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A new generation of power supplies for pulsed loads

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Pulsed power supply systems are employed in many fusion projects and in other scientific applications. A novel power supply was specifically developed to feed pulsed loads (low duty cycle), as the resistive or superconducting coils used to produce high magnetic fields for some seconds or longer.
Thanks to the integrated energy storage devices, it is not necessary to draw directly from the electrical grid the high pulsed power required for the load. In fact, a huge amount of energy (more than 800 kJ and 220 Wh) can be stored at low power (even through a single-phase 10 A plug, as normally used for household appliance) inside an easily movable cabinet. This energy is promptly available at higher power when required. A significant fraction of the energy delivered to the load can be recovered for successive operations.
Without such energy storage, all the power supply devices must be oversized. Therefore, the related activities can be performed only in locations provided with adequate power. Moreover, a specific solution was implemented to achieve a very fast energization of the magnets.
The maximum output current and voltage of the power supply are 2 kA and 300 V (600 kW), respectively. The current ripple is kept within ±10 A at the flat-top and the acoustic noise is minimized by the converter's high switching frequency.
The energy storage capability is intrinsically scalable: the setup can be rearranged and the storable energy can be updated even after the installation (for example, to increase the pulse duration).
The first power supply unit was installed to feed the external coils of the compact spherical tokamak PROTO-SPHERA, located in the ENEA laboratories in Frascati. This unit can replace a previous system with comparable performances, but this system occupies an extremely larger volume and needs a 20-kV connection at the input.

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