Light Rail Vehicles

REALIZING SYSTEM SYNERGIES
Light rail vehicles can be an attractive option when existing local transport systems have reached their limits. They can have diverse capacities and individual performance characteristics and can act as important feeders for the metro system. Major Asian cities in particular are showing an increasing interest in this type of transport, which is relatively new to their part of the world. When road traffic has ground to a halt, agile LRVs can glide quietly past the automobiles with minimum environmental impact. However their sheer complexity can be a challenge, even for experienced vehicle builders. As a competent and reliable partner, Knorr-Bremse can help with their development and production – and of course maintain them as well.
THE PERFECT COMBINATION OF HIGH-QUALITY SYSTEMS AND SERVICES

**KNORR-BREMSE**
Knorr-Bremse is the world’s leading manufacturer of braking systems for rail vehicles. The product portfolio also includes intelligent entrance systems, HVAC systems, auxiliary power supply systems, control components and windscreen wiper systems, platform screen doors, friction material, driver assistance systems, and control technology. As a technology leader through its products the company has been making a decisive contribution to greater efficiency, cost effectiveness and safety in the international rail business.

**IFE**
IFE is the leading manufacturer worldwide of automatic entrance systems for rail vehicles. The guiding principle “Success through Quality and Innovation” has marked the company’s development for more than 60 years. Today, external and internal doors, door control units and access devices are among the range of solutions offered. With the experience of an unparalleled 50,000,000 entrance systems delivered in the company’s history IFE continues to shape the industry.

**MERAH**
Our mission is to be the most respected partner for rail climate control solutions, through shared values, engineering experience, and global presence. Close customer cooperation, continuous improvement, and innovation have made Knorr-Bremse a world leader for heating, ventilation, and air conditioning (HVAC) systems, with >70,000 units in successful daily service.

**MICROELETTRICA SCIENTIFICA**
Microelettrica Scientifica, based in Italy, has been developing and producing power switches, transducers and resistors dedicated to the most advanced applications of the rail vehicle industry and industrial applications for more than six decades. The company’s high product quality results from continuous research, realized in close cooperation with its customers in order to precisely and punctually meet their needs.

**POWERTECH**
Knorr-Bremse PowerTech is a specialist in advanced power supply systems for all types of rail vehicle. The brand’s mission is to ensure their availability and to use them as effectively as possible. Whether in rail vehicles, in industry or in research and development, its power supply systems operate efficiently and reliably and ensure that optimum use is made of energy.

**SELECTRON**
State-of-the-art rail vehicles can only be realized with advanced control technology. For many years, Selectron Systems AG has been successfully developing such solutions for the automation, networking, and control of rail vehicles. As Selectron is able to utilize the worldwide Knorr-Bremse sales and service network it can provide its customers with even better support at international level.
BRAKE SYSTEMS

More than 110 years of experience have made Knorr-Bremse the world’s leading manufacturer of rail vehicle braking systems. The company’s skills are evident not just in the individual components it manufactures but also in their perfect interaction – the key to a braking system that meets the highest standards of functionality, reliability and safety. Building on both proven and innovative technologies, Knorr-Bremse works closely with customers to develop project-specific solutions from a single source with a carefully designed combination of electronic, pneumatic, mechanical and hydraulic components. A single, direct interface ensures cost-effective and resource-efficient integration into the overall vehicle system.

CUTTING-EDGE TECHNOLOGIES

HYDRAULICS I HYDRAULIC UNIT HGES
- Best power density due to optimized design for brushless DC application
- Combination of various additional functions possible (security brake, auxiliary release circuit)
- Customized interfaces
- Ideal for stopping/holding brakes and brakes with wheel slide protection
- Smallest measurement: 148 mm height

HYDRAULICS I HYDRAULIC BRAKE CALIPER HS1A30
- Compact and designed for limited installation space
- Further improved force density
- Wide temperature range for application area
- Low maintenance necessary

SYSTEMS SOLUTIONS – BENEFITS FOR THE CUSTOMER
The more closely braking systems are networked with other rail vehicle sub-systems, the greater the benefit for the operator, as this reduces overall complexity by avoiding redundant infrastructure. For example the braking system’s vehicle weight sensors can be used by the HVAC system to adjust output when passenger density drops.
PRODUCTS FOR ALL STANDARDS

Knorr-Bremse is the partner of choice for streetcar applications – with systems based on more than 110 years of development, production and practical field experience. With innovative solutions tailored to local standards and conditions and individual operating scenarios. And with a worldwide production and service network that meets even the strictest requirements for local content.

WORLDWIDE COMPETENCE IN LIGHT RAIL VEHICLE APPLICATIONS
**BRAKE SYSTEMS**

**PRODUCT RANGE**

**ELECTRONIC BRAKE CONTROL UNIT**
- Modular and flexible design with standard board configuration
- Functionality for wheel slide protection and load correction integrated
- Ethernet connection possible

**HYDRAULIC CONTROL MODULE**
- Simplified diagnostics and functionality including step control
- Simplified hardware interface including LED visual status display
- Software installation, diagnostic and maintenance via a standardized interface

**HYDRAULIC UNIT HGES**
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**AUXILIARY RELEASE UNIT**
- Electrical activation of release pressure
- Various installation options
- Small and compact design

**HYDRAULIC BRAKE CALIPER**
Knorr-Bremse brake caliper units are ideally suited for tram platforms, especially the low-floor segment, where installation space is at a premium. These high-performance modules can be installed even in the most confined spaces and operate with low maintenance requirements. The universally installable basic units can be easily modified to take special interfaces.

**HYDRAULIC BRAKE CALIPER HSC1P10N**
- Low lifecycle costs
- Optimized material use
- Enhanced maintainability
- Improved safety
- Increased energy efficiency
- Reduced emissions

**SANDING SYSTEMS**
- Modular design delivers a wide range of systems
- Optimal performance with low weight and installation space
- Low life-cycle costs

**WINDSCREEN WIPER AND WASH SYSTEMS**
- High system availability
- Plug and play system
- Low life-cycle costs
iCOM
iCOM transfers the mobile device philosophy to the railway industry:
- Condition Based Maintenance (iCOM Monitor)
- Driver Advisory System (iCOM Assist)
- Energy Metering (iCOM Meter)
- One common back office
- Addition of functions via apps
- Open system platform and architecture

HYDRAULIC UNIT HGK
- DC, brushless DC or AC motor
- Smallest dimension: 100 mm
- Installation options: horizontal or vertical

HYDRAULIC UNIT HGF
- For pressure- or spring-actuated brake calipers
- Option for security brake
- Integrated hydraulic levelling control

MAGNETIC TRACK BRAKE
- Modular standardized solutions
- Robust and proven design
- Wear-optimized pole shoes available

AXLE-MOUNTED BRAKE DISC
- Standardized interface and mounting on wheel
- Resistant against thermal cracks due to movable friction disc
- Robust design with high protection against external shock and vibration

OIL-FREE COMPRESSOR 2.0
- No oil exchange, no disposal of used oil, no contaminated condensate to collect
- Specially optimized design to minimize noise and vibrations
- Cold starts without preheating, down to -50 °C

SUSPENSION LEG
- Part of hydro-pneumatic suspension and levelling system
- Vertical and lateral suspension functionality
- Installation space corresponding to steel springs
ENTRANCE SYSTEMS

41,000,000 safe opening and closing cycles daily with IFE products around the world: Safe and reliable opening for LRVs, metros and monorails requires highly dependable entrance systems. Matching the steadily increasing requirements regarding safety, passenger comfort and uninterrupted availability for persons with reduced mobility is a technical challenge for rolling stock manufacturers, system suppliers and train operators.

As a leading manufacturer of LRV, metro and monorail entrance systems we offer the full range of suitable products: from sliding plug doors and sliding doors with opening widths between 650 and 2,000 mm and a choice of all glass, aluminum sandwich or stainless steel door leaf options, up to boarding aids such as sliding steps, ramps and gap-bridging devices. Further development is not only driven by technical and functional excellence but also by long-term economic considerations. Our products are characterized by a particularly low-maintenance and easy-to-install design featuring the lowest life cycle costs.

IFE is globally renowned as a reliable partner for the supply of entrance systems. The range of offered services, however, goes far beyond this area and furthermore includes installation, commissioning as well as maintenance over the whole product life of our entrance systems, including spare parts management.

CUTTING-EDGE TECHNOLOGIES

RLS ENTRANCE SYSTEM
The RLS entrance system is one of the top selling systems worldwide. It is characterized by reliable operation even under the worst climatic conditions – the system has been successfully implemented in the far north at extreme sub-zero temperatures as well as in desert areas with enormous heat and sand. Thanks to the modular design of the system, we are able to cover the worldwide demand for trams and metros with standardized modules.

The IFE RLS door drive design is straightforward and simple. It needs no more than one linear guiding system for the swiveling and sliding movements of both door leaves. This drive – which needs no rotary columns – is mainly used for low train speeds and reduced loads but with frequent opening and closing cycles.

ADVANTAGES
■ Flexible: Integration in all types of vehicles with only a small protrusion outside of the portal
■ Robust: Durable ball bushing guide allowing for a high number of cycles
■ Low maintenance: Use of a lubrication-free spindle drive and encapsulated recirculating ball bushings
■ Single-leaf and double-leaf versions
■ Straightforward and simple design
■ Needs no more than one linear guiding system for the swiveling and sliding movements of both door leaves

SYSTEMS SOLUTIONS – BENEFITS FOR THE CUSTOMER
The more closely entrance systems are networked with other rail vehicle sub-systems, the greater the benefit for the vehicle builder, as a well-designed solution can enable data from adjoining systems to be used. For example sub-systems can share information on the train’s speed to ensure that the doors only open once the train has come to a complete standstill in a station.
PRODUCT RANGE

E4 DOOR DRIVE
(within the door portal),
DOUBLE-LEAF
- Increased safety thanks to four over dead center locks
- Active floor-level locking device fitting in the installation space of a rotary column
- Adjustment-free design
- Rugged guiding system
- Maintenance-free door drive

RLS DOOR DRIVE
(outside the door portal),
SINGLE- AND DOUBLE-LEAF
- Linear and encapsulated guiding system for swiveling and sliding
- Lubrication-free spindle drive
- Modular design
- Suitable for frequent opening and closing cycles
- Decades of field experience ensures high reliability

S3 DOOR DRIVE
(outside the door portal),
SINGLE- AND DOUBLE-LEAF
- Central drive unit → optimized accessibility
- Robust and dirt-resistant guiding system
- Low system weight
- Adjustment-free design
- Lubrication-free spindle drive
- Direct, individual cut-out of each door leaf, independent of the spindle drive

X4 SLIDING STEP
- Reduced installation height of 50 mm
- Jamming-free 3-point guiding system
- Tolerant to torsion of the vehicle
- Maintenance- and adjustment-free locking module
- Rugged design, not affected by dirt, corrosion or by ice and snow

RAMP
- Secure access to the vehicle for wheelchair users, even with high level difference between vehicle and platform
- Delivered as a narrow, pre-mounted cassette
- Requires only minimal installation space at low altitude
- Versions (allowed distance, slope, etc.) can be adapted to the conditions of the customer infrastructure

GAP FILLER
- Reduction of the distance between the vehicle and the platform edge
- Easier access for people with reduced mobility
- Less installation space
- Easy design
- High reliability
HEATING, VENTILATION AND AIR-CONDITIONING

Passengers expect the rail sector to steadily improve levels of comfort. Noise and vibration are increasingly regarded as sources of irritation, and a properly air-conditioned interior is taken for granted. Merak HVAC systems ensure the right level of comfort for all passengers, whether they are commuters on urban metro trains operating in tropical conditions, or long-distance travellers in the arctic winter. Project-specific application of service-proven technologies means that systems can be flexibly configured for all rail vehicle types and operating environments, and always deliver the right performance with low weight, noise, and energy consumption. Available as roof-mounted, floor-level, or under-floor units, for driver’s cabs or passenger cars, for newly-built vehicles or modernizations, Merak HVAC systems are in operation in all parts of the world – with local teams ensuring seamless service, every day.

CUTTING-EDGE TECHNOLOGIES

ADAPTIVE LIGHT RAIL SALOON HVAC SYSTEM
- Roof-mounted
- Very compact and low weight with an excellent ratio of size vs. cooling capacity (45 kW in 500 kg)
- Adaptive temperature control
- Fresh air input control according to occupation and exterior conditions
PRODUCT RANGE

LIGHT RAIL HVAC UNIT
Saloon
- Roof-mounted HVAC system with 1 or 2 cooling circuits
- Control panel mounted inside or outside the unit
- Variable fresh air input and capacity control
- Compact and low-weight

Cabin
- Roof-mounted HVAC system with 1 cooling circuit
- Control panel mounted inside the unit
- Compact and low-weight

SYSTEMS SOLUTIONS – BENEFITS FOR THE CUSTOMER
The more closely an HVAC system is networked with other rail vehicle sub-systems, the greater the benefit for the vehicle builder and operator, as this enables to respond intelligently to the other systems’ current operating status. For example the HVAC unit can be immediately shut down if a fire alarm is triggered, instead of continuing to blow air into the vehicle.
POWER SUPPLY

As the number of different energy consumers on rail vehicles increases in line with growing comfort and safety expectations, the power supply system is assuming an increasingly central role. The PowerTech brand brings together Knorr-Bremse’s full range of expertise in power converters and electrical equipment for rail vehicles, power generation and storage, engine and transmission test benches and research applications. From tailor-made control and regulation solutions to real and simulated test runs, we cover today’s professional energy conversion requirements for all performance categories and train types – including a service network on every continent.
PRODUCT RANGE

AUXILIARY POWER SUPPLY
- Auxiliary power supply for supplying an AC grid in a rail vehicle with integrated battery charger
- Communication with the train via IP, CAN Open or MVB
- Parallel connection of DC outputs possible with the optional DC-decoupling
- Lightweight and compact design thanks to medium-frequency electrical isolation
- Easy maintenance due to modular design
- Low noise thanks to continuously speed-controlled fan

HVAC INVERTER
- Inverter for HVAC compressor supply
- Compact design
- Optimized mechanical concept
- Cooled by natural convection
- VVVF operation for motor management

SYSTEMS SOLUTIONS – BENEFITS FOR THE CUSTOMER
The more closely power supply systems are networked with other rail vehicle sub-systems, the greater the benefit for the vehicle operator. For example a smart air supply unit could adjust compressor performance when the train enters a station, thereby reducing noise emissions.
Resistors enable safe, controlled braking to take place, contactors connect and disconnect circuits under load, and disconnectors change the configuration of the traction circuit when the catenary voltage changes. High-voltage metering transducers provide reliable data for the vehicle logic, drive control and many other measuring devices. Systems like these are often invisible to the outside world but are essential for the proper functioning of a modern vehicle. And however diverse their tasks, such control components have one thing in common: There can be no compromises in terms of safety. Microelettrica Scientifica’s cutting-edge solutions have met this requirement for more than 50 years, and today the company is a global market leader in electrical and electromechanical control components for rail applications.

**CUTTING-EDGE TECHNOLOGIES**

**LPRC1000 LINE AND PRE-CHARGING CONTACTOR UNIT**
- Single unit including a line contactor, a pre-charging contactor and a pre-charging resistor
- Rated voltage up to 2000 V DC
- Electrical connections between the contactors and the resistors are implemented
- Easy installation, wiring and maintenance
- Type and routine tests are made on the unit (and not only on the single components)

**LTHS320HF MOTOR PROTECTION CONTACTOR**
- Three-phase contactor, with voltage rating up to 2 kV
- Intended to separate permanent magnet motors from inverters during short circuits
- Capability of interrupting currents at high frequency, up to 300 Hz
- Compact design and high breaking capacity

**SYSTEMS SOLUTIONS – BENEFITS FOR THE CUSTOMER**
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PRODUCT RANGE

LINE CONTACTORS
- Compact design for easy installation within traction converters
- Widest range on the market, consisting of standard units and customized versions
- Availability of energy-saving devices on the control coil

PRE-CHARGE RESISTOR
- AC/DC pre-charge contactor
- Pre-charge resistor, with customizable resistance level, 1 to 100 ohm
- Compact design
- Integrated solutions of various contactors and resistors assembled on a common baseplate and wired, for saving time during installation

AUXILIARY-CONVERTER OUTPUT CONTACTOR
- 3-phase contactor range for 400 V, 50 Hz power supply
- High breaking capacity
- Compact design

BATTERY SWITCH
- 2 poles
- 2 stable positions, for saving energy when closed
- Suitable for low voltages, but high currents
- Compact design

HEATING CONTACTORS
- Electromechanical or solid-state contactors available
- Conceived for high switching frequency
- High performance in a very compact design

TRACTION CONVERTER COOLING FAN
- Centrifugal, centrazial or axial design
- Very wide range of fans, with flexible design
- High resistance to corrosion

BRAKING RESISTOR
- Installation on-board the train or within the ground-based power supply switchgear
- Naturally or ventilator-cooled
- Custom-designed resistance value and cooling pattern
- Custom-designed interfaces

CITYMETER
- Energy metering solution tuned for urban transport
- Aimed at analyzing the energy consumption of a fleet and defining strategies to reduce it
- Made of an on-board transducer, a ground-based receiver and a software for data analysis
Modern rail vehicles are highly complex systems incorporating braking, door and HVAC systems as well as traction, lighting and power supply components. They also carry a wide range of display units for vehicle diagnostics, passenger information and safety alerts. The train control management system (TCMS) links all these functions into a single, intelligent system that offers maximum precision, safety and reliability. This is where Selectron Systems AG comes in – the market leader in rail vehicle control technology and automation. Selectron’s comprehensive product portfolio includes freely programmable control units, central and distributed remote I/O systems and train setup components. At the heart of the systems is an EN 50155-compliant family of control systems.

The more closely a rail vehicle’s sub-systems are networked with each other, the greater the benefit for the vehicle builder and operator. For example, cross-system diagnostics can make individual service tools superfluous. Cutting-edge control technology from Selectron Systems AG provides the perfect basis for this.
CUTTING-EDGE TECHNOLOGIES

SMARTIO
The smart remote I/O system (“Smartio”) simplifies the complexity of the wiring in the body of the vehicle, in the cabinet, and in the driver’s desk allowing a lean design, savings on installation and service time, and is extremely space-saving and easy to install. It can be flexibly expanded for all applications and is, therefore, a “just enough” solution.

PRODUCT RANGE

ROUTER/SWITCH
The new switches and routers provide flexible network architectures and meet the new TCN standard IEC 61375. Configuration of individual devices within the network is carried out across the trains from one data access point. Application development, commissioning, and service are simplified.

MAS 835
The MAS 83x family of controllers has been generically designed and can be used, for example, as a safe vehicle control unit or as a safe monitoring unit. The processing unit has high performance, is flexibly expandable, and easy to program. Variations from SIL0 up to SIL2 are available. The generic certificate for safe applications simplifies vehicle registration.

HMI
The HMI portfolio includes display sizes from 8.4” up to 12.1”. The units are available as both SIL0 and SIL2 versions. The high processing power allows, among other things, multichannel video streaming over Ethernet; the display is particularly bright. The simple and intuitive graphical programming interface reduces development and commissioning times.
A reliable service partner – over the entire life cycle. All train operators are unique – and their servicing requirements for braking and on-board systems are also highly specific. But they have one thing in common: They depend on their vehicles remaining operational at all times and in all places. The mission of our RailServices brand is to ensure that this happens – for all Knorr-Bremse subsystems and over the vehicle’s entire life cycle.

The extended RailServices portfolio includes comprehensive service and support for all our products and systems, including vehicle maintenance.

- Worldwide Service Center close to the customer
- Highest quality of maintenance via standardized production system
- RailServices standards for services and maintenance for on-train and off-train operations
- Field service and training
- Innovative component upgrades and systems modernization for existing fleets
- Service life extended and its life-cycle costs reduced
- Maintenance of rail vehicles ranging from commissioning to overhaul as well as light maintenance and repair campaigns.
- Original quality parts over the entire life cycle
- Parts management
- Supply chain premium services
- iCOM serving as a platform for applications that require a connection to the wayside to enable digital solutions
- Upgrade of trains with Knorr-Bremse components from the one source
Products and services creating genuine added value in line with ongoing changes in the rail sector – RailServices is further developing its range of services.

**Service Centers – always close to the customer**
Excellent service calls for rapid reaction times. With 30 service centers in all continents, our RailServices specialists are close at hand when local customers need them. The first European Rail Services sites already fulfill the requirements of European Regulation (EU) no. 445/2011 for freight wagons.

**Modernization – customer-specific solutions breathe new life into existing vehicles**
RailServices provides innovative component upgrades and systems modernization for existing fleets. We offer attractive system solutions worldwide for rail vehicles of all ages. Modernization is delivered by RailServices specialists with expertise and above all, passion. It is our ongoing commitment to your operational needs and to continued product innovation that makes modernization projects a realistic and affordable option for our customers.

**iCOM – digitalization on board**
iCOM ushers in a new era in vehicle servicing: This retrofittable system extends rail vehicle diagnostics to cover not just specific systems but whole vehicles. By introducing tablets, smartphones and apps to the railroad sector, it offers unique access to data on the condition of the entire vehicle fleet. Sophisticated measurement and analysis processes combine with automatic diagnostics to enable iCOM to predict maintenance requirements in advance – allowing operators to take measures pro-actively. This powerful and flexible system already supports additional applications such as driver advisory systems and energy metering as well as third-party products due to the open architecture.