RAILWAY TECHNOLOGY SOLUTIONS

Power Conversion Systems for Rolling Stock
design and manufacture a wide range of high performance power electronic and electrical machine products for Original Equipment Manufacturers, Rail Operators, Fleet Owners and System Integrators / Overhaul firms. The range includes auxiliary power supply units and variable speed drives through to high speed permanent magnet motors and generators. Our highly skilled engineers and technicians have a history of successfully developing auxiliary power conversion systems for rolling stock applications spanning more than 30 years, and can design to your specific customer requirements. Proven designs are applied to all products and are based on a pedigree gained with rail networks worldwide.
PRODUCTS

- Auxiliary Power Supply Units (Up to 200kVA)
- Power Converters; DC-DC, DC-AC, AC-AC
- Standalone Battery Chargers (Up to 50kW)
- Auxiliary Battery System / Raft - Charger, Batteries etc.
- Traction Inverters

SERVICES

- Electrical, Mechanical and Software Design
- Product Verification and Testing
- Reliability Analysis (RAMS)
- Comissioning Support and Training
- Site Installation and approval
- Feasibility Study and development of platform product
- Safety case support and validation

CAPABILITIES

- Circuit Design and Simulation
- Printed Circuit Artwork Design
- Production of supporting documentation and manuals
- Creation of 3D models and design drawings
- Equipment reliability studies and through life support
- Reconditioning and obsolescence management
- Compliance & Certification testing to meet regional and international standards

AFTER MARKET SERVICES

- Maintenance:
  + Diagnostic health check service
  + Advisory services & programs on product life cycle maintenance
- Repair:
  + Long term service & standard repair agreements
  + Local after sales and engineering support
- Overhaul:
  + Expertise in replacing legacy applications
PRODUCT FEATURES

- High reliability & availability
- Wide operating range
- Designed for harsh environments
- Shock and vibration resilient
- Overcurrent, overvoltage and harmonic protection
- Designed to last a trains life time
- Greener and energy efficient
- Input reverse polarity protection
- Dead battery start capability
- Communications (CAN, MVB, Ethernet, RS232)
- Compact and lightweight design
- Lower through life costs

DC-AC & AC-AC CONVERTERS –
A variety of at seat, auxiliary power supply options are available. Power Input voltage options range from 24V DC to 110V DC and 240V AC, with a maximum power output of 3kW.

AT SEAT SOCKET POWER SUPPLY

AUXILIARY POWER UNIT (APU)

**Bombardier, CTA 5000**
- DC Input Voltage: 600V
- AC Output Voltage: 230V AC / 60Hz
- AC Output Power: 45kVA / 5kVA
- DC Output Voltage: 37.5V DC
- DC Output Power: 9kW / 3.75kW

**Bombardier, Toronto Rocket**
- DC Input Voltage: 600V DC
- AC Output Voltage: 208V AC / 60Hz
- AC Output Power: 50kVA / 5kVA
- DC Output Voltage: 37.5V DC
- DC Output Power: 17.5 kW

**Bombardier, SPET/KAFD Monorail**
- DC Input Voltage: 750V DC
- AC Output Voltage: 380V AC / 60Hz
- AC Output Power: 30kVA / 2.5kVA
- DC Output Voltage: 124.5V DC
- DC Output Power: 8kW / 3.6kW
### STATIC CONVERTER

**Motor alternator replacement - Chiltern Mark 3 Coach**

- **Input voltage range**: 750-1050V AC/DC
- **Output voltage**: 415 V AC ±5%
- **Rated power**: 28kVA
- **Efficiency**: > 93% full load

### Air Conditioning Power Supply - Wabtec Class 321

- **Input voltage range**: 240-300V AC
- **Output voltage**: 400 Vac ± 5%
- **Rated power**: 40 kVA
- **Efficiency**: >90%

### LOW VOLTAGE POWER SUPPLY (LVPS) / BATTERY CHARGER

**Turbostar, DMU**

- **Input voltage range**: 360-440V AC
- **Output voltage**: 110V DC
- **Rated power**: 12kW
- **Efficiency**: 88%
A comprehensive monitoring system is available that records the status of the power conversion equipment. The monitoring system interfaces with Portable Test Equipment (PTE) and with train car networks via a variety of protocols. The monitoring system continuously maintains time tagged records of the main operating parameters. These include instantaneous values and also average values on an hourly, daily or monthly basis.

A typical screen from the Portable Test Equipment can be seen to the right.

Design Expertise

Design expertise is provided during the early stages of a project for all electrical and mechanical aspects. Extensive experience has been gained within a wide variety of transit power supplies and on-train interfaces. This allows results from similar in-service equipment to be considered in support of decisions at the early project stages.

A design analysis is conducted for all new projects to ensure the power conversion systems comply fully with the functional requirements. In addition, all safety analysis, constructional and material requirements are addressed.

Circuit simulations are conducted with specialist software which support a range of activities as part of the design process.

Fail Mode, Effects, and Criticality Analysis is carried out with a dedicated software suite.

Electromagnetic Compatibility of equipment features highly in the design process. This includes ‘in house’ and external testing at accredited test facilities. Equipment compatibility with track signalling circuits and harmonic measurements are also completed ‘in house’.

Mechanical integrity is assured with Finite Element Analysis, and further validated at an Accredited Test House.

Comprehensive Monitoring

A comprehensive monitoring system is available that records the status of the power conversion equipment. The monitoring system interfaces with Portable Test Equipment (PTE) and with train car networks via a variety of protocols. The monitoring system continuously maintains time tagged records of the main operating parameters. These include instantaneous values and also average values on an hourly, daily or monthly basis. A typical screen from the Portable Test Equipment can be seen to the right.

Innovative Solutions

Since the formation of our company we have strived to utilise the latest innovations in our end products. For our power electronics solutions we carefully combine the elements required to produce high efficiency, highly reliable, cost-effective products. Being able to supply the most appropriate solution by selecting the best technical approach underpins our approach to satisfying customer requirements. We work closely with our supply chains to identify and source the next generation components (for e.g. SiCs) which allows us to develop best in class products and gives our customers a competitive advantage in their own markets.

World of Experience

TPS performs a complete scope of work from initial hardware and software design, PCB layout, assembly and test through to installation, training and on-site-support. We have 30 years pedigree in supplying reliable power conversion equipment for global rolling stock projects all over the world.
<table>
<thead>
<tr>
<th>Rolling Stock Platform</th>
<th>Country</th>
<th>Project Name</th>
<th>Quantity</th>
<th>Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light Rail</td>
<td>China</td>
<td>Beijing Dongzhimen Airport Express</td>
<td>40</td>
<td>65kVA Inverter / 5kVA Inverter / 16kW LVPS</td>
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<tr>
<td></td>
<td>Malaysia</td>
<td>PUTRA Kuala Lumpur</td>
<td>70</td>
<td>2 x 21kVA Inverter / 3kVA Inverter / 15kW LVPS</td>
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<tr>
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<td>USA</td>
<td>JFK Airport Access</td>
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<td>2 x 27kVA Inverter / 3kVA Inverter / 16kW LVPS</td>
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<tr>
<td></td>
<td>Canada</td>
<td>CN / AMF / Montreal</td>
<td>112</td>
<td>3 x Inverter</td>
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<tr>
<td></td>
<td>Canada</td>
<td>Toronto Transit Commission - T1</td>
<td>222</td>
<td>43kVA Inverter / 10kW LVPS</td>
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<td></td>
<td>Canada</td>
<td>Toronto Transit Commission - H6</td>
<td>126</td>
<td>50kVA Inverter / 12kW LVPS</td>
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<td>Canada</td>
<td>Toronto Transit Commission - S1</td>
<td>234</td>
<td>60kVA Inverter / 3kVA Inverter / 18kW &amp; 125kW LVPS</td>
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<td>Canada</td>
<td>Toronto Rocket</td>
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<td>50kVA Inverter / 5kVA Inverter / 18kW LVPS</td>
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<tr>
<td></td>
<td>USA</td>
<td>Chicago Transit Authority - 5000</td>
<td>712</td>
<td>45kVA Inverter / 5kVA Inverter / 4kW &amp; 9kW LVPS</td>
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<tr>
<td></td>
<td>Turkey</td>
<td>EGO Ankara</td>
<td>111</td>
<td>45kVA Inverter / 3kVA Inverter / 5kW LVPS</td>
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<tr>
<td></td>
<td>UK</td>
<td>London Underground District Line</td>
<td>150</td>
<td>6kVA Inverter</td>
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<td>USA</td>
<td>MARTA</td>
<td>220</td>
<td>55kVA Inverter / 4kVA Inverter / 14kW LVPS</td>
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<td>UK</td>
<td>Chiltern Railways - Mk3 Coach</td>
<td>41</td>
<td>28kVA Inverter / 2kVA Inverter / 10kW LVPS</td>
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<td></td>
<td>UK</td>
<td>Greater Anglia - Class 321</td>
<td>60</td>
<td>40kVA Inverter / 8kW LVPS</td>
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<td>UK</td>
<td>Greater Anglia - Class 321</td>
<td>120</td>
<td>3kVA Inverter Using SiCs</td>
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<td>UK</td>
<td>Scotrail - Class 318</td>
<td>66</td>
<td>3kVA Inverter Using SiCs</td>
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<td>UK</td>
<td>Scotrail - Class 320</td>
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<td>3kVA Inverter Using SiCs</td>
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<td>UK</td>
<td>First Group - Night Riviera Sleeper</td>
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<td>3kVA Inverter with modified heatsinks</td>
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<td></td>
<td>UK</td>
<td>Chiltern Railways - Class 165</td>
<td>90</td>
<td>Raft Including Alternator, AVR and APU</td>
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<td>South West Trains Class 442</td>
<td>82</td>
<td>40kVA Inverter and 36kVA Inverter</td>
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<td></td>
<td>UK</td>
<td>Various DMUs</td>
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<td>12kW LVPS</td>
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<tr>
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<td>UK</td>
<td>Various EMUs and Mk3 Coaches</td>
<td>1000+</td>
<td>3kVA Inverter</td>
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<tr>
<td>High Speed / Intercity</td>
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<td>National Railway Engineering Corp.</td>
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<td>Inverter / DC Choppers / LVPS</td>
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<td>Netherlands</td>
<td>Ned Trains</td>
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<td>3kVA Inverter / 0.6kW LVPS</td>
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<tr>
<td>Locomotive</td>
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<td>National Railway Engineering Corp.</td>
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<td>Saudi Arabia</td>
<td>King Abdullah Financial District</td>
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<td>30kVA Inverter / 3kVA Inverter / 8kW &amp; kW LVPS</td>
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<td>Brazil</td>
<td>Sao Paulo SPET</td>
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<td>30kVA Inverter / 3kVA Inverter / 8kW &amp; kW LVPS</td>
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<tr>
<td></td>
<td>Malaysia</td>
<td>Prasarana Kuala Lumpur Monorail</td>
<td>40</td>
<td>40kVA Inverter / 2kVA Inverter / 10kW LVPS</td>
</tr>
</tbody>
</table>
‘Our story begins back in 1987, where Professor Colin Besant and his team representing Turbo Genset were developing patented axial flux technology for use in high speed generators.

Many years later, Turbo Genset acquired Intelligent Power Systems to provide the power electronics for the company’s generator systems as well as to expand its power electronics technology into the rail industry. This was also the birth of Turbo Power Systems, an amalgamation and collaboration of the two companies. Not long after, TPS acquired a Rolls Royce Industrial Control Unit and along with it came a team of highly experienced engineers and technicians.

This fusion of engineers strengthened the company increasing our ability to customise products to your specific requirements. To date, TPS has a proven and worldwide track record in the development and deployment of equipment in many sectors, and especially in transportation (rail). With solutions from cradle to grave, TPS are the go-to power electronics provider.

This story is to be continued; perhaps the next chapter will include you…’

POWERING EFFICIENCY IN NOT ONLY TRANSPORTATION, BUT ALSO ENERGY, INDUSTRIAL & DEFENCE