Operating Instructions

TLM-10

Train Line Modem

Version 02

LÜTZE TRANSPORTATION

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

This manual is part of the device and contains important information on safety and operation. Please read the manual before use to avoid possible dangers and to ensure proper use.

This manual and the information contained herein have been compiled with due care. However, the company Lütze Transportation GmbH accepts no liability for printing or other errors or resulting damage.

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1 Introduction

This manual is part of the product TLM-10 Train Line Modem. It contains important information about the handling and safety of the following devices:

Part no.	Type
806600*	TLM-10 10TE DC 24-110V PI
806601*	TLM-10 10TE DC 24-110V PI PB
806610*	TLM-10 10TE DC 24-110V FM
806611*	TLM-10 10TE DC 24-110V FM PB
806710*	TLM-10 10TE FM PoE

These*) are the basic articles. There are also customized versions available upon request.

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.

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 ensure correct use.

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 are available on the website of the Lütze Transportation GmbH:
www.luetze-transportation.com

Search for the **article number**, or the product name "**TLM-10...**".

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 colour 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 Copyright

This document is intended for the operator and his staff. It is prohibited to give the content to a third party, to duplicate, exploit or impart it. The Lütze Transportation GmbH has to allow it explicit in writing.

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.

2.3 Disclaim of liability

This document was written in consideration of the applied standards, regulations, and the current state of technology.
The content has been checked for accuracy. 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

2.4 Standards and regulations

The product is state of the technology and complies with the applicable safety regulations and the corresponding harmonized European standards (EN).

NOTICE

See also the standards in the respective data sheets. The current editions of the standards as well as further information on the product can be found in the respective data sheets.

2.5 Observe other applicable documents

When operating the device, please also observe all operating instructions enclosed with other components of your system.

NOTICE

Always keep these operating instructions and the applicable documents (e.g., data sheets, instruction leaflets, declarations of conformity, etc.) within easy reach so that they are available when required.

This applies until the device is disposed of. Pass on all documents when selling, disposing of, or renting the device.

For reasons of clarity, we would like to point out that these operating instructions cannot describe all conceivable problems in connection with the use of this device.

Should you require further information or encounter special problems that are not dealt with insufficient detail in the operating instructions, you can request the necessary information about service from Lütze Transportation GmbH (For the contact information, See “Maintenance and service” on page 40.)

2.6 Labeling

Observe the adhesive labels.

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

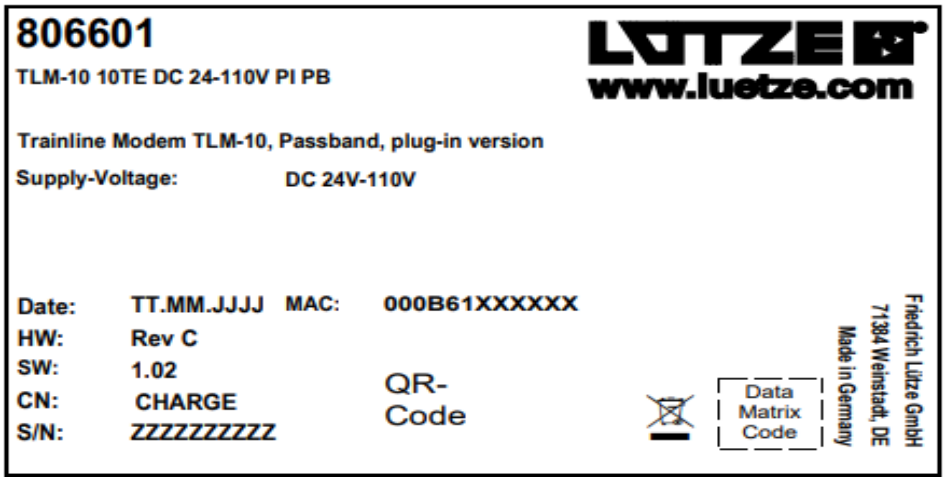


Fig. 1: Example label for TLM-10

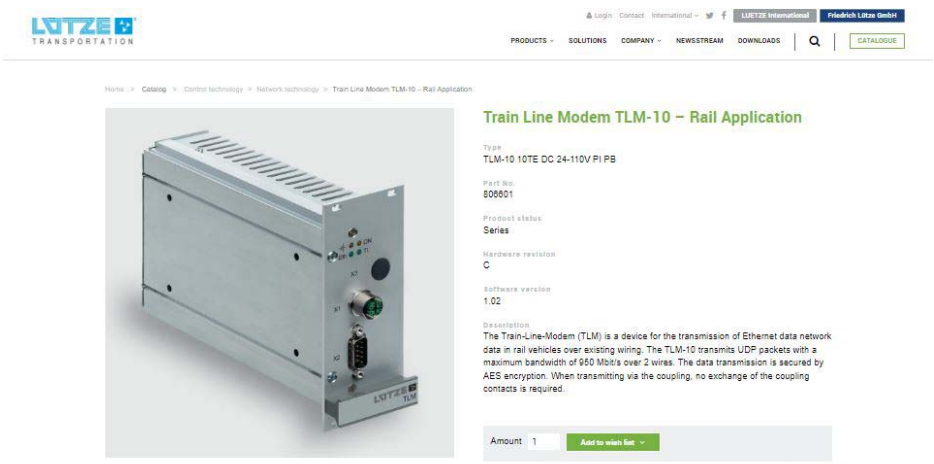
The label contains the following information:

- Part number
- Type (assembly designation/module designation)
- Module description
- Version number / firmware version (SW)
- Hardware revision (HW)
- FA number (X) place of manufacture (YYY: „LUT“ for Weinstadt and „WEQQ“ for Czech Republic)Company name/address
- Block diagram
- Company name / web address
- Approvals / declaration of conformity (e.g., CE marking, UL, etc.)
- D bar code with product information
- Data Matrix Code, content: Serial number, product number, date, MAC-IDs

2.7 QR code - product information

The code refers to further product information in the online catalog on the Lütze Transportation website. To access the site, please proceed as follows:

1. Scan the QR Code with a smartphone or any other device that can read and interpret QR Codes.
2. Open the standard browser with the corresponding page.



3. Choose a language.
4. Under *Downloads* you can download further technical documentation.

Fig. 2: QR code for TLM-10

3 Safety

3.1 Safety notes

3.2 Applicable documents

- Package leaflet
- Data sheets

CAUTION

Risk of injury and property damage caused by non-observance of the related documents, especially the safety instructions in the respective package leaflets

These operating instructions alone are not sufficient when operating the assemblies in a system.

To avoid injury and damage, read the applicable and related documents before using the device.

3.2.1 Content of these operating instructions

NOTICE

These operating instructions must have been read and understood prior to installation, use or servicing the device.

3.2.2 Intended Use

The components are designed for exclusive use in rail vehicles. 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.

3.2.3 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.

3.2.4 Operating personnel

WARNING

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 qualifiation levels of the operating personnel.

3.2.5 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 system before the initial operation.

3.3 Protective clothing and equipment

Since all devices are ESD-tested, no special ESD protective clothing is necessary.

3.3.1 Reconstruction and modifiactions of the product

WARNING

Personal injury and damage to property due to changes and modifcations to the assembly

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.

3.3.2 Special safety messages

NOTICE

Follow the ESD guidelines.

NOTICE

Only use certified components. Only then a reliable function is ensured.

NOTICE

Observe the applicable safety regualtions and general provisions on technical standards.

NOTICE

The device is designed for indoor use, mounting in cabinets, and for flange mounting.

DANGER

Danger to life due to errors in the overall system

Incorrect project planning of the assemblies and their non-observance of the valid standards and regulations can lead to errors in the overall system.

Observe all valid standards and regulations due to project planning.

CAUTION

Electric shocks and material damage due to overvoltage

Failure to comply with the specified voltage limits may result in electric shocks and the assemblies may be destroyed.

4 Product overview

4.1 System overview

The TLM-10 Train Line Modem (TLM) is used to transmit Ethernet network data in rail vehicles over existing lines. The signals between the TLMs are modulated onto existing lines.

This means that a vehicle-compatible Ethernet network can be set up in existing vehicles or via the coupling without laying new lines and with relatively little effort.

The TLM-10 uses existing cabling (for e.g., a NF cabling) for data transmission. Data transport that is unhackable is ensured by 128-bit AES encryption. The bandwidth of the transmission line is constantly determined by a DSP, which ensures optimum data throughput. The greatest data throughput is always attainable since connecting vehicles causes the line's length to fluctuate. A manual adjustment or configuration is no longer necessary after the initial commissioning. This makes the TLM-10 user-friendly and easy to service.

Furthermore, the TLM-10 establishes a transparent connection between the connected network components, i.e., no presetting of a device address or IP number on the TLM-10 is required to transmit information to the target device. The numerous application options match the convenience and needs of upcoming device generations, where network-based communication will be the norm.

Even if the contact at the coupling is briefly interrupted with a small distance of max. 10 mm, the TLM-10 can maintain its connection. Data transfer will be reduced during this time. As soon as the connection is re-established, the TLM-10 will communicate again at maximum speed.

4.1.1 Possible applications

This results in many application possibilities. For example, the use of video technology, infotainment, operating terminals, passenger counting systems, LCD/TFT displays, WLAN modules, etc. in railway vehicles can be implemented very easily on an Ethernet network basis. As the TLM in principle behaves like a piece of cable and is not visible to the participants, it does not affect data traffic.

4.2 Communication within the TLM devices

All TLM10 devices with firmware version V01.01.0000 and newer have a so-called heartbeat function. Using this function, the device sends a heartbeat at the specified interval to the specified IP address. Among other things, the heartbeat contains information about the current data throughput of the device as well as some other device information.

The heartbeat status shows the current status of the device. If the device is working correctly, OK is displayed here. If an error is detected, NOK is displayed here.

The exact structure can be found in Appendix A. **See “Appendix A” on page 43**

NOTICE

A detailed description of the settings to be made can be found in the TLM manual Config Tool in chapter 7.1.4.

4.3 Functional description

The TLM-10 module is specially designed for data transmission in rail vehicles. In contrast to the methods used in stationary applications, such as DSL or ADSL, the line length in rail vehicles is not constant. Depending on the train configuration of the vehicles, the length of the transmission line can vary up to 300 meters. This changes the parameters of the line and thus the transmission behavior.

The TLM-10 constantly “scans” the line and uses the channels or frequencies with the lowest attenuation value for data transmission. This makes it possible to couple vehicle parts during operation without interrupting a running data transmission. This Dynamic Line Management (DLM) is a special feature of this product.

In combination with the already established "OFDM“ (Orthogonal Frequency Division Multiplex) technology, safe signal transmission in an environment with interference is possible. The OFDM method suppresses existing noise or interference by filtering the channels or switching to adjacent channels.

The signals of the different frequencies (2–200 MHz) generated with the "OFDM" method are fed in parallel to the UIC, intercom, or train-NF line. Thus, data is transmitted simultaneously over all frequencies used. In each used frequency, these data are independent of the data in another frequency, but only all the data together result in the transmitted data packet.

The greatest advantage of the TLM-10 is certainly the ease of installation in the vehicle, since no additional line has to be laid over the coupling. The TLM-10 uses an existing shielded cable, which is available in the train set. The familiar UIC lines for ELA (PA), intercom, IBIS, RS485 or other shielded control lines are suitable for this purpose, as are free lines, of course.

Between the TLM-10s, 128-bit AES encryption is employed to strengthen security against tapping (Advanced Encryption Standard). This prevents "eavesdropping" on the data line inside and outside the train, even if the lines are openly accessible.

4.3.1 Service-friendly updates

The TLM-10 Train Line Modem provides service-friendly updates

With the linked TLM-10, a notebook may be used to monitor and update the firmware on all TLMs. Logging into each TLM individually is not necessary.

5 Transport and storage

NOTICE

- **Product damages caused by humidity**

  Store the devices in dry rooms between -40°C and +85°C. Make sure that the humidity is less than 75%.

- **Product damages caused by non safely packed products**

  Wrap the products safely for transporting to absorb possible crushes.

- **Product damages caused by dust**

  The circuit boards of the modules are coated, try to transport and store them in a dust-free environment to avoid damages of the modules.

- **Product damages by electrostatic static discharge**

  Store and transport electronic components in ESD-safe and conductive packaging

6 Scope of delivery

Check the completeness of the delivery:

If any of the parts listed below are missing or damaged, do not hesitate to contact our service, the contact address can be found in chapter “Maintenance and service” on page 40.

The TLM-10 Train Line Modem consists of:

- TLM-10 Train Line Modem
- Package leaflet

You can also find the constantly updated data sheets at

www.luetze-transportation.com

There, you enter either the product name in the search field. TLM-10 Train Line Modem or the product number. You can find the latest documents (e.g., operating manuals) for the product as well as additional articles and technical information.

Observe the ESD regulation during unpacking

Only install and use undamaged products

Do not used damaged parts, a correct function of the device is then no longer guaranteed according to specfications.

The following problems may occur when using damaged parts:

- Accidents and physical injuries
- Loss of approvals
- Violation of ESD regulations
- Damage to the device and other components

7 Product description

7.1 Product variants

The TLM-10 Train Line Modem is available in five variants:

- Plug-in 19“ (rack)
- Flange with foot angles
- Bandpass flange
- Bandpass plug-in
- Flange with PoE

TLM-10 10TE DC 24-110V FM PB (Part no. 806611)

Wihout X3 on the front side and with F48 male connector on the backside

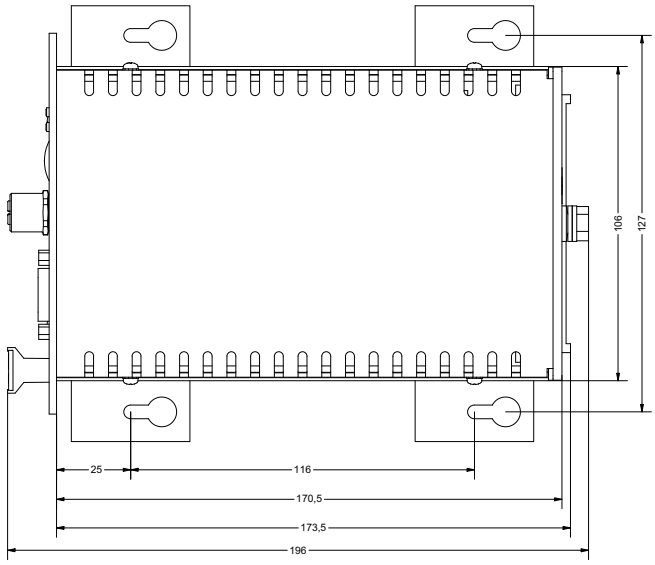


Fig. 3: Bandpass Flange mounting

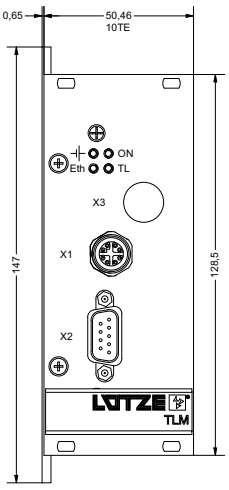


Fig. 4: Flange with foot angles

TLM-10 10TE DC 24-110V FM (Part no. 806610)

Without a F48 male connector on the backside and with an earthing bolt

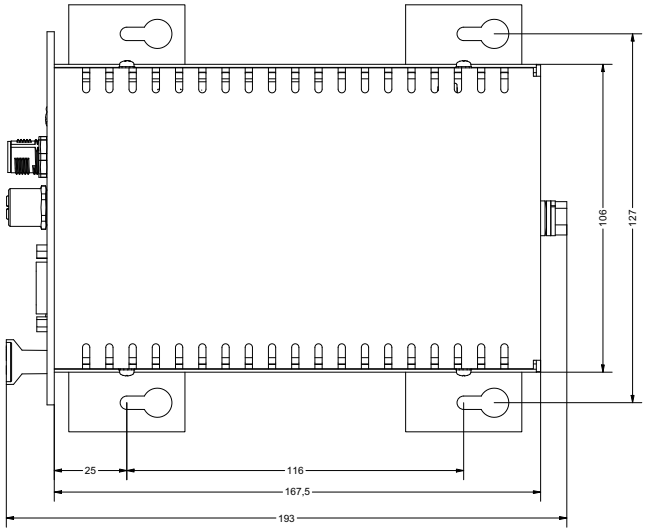


Fig. 5: Flange mounting

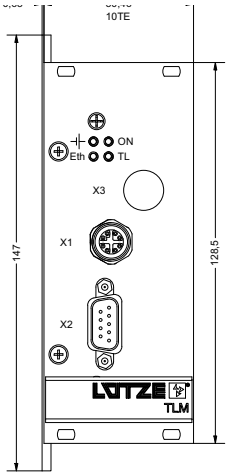


Fig. 6: Without F48 male connector on the backside

TLM-10 10TE DC 24-110V PI (Part no. 806600)

Without connector on the rear and earthing bolt

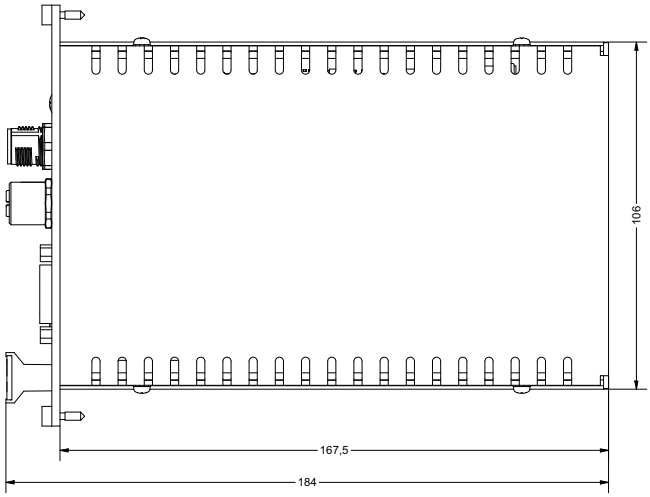


Fig. 7: Plug-in

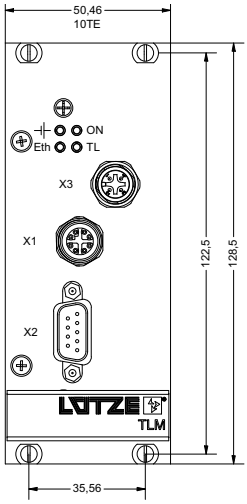


Fig. 8: Without F48 male connector on the backside

TLM-10 10TE DC 24-110V PI PB (Part no. 806601)

Without X3 on the front side and with F48 male connector on the backside

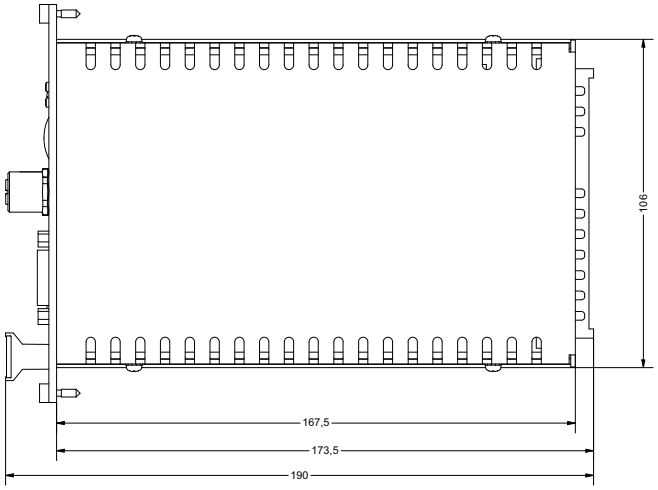


Fig. 9: Bandpass Plug-in on the front side

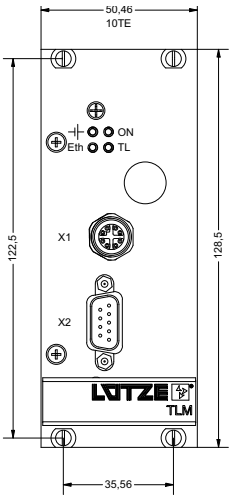


Fig. 10: With F48 male connector on the backside

TLM-10 10TE FM PoE (Part no. 806710)

Without X3 on the front side but with PoE

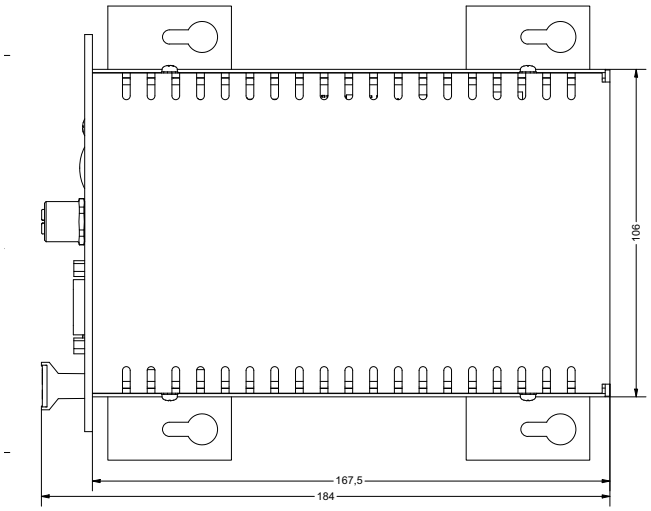


Fig. 11: Flange mounting with PoE

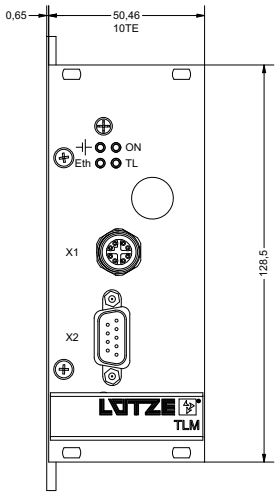


Fig. 12: Without X3 on the front side

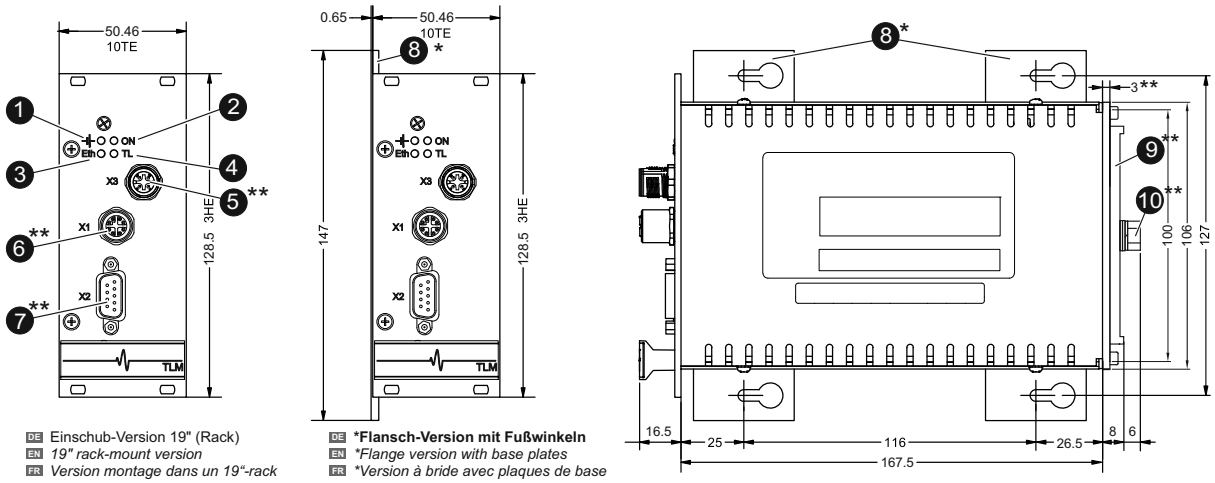


Fig. 13: Status LEDs and pins

1	Status LED: Power, yellow
2	Status LED: On, yellow
3	Status LED: Ethernet Link/Act, green
4	Status LED: TL Link /Act, green
5	X3: M12 A-coded (power supply), male**
6	X1: M12 X-coded (Ethernet), female**
7	X2: 9-pin Sub-D-connector, male for 2-wire connection (for Train Line)**
8	Flange plates (only for flange variant)
9	F48 plug, male**
10	M6 grounding screw**

* flange version
** product-specific

7.2 LED status

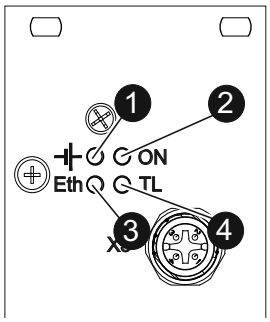


Fig. 14: LED status

LED	Color	Status	Description
Power (1)	yellow	on	Module is in operation mode
		off	Not ready
On (2)	yellow	on	Module is in operation mode
		off	Not ready
Eth-Link/Act (3)	green	on	ETH--Link recognized
		off	No Link detected
		flashing	Data is sent/received
TL-Link/Act (4)	green	on	TLM-Link detected
		off	No Link detected
		flashing	Data is sent/received

For further information also see chapter Functional test.

8 Connection concepts

Various connection concepts are possible for the TLMs. Selected configurations with the train-NF line as a transmission medium are listed here as examples. However, others are possible.

8.1 Connection concept A: Via train NF coupling

In this example, there is only one TLM per vehicle. A connection between the TLMs is established between the vehicles via the continuous NF line.

In this way, the individual vehicle sections can be connected to each other via Ethernet.

Additional network nodes can be connected via a switch on the X1 port, and the network can thus be expanded.

NOTICE

To avoid spur lines, the line train NF-PA in the TLM is routed through a low-pass-filter. The low-pass filter prevents the NF line from being fed back, which would result in unwanted noise.

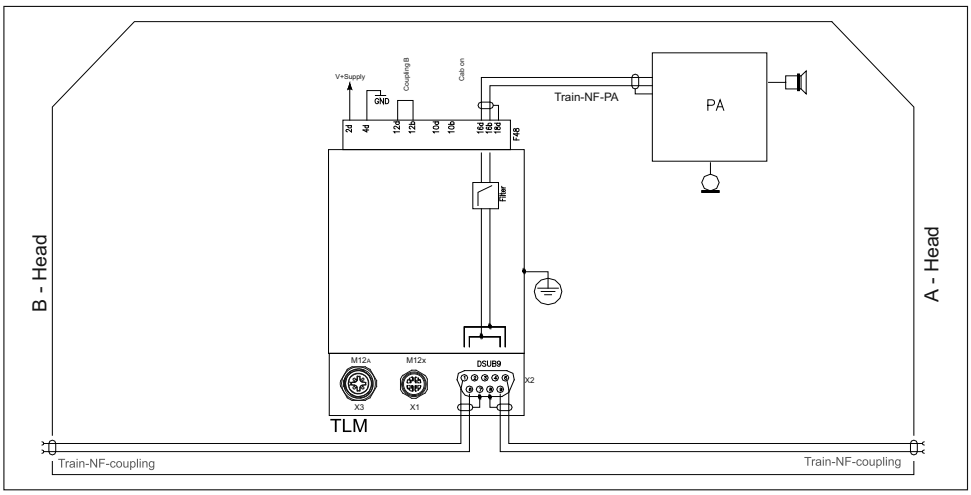


Fig. 15: User example 1

As shown, the line train-NF of the coupling has to be connected at the Sub-D connector of the TLM-10.

The installation location can be freely selected.

Usually, one TLM-10 per vehicle is provided in this configuration.

It is important to have a short connection to the vehicle chassis. See also chapter Grounding.

The connection to the TLM must not be a spur line, since the resulting reflections can severely impair data transmission.

8.1.1 Configuration examples

The TLMs are connected to each other by NF cable. The band-pass filters filter out disturbances. The PA is connected to the TLM via the rear-side F48 port.

NOTICE

In this configuration example, the length between two TLMs can be a maximum of 300 m.

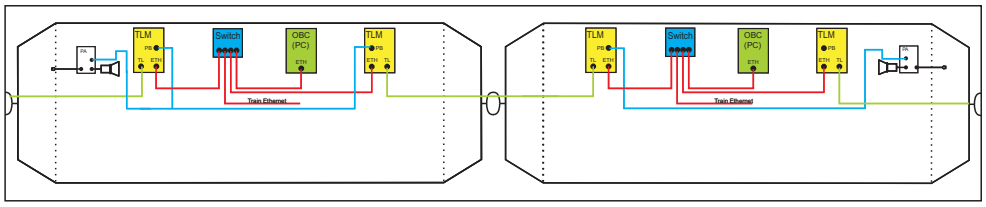


Fig. 16: Configuration example for Tram/Railbus

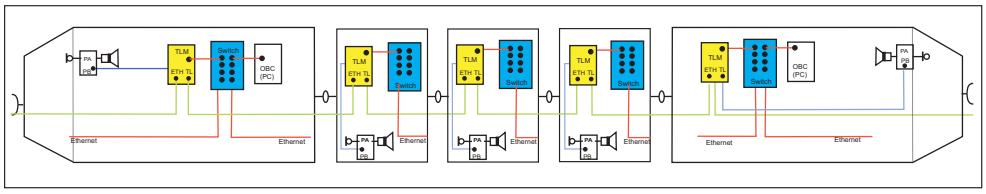


Fig. 17: Configuration example for Railroad/S-Bahn

Legend	
PA	Passenger announcement / Intercom system
TLM	Train Line Modem
OBC	On board computer (PC)
SWITCH	Switch, managed or unmanaged, for distributing Ethernet data to end devices such as video surveillance, infotainment, displays, WLAN
Green line	existing UIC or NF train bus line
Blue line	filtered UIC or NF train bus line
Red line	vehicle internal Ethernet line CAT 6+/CAT7

8.2 Connection concept B: Only via couplings

The data transmission via TLM-10 here is only done over the couplings.

This example is used when there is already an Ethernet line in the vehicle but there is no more free space above the coupling; then, the Ethernet signal is modulated onto an existing line with the TLMs.

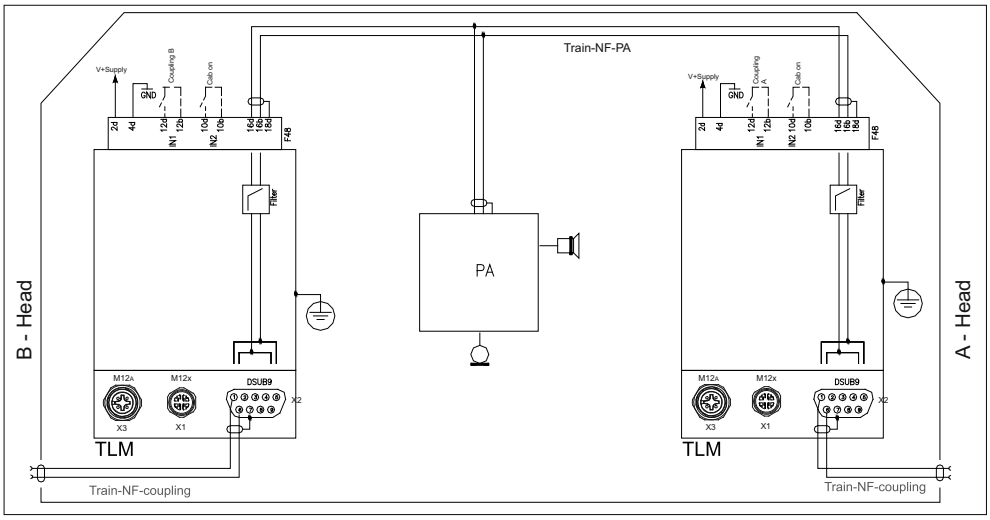


Fig. 18: User example 2

In this configuration, two TLMs are provided per vehicle. The NF train line is split here and routed through the installed filter. The filter ensures that no RF signal from the TLMs is coupled onto the AF line, which would cause interference. For good decoupling, the TLMs should be installed as close as possible to the vehicle heads, e.g., at the first end point of the coupling lines. This application example can be used when the lines and environmental bending are not sufficient for one TLM per vehicle or the route is otherwise too large.

NOTICE

The lines NF-coupling and NF-PA (Passenger Announcement) should not be laid parallel.

NOTICE

A short connection to the vehicle chassis is important (See also Chapter Grounding.)

The TLM-10s have two switching inputs not shown here. It may be necessary to deactivate the TLM-10s at the open couplings by means of a control signal, e.g., "coupling engaged or coupled". The input IN1 is available for this purpose.

With the switching input IN2, it is possible to restart the TLM-10s after each coupling process via, e.g., the control line "train upgraded/cab on". See chapter "Switching inputs," on page 37.

NOTICE

The data transfer can only be carried out within a vehicle / car from one coupling side to the other via a 2-wire line.

However, this allows any vehicle length.

NOTICE

Errorcase for connection concept 2: “Only via the couplings“:

The “TLM-Link/Act” LED must not light up, if the vehicle is not coupled. Otherwise, it is an indication of insufficient coupling between two TLM-10s within a vehicle.

8.2.1 Configuration example 2

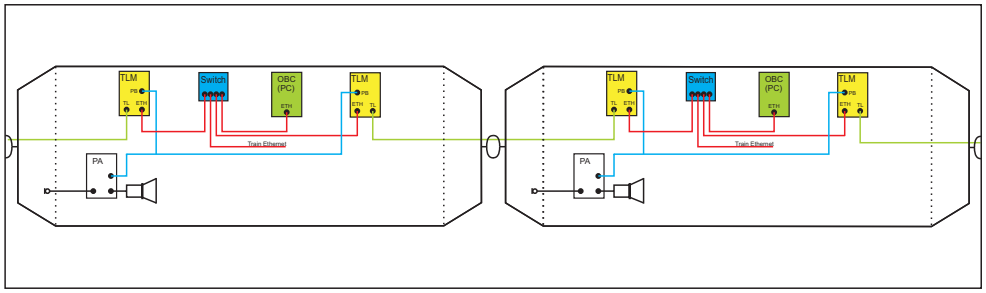


Fig. 19: Configuration example 2

Legend	
PA	Passenger announcement / Intercom system
TLM	Train Line Modem
OBC	On board computer (PC)
SWITCH	Switch, managed or unmanaged, for distributing Ethernet data to end devices such as video surveillance, infotainment, displays, WLAN
Green line	existing UIC or NF train bus line
Blue line	filtered UIC or NF train bus line
Red line	vehicle internal Ethernet line CAT 6+/CAT7

NOTICE

See also section Connection concept 1.

8.3 Connection concept C: coupling bridging and in the vehicle + redundant

In this configuration, 16 TLMs are provided per vehicle. The upper row consists of four TLM-10 per cab, one of which is a TLM for the clutch (nearest the coupler) and two more TLM's for communication between the driver's cabs. The TLMs are connected to a switch (unmanaged). The second row is identical to the above but with another internal seed. (A seed represents a specific address at which the TLM receives and sends its partner information).
The TLMs of both rows use different seeds to prevent crosstalk. The delivered TLMs are already configured and labeled. It must be ensured that the correct TLMs are connected to their seeds in the train. With the marking on the TLMs they can set on the right position on train.
The following diagram shows the correct location of the 16 TLM10.

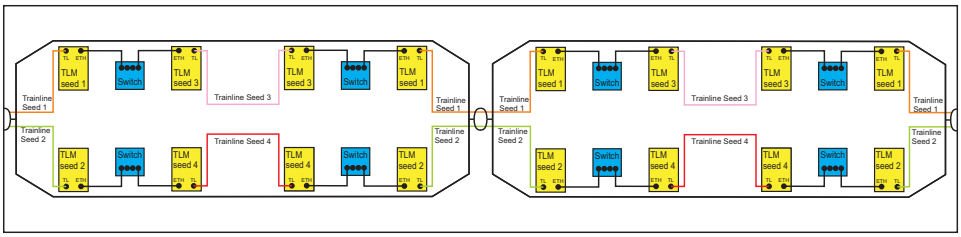


Fig. 20: Configuration example 3

Legend	
PA	Passenger announcement / Intercom system
TLM	Train Line Modem
SWITCH	Switch, managed or unmanaged, for distributing Ethernet data to end devices such as video surveillance, infotainment, displays, WLAN
Orange line	Filtered UIC or NF train bus line existing UIC of NF Train Bus Line seed 1
Green line	Existing UIC or NF train bus line seed 2
Pink line	Existing UIC of NF Train Bus Line seed 3
Red line	Existing UIC of NF Train Bus Line seed 4
Black line	Vehicle internal Ethernet line CAT 6+/CAT7
Blue line	Filtered UIC or NF train bus line

9 Installation

The TLM has been designed and developed for use in rail vehicles. Due to the wide voltage range of 24–110V, it can be used flexibly. It can be mounted either as a slide-in version (19" rack or assembly carrier) or as a "stand alone" flange version in a housing with foot brackets.

WARNING	**Never carry out the wiring of electrical connections when they are electrically live.**

WARNING	**Do not perform installation work on the device when it is under electrical voltage.**

9.1 Mounting options

NOTICE	**All positions and angles are possible for mounting.**

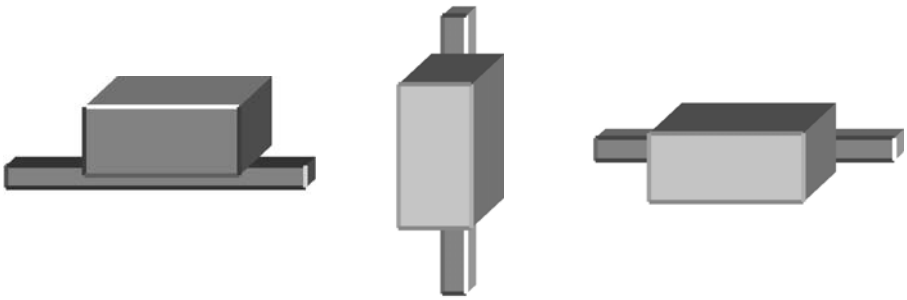


Fig. 21: Mounting options

9.1.1 TLM-10 for 19” (Rack) slide-in mount

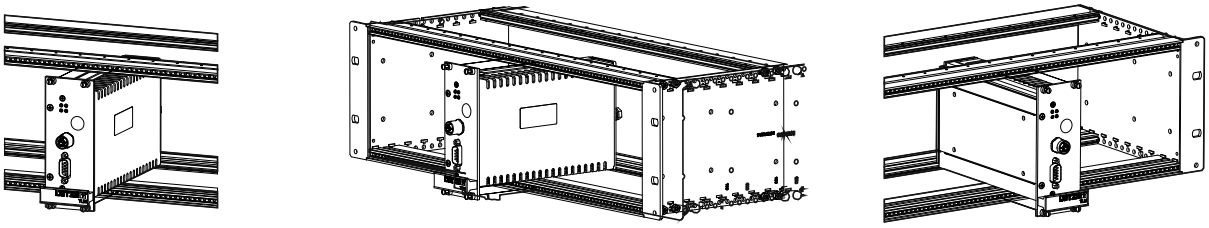


Fig. 22: Slide-in mount

9.1.2 TLM-10 Flange mount

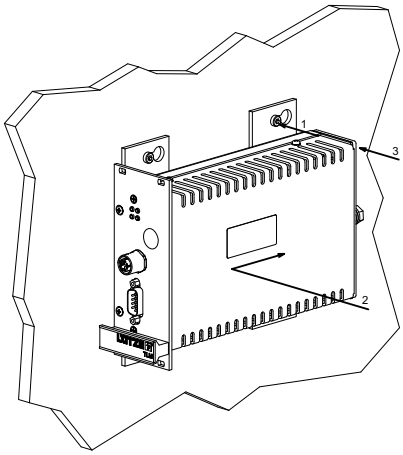


Fig. 23: Flange mount

Screws and fasteners for flange mounting are not available as accessories.

In the slide-in variant, the fastening screws are already included.

9.2 Wiring

The TLM is "hot-plug" capable. To ensure smooth operation and eliminate sources of error, the connections should already be made before the TLM is supplied with voltage.

Lütze recommends the following best practice approach:

- A continuous shielded 2-wire cable from coupling to coupling is required. The line should be accessible from the interior via clamping points as close as

possible to the couplings. Here e.g. the train-NF-line is suitable.

- The line impedance should be between 50 and 200 Ohm
- Shielded cables with a cross-section of 0.5 to 0.8 mm^2 such as LIHCH 2 x 0.5 or other data cables from established manufacturers can be used, provided the cables have a capacity of ≤ 160 pF / meter.

Before delivering the series, Lütze Transportation advises doing a sample installation in the intended vehicles.

During this sample installation, our technicians measure the line parameters of the signal lines in question for transmission, determine the maximum Ethernet data transmission rate, and optimize it if necessary.

9.3 Coverage

NOTICE

The range and transmission speed depend on the cable properties and their transitions.

9.4 Grounding in general

It is important that the TLM be grounded to effectively dissipate interference and achieve the transmission range and speed.

In order to ensure optimal function, grounding tapes with a rectangular cross-section and a length of < 30 cm must be used.

9.4.1 Grounding for the slide-in version (19“ rack/subrack)

NOTICE

The grounding is done via the conductive front panel.
This requires a subrack with conductive surfaces.

NOTICE

The subrack itself should be connected to the vehicle chassis with a low-impedance ground strap.

9.4.2 Grounding for the „Stand alone“ flange version

NOTICE

For the flange version with foot bracket, the TLM should be mounted on a conductive mounting plate measuring approximately 20 x 15 cm. This plate must then be bolted to the vehicle chassis in an electrically conductive manner.

NOTICE

If the foot bracket can be mounted to the vehicle chassis in a conductive manner over a large area, the mounting plate is not required.

NOTICE

If reliable grounding via the foot brackets is not possible, the TLM housing can be connected to the rear grounding connection via a suitable grounding strap with the vehicle chassis.

10 Pin allocation

The power supply of the device is possible either via the front M12A connector or via the rear F48 connector. Depending on the version of the device, the unused connector is not available.

The following figure shows the schematic structure of the TLM. This differs depending on the variant.

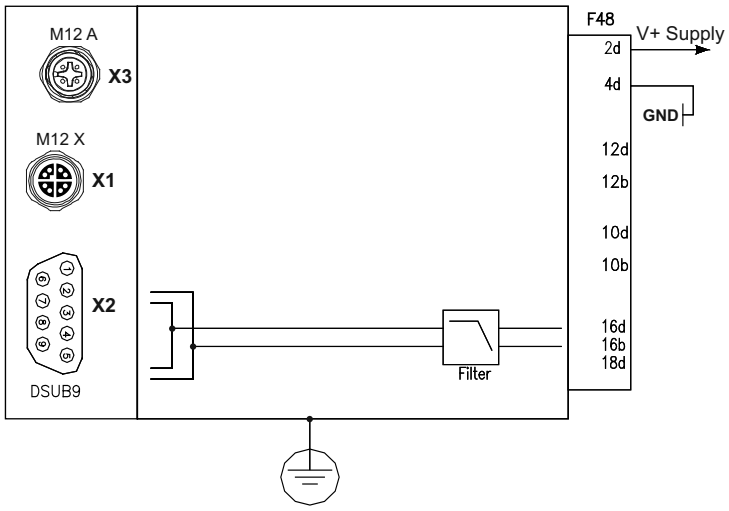


Fig. 24: Pin allocation

10.1 Front: X1 Ethernet (M12 X-coded)

Pin	Signal
1	DA+
2	DA-
3	DB+
4	DB-
5	DD+
6	DD-
7	DC-
8	DC+
Housing	*Shield*

10.2 Front: X2 Data (9-Sub-D)

Pin	Signal
1	Trainline-
2	-
3	TrainlineCom/Shield
4	-
5	Trainline-
6	Trainline+
7	-
8	-
9	Trainline+
Housing	Shield

NOTICE

Errorcase for connection concept 2: "Only via the couplings":

The "TL-Link/Act"-LED must not light up if the vehicle is not coupled. Otherwise, this is an indication of insufficient decoupling between two TLM-10s within a vehicle.

10.3 Front: X3 Power (M12-A)

This connection is not available for all variants, only for 806000 and 806610.

Pin	Signal
1	V+ Supply
2	-
3	GND Supply
4	V+ Supply
Housing	Shield

10.4 Backside F48 connector

This connection is not available for all variants, only for 806001 and 806611.

NOTICE

If the switching input IN1 is not used, connect the PINs "IN1a" and "IN1b" together.

Pin	Signal	Pin	Signal	Pin	Signal
02d	V+ Supply	02b	V+ Supply	02z	V+ Supply
04d	GND Supply	04b	GND Supply	04z	GND Supply
06d	-	06b	-	06z	-
08d	-	08b	-	08z	-
10d	**IN2a Cab on/** ”train upgraded“	10b	**IN2b Cab on/** ”train upgraded“	10z	-
12d	**IN1a Coupled/** ”coupling engaged“	12b	**IN1b Cab on/** ”train upgraded“	12z	-
14d	-	14b	-	14z	-
16d	TrainLine/PA+	16b	TrainLine/PA-	16z	-
18d	TraineLineCom/ PA Shield	18b	-	18z	-
20d	-	20b	-	20z	-
22d	-	22b	-	22z	-
24d	-	24b	-	24z	-
26d	-	26b	-	26z	-
28d	-	28b	-	28z	-
30d	-	30b	-	30z	-
32d	-	32b	-	32z	-

10.5 Configuration of the switching inputs

The switching inputs for ”coupling engaged / Coupled“ and ”train upgraded / Cab On“ can be adapted to the respective conditions.

10.5.1 Switching inputs

The switching inputs can be connected with an external or internal GND reference.

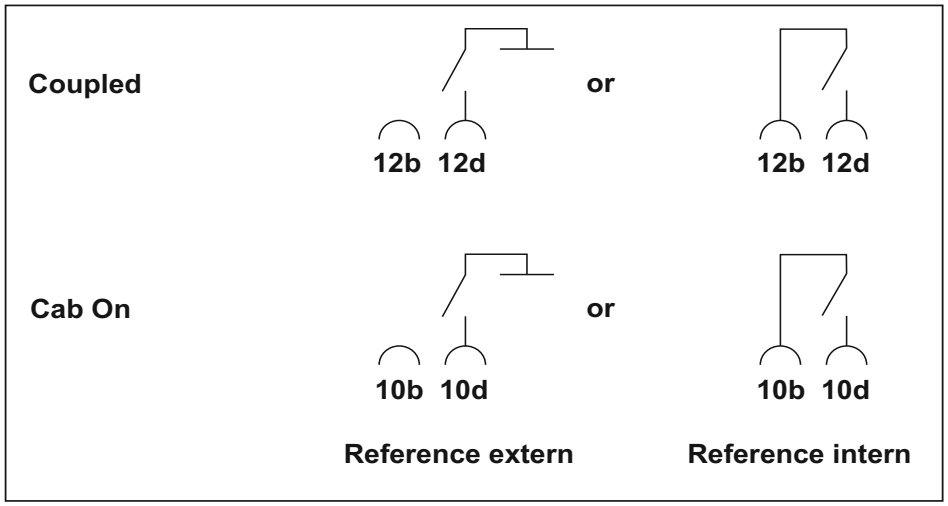


Fig. 25: Switching inputs

The figure shows the configuration of the switching inputs as "active low" (the default) and their wiring at the F48 connector.

The inputs can also be configured differently.

The configuration is fixed by Lütze and must be clarified in advance or communicated when placing an order.

The "**Coupling engaged**" signal should either always be applied or be applied as soon as the coupling is completed; otherwise, the device will not start up.

The "**Cab on**" signal is used to restart the paring process between two TLMs. This may be necessary, if the TLMs do not find each other and no connection is available.

If the connection is permanent, there will be no further resets and Cab on will not be coupled.

11 TLM Configuration Tool

The TLM-10 can be set and configured with the Lütze configuration tool. However, this is not absolutely necessary.

NOTICE

You can get the tool on request from the service. The contact address can be found in chapter “Maintenance and service” on page 40.

12 Operation

After the installation and initial operation, no further commissioning, manual adjustment, or configuration (such as setting MAC or OP addresses) is required on the TLM-10 train modem.

13 Maintenance and service

The system and the single modules do not require preventive maintenance.

If you have any further questions regarding the product or our repair service, please contact us at:

Lütze Transportation GmbH
Bruckwiesenstraße17-19
71384 Weinstadt
Germany

Phone: +49 (0) 7151 6053-545
Fax: +49 (0) 7171 6053-6545

E-Mail: Sales.Transportation@luetze.de

14 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.

15 Revision history

Version	Revision	Date
00	Newly created document	06/14/2023
01	Exchange of drawings in chapter	01/18/2024
02	10.1. Front: X1 Ethernet: Pin assignment corrected;	06/04/2024

Technical changes reserved.

Appendix A

Heartbeat configuration

UDP Heartbeat Package																													
Octet	**Bit**	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**
0	**0**	Source Port																Dest Port															
4	**32**	Length																Checksum															
8	**64**	TLM OK								;								Line Link Status								;							
12	**96**	Line Link speed TX																															
16	**128**	;								Line Link Speed RX																							
20	**160**	Line Link Speed RX								;								Firmwareversion															
24	**192**	Firmwareversion																															
28	**224**	Firmwareversion																															
32	**256**	Firmwareversion								;								Configversion															
36	**288**	Configversion																															
40	**320**	Configversion																															
44	**352**	Configversion								;								Junction Temperature															
48	**384**	Junction Temperature								;								MAC Address															
52	**416**	MAC Address																															
56	**448**	MAC Address																															
60	**480**	MAC Address																															
64	**512**	MAC Address