Image: Courtesy Bombardier Transportation

Efficient and Reliable Power Conversion Systems

TURBO POWER SYSTEMS

Powering Intelligent Solutions

About Us

SUMMARY

Turbo Power Systems (TPS) are a global company headquartered in the heart of North East England. We design and deliver innovative high-speed permanent magnet machines and power electronics systems for the Transportation, Energy, Industrial and Defence markets.

Our Vision
The Customers first choice for Electrical Power Systems Solutions.

Our Mission
Deliver excellence and continuously exceed Customer expectations by adding value in everything we do.

HISTORY

The story began in the late 1980s when Professor Colin Besant and his team representing Turbo Genset were developing patented axial flux technology to design efficient high speed generators. Their successful developments led to collaboration and acquisition of another firm 'Intelligent Power Systems', to deliver power electronics solutions for their generator systems as well as to expand into the railway industry – this was the birth of TPS, a merger of these two companies. Not long after, TPS acquired Rolls Royce Industrial Control Unit and a team of highly experienced engineers and technicians, which further fortified the railway competency of TPS.

Today our rail reputation stands on an unparalleled record of understanding customer needs, designing solutions and delivering results. The ability to create bespoke products for clients is the key to our excellence. Just a few companies can match the engineering pedigree we hold and our proven record of successfully solving some of the world's most complex rail projects.

A Pedigree You Can Trust

1. **PEDIGREE -** Pioneering specialists in Rail Power Electronics since 1987.
2. **EXPERIENCE -** In major rail projects and successful execution of 50+ rolling stock projects across the globe.
3. **EXPERTISE** - Our power electronics design engineers have an experience of 30+ years in the rail industry.
4. **CAPABILITY** - In depth knowledge of Rail Power Conversion Systems resulting in seamless integration and support.
5. **CREDIBILITY** - Focused on product quality and delivery resulting in credible and reliable solutions for our rail customers.
6. **CAPACITY** - Manufacture facility 55,000 ft^2 and 100+ dedicated resources for power electronics products.
7. **AFTER SALES SUPPORT** - Highly qualified service staff to support maintenance, repair and overhaul of our global rail products.

UKRIA WINNER 2016 TRACTION & ROLLING STOCK

UK ENERGY Innovation Awards 2015 Winner

Products and Services Portfolio

TPS supplies the following products and services to global rolling stock manufacturers, train operating companies, transit authorities and overhaul firms:

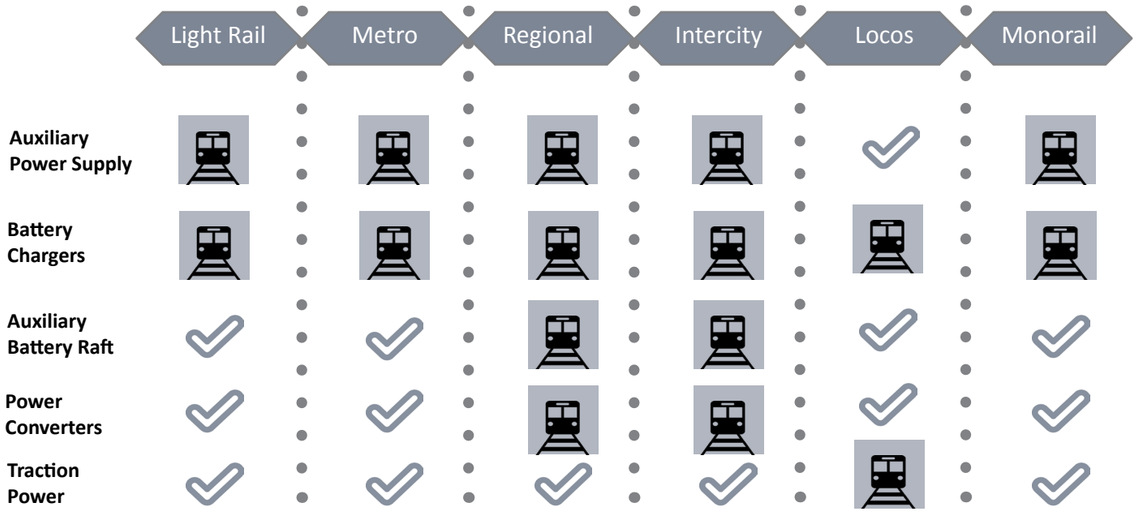
Products

o Auxiliary Power Supply (APS) up to 200kVA
o Power Converters; DC-DC, DC-AC, AC-AC & AC-DC
o Standalone Battery Chargers up to 50kW
o Integrated Auxiliary Battery Charger Raft
o Traction Power - Converters

Services

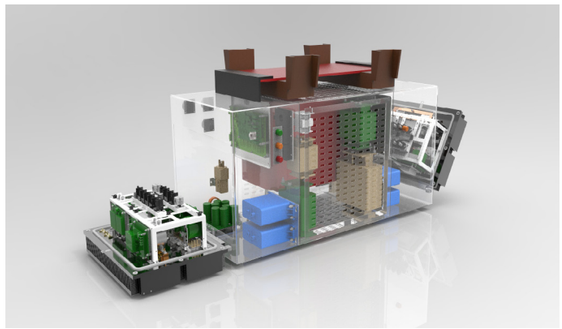
o Maintenance, Repair & Overhaul
o Electrical and Mechanical Design
o Installation and Safety Validation
o New Product Development
o Commissioning Support & Training

TPS offers turnkey light weight and efficient rail power conversion solutions for complete spectrum of rolling stock providers.



Experience of delivering a project

Capability of delivering a project



1. Light Rail

Product: Auxiliary Power Supply
Project: JFK Airport Access

o Input Voltage	750 Vdc
o Output Voltage	3Ø, 2 x 480 Vac
o Output Voltage	1Ø, 120 Vac
o Output Power AC	2 x 27 kVA/3 kVA
o Output Power DC	15 kW
o Efficiency	95% full load
o Cooling	Forced air

Product: Auxiliary Power Supply
Project: Beijing Airport Express

o Input Voltage	750 Vdc
o Output Voltage	3Ø, 380 Vac
o Output Voltage	1Ø, 220 Vac
o Output Power AC	65 kVA/ 5kVA
o Output Power DC	16 kW
o Efficiency	93% full load
o Cooling	Forced air

2. Metro

Product: Auxiliary Power Supply
Project: Toronto Rocket

o Input Voltage	600 Vdc
o Output Voltage	3Ø, 208 Vac
o Output Voltage	1Ø, 120 Vac
o Output Power AC	60 kVA/ 5kVA
o Output Power DC	12 kW
o Efficiency	93% full load
o Cooling	Natural air

Product: Auxiliary Power Supply
Project: Chicago Transit Authority 5000

o Input Voltage	600 Vdc
o Output Voltage	3Ø, 230 Vac
o Output Voltage	1Ø, 120 Vac
o Output Power AC	45 kVA/ 5kVA
o Output Power DC	9 kW/ 3.75 kW
o Efficiency	94% full load
o Cooling	Natural air

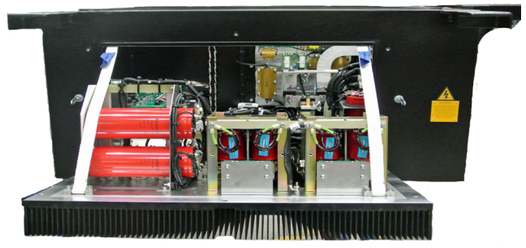
3.Regional

Product: Auxiliary Power Supply
Project: Mark 3 Coach

o Input Voltage	850 Vac/Vdc
o Output Voltage	3Ø, 415 Vac
o Output Voltage	1Ø, 240 Vac
o Output Power AC	28 kVA/ 2 kVA
o Output Power DC	10 kW
o Efficiency	93% full load
o Cooling	Natural air

Product: Battery Charger
Project: Diesel Multiple Unit

o Input Voltage	3Ø, 400 Vac
o Operating Range	360 Vac to 440 Vac
o Output Voltage	28 Vdc
o Voltage Monitoring	Yes
o Output Power DC	12 kW
o Efficiency	88% full load
o Cooling	Natural air



4. Intercity

Product: AC-AC / AC-DC At Seat Socket
Project: Various EMUs & DMUs

o Input Voltage	110/24 Vdc 240 Vac
o Output Voltage	1Ø, 230 Vac
o Output Power AC	3kW or 800W(24v)
o Output Overload	1.2x for 30sec
o Efficiency	85% full load
o Cooling	Natural air

Product: AC-AC Catering Coach Supply
Project: Intercity Fleets UK

o Input Voltage	249 Vac to 448 Vac
o Output Voltage	1Ø, 240 Vac
o Output Harmonics	<5% at full load
o Output Power AC	5kW
o Output Frequency	50Hz
o Efficiency	92% full load
o Cooling	Natural air

5. Locomotives

Product: Chopper Drive
Project: NREC USA

o Input Voltage	150 Vdc -1000 Vdc
o Output Voltage	1000 Vdc at high speed
o Output Current	1450 Adc
o Efficiency	90% full load
o Cooling	Forced air

BENEFITS OF TPS PRODUCTS

1. **High reliability & efficiency**
2. **Wide operating range**
3. **Sustainable in harsh environments**
4. **Shock and vibration resilient**
5. **Harmonic protection**
6. **Greener and energy efficient**
7. **Compact and lightweight design**
8. **Dead battery start capability**
9. **Communications (CAN, MVB, Ethernet, RS232)**

6. Monorail

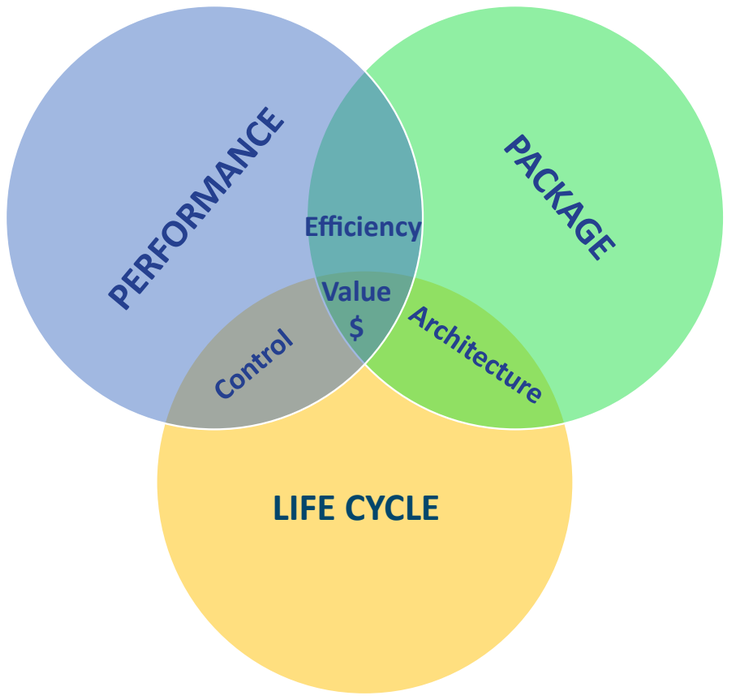
Product: Auxiliary Power Supply
Project: Sao Paulo/ KAFD Saudi Arabia

o Input Voltage	750 Vdc
o Output Voltage	3Ø, 380 Vac
o Output Voltage	1Ø, 220 Vac
o Output Power AC	30 kVA/ 2.5kVA
o Output Power DC	8 kW / 3.6 kW
o Efficiency	94% full load
o Cooling	Liquid

Product: Auxiliary Power Supply
Project: Kuala Lumpur Monorail

o Input Voltage	750 Vdc
o Output Voltage	3Ø, 415 Vac
o Output Voltage	1Ø, 220 Vac
o Output Power AC	40 kVA/ 5kVA
o Output Power DC	10 kW
o Efficiency	95% full load
o Cooling	Forced air

Key Differentiators



Efficiency

o Lowest power consumption
o Reduced size and weight
o Lower audible noise
o Simplified cooling
o Low total cost ownership

Architecture

o Input optimisation
o Output optimisation
o Component reduction
o Configuration flexibility

Control

o Performance optimisation
o Adaptive control
o Service reporting

OUR INFRASTRUCTURE

o 55,000ft^2 Manufacturing facility
o Standard Practice Measures
- 5S
- Straight Through Rate
- OTIF (On Time in Full)
- Kaizen improvement teams

o Core capability of assembly
- Experienced work force
- Rail assembly - IRIS

o High reliability Testing
- 100% Full functional test prior to product release
- Thermal Cycle: -40 to +120° C
- HASS - Hot Box burn in

Our Expertise Is Your Advantage

ENGINEERING EXPERTISE (in-house)

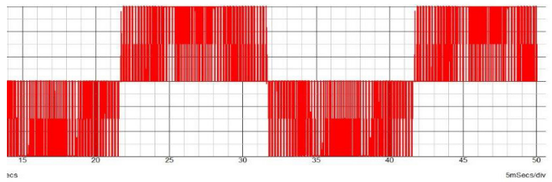
o Circuit design and circuit simulations
o Design suited to global specifications
o Printed circuit artwork design
o Embedded software development
o System routine functional testing
o Qualification/type testing
o Documentation and manuals
o Creation of 3D models and drawings
o Equipment reliability studies (RAMS)
o Offer 'through life' support
o Commissioning support and
o Training at all levels
o Proprietary diagnostics software suite for comprehensive monitoring and event recording

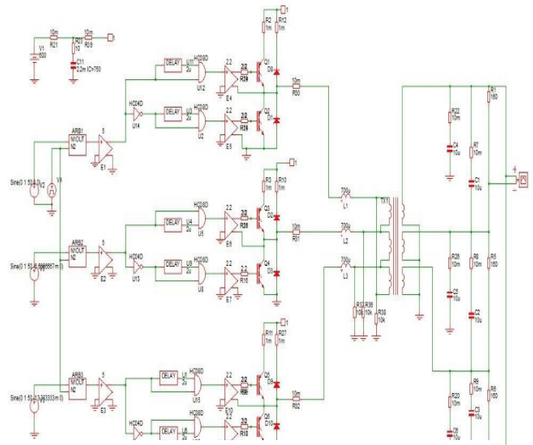
COMPREHENSIVE MONITORING

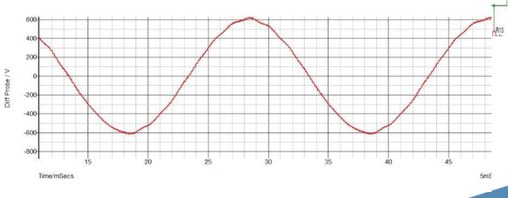
The APS monitoring system interfaces with Portable Test Equipment (PTE) and with train systems via a variety of protocols. It maintains time tagged records of operating parameters, including real time values, average values on an hourly, daily or monthly basis.

OUR SIMULATION CAPABILITY

Analysis	Analysis Tool
System and Control Design	Matlab / Simulink
Circuit and Thermal Design	PLECS
Circuit Analysis (SPICE)	SIMetrix, ICAPS
3D Solid Modelling	Creo (ProE™), Inventor
Electromagnetic FEA	MagNet (Infolytica)
Structural FEA	Ansys™
Thermal FEA	Ansys™
CFD Analysis	Ansys™ (CFX)







1

Light Rail

150+ Units

China - Beijing Airport

Malaysia - KL Putra

USA - JFK Airport Access

2

Metro

2000+ Units

Canada - CN/AMF/Montreal

Canada - Toronto Transit (TTC) H6

Canada - Toronto Transit (TTC) T1

Canada - Toronto Rocket (TTC)

USA - MARTA

Turkey - Ego Ankara

UK - London Underground

3

Regional

1000+ Units

UK - Chiltern Railways Mk3 Coach

UK - Chiltern Railways Class 165

UK - Greater Anglia Class 321

UK - Scotrail 318 & 320

UK - Night Rivera Sleeper

UK - South West Trains Class 442

UK - Bombardier Turbostar

4

Intercity

1000+ Units

UK - Alstom Pendolino

UK - Virgin East Coast

UK - Great Western Railways

5

Locomotive

120 Units

USA - NREC Locomotives

Netherlands - Ned Trains

6

Monorail

450+ Units

Saudi Arabia - KAFD

Brazil - Sao Paulo SPET

Malaysia - Kuala Lumpur

TPS a truly global company

Next Stop TPS

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