## Design Features

### Realizing the PoE+ Future

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*by Matt Tyler*
*ON Semiconductor Inc.*

Power over Ethernet (PoE) has allowed communication and power infrastructure to be combined, significantly reducing hardware installation problems and curbing the required investment, as well as bringing greater functionality and improved flexibility to a plethora of different applications. The recent ratification of IEEE802.3at (PoE+) has the potential to progress this technology still further. ON Semiconductor's Matt Tyler looks at the implications of this higher power standard, and details the size, cost and performance challenges that lie ahead.

Using only standard CAT-5 data cables, thanks to PoE it has for several years now been possible to connect Powered Devices (PD), such as IP phones, wireless access points, security cameras and various handheld terminals to Power Sourcing Equipment (PSE). The proliferation of this technology has, until this stage, been somewhat restricted though by the output power that could be handled. The IEEE802.3at standard is able to support power levels of up to 30W, compared with the 13.4W offered by the previous IEEE 802.3af version. This will expand the number of products/devices that can profit from PoE and help to satisfy the growing need for greater levels of power.

### Application opportunities

A wide array of mainstream consumer oriented products like home/business automation panels, netbook computers and low power laptop models have power requirements that conform with PoE+. As a result a basic docking station consisting of nothing more than a RJ45 connector could be utilized for power distribution. Public information kiosks and point of sale terminals would also benefit greatly from having to forego a dedicated power connection. These units will often have heavy power demands due to their flat panel LCD displays, embedded computing platforms and printer systems, but many will be able to run off a 25 W supply (or the 50W made possible be connected through spare pairs). Wireless infrastructure is also a huge potential growth area for PoE. Access points for WiFi and WiMax transmission have to be connected back to a router, switch, or primary network connection. The additional power delivery that IEEE802.3at permits would greatly simplify deployment, again needing nothing more than a RJ45 interconnect. Another wireless application activity that could gain from the support of high power PoE is the roll out of femto/picocells. These small-scale access points allow mobile communication coverage in non-traditional locations (such as in large buildings) as well as supplementing the existing coverage in high population areas.

### Enhancing IEEE802.3at

The person operating the PD will of course expect it to be feature-rich and have acceptably high performance benchmarks. However, they will also have become accustomed to sleek form factors - not having to contend with bulky wall-mount transformers, etc. Continued demand for greater performance will of course bring higher power consumption with it. Though introduction of IEEE802.3at was intended to address the increasing need for power, state of the art system design is already pushing this envelope. This could mean that PoE standards will still struggle to keep pace with advances in product innovation.

Given that the maximum voltage applied to the Ethernet cable is limited by the generally accepted theory that going above 60V could be life threatening, stringent regulations prevent conductors from carrying such elevated voltages. This means that any PD must realistically keep to below the 57V mark. The current is the primary reason for efficiency loss in a given part of the system. This is described in the familiar formula $P = I^2R$.

In order to increase the total power that can be delivered to a given PD node, it is thus necessary for the series resistance to be lowered, and the relation to the thermal performance of the entire PoE system must in turn be considered. Unfortunately, the specifications set out for the majority of PoE products are only qualified to cope with standard industrial temperatures and could exhibit poorer performance or have a shortened operational lifespan if the power delivery limits imposed by the PoE standards are exceeded.

If this hurdle is to be overcome, the PoE electronics must offer the possibility of externally configuring the embedded current limit. Furthermore it must also be manufactured in a technology that can support running at higher temperature levels without detriment to its performance or its overall operating life. Most PD and PSE products allow the maximum current threshold to be configured, but only a limited number will offer true high temperature operation.

If the spare pairs are made use of, it is easy to implement a PD node with two PoE controllers and combine the outputs on the secondary side of the power transformers (as shown in Figure 1). There are a few commercially available PoE-enabled products that can supply a 30W output to each pair (allowing 60W to be delivered to the load) and still remain compliant with both the IEEE802.3at and IEEE802.3af PoE standards.



## Did You Know?

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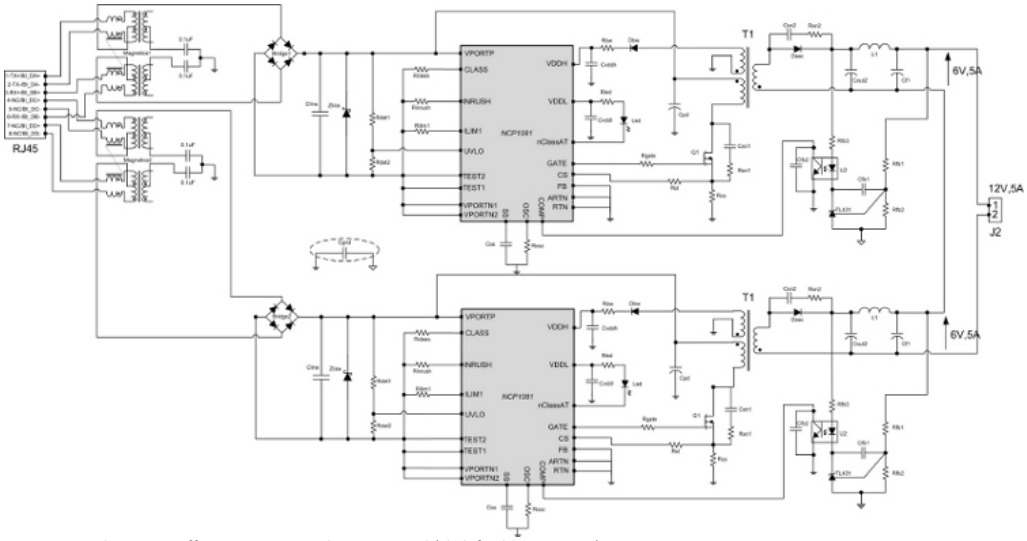


**Figure 1**: Dual PoE-PD, Offering 60-80 W Delivery to Load (click for larger image)

Through extended thermal performance it is possible for a PoE controller to support up to 40W per pair. This would translate to a total of 80W (rather than 60W) if the PSE operates with a further increased current limit via two pairs. 80W capable PoE-PD devices, such as the NCP1081 or NCP1083 DC-DC converters (see Figure 2) produced by ON Semiconductor, have the capacity to support the power requirements of the various applications outlined earlier in this article.

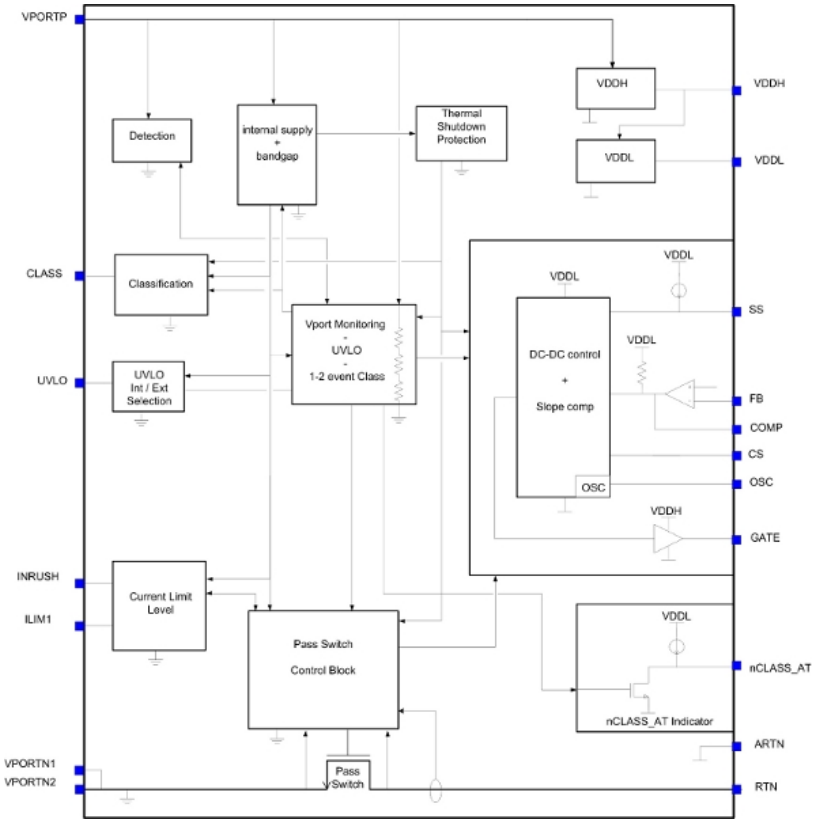


**Figure 2**: Functional block diagram for the NCP1081 and NCP1083 from ON Semiconductor (click for larger image)

### Balancing size, cost & performance criteria

For each of the PoE implementation types discussed, there will be a specific set of design choices that must be dealt with, and a suitable approach taken that addresses the particular size constraints, bill-of-materials costs, and performance requirements. As PoE functionality moves further into the mainstream, all three of these factors will become increasingly important. Size and cost will clearly prove most critical in consumer applications, leading to employment of simple highly durable PoE-PD modules being paired with more sophisticated PSE electronics. For the less cost sensitive designs, some of the higher spec PD controllers could be implemented with the proviso that external software is developed to achieve high performance, but can also be implemented with less sophisticated PSE electronics.

In conclusion, the IEEE802.3at standard will allow greater power delivery to a single PD node, and as a result PoE will make further inroads into electronic equipment design, becoming a far more commonplace feature. Delivery can potentially be extended way beyond IEEE802.3at limitations to enable new markets to be explored while still maintaining reverse compatibility. This will allow a wide range of products that were previously incompatible with this technology to reap the benefits that PoE holds.

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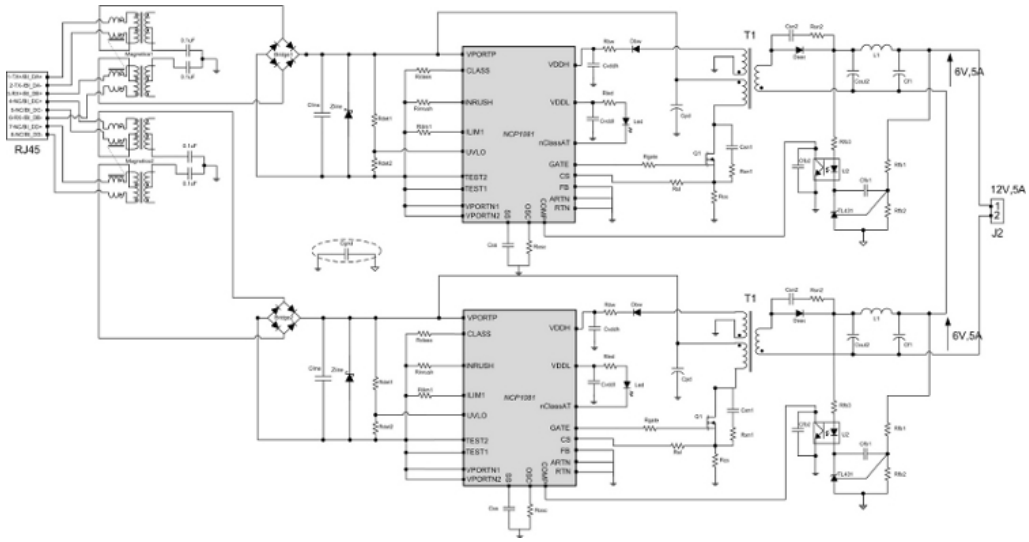


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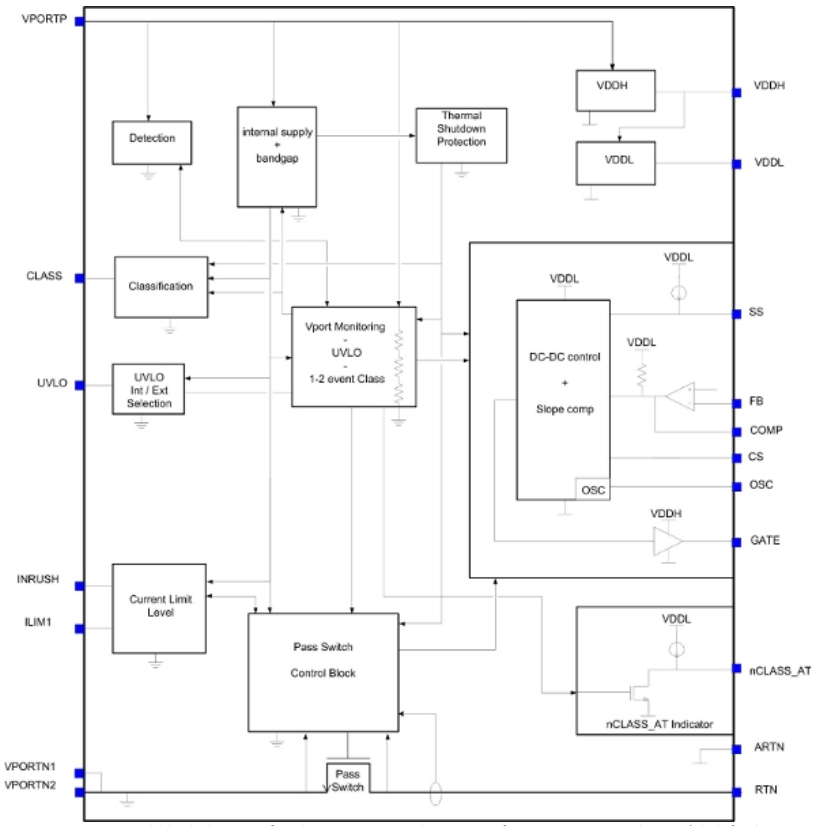


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