. Data matrix code contains: serial number, part number, and a date
10. Manufacturing date (Date)
11. **Software version (SW)***
12. Batch identification (C/N)
13. **Serial number (S/N)***

* These are the four crucial pieces of information LION-029 needs for identification and system configuration verification.

2.6.1 QR code – product information

The code links to further product information in the online catalog on the LÜTZE Transportation website. To reach the page, proceed as follows:

1. Scan the QR code with a smart phone or another device that can read such codes.
2. A standard browser will open with the linked page.



3. Choose a language.
4. Under *Downloads,* it is possible to download further technical documentation.

3 Terms and abbreviations

3.1 Terminology

In this document, we use the following terms that are defined exactly below:

Actor	Synonym for actuator
Fieldbus	A fieldbus is used for data communication within a rail vehicle (e.g., MVB, TRDP)
LOGIC	The LOGIC is the data processing component of the train. (Equivalent terms are VCU or PLC.)
HEAD	HEAD is the designation for the LION bus coupler (BC) or the LION CCU in the LION system. The designation HEAD refers to the LION subsystem and the internal communication bus L-Bus^2, respectively. The HEAD is the system master of the I/O station and controls the communication with the I/O modules.
DEVICE	A DEVICE is a communication device on the L-Bus². It is an I/O module that is addressed by the HEAD within the I/O station.

3.2 Abbreviations

In this document we use the following abbreviations:

AC	Alternating current
AI	Analog input
AERR	Application error
AO	Analog output
BC	Bus coupler - the LION Bus coupler. It is also called HEAD in the LION system.
CCU	Compact Control Unit
CH	Channel
CPU	Central Processing Unit
CRC	A cyclic redundancy check is an error detection code commonly used in digital networks and storage devices to detect accidental changes to raw data. It generates a safety checksum.
CON	Configuration error
DC	Direct current
DI	Digital input
DIAG	Diagnostic information
DO	Digital output
EMC	Electromagnetic compatibility
EN	European Standard

ERR	Error (test pulse error)
ESD	Electrostatic discharge
EXTV	External voltage
FR	Failure Rate (formerly HR – Hazard Rate)
GND	Ground
I/O	Input/Output
IEEE	Institute of Electrical and Electronics Engineers
IODB	Input/Output Data Base
IP address	An Internet Protocol address is a numerical label assigned to each device connected to a computer network that uses the Internet Protocol for communication. An IP address serves two main functions: host or network interface identification and location addressing.
IP code	ingress protection code (e.g., IP20)
L-Bus²	L-Bus² is the short form of "**Lütze Bus 2**". Lütze's own communication bus is used by LION, which is based on RS485.
LCF	LION Configuration Framework
LION	Lütze Input/Output Network
MTBF	Mean time between failures
MTTR	Mean time to repair
MVB	Multifunction Vehicle Bus
NSDB file	The NSDB file is a configuration file for an I/O station with a SIL2 Bus coupler MVB. The input, output, and diagnostic data of the MVB ports of the I/O station are assigned there. The NSDB file can be used to configure individual modules of the I/O station during commissioning. The NSDB file is created exclusively with the LCF configuration tool and assigned to the bus coupler.
PE	Protective Earth
PLC	A programmable controller is a device that is used to control or regulate a machine or system and is programmed on a digital basis. (See also LOGIC)
PS	Power supply or supply voltage
PST	Process Safety Time
RAMS	Reliability, Availability, Maintainability, and Safety
RO	Relay output
SCC	Switching cycle counter
SDTv2	The Safe Data Transmission Protocol is defined in the standard IEC 61375-2. NOTE: The Safe Data Transmission Protocol (STDv2) is basically explained in the LION System Description chapter ”Safety layer SDTv2“.
SIL	Safety integrity level
SO	Switching output

TCMS	Train Control and Management System
TDB file	The TDB file is a configuration file for an I/O station with a TRDP bus coupler; the input, output, and diagnostic data for the TRDP ports of the I/O station are assigned there. The TDB file can be used to configure individual modules of the I/O station during commissioning. The TDB file is created exclusively with the LCF configuration tool and assigned to the bus coupler.
THR	Tolerable Hazard Rate
TR	Transistor
TRDP	Train Realtime Data Protocol
TH35	The top hat rail (TH35 according to IEC 60715, formerly known as TS 35 according to EN 5002) is a mounting rail with a top hat profile. A mounting rail, also known as a DIN rail, is a universal carrier made of a sheet metal profile in electrical engineering for fastening electrical equipment in distribution boxes, switch cabinets, terminal boxes, etc.
VCU	Vehicle Unit Control (See also LOGIC)
VDP	Vital Data Package (See also SDTv2)

4 Safety

4.1 Related Documents

CAUTION

Risk of injury and property damage caused by nonobservance of the related documents

- This document is insufficient when the LION components are used in a system with other modules.
- To avoid injuries and damage, also read the related documents before planning the system.

The system description, the safety manual, and the manuals for the LION bus coupler and the LION I/O modules can be found via the following QR links, or at: *www.luetze-transportation.com*

4.2 Overview of the LION documents

	Name of the document	Description
1.	**LION_System_SD_EN**_Vxx	*LION System description*
2.	**LION_SIL2_Bus_coupler_803001_MA_EN**_Vxx	*LION SIL2 Bus coupler MVB EMD manual*
3.	**LION_SIL2_Bus_coupler_803002_MA_EN**_Vxx	*LION SIL2 Bus coupler ETH TRDP manual*
4.	**LION_SIL0_Bus_coupler_803011_MA_EN**_Vxx	*LION SIL0 Bus coupler MVB EMD manual*
5.	**LION_SIL0_Bus_coupler_803012_MA_EN**_Vxx	*LION SIL0 Bus coupler ETH TRDP manual*
6.	**LION_Infrastructure_MA_EN**_Vxx	*LION Infrastructure modules manual*
7.	**LION_SIL0_IO_Modules_MA_EN**_Vxx	*LION SIL0 modules manual*
8.	**LION_SIL2_IO_Modules_MA_EN**_Vxx	*LION SIL2 modules manual*
9.	**LION_LCF_MA_EN**_Vxx	*LION Configuration Framework (LCF) application manual*

4.3 Intended Use

The components are designed for exclusive use in rail vehicles, and for the specific purpose of the LION system only *(e.g. as LION power supplies, LION I/O modules or LION bus couplers, etc.).*

The intended use also includes use in accordance with the operating instructions.

DANGER

Danger to life, serious injuries, and property damage caused by an unsafe system

Use the modules only for the listed cases and according to the system architecture.

4.4 Recipients

This document addresses planners, project managers, and programmers. It also addresses the operating personnel, who are responsible for the initial operation, the operation and the maintenance of the products and systems. Regarding the personnel, three qualification levels can be distinguished.

4.5 Operating personnel

Risk of injury by deploying insufficiently qualified operating personnel

- Inappropriate deployment of unqualified or insufficiently qualified personnel can cause property damage and personal injuries.
- Tasks that apply special procedures should be done by trained and qualified personnel or experts, especially electricians.

Trained personnel
The employee was trained by the employer on the task and possible hazardous situations. The employee does not have any technical knowledge.

Experts
The employee has technical education, knowledge and/or experience in the required field. The employee is capable of doing specific operations on and with the product.

Qualified electrician
The employee has technical education in the required field. The employee is capable of performing special operations on and with the product.

The different sections of this document refer to the different qualification levels of the operating personnel.

4.6 Responsibility of the Operator

Since the device is used in a commercial area, the operator of the device is subject to legal obligations for occupational safety:

- The operator of the device is obliged to instruct the operating personnel and to inform himself about the industrial safety regulations.
- The operator must ensure that safety, accident prevention and environmental protection regulations are observed.
- The operator must make an appropriate risk assessment on the workplace or location to detect and warn of special hazards.
- The document must be kept in the immediate vicinity of the device.
- The information in the operating instructions must be followed.
- The device may only be operated in technically perfect condition.
- The operator is responsible for validating the LION system before the initial operation.

4.7 Protective clothing and equipment

NOTICE

- **Destroyed parts and malfunction of the product.**

  Inappropriate clothing can cause electrification and can damage the product.
- **Wear appropriate ESD protective clothing.**
  Static charging can damage individual components and lead to a defect in the device.
- **Always follow the employer's instructions and regulations.**

4.8 Electrostatic Discharge (ESD)

Electrostatic discharge can destroy electronic components by generating voltage and energy that are not noticeable to humans. Damage can occur if an electronic component is touched by an electrostatically charged person.
Modules will not be immediately recognized as malfunctioning; the malfunction will occur after a longer operating time.

- Switch off the voltage before working with or on the module and work according to the ESD guidelines.
- Electronic components should have no contact with electronic insulated material like plastic foil, plastic parts, insulated table pads, or clothing.
- Place the modules on conductive surfaces only.

4.9 Reconstruction and modifications of the product

⚠ WARNING

Modifications and conversions lead to personal injury and property damage

Unauthorized modifications to the product may result in electric shock or injury and may destroy the product.

- Do not make any changes or modifications to the product.
- If a modification or change cannot be avoided, have the modification approved in writing by Lütze Transportation GmbH.

4.10 Special safety messages

⚠ WARNING

Electric shocks and product damage caused by the wrong voltage application

- Use the nominal operating voltage (see technical data).
- The lower and upper thresholds are also given in the technical data.

NOTICE

Product damage caused by compensating current

- Disconnect all electronic modules and their connections from the frame if you intend to do some welding.

5 System planning

NOTICE

The chapter “System planning“ can be found in the corresponding document "LION System description".

> This link opens the product webpage of article no. 800101 on the LÜTZE Transportation website, below in the download area you will find the:

„System description, LION-Lütze Input/Output Network“

6 Transport and storage

NOTICE

- **Product damage caused by humidity**
  Store the products in a dry environment between -40° and 85°C.
- **Product damage caused by improperly packed products**
  Wrap the products safely for transport to absorb possible crushes.
- **Product damage caused by dust**
  The circuit boards of the modules are coated. Try to store and transport them in a dust-free environment to avoid damage to the modules.
- **Product damage by electrostatic discharge**
  Store and transport electronic components only in ESD-safe and conductive packaging.

6.1 Scope of delivery - Power Supplies

- 1 × LION Power Supply module
- 1 × L-Bus² Dummy connector, X30 (Part no. 800202)
- 1 × L-Bus² 1:1 Plug connector (Cable) (Part no. 800203)
- 1 × Instruction leaflet
- Push-in terminal sets:

  Power supply 36 W:
  800103, 800113:
  1 × Set of LION I/O plug-connector 5-pole, part number 800208
  1 × Set of coding pins for terminals and connectors

  Power supply 72 W:
  800101, 800111:
  2 × Sets of LION I/O plug-connector 5-pole, part number 800208
  2 × Sets of coding pins for terminals and connectors

6.2 Scope of delivery - Line Coupler

- 1 × SIL0 Line Coupler Module (Part no. 800102)
- 1 × L-Bus² Dummy connector, X30 (Part no. 800202)
- 1 × Instruction leaflet

7 Installation

NOTICE

The chapter “Installation“ can be found in the corresponding document “LION System description“.

> This link opens the product webpage of article no. 800101 on the LÜTZE Transportation website, below in the download area you will find the:

“System description, LION-Lütze Input/Output Network“

8 Product description

The LION infrastructure components are especially designed for use in a LION I/O station. These modules are used to organize and supply the LION system.

8.1 Characteristics

SIL relevant

LION-010 **An I/O station can execute safe functions in compliance with the specifications with safe power supplies, a safe bus coupler, and one or more safe I/O modules.**

Only these modules are able to ensure the safe acquisition, processing, and transmission of the connected process signals on the module as well as the safe reception, processing and output of the process states at the outputs across the entire chain and to initiate safe reactions.

CAUTION

If a non-safe power supply is used, a SIL classification cannot be achieved for any safety functions within the I/O station!

The LION line couplers (SIL0) are transparent and not visible as bus subscribers. The LION line couplers have no address and do not influence any data, but only tunnel them through.

8.2 Product family overview

The infrastructure components are divided into function groups:

The power supplies galvanically isolate the system from the train power voltage and generate the power supply for a section of the LION system.

The line coupler connected modules (lines) that are not attached directly to the HEAD.

8.2.1 LION SAFE Power Supplies SIL2 (PS)

800101

800103

8.2.2 LION Power Supplies, non-safe (PS)

800111

800113

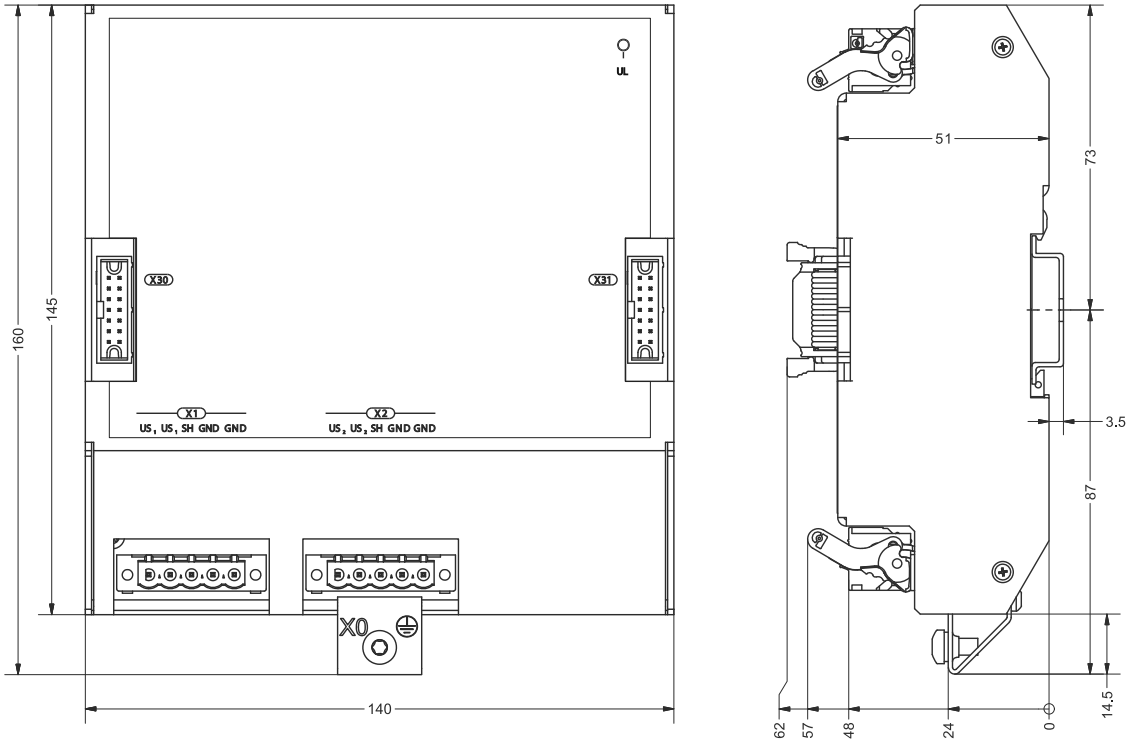
8.2.3 LION Line Coupler SIL0 (LC)

800102

8.3 Product overview

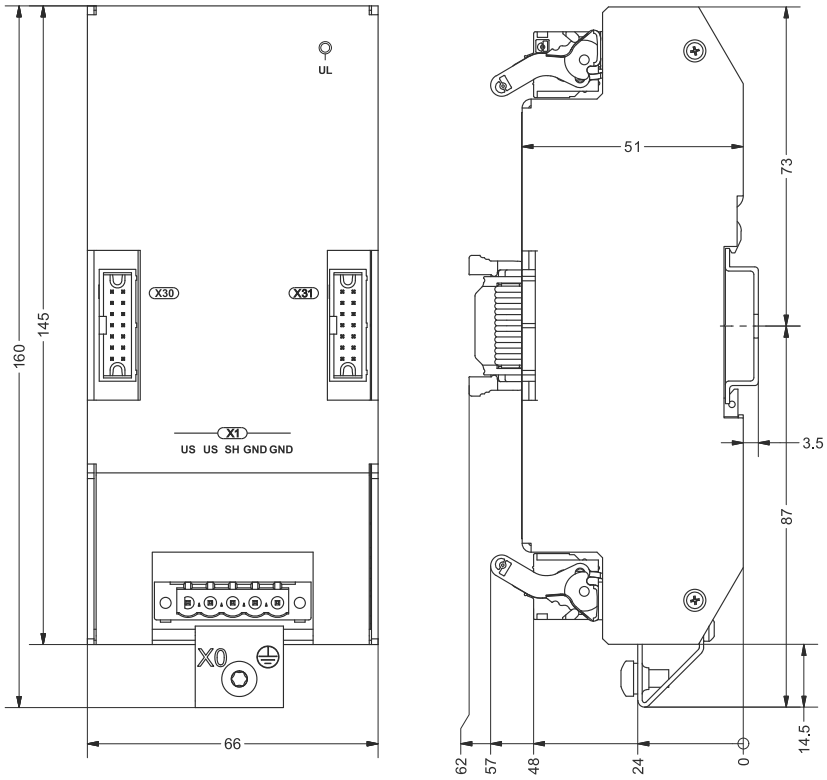
8.3.1 Form of construction 1 (Width 140 mm)

The LION Power Supplies, 72 W (800101, 800111) have this form of construction:



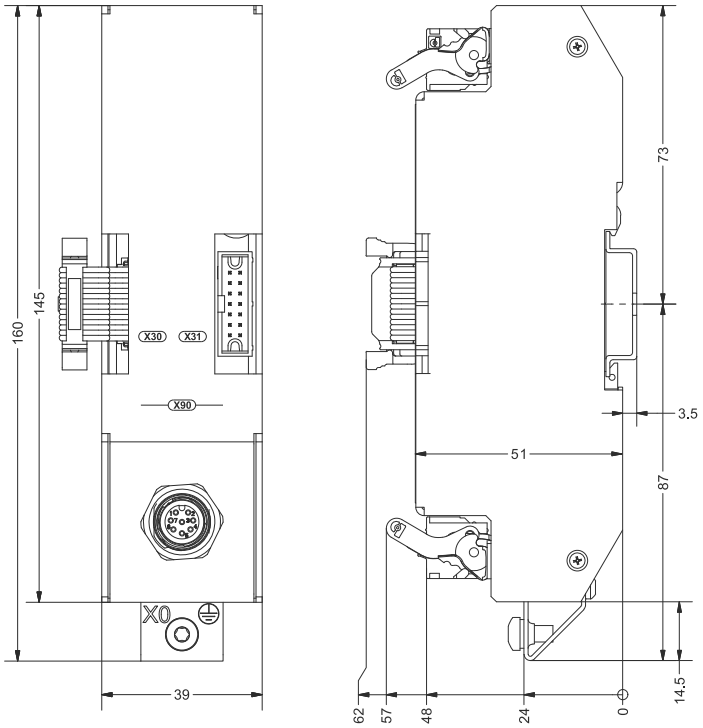
8.3.2 Form of construction 2 (Width 66 mm)

The LION Power Supplies, 36 W (800103, 800113) have this form of construction:

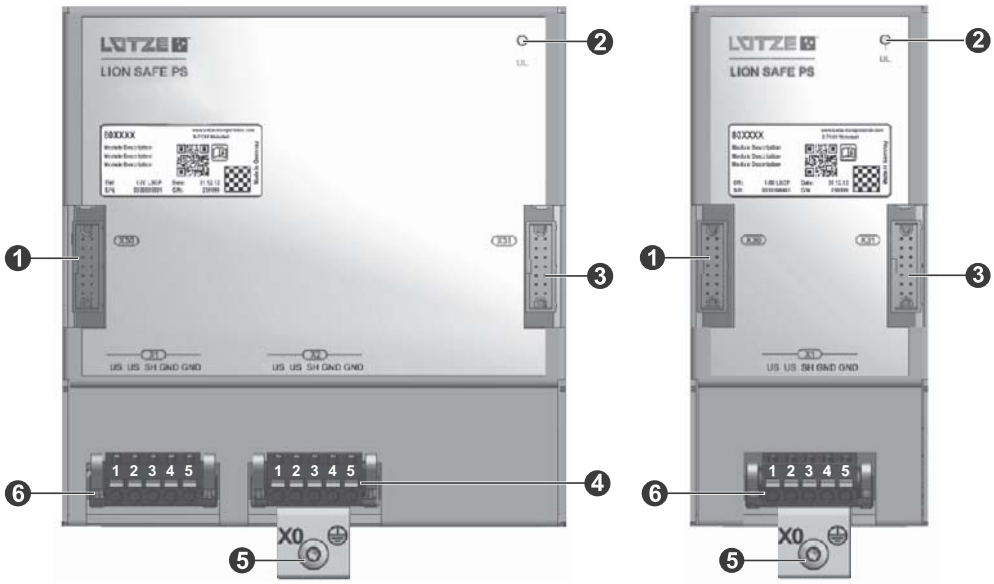


8.3.3 Form of construction 3 (Width 39 mm)

The LION Line coupler (800102) have this form of construction:

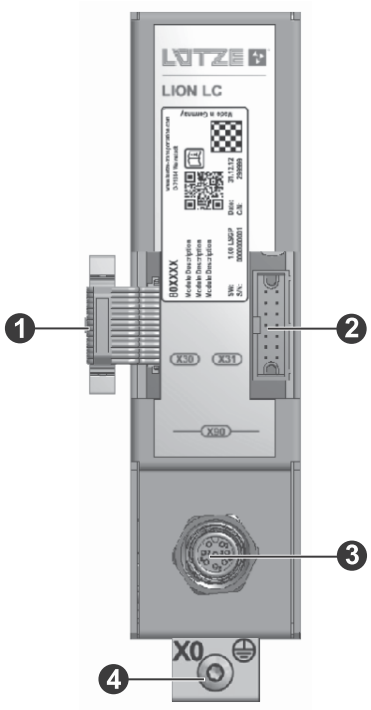


8.3.4 General product structure - Power Supplies



1	X30: L-Bus^2 interface, incoming bus, female connector IDE, 14-pin
2	Module status LED (UL)
3	X31: L-Bus^2 interface, outgoing bus, male connector IDE, 14-pin
4	X2: Push-In terminal for Supply
5	X0: PE contact
6	X1: Push-In terminal for Supply

8.3.5 General product structure - Line Coupler



1	X30: L-Bus^2 interface, incoming bus, female connector IDE, 14-pin
2	X31: L-Bus^2 interface, outgoing bus, male connector IDE, 14-pin,
3	X90: Line change connector, M12, female, 8-pin (A-coded, shielded) for line change
4	X0: PE contact

8.3.6 Technical data

To get detailed technical data on the modules, download the data sheets from *www.luetze-transportation.com* or scan the QR code.

8.3.7 Addition to the data sheets

To get the detailed technical data of the modules, download the data sheets on *www.luetze-transportation.com* or scan the QR code on the product label or below.

Additional guidelines for operation

Guidelines for operation at an altitude of > 2000 m up to 4000 m about sea level

ASSESS-MENT REPORT

SRAC 09

Pollution degree for operation at an altitude of > 2000 m up to 4000 m above sea level.

The user must ensure that the degree of pollution PD1 according to EN50124-1 is not exceeded (for example, through a control cabinet with at least IP51).

ASSESS-MENT REPORT

SRAC 10

Operating voltage for operation at an altitude of > 2000 m up to 4000 m above sea level.

The user must ensure that the maximum permissible operating voltage according to EN50155 is at maximum of 72 V (supply voltage/input voltage/ output voltage/ ...).

ASSESS-MENT REPORT

SRAC 11

Test voltage operation at an altitude of > 2000 m up to 40000 m above sea level.

The user must ensure that the maximum permissible test voltage between all potentials in the vehicle does not exceed AC 1000 V at an altitude of > 2000 m.

9 Power Supplies 72 W

9.1 Module types

Part no.	Product	Type	Description
800101 	**LION SAFE Power supply 72 W** LION SAFE Power supply SIL2 ***ID 200***	LION-SAFE-PS-24V-110V-72W-LUE	LION SAFE Power supply SIL2 for supplying the connected L-Bus² modules in the LION system. *The power supply supports redundant wide range input from DC 24V to DC 110V.* The output rating is 72 W.
800111 	**LION Power supply 72 W** LION Power supply non-safe ***ID 1200***	LION-PS-24V-110V-72W-LUE	LION Power supply, non-safe for supplying the connected L-Bus² modules in the LION system. *The power supply supports redundant wide range input from DC 24V to DC 110V.* The output rating is 72 W.

The QR Codes links opens the product web page in your browser.
The download area is located at the bottom of the product web page.
There you will find the data sheets and further information about the product.

SIL relevant

LION-010 **An I/O station can execute safe functions in compliance with the specifications with safe power supplies, a safe bus coupler, and one or more safe I/O modules.**

Only these modules are able to ensure the safe acquisition, processing, and transmission of the connected process signals on the module as well as the safe reception, processing and output of the process states at the outputs across the entire chain and to initiate safe reactions.

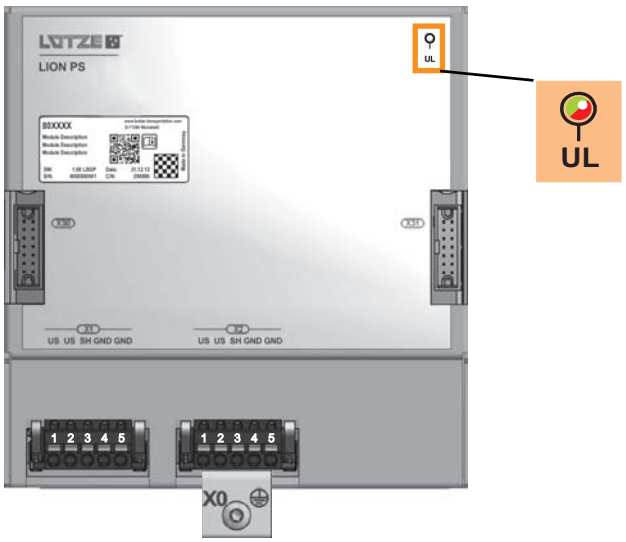
NOTICE

If a non-safe power supply is used, a SIL classification cannot be achieved for any safety functions within the I/O station!

9.2 Assembly 800101, 800111

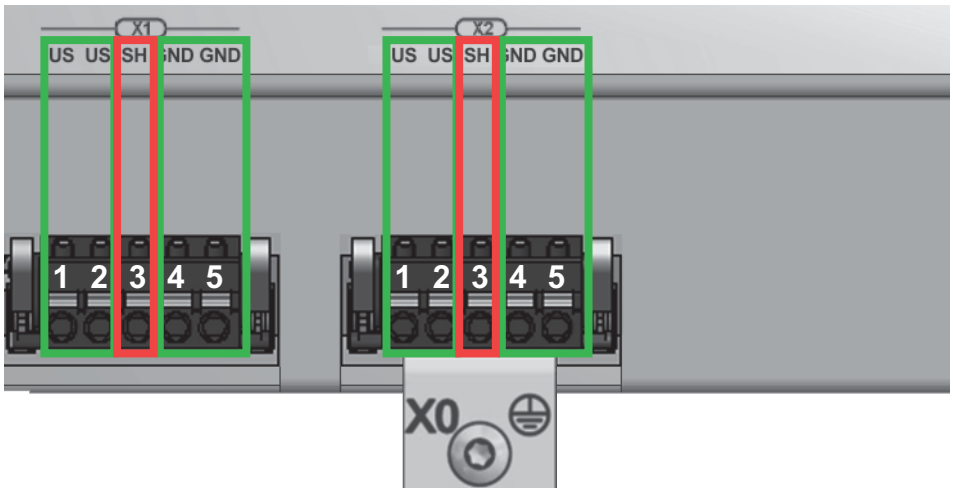
9.2.1 LED status

Every LION power supply module has a supply status LED (UL).



LED	Color	Status	Description
UL	green	on	*Supply active*
UL	red	on	*Error*

9.2.2 Pin assignment



X1/X2

Pin	Signal	Description
1	US	Supply (Potential A)
2	US	Supply (Potential A)
3	SH	Shield (Potential PE)
4	GND	Ground (Potential A)
5	GND	Ground (Potential A)

9.2.3 Potential groups

SIL relevant

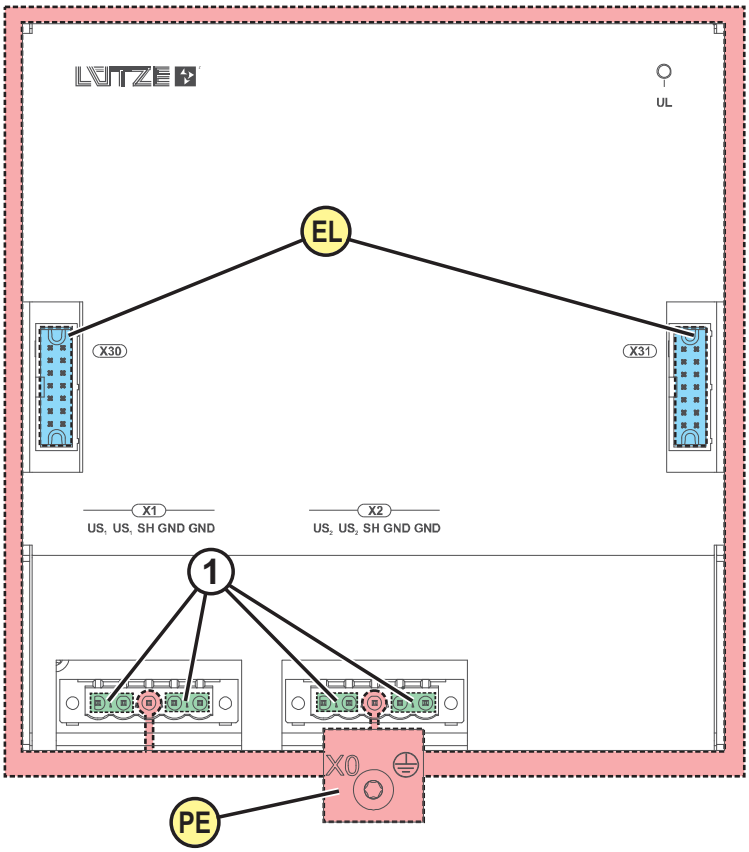
LION-007 The LION I/O system is designed in such a way that a galvanic isolation between the safety-relevant areas and the non-safety-relevant areas is implemented in all interfaces.

This means that every potential has reinforced insulation (at least 2x basic insulation) compared to another potential.

The only exception is the potential for grounding (basic insulation.)

NOTICE

If a non-safe power supply is used, a SIL classification cannot be achieved for any safety functions within the I/O station!



1.
DE Potentialgruppen
EN *Potential groups*
FR *Groupes de potentiel*

(PE): **PE *(X0)*, HOUSING, SH *(X1.3, X2.3)***
Potential PE

(EL): **L-BUS² *(X30, X31)*, ELECTRONIC**
Potential EL

(1): **SUPPLY *(X1.1, X1.2, X1.4, X1.5, X2.1, X2.2, X2.4, X2.5)***
Potential A

2.
DE Kapazitive Kopplung
EN *Capacitive coupling*
FR *Couplage capacitif*

ca. 19 nF: **(PE) ⇔ (1)**
ca. 4.7 nF: **(EL) ⇔ (1)**

3.
DE Trennspannung/
EN *Isolating voltage/*
FR *Tension d´isolement*

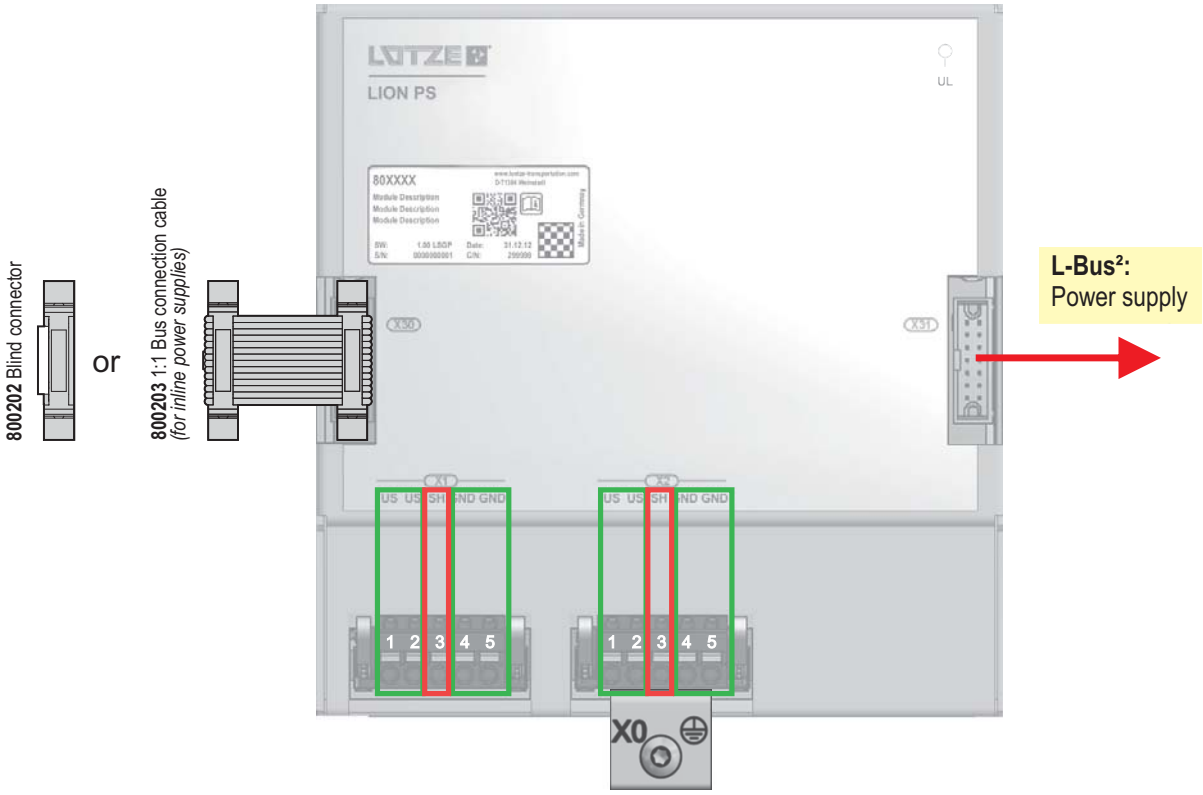
3.1
Basisisolierung/
Basic insulation/
Isolation de base
AC 1500 V: **(PE) ⇔ (1)**

3.2
Verstärkte Isolierung/
Reinforced insulation/
Isolation renforcée
AC 1500 V: **(PE) ⇔ (EL)**
AC 1500 V: **(EL) ⇔ (1)**

9.3 PS - Function description

9.3.1 Architecture of the interfaces

The supply interface X1/X2 can used as a single or redundant connection.



9.3.2 Module status error description

If certain events occur, the module behaves as follows:

Event	Modul status	Description
Operable	*Supply active*	The power supply for the section is running.
Internal hardware error	*Fail-safe*	The power supply has a fatal error and enters fail-safe state. The power supply is switched off.

9.3.3 Functions

The train power (in the voltage range of DC 24 V ... 110 V) is converted galvanically isolated to the L-Bus² voltage supply for the modules in the section.

For further details see also chapter 5.6.5 "Energy supply range" in the LION system description.

NOTICE

Please note the technical data in the corrsponding data sheet.

9.3.4 Interfaces

1. L-Bus² Interface – X30/31

Via interface the modules are connected on the left and the right. If the module is mounted at the beginning of a line, a dummy connector (Part no. 800202) has to be plugged in on the left (X30). *See "Bus Dummy Connector" on page 36.*

2. Supply Interface – X1/X2

Via interface the voltage supply is connected.

NOTICE

The voltage supply can be connected redundant.
For redundant operation X1 and X2 can be connected to different sources. Both sources must have the same potential (GND of the sources must be connected externally).

9.4 Error detection

SIL relevant

LION-028 **Fail-safe power supply**

The output power is switched off in the event of a fatal hardware error, overtemperature, overcurrent, or exceeding the maximum output voltage on the L-Bus².

SIL relevant

LION-016 **Safety-related failure reaction of the power supply.**

In the fail-safe state of the power supply, the output voltage is switched off. All modules that are connected to the power supply are shut down. If there is a bus coupler after the power supply, the entire I/O station goes into fail-safe state.

A reactivation is not possible until restart of the I/O station.

10 Power Supplies 36 W

10.1 Module types

Part no.	Product	Type	Description
800103 	**LION SAFE Power supply 36 W** LION SAFE Power supply SIL2 ***ID 201***	LION-SAFE-PS-24V-110V-36W-LUE	LION SAFE Power supply SIL2 for supplying the connected L-Bus² modules in the LION system. *The power supply supports wide range input from DC 24V to DC 110V.* The output rating is 36 W.
800113 	**LION Power supply 36 W** LION Power supply non-safe ***ID 1201***	LION-PS-24V-110V-36W-LUE	LION Power supply, non-safe for supplying the connected L-Bus² modules in the LION system. *The power supply supports wide range input from DC 24V to DC 110V.* The output rating is 36 W.

The QR Codes links opens the product web page in your browser.
The download area is located at the bottom of the product web page.
There you will find the data sheets and further information about the product.

SIL relevant

LION-010 **An I/O station can execute safe functions in compliance with the specifications with safe power supplies, a safe bus coupler, and one or more safe I/O modules.**

Only these modules are able to ensure the safe acquisition, processing, and transmission of the connected process signals on the module as well as the safe reception, processing and output of the process states at the outputs across the entire chain and to initiate safe reactions.

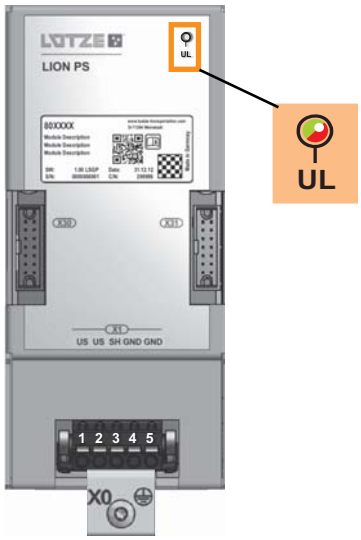
NOTICE

If a non-safe power supply is used, a SIL classification cannot be achieved for any safety functions within the I/O station!

10.2 Assembly 800103, 800113

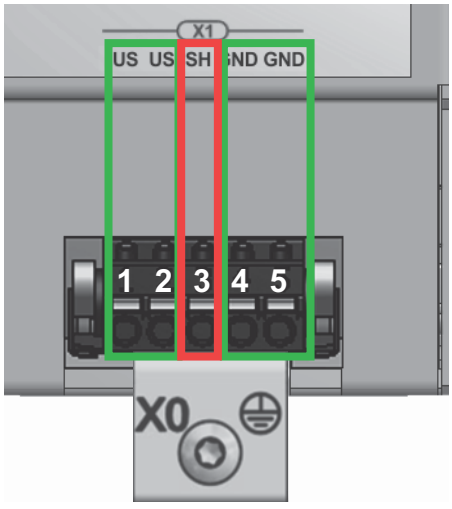
10.2.1 LED status

Every LION power supply module has a supply status LED (UL).



LED	Color	Status	Description
UL	green	on	*Supply active*
UL	red	on	*Error*

10.2.2 Pin assignment



X1		
Pin	**Signal**	**Description**
1	US	Supply (Potential A)
2	US	Supply (Potential A)
3	SH	Shield (Potential PE)
4	GND	Ground (Potential A)
5	GND	Ground (Potential A)

10.2.3 Potential groups

SIL relevant

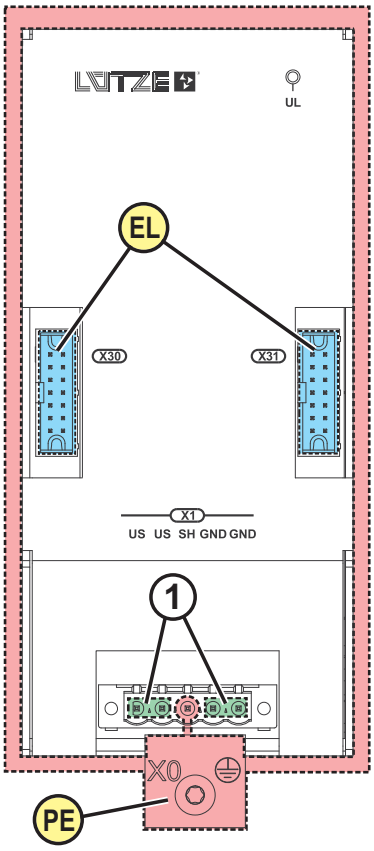
LION-007 The LION I/O system is designed in such a way that a galvanic isolation between the safety-relevant areas and the non-safety-relevant areas is implemented in all interfaces.

This means that every potential has reinforced insulation (at least 2x basic insulation) compared to another potential.

The only exception is the potential for grounding (basic insulation.)

NOTICE

If a non-safe power supply is used, a SIL classification cannot be achieved for any safety functions within the I/O station!



1.
DE Potentialgruppen
EN *Potential groups*
FR *Groupes de potentiel*

(PE): **PE *(X0)*, HOUSING, SH *(X1.3)***
Potential PE
(EL): **L-BUS² *(X30, X31)*, ELECTRONIC**
Potential EL
(1): **SUPPLY**
(X1.1, X1.2, X1.4, X1.5)
Potential A

2.
DE Kapazitive Kopplung
EN *Capacitive coupling*
FR *Couplage capacitif*

ca. 9.5 nF: **(PE)** ⇔ **(1)**
ca. 4.7 nF: **(EL)** ⇔ **(1)**

3.
DE Trennspannung/
EN *Isolating voltage/*
FR *Tension d´isolement*

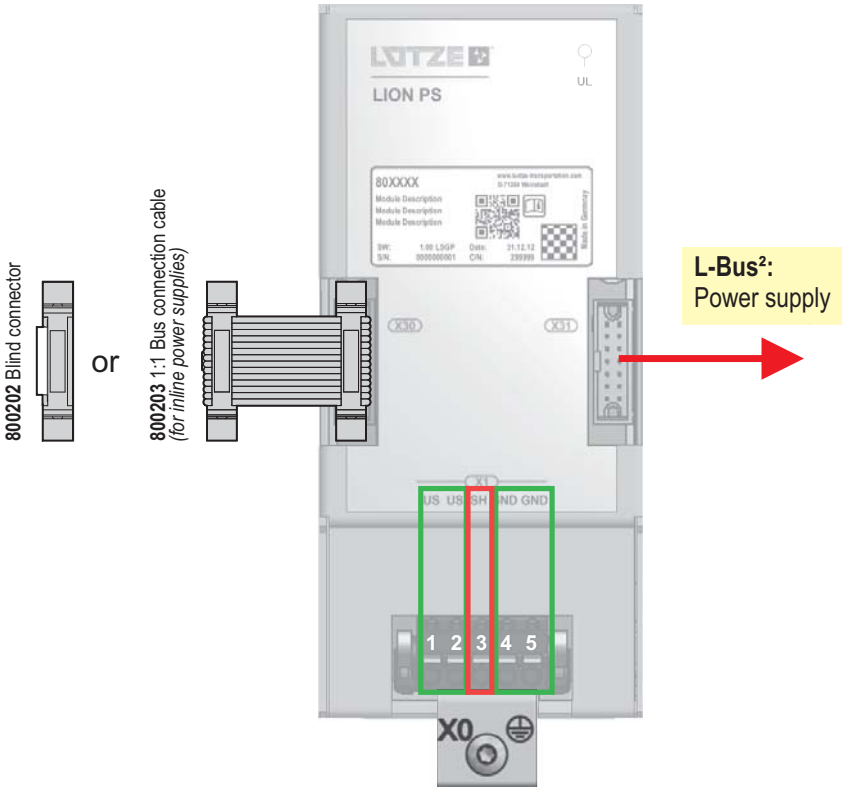
3.1
Basisisolierung/
Basic insulation/
Isolation de base
AC 1500 V: **(PE)** ⇔ **(1)**

3.2
Verstärkte Isolierung/
Reinforced insulation/
Isolation renforcée
AC 1500 V: **(PE)** ⇔ **(EL)**
AC 1500 V: **(EL)** ⇔ **(1)**

10.3 PS - Function description

10.3.1 Architecture of the interfaces

The supply interface X1 can used as a single connection.



10.3.2 Module status error description

If certain events occur, the module behaves as follows:

Event	Modul status	Description
Operable	*Supply active*	The power supply for the section is running.
Internal hardware error	*Fail-safe*	The power supply has a fatal error and enters fail-safe state. The power supply is switched off.

10.3.3 Functions

The train power (in the voltage range of DC 24 V ... 110 V) is converted galvanically isolated to the L-Bus² voltage supply for the modules in the section.

For further details see also chapter 5.6.5 "Energy supply range" in the LION system description.

NOTICE

Please note the technical data in the corrsponding data sheet.

10.3.4 Interfaces

1. L-Bus² Interface – X30/31

Via interface the modules are connected on the left and the right. If the module is mounted at the beginning of a line, a dummy connector
(Part no. 800202) has to be plugged in on the left (X30). *See "Bus Dummy Connector" on page 36.*

2. Supply Interface – X1

Via interface the voltage supply is connected.

10.4 Error detection

SIL relevant

LION-028 **Fail-safe power supply**

The output power is switched off in the event of a fatal hardware error, overtemperature, overcurrent, or exceeding the maximum output voltage on the L-Bus².

SIL relevant

LION-016 **Safety-related failure reaction of the power supply.**

In the fail-safe state of the power supply, the output voltage is switched off. All modules that are connected to the power supply are shut down. If there is a bus coupler after the power supply, the entire I/O station goes into fail-safe state.

A reactivation is not possible until restart of the I/O station.

11 Line Coupler

11.1 Module type

The LION Line Coupler is an infrastructure module of the LION System and behaves transparent within the LION system.

Part no.	Product	Type	Description
800102 	**LION Line Coupler** SIL0 ***ID 2700***	LION-PS-24V-110V-72W-LUE	LION Line Coupler (SIL0) for galvanic and spatial isolation of the L-Bus² in the LION system.

The QR Codes links opens the product web page in your browser.
The download area is located at the bottom of the product web page.
There you will find the data sheets and further information about the product.

NOTICE

The LION Line Coupler is only available in a SIL0 version.
See also chapter „Line change“ in system description.

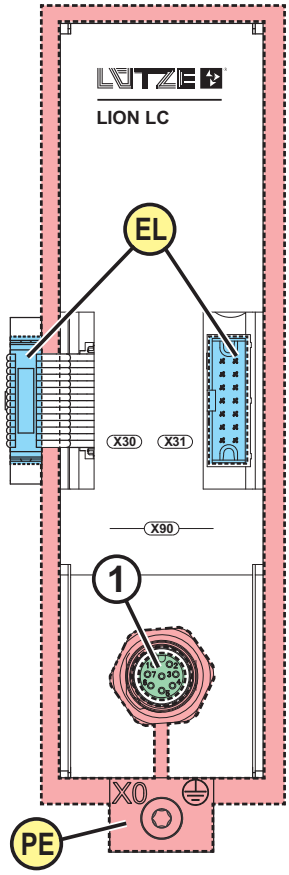
11.2 Assembly 800102

11.2.1 Potential groups

The LION I/O system is designed in such a way that a galvanic isolation between the safety-relevant areas and the non-safety-relevant areas is implemented in all interfaces.

This means that every potential has reinforced insulation (at least 2x basic insulation) compared to another potential.

The only exception is the potential for grounding (basic insulation.)



1.
DE **Potentialgruppen**
EN ***Potential groups***
FR ***Groupes de potentiel***

(PE): **PE** ***(X0)*****, HOUSING**
Potential PE

(EL): **L-BUS²** ***(X30, X31)*****, ELECTRONIC**
Potential EL

(1): **M12**
(X90)
Potential A

2.
DE **Kapazitive Kopplung**
EN ***Capacitive coupling***
FR ***Couplage capacitif***

–

3.
DE **Trennspannung/**
EN ***Isolating voltage/***
FR ***Tension d´isolement***

3.1
Basisisolierung/
Basic insulation/
Isolation principale
AC 1500 V: **(PE)** ⇔ **(1)**
AC 1500 V: **(PE)** ⇔ **(EL)**

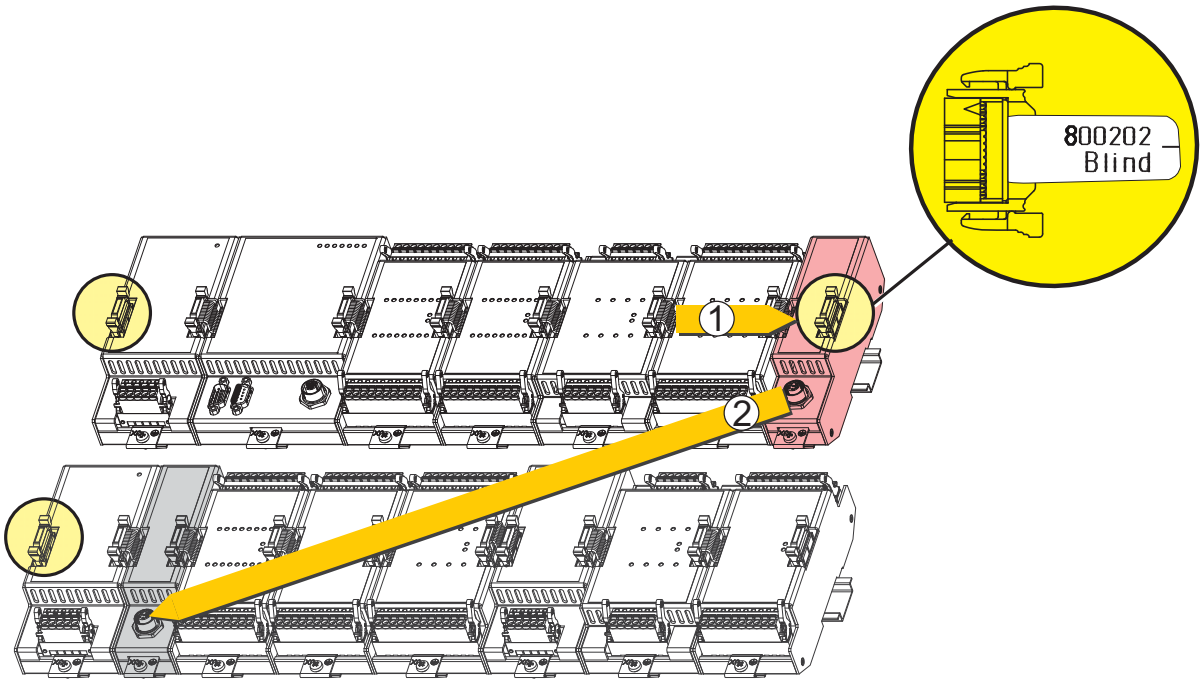
3.2
Verstärkte Isolierung/
Reinforced insulation/
Isolation renforcée
–

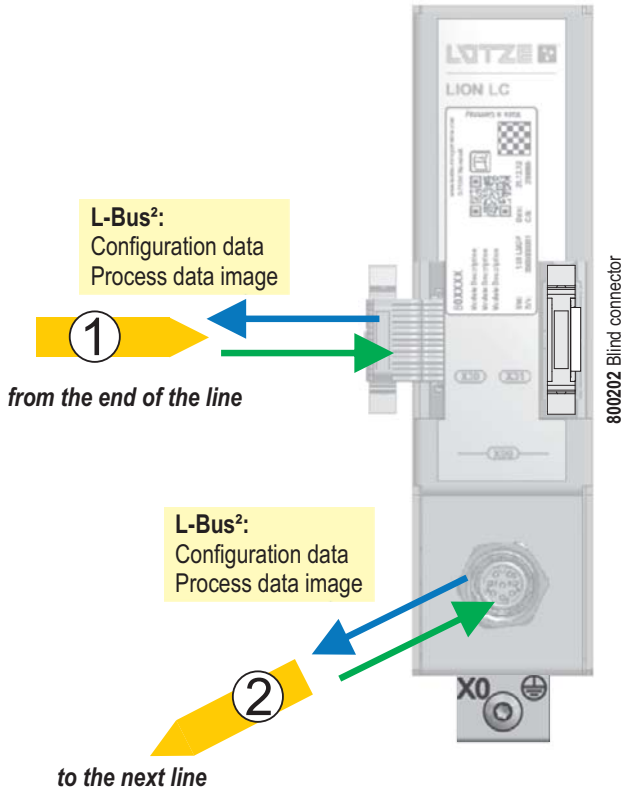
3.3
Funktionsisolierung/
Functional insulation/
Isolation fonctionnelle
AC 1500 V: **(EL)** ⇔ **(1)**

11.3 LC - Function description

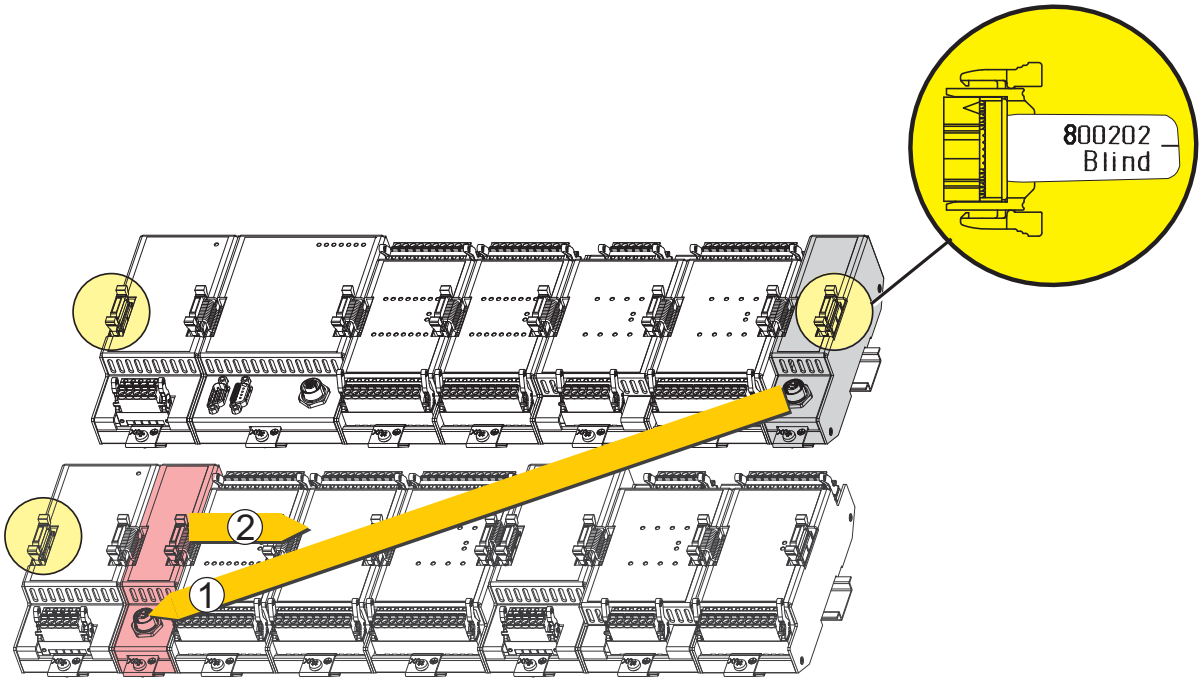
11.3.1 Architecture of the interfaces

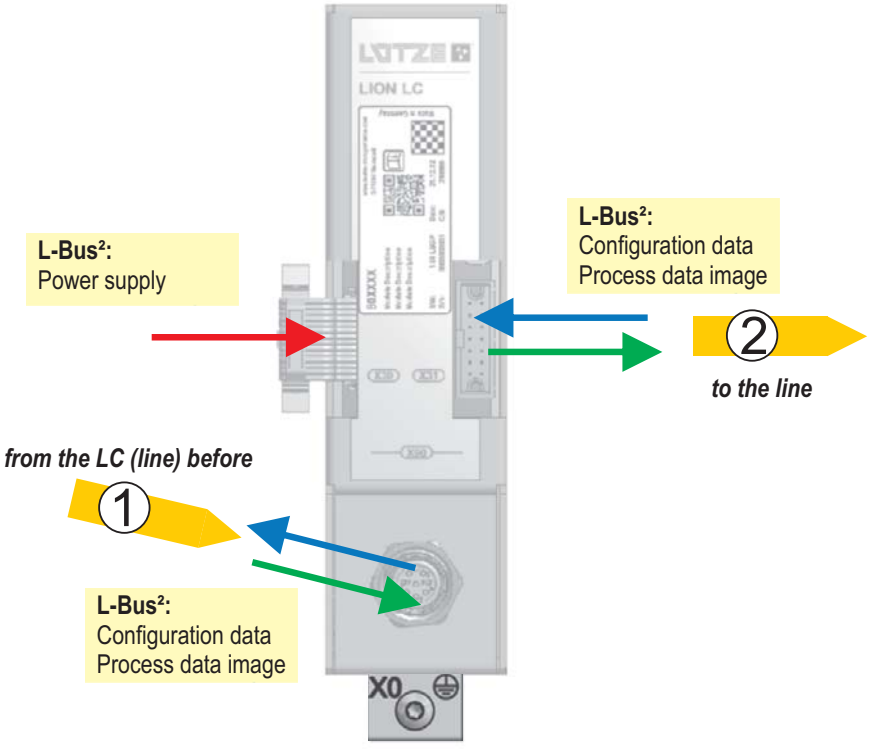
1. At the end of a line





2. At the beginning of the next line





11.3.2 Module status error description

The module behaves passively and has no own module status.

11.3.3 Functions

The LION Line coupler is an infrastructure module and connects two lines in the LION System.

NOTICE

Please note the technical data in the corrsponding data sheet.

11.3.4 Interfaces

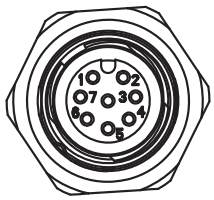
1. L-Bus^2 Interface – X30/31

1. Plug the X30 connector in the connector of the IO module on the left.
2. Plug the termination connector (Part no. 800201) in the X31 connector, if the line coupler is the last module in the line.
   Otherwise, plug in the next IO module or power supply to the right.
   See "Installation of dummy connector and terminator" on page 35.

2. M12 Interface – X90

Via the interface, a line coupler from the end of a line can be connected to a line coupler at the beginning of the next line.

M12 socket, 8-pin (A-coded according to IEC 61076-2-101) for line switching



SIL relevant

LION-045 **For connecting the line couplers via M12 interface, use a cable that has a basic insulation according to EN 50124-1.**

Part no.	Type	Length
800205	LION-LC-10M	10 m
800206	LION-LC-5M	5 m
800207	LION-LC-2M	2 m

11.4 Error detection

11.4.1 Fail-safe line coupler

An error in the line coupler prevents the addressing or communication with the following modules. A defective line coupler has the consequence that all following modules can no longer be addressed and these assume the safe state.

12 Maintenance and service

The system and its individual assemblies do not require preventive maintenance.

For questions about the product or repair requests, please contact:

Lütze Transportation GmbH
Bruckwiesenstraße17-19
71384 Weinstadt
Germany

Phone: +49 (0) 7151 6053-545
E-Mail: Sales.Transportation@luetze.de

Module exchange

ASSESS-MENT REPORT	SRAC 02	The higher-level system—the specific application—must ensure that, in the event of a fault in the system or in an individual module, this module is replaced or de-energized after seven days at the latest and remains in this state.

The system is designed so that a module replacement can be performed within 10 minutes. To do this, identify the defective module using the diagnostic information and perform the following points:

1. Disconnect the supplies from the system.
2. Disconnecting the connections.
3. Removal of the defective module
4. Placing the new module and checking the type of the module
5. Connecting the terminals.
6. Switching on the system supplies
7. After checking the module for possible error messages after a module replacement, necessary checks of the periphery must be performed to exclude further errors.

SIL relevant	LION-034	**After a module replacement, all safety-relevant functions in which the module is involved must be tested and verified again.**

12.1 Service Life

Assemblies that permanently fail to start correctly or that give diagnostic messages indicating a defect must be replaced.

SIL relevant

LION-057 **The modules of Safety Class 2 are intended for a maximum service life.**

For the service life of the assemblies, we assume an average service life of a rail vehicle in which there is no accumulation of dangerous failures that exceed the determined hazard rate.

The MTBF and hazard rates determined during the development phase are checked quarterly using a field data analysis and necessary measures are taken if the values deviate from the statistics.

12.2 Extending the LION system

WARNING

Risk of injury by deploying insufficiently qualified operating personnel

Inappropriate deployment of not qualified or insufficiently qualified personnel can cause property damage and personal injuries.

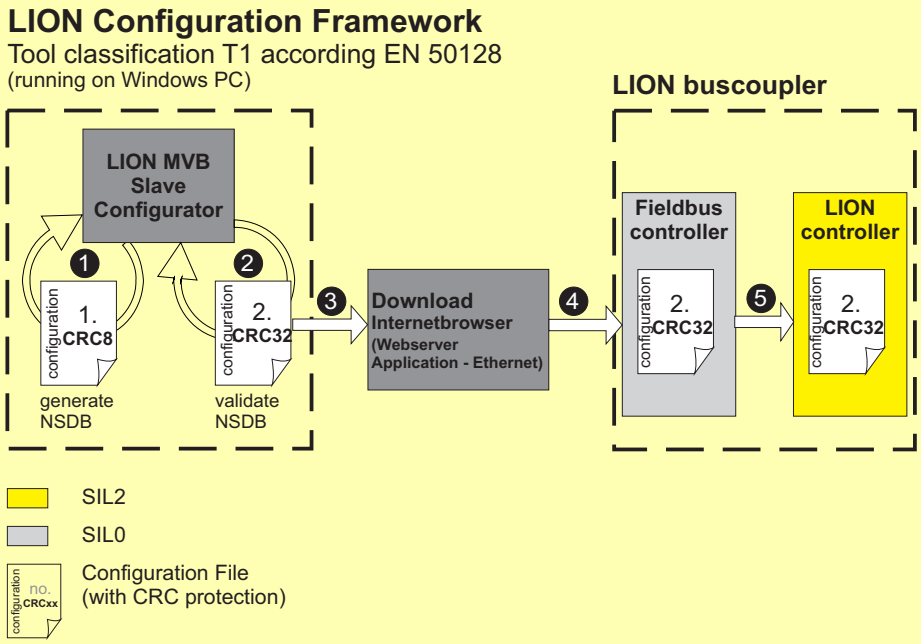
- The extending of the LION system applies special procedures and must be done by trained and qualified personnel or experts, especially electricians.

When expanding the LION system with additional modules, the following points must be followed:

1. Configuration of the extended system with the LION framework (IODB and NSDB/TDB)

SIL relevant

LION-004 **Ensuring the validity of the configuration**



(1) The configuration file generates an NSDB (TDB) file via the IODB.
(2) The NSDB (TDB) file has undergone verification. A configuration ID is generated (Safety CRC) if the file was created appropriately.
(3) The bus coupler's web server offers the NSDB (TDB) file for download.
(4) When the bus controller unit starts up, an internal integrity check is performed on the NSDB (TDB) file.
(5) In order to be verified in the higher-level system, the configuration ID is output to the diagnostic data via the fieldbus (see LION-024).

2. Checking the deviations of error response times (see LION-031) or process times (see SRAC03) compared to the previous system
3. Disconnect the supplies from the system.
4. Assemble and install the modules.
5. Switching on the supplies in the system.
6. Download the new NSDB/TDB into the system (see operating manual bus coupler).
7. Checking the configuration ID via the field bus (see LION-024)
8. Execution of a new system test (see LION-002).

ASSESS-MENT REPORT

SRAC 08 A validation of the configuration data for commissioning must be carried out.

ASSESS-MENT REPORT

SRAC 07 The safety qualification tests of the LION system must be carried out as part of the safety qualification tests of the specific higher-level application.

13 Shutdown and disposal

Observe the valid environmental regulations of your country for the final shutdown and disposal.

Disassemble the device and completely dismantle it before disposal.

Dispose of electric parts in line with the regulation for Waste of Electrical and Electronic Equipment (WEEE DE 65543672). You assume the obligation to properly dispose of the delivered goods after termination of use at your own expense in accordance with the statutory provisions and release Friedrich Lütze GmbH from the obligations under § 19 section 3 ElektroG (obligation of manufacturers of electrical and electronic equipment to take back electrical and electronic equipment) and related claims of third parties.

If you have handled the device to a commercial third party without any contractual acceptance of the disposal, you have to take it back after the final shutdown at your own cost and risk of legal liability.

The claim of Friedrich Lütze GmbH for takeover or indemnification by the customer shall not become time-barred before the expiration of two years after the final termination of the use of the equipment. The two-year period of suspension of expiry shall commence at the earliest upon receipt by Friedrich Lütze GmbH of a written notification on its part of the termination of use.

14 Revision of the document

Version	Revision	Date
00	Release of document	03/08/2017
01	Complete revision of the document. Extension by the SIL0 modules	08/30/2022 01/26/2023
02	New conditions for the disposal of old equipment; Update of the appendixes	05/23/2023
03	Update of *Appendix B;* *Chapter 12.1 „Module exchange“, new text: LION-034;* *chapter 12.3 „Extending the LION system“: new Text: LION-004*	08/04/2023 10/23/2023
04	*Revised: New LÜTZE logo; 12.1 Service Life; 16.1.1 Overview;* *Spelling errors corrected*	01/24/2025 04/08/2026

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15 Appendix A

Contains safety related application conditions

15.1 Structure note

ASSESS-MENT REPORT	SRAC XX	**Safety-related application condition**. Reference to a safety-relevant application condition from the assessment report. These references are marked with an ID, for example SRAC 01.

15.1.1 Overview

ID	Safety related application conditions
SRAC 01	The higher-level system - the concrete application - must consider in the definition of the safe state of the application that the generic LION system reports a logical "0" in the event of a failure and in the event of an error.
SRAC 02	The higher-level system, the specific application must ensure that, in the event of a fault in system, or in an individual module, this module is replaced or de-energized after seven days or at the latest remains in this state.
SRAC 03	The higher-level system - the concrete application - must consider in the system design that a telegram loss within the timeout is possible and thus data or events that are shorter than the timeout can get lost unnoticed.
SRAC 04	The user must carry out life-sign monitoring (for example, via MVB sink time supervision) of the bus coupler to be able to detect failures of the LION system, to react safely and to maintain the safe state.
SRAC 05	omitted
SRAC 06	The user must ensure that the LION system is protected against unauthorized access.
SRAC 07	The safety qualification tests of the LION system must be carried out as part of the safety qualification tests of the specific higher-level application.
SRAC 08	A validation of the configuration data for commissioning must be carried out.
SRAC 09	Pollution degree for operation at an altitude of > 2000 m up to 4000 m above sea level. The user must ensure that the degree of pollution PD1 according to EN50124-1 is not exceeded (for example, through a control cabinet with at least IP51).
SRAC 10	Operating voltage for operation at an altitude of > 2000 m up to 4000 m above sea level. The user must ensure that the maximum permissible operating voltage according to EN50155 is at maximum of 72 V (supply voltage/input voltage/ output voltage/ ...).
SRAC 11	Test voltage for operation at an altitude of > 2000 m up to 4000 m above sea level. The user must ensure that the maximum permissible test voltage between all potentials in the vehicle does not exceed AC 1000 V at an altitude of 4000 m.
SRAC 12	The user must ensure that the area around 0 mA (+/-0,5mA) is not used since the safe AI4 module cannot distinguish between a line break or defective sensor or a measured 0 mA.

16 Appendix B

Contains important information for correct use in SIL-relevant enviroments

16.1 Structure note

SIL relevant

LION-XXX **Important information on correct use in a safety-relevant environment.**
These notes are marked with an ID, for example LION-001.

16.1.1 Overview

ID	Important information	Old designation (in the versions of the documents see table below)
LION-001	*omitted*	*LION-001 (only Checkpoint)*
LION-002	Safety qualification tests of the LION systems	LION-002 + SRAC 07
LION-003	Error reaction of the BC	LION-003 + LION-073 + SRAC 04
LION-004	Ensuring the validity of the configuration.	LION-004 + SRAC 08
LION-005	Certifcation of the system	LION-005 + LION-030 + LION-070
LION-006	Validity of certification	LION-006 + part from LION-008
LION-007	Galvanic isolation of the safety-relevant area from the non-safety-relevant areas	LION-007 + LION-042 + LION-047 + LION-048 (+ LION-052)
LION-008	Possible components of a certified system	LION-008 + LION-023
LION-009	Safety-related conditions of the assessment report	-
LION-010	Requirement for a safe function of the I/O station	LION-010 + LION-011
LION-011	*omitted*	*replaced with LION-010*
LION-012	*omitted*	*replaced with LION-050*
LION-013	*omitted*	*omitted*
LION-014	Safety-related failure reaction of the buscoupler	LION-014
LION-015	Safety-related failure reaction of the input/output modules	LION-015

ID	Important information	Old designation (in the versions of the documents see table below)
LION-016	Safety-related failure reaction of the power supply	LION-016 + LION-043 + LION-044
LION-017	MVB safety layer	LION-017 + part from LION-018
LION-018	Structure of the Safety data sets	LION-018 + part from LION-017
LION-019	MVB diagnosis port	LION-019
LION-020	Error response to detected inconsistencies in the safety data set	LION-020
LION-021	NSDB format	LION-021
LION-022	L-Bus² master	-
LION-023	*omitted*	*omitted*
LION-024	Mechanism for checking the configuration by each restart is implemented.	
LION-025	Fail-safe Master-Module	LION-025
LION-026	Fail-safe Slave-Module	LION-026
LION-027	Configuration data, process image and error states of a safe digital output module.	LION-027
LION-028	Fail-safe Power Supply	LION-016 + LION-043
LION-029	Identification of the modules	
LION-030	*omitted*	*replaced with LION-005*
LION-031	Fault detection and reaction time	LION-031 + LION-074
LION-032	Configuration check during startup	LION-032
LION-033	*omitted*	-
LION-034	Module exchange	LION-034
LION-035	*omitted*	*replaced with LION-050*
LION-036	Configuration data, process image and error states of a safe digital input module.	
LION-037	Safe state at a digital input	LION-037

ID	Important information	Old designation (in the versions of the documents see table below)
LION-038	Error detection digital input	LION-038
LION-039	Safe state at a digital output	LION-039
LION-040	Error detection digital output	LION-040 + LION-027
LION-041	Testpulse at digital output	Part of LION-041
LION-042	*omitted*	*replaced with LION-007*
LION-043	*omitted*	*replaced with LION-016 + LION-028*
LION-044	*omitted*	*replaced with LION-016 + LION-028*
LION-045	Requirement for the cable between the lines	LION-045
LION-046	Supply SAFE BC with SAFE PS at X30	LION-046
LION-047	*omitted*	*replaced with LION-007*
LION-048	*omitted*	*replaced with LION-007*
LION-049	*omitted*	-
LION-050	Calculating the FR for a safe function	LION-050 + LION-035 + LION-012
LION-051	*omitted*	-
LION-052	*omitted*	-
LION-053	Diagnosis and configuration via the web server	LION-053 + SAC 06
LION-054	Conditions and errors during the start-up and run-down phase	LION-054 + LION-055 + LION-056
LION-055	*omitted*	*replaced with LION-054*
LION-056	*omitted*	*replaced with LION-054*
LION-057	The modules of Safety Class 2 are intended for a maximum service life.	LION-057
LION-058	DI One-channel SIL architecture	LION-058
LION-059	DI Two-channel SIL architecture	LION-059
LION-060	DO Single switching output SIL architecture	LION-060

ID	Important information	Old designation (in the versions of the documents see table below)
LION-061	DO Double switching output SIL architecture	LION-061
LION-062	DO Plus/minus switching output SIL architecture	LION-062
LION-063	*omitted*	-
LION-064	Testpulse at digital input	part of LION-041
LION-065	*omitted*	-
LION-066	Leak current in case of error	-
LION-067	Start synchronization by the bus master	-
LION-068	Evaluation of the feedback from the digital output module	-
LION-069	Limited Run Slave-Module	LION-069
LION-070	*omitted*	*replaced with LION-005*
LION-071	Sink time supervision	LION-071
LION-072	SDTv2 Safety Manual	LION-072
LION-073	MVB Monitoring concept	LION-003 + LION-073 + SAC 04
LION-074	*omitted*	*replaced with LION-031*
LION-075	Risk about of two different implementations of the SDTv2 protocol	LION-075
LION-076	SDTv2 Implementation	LION-076
LION-077	Safe state at an analog output	-
LION-078	Error detection at an analog input	-
LION-079	AI One-channel SIL architecture	-
LION-080	AI Two-channel SIL architecture	-
LION-081	Configuration data, process image and error states of a safe analog input module.	-
LION-082	Monitoring concept	-

ID	Important information	Old designation (in the versions of the documents see table below)
LION-083	The SDTv2 safety protocol	-
LION-084		-
LION-085		-
LION-086	Application profiles for the FR calculation	-

16.1.2 Documents with the old designation of the LION-ID

LION System description (SD)

Version	Document title	Release date
03	SB_LION_System_Description_V03_en	06/16/2020
02	SB_LION_System_Description_V02_en	11/30/2018
01	SB_LION_System_Description_V01_EN	07/26/2018
00	LION_System_Description_V00_EN	03/08/2017

LION Infrastucture Components (MA)

Version	Document title	Release date
00	BA_Infrastructure_Components_LION_V00_EN	03/10/2017

LION BC MVB SIL2 (MA)

Version	Document title	Release date
05	BA_LION_Buscoupler_V05_EN	not released
04	BA_LION_Buscoupler_V04_EN	01/15/2019
03	BA_LION_Buscoupler_V03_EN	12/20/2018
02	BA_LION_Buscoupler_V02_EN	11/30/2018
01	BA_LION_Buscoupler_V01_EN	02/23/2018
00	BA_LION_Buscoupler_V00_EN	03/08/2017

LION BC ETH TRDP SIL0 (MA)

Version	Document title	Release date
02	LION_SIL0_Buscoupler_ETH_MA_EN_V02	04/11/2022
01	BA_LION_Bus_coupler_ETH_803012_V01_en	03/19/2019
00	BA_LION_Bus_coupler_ETH_803012_V00_en	12/13/2018

LION SIL0 I/O modules (MA)

Version	Document title	Release date
00	BA_IO_Modules_LION_V00_EN	03/10/2017

LION SIL2 I/O modules (MA)

Version	Document title	Release date
01	BA_SIL2_IO_Modules_LION_EN_v01	07/18/2019
00	BA_SIL2_IO_Modules_LION_EN_V00	07/20/2016

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