Edition 4

# ON TRACK!

The international magazine of Lütze Transportation GmbH

**Better safe than sorry:**
**SIL 2 safety relay**

**Very clever:**
**AI is modernizing train traffic**

**With anticipatory action:**
**Predictive maintenance on the railway**

**Cleanly dosed: perfectly functioning train toilets**

**Catch the right tone: intelligent audio signal transmitters by TRDP**

LÜTZE TRANSPORTATION

# EDITORIAL

Dimitrios Koutrouvis
Managing Director
Lütze Transportation GmbH

**The Future of Mobility!**

We are on the threshold of a new era of rail transport. One thing is already clear: the future of mobility is data-driven and networked. Preventive maintenance on trains, coupled with artificial intelligence, is a development that will revolutionize not only the efficiency but also the safety and sustainability of rail transport.

It will be exciting to see how the industry takes up these technologies and develops them further in order to meet future challenges. We at LÜTZE TRANSPORTATION are already making our contribution, as you can read about on the following pages.

I hope you enjoy reading the latest edition of our magazine ON-TRACK!

Best wishes,
Yours, Dimitrios Koutrouvis

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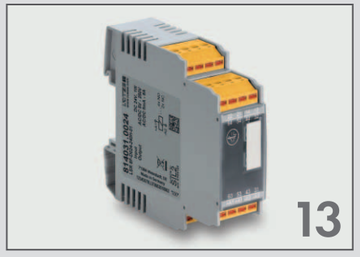


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**5 new safety relays for applications up to SIL 2**


**Very clever:**
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**predictive maintenance on rail vehicles**


**Cleanly dosed:**
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**Hitting the right note:**
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*Cover image: Hybridlokomotive Modula from Vossloh Rolling Stock*

# WELCOME TO THE FUTURE

Author: Andreas Schindler, LÜTZE TRANSPORTATION with material from Vossloh Rolling Stock

**In the rail sector, modern consumption and emission-optimized engines complying with EU Emission Stage V are increasingly being used. Also, hybrid drive systems are becoming a focus on the rails. This trend is also driven by the public awareness of emissions from combustion engines. With the Modula hybrid locomotive, Vossloh Rolling Stock is significantly advancing this development, therefore serving future transport tasks by combining shunting service and freight traffic.**

*(Image: Modula Hybrid Locomotive from Vossloh Rolling Stock)*

No matter which form of energy storage will prevail in the future. Whether it's a diesel, battery or hydrogen fuel cell, or the more durable hydrogen piston engine, with the modular platform of the Modula locomotive, the manufacturer Vossloh Rolling Stock offers a high degree of variability and enables the integration of current and future energy storage and generation technologies.

The rail vehicle operator can choose the hybrid equipment suitable for their operational area, and precisely tailor the locomotive's equipment to their actual operating conditions. In addition, the Modula stands out due to consistently reduced energy costs in branch line and construction train operations, while maintaining excellent shunting capabilities. Additionally, the environmental and cost balance is improved by the ability to switch quickly between overhead line and internal energy storage or diesel module while in operation. The principle of the hybrid locomotive also extends the range while simultaneously feeding back braking energy into the overhead line network or the traction battery.

**Preventive Maintenance**

Unlike the usual regular maintenance of vehicles, the Modula platform allows for very flexible maintenance depending on the condition, individual mileage, and usage time. This new principle of "Predictive Maintenance" ensures high availability and reliability, and contributes to reducing operating costs per kilometer.

In this context, "proactive maintenance, plays a central role. This involves monitoring the condition of vehicle components through real-time data analysis so that preventive maintenance can be performed at signs of wear before the component fails. This significantly reduces downtime.

With the new LUNA system LÜTZE Universal Network Adapter) by LÜTZE Transportation,used in the Modula locomotive, such preventive maintenance can be implemented. The system enables continuous energy management based on the data collected through constant current monitoring. Sensor data is continuously analyzed to predict forthcoming failure, and to plan necessary maintenance in advance.

For more details on LUNA and predictive maintenance on the new Modula, see the article "Predictive Maintenance on Rail Vehicles" on page 16.

# Integrated into Daily Life:

# USB-C and USB-C Power Delivery

## *for use in Rail Vehicles*

Authors: Andreas Schindler and Yima Zimmermann, Product Managers at Lütze Transportation GmbH, Weinstadt

(Image: iStockphoto)

**Rail technology specialist LÜTZE TRANSPORTATION offers a comprehensive range of rail-compatible USB charging solutions for rail vehicles. Following the introduction of the first USB-C solutions, USB-C charging solutions with Power Delivery are now available for daily use in rail vehicles. In the near future, USB-C Power Delivery solutions with up to 240 watts of power will be available in rail vehicles. This could make power sockets in passenger areas and driver cabs mostly obsolete.**

**Increased use of Mobile Devices on Trains. The usage for tamper-proof charging infrastructure is growing.**

Mobile devices such as smartphones and tablets are now indispensable in our lives. Accordingly, the daily usage time of smartphones in Germany averages around 2.5 hours. The use of mobile devices among train passengers in local and long-distance travel is also continuously increasing. Evidence of the growing use of mobile devices on trains is the rising use of Wi-Fi in long-distance trains. Deutsche Bahn documented that in 2018, about 30 terabytes of data were transmitted monthly via the Wi-Fi network in ICE trains, and this data volume increased to about 50 terabytes per month in 2019. Train drivers and conductors also use tablet PCs and laptops to access timetables, route information, and emergency protocols in real-time.

With the increasing use of mobile devices on trains, the demand for appropriate charging options is rising. Since the early 2000s, Deutsche Bahn has installed Schuko sockets for charging mobile devices in its trains. However, with the introduction of power sockets, issues with vandalism have repeatedly occurred: sockets were tampered with, endangering the health of unsuspecting travelers. Overuse from simultaneously connecting multiple or high-power devices is also a known issue.

To address these challenges, rail vehicle manufacturers and operators are increasingly relying on USB charging infrastructure in passenger areas. Since around 2015, Deutsche Bahn has begun installing USB-A sockets in its trains.

In October 2022, the European Union adopted a directive mandating USB-C as the standard connection for many electronic devices, replacing USB-A and other USB connector. This requirement is expected to lead to USB-C charging infrastructure becoming the sole standard in European rail vehicles in the near future.

LÜTZE TRANSPORTATION has been offering various charging systems for rail vehicles for many years. In addition to the proven USB-A variants, with and without power sockets, USB-C variants are now also available. Due to demand from non-European regions, USB-A variants will continue to be supplied. All charging systems from LÜTZE TRANSPORTATION meet the rail-related standards EN 50155, EN 50121-3-2, EN 61373, EN 45545-2, as well as Regulation No. EMV 06 of the Federal Railway Authority. Thanks to EMV 06, which regulates electromagnetic compatibility with railway radio services, retrofits by the operator are possible.

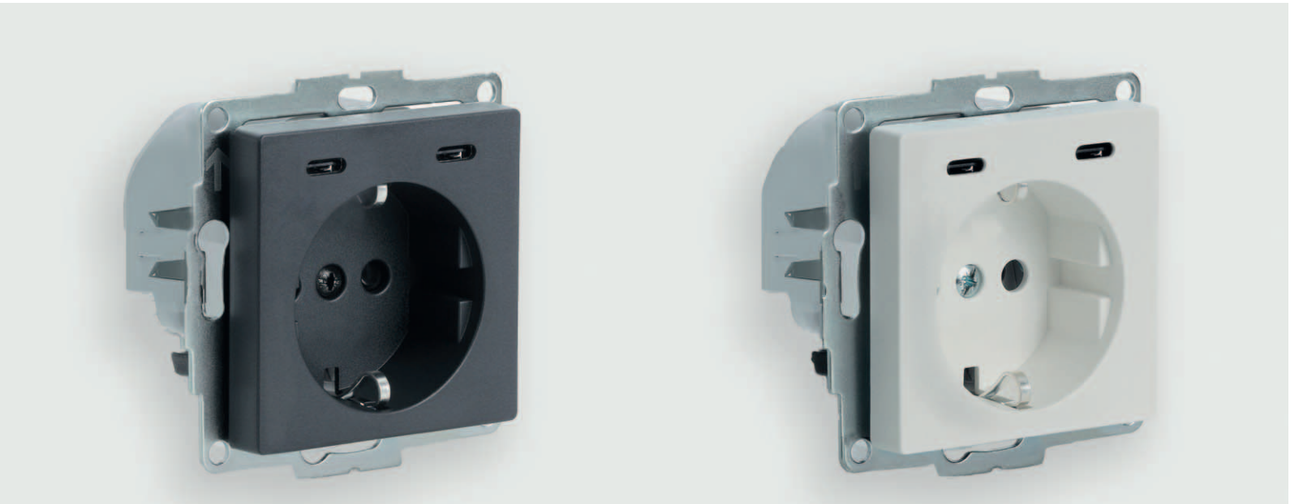
**LÜTZE focuses on USB-C for Rail Vehicles**

In early 2024, LÜTZE introduced its first charging units with two USB-C ports, suitable for both passenger areas and driver cabs. Additionally, these charging units feature a classic power socket (Type F/CEE 7/3). The compact sockets are

# USB-C Power Delivery for use in Rail Vehicles

suitable for installation in passenger areas and driver cabs. USB-C offers significantly better mechanical durability compared to USB-A, with up to 10,000 insertion cycles, and is independent of plug-in orientation.

The 230 V sockets with two USB-C charging ports provide a charging current of 1.5 A each at 15 W. If only one port is used, a charging current of up to 3 A is available. The USB-C charging ports use less than 50 mW in standby mode, reducing the demand on the onboard networks. Thanks to the dynamic detection of the charging protocol, the power requirement of the connected mobile device is recognized and the charging current is adjusted accordingly.



*The 230 V Sockets from LÜTZE TRANSPORTATION with two USB-C/USB-C Charging Ports*

**Powerful USB-C PD charging ports for passenger areas**

However, as previously described, power-sockets are not tamper-proof, and traditional USB-C ports offer insufficient power for high-power laptops, for example. The standard USB-C specification is limited to 5 V and a maximum of 3 A (15 W).

*Powerful and tamper-proof USB-C PD charging systems for passenger areas by LÜTZE TRANSPORTATION*

LÜTZE TRANSPORTATION has therefore now included USB-C charging solutions with PD (Power Delivery) in its range. With USB PD, significantly higher charging powers can be achieved. LÜTZE TRANSPORTATION offers USB-C charging solutions with 3 A power and up to 20 V, and is working on next-generation solutions that are expected to support up to 5 A according to the USB Power Delivery 3.1 specification.

An important advantage of Power Delivery is the "Handshake," which ensures compatibility between device and charger and negotiates optimal voltage and current. This prevents overloading of the charger and battery.

With the new USB-C charging ports for passenger areas offering 65 watts, LÜTZE TRANSPORTATION presents 100% rail-compatible charging systems, and offers OEMs and rail operators the possibility to completely eliminate 230 V power sockets in passenger compartments. The LÜTZE USB-C socket delivers 65 W output power at 5 to 20 V, and up to 3.25 A, sufficient for powerful laptops and tablets. With an energy efficiency of over 80% and a standby consumption of under 50 mW, the onboard power system is capable of managing the demands. Continuous operation is possible at temperatures from -25 to +55 °C, with a service life of 20,000 operating hours at full load.

With dimensions of 40 x 42 mm and a depth of 40 mm, the system is significantly more compact and space-saving than traditional power socket units. This makes it ideal for installation between seats or into the cabin walls.

During the development of the new USB-C sockets, particular focus was put on safety. The system is completely tamper-proof. The passenger-side front cover is clicked into place from the front and must be released from the back. It is also not screwed on, making the USB socket inaccessible from the passenger side. The USB system operates on the input side with AC 230 V and delivers a maximum of 20 V on the output side. This means there is no risk of electric shock for passengers.

**USB-C Power Delivery chargingsystem for the driver's cab**

The demand for more powerful USB charging systems is also high in the driver's cab. LÜTZE TRANSPORTATION supplies a

*60 Watt USB-C PD charging system for the driver's cab by LÜTZE TRANSPORTATION with DC/DC converter (24-110 V DC) and USB-C port*

# USB-C Power Delivery for use in Rail Vehicles


*LÜTZE TRANSPORTATION USB charging systems have been used in the driver's cab for many years. With just a few adjustments, the system can now be upgraded from USB-A to USB-C with Power Delivery.*

60 W Power Delivery charging system with a DC/DC converter and an input voltage range of DC 24 - 110 V as a wide-voltage supply, including a two-meter charging cable and USB-C port. The USB-C charging system offers a significant power increase over the proven USB charging system with two USB-A ports. This enables efficient use of high-power laptops and tablets to conveniently update travel data, such as route tables, schedules, and speed restrictions.

A key advantage is the compatibility of the dimensions of the DC/DC converter and charging cable with the existing USB-A system. Operators can easily upgrade to the new USB-C system by simply replacing the converter without changing the wiring on the input side. No additional installation space is required, and the charging cable can be replaced 1:1. The converter is mounted on DIN rail TS35-15 or TS35-7.5 (EN 60715).

Thanks to the wide input voltage range of DC 24 V to 110 V, the DC/DC converter can be used in both diesel and electric vehicles. The output provides 3 A at 5 to 20 V DC. The new USB-C system is suitable for installation in the driver's cab or in small control cabinets.

The USB-C charging system is designed for continuous operation in the temperature range of -40 °C to +70 °C. The DC/DC converter features reverse polarity protection on the input side. On the output side, it provides short-circuit and overload protection. The output voltage is indicated by a separate green LED. The charging cable is two meters long. An adequate conductor cross-section ensures a low voltage drop.

BACKGROUND

### Background on USB-C

Key requirements and goals of the USB-C EU directive include:

- By the end of 2024, all small and medium-sized portable devices must be equipped with USB-C, including smartphones, tablets, e-readers, cameras, headphones, speakers, and handheld consoles.
- By spring 2026, laptops must also have USB-C charging ports.
- Devices with fast-charging functions must offer the same charging speed regardless of the charger.
- The directive aims to reduce electronic waste by eliminating different types of chargers and cables.
- Standardized charging ports are expected to enhance consumer protection and convenience by reducing the need for various chargers and cables.

### Background on USB PD Power Delivery

- USB Power Delivery 1.0 was introduced in July 2012. It enables power delivery of up to 100 watts (20 V, 5 A).
- USB Power Delivery 2.0 was released in August 2014. This version introduced improvements in device communication. USB PD 2.0 was the basis for the introduction of USB-C.
- USB Power Delivery 3.0 was released in September 2015. This version added the ability to monitor charging status and improved energy management protocols.
- In 2017, the USB PD 3.0 specification was extended with the "Programmable Power Supply" (PPS) feature, allowing dynamic adjustment of voltage and current, which is particularly advantageous for fast charging.
- The USB PD Revision 3.0, Version 1.1 from 2019 introduced additional safety measures and further optimized communication protocols.
- The latest specification, USB Power Delivery 3.1, was released in May 2021 This version increased the maximum power to 240 W (48 V at 5 A).

# Award-Winning S-Bahn Trains for Cologne

**Rides aboard the S-Bahn in the Rhine metropolis of Cologne and the surrounding regions will soon become even more modern and comfortable. Since this year, DB Regio NRW has been introducing the first fully modernized trains from the "ET 424" series onto the tracks—vehicles that have been honored with the prestigious "German Design Award 2024."**

The thoroughly revamped vehicles impressed the "German Design Award" jury not only with their appealing exterior design but, more importantly, with their fully modernized interior, which almost makes the trains feel like new vehicles. There is now more space for bicycles, wheelchairs, strollers, and luggage. Technologically, the trains are also state-of-the-art: large, modern displays provide passengers with detailed information about their journey. Additionally, passengers will benefit from Wi-Fi and USB sockets.

From LÜTZE TRANSPORTATION's extensive USB charging portfolio, sockets with integrated USB-C and USB-A charging ports were selected. The sockets meet the standards EN 50155, EN 50121-3-2, EN 61373, EN 45545-2, and Regulation No. EMV 06 of the Federal Railway Authority.

Thanks to compliance with these regulations, retrofits, such as those for the Cologne S-Bahn, are also possible.

The USB charging ports consume less than 70 mW in standby mode in the USB-A /USB-C version, and less than 50 mW in the version with two USB-C ports. Therefore, onboard networks are capable of managing the demands, by means of dynamic recognition of the charging protocol. The power needs of the connected mobile device, be it a phone or tablet, are recognized and the charging current is adapted efficiently. The USB-A charging ports are designed for a minimum of 5,000 insertion cycles, and the USB-C charging ports for a minimum of 10,000 insertion cycles.

The power sockets feature a mechanical protection against accidental contact (shutter) and are designed for a lifespan of at least 5,000 insertion cycles. With an installation depth of only 44mm, the sockets can be easily integrated into seating units or bulkheads.

LÜTZE TRANSPORTATION is also currently expanding its range of USB sockets with plans for charging ports based on USB-PD (Power Delivery). Thanks to PD technology, safe high-speed charging is enabled without damaging the battery. It supports a power output of up to 65 watts, allowing for the charging of high-performance laptops and tablets.

*The completely renovated vehicles of the Cologne S-Bahn (Image: DB Regio / Smilla Dankert)*

*USB charging socket by LÜTZE TRANSPORTATION in the Cologne S-Bahn (Image: DB Regio / Smilla Dankert)*

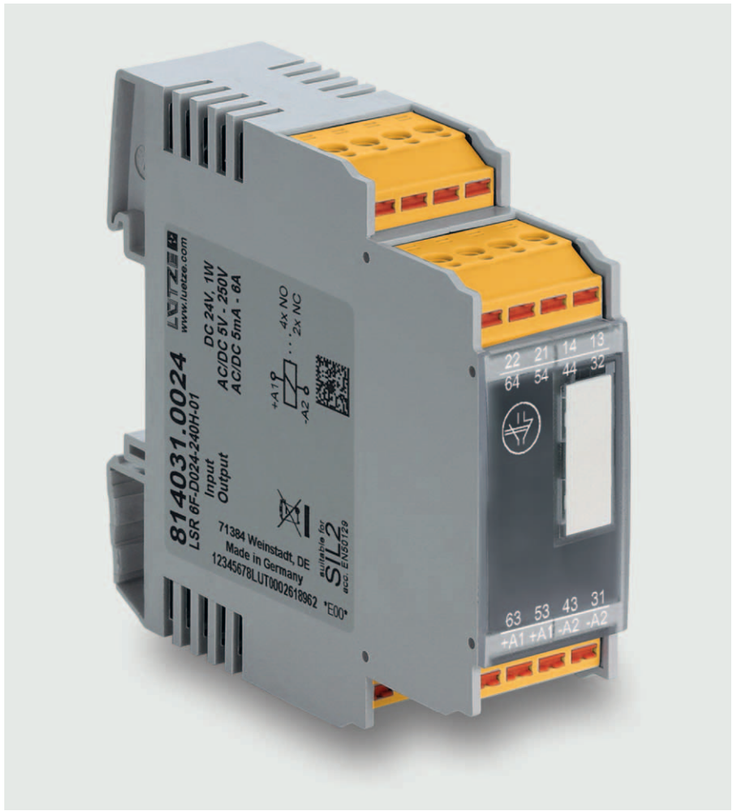
*More space and comfort: Cologne S-Bahn after the retrofit (Image: DB Regio / Smilla Dankert)*



# Safety Relay Module

## for Safety Applications up to SIL 2

**At InnoTrans 2024, railway technology specialist LÜTZE TRANSPORTATION will present five new safety relay modules with force-guided contacts according to IEC 61810-3 (Application Type A). The safety relays are available for all common onboard voltages from DC 24 V to DC 110 V.**




*LÜTZE TRANSPORTATION presents five new safety relays (DC 24 - DC 110 V) for safety-critical applications up to SIL 2*

The safety relays by LÜTZE TRANSPORTATION, each with two normally open, and four normally closed contacts (250 V / 6 A), are suitable for switching small to medium loads in safety circuits. They can be used for safety applications up to SIL 2, taking into account defined Safety Application Conditions (SAC). The safety relays are ideal for contact extension and increasing switching capacity in safety-related circuits. Additionally, providing galvanic isolation to protect against EMC interference.

Typical applications for these safety relays include safety-critical systems in railway technology, such as door controls and braking and train control systems. Furthermore, the new relays from LÜTZE TRANSPORTATION are also used in fully automated, driverless trains and in safety driving circuits.

Depending on the version, the LÜTZE safety relays can be operated with voltages of DC 24 V, DC 36 V, DC 48 V, DC 72 V, or DC 110 V. They offer an extended operating temperature range from -40°C to +70°C. With compact dimensions of 22.5 x 79.0 x 84.0 mm (W×H×D), the relays can be easily mounted on a TS35 DIN rail. The relays comply with all relevant railway standards, including EN 50155, EN 50121-3-2, EN 50124-1, EN 61373, the fire protection standard EN 45545-2, and the EMC 06 regulation of the Federal Railway Authority.

# AI IN THE RAILWAY ECOSYSTEM

**Artificial intelligence is associated with innovation and now we see it penetrating all areas of our Lives - travel included. But how about the rail industry? Is there a chance for AI to modernize rail travel? Every year billions of people travel by train. Maybe it is still less than air passengers, but rail travel is far from being obsolete. Yet to compete with other travel modes in terms of safety and convenience the rail industry must develop, which today means embracing digitization. Innovative technologies based on artificial intelligence and machine learning offer Railways of vast potential for improvement. So today we look at five ways for AI to make rail travel better.**

## Autonomous trains

The most obvious AI implementation in the rail industry is autonomous trains. We already have working prototypes of flying vehicles, self-driving vehicles and even flying self-driving Vehicles. While the world is going into a frenzy about unmanned cars, many rail systems have been successfully operating autonomous trains for decades. In 1968 the Victoria line of the London Underground opened as the first fully automated metro line. Today multiple cities like Paris, Dubai, Tokyo and Barcelona operate modern driverless Urban trains. As for non-metro rail in October 2021 Siemens and Europe's largest railway company Deutsche Bahn revealed the world's first automated driverless train in Hamburg, Germany as part of a 70-million-dollar modernization project . China started the operation of a completely autonomous bullet train for the 2022 Winter Olympics. It can travel 350 km/h moving its passengers from Beijing's downtown to the Olympic venues in just 50 minutes down from three hours via a regular Express train . Here is how it works: automatic train operation or ATO controls the train traction system and brakes. It also gets the current traffic information over the radio to adapt operations in real time. So, the increase in efficiency is achieved by optimizing speed and reducing braking. The result is more punctual trains, more stable timetables, greater travel comfort, less energy consumption and reduced mechanical stress on vehicles. On top of all that, the automated operation is reported to reduce accident Risk by eliminating human error which brings us to an important topic of Safety and Security in rail. There are some ways that AI can help here when combined with video surveillance.

## CCTV for passenger safety and service

We are used to cameras all around us. It's estimated that over 1 billion cameras are installed in cities worldwide. The main goal of video surveillance is security and when enhanced by AI CCTV technology can identify threats and prompt reactions more efficiently. In the rail industry cameras installed on stations can detect people on tracks and immediately inform controllers who can stop the train thus saving lives. One example for this technology is the implementation of such a system by Docklands Light Railway in London. The operator has defined detection zones along the platform edge. When a person enters the zone, an alert sounds, and a live video image is immediately displayed in the control center. Similar computer vision technology also spots trespassers. Moreover, it can even be trained to identify aggressive behavior loitering, theft or unattended baggage and alert security teams.

*(Image: iStockphoto)*

# AI IN THE RAILWAY ECOSYSTEM

**Digital assistants**

Another application of AI enhanced video technology is analyzing passenger density in rail cars. Then the system sends this information to passengers waiting at the station so they can be directed to a less crowded car and so we move from safety to convenience and service quality. That's another potential area for AI implementation namely digital assistance. If you have an iPhone, you're probably familiar with Siri. Those who have ever dealt with a smart home system might have used Alexa or Google Assistant to control it and most likely you're one of the 1.5 billion people who have encountered an online chat bot at least once. All of these tools are powered by conversational AI. This is a technology that can understand the user's natural language and provide personalized answers.

**Here are some examples:**

- Amtrak launched its virtual assistant JULIE back in 2001 to handle passenger queries. Today Julie assists with 5 million questions annually booking tickets and providing other helpful information like train schedules directions refund and baggage policies and much more.

- Indian railways presented their chatbot DISHA in 2018. This smart bilingual assistant processes about 150 000 passenger queries daily improving customer satisfaction by 70 percent. It also reduced the usage of other communication channels by 70 percent, taking heat off the customer support teams.

- Japan Railways launched their multilingual BEBOT to guide visitors that arrive at the Tokyo train station. It can provide information on landmarks, local restaurants, currency exchange offices and sightseeing spots in the area.

**Route planning and scheduling**

One more way AI can enhance rail travel is through route planning and scheduling. Today many trains run on age-old routes that are no longer optimal while missing out on areas with high demand. AI tools analyze both historical and real-time data on ticket sales and travel patterns. This way they identify Trends in passenger flow and find ways to optimize train routes and schedules. On top of that AI can incorporate such information as weather changes, holidays or special events to predict demand and best adjust rail operations to actual passenger needs. Toshiba a technology Provider from Japan created a digital twin simulator model for the UK rail operator Greater Anglia to optimize its operations. Digital twins are essentially virtual replicas that reproduce real world environments. This technology helps better understand the system performance and tryout or simulate various scenarios to find the optimal one. A digital twin made by Toshiba is designed to analyze the Greater Anglia rail network and improve their train schedules. What if delays happen and planned schedules are disrupted? Hitachi's hybrid Railway traffic management system is one of the solutions that are designed to address operational disruptions. It incorporates intelligent ML-based technology to automatically recalculate and modify timetables and train routes in real time.

**Internal operations**

Besides passenger-related processes AI can greatly enhance internal operations. It plays a significant role in predictive maintenance, railway inspections drive for behavior analysis and much more. Today rail companies install multiple sensors on tracks and rail cars. That turns trains into a kind of rolling data centers. Powerful onboard computers analyze incoming data and find ways to increase operational efficiency reliability and security. SNCF a French rail operator spent over 10 years installing thousands of sensors and transmitting devices on its rail stock. The results of this arduous project are impressive: today they analyze over 8 000 variables per train including 2 000 in real time from over 1 000 trains at the same time. With remote diagnostics and predictive maintenance in place they can eliminate about two-thirds of breakdowns. Moreover, their maintenance costs were cut by 20 percent.

These were just a few examples from completely different areas of application that impressively demonstrate the great importance of AI for railway technology. Regardless of whether it is in service to increase passenger comfort, operational safety and reliability or predictive maintenance, the applications described and already in use show the great future potential of AI in the railway sector.

*Author: Dimitrios Koutrouvis, Managing Director, Lütze Transportation GmbH*

*(Image: iStockphoto)*

# Predictive Maintenance
## *on Rail Vehicles*

**Authors: Andreas Schindler, Product Manager at LÜTZE TRANSPORTATION, and Volker Nefzer, R&D Project Manager at LÜTZE**

**With LUNA, LÜTZE TRANSPORTATION offers an intelligent and modular control system based on Ethernet TRDP and the local L-Bus2. It is designed for 2-pole switching, monitoring, and securing of 24 V actuators in rail vehicles. LUNA enables predictive fault forecasting and thus preventive maintenance. Data and the condition of a rail vehicle can be read in real-time, and remotely via the cloud by the vehicle manufacturer or operator. The LUNA system includes power supply and expansion modules, TRDP bus couplers, and current monitoring modules. LUNA provides entirely new possibilities for maintenance and service, as demonstrated in a dual-mode locomotive application.**

*Maintenance on a rail vehicle (Image: iStockphoto)*

# SWITCHING, MONITORING AND PROTECTION

For rail vehicle operators, the costs for maintenance and service of their vehicles are crucial for economic success and to remain competitive with other modes of transportation. Increasing system complexity, the challenging availability of spare parts—especially for older vehicles or specialized components—along with the shortage of skilled workers and high wage costs are significant. Consequently, manufacturers are required to offer maintenance and service options that ensure efficiency, reliability, and safety in rail transport.

In this context, "Predictive Maintenance," or proactive maintenance, plays a central role. This involves monitoring the condition of vehicle components through real-time data analysis, so that preventive maintenance can be performed at signs of wear before the component fails. This significantly reduces downtime.

The new LUNA system (LÜTZE Universal Network Adapter) from LÜTZE TRANSPORTATION implements such preventive maintenance, as demonstrated in applications within a modern dual-mode locomotive. The system enables continuous energy management based on the data collected through constant current monitoring. Sensor data is continuously analyzed to predict and prevent forthcoming failures of loads and to plan necessary maintenance in advance.

In addition to continuous current monitoring, LUNA offers remote on/off switching of all connected actuators via Ethernet TRDP. This allows LUNA to be installed in hard-to-reach locations and eliminates the need for additional relays or semiconductor switches for switching actuators.

The LUNA system is suitable for installation in the driver's cabin, in enclosed electrical operating areas, as well as in the passenger compartment. It is fully rail-compliant and meets the standards EN 50155, EN 50121-3-2, EN 50124-1, EN 61373, EMV06, EN 45545-2, as well as Regulation No. EMV 06 of the Federal Railway Authority. Thanks to EMV 06, which regulates electromagnetic compatibility in the railway environment, retrofits (retrofit) by operators are possible.

## LUNA System Components Power Supply and Expansion Modules

The LUNA compact power supply modules are functional units with 6 or 11 slots. The first slot is reserved for a bus coupler, while the remaining slots can be equipped with current monitoring modules. The system can be expanded with compact expansion modules (6 or 11 slots for current monitoring modules) to a maximum of 32 current monitoring modules. The expansion modules need to be supplied separately, while internal communication is passed through the L-Bus2.

With the LUNA power supply and expansion modules, LÜTZE TRANSPORTATION has developed rail-compliant compact units that significantly differ from conventional industrial plug-in housings. The LUNA system does not require data bridges or power bridges, simplifying installation considerably. Conventional plug connections often cause transition resistances that can reduce the supply currents. Since the LUNA system does not use these additional plug connections, supply currents of up to 100 A per power supply or expansion module is possible.

## LUNA System Components Current Monitoring and Protection Modules

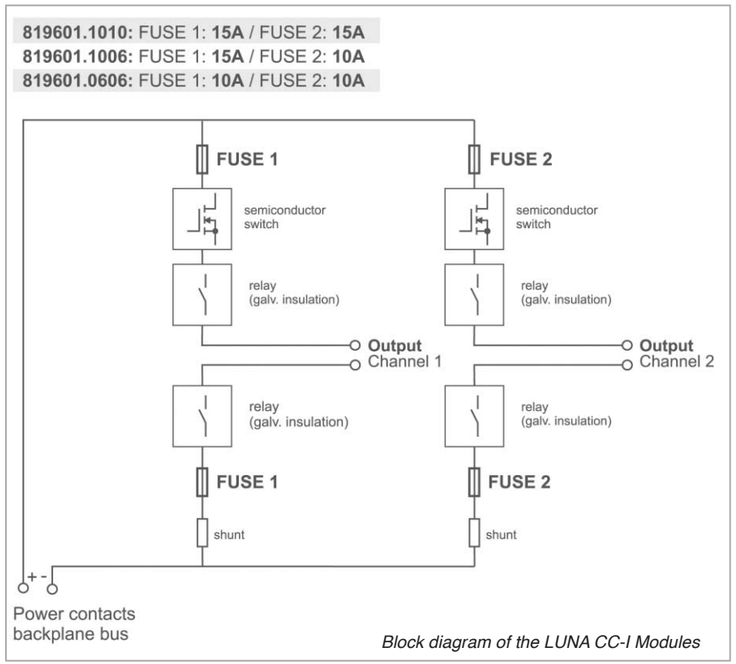
The LUNA protection modules are characterized by their compact width of 22.5 mm, allowing for space-saving installation. Unlike many comparable industrial systems, the modules are designed with two channels. This means that two load monitoring units are built into one housing, which disconnects in a two-pole galvanically isolated manner in case of a fault or overcurrent: First, a transistor interrupts the current flow in the positive path. Then, a relay contact in both the positive and negative branches opens, ensuring a 2-pole, galvanically isolated disconnection.

*The intelligent control system LUNA enables intelligent switching, monitoring, and securing of actuators on trains*

In comparable industrial systems without galvanic isolation, where only a transistor disconnects, leakage currents can occur that continue to flow through the transistor. While these leakage currents are usually very small, they can cause significant problems in fully grounded networks (TN systems) and IT networks (isolated grounding systems). In TN systems, leakage currents can cause residual current devices (RCDs) or circuit breakers (MCBs) to trip even if no dangerous fault current is flowing. In IT systems, small leakage currents could affect insulation monitoring and make fault detection more difficult.

For the protection modules, extremely precise and realistic characteristics have been developed: quick, medium, slow 1, slow 2, and slow 3. These five characteristic curves have been electronically replicated and show significantly fewer tolerances than idealized curves based on magnetic or thermal principles. A disadvantage of the thermal principle is that the disconnection behavior can vary significantly between a cold and a warm circuit breaker. In rail applications, where large temperature fluctuations occur, this is problematic. The electronically replicated characteristics of LÜTZE TRANSPORTATION offer a much more reliable and consistent performance.

# ONE SYSTEM - FOUR FUNCTIONS




*Block diagram of the LUNA CC-I Modules*

**The electronic LUNA load monitoring units are available in three variants:**

- Adjustable current range DC 1 A – 6 A | Channel 1: DC 6 A; Channel 2: DC 6 A
- Adjustable current range DC 1 A – 10 A | Channel 1: DC 10 A; Channel 2: DC 6 A
- Adjustable current range DC 1 A – 10 A | Channel 1: DC 10 A; Channel 2: DC 10 A

All load monitoring modules feature a permanently installed fuse in the positive and negative paths to ensure line protection in case of electronic failure. The 6 A channels are protected with a 10 A fuse, and the 10 A channels are protected with a 15 A fuse. The cross-sections of the connected cables must be designed to match the tripping current of these backup fuses.

**LUNA System Components**
**TRDP Bus Coupler**

The LUNA TRDP bus coupler with a backplane bus L-Bus2 is installed in the first slot of the power supply modules. Up to 32 load monitoring moles (Devices) can be connected. Due to the modular design, connection to other fieldbuses is also possible.

**Application example in a Dual-Mode Locomotive A system with four functions**

The use of LUNA in a modern dual-mode locomotive for freight transport exemplifies the possibilities of the LUNA system. The vehicle combines the characteristics of a mainline locomotive with those of a shunting locomotive, and currently offers three drive variants: overhead line + diesel, overhead line + battery, and battery + diesel. The LUNA system provides four functionalities on the locomotive:

- Protection and intelligent current monitoring
- Continuous current monitoring for "Predictive Maintenance"
- Energy management
- Switching elements for loads

The intelligent current monitoring reports deviations in load currents, disconnects in case of overload according to the chosen characteristic, and can be reactivated via the control system. Conventional fuses are integrated into the positive and negative paths to protect the wiring.

With the permanent current monitoring of the LUNA system, the condition of each connected load can be monitored. Maintenance forecasts can be made as part of "Predictive Maintenance". For example, an increased start-up current or a continuous increase in current in a motor may indicate potential bearing damage. Persistent changes in current and voltage allow conclusions about the condition of an actuator, enabling preventive maintenance to be carried out in a timely manner. This reduces the frequency of total failures and allows for long-term, cost-effective maintenance planning. Through the TRDP connection, monitoring data can also be sent to the vehicle manufacturer's or operator's cloud for more in-depth analysis.

The LUNA system manages the energy of the DC 24 V onboard network of the dual-mode locomotive. In critical voltage states, a shutdown profile with various levels and priorities can be implemented. Loads with comfort functions can be switched off first, while safety-related functions remain operational.

LUNA also acts as a digital output module to remotely switch loads on and off. Electronic fuses control various loads such as signal and driver's cab lighting, step and gangway lighting, and window heating. This allows a combination of electronic protection and switching elements, eliminating the need for relays or semiconductor switches.

## B A C K G R O U N D

### Background TRDP vs. MVB

**LÜTZE TRANSPORTATION currently uses TRDP (Train Real-time Data Protocol) for LUNA because it can transmit a significantly larger amount of diagnostic data compared to MVB (Multifunction Vehicle Bus). Additionally, the number of addressable participants is limited with MVB. The central advantages of TRDP Ethernet over MVB are:**

### Examples:

- **Data Transfer Rate and Bandwidth:** TRDP Ethernet offers higher data transfer rates and greater bandwidths from 100 Mbps to several Gbps, compared to MVB Ethernet, which typically provides up to 1.5 Mbps
- **Flexibility and Scalability:** The MVB fieldbus is less flexible and scalable than TRDP. TRDP-based networks are easily expandable and support a large number of devices and communication nodes.
- **Network Topology:** TRDP Ethernet supports various network topologies such as star, tree, and ring, allowing for more flexible network configurations than MVB, which is limited to a bus topology.
- **Fault Tolerance and Reliability:** TRDP Ethernet offers advanced mechanisms for error detection and correction compared to MVB, which increases reliability.

# RETROFIT: HIGH-SPEED ETHERNET


*The Train Line Modems TLM-X and TLM-20 from LÜTZE TRANSPORTATION enable Gigabit Ethernet over existing routes across the entire train via the coupling.*

**Rail technology specialist LÜTZE Transportation introduces the new Train Line Modems TLM-X and TLM-20, powerful solutions for transmitting Gigabit Ethernet over existing routes with speeds up to 2 Gbit/s. Both modems enable data transmission both within the vehicle and across vehicle couplings over distances of up to 300 meters.**

The TLM-X uses a robust transmission method that is ideal for retrofit projects with older, partially unshielded wiring. It particularly demonstrates its strength in environments with high electromagnetic interference, and at contact and coupling transitions prone to disturbances. Under these conditions, the TLM-X often enables a stable high-speed Ethernet connection with speeds of up to 950 Mbps between train sections, which is especially advantageous for time-critical applications. The TLM-20, on the other hand, relies on a transmission method that can fully exploit its advantages in technically superior infrastructure, allowing bandwidths of up to 2 Gbps. Both Train Line Modems support the use of video technology, infotainment, operator terminals, passenger counting systems, LCD/TFT displays, WLAN modules, GPS, and mobile applications, as well as the reservation system on an Ethernet network basis. Both modems will soon also be available in variants with Power over Ethernet (PoE), eliminating the need for a separate power supply.

The two Train Line Modems use existing lines for communication and modulate and demodulate their signals there. The TLMs act like a cable and ensure a transparent connection for all participants, keeping data traffic undisturbed, which simplifies the retrofitting of Ethernet in existing vehicles. After network discovery, the modems establish 128-bit AES-encrypted communication between all devices. To ensure optimal data throughput, the modems continuously monitor the bandwidth using a Digital Signal Processor (DSP). The TLMs are configured via the TLM Config Tool, which offers comprehensive features for management, diagnostics, and updating the modems, including network settings, management of seeds for parallel networks, configuring the heartbeat, and saving and loading personal configurations.

The TLMs feature a wide-range input voltage of 24 V to 110 V DC suitable for worldwide use in all rail networks, both diesel and electric vehicles. Both models are fully rail-compatible and meet the relevant standards for vibration and shock loads, electromagnetic compatibility (EMC), and fire protection according to EN 50155, EN 50121-3-2, EN 50124-1, and EN 61373. Continuous operation is guaranteed in a temperature range from -40 °C to +70 °C.

Typical applications of the Train Line Modems include direct data transmission over the vehicle coupling or within a vehicle, especially in long vehicle configurations. TLMs can also be used as a redundant system across the coupling to ensure faster and more reliable data transmission. By using additional redundant TLM pairs in the train, availability can be increased and safety-critical applications can also be transmitted.

**The new LÜTZE TRANSPORTATION LINKEDIN channel – follow us for the latest information!**

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# TRDP makes Audio Signal Devices Intelligent

Authors: Daniel Herbst and Andreas Schindler and Yima Zimmermann, Product Managers at Lütze Transportation GmbH, Weinstadt


*Intercom in a rail vehicle (Image: iStockphoto)*

The universal audio signal device TRDP-AST for TRDP networks (Train Real-time Data Protocol) enables manufacturers and operators to perform configurations via a web server almost in real-time. For the first time, the device supports the remote uploading of up to 256 MP3 or WAV files with a maximum total playtime of up to 15 MB.

Audio signals in rail vehicles fulfill functions that are both safety-related and comfort-enhancing. For passengers, acoustic signals such as warning signals when doors are closing and automated station announcements are indispensable. Audio technology from LÜTZE Transportation GmbH supports accessibility with multilingual announcements in disabled-accessible toilets and acoustic cues for the blind when opening and closing doors. In the cab, LÜTZE signal devices enable the reliable implementation of acoustic warnings for safety-critical systems such as PZB (Point Train Control), SIFA (Safety Driving Switch), and fire alarms. Similarly, emergency communication between the train driver and train crew can be supported by automated announcements. In addition to safety-related applications, comfort functions can also be integrated, such as in the City Airport Train (CAT) Vienna. There, in the washrooms enhanced with Viennese highlights, music classics like Le Nozze di Figaro by Mozart, Wiener Blut by Johann Strauss, or the famous zither sounds from Anton Karas' The Third Man are played through audio signal devices by LÜTZE TRANSPORTATION.

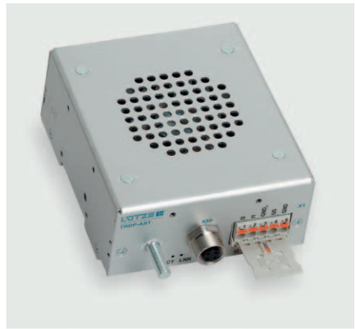
**Global Signaling in Use**

LÜTZE TRANSPORTATION has been one of the leading global providers of audio signaling and audio accessories for rail vehicles, suited for special purposes, for many years. In addition to piezo signal devices and digital signal generators, digital audio signal devices and audio signal devices with TRDP are also available.

The piezo signal devices (buzzers) are characterized by their high efficiency and low power consumption, and are used to transmit warning signals and acoustic alarm signals. These devices are based on proven piezoelectric technology and can reproduce tones at various volumes and frequencies, with the frequency of each tone individually adjustable. It should be noted that the simultaneous output of multiple warning tones requires the installation of a corresponding number of devices.

The digital signal generators from LÜTZE TRANSPORTATION are specially designed for use in public transportation in outdoor areas, such as on suburban trains. They feature digital high-power amplifiers with an output of up to 200 W, enabling warning signals with very high sound pressure levels. The activation of the signals is carried out via 12 or 15 opto-isolated control inputs.

The microprocessor-controlled audio signal devices from LÜTZE TRANSPORTATION offer the possibility to play up to 63 audio files at six digital inputs, including realistic warnings and information in the form of speech, melodies, and signals. LÜTZE TRANSPORTATION also offers support for voice recording in a professional sound studio as a service to optimally



*LÜTZE TRANSPORTATION Universal Audio Signal Device TRDP-AST*

# AUDIO SIGNAL DEVICES SPEAK TRDP

adjust the desired sounds and signals. The specific signals and configurations are stored on the signal device either directly via a PC or with the LÜTZE Handheld Programmer using the specially developed LÜTZE AudioConfig Tool software. After installation in the vehicle, the stored configuration can only be changed with an update of the configuration software and uploading to the ASG. Access to the device is necessary.

**LÜTZE Signal Devices now also speak TRDP**

With the TRDP-AST (Audio Signal Transducer), a change in configuration and the uploading of new sound files are possible at any time without dismantling the device. Thanks to Ethernet integration and TRDP, the signal device can be remotely controlled almost in real-time, significantly simplifying the updating and changing of sound files. For example, a vehicle could be switched from a French to an English language set in just a few minutes.

The programming of the new signal device can be done via the central computer and a user-friendly web interface. Complicated programming with special hardware and software is not required. In addition to warning tones and acoustic signals, voice recordings or music pieces in the passenger area or cab can be individually configured.

Through the web interface, all sound files can be uploaded and assigned a unique ID. Optionally, a comment can be added


*User-friendly web interface for setting diagnostics and configuration*


*Under the section "Audio Configuration," users have the option to individually adjust the uploaded audio files*

to each sound file. The TRDP signal device also enables the programming of complex queues, allowing certain sequences of tones to be played. Sound files can be played once or repeatedly and also interrupted. The playback can be individually delayed, and a specific volume can be set for each sound file.

**Integrated Onboard Intelligence**

The audio signal device is fully integrated into the TRDP (Train Real-time Data Protocol) with real-time exchange of status information, diagnostic messages, passenger information, and control commands between all devices and the central computer of a rail vehicle.

The TRDP-AST is thus able to respond to signals from devices connected to the network and, for example, play certain tone sequences when requested by the central computer. As a result, the audio signal device from LÜTZE TRANSPORTATION is very flexible in its use.

All TRDP-capable devices in the network of a rail vehicle can thus issue signals and information in real-time via the TRDP audio signal device. The delay-free signal transmission ensures that important signals, such as SIFA messages, are passed on to the vehicle driver without time loss. Additionally, the audio signal device reports back to the central computer whether the signal was successfully played in the cab. The diagnosis in the form of feedback and associated protocol data can be read out. This is a significant advantage of the TRDP-AST audio signal device from LÜTZE TRANSPORTATION, and is not possible with conventional models that have digital inputs. In these older models, only a status feedback on the operating condition of the device is provided.

If multiple TRDP audio signal devices are installed in a rail vehicle, they can be grouped together via the web configuration and controlled collectively. For example, when all doors on one side of a car are opened simultaneously. The signal device is designed for an extended working temperature range from -40 °C to +70 °C and meets rail-relevant standards EN 50155, EN 50121-3-2, EN 50124-1, EN 50657, EN 61373, and the fire protection standard EN 45545-2. It also meets the EMC standard 06 of the Federal Railway Authority, allowing smooth retrofitting in existing systems. for a uniform sound output can be addressed together, without needing to address each signal device individually.

The audio signal device can be easily integrated into Ethernet networks by connecting it via an RJ45 plug to TRDP. Additional wiring is not required, simplifying installation. In addition to the primary control via TRDP, the signal device offers two configurable digital inputs as a safe fallback solution. In case of a network failure, alternative signals, such as for emergency situations, can be activated via these inputs.
The integrated broadband loudspeaker produces a sound pressure level of up to 103 dB at 2.5 kHz at a distance of one meter, providing clear and penetrating acoustic signaling. Equipped with a wide-range power supply (24 to 110 V), the audio signal device is usable worldwide on rail vehicles.

The audio signal device, with dimensions of 92.0 mm x 135.1 mm x 48.5 mm, is suitable for mounting on DIN rails or on the rear panel, enabling flexible integration into various switch cabinets and applications.

**Outlook**

Currently, the engineers at LÜTZE TRANSPORTATION are developing an advanced version of the TRDP-AST with Power over Ethernet (PoE). By utilizing PoE, the device is directly powered via the Ethernet cable, significantly reducing wiring effort and saving both time and cost. The need for a separate power supply is eliminated, allowing PoE-capable devices to be operated at installation locations without an extra power line.

# Neat Dispensing

Author: Andreas Schindler, Product Manager Interface, Lütze Transportation GmbH

**Washing your hands without a hitch requires perfectly coordinated, functioning com-ponents. LÜTZE is on board to assist you.**

With the Mireo, Siemens Mobility has introduced a first-class platform solution. The concept impresses with its many features, providing operators with a high degree of added value. LÜTZE contributes a significant to the Mireo Lausitz trains, with three components installed by the supplier RCS (Rail Components and Systems).

RCS works for various train manufacturers, it manufactures driver cabs, front masks and interior panels, along with aspects of the train. They develop the corresponding electronic and electrical systems including complete sanitary modules. The practical example involves automatic dispensers for soap and hand sanitizer.

A 12VDC dispensing pump is controlled via a timer relay and a DC-DC convertor to deliver the correct amount of soap or hand sanitizer required. A compact and rail-compatible product with lower power consumption and TS35 Din rail mounting was required, since only a low load dispensing pump is connected. "We chose LÜTZE Transportation timer relays because we were looking for a flexible and programmable solution," reports Mathias Wacke, Product Manager for cab control panels and lavatories at RCS. At the beginning of the project, the ideal output times were not yet exactly known, which is why they had to be variable. "This was also the case because different rail companies might use substances of varying viscosity," explains Mathias Wacke. "The oper-ator can then run an update of the parameter set by themselves via free software and a programming cable." RCS developed the system together with its customer, Siemens Mobility. It first went into operation in the Mireo network of Lausitz, which is operated by DB Regio AG.

The retroactive integration of relays and converters in an existing platform is similar to a modernization project. "Therefore, testing according to EMC 06 was required, which LÜTZE Transportation obtained. We have had a long-standing partnership in general," says Wacke. RCS already installs LÜTZE DC/DC converters in driver control panels or their USB charg-ing stations, and sound generators in its own projects.

A standalone solution was required by Siemens; otherwise, the Toilet Control Unit would no longer be useable as a common part across multiple projects. The different rail operators want either manual or automatic dispensers, with or without dryers. And the toilet control should remain unaffected by this.

RCS decided on the programmable time relays because they wanted to bypass a compact con-troller. Firstly, because these three components are more affordable than rail-compatible compact controllers. The issue of software effort also played a role.


SIEMENS Mobility Mireo regional train, Lausitz network (Image: Siemens AG, Munich/Berlin)



*Automatic dispenser for soap and hand sanitizer controlled by time relay (Image: RCS)*

# We are on Track!

## Electronic control for rail vehicles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