Maximize Gains Using Miniaturized PoL Converters

System power requirements today are challenging, with designers needing to overcome issues such as multiple supply voltages, voltage sequencing, high transient load currents, and excessive heat. Rather than address these problems at the system power supply, it is more beneficial to introduce measures at the PCB (printed circuit board) level, meaning some form of point-of-load (PoL) converter is required.

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Numerous key trends have dominated the electronics industry in recent years, not least of which is the industry's shift away from centralized power systems, and even from decentralized or distributed power architectures (DPA). Instead, the latest preference is for intermediate bus architectures (IBA), where an isolated front-end DC/DC converter supplies multiple small non-isolated DC/DC converters (known as Point-of-Load/PoL converters) placed near the loads they are supplying (Figure 1).

In relation to the deployment of PoL converters, another set of trends has emerged, including the need for ever-greater performance levels, reduced costs, and system/component miniaturization. The latest electronic devices are not just faster and smarter, they are also considerably smaller, lighter, more power dense, and more efficient than previous generation products.

This factor has enormous ramifications for power supply design. In the first instance, every square millimeter of PCB real estate commands a high value, so the smaller the converter, the better. But there is another issue to consider here. PoL power supplies solve the challenge of high peak current demands and low noise margins required by high-performance semiconductors such as microcontrollers or ASICs, predominantly by being placed close to their point of use. Unfortunately, many designers end up leaving power supply considerations to the last minute due to their tight development schedules and complex boards. As a result, PCB space is frequently compromised, only leaving space for a miniaturized device.

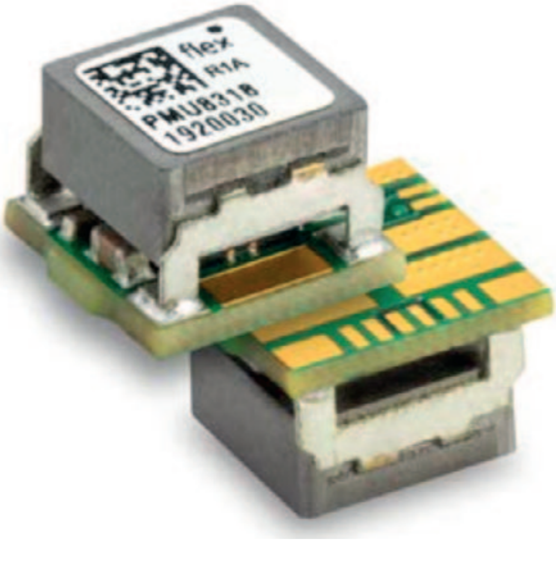

Figure 1: PoL converters such as the PMU8000 series offer an alternative to centralized power systems
Source: Flex Power Modules

Versatility for a multitude of applications

Another consideration is versatility. It is advisable to assess whether a PoL converter is suitable for both ASICs and FPGAs, for example. While most optimized PoL power supplies represent simple analog (not digital) solutions, the capability to serve FPGAs is important as they are gaining popularity among designers for a multitude of applications.

FPGAs offer many advantages over custom-designed ASICs, including lower cost, a wide range of sizes, and the potential to reconfigure circuits. However, although these benefits are highly appealing to design engineers, there is a problem. Each FPGA will require multiple DC voltage supplies. Often four, six or more DC rails will be needed, some at relatively high currents for the core, but many at much lower currents. Which is why diligent PoL converter selection is critical, especially as the latest high-density FPGAs (and ASICs) are becoming more sophisticated and demanding. In simple terms, performance, efficiency, quality and flexibility cannot be sacrificed in the name of miniaturization.

Yet with PCB real estate at a premium, there is no overlooking the importance of size. A key point is that small PoL converters are often low-profile and light enough to be used on the underside of a PCB, saving more space and increasing design flexibility. Compare this space saving concept to larger/heavier/taller PoL power supplies or individual isolated converters which can only be mounted on one side of the board, and the benefit is clear.

In addition, miniature PoL converters can be placed far closer to their loads, again presenting a number of key advantages. By way of example, DC/DC distribution losses will be minimized, while noise sensitivity and EMI emissions issues will be overcome. Furthermore, stray inductances can be reduced, enabling a quicker response to transients.

Deploying multiple PoL converters will also make it far easier to provide the various voltage supplies typically demanded by high-specification components on today's PCBs.

A further area that requires scrutiny is thermal performance. As power components become smaller and more densely packed, the potential for higher heat transfer is more prevalent. However, it is well established that power dissipation, and hence heat, must be kept to a minimum, to avoid temperature rises and potential unreliability, as well as the extra cost of removing any excess heat. The best advice, therefore, is to give the PoL converter's datasheet a detailed read, especially when checking the thermal performance and efficiency data. The information related to thermal performance is often provided as a 'derating curve', depicting how the maximum output of a converter depends on ambient temperature and cooling conditions (Figure 2).

The product's efficiency data is also found in a corresponding 'efficiency curve' in the data sheet and must be given a thorough review (Figure 3).

It is also recommended that system designers seek out additional functionality that can potentially increase performance. For instance, some regulators include a loop optimization feature that enables engineers to optimize their transient response for different capacitive loads, thus increasing flexibility in system design. Certain PoL solutions also provide a configurable soft start or tracking feature, which makes time sequence design easier and more flexible.

Miniature PoL converters such as the PMU8000 which are packaged in a standardized form factor in the market, can be applied on the top or bottom side of the board, making them a highly flexible solution for design engineers. One footprint covers current levels of 4 A, 6 A, and 8 A, which provides even more flexibility to system designers aiming to optimize power design. Moreover, the modules can also function in high temperatures (up to 105°C) and harsh environmental conditions. Here, the robust design means that the mean time between failure (MTBF) is specified at 171 Mhrs. The PoL regulators from Flex Power Modules are suited to a wide range of power conversion applications, including FPGAs, ASICs, network processors, CPUs and GPUs, across sectors such as ICT (telecom and datacom), industrial, test and measurement, IoT, railway, and medical.

Conclusion

In summary, miniature DC/DC converters are suitable for a wide range of applications on boards where space is at a premium. Such regulators are compact and cost-effective, and provide many generic project benefits, such as shorter development cycles, easier qualification efforts, design placement flexibility, higher quality levels, and development cost savings. To meet the ongoing demand for miniaturized PoL regulators, Flex Power Modules sells its compact product family through Digi-Key, which provides an excellent price/performance ratio in a small, low-profile, feature rich package. Efficiency is high at typically 95.3 %, while thermal performance is also exceptional, in part because the LGA design allows heat to be transferred down to the host PCB.

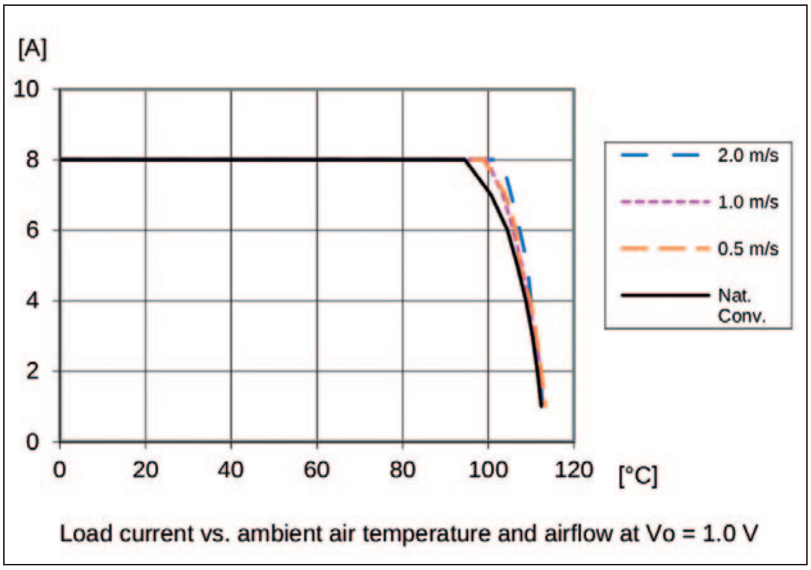

Figure 2: **The PMU8418 product's (4.5-17 VIN, IOUT set point, 8 A) output current derating curve shows that current remains stable at 8 A with no airflow until the temperature value of +105°C is reached.** **Source: Flex Power Modules**

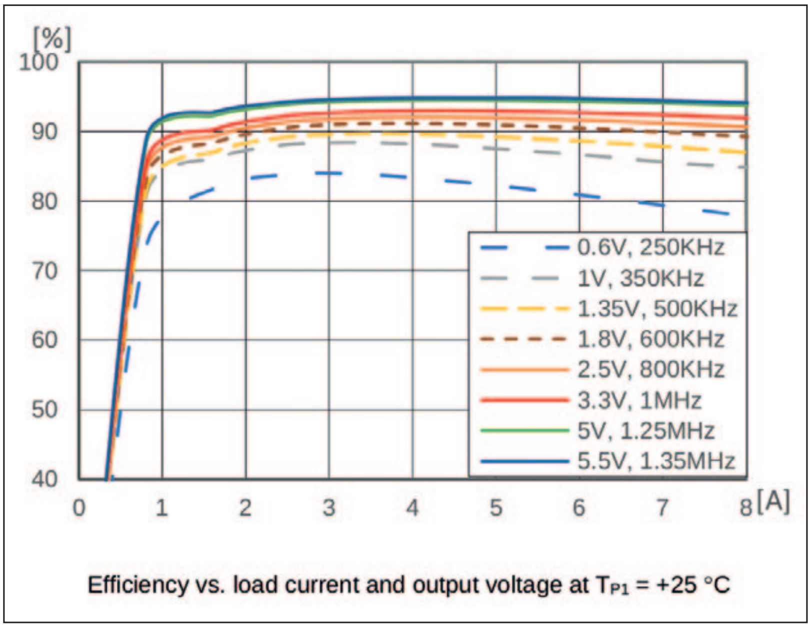

Figure 3: **The efficiency curve must also be considered when choosing a POL. Shown here is the typical efficiency characteristics of the PMU8418 product (4.5-17 VIN, multiple VOUT and switching frequency levels shown, 8 A max)** **Source: Flex Power Modules**