

Power Management 2.0:

How PSiPs And PwrSoCs Are Changing Board-level Power Design

by Arnold Alderman, Anagenesis, Los Angeles, Calif.

Why is it important that the power supply in a package (PSiP) and the power supply on a chip (PwrSoC) are emerging on the power management scene? Many ask, "Do customers really need these miniature integrated power supplies?" Expecting a single answer, I found there are several, and in quite unexpected places.

One answer, discovered while researching our recent report on these devices, was sitting in the crowded economy class section of an airplane that had just taken off from San Jose airport on its way to Taipei. There sat an integrated circuit (IC) application engineer, apparently one of a whole crowd of such experts who shuttle weekly to Asia to help customers "put the pieces together" to make a point-of-load (POL) power supply.

Fortunately, that situation is about to change. Companies that have bought into the PSiP concept are about to change the fate of these technical troubadours. Perhaps PSiPs won't eliminate the "shuttle," but company travel expenses for IC technical support will become a fraction of what they are now. The PSiP concept is simple: Don't provide part of the solution, provide the *entire* solution—in this case, the POL power supply.

The Great Divide

This problem would have been solved long ago had it not been for the fact that the power supply is confounded with a multiplicity of component technologies that don't mix well. It has semiconductors, power capacitors, and that incorrigible power *inductor*—that magnetic thing. The obvious solution is to provide the entire power supply in a very compact single package. Doing so, however, places solution providers in the schizophrenic position of having one foot in the power supply world and one foot in the semiconductor world, with neither taking responsibility for the integrated solution. In the past, the vendors in these two industries could not handle this dichotomy, so initially both the power supply and semiconductor industries failed to take responsibility for the integrated solution.

Going back to the mid 1990s, the power supply (PS) manufacturers were providing the POL and voltage regulator module (VRM) power supplies as components assembled on printed circuit (PC) boards. They deftly created incredible POL and VRM power supplies, needed as the distributed power architecture became widely used in OEM systems. However, the PS companies did not stay current with the fast pace of packaged solutions and the ever-increasing power density. Those boards became too huge for the job of supplying power to the countless processing chips as system densities increased.

To achieve the next step in the POL power density evolution, and eliminate the bulky "board" approach, designers implemented the "down" design with all components laid out directly on the motherboard. However, in this move, the power supply manufacturer relinquished most of their POL and VRM design role. In fact, there was quite a migration of power designers from the PS companies to the IC companies or to OEM customers. Over time, it resulted in the power-management design landscape completely changing to 5% power supply companies and 95% OEM system companies.

Integration has progressed, but in a limited way. On the IC supplier side, the result was an unimaginable list of power management devices introduced over the past two and a half decades. These devices included some partially integrated ones, then more-integrated ones, and then even-more-integrated ones. Struggle as they might, this integration always remained within the semiconductor boundaries, with the power passives remaining elusive orphans.

In this situation of divided responsibility, it has finally boiled down to one basic question, "Whose job is it to provide the complete power supply design?" At this point, it has fallen either on the OEM customers whose power expertise has been dwindling year by year, or on the semiconductor supplier who is usually quite remote from the motherboard design point.

PSiP And PwrSoC Development

Well, that all started to change, very quietly, shortly after the millennium. A couple of insightful power management visionary companies foresaw that the best solution was to provide the entire solution in one package, but don't make it a "board." The CTO of one manufacturer actually envisioned this possibility in the

early 90s. Their work on developing within-reach technologies early in the 2000s produced the first PSiPs by 2005.

Initial PSiP attempts integrated a number of components into a single package containing the semiconductors *and the power passives*. They desired to make this quantum jump in power management devices transparent to their customers, so they molded the PSiP to look like a pick-and-place component, much like an IC. Thus, we have the widely accepted PSiP products in today's market.

We have seen their performance improve over the past few years. The PSiP power density has more than doubled with output current now at 15 amperes. As you would expect, their work continues as these visionaries move on toward their ultimate goal—creating the power supply on a chip (PwrSoC) that merges all of the power converter elements into a very-high-volume, low-cost semiconductor processing flow.

The Impact Of PSiPs And PwrSoCs

At this point, several questions come to mind. "How will the power management product landscape evolve over the next few years?" "Do the semiconductor suppliers become the only players?" "Will the power supply manufacturers get back in the game or walk away?" There is argument for their staying. They have excellent converter design capability and the fabless IC model now has considerable strength to it.

Then there is the question, "What becomes of magnetic element sourcing? Does it stay with the magnetic component supplier, or does it move to being a semiconductor thing?" My guess is that it will ultimately become part of the semiconductor-type manufacturing process—but for most suppliers, this will take considerable time to implement. The long-term prognosis may not be very comforting to the magnetic community. However, in the end, acquisitions can cure many ills. You might retort, "This was already attempted, and it did not work." Well, I maintain that it can be a successful move, but that is a point I'll address at another time.

"How will the packages change?" Today, those providing PSiP devices are rapidly moving toward modified high-current IC packages with much better thermal performance. I believe that a whole new set of packages, now in early-stage design, will house the next-generation PSiP and PwrSoC products. You may think that these packages will be too expensive. Yet, I maintain that may not be the case, especially in the long run as these devices reach into more and more high-volume applications.

Everyone has great expectations for digital control in these PSiP and PwrSoC products, with at least one such product already available. However, like many, I have concerns about digital control achieving the bandwidth needed to achieve multi-megahertz switching frequencies. Designers want to get to a switching frequency of 20 MHz. However, there are questions as to whether switching frequencies beyond 5 MHz are possible with digital control in the near term. I know of only one technology that approaches 20-MHz bandwidth. I am hoping to find more advanced digital technologies in development. Since the PSiP and PwrSoC really add benefits when operated at these higher switching frequencies, I have confidence that technologists and power designers will rise to the occasion.

What Next?

In any case, one cannot deny that PSiPs and PwrSoCs will significantly impact the future choices in power management devices available to system designers. It is quite apparent they will become mainstream products. Longer term, it will be interesting to see how these devices will perhaps eventually evolve into an element within the system on a chip or SoC architecture.

Reference:

["Market Report: The PSiP & PwrSoC: The Ultimate Power Density Challenge, 2008 – 2015", by Arnold Alderman and Ada Cheng, Anagenesis, Inc., 2011, Los Angeles, CA](#)

About The Author



Arnold Alderman is president of [Anagenesis](#), a technical marketing consultancy founded in 2001. He is the author of numerous publications, articles, and presentations on PSiP and PwrSoC technologies and markets. Arnold helped organize the PowerSoC 2010 and 2012 workshops. His firm, Anagenesis, wrote the first report on these devices, published by the Power Sources Manufacturers Association (PSMA) in 2008. He is a member of the PSMA Board of Directors and is a past board chairman and past president. Presently, he is a member of the PSMA Energy Efficiency, Nanotechnology, Semiconductor, and Packaging committees, and is a member of both the Power Electronics Society (PELS) and the Industrial Applications Society (IAS) of the IEEE.