REALIZING SYSTEM SYNERGIES
Metros provide the backbone for local public transport systems in cities and major urban conglomerations. Without their ability to transport millions of passengers on a daily basis, traffic gridlock would be virtually inevitable. And as urban centers continue to grow, so too does the need for attractive metro networks. There is increasing demand for lightweight, compact technologies offering enhanced economy, safety and comfort, and Knorr-Bremse sub-systems are global market leaders in this respect. But it is the company’s cross-system approach that offers that crucial extra element of efficiency – enabling manufacturers to deliver their vehicles on time and operators to run them economically throughout their entire operating life.
**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.

**MERAK**
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

BRAKE CONTROL | DISTRIBUTED BRAKE CONTROL EP2002

Growing passenger numbers on metro networks call for greater availability of trains and shorter headway – which puts greater demands on brake reaction times and tolerance to failure of the brake system. The intelligent distributed brake control system EP2002, which combines mechatronic and electronic elements in a single, extremely compact system, is the outstanding answer to these challenges. The latest development – EP2002® Cube – allows optimized integration of a wide range of additional functions in a single cube-shaped unit with integrated piping.

BOGIE EQUIPMENT | ALUMINUM DISC

The aluminum brake discs weigh half as much as conventional cast-iron ones, saving over 400 kilograms per individual car. Although the aluminum discs cost more, the investment pays off within a few years.

The energy savings due to reduced weight are particularly significant in the case of a metro, which is constantly braking and accelerating. And there is a double benefit, as the discs are mounted directly on the axle and therefore also cost energy through the rotational acceleration required. Cast aluminum discs also last three times as long as conventional ones and do not heat up as much when the brakes are applied. What’s more, the brake pads also wear more slowly, reducing the environmental impact of the dust generated.

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 information can be used by the HVAC system to adjust output to the number of passengers.
PRODUCTS FOR ALL STANDARDS
Knorr-Bremse is the partner of choice for metro 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 METRO APPLICATIONS
BRAKE SYSTEMS

PRODUCT RANGE

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

SCREW COMPRESSOR
- Special design, to cope with tough railway operation conditions
- Low noise level
- Low vibration

EP2002* CUBE
- Distributed control
- Compact design

EP COMPACT LITE
- Central control
- Compact design
- Modular and suitable to various customer requirements
- Optional electronics underfloor

WHEEL- AND AXLE-MOUNTED BRAKE DISCS
- Standardized interface and mounting
- Resistant against thermal cracks due to movable friction disc
- Robust design with high protection against external shock and vibration
- Aluminum friction rings

COMPACT BRAKE CALIPER
- Only one interface to bogie
- Highly modular design
- Optimized design regarding weight, assembly and costs
- Reduced maintenance

WINDSCREEN WIPER AND WASH SYSTEMS
- Customized systems for every vehicle type
- Wide variety of functionalities and options
- High system availability
- Long-life components

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

Bogie Equipment
- Brake Control
- Brake Systems
- Auxiliaries

Air Supply
CAPSULED UNITS
- Compact, light, reliable
- Developed especially to deliver very low noise levels
- All components to be maintained can be accessed through a maintenance port

SYSTEMS FOR BOGIE MONITORING (e.g. COMORAN®)
- Desaliment detection (e-EDT® second generation)
- Hot box detection
- Detection of unstable running
- Fulfills TSI requirements
- Condition monitoring

INTELLIGENT AIR DRYER
- Compact, lightweight modular design
- Diagnosis with continuous monitoring of air dryer condition
- Optimized closed-loop regeneration minimizes purge air losses
- Low noise emission

MOTION CONTROLLER KIT
- Brake, traction and master controller
- Compatible with UIC standard
- Small, flexible installation space
- Robust modular design, proven application

TREAD-BRAKE UNIT
- Modular design
- Flexible mounting
- High output forces

CLEANING-BLOCK UNIT
- Wheel surface conditioning to improve friction
- Flexible mounting in bogie
- Robust and service-proven design

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
ENTRANCE SYSTEMS

41,000,000 safe and reliable opening and closing cycles with IFE products around the world for LRVs, metros and monorails require 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, aluminium 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
- Can be used for sliding pocket doors or for external sliding doors
- 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
HVAC SYSTEMS

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

HVAC SYSTEM WITH SAND FILTRATION
- Roof-embedded HVAC system
- Dual refrigerant circuits for redundancy, capacity control and energy optimization
- Equipped with state-of-the-art, easy to maintain sand filtration system, specifically designed to guarantee continuous uninterrupted operation through sand and dust storm environment
- Also includes emergency cooling, smoke management, and other advanced features

HVAC PLATFORM FOR LOW-PROFILE APPLICATIONS
- Roof-mounted or fully embedded HVAC system
- Catalogue of different frame and coil materials
- Wide power range (up to 41 kW) and flexible interfaces
- Ideal for metros with low profile, due to its low height (< 300 mm) and 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 intelligent response 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. 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
- Liquid cooling: efficient and optimal use of space
- Bus connection via Ethernet and MVB
- High level of serviceability thanks to easy accessibility of the power modules
- Auxiliary power supply for supplying an AC grid in a rail vehicle

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.
Brake resistors enable safe, controlled deceleration, preserving friction brakes; contactors switch on and off electric circuits under load; disconnectors change the configuration of the traction circuit adapting it to different catenary voltage levels; energy metering transducers provide reliable data for the energy consumption calculation, for the vehicle logic, drive control and for 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 are, 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.

**POWER SUPPLY**

**CUTTING-EDGE TECHNOLOGIES**

**CITYMETER**
- Energy metering solution tuned for urban transport
- Aimed at analyzing the energy consumption of a fleet and defining strategies to reduce it
- Comprises an on-board transducer, a ground-based receiver and software for data analysis.

**LPRC1000 LINE AND PRE-CHARGING CONTACTOR UNIT**
- Single unit including a line contactor, a pre-charging contactor and a pre-charging resistor
- Rated voltage: 1500 V DC
- All connections between the contactors and the resistors are implemented
- Easy installation, wiring and maintenance

**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.
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-CHARGING SYSTEM
- 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

DC HIGH-SPEED CIRCUIT BREAKER
- Up to 2 kV voltage rating
- Thermal current up to 3 kA
- Vertical and horizontal versions
- Enclosures for underframe or on-the-roof installation
- Very low life cycle cost

BRAKING RESISTOR
- Naturally or ventilator-cooled
- Custom-designed resistance value and cooling pattern
- Custom-designed interfaces

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

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.

SYSTEMS SOLUTIONS – BENEFITS FOR THE CUSTOMER
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.