

Rail solutions
Rolling stock



**Build better
and safer trains**
On board with Eaton.

EATON

Powering Business Worldwide

At Eaton, we are helping many of the world's rail leaders build a more sustainable future.

Eaton is a leading power management company, providing energy efficient solutions that help customers use electrical, fluid and mechanical power more reliably, efficiently, safely and sustainably.

We provide innovative solutions globally that help you build a more sustainable business.

Eaton brings a new dimension of expertise.

With many methods of transportation available today, you're challenged to make travelling the railways the reliable, efficient, safe, comfortable and cost-effective choice. To meet customer expectations, regulatory requirements and the demands of increased globalization, you must find ways to reduce downtime, increase productivity and enhance safety and security to drive profitability. All with an eye on making the industry more sustainable for the future.

At Eaton, powering the rail industry means both helping our customers build better and safer trains and enabling railway operators to operate competitively through a broad portfolio of electrical, hydraulic and filtration solutions designed for maximum reliability in any environment. With a focus on energy efficiency and safety, and through our technical expertise and project management capabilities, we can help you meet stringent regulations, minimize risk, secure your rail projects and drive sustainability.





Our solutions help improve safety, drive profitability and maximize reliability.

In today's competitive transportation landscape, both new and refurbished trains must offer high levels of energy efficiency, safety, reliability, passenger comfort and capacity.

As operators and train manufacturers, you must find ways to reduce downtime, increase productivity and enhance passenger safety while meeting strict rail industry standards and striving for improved sustainability.

Eaton can help you build better and safer trains through a depth of customized electrical, hydraulic and filtration solutions. Remote monitoring capabilities ensure safety through preventive maintenance. High reliability rail-approved products and engineering competencies reduce downtime and project risk. Energy efficient solutions help reduce train energy consumption so you can focus your investment on passenger experience.

Eaton help you build better and safer trains

Compliance

Eaton is offering leading products that guarantee the highest levels of safety and performance according to specific standards such as IEC 61373 (Rolling stock equipment - Shock and vibration tests) or EN 45545-2 (Fire protection on railway vehicles).

Eaton products comply with the usual electrical standards (IEC and UL) for a worldwide usage.

With a unique mix of electrical and hydraulics products, Eaton possesses industry-recognized safety products that are specifically designed for the railway's harsh and hazardous environment.

Competitiveness

Eaton is providing a large range of standard products covering the major electrical components used in rolling stock, and which are designed to reduce the level of maintenance required even when operating in harsh environmental conditions.

You can optimize your total cost of ownership by reducing the maintenance cost with our proven long life-time products.

Our innovation center and engineering teams are designing customized solutions that enhance productivity. Our engineering services help to optimize investment cost.

Expertise and Partnerships

With our rail competency center and a network of application engineers, we ensure that new and refurbished trains offer high levels of reliability and help to reduce total cost of ownership.

Legacy of innovation

With 30 years of experience in rail, our innovative portfolio has grown, including solutions from:

Heinemann	Cooper
Bussmann	Walterscheid
Moeller	Vickers
Martek Power	Aeroquip





With the decades of experience in the rolling stock industry, we understand your business and the challenges you face every day.

We can help you to

- protect your passengers and equipment
- control your functions
- convert and store your power
- transport your power
- increase the comfort of your passengers





To address your challenges, select the right technology for the right application.

Protect your passengers and equipment

Applications

Protection of electrical equipment such as:

- Motors
- HVAC systems
- Power outlets
- Door control
- Lighting
- Signaling
- Battery box

Your challenges

- Fire safety
- Harsh environmental conditions
- Long life cycle
- Long cables
- Temperature variation

Our solutions

Eaton has an unique offer of power protection devices, including:

- Miniature Circuit Breakers (MCB)
- Hydraulic Magnetic Circuit Breakers (HMCB)
- Molded Case Circuit Breakers (MCCB)
- High speed fuses
- Residual Current Devices (RCD)

Control your functions

Applications

- HVAC
- Door control (exterior and interior),
- Lighting
- Control converters
- Brake

Your challenges

- Fire safety
- Harsh environmental conditions
- Long life cycle
- Aesthetic and modern design

Our solutions

Eaton contactors, motor-protective circuit breakers and push-buttons can be installed in any environment including passenger car or driver's cabin, for main or urban line trains, metros or trams.



Convert and store your power

Applications

- Braking energy regeneration and storage
- Powering of safety devices (Onboard emergency lighting, Video surveillance and security, Passengers info system and internal controls, Train protection and Warning system)
- Passenger comfort (Air conditioning fan, Reading and vestibule lighting, Passengers entertainment systems, Headlamps & tail lights, Commuters plug sockets, Onboard wifi)
- Signaling and IT system (GPS tracking system, Onboard computer, Automatic train protection)
- On board information (Information displays)
- Embedded control system (Door control, Traction control systems)

Your challenges

- Braking energy recovery
- Energy waste
- Power quality

Our solutions

- Supercapacitor energy storage
- High efficiency converters and inverters

Transport your power

Applications

- Compressed air (brakes)
- Sanding lines
- Condensate lines
- Rain water dissipation
- Waste water
- Diesel engines
- Heating cooling circuit
- Electric converter liquid cooling
- Hydraulic systems
- Air-conditioning

Your challenges

- Often connect and disconnect on rail maintenance
- Environment impact and oil costs when loss of fluid

Our solutions

Eaton is offering leading hydraulic products that guarantee the highest levels of safety and performance for all areas within the conveyance systems used, including

- Hydraulic, Fluid transportation, Suction hoses compliant to EN45545-2
- Couplings and connectors

Various sizes of hoses and end connections gives designers flexibility in their development. Outstanding performance gives customers long lifetime and safety.

The Eaton railway hose series conforms to the EN 45545-2 standard and is now available for use on a variety of railway applications.

Protect your passengers and equipment



Product description

The combined xEffect MCB/RCCB breakers (RCBOs) for short-circuit, overload and residual current protection guarantees highest protection and selectivity in case of a fault. The compact shape of the RCBOs ensure lowest space requirement and global approvals allow a worldwide use. A comprehensive range of auxiliaries, tripping modules, interlocks, busbars and other accessories complete the portfolio.

The xEffect residual current circuit breaker (RCCBs) range offers protection against residual currents in systems and installations worldwide. xEffect RCCBs can be used for fault and additional protection. Time delayed types, and specially developed tripping curves, ensure an interference-free operation. The portfolio is completed by a comprehensive range of accessories.

The xEffect RCDs for fault or additional protection with digital features to keep system's up-time high. The digital features provides prewarning of creeping currents. This helps the operator of the system to solve problems without unwanted downtime. The digital RCDs are available as Type A, B, Bfq and B+. The wide range of accessories can be also used for the digital RCDs.

Technical features

In (A)
up to 40A

Un (V)
240 / 415VAC

Residual current detection
up to 300mA

Short circuit level (kA)
up to 10kA

Features

- Pole: 1N, 2, 3, 3N
- Tripping characteristics: B, C, D
- Sensitivity: AC, A
- Contact position indicator (red / green)
- Tripp indicator (white / blue)
- Global approvals
- Wide range of accessories

up to 100A

240 / 415VAC

up to 500mA

- Pole: 1N, 3N
- Sensitivity: AC, A, F
- Contact position indicator (red / green)
- Tripp indicator (white / blue)
- Global approvals
- Wide range of accessories

up to 80A

240 / 415VAC

up to 300mA





- Pole: 3N (RCCB); 1N, 2 (RCBO)
- Real-time measurement of the residual current
- Local pre-warning via LEDs
- Remote pre-warning via potential free output (only RCCB)
- Yearly test interval
- Global approvals
- Sensitivity: A, B, Bfq, B+
- Tripping characteristics (only RCBO): B, C, D

Applications

- Protection of electronic equipment and cables against overload & short circuit
- Protection of people and equipment against residual currents (e.g. circuits with socket outlets...)
- Fits perfectly in applications with less space

- Protection of people and equipment against residual currents (e.g. circuits with socket outlets...)
- Protection of people and equipment against residual currents in applications with frequency drives

- Protection of electronic equipment and cables against overload & short circuit (only RCBO)
- Protection of people and equipment against residual currents (e.g. circuits with socket outlets...)
- Protection of people and equipment against residual currents in applications with frequency drives (1phase & 3phase)

MCBs	HM CBs	New HM CB	Remote reset system
 <p>FAZ, FAZ-DC, FAZT</p>	 <p>JS, AR, GJ</p>	 <p>ADR</p>	
<p>The xEffect MCB range provides a broad range of thermal magnetic circuit breakers. They guarantee a reliable protection against overload and short-circuits in installations and systems worldwide. The high level of rated switching capacity up to 25kA, as well as an effective current limitation and selectivity ensure optimum system protection and availability. A big range of auxiliaries, tripping modules, interlocks, busbars and other accessories complete the portfolio.</p>	<p>Heinemann Hydraulic-magnetic circuit breakers are providing precise, stable and reliable protection against equipment and cable overload or short-circuits without the disadvantage of nuisance tripping caused by ambient temperature variations, shocks and vibrations, or inrushes caused by motor starts or capacitive circuits. Eaton's Heinemann circuit breakers have a proven track record of electrical protection in harsh environments.</p>	<p>In addition to all advantages of hydraulic-magnetic circuit breakers, the new ADR series provides the same Fit and Form as the standard MCB. This unique design provides a significant advantage by simplifying refurbishment or technology upgrade projects.</p>	<p>The Remote Breaker Reset (RBR) in association with Eaton Heinemann hydraulic magnetic circuit breakers (HM CB) is the perfect fit to delocalize electrical protection for any new or retrofit rolling stock program taking place in "non-accessible" areas. This will free-up valuable space in coaches, increasing passenger comfort and your total cost of ownership without compromising security.</p>
<p>up to 63A up to 254 / 440VAC or 500VDC</p>	<p>0.1 - 1'200A AC or DC</p>	<p>0.1 - 63A Up to 110VDC (137.5VDC peak)</p>	<p>Available voltages in 24, 48, 72 and 110VDC</p>
<p>NA up to 25kA</p>	<p>NA up to 25kA</p>	<p>NA</p>	<p>NA</p>
<ul style="list-style-type: none"> • Pole: 1, 1N, 2, 3, 3N, 4 • Tripping characteristics: B, C, D, K, S, Z • Contact position indicator (red / green) • Global approvals • Wide range of accessories 	<ul style="list-style-type: none"> • Front mounting (JS-AR-CD-GJ), rear mounting (CD-GJ) or rail mounting (ADS) • Constant rated current from -40°C to +85°C • Standard In-Rush of 8x, 15x and 22x In • Embedded auxiliary contact on same pole (SPDT or DPDT on some products) • Mid-trip function 	<ul style="list-style-type: none"> • Mounting on DIN rail 35mm 17.5mm wide • Constant rated current from -40°C to +85°C • Standard In-Rush of 8x, 15x and 22xIn • Embedded auxiliary contact on same pole (SPDT) with different connectors configurations and types available 	<ul style="list-style-type: none"> • 3 sizes of RBR for different sizes of circuit breakers to reset • Operating T° range from -40°C to +85°C • Very fast reaction time avoiding risk of arcing during reset of the circuit breaker
<ul style="list-style-type: none"> • Protection of electronic equipment and cables against overload & short circuit 	<p>Front or rear mounted premium protection of electrical devices and cables in harsh environment such as:</p> <ul style="list-style-type: none"> • with ambient T° variations shocks and vibrations, saline environments • Protection on long cables circuits with DC voltage and low current • Protection of motors or capacitive circuits 	<p>DIN mounted Premium protection of electrical devices and cables in harsh environment such as:</p> <ul style="list-style-type: none"> • with ambient T° variations shocks and vibrations, saline environments • Protection on long cables circuits with DC voltage and low current • Protection of motors or capacitive circuits 	<ul style="list-style-type: none"> • Remote reset of Eaton Heinemann hydraulic-magnetic circuit breakers JS,AR or GJ series • Rolling Stock and harsh environments with shocks and vibrations, saline environments • Fast reset of circuit breakers authorizing reset on loaded circuits • Enable full control of circuit breaker located in inaccessible places Possible delocalization outside the coach

Protect your passengers and equipment

Fuses



Fuse box



Product description

Eaton's Bussmann series traction fuse links have been specifically designed to cope with the demand of rail applications.

Eaton's Bussmann series fuse box has been specifically designed to cope with the demands of rail applications.

Technical features	In (A)
	Un (V)
	Short circuit level (kA)

Up to 1600A
Up to 4000VDC
Up to 100kA

Custom designed to suit the application

Features

- Semi-conductors high speed traction fuse links available in gG, aR and gR class to meet a wide range of customers' application needs
- Specialist DC rated fuse links have been continually developed to cope with the unique demands of rolling stock and rail infrastructure applications
- Expert Field Application Engineers available to help with rail circuit protection applications

- Off the shelf boxes available to suit general applications as well as custom solutions
- Expert Field Applications
- Engineers available to help with Rail circuit protection applications

Applications

- Third rail
- Protection of high speed DC breakers in low time constant, high fault conditions in third rail applications
- Protection of high speed circuit breaker
- Heating Ventilation Air Conditioning (HVAC)
- Third rail converter
- Auxiliary converters
- Lights
- Power distribution converters
- Pantograph
- Converter protection
- Protection of high speed DC breakers in low time constant, high fault conditions
- Instrumentation and control

Traction system of rail transit to protect the traction equipment under pantograph.

Control your functions

Contactors



DILM

Continuous operation requires all components to possess high operational reliability. The DILM contactor achieves the best lifespan values in AC-3 applications and is ideal for heavy AC-4 jogging. The solution is compatible with bi-metal or electronic overload relays as well as motor starters for various applications.

up to 170A

up to 690V

- Identical size for AC- and DC-operated contactors
- High wiring security through double box terminals
- Direct actuation from PLC for contactors up to 38A
- Integrated suppressor circuit for DC-operated contactors
- Spring-loaded terminals for auxiliary contacts
- Direct fieldbus connection via SWD through plug-in module
- xStart contactors for switching and control of motor loads (AC-3 / AC-4) or resistive loads (AC-1) with high life span and switching frequency
- Coils for AC- or DC-actuation for various voltages
- Wide range of accessories available
- Ready for IE3-motors
- Approvals for worldwide use

Motor starters



PKZMO

Machinery and installation downtimes should always be kept to a minimum. The PKZ fuseless motor-protective circuit-breakers combine short-circuit and overload protection in one device, allowing fast restart readiness. PKZM01, PKZM0, PKZM4 and PKE have the same accessories. Combines easily with DILM contactors and DS7 soft starters. Connecting PKE to SmartWire-Darwin facilitates high data transparency.

up to 65A

up to 690V

up to 150kA

- Short-circuit proof up to 150kA for easy engineering
- High safety through application as main switch or repair and maintenance switch
- ATEX approval for protection of EEx e motors up to 65A
- PKE with high flexibility through plug-in tripblock and wide setting ranges
- Direct fieldbus connection via SWD through plug-in module
- Motor-protective circuit-breakers for short-circuit and overload protection of motors or systems
- Combinable with contactors to compact motor starters with high braking capacity
- PKE for heavy starting motors up to Class 20
- Wide range of accessories available
- Ready for IE3-motors
- Approvals for worldwide use

Push buttons



RMQ-TITAN

The pilot devices in the RMQ-Titan M22 and M30 series are characterized by enormous versatility, making them the perfect solution for a wide variety of applications and processes. Their ergonomic operators combine stylish design with optimum functionality, and using their new slim contact elements makes it possible to combine RMQ-Titan devices with minimal mounting depths. Their shape and design makes RMQ-Titan pilot devices comfortable and intuitive to use. The tried and tested M22 product series is complemented by M30 elements with a slim design. Contact and LED elements are available in two mounting depths for flush mounting plates for both series. Emergency stop buttons in a wide variety of designs are an important element in ensuring that dangers can be safely averted, and accordingly play a key role in protecting personnel and property. Accordingly, the emergency-stop buttons in the RMQ-Titan series are tamper-proof. Numerous type approvals and classification society approvals ensure that RMQ-Titan devices can be used worldwide.

Up to 6A / 230V / AC-15

Ui = 500V

- Wide modular system
- Two lines: M22 and M30 Flat Front
- LED Technology
- Individual inscription
- Worldwide approvals
- Emergency-STOP buttons
- High protection degree
- EN60947-5-1
- MOEM/EOEM
- Building
- Marine
- Renewable energy
- Wood processing
- Textile and winding machines
- Tooling machines
- Packaging industry

Convert and store your power

Power converters



Supercaps



Product description

Eaton converters and inverters are used in a wide variety of applications, including LED lighting, communications, engine management systems, passenger information systems, ERTMS, Wi-Fi and fire protection systems. Our products offer

- High efficiency
- Fully isolated
- No minimum load requirement for multi output versions

Eaton supercapacitors are high reliability, high power, ultra-high capacitance energy storage devices utilizing electrochemical double layer capacitor (EDLC) construction combined with proprietary materials and processes. This combination of advanced technologies allows Eaton to offer a wide variety of capacitor solutions tailored to applications for back up power, pulse power and hybrid power systems. They can be applied as the sole energy storage or in combination with batteries to optimize cost, life time and run time. System requirements can range from a few micro-amps to megawatts. All products feature low ESR for high power density with environmentally friendly materials for a green power solution. Eaton supercapacitors are maintenance-free with design lifetimes up to 20 years.

Technical features

- Power range from 5W to 15kW
- AC/DC, DC/DC, DC/AC, AC/AC
- Nominal inputs of 24V, 36V, 52V, 74V and 110Vdc

- Capacitance: up to 3400F per 2.7-3.0V cell
- Operating voltage up to 1700VDC per string
- Max current per cell 3000A
- Operating temperature: -40C up to +85C

Features

Designed to meet harsh environment:

- Shocks, vibrations,
- Dust, water, oil, salt spray
- Compliance to EN50155, EN50121-3-2, EN45545-2

- Market leading power and energy density
- Standard modules with up to 69V available for wayside and on-board energy storage
- UN ECE R100 certified modules – XLR series
- IP65 rating for harsh environments – XLR series
- 95%+ efficient energy regeneration and storage

Applications

- Powering of safety devices (Onboard emergency Lighting, Video surveillance and security, Passengers info system + internal controls, Train protection and warning system)
- Passenger comfort (Air conditioning fan, Reading and vestibule Lighting, Passengers entertainment systems, Headlamps & tail lights, Commuters plug sockets, Onboard wifi)
- Signaling and IT system (GPS tracking system, Onboard computer, Automatic train protection)
- On board information (Information displays)
- Embedded Control system (Door control, Traction control systems)

- Regenerated braking energy storage and section voltage stabilizer - MegaWatt size wayside or on-board
- OnBoard bridge power delivery at dead tracks
- Main energy storage for catenary free trams and trolleys - recharge per every station
- Signaling UPS - high reliability

Transport your power

Couplings and connectors



WAL series, ADB and 5400 series

Aluminium Dry Break couplings (ADB) series are developed to use in cooling lines for electrical applications where Electrical Converters are installed and needs Water-Glycol cooling. These lightweight couplings are easy to connect with no fluid loss while disconnecting. The aluminium material ensures reliable performance in harsh conditions.

Eaton 5400 series couplings developed for air conditioning systems harsh liquids, where you need to avoid air inclusion or fluid loss. Made out of carbon steel with the newest plating, guaranties you a 720 hours corrosion protection.

High pressure resistant Walterscheid™ WALFORMplus™ tube connectors. WALFORMplus metric tube fittings are engineered to meet and exceed DIN 2353 and ISO 8434-1 in sizes and configurations required for demanding rail applications. Provide the highest quality leak-free solutions in the industry and feature Guardian Seal™ plating technology for high corrosion protection required in rail fire suppression systems. WALFORMplus metric tube fittings improve equipment utilization, reduce replacement costs, maintain original equipment appearance simple to install, service friendly, compact machine design for the tube end forming, robust and proven machine technology. WALFORMplus is approved for the use of welded stainless steel tubes in different stainless steel grade.

- ADB couplings fulfill vibration resistance requirements in rail applications according to EN 61373
- Eaton 5400 series is available in DN4 till DN16 and offers connect under pressure functionality
- WALFORM-SR system enables forming solution for very thin wall tubing through deployment of adapter ring
- Eaton Walterscheid offers the full range of hydraulic tube fittings in accordance to DIN ISO 8434-1 in Carbon steel and Stainless Steel (1.4571)
- Guardian Seal Nickel-free corrosion protection plating on Eaton Walterscheid carbon steel tube connectors is approved for more than 1.000 hours vs. red-corrosion

- High pressure coupling
- Flow coupling
- Hydraulic brake line
- Climate technology
- Cooling technology

Hoses



EC112 and EC190 rail hoses

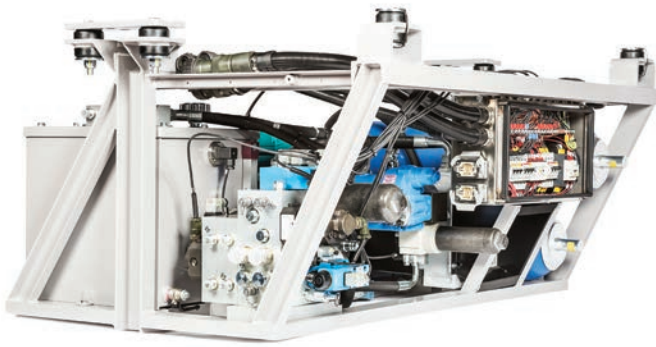
The Eaton railway series of hoses conforms to the EN45545-2 standard and is available for use on a variety of railway uses. In fact, the Railway series of hoses also meet up to R22/HL3 and R23/HL3 requirements for our EC109 and EC209. The railway series of hoses are available with R22/HL2 and R23/HL3 in 1SC(EC112), 2SC(EC212) and 2TE(EC045) models. Further hose types are tested to cover additional applications with R22/HL1 and R23/HL2.

EC190 has been engineered to comply with the (EN45545-2) new European rail fire safety regulations and EN ISO-155409 standard, without the use of an extra fire sleeve. EC190 is suitable for low pressure suction applications such as cooling, fuel delivery and on-board washroom facilities. The EC190 is extremely flexible, when compared with the SAE 100R4 standards, it delivers 3 to 4 times greater flexibility (subject to the hose size).

- EC190 offers +25% temperature resistance vs
- EC190 is compliant with EN45545-2 standards and meets HL1/ R22 and HL2/ R23 requirements as well as the common EN854 (2TE) and EN857 (1SC/2SC) standards
- Eaton's SC railway hoses provides a better bend radius performance compared to the existing standard EN857
- ISO15540 certification for 1SC and 2SC
- Qualified with Eaton TTC and OTC fittings
- Increased temperature performance up to +125°C Eaton's railway hoses exceed at minimum HL2 / HL3 (including 2TE hose)
- Further hose types are tested to cover additional applications with R22/HL1 and R23/HL2

- Compressed air (brakes)
- Sanding lines
- Condensate lines
- Rain water dissipation
- Waste water
- Heating cooling circuit
- Hydraulic systems
- Air-conditioning

Increase the comfort of your passengers



Tilting systems

Eaton's tilting mechanism developed since the 1970s.

- Enables trains to corner at high speeds on the existing track without creating discomfort for the passengers or safety hazards through shifting luggage
- Latest configurations mounted on each bogie or undercarriage, use a single power unit to drive two double effect cylinders in parallel, synchronizing carriages and controlling the tilt angle to ensure stability. The core of the hydraulic system is an electrically-powered, highly reliable Eaton pump
- The pump's operating life is optimized by using accumulator charging.
- Additional benefit of noise reduction for passenger comfort



Customer case

Powering a modern Swiss railway

Customer challenge

- Update hydraulics to a modern system that is the same package size as 15-year-old circuitry

Eaton solution

- Designed a 'dummy' power unit prototype to verify connection positions
- Totally re-engineered layout with newly positioned hydraulic and electric connections while being 100% interchangeable with previous power unit

Business outcome

- Delivered all nine power unit packages in just four months
- Eliminated train downtime due to hydraulic system failures and associated maintenance requirements



Remote control for hydraulic-magnetic circuit breaker

- Remote control of protection or switching function which allows for equipment relocation, freeing up space in vehicles and reducing operation and maintenance costs and downtime
- Customized solution with remote breaker-reset system associated with Eaton's Heinemann hydraulic-magnetic circuit breaker
- Hot-reset of the circuit breaker, leading to reduced downtime and simplified reset procedure
- Unique triggering system of hydraulic-magnetic circuit breakers offers a tripping point insensitive to temperature variations and has a proven resistance to shock and vibration



Customer case

Increase capacity and profitability

Customer challenge

- Increase number of seats per coach without compromising on passenger comfort and security with the same level of electrical protection control

Eaton solution

- Eaton Heinemann Hydraulic-Magnetic Circuit Breakers have been paired with Remote Breaker Reset (RBR) that allow delocalization of electrical cabinet outside the coach and a complete remote control (triggering and resetting)

Business outcome

- The world's biggest train manufacturer has relocated the electrical cabinet, creating space for two additional seats per car
- This represents an additional income for the operator of \$0.5m per eight-car train



Discover how Eaton can help you solve your power management challenges.

Providing your business with a new dimension of expertise, customized innovative solutions and uninterrupted railway operations.

[Eaton.com/Rail](https://www.eaton.com/Rail)

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