WHITE PAPER

VIA PFM from Vicor Enables Power Component Design Methodology from AC to the Point of Load

May 2015

Abstract

This White Paper describes how the new VIA PFM, a power component that performs the front-end AC-DC conversion required in many systems, allows the application of Vicor's Power Component Design Methodology from AC to the Point of Load (PoL). The performance of the component is described, highlighting how the VIA PFM can contribute to the development of power systems that offer exceptional flexibility, density and efficiency.

The Power Component Design Methodology

In the early days of electronic systems, designers used centralized power architectures (CPA), where all the required voltages were provided by a single "silver box" or open frame supply. As the demands on the power system grew, particularly with the emergence of semiconductor loads such as processors and FPGAs that required low voltage, high current supplies, engineers distributed converters and regulators throughout the system. Point of load converters have therefore been a popular choice to provide voltage step-down regulation, close to the load, enabling the higher currents required for low-voltage components.

The Vicor Power Component Design Methodology is an approach that partitions the power system into several separate components, each optimized to perform a specific role. These power components connect seamlessly to other components in the power chain, making the design and development of complex systems quick and easy, while retaining unprecedented flexibility.

An AC-DC Power Component for the Front End

Although the Power Component Design Methodology has been recognized by engineers at many companies, the lack of a true AC-DC power component meant that the methodology could be difficult to apply from AC to PoL. The launch of the VIA PFM changes this, making the Power Component Design Methodology an end-to-end solution for developing high-performance power systems.

Power components are defined as building blocks that perform functions which can be flexibly joined together to make complete power chains. If they are to be easy to use, they should require a minimum of additional circuitry, and therefore an AC front-end component needs to provide PFC (Power Factor Correction), EMI filtering and protection against transients, surges and inrush. The VIA PFM integrates all of this functionality into the flexible, thermally-adept VIA package.

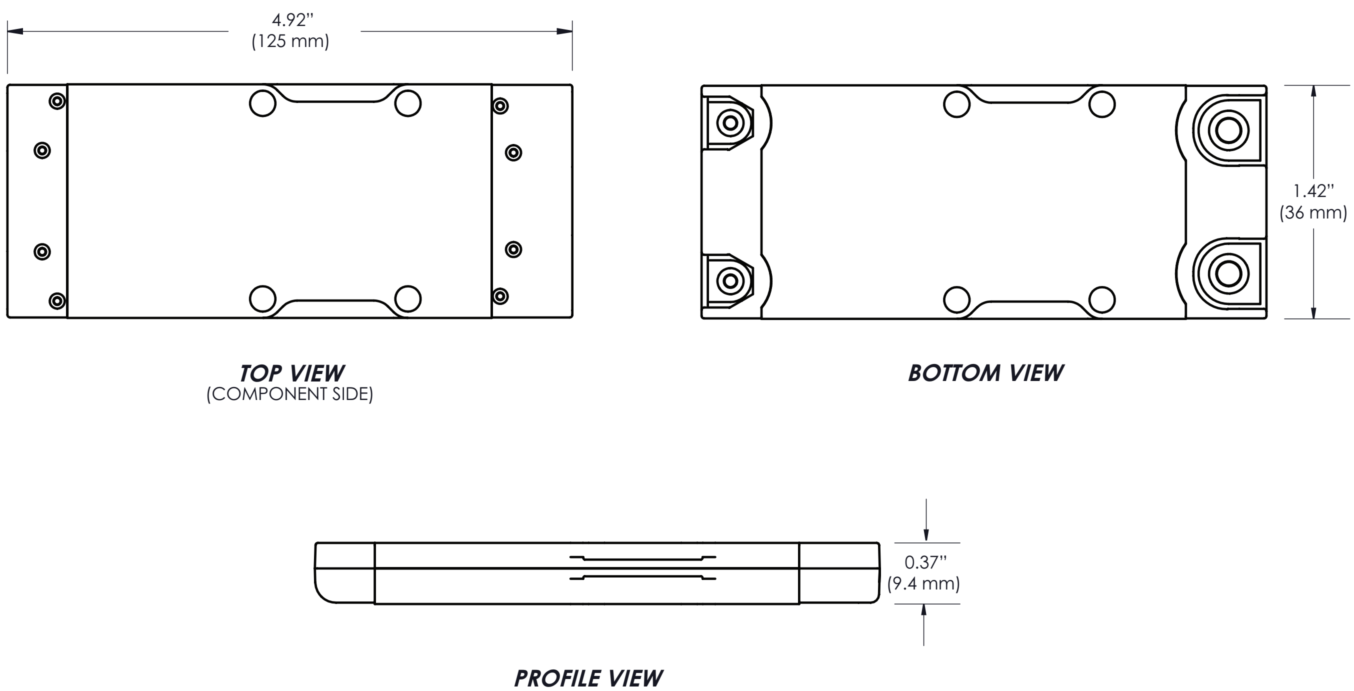
The Benefits of VIA Technology

VIA packaging technology provides industry-leading power density. It has a compact footprint of just 35.5 mm wide with lengths ranging from 72 to 141 mm, as well as a low profile height of only 9.3 mm. Both board-mount and chassis-mount versions of the package are available, allowing engineers to mount the component in the most efficient and convenient position.

The highly-efficient double-sided thermal housing removes heat from the top and bottom of the components within the VIA package, but requires heat sinking on only one side, optimizing the removal of heat while simplifying the thermal design. The space required for the power system is further minimized by the chassis-mount version, which allows the system chassis to be part of the thermal design, and in many applications fans can be eliminated, further reducing the space required whilst increasing system reliability.

Figure 1:

Construction of the VIA package



The small size of the VIA platform, particularly the low profile of the package, allows unprecedented flexibility of location. A VIA component can often be mounted in space within the system that might previously have been unused: for example behind DIN rails. The effect of this is that these power components can require no additional space within the system.

The VIA family also integrates critical ancillary functions such as transient protection, EMI filtering, and inrush limiting. Implementing these functions within the module essentially reduces the front-end power subsystem to a component; reduces implementation size and parts count; simplifies the power chain design; and simplifies PCB layout or chassis wiring.

The VIA platform can be applied to Vicor's current and future power-conversion topologies including the ZVS non-isolated regulator, the isolated fixed-ratio sine amplitude converter, and isolated double-clamped ZVS regulator. VIA components will also integrate directly with other Vicor power components, including our extensive portfolio of PoL regulators and DC-DC converters.

Overview of the First VIA PFM

The first VIA PFMs offer a universal AC input (85 – 264 Vac with frequencies of 47 to 63 Hz) and provide either a 24 V (PFM4914xB6M24D0yzz) or 48 V (PFM4914xB6M48D0yzz) isolated, regulated output at 400 W. Unlike some other AC-DC converters, the VIA PFMs maintain maximum output power over the entire AC input voltage range.

Both devices are housed in a compact 125 x 36 x 9.4 mm, which is available in chassis-mount and PCB-mount form-factors. The VIA PFMs also offer exceptional peak efficiency of 92% (24 V output) or 93% (for the 48 V component), with an efficiency curve that is extremely flat over the entire voltage range.

Extensive filtering and protection means that only minimal additional components are required at both the input and output. The VIA PFMs integrate active PFC (Power Factor Correction); EMI filtering; and transient surge & inrush protection. The VIA PFM also integrates voltage, current and temperature protection, ensuring that systems built using the component are robust and reliable. An extended "T-Grade" (-40°C to 100°C) temperature range is available as well as standard "C-Grade" (-20°C to 100°C).

A small number of external components are required to create a complete AC-DC converter using the VIA PFM. In addition to a rectifier, the input of the VIA PFM requires only a fuse and MOV (metal-oxide varistor) for protection and hold-up capacitors, while the output needs just hold-up capacitors.

A single design can be used across the globe, as the universal input supports the full range of AC input voltages, while the Active PFC exceeds 0.95 at most line conditions, allowing a system to easily meet all agency standards.system should be capable of handling full power for a short time.

The power system designer should also consider the maximum slew rate of the load and its repetition rate. These functions require smart management from control circuits. To facilitate this, digital power-management control circuits can automatically detect the load condition and smoothly switch to the appropriate converter.

The VIA PFM is ideal for AC-DC applications where power density is a key requirement, such as small cell base stations and other telecom equipment; DIN Rail power systems; LED lighting; test and measurement systems; and a wide range of industrial applications.

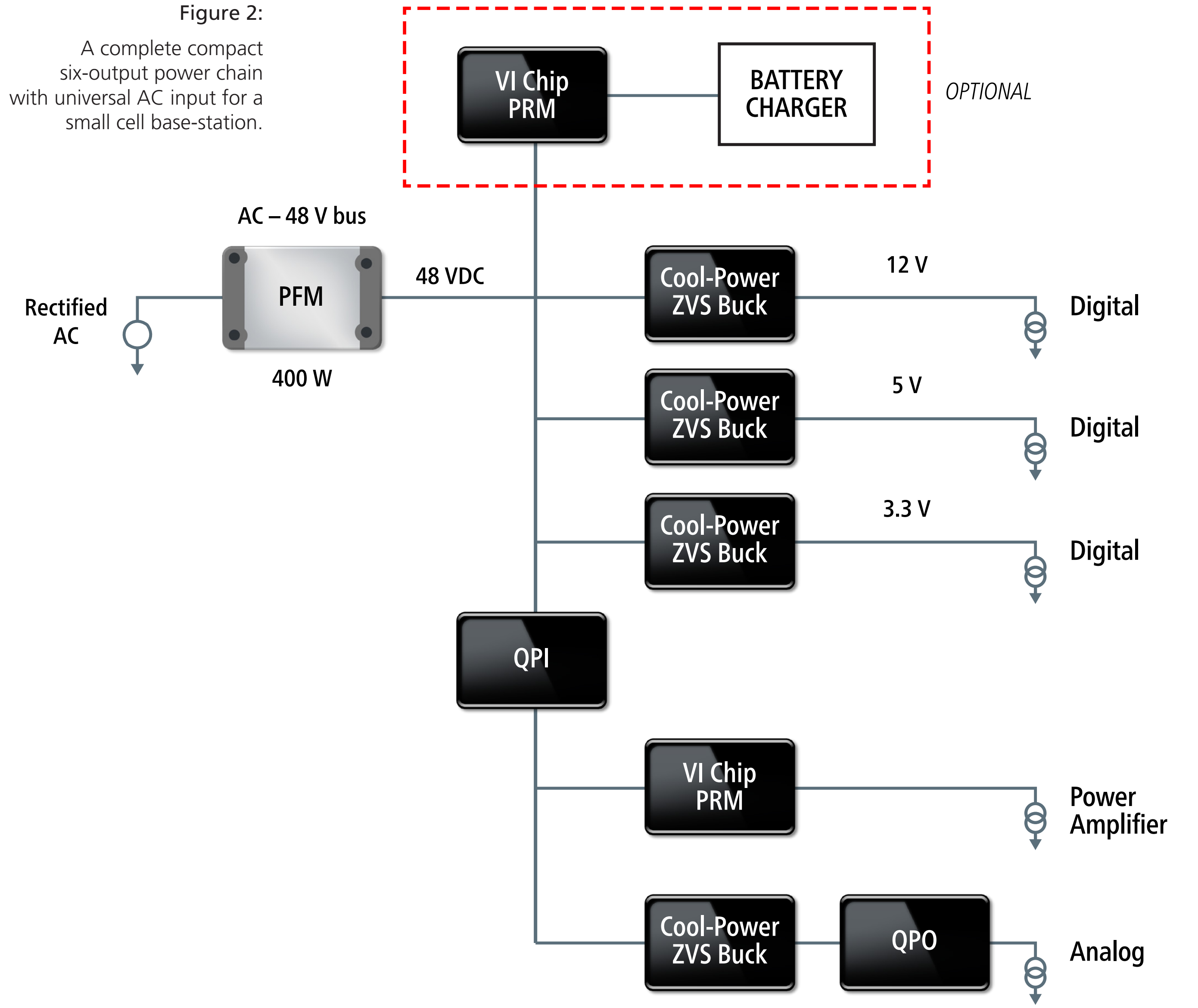


Figure 2:

A complete compact six-output power chain with universal AC input for a small cell base-station.

Future Developments

VIA Packaging Technology will provide a platform for a complete range of front-end power components. Vicor has already announced that, in addition to a growing range of AC-DC front ends, a family of DC-DC front end converters are being developed, including components that support high voltage DC (HVDC) inputs.

The AC-DC family will also be expanded, with additional filtering options, intelligent control and enhanced scalability. The VIA platform could also be used for other peripheral components.

Conclusion

Building on the flexible, thermally-adept VIA Packaging Technology, Vicor has created a family of AC-DC front-end components that allow the Power Component Design Methodology to be used from AC to Point of Load. This enables engineers to create flexible, efficient and dense high-performance power systems quickly and easily, using a building-block approach.

While the application of the Power Component Design Methodology will typically enable the creation of optimal power systems, the VIA PFM is also an important device in its own right, offering a high level of integration and an unprecedented power density in a form-factor that simplifies thermal design. The VIA PFM can therefore be deployed in a wide range of applications where space is a critical design criterion.