Dc/dc converters for military and aerospace

Homeland security, airborne drones, and future warrior technologies increase the demand for proper device selection

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Over the last decade, several salient technology drivers have caused a transformation in the design and manufacture of dc/dc converters for the military and aerospace markets. This transformation has caused designers to evaluate several new selection criteria before making their technical and cost decisions. New military and aerospace programs, homeland security, airborne drones, and future warrior technologies are all vying for low-cost, lightweight, highly reliable electronic packages that must survive rugged environments on new platforms.

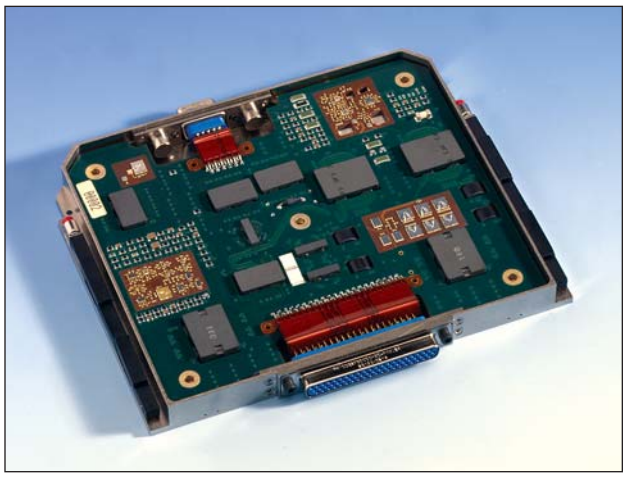

Fig. 1. This 6U COTS dc/dc converter uses COB and planar magnetics technology.

Power trends

One of these drivers is the trend for digital ICs to use lower and lower power supply voltages, partially due to device scaling in finer geometry CMOS devices from several microns to submicron features. Thus, CMOS devices with 3.3-, 2.8-, 1.8-, and sub-1.0 -V requirements are replacing 5-V bipolar technology.

These low-voltage ICs demand high currents (>40 A) that in turn cause voltage drop, ripple voltage, and noise issues. In addition, analog circuits that used bipolar integrated circuits with ±15 V are now being replaced with CMOS and BiCMOS devices using ±5-V and lower circuits.

The commercial-off-the-shelf (COTS) movement has introduced the military and aerospace markets to commercial surface-mount (SMT) technology, plastic parts, planar magnetics, and chip-on-board (COB) architectures to dc/dc converter topology (see *Fig. 1*). Other commercial technology drivers such as the new 42-V power bus for automotive systems are forecasted. New power-generation topologies will be created to meet these new demands for dc/dc converters, which may include the use of ultracapacitors and new pulse width modulation (PWM) ICs.

Another trend is the development of the "digital power supply," using microcontrollers and DSPs to replace many analog functions in the dc/dc converter such as digital dc/dc control, fault management PWM, and active in-rush blocks. This new software approach also simplifies the manufacturer's production by having one universal design, which is programmed by software to each unique dc/dc converter application.

Power levels and device choice

Applications of less than 1 W are usually designed with off-the-shelf ICs or discrete semiconductors. Many of the major semiconductor vendors have application circuits or Spice models online for the designer to easily develop the circuits and bills of material.

As power increases to the 1 to 10-W levels, designers have several choices. They can develop the dc/dc converter circuit themselves or outsource the job to established vendors.

At the 10 to 350-W power levels, the choices include bricks, COB modules, hybrids, or modules containing multiple hybridized dc/dc converters. At higher power levels, the choices decrease with rack-mount or open-frame devices dominating the potential solutions. EP