

The background of the advertisement is a photograph of a snowy mountain landscape. A cable car, a white and blue cogwheel train from the Bayerische Zugspitzbahn, is on the tracks in the foreground. It has a crest on its front and the text 'Bayerische Zugspitzbahn'. To the right of the train is a small grey station building with a sign that reads 'RIFFELRIß'. The train is connected to overhead power lines. The Siemens logo is in the top left corner.

SIEMENS

Ingenuity for life

DC Traction Power Supply

Powerful, efficient and safe

[siemens.com/rail-electrification](https://www.siemens.com/rail-electrification)

More people, more challenges, one solution



Demographic change, urbanization and climate change: these are the global trends of today and tomorrow. For the world population is not only growing, it's also getting older. Current forecasts expect it to rise to 9.2 billion by 2050.

These people will need efficient transportation and logistics. And that calls for innovative electrification solutions.



Needed more than ever before: efficiency and sustainability

Not only the world's population will continue to grow in the coming years, urbanization will also be on the increase. So much so that experts are predicting that 90 percent of future population growth will be concentrated in cities.

Such trends mean however that traffic densities all over the world will likewise increase – and with them the demand for intelligent, sustainable solutions for mobility.

Intelligent and efficient rail electrification solutions

Concepts that make transport more efficient are in demand with the ever-increasing need for mobility. With our long-standing transport-expertise and our IT know-how, we are constantly developing new, intelligent mobility solutions that increase availability of infrastructure, optimize throughput and improve passenger experience. It's in how we electrify, automate and digitalize infrastructure that we're setting the benchmark for tomorrow's mobility – today.

Optimal service – a competent partner

You can benefit from our decades of experience in the engineering, construction and commissioning of DC traction power supply systems. As one of the world's leading suppliers of electrotechnical plants and innovative technology partner to all major rail operators, we offer you all services from one source and enable you to tap a lot of potential savings. Savings made possible by energy-efficient, heavy-duty traction power supplies and by even more reliable systems and enhanced performance capabilities. And by engineering tools which uncover open questions as early as the project analysis phase.

Place your trust in our ability to take a good component and make an even better traction power supply system. When it comes to mass transit, regional and main-line railways, we are the right partner for your DC traction power supplies, for consultation and planning, for project implementation and commissioning, and for worldwide service.



Profit from our know-how: Sustained performance for your success



For reliable traction power supply systems, you need an experienced partner who knows the alternatives and makes the advantages clear to you.

This is why we start our work with a thorough analysis of all the static and dynamic aspects of your project. It establishes the prerequisites for customized engineering and for a future-oriented solution that meets your requirements reliably and efficiently.

Extremely well advised

We see your traction power supply system within a wider context, in which the performance of your system can be directly affected through the interfaces.

Our work therefore starts with a thorough analysis of the project conditions and the interfaces. It allows us to correctly estimate the overall implications of the project. We use it as the basis for developing the alternatives, the effects of which we investigate with the aid of simulation tools which we have developed ourselves.

Saving energy and costs

By taking this wide-ranging approach to projects we avoid problems at interfaces and dimension the network correctly right from the start. This particularly affects the number, spacing, output and consequently the optimal location of the DC substations.

During the system design, we work out the best compromise between the structural possibilities and the technical requirements which are determined by the following criteria:

- Voltage drop on the overhead contact line
- Operation in case of substation failure
- Stray currents / rail potentials
- Losses

Security for your decision

We evaluate your network on the basis of a train movement simulation, which then forms the basis for the system design. Our specialized Sitras® Sidytrac software makes it possible to optimize energy consumption, regenerative behavior, potential for saving energy and many other factors.

Sitras Sidytrac calculates all the characteristics of the power supply for your railway system as a function of train operations, taking into account the interactions between vehicle and overhead contact line system during regenerative feedback. Earthing and the return current circuit are integral parts of the system design. That gives you security.



A separate concept is prepared and specifies the principles for grounding, including lightning and overvoltage protection, for all of the systems involved:

- Negative return
- High- and medium-voltage systems
- Traction power supply
- Low voltage system
- Buildings, structures and infrastructural facilities

All this successfully results in a traction power supply system offering the lowest life cycle costs and meeting your requirements of today as well as tomorrow.

Electromagnetic compatibility

Our Sitras EMF simulation tool has been specially developed to calculate the magnetic fields around traction power supply systems.

This calculation is a main part of the EMC planning, with which we eliminate interferences and ensure operator and plant protection throughout all systems.

DC power supply for mass transit and main-line railways: Economical and efficient



With our complete solutions, we offer many opportunities for sustained cost reduction.

You can profit from our vast system know-how in mass transit service and DC operation of main-line railways. It gives you decisive advantages in the planning and dimensioning of your traction power supply.



Reliability: the all-important factor

Traction power supplies can be trimmed down for the sake of a low purchase price, but that does not help you if it is achieved at the expense of reliability. We mean something else when we speak of a cost-efficient solution: for us, it is important to place priority on the reliable operation of our customer's railway system – at optimized costs.

It also means that the DC substations have to fulfill the characteristic requirements of mass transit and main-line railways. In mass transit, these are above all the short distances between stations, high starting acceleration rates and high train densities combined with less space for overall network expansion and therefore more tightly intermeshed networks.

DC traction power supply solutions for main-line railways have to meet completely different requirements due to their different transportation parameters. Longer distances between stations have to be taken into account and, of course, much more electricity has to be transported over a much larger route network.

The starting situation, however, is the same for both mass transit and main-line railways. The voltage from the three-phase medium-voltage network is converted in the DC substation and the three-phase current is rectified. The direct current is then fed into the various track sections of the overhead contact line system.

Short distances for higher energy efficiency

While the lower voltages of direct current offer many advantages in terms of safety and structural requirements, the crucial

factor when locating the substations is to keep the path of the current to the vehicles as short as possible. We therefore locate the DC substations directly at the trackside wherever possible.

Thanks to their compact modular design, this is not usually a problem so they can be positioned under optimal conditions during the system design phase. This avoids long cable routes and the energy losses associated with them.

Flexibility of construction

The extremely compact dimensions of the modules ensure high flexibility in the construction of our substations. For example, we can integrate your substation into an existing building or, as an alternative, install it in previously unused tunnel spaces.

Prefabricated buildings are another cost and timesaving option. We can even install your substation in a container to give you maximum flexibility and the shortest project time. These containerized substations can reduce on-site assembly and commissioning work to a minimum.

Built-in economy

With our perfectly harmonized modular portfolio, we are one of the few complete providers of DC traction power supplies. Let your company take advantage of a comprehensive solution from a single source – a solution offering everything from engineering and system components to installation, commissioning and after-sales service.



Intelligent traction power supply: For sustainable mobility



For you as a rail operator, the increasing costs of energy and other resources are making the energy management in your network more important than ever before.

Profit from our ideas: transforming braking energy into electricity for later use is just one of many new perspectives that we have to offer.



Success through clean mobility

It is equally important to improve the eco-friendliness and economy of mass transit systems in order to make them more attractive to the public, especially in large metropolitan regions. We contribute to this endeavor by enabling you to save up to 30 percent on energy and by increasing the long-term attractiveness of your transit services.

Optimized energy balance

Sitras Sidytrac – our design and optimization program – plays a decisive role in the energy management of your system. We use it to calculate your entire DC traction power supply system in advance – and with an eye on energy management even at this early stage. This analysis is then used to plan your DC traction power supply system, to meet to your requirements, and to optimize energy consumption and regenerative behavior. Thus, we not only improve the ecological aspects of your system but also, when all

measures have been implemented, sustainably reduce your costs.

During operation, our intelligent energy management system Sitras iEMS supports you with full energy transparency and load management.

Key innovations

Our energy management components are based on the years of experience gained by our engineers in all areas of traction power supplies, and the latest research and development results.

With a self-commuted IGBT inverter Sitras PCI the energy distribution in the complete traction power supply grid can be optimized. The increased demands regarding power quality are fulfilled and the quality of the recovery is enhanced. Additionally to the recovery of energy into the medium-voltage grid, reactive power compensation can be carried out.

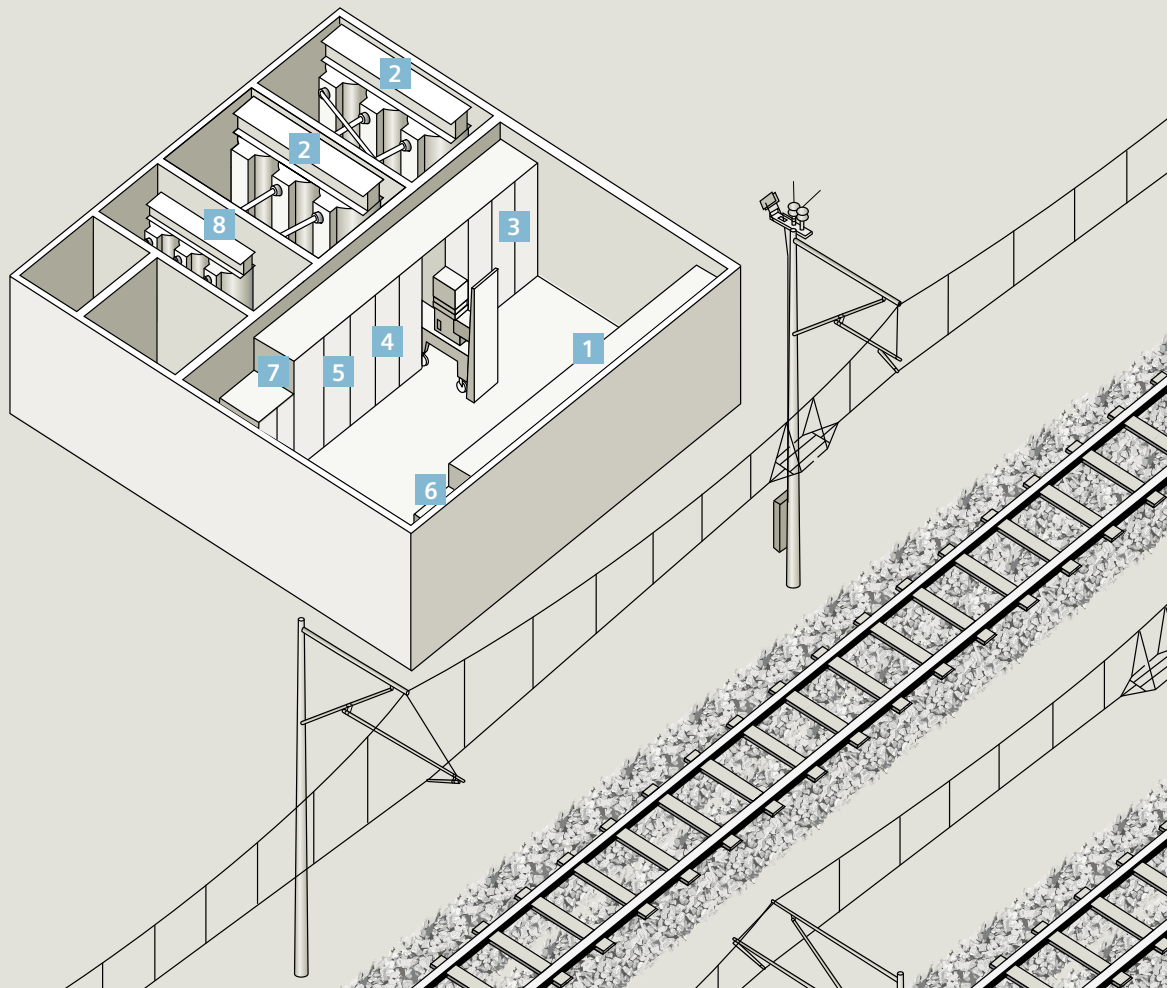


Perfection in detail: One modular system for all applications



In addition to the proven standard products from the industrial area, the Sitras product family enables us to offer an optimum solution for every function in the substation. It has been specially developed under the aspect that a large number of individual components have to be integrated to form one perfect system.

- | | |
|-----------------------------|---------------------------|
| 1 Medium-voltage switchgear | 5 Protective devices |
| 2 Rectifier transformer | 6 Station control system |
| 3 Rectifier | 7 Short-circuiting device |
| 4 DC switchgear | 8 Auxiliary power supply |



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