

Power Supplies Keep Railway Systems On Track

by Spencer Chin, Contributing Writer

Driven by the need to provide more reliable power for next-generation railway systems, power supply manufacturers have introduced a slew of products especially designed to meet the power specifications and operating conditions of railway power converters and subsystems. The demand on railway power supplies are more stringent than those for many commercial applications. Railway power supplies must be built to withstand the harsh shock and vibration prevalent in railroad equipment, as well as be able to withstand high surge currents, transient voltages, and EMI.

A series of standards dictate the minimum safety and performance requirements for railway power supplies. Some of these include EN 50155 (electrical safety), EN 50121-3-2 (EMI/RFI), EN 45545-2 (fire protection), EN 61373 (shock and vibration), EN 61000-4-2 (ESD), EN 61000-4-3 (HF-field), and EN 61000-4-4 (burst).

This Power Product Roundup on railway power supplies primarily highlights dc-dc converters though some models also offer battery charger or ac-input versions. The power converters featured in this article were introduced over the past 12+ months.

DC-DC Converters featured here include:

- Schaefer's 6000-W C/B5600 series
- Artesyn Embedded Technologies' 10-W and 20-W ERM family
- ABSOPULSE Electronics' 30-W DCR 30R-F0 series
- ABSOPULSE Electronics' 200-W LTH-65R-F3TH
- ABSOPULSE Electronics' 250-W RWR 252-P400 series
- ABSOPULSE Electronics' 300-W BHT-319R-F4 series
- Absopulse Electronics' 3-kW HVI 3KR-3U4 series
- MTM Power's 150-W PCMDS19 150
- MTM Power's 30-W PMDS/PCMDS30 series
- MTM Power's 60-W PCMDS60 series
- MTM Power 14-W PMGS/PCMGS14 series
- Murata's 100-W IRQ series
- Maxim Technology's 20-W MKZI10/20 series.

One example of the recent railway power supply introductions is the C/B5600 series of 6000-W dc-dc converters from [Schaefer](#). Built using industrial-grade components, the converters operate from -20°C to $+75^{\circ}\text{C}$, with -40°C to $+75^{\circ}\text{C}$ optional. The converters target

transportation and railway controls and communications equipment (onboard and trackside), substation applications for dc switches, computer-based train control (CTBC), and emergency lighting.



Schaefer's C/B5600 series dc-dc converters provide outputs from 5 to 400 V and accept inputs from 80 to 800 V.

The C/B5600 series offers over 150 standard models with dc input voltage options spanning a range from 80 to 800 V. Ac input models offer single- or three-phase as well as battery charging models. Single-output voltages range from 5 to 400 V. All outputs are adjustable and fully regulated to 0.2% or better (load) and 0.1% (line).

The converters have remote-sense capability and features comprehensive protection circuitry and efficiencies up to 95%. They are packaged in space saving 6U or 9U rack modules or a wall mount module. Options include parallel/redundant operation, inhibit, power-OK/dc-OK alarms, system reset signaling, and programming/monitoring functions.

[Artesyn Embedded Technologies](#) recently added 72 new models to its ERM family of dc-dc converter modules for railway rolling stock applications. Covering 10- and 20-W power ratings, each series includes models with single outputs of 5 V, 12 V, 15 V, or 24 V, or dual outputs of ± 12 or ± 15 V and input ranges of 9 to 36, 18 to 75, or 40 to 160 V.



Artesyn's ERM modules come rated at 10 or 20 W with 4:1 input ranges of 9 to 36, 18 to 75, or 40 to 160 V.

The ERM modules come in 1- x 2-in. dual-in-line packages and operate from -40 to +85°C with derating. A reinforced insulation system with 3000 Vac rms I/O isolation, combined with high EMC immunity, suits the modules for applications such as engine management, traction control, door control, video surveillance, communications, and other on-board electrical equipment.

[ABSOPULSE Electronics](#) recently added the 30-W DCR 30R-F0 series to its line of RIA12 railway quality dc-dc converters. These converters accept inputs of 24, 48, 72, 96, or 110 V and provide outputs of 12, 24, or 48 V. The input voltage surge withstand capacity is 3.5 times greater than the nominal input voltage for 20 milliseconds, which ensures that the converters meet RIA12 railway transient and surge specifications.



Absopulse's RWR 252-P400 dc-dc converters accept inputs of 24, 36, 48, 72, 96, or 110 V and provide outputs of 12, 24, 36, 48, or 125 V.

Other specifications for the DCR 30R-F0 include line and load regulation of $\pm 1\%$, output ripple and noise of better than 1%, and mean time between failure of 150,000 hours at 45°C. The converter measures 3.7 x 1.9 x 6.3 in.

While the DCR 30R-F0 is one of Absopulse's newer converters for railway applications, the company introduced a number of new products in this category last year at power levels ranging from 200 W to 3 kW.

For example, the LTH-65R-F3TH series heavy-duty, railway quality dc-dc converters deliver up to 200 W output power with pure convection cooling. Designed to float charge hold-up batteries for on-train electrical equipment, the units are also



Absopulse's LTH-65R-F3TH series dc-dc converters deliver up to 200 W with pure convection cooling.

suitable for a range of other transportation and industrial applications.

The converters operate from a 12-V (10.5 to 16 V) input and deliver 12 V, 24 V, 48 V or the corresponding float voltages. Other input values and output voltages up to 125 V are available. An optional built-in redundancy diode allows for paralleling and N+1 operation or back-up battery connection. An output fail alarm (Form C) is also available on request.

Cooling is via heat sink fins on the top of the unit, which makes the design ideal for installations where surface mounting is not possible. The units are rated for operation over a -25°C to +55°C temperature range for full specification with no derating required; wider temperature ranges are available on request. The LTH-65R-F3TH converters meet the requirements of EN50155 for electronic equipment used on railway rolling stock, as well as EN50121-3-2 (EMI), EN61000-4-2, EN61000-4-3, EN61000-4-4, EN61000-4-6 and EN45545.

Another Absopulse converter targeting rail applications is the RWR 252-P400 series of fully encapsulated, dc-dc converters delivering up to 250 W. The units meet EN50155 requirements for electronic equipment used on rolling stock. With an input surge withstand capability of 3.5 Vn for 20 ms, they meet RIA12 specifications for protecting traction and rolling stock equipment from transients and surges in dc control systems. Wide input ranges include 24 V (14.4 to 34 V), 36 V (22 to 51 V), 48 V (29 to 67 V), 72 V (43 to 101 V), 96 V (58 to 135 V) and 110 V (66 to 154 V). Output voltages are 12, 24, 36, 48, or 125 V.

The RWR 252-P400 converters comply with EN50121-3-2 and also meet EN61000-4-2 (ESD), EN61000-4-3 (RF Immunity), EN61000-4-4 (Fast Transients), EN61000-4-6 (Conducted Immunity) and EN45545. The units are fully encapsulated with a thermally conductive MIL-grade silicon rubber compound with a UL94V-0 flammability rating. They also comply with MIL-810C, D for resistance to shock and vibration, moisture, and other contaminants. The conduction-cooled converters operate from -40 °C to +70 °C without derating.

Going up higher in power, Absopulse's BHT-319R-F4 series dc-dc converters are designed for an operational life of 30 years at high temperatures in railway and industrial environments. The convection cooled units deliver 300 W of continuous output over a -40°C to +85°C temperature range without derating. By eliminating optocouplers and electrolytic capacitors, the MTBF of the units is significantly higher than in conventional converter designs.

Accepting nominal inputs of 72 V, 96 V, or 110 V, with wide EN50155 input ranges, these converters deliver a 24-V, 48-V, 72-V, or 125-V output or a custom output voltage. The railway quality series meets EN50155 for electronic equipment used on railway rolling stock and units comply with EMC standard EN50121-3-2. (An industrial quality version of this series is also available.)

For even higher power applications, Absopulse's HVI 3KR-3U4 series high-input-voltage, railway quality dc-dc converters deliver up to 3 kW. The units accept a 750-V input nom. (or a 525-V to 975-V input range), the traction voltage required for mass transit vehicles and mining locomotives. Output voltages include 24 V, 36 V, 48 V or 110 V. The series is designed to meet EN50155 for electronic equipment used on railway rolling stock.

The units are filtered on the input and output and comply with EN50121-3-2. They also meet the EN61000 standards for ESD, RF Immunity and Fast Transients. Electronic protection also includes 4300-Vdc input to output isolation, reverse polarity protection, overload protection, thermal protection and current limiting. The HVI 3KR-3U4 converters are built with three internal power modules operating parallel via redundancy diodes. This construction provides internal redundancy: if one internal module fails, the unit will continue to function as a 2-kW redundant power supply.



Absopulse's HVI 3KR-3U4 series high-input-voltage, railway quality dc-dc converters accept a 750-V input nom., the traction voltage required for mass transit vehicles and mining locomotives.



MTM Power's PMDS/PCMD30 converters are rated at 30 W and produce outputs of 5.1, 12, 24, or 48 V.

[MTM Power](#) has introduced several supplies for railway applications. One is the PCMD30 2452AUVT, a 24-V output, 19-in. rack plug-in unit based on the company's PCMD30. A special feature of the PCMD30 2452AUVT is the connector on the front plate where both input and output voltage can be connected. The 30-W converter is available with a wide input range of 50.4 to 154 V for the battery voltage of 110 V according to EN 50155 and an isolation of 2.2 kVac. The supply measures 178.5 x 70.8 x 128.4 mm (L x W x H).

The converter has vacuum encapsulation to ensure uniform heat dissipation within the module, as well as resistance against shock, vibration and humidity. The maintenance-free converter can operate in parallel, is suited for applications requiring Class II protection, and can be switched into an energy-saving stand-by operation mode by a remote control input.

Also new from MTM Power is the series PMDS/PCMD30 for distributed power systems in railway vehicles and industrial

applications. These push-pull converters operate at a frequency of 70/140 kHz. They cover an input voltage of 14.4 to 154 V with only two different nominal voltages (24 V and 110 V). They are available with an output voltage of 5.1, 12, 24, or 48 V with 30 W.

The converters incorporate short circuit protection, and reverse polarity protection in connection with an active input current limiting. Versions are available either for pc board (110 x 80 x 27.5 mm) or chassis mounting (110 x 80 x 25.5 mm).

MTM Power has also introduced a 60-W dc-dc converter series for rail applications. Without any additional external components the PCMDS60 meets all functional and normative requirements of electronic equipment in railway applications according to EN 50155, EN 50121-3-2, and EN 61373 Cat. 1, Class B. As a plug-and-play solution for sensitive electrical subsystems, the converters can be easily installed and operated in the field.

The primary-switched dc-dc converters are available with a wide input range for battery voltages of 24 V, 36 V, 48 V, 60 V, 72 V, 96 V and 110 V per EN 50155. These converters generate galvanically isolated output voltages of 5.2 V, 12 V, 15 V, 24 V or 48 V. The dimensions are 130 mm x 69 mm x 30 mm (length x wide x height).

For low-power applications, MTM Power offers the 14-W PMGS/PCMGS14 series. The devices accept a 72- or 110-V input and output 24 V (12 and 48 V are also available on request) with efficiency exceeding 90%. The PMGS/PCMGS14 are available with input reverse polarity protection by a series diode and are continuous short-circuit protected.

The converters operate over ambient temperatures ranging from -25°C to +70°C, meet EN 50155 and EN 50124-1 safety standards, and meet the EMC requirements of EN 50123-1. The converters are designed to withstand interruptions of the supply voltage up to 10 ms and thus comply with class S2 per EN 50155.

The Model PMGS measures 76.0 x 50.7 x 22.7 mm and mounts on pc boards, while the Model PCMGS measures 110.0 x 50.8 x 23.0 mm for chassis mounting.

[Murata](#) has introduced the first in a series of encapsulated dc-dc converters for industrial and railway applications requiring power conversion from either 96 or 110-V bus voltages. The IRQ series delivers fully regulated dc outputs of 5, 12, or 24 V at 100 W.

The converters' 3:1 wide input range of 57.6 to 160 V meets the requirements of EN50155 for input voltages of 96 V and 110 V including brownout and transient conditions. Each module is designed to deliver full power with efficiencies reaching 87% at 12-V out.

The IRQ is supplied in an encapsulated, industry-standard quarter-brick package. Additional features include on/off control options, reinforced insulation, 3-kVdc isolation, and options for mounting a heat sink or cold wall application.



Murata IRQ series dc-dc converters output 5, 12, or 24 V at 100 W. They have a 3:1 wide input range of 57.6 to 160 V.



Minimax's MKZ12055 dc-dc converters come in 18 models with inputs of 24, 48, 72, or 110 V and outputs of 5, 12, 15, 24, ±12, or ±15 V.

The MKZI10/20 series from [Minimax Technology](#) offers 20-W isolated dc-dc converters in an encapsulated 2- x 1-in. package for railway applications. There are 18 models available for railway input voltages of either 24 V nom. (9 to 36 V) or 48 V nom. (18 to 75 V) or 72/110 V nom. (40 to 160 V). Outputs are 5, 12, 15, 24, ±12, or ±15 V.

Other features include protection from overcurrent, overvoltage, and short circuits; remote on/off; output trim; and EMI filtering. The converters meet EN55032/22 and FCC Part 15 Class A as well. The MKZI10/20 series conforms to vibration and thermal shock test per EN61371, and meets the cooling, dry and damp heat test requirements of IEC/EN 60068-2-1, 2, 30. It also conforms to railway EMC standard EN50121-3-2.