FUSE PROTECTION
FOR THE RAIL INDUSTRY

Reliable protection throughout the entire energy flow – from railway infrastructure and rolling stock to signalling and control systems.

SIBA
FUSE TECHNOLOGY

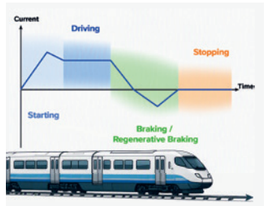
SAFE RAIL OPERATIONS
START WITH THE RIGHT DESIGN

Whether it be rail vehicles, railway infrastructure or signalling technology: Railway applications place significantly higher demands on protection systems than conventional industrial plants. Dynamic load profiles, complex short-circuit conditions, specific network structures, as well as mechanical and thermal stresses, shape the design of every protection solution. It is therefore not the selection of a standard product that is crucial, but rather a protection concept that is tailored to the actual operating conditions of the respective application.

THE BIGGEST CHALLENGES IN RAIL APPLICATIONS

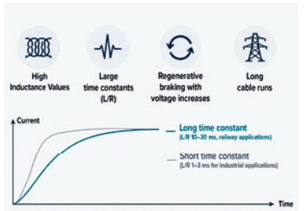
DYNAMIC LOAD PROFILES

Acceleration and braking/regenerative braking generate highly dynamic current waveforms with millions of load cycles over the service life. Its not the peak current that is decisive, but the overall load profile.



COMPLEX SHORT-CIRCUIT CONDITIONS

Long cable runs, high inductance and time constants, as well as energy recovery, have a signification influence on the potential fault currents and on the trip conditions in the event of a fault.



EXTREME ENVIRONMENTAL CONDITIONS

Shock, vibration, temperature fluctuations and long service lives place particularly high demands on fuses.

MAXIMAL AVAILABILITY IS CRITICAL

Any disruption can have an impact on the entire rail network – ranging from delays to high downtime costs. Protection solutions must be permanently available and require minimal maintenance.

Consequence: If high thermal loads and cyclic loading are not sufficiently taken into account, there is a risk of incorrect product selection leading to premature ageing and unplanned failures. This jeopardises availability, safety and increase operational costs.

These challenges demonstrate why fuses in railway applications should not be selected solely on the basis of rated current and rated voltage. Load profiles, time constants, regenerative voltages, environmental conditions and regulatory requirements all interact and influence the level of protection, service life and system availability.

SIBA develops fuse solutions in which electrical, thermal and mechanical requirements are considered together. This results in protection solutions that ensure safe disconnection in the event of a fault, offer high cycle life and contribute to availability throughout the entire life cycle of the application.

DYNAMIC LOAD PROFILES

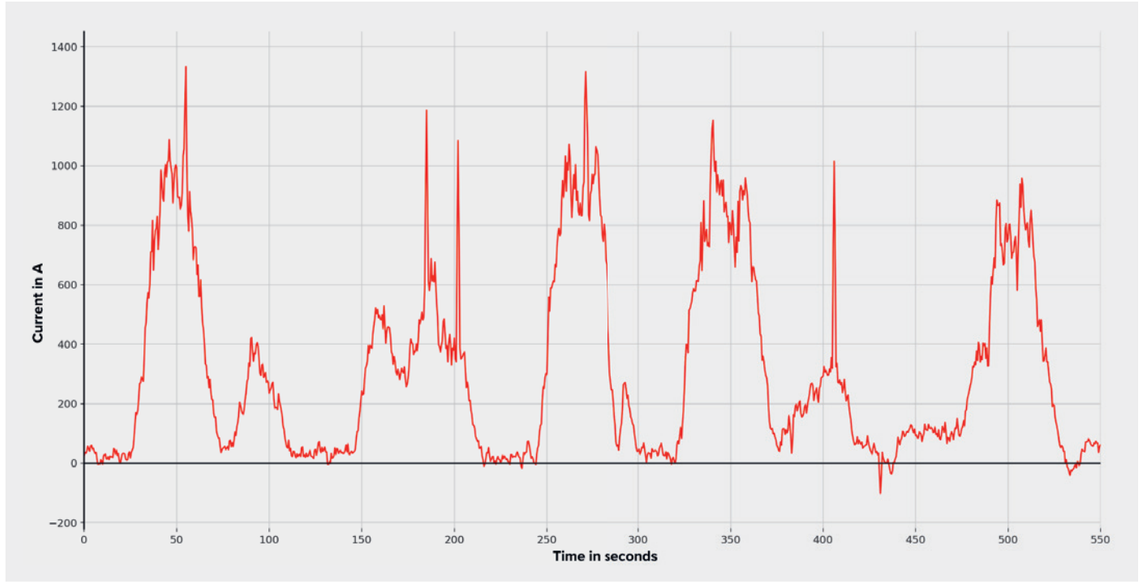
In railway operations, acceleration, braking and regenerative braking result in highly dynamic current waveforms. Fuses must reliably withstand these loads over millions of load cycles without premature ageing or unwanted tripping. Crucial to the design is therefore not only the maximum current, but the entire load profile.

Our solution

SIBA develops fuse solutions based on real load profiles and decades of experience in railway applications. Our products are designed for high cycle endurance, sustained thermal load and reliable tripping in the event of a fault – even under demanding conditions.

Expert tip: Peak current and root mean square (RMS) value

When sizing a fuse, it is not just the maximum current that is decisive. The decisive factor is the thermal load over the entire operating cycle. The root mean square (RMS) value of the current profile therefore provides the crucial basis for optimal sizing.



Comparison of a load profile with peak current. RMS value and thermal load

SHORT-CIRCUIT CONDITIONS IN RAILWAY SYSTEMS

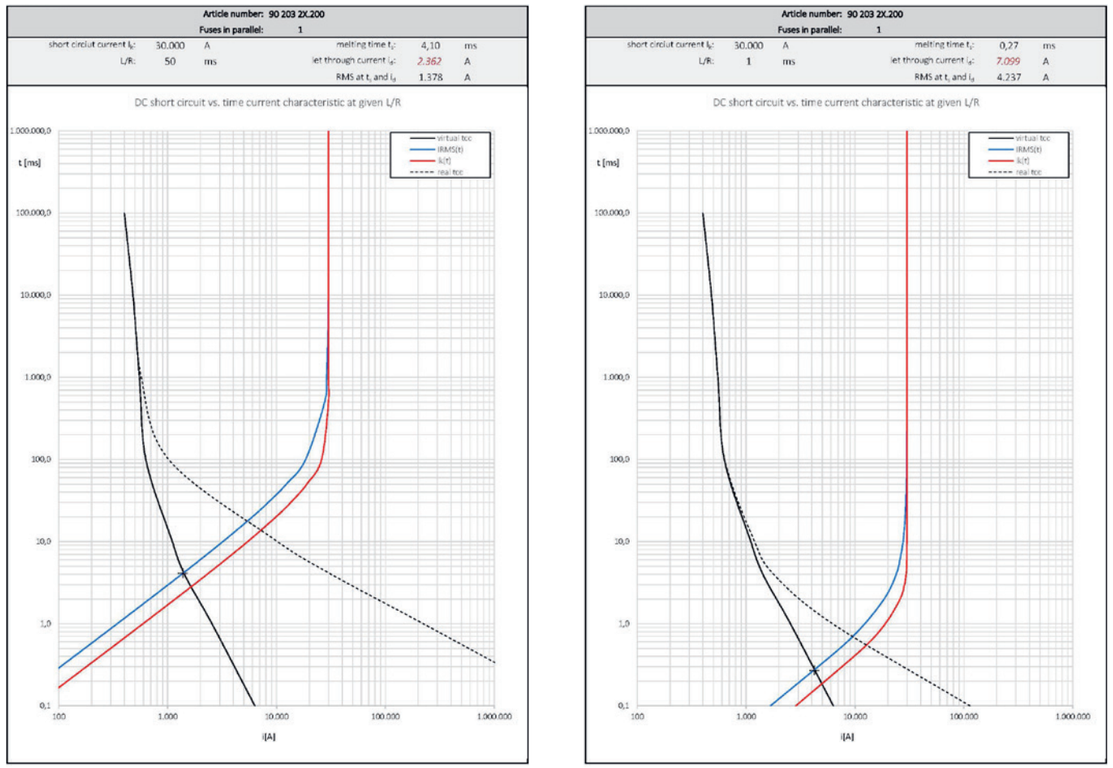
Railway power systems differ significantly from traditional industrial applications. Long cable runs, high inductance and regenerative operation affect short-circuit behaviour and can lead to higher voltages. In such cases, the selection of a fuse is not determined solely by the rated current and rated voltage. The actual operating and fault conditions are decisive.

Our solution

SIBA provides support right from the early project phases in the selection and design of suitable fuses. In addition to voltage and current, we take into account time constants, regenerative operation, project-specific short-circuit conditions and the requirements of relevant railway standards, such as IEC 60077-5. This results in protection solutions that are optimally tailored to the respective application.

Expert tip: Taking time constants (L/R) into account correctly

In railway power systems, overhead lines, conductor rails, transformers and long cable runs lead to significantly higher inductance than in conventional industrial applications. As a result, the short-circuit current rises more slowly and the fuse's tripping behaviour changes. Taking the time constant (L/R) into account is therefore an essential part of a reliable fuse design.



Comparison of the short-circuit current curve for small and large time constants with different tripping characteristics of the fuse

ABILITY TO OPERATE UNDER EXTREME CONDITIONS.

Shock, vibration, temperature fluctuations and long life cycles place the most demanding requirements on protection solutions. At the same time, the failure of a single component can compromise the availability of entire vehicles or infrastructure systems. Protection solutions must therefore function reliably even under the most demanding operating conditions.

The solution

SIBA fuses are designed for long-term use in railway applications. They withstand mechanical and thermal stresses, meet the requirements of relevant railway standards and contribute to high system availability throughout the entire life cycle.

Expert tip: The right operating class makes all the difference

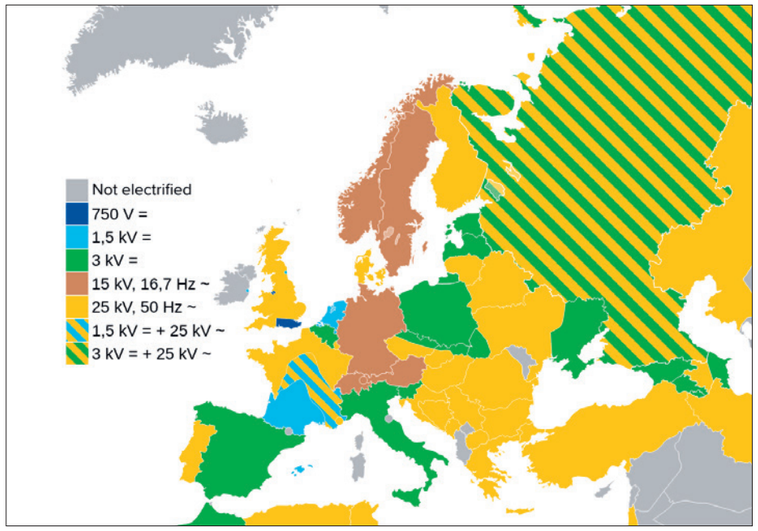
Not every railway application has the same requirements in terms of protection. Whether it's traction power supply, power converters, auxiliary systems or signalling – every application requires a fuse tailored to the electrical and mechanical operating conditions. The correct operating class increases operational safety, extends the service life and improves system availability.

Expert tip: Assessing the voltage correctly

The rated voltage of the catenary alone is not sufficient for selecting a fuse. The maximum operating voltages, regenerative voltages and the required test and cut-off voltages are also crucial. A professional design therefore always takes the entire electrical system into account – not just the rated voltage of the network (catenary).

Rated catenary voltage	Rated voltage	Test cut-off voltage
V	V	V
600	720	800
750	900	1000
1500	1800	1950
3000	3600	3900

Rated and test voltages for DC fuse links, which are supplied from the power supply.



Expert tip: The railway power supply network is not the same as the industrial power supply network

Large sections of the European rail network operate at 16 2/3Hz, which is different to conventional industrial power supply networks. Anyone designing fuses for railway applications must take these specific characteristics into account to ensure reliable protection and high system availability.

RELIABLE PROTECTION
FOR RAIL VEHICLES, TRACTION POWER SUPPLY,SIGNALLING SYSTEMS AND RAILWAY INFRASTRUCTURE

For all Applications
Rail vehicles, infrastructure, signalling and control systems

High Cycle Life
Designed for demanding load profiles and continuous operation

Shock- and vibration-resistant
Developed and tested in compliance with railway requirements

Customised Solutions
Technical consulting and customised development

RAIL INFRASTRUCTURE
Substation · Rectifier station · 16.7 hertz railway power supply

POWER CONSUMPTION & MAIN POWER SUPPLY
Third rail (metro / underground) · Pantograph / Current Collector · Main Power Supply

TRACTION & POWER ELECTRONICS
Power Converter / Traction Converter · Drives / Traction Motors · Regenerative braking / DC link

SUPPORT SERVICES & VEHICLE SUPPLY
Heating / Cooling · Ventilation / Air conditioning · Lighting / Interior · Support Services / Distribution

BATTERY & EMERGENCY POWER SUPPLY
Battery Systems · Emergency power supply · Hybrid/ DC systems

SIGNALLING & CONTROL TECHNOLOGY
Signal Technology · Communication Systems · Passenger Information

Why are fuse links used on trains?

Fuse links operate maintenance-free, without the need for auxiliary power, and enable a defined tripping behaviour – even with high duty cycles, in harsh conditions and within complex systems. This is why they have been a key component of safe and reliable railway systems for decades.

Load profiles

Dynamic loads and energy recovery require the entire driving cycle to be taken into account – not just individual power values.

Time constants (L/R)

High inductance results in long time constants. This affects the short-circuit current waveform and the tripping behaviour of the fuse.

Voltages

Catenary voltage, regenerative voltage, and test and cut-off voltages are crucial factors when selecting a fuse.

Operating Classes

Selecting the correct operating class is crucial for protection performance, service life and system availability.

16.7 Railway power supply network

The 16.7 Hz traction power supply differs significantly from 50 Hz industrial grids and imposes specific requirements.

SIBA Product Families

UR Fuses · HV Fuses · LV Fuses · M Device Protection Fuses

Where the fuse links are located

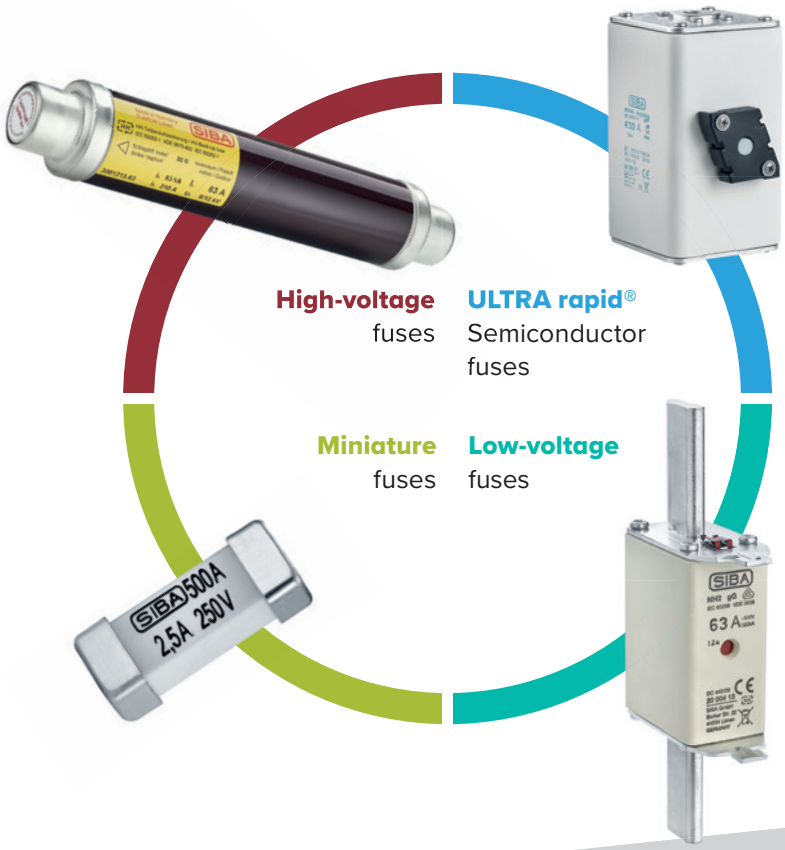
The diagram shows typical points of use for SIBA fuses in railway applications. The specific design is tailored to the application and adapted to the relevant operating conditions and regulatory requirements.

Your benefits with SIBA

- Practical expertise: understanding of operating conditions in real-world scenarios
- Tailored solutions: Customised development and consultancy
- High reliability: Proven in railway applications worldwide
- Long-term security: protection you can rely on permanently

SIBA
FUSE TECHNOLOGY

SIBA – RELIABLE PROTECTION
FOR SAFE AND COST-EFFECTIVE RAIL OPERATIONS



HOW TO
REACH US ...

SIBA GmbH
Borker Strasse 20–22 | 44534 Lünen (Germany)
Tel. +49 2306 7001-0
info@siba.de | **www.siba-fuses.com**

K0100421 | 09/2026