

# High-Power Resistors for Demanding Industrial Applications

Converters/inverters are core systems in industrial power electronics. Their continued development is driven by reduction of installation space and improved power/current quality to reduce harmonics and parasitic currents in order to protect connected drives and generators. Other factors of concern are improved efficiency by reducing parasitic inductances, and the general need to improve the cost structure by minimizing material and assembly cost, thus also increasing the lifetime. **Ch. Lindner, EBG Elektronische Bauelemente; T. Zimmerman, EBG Resistors; D. Custic, DAU; and R. Ratzi, Miba Energy Holding, Austria**

High power resistors in converters can take over protection as well as safety functionalities like pre- and discharging of

DC-links, di/dt filtering, current limiting, as snubber and chopper resistors, and braking resistors. Now with the

possibility to integrate a high-voltage fuse inside the UXP/ULX resistor housing, it is possible to leverage the protective



Figure 1: UXP2000 (left) and ULX2000 resistor type for inverter applications

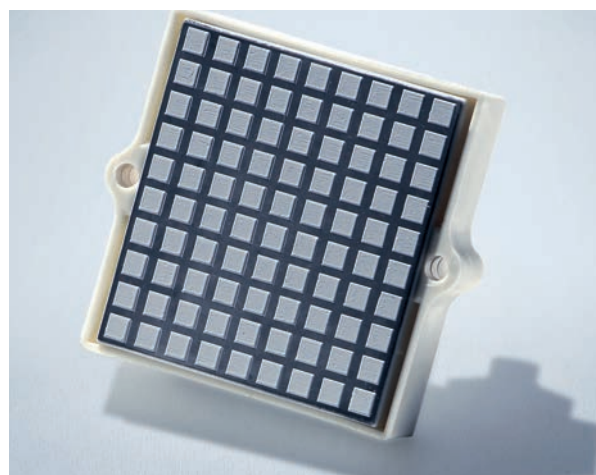


Figure 2: Resistor heat-sink unit for industrial filter application (left), and resistor with preapplied PCM (phase change material)

functionality of the resistor element as well.

#### High-performance resistor family

The new UXP/ULX 2000 (Figure 1) resistor family is the solution to reduce installation space as well as installation cost, and to contribute to improved TCO of converters and the connected electric motors.

The resistors offers a wide range of unique properties. The outside dimensions are identical with the proven UXP600/UXP800 resistor series, therefore multiplying the applicable power and reducing the installation space by a factor to up to 3.3 versus the standard UXP resistor series. Based on resistor substrate technology, incorporating high thermal

conducting ceramics the prerequisite for high performance is given. The resistors withstand typically currents of up to 80 A at a dielectric strength of  $>20$  kV DC combined with a partial discharge capability of up to 8 kV @ 5 pC at resistances down to  $0.15 \Omega$ . Similar to the standard UXP series the mechanical features of the UXP/ULX family comprise the baseplate which automatically aligns itself with the heat-sink surface. A wide range of electrical connection options with different electrical contact heights, different insulation lengths, and the option to connect via cables (ULX 2000) is available, too.

An efficient thermal interface to the heat-sink is mandatory to utilize the performance and improvements given by the UXP/ULX200 resistor technology. Proper usage and application of thermal interface material is also a mandatory requirement such as using a high-performance thermal grease. EBG can also offer a TIM based phase change material which is already applied onto the resistors baseplate as per special request, making the UXP/ULX2000 resistors suitable for automated assembly. In addition EBG also offers fully assembled resistor – heat-sink units as well (see Figure 2). The thermal

engineering of these assemblies is performed by DAU, a sister company of EBG, and can be optimized for the individual application. Thermal experts at DAU can provide the proper thermal engineering (including CFD simulation) and testing.

#### Fit for demanding applications

Such heat-sink units are suited for demanding modern industry applications ranging from deep drawing presses in steel working to powering advanced electric propulsion systems in large ships. It is not only the sizing and power level of the UXP2000, also the robustness and performance levels are outstanding, too. An empirical load testing of up to 3000 W did not show any degradation. This makes the EBG UXP/ULX 2000 resistors also the preferred choice for applications where other technologies such as cooled wire wound resistors are normally used.

Because of its small size the UXP/ULX 2000 is easily scalable to be combined to high power resistor units as shown as an example in Figures 2/3. If necessary the integrated heat-sink can be engineered to hold resistors on both sides, making the whole unit still more powerful and further minimizing the footprint.

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