

# Challenges of Space-Saving Power Supplies for Harsh Environments

**Operating reliably in extreme ambient temperatures is no small task for AC to DC power supplies with PFC that are employed in indoor and outdoor-mounted electronic equipment where compact size is mandatory**

Compact DC-DC converters have made their way into millions of electronic products and systems. The vast majority of these depend upon an AC front-end-box to convert the AC power source into a DC voltage from which the converters operate. In addition, regulations have mandated that these front-end-boxes include Power Factor & Harmonic Correction (PFHC) to maximize the available power from the power grid. Add to this the need to be as small as possible and to operate with harsh ambient temperatures and the designer is faced with a problem that is not easily solved.

## Traditional Distributed Power Solutions

Traditional designs that employ distributed power architecture place DC-DC converters on PC boards very close to the point-of-load to maximize system speeds and efficiencies. To power the DC-DC converters, the required AC-DC power supply with PFHC is typically mounted somewhere in the system's enclosure, external to the main pc-board (Figure 1).

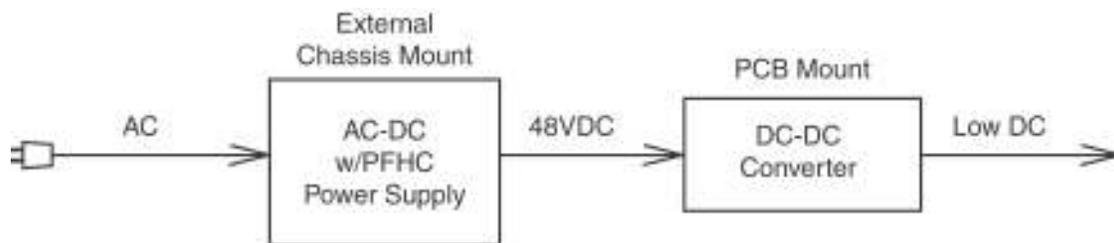


FIGURE 1

This technique is quite reasonable for most applications. However, when it comes to equipment that must be mounted outdoors and occupy the smallest possible volume, there are now improved power products available.

## Improved Power Distribution Methods

Typical medium power (400-700 watts) PCB mounted DC-DC converters are packaged in "full brick" sizes (e.g., 2.4" W x 4.6" L x 0.5" H). A number of major manufacturers of DC-DC converters have seen the need for, and are now providing AC input PFHC front ends in brick-formats that are PCB mountable near to the DC-DC converter(s). This has the advantage of placing all the power components on the same pc-board thus reducing the end products size and eliminating the power interconnect wires (Figure 2).

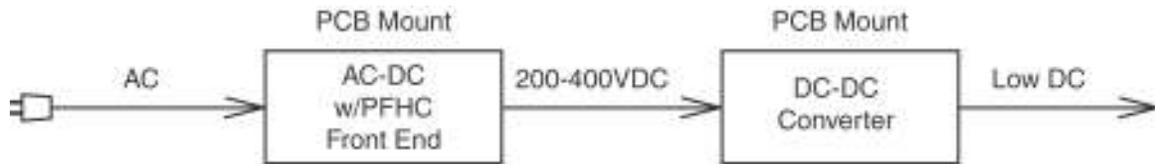


FIGURE 2

These AC-DC w/PFHC front-end bricks require some external components (capacitors, resistors, etc.), but the space required for these items is small in comparison to the elimination of the external “metal boxed AC front end”. And, these external components can be robotically inserted during the production of the pc-board. An added benefit of utilizing these brick packages is that they can be cooled without fans, by means of heat sinks or cold plates (e.g., mounting the brick bases against the system’s metal enclosure).

### The Latest AC-DC Power “Brick” Solutions

Power Supply manufacturers have not stopped developing smaller and better power solutions. In fact, in recent times the AC/PFHC brick mentioned above has been merged with a DC-DC converter to form the ultimate power solution; an AC/PFHC/DC integrated brick. These 2-in-1 devices accept wide range 85 to 265 VAC inputs, correct the power factor, and provide the DC output(s) to the system. All this is accomplished within the same size constraints of a single “full brick” package measuring only 2.4” W x 4.6” L x 0.5” H, thus providing a 50% board space savings (Figure 3).

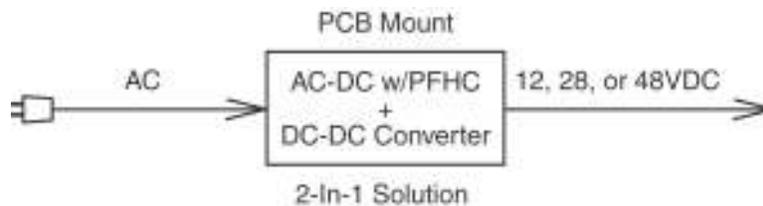


FIGURE 3

These integrated 2-in-1 pcb-mounted Power Bricks are ideal for Distributed Power Architectures where POL (Point of Load) Converters are needed. Since the 2-in-1 Power Bricks provide the conversion from AC to DC (with PFHC) along with the needed isolation, and the Intermediate Bus Voltage, the use of multiple low-cost, non-isolated POL converters becomes quite practical (Figure 4).

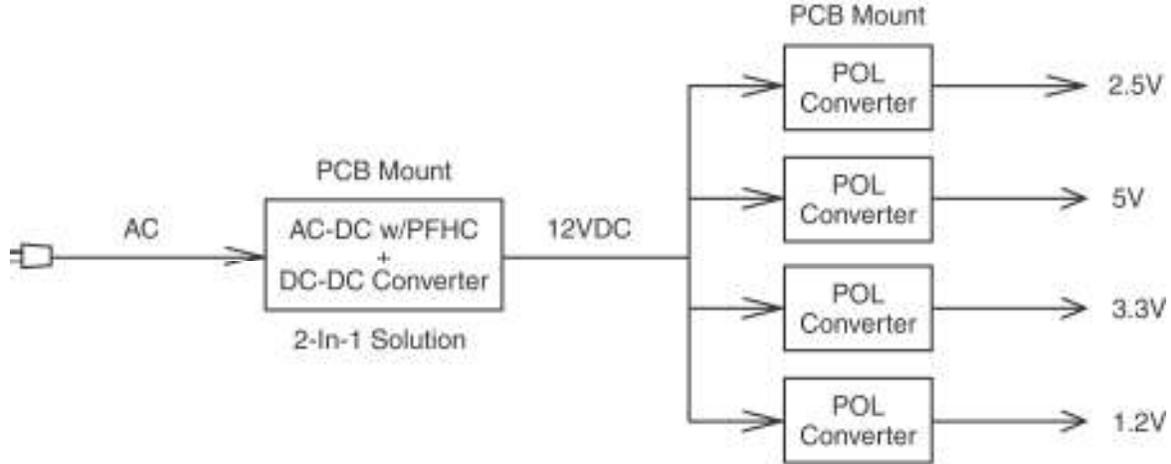


FIGURE 4

Recent advances in components and power design technologies have made these new 2-in-1 pcb-mount power bricks possible. In order to increase power densities, special Permalloy cores have been developed and employed in the inductors. New substrates and innovative transformer winding techniques have facilitated component height compressions and improved thermal management. And, of course, advances in integrated and hybrid circuits have contributed greatly to this next generation of power products.

### Applications of 2-in-1 AC-DC Power Bricks

These new “2-in-1” AC-DC power bricks are ideal for many outdoor and indoor applications including:

- Custom Power Supplies
- PCB Mounted Bulk Power for Multiple DC-DC or POL Converters
- Large LED & Liquid Crystal Displays
- Traffic Information, Control, & Signaling Equipment
- Toll Devices
- Pico & Cell Phone Repeaters
- WiFi, Telecom Sub-Station
- Underwater Surveying Devices
- Automatic Pass-Reading-Devices for FastTrac Car Lanes
- Oil Pumping & Pipeline Monitoring Devices
- Security Systems

### New 2-in-1 AC-DC Power Bricks

Lambda, a unit of TDK Corp., is currently one of the manufacturers of a new range of integrated “single-brick” AC-DC power bricks. These “2-in-1” pcb-mount devices are so innovative, they have seven patents pending.

Some of the salient features of Lambda's single-brick AC-DC **PFE Series** power modules include:

- Operates from Universal 85 to 265VAC, 47-63Hz Input
- Power Factor & Harmonic Correction Meets EN61000-3-2
- Low Profile, Single-Brick Footprint
- High Power Density (up to 129W/in<sup>3</sup>) & Efficiency (up to 90%)
- Regulated and Isolated DC Outputs with Wide Operating Temperatures (at baseplate)
  - PFE500-12: 12VDC Output, 400 Watts, -40 to +85°C
  - PFE500-28: 24 to 28VDC Output, 500 Watts, -40 to +100°C
  - PFE500-48: 48VDC Output, 500 Watts, -40 to +100°C
  - PFE700-48: 51VDC Output (semi-regulated), 714 Watts, -40 to +85°C
- +/-20% Output Voltage Adjustment Range
- Over Voltage/Current/Temperature Protection
- Approved to UL/CSA/EN60950-1, CE Marked, & RoHS Compliant
- Optional Heatsinks & Evaluation Kits Available



Photo of Lambda's PFE 700-watt AC-DC Power Module

For more information about the PFE Series, please contact Lambda at [www.lambdapower.com](http://www.lambdapower.com)