Since 1981 SMA Railway Technology GmbH has been successfully developing and manufacturing customized products in the field of power electronics. Experienced development engineers select the optimum power electronic topology within the preliminary planning of the project considering all customer requirements. It is thus possible to develop a custom solution within a very short time. Of course we will mass-produce these devices on demand.
The GTO was yesterday

The great progress in the field of semiconductor technology can be compared with the rapid development in computer technology: What can be considered as "state-of-the-art" today will be obsolete tomorrow. But this also means, that components which were state-of-the-art some years ago are not available any more today.

For more than 30 years now, power and micro-electronics is an essential component in rolling stock. It has drastically changed in the course of time. In the field of power converters not only the enclosure dimensions but mainly the electronic components used have been changed. Specifically changing from GTO to IGBT technology resulted in great advantages. However, such a process of change in technology causes that the power converter's electric components are only available in limited quantities after years.

Repair and maintenance costs of old devices are thus drastically increased and a complete or partial exchange of these devices is therefore more efficient in most cases. This was the case for the traction power converter in the diesel-electric dual engine cars VTA of the local traffic operator AKN in Kaltenkirchen, Germany.

The original equipment manufacturer used traction power converters on the basis of bipolar transistors for the 19 vehicles. Since these transistors are hardly available as spare parts AKN decided to replace the installed traction power converters with SMA IGBT power units.

Plug & Play

The main goal of redesigning the vehicles was to have a power unit, which was compatible in terms of form and function. Only the power unit was supposed to be changed to IGBT technology. The enclosure, the ventilation technology as well as the filter and even control and regulation are maintained. This new design was a great challenge.
The IGBT power unit developed by SMA is designed for installation into the existing underfloor enclosure. Two power units are installed in one underfloor enclosure, each.

The IGBT power unit is used in vehicles driven by three-phase current asynchronous motors and supplied by a three-phase current generator with a rectifier bridge connected in outgoing circuit (figure 3).

The IGBT power converter converts the DC voltage into a frequency-variable three-phase voltage for controlling asynchronous motors during driving operation. The energy of the brake resistors installed in the two heating/ventilation units is converted into heat during the electric braking process.

The switching behavior of the bipolar transistors is ensured with new device drivers developed for the IGBT's. Stress of the traction motors by too steep edges can thus be prevented. Using a du/dt filter was not necessary.

The cooling of the power components is achieved via aluminum cooling plates with internal coolant. Cooling medium is a mixture of service water and antifreeze cooling the respective traction motors as well.

The mounting spaces are ventilated by natural convection without fan.

The control impulses for the IGBT's are generated in the control unit and transferred to the power converter via optical fibres. The status signals of the semiconductor control are transferred in the same way. Each power converter is driving one traction motor.

Device protection

The IGBT power unit monitors the phases for overcurrent, the intermediate circuit voltage and the heat sink temperature in order to protect the device. The control signals sent by the control unit for inverter and brake chopper are monitored as well. Occurring failures are permanently saved.

In case of a failure, the device protection disconnects the power unit and sends a corresponding message to the control computer. Apart from failure monitoring, the device protection does not have any impact on the operation of the traction power converter. If the device protection fails, the system functions in a "fail safe" manner, which means...
that semiconductors are not uninten-
tionally activated. When servicing
the vehicle the failure memory can
be read out providing the opera-
tor with information on the state of
the power unit. In case of repair
works the failure memory provides
information on the failure and a test
program supports restarting proce-
dures.

Summary

When designing custom power elec-
tronics SMA relies on the know-how
of its highly qualified and dedicated
employees developing a solution
specific for any application. Our
experienced development team
only needed six months from plan-
ing to installing the first prototype.

Technical Data

of the Power-Stacks

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal input voltage</td>
<td>750 V DC</td>
</tr>
<tr>
<td>Nominal input current</td>
<td>120 A</td>
</tr>
<tr>
<td>Output voltage (phase-to-phase)</td>
<td>0 ... 560 V</td>
</tr>
<tr>
<td>Nominal output current</td>
<td>160 A</td>
</tr>
<tr>
<td>Output frequency</td>
<td>0 ... 200 Hz</td>
</tr>
<tr>
<td>Switching frequency</td>
<td>500 Hz</td>
</tr>
</tbody>
</table>
| Cooling                            | Water with antifreeze addi-
tive                         |
| Overvoltage protection            | For each half of the inter-
mediate circuit by a crowbar
thyristor                     |

Figure 5: Detailed view on the control board of the IGBT power unit

SMA Railway Technology GmbH

Miramstrasse 87
34123 Kassel
Germany
Tel. +49 561 50634-6000
Fax +49 561 50634-6001
E-Mail: Info@SMA-Railway.com
www.SMA-Railway.com