

# A 20-Cent PoE Interface for VoIP Telephony

*Meet the requirements of IEEE 802.3af*

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*By Andrew Smith, Power Integrations*

A leading provider of network management solutions was looking to simplify the power conversion stage for its next-generation Voice over Internet Protocol (VoIP) products. Power Integrations (PI) developed a discrete Power over Ethernet (PoE) interface circuit for the phone, enabling the OEM to meet its design and cost objectives.

PoE enabled hubs, routers and switches are becoming standard equipment. Consequently, many OEMs are designing their wireless access points, VoIP telephones and closed-circuit security cameras to be powered from the CAT-5 cable that connects them to a communications network.

The DC-DC power conversion stage of powered devices (PDs) must communicate its power requirements to the power sending equipment (PSE) so that the PSE can energize the cable (see Figure 1). The converter

must step down and regulate the cable voltage and be able to accommodate the considerable line voltage drop (especially at higher power loads) associated with CAT-5 Ethernet power transmission. This raises several design issues.

## A Simple, Cost-effective, Reliable PD Power Solution

After considering their client's BOM cost target for an interface and power conversion stage to support Class 2 and 3 PDs, PI based the DC-DC converter design on a member of its DPA-Switch family of highly integrated power conversion ICs – resulting in a highly reliable solution. The simplified design process afforded by the use of DPA-Switch and the cost reduction realized by using the discrete interface circuit enabled the OEM to meet their objective without sacrificing functionality, reliability or robustness. The resulting parts count reduction helped to keep the overall solution cost down while

improving the mean time between failure (MTBF) rating and the reliability of the DC-DC converter stage.

## A Flexible 20-cent Solution

It takes only a few, discrete components to implement a PD/PSE interface that meets the requirements of IEEE 802.3af, and the following 20-cent solution is also flexible, enabling the PD to classify itself as a Class 0, 1, 2 or 3, with the change of a single resistor value.

The DPA-Switch family of ICs combines a high-frequency power MOSFET, a PWM controller and numerous protection functions fabricated on a single CMOS chip. This simplifies the design process while reducing the component count of the DC-DC converter stage. DPA-Switch family members feature MOSFETs of varying sizes, so the output power can be scaled by changing the IC used.

For the VoIP application under consideration, PI chose to design the DC-DC converter stage around its DPA423P device. Since the VoIP phone only required a single 3.3V output and a maximum of 2A, the converter was designed as a flyback (see Figure 2), to minimize cost. Initially, VR31 and VR32 inhibit the Classification and PWM circuits until the signature phase has been successfully completed. Following Signature identification, the voltage delivered to the PD rises until Zener diode VR31 begins to conduct. A constant current source then turns on to provide the Classification current signal that is read by the PSE. Class is determined by the value of resistor R34. Once Classification has been successfully determined, voltage again ramps turning on Q35 via VR32 and the power converter stage begins operating. The constant current classification circuit is disabled via R35 to reduce power consumption.

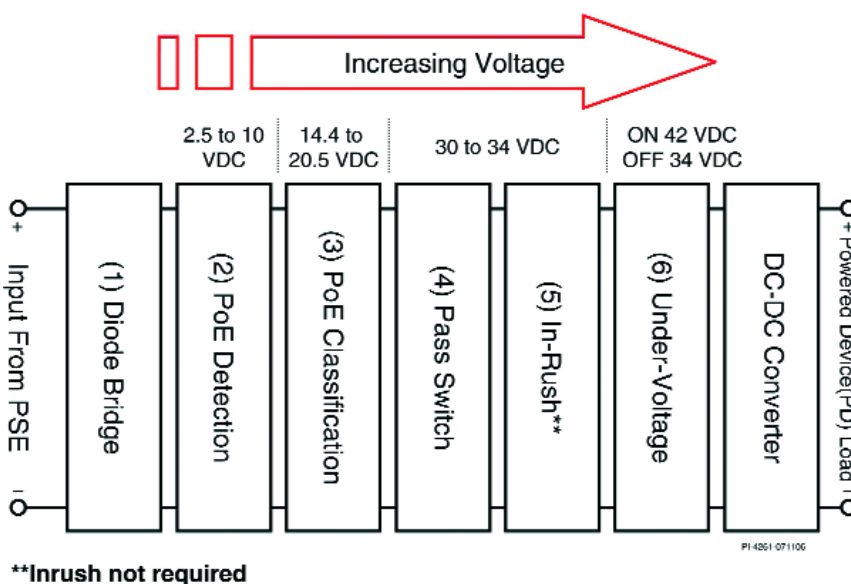


Figure 1: Communicate its power requirements

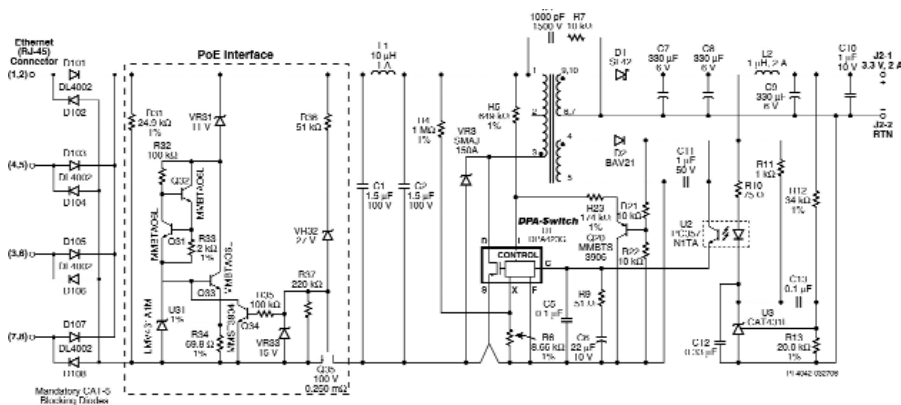


Figure 2: The converter was designed as a flyback

The input bulk capacitance (C1 and C2) is split in two to form a simple pi ( $\delta$ ) filter, to attenuate differential mode conducted EMI. Resistors R4 and R6 lower the internal current limit of the MOSFET and make the maximum duty cycle scale with input voltage, for true maximum (output) power limiting. This approach simplified the design of the converter and meant that a lower voltage and current (30 V, 4 A) Schottky diode could be used for the output rectifier. Resistor R5 activates U1's input under-voltage lockout (UVLO) and overvoltage shutdown functions,

while R21, R22, R23 and Q20 extend the hysteresis of the UVLO function to accommodate the large line voltage sag encountered with IEEE802.3af Ethernet power applications.

The DPA-Switch auto-restart function limits the supply's output power to about 4% of full load—whenever the output voltage goes out of regulation—instead of depending upon the loss of the VDD supply to the IC. This provides robust protection for both the supply and the load.

## Conclusion

To be truly universal, PoE PD solutions must meet the requirements of IEEE 802.3af. PI's simple PD design has been verified by the University of New Hampshire Interoperability Consortium (UNH-IOC) – an authority on IEEE 802.3af – and tests show that the design not only meets the requirements for IEEE 802.3af, but also operates correctly with all available PSE. Copies of the UNH-IOC test reports and a list of the PSE that were shown to work with the PI solution can be found at [www.powerint.com/PoE](http://www.powerint.com/PoE).

This solution not only met the customer's requirements for a simple, reliable, robust, approved and cost-effective circuit, but the versatility and scalability of the DPA-Switch family has allowed the customer to quickly and easily adapt this solution for use in other PD applications.

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