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RAILFOCUS

THE DINGHAN SMART MAGAZINE

SERVICE LIFE

GREATER RUNNING PERFORMANCE FOR ICM EMU

POWERELECTRONICS

THE MEANING OF SIC

LIGHTHOUSE

STRONG PROJECT FOR A GOOD CLIMATE



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DEAR READER,

More than ever, products must satisfy demands for longevity and eco-friendliness as well as cost savings. In particular in the field of rail-based mobility, this thinking is becoming dominant at all levels. Powerful and energy-saving, that is the motto for the products of the future.

This is nothing new for Dinghan SMART. For years, improving energy conversion efficiency has been the guiding principle for our product development. For this very purpose, we are relying on new power semiconductors such as silicon carbide (SiC). Used properly, they open up new potential for the energy efficiency of rolling stock.

Auxiliary loads in particular account for about half of the total energy consumption. Our auxiliary power converters make a crucial contribution towards lowering energy consumption thanks to their low-loss conversion of the required energy.

Today, we would like to share with you some examples that illustrate just how much this concept defines the work we do. See for yourself: Bridging the gap between powerful and energy-saving is what makes our products special.

We hope you will enjoy the read.

Alexander Schmidt
General Manager, Dinghan SMART Railway Technology GmbH

NEWS

LONG HAULER

Running for more than 20 years and still reliable in national or cross-border passenger traffic: multi-voltage auxiliary power converters made by Dinghan SMART. They are installed for instance in the couchette cars of the night express that runs from Salzburg in Austria to the island of Sylt in the North Sea. Based on the positive response, the privately owned Railroad Development Corporation (RDC) has expanded its service portfolio and offers an environmentally friendly alternative to flying or driving.



STRONG RUNNER

The original idea was conceived in early 2020 during a breakroom chat between runners: A Dinghan SMART team should enter the local marathon. What a great idea! But then came the coronavirus pandemic and ruined the plans for entering the race together. But that did not mean that no fun could be had. Regular meet-ups or virtual get-togethers ensure that running remains a hot topic among employees. And it provides exactly the right break from the daily routine at work...



SPECIAL

The SMARTconverter 3 in the 220 kVA + 30 kW power class has received the official approval from the authorities in China. With its medium-frequency galvanic separation, the auxiliary power converter proved its worth in a research and development programme. After a trial run of 5,000 km and many other tests, it passed the examination by the experts and received the authorization from the Chinese Board of Transport. Since 2020, the SMARTconverter 3 has been used in public transport in Guangzhou.



MONEY SAVER

For a university project, Dinghan SMART supplied a double-insulated DC/DC converter. Together with an automatic overhead current collector system developed at the University of Applied Sciences in Zwickau in Western Saxony, an electric bus can be converted into a hybrid trolleybus. The DC/DC converter that is installed directly downstream from the current collector does away with the need for a costly double insulation of all components.



SERVICE LIFE

GREATER RUNNING PERFORMANCE FOR ICM EMU



The ICM electric multiple unit was developed in the late 1970s.

Rolling stock is an industrial good with a long service life. The vehicles are built to be used for many decades. Typically, rolling stock undergo a major modernization half-way through their service life in order to adapt them to typically more stringent requirements and to upgrade them for the second half of their service life. But sometimes, things do not go according to the original plan and the vehicles are needed for a longer time. This happened for example to the Dutch railway operator and their ICM.

The ICM is an electric multiple unit (EMU) used by the Dutch railway operator. It was developed in the late 1970s. Between 1983 and 1994, a total of 144 units were manufactured in four model series.

Between 2006 and 2011, the vehicles underwent a major modernization, which included the installation of new, powerful Dinghan SMART auxiliary power converters, to get them in shape for another 15 years of service. The plan was to retire the ICM from service gradually starting in 2021, and to replace it with new vehicles.

Things did not work out that way. While the availability of the new vehicles was delayed, the number of passengers kept rising. It was not possible to phase out the ICM, and so the decision was taken to increase the service life of the vehicle by another seven years. This meant that all systems and components of the vehicle had to be examined. It quickly became clear that the auxiliary power converters also needed an overhaul in

order to ensure reliable operation beyond the originally planned service life. This extension of the service life was performed while the vehicles were in regular use for passenger transport.

This entailed some enormous logistic challenges. Every time a vehicle returned to the depot for planned maintenance, the overhauled auxiliary power converters had to be ready and available. The units were then replaced on the vehicle and returned to Dinghan SMART. Within just one week, the auxiliary power converters had to be overhauled by Dinghan SMART. In addition to replacing components that had reached the end of their service life, in-depth diagnostics were performed on the auxiliary power converters. If components were identified whose



Technical Data

Auxiliary power converter for ICM electric multiple unit

Input voltage	1,500 V DC
Output voltage	3 x 230/400 V AC, 50 Hz
	140 kVA
	110 V DC, 16 kW
Dimensions	1,500 x 1,700 x 600 mm

condition put them at an increased risk of failure, these components were replaced during the overhaul as a preventive measure. At the end of 2020, the project of the ICM was completed as planned. With its duration, the ICM is today a real proof of longevity.

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LINE ART

ART ALONG NEAPOLITAN LINES



The Metrò dell' Arte underground stops delight not just art lovers.

Italy is always a great travel destination – in the city of Naples, just taking the underground train provides fantastic glimpses of art and culture. It is not just dedicated art lovers who enjoy the underground stations of the Metrò dell'Arte (Art Underground). A variety of artists such as sculptors, painters and photographers exhibit their contemporary pieces directly in the stations. And our SMARTconverter 3 is along for the artistic ride on Line 1.

The interaction of art and urban culture provides a new attraction at every stop: In addition to contemporary works of art, the different stops on Line 1 also exhibit

archaeological items that were found during the construction of the underground tunnels. They include an antique ship that was found near the harbour during the construction of the Stazione Municipio.

This individualistic approach allows the city of Naples to detach the exhibits from the museum context and to include them in the everyday experience of the observer. This makes the museum tangible for everybody. The experience of art is no longer limited to just those who visit the museum. At the same time, the underground itself is becoming an attraction in its own right and invites tourists to explore the city using green transport.

The standard SMARTconverter 3 is actually in stark contrast to this individuality. It is standard, and yet flexible: Its comprehensive "basic equipment" already makes the SMARTconverter 3 suitable for many applications, but it can also be adapted to custom requirements at any time. This makes it an attractive solution, both with a view to costs and to flexible technical design.

The Naples metros use the SMARTconverter 3 with 170 kVA + 30 kW of power. A total of 36 units were ordered by the Spanish rolling stock manufacturer Construcciones y Auxiliar de Ferrocarriles, S.A (CAF). These are built into vehicles based on the INNEO plat-



Technical Data

Auxiliary power converter for Naples metro

Input voltage	1,500 V DC
Output voltage	3 x 230/400 V AC, 50 Hz
	170 kVA
	110 V DC, 30 kW
Dimensions	2,300 x 750 x 560 mm

form. The first trains have been tested on Line 1, and passenger transports are planned for the first half of 2021.

The current additional orders from CAF confirm the benefits of the standard: one unit for many types of demand. Not only will the auxiliary power converter continue to be used in the Naples underground trains, but also in further projects and on other platforms. Its tried-and-tested design and reliability are among the main selling points of the system, as is its outstanding ease of maintenance.

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POWER ELECTRONICS

THE MEANING OF SiC

New power semiconductor technologies open up new opportunities for manufacturers of power electronics. Power semiconductors based on silicon carbide (SiC) or increasingly on gallium nitride (GaN) stand out for their significantly improved properties. They have the potential to supersede the power semiconductors based on the ubiquitous silicon that have been used for more than 30 years.

Silicon carbide (SiC) in particular is the talk of the town. There is hardly a manufacturer of power electronics who can afford to ignore this trend. Initially, this technology was used primarily for renewable energies, but now it is making more and more inroads into the field of electric vehicles. The rolling stock industry, too, is now using SiC. But is this also true for auxiliary power converters? In her position as Electrical Engineering Group Leader, Jiamei Wang has intimate knowledge of this topic and provides some insights into the possibilities offered by these components.

What exactly is SiC, and what are its benefits?

Silicon carbide (SiC) is by now an established technology for power semiconductors. SiC-based semiconductors are characterized by their significantly lower conducting and switching losses. This means that using SiC makes it possible to build power electronics equipment that is more energy-efficient, smaller and lighter. SiC provides many benefits in particular for the medium-frequency galvanic separation that we are using.

What can you use it for?

As with any new technology, we need to ask the question why we would want to use it. The benefit for the customer must always be our main consideration. Using it just for the sake of technology does not make much sense. At least today, SiC semiconductors are considerably more expensive than comparable silicon-based semiconductors. And some customers are currently still sceptical of SiC-based solutions because long-term experience is not yet available. But we believe that SiC is here to stay.

Basically, the use of SiC makes it possible to reduce the conversion losses in power electronics or minimize the size and weight of passive components – in particular inductive components – through higher switching frequencies. In our opinion, the focus should be on the reduction of conversion losses and thus the increase of the energy conversion efficiency.

Why is the energy conversion efficiency so important?

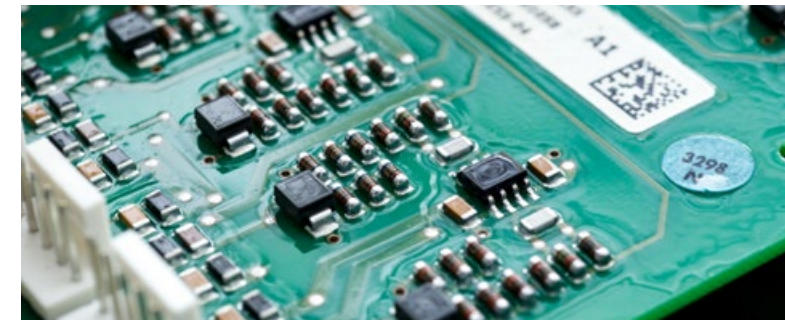
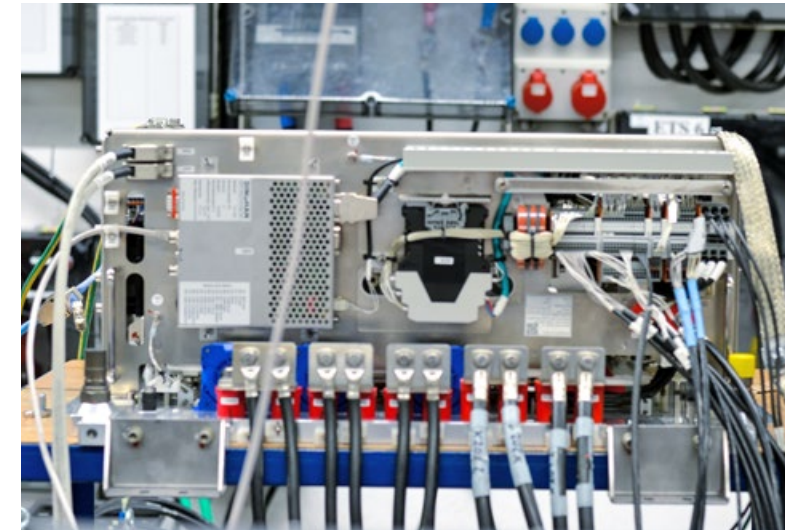
For one thing, higher energy conversion efficiency means less energy consumption. We need to be aware of the fact that about 50 % of the energy consumption of rolling stock is used by the loads in the on-board power network. A decrease of the energy consumption becomes immediately visible through lower electricity costs. These savings really add up over the years.

Another important consideration for us is that we do not need to discharge the conversion losses, which turn into heat in the unit. The need for cooling is always a cost issue. This is true not just for the manufacturing of auxiliary power converters but in particular also for their operation.

Is SiC already being used?

Of course. Many of our units are now made with SiC or are partly available with SiC. Like I said, using SiC does not make sense everywhere. But where SiC makes sense, we do use SiC. The SMARTconverter 3, for example, is available as an SiC model. The same is true for the new SMARTconverter DC and SMARTconverter HV. By contrast, our new SMART-charger are completely based on SiC.

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LIGHTHOUSE

STRONG PROJECT FOR A GOOD CLIMATE



The highly efficient SMARTconverter DC had to be installed in the tightest of spaces.

A lighthouse project on a strict schedule is approaching its successful conclusion: In September 2019, representatives of Deutsche Bahn (DB) and the Dinghan Group signed a trial agreement. The goal was to equip a double-decker coach with air-conditioning systems that use carbon dioxide (CO₂) as a natural refrigerant in order to reduce greenhouse gas emissions. At the start of the project, the involved parties faced many imponderables. The trial is starting on schedule in 2021.

A double-decker coach of the 94 series was chosen as the trial vehicle for the climate-friendly supply system. In this car, the CO₂ air-conditioning system as well as


the matching auxiliary power converter had to be installed in a very tight space. This was made possible by using the SMARTconverter DC, a highly efficient auxiliary power converter for DC and AC applications. The SMARTconverter DC, which is available with and without SiC, achieves an exceptionally high energy conversion efficiency. In the context of the project, the success was two-fold: fewer emissions thanks to a natural refrigerant in the air-conditioning unit, and at the same an auxiliary power converter that reduces energy consumption.

This was a lighthouse project for all involved parties. They had to navigate new and complex technologies (in



this case, CO₂), coordinate the first collaboration of the various project teams, as well as overcome language barriers and cultural challenges.

Immediately after the planning and budgeting stages were complete, development work started with the goal of raising the potential of this new technology relative to the previously used refrigerant R134a. DB project management and Dinghan SMART agreed to use a maturity level model as a quantifiable product indicator. In close collaboration, five out of nine maturity levels were reached by the end of 2020. And in spite of the coronavirus pandemic, the strategic DB project remained on schedule. The installation and test



Technical Data

Power converter for double-decker coach DB

Input voltage	1,000 V AC
	16,7 Hz; 22 Hz; 50 Hz
Output voltage	700 V DC, 100 kW
Dimensions	800 x 400 x 365 mm

phase started in February 2021. Putting into service the air-conditioning system in combination with the SMARTconverter DC proved to be an outstanding team performance. In retrospect, all parties agree: The targeted, transparent planning was the key to success, because projects of this type do not have any models or blueprints to go by. A lot of improvisation, transparency and communication were and are required until the trial run at the Südostbayernbahn.

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NOISELESS

SMARTCHARGER FOR REGIONAL MULTIPLE UNIT TRAIN



The first of a total of 45 Zefiro Express trains is ready at the Alstom location in Hennigsdorf.

The first Zefiro Express out of a total of 45 regional multiple unit trains for the Västtrafik transport network, made by rolling stock manufacturer Alstom, stands ready in Hennigsdorf near Berlin, Germany. After the conclusion of comprehensive testing in Germany, the next trial awaits. Winter testing is planned for the coming season and will be conducted in the train's new home, the Swedish province of Västra Götaland. Travel companion from the start: the SMARTcharger. Quiet and maintenance-free thanks to natural cooling – these properties make our battery charger the perfect fit for these trains that achieve peak speeds up to 250 km/h.


In 2018, Bombardier Transportation, Member of the Alstom Group since January 2021, was awarded the contract by the second-largest transport network in Sweden. In addition to the new trains built on the high-speed platform, which will be used in urban and sub-urban public transport, Västtrafik operates a fleet of buses, ferries, trains, taxis and trams.

The investment into the new regional multiple unit trains is part of Västtrafik's long-term objective of increasing the number of train trips to 130,000 trips per day by 2035. They chose the Zefiro Express not just because of the excellent comfort it offers passengers, but also under the aspects of high reliabil-

ity, energy efficiency and optimized life cycle costs. The Zefiro Express built for the Swedish customer has been equipped with a winter package that ensures reliability in rough weather. This includes temperatures of -40 °C and 80-centimetre snow drifts.

The SMARTcharger is a compact battery charger with natural cooling that is ideally suited to Zefiro Express platform. Convection cooling provides for quiet, maintenance-free operation while achieving maximum energy efficiency.

Under the contract, Dinghan SMART supplies a total of 92 battery chargers as complete systems with an



Technical Data

Battery charger for Zefiro Express

Input voltage	3 x 400 V AC, 50 Hz
Output voltage	110 V DC, 2 x 10 kW
Dimensions	730 x 600 x 500 mm

input voltage of 3 x 400 V AC, 50 Hz and an output voltage of 110 V DC, 2 x 10 kW. In the Zefiro Express, the SMARTchargers are installed under the floor; however, they are also available as stand-alone integration modules with 10 kW of power.

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SERVICE & EXHIBITIONS

Service



Our service line is available to provide expert advice.

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RAIL SOLUTIONS ASIA

2021/11/09 – 2021/11/11
Kuala Lumpur Convention Centre
Kuala Lumpur, Malaysia

OUTLOOK

Good partner



On-site service, training, support for commissioning, comprehensive repair reports, functional and continuous testing of repaired components – just some of the items in our portfolio of repair service offerings. As a service partner, our mission has been for years: We do not simply repair the unit – we increase the service life of the train and prevent potential failures. Learn more about the benefits of SMARTservices in our next issue.

More power



The SMARTconverter HV expands Dinghan SMART's product portfolio with a solution for input voltages of 3 kV DC. Some countries and regions use this high input voltage as the contact line voltage for underground and suburban trains. This new auxiliary power converter now makes the SMARTconverter benefits, in particular its compact size and light weight coupled with high energy conversion efficiency, available for this type of rolling stock.

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