

Figure 3. A high-end, feature-rich IP camera. The features may demand more than the IEEE standard 12.95W.

petrator must gain physical access to the network to eavesdrop or spoof the information stream. Wired Ethernet can supply power also via PoE, so that powering remote devices is simplified. In most jurisdictions, installation of data cabling is not tightly regulated where installation of AC power requires licensed installers and many times a permitting process. Power over Ethernet also makes it simple to provide centralised power backup. If the wiring is installed in conduit, the end-to-end connection can be both reliable and very secure.

Today's current standard for PoE was ratified by the IEEE in June of 2003 as IEEE Std 802.3af-2003. Since then, this standard has been incorporated into the body of the main Ethernet standard as Clause 33 during the regular revision process that created IEEE Std 802.3-2005. There are no differences between the text of the original freestanding document and the roll-up. However, with the release of the 2005 edition, IEEE Std 802.3af-2003 has become obsolete, technically speaking.

The IEEE standard for PoE allows devices such as IP cameras to source no more than 12.95W at the RJ-45 connector. In practical terms, this means that the application circuitry can expect to see only about 10W due to the combined losses of rectification diodes, the front-end and DC/DC converter efficiency. The limitation to 10W or less means that camera

designers must be constantly on guard against going over the power budget. While the power budget is tight, a reasonable limitation on the feature set and careful design of the application circuit allow for standards-compliant PoE to power IP cameras.

Figure 1 is a representative block diagram for a stationary surveillance camera which is appropriate for indoor fixed-location observations. Depending on the choice of processor and imager, adding an intermediate decoder may be required. Some applications may include audio surveillance. An optional block for audio input is shown. Notably missing from figure 1 are power-hungry features such as support for Pan/Tilt/Zoom motors, or anti-

fogging heaters for outdoor use.

For the basic IP surveillance camera, an integrated powered device (PD) employing pulse width modulation (PWM), such as the TPS23750, provides the primary side regulation and PoE interface. The PWM controller is shown in figure 2 as an isolated power supply. However, for camera applications, the camera body could supply the isolation barrier for the PD. Therefore, the cost could be reduced by changing to a non-isolated configuration. In addition to the primary DC/DC converter, many applications have secondary voltages that can be generated by low-cost LDOs. Otherwise, buck converters are required to meet efficiency, cost and board space trade-offs.

Figure 3 is representative of a higher-end, more feature-rich IP camera. Typically, such devices contain motors to redirect the camera's aim as well as zoom-in and out to focus or broaden the camera's field of view. For outdoor installations, a heating element is required to ensure that the camera lens does not fog over. Today's highest speed and resolution imagers do not have integrated digital interfaces so a video decoder is required. Additionally, for many installations, the ability to listen or announce is also a necessity. All these features are at a cost of increased power consumption. Thus, fitting within the IEEE standard's 12.95W budget becomes unattainable.

For today's high-end IP surveillance camera, figure 4 provides a block diagram of the PoE interface required. The TPS2376-H is a stand-alone PD front end that delivers 600mA of current through the Ethernet interface. This current is in excess of the IEEE standard. To utilise this power level, the power sourcing equipment (PSE) matched with the high-power PD must also be capable of delivering high power—not an IEEE compliant PSE. Using just a PD front-end means that the power supply designer is free to choose the best system topology to power the application. Still designers may utilise a single primary side converter

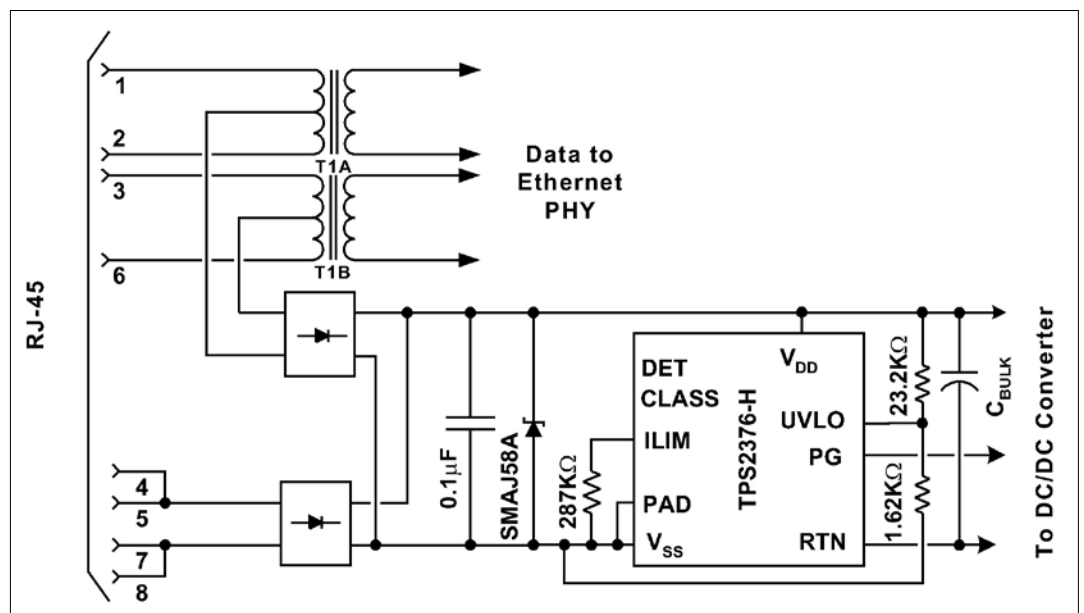


Figure 4: PoE interface for a high-end IP surveillance camera. The TPS2376-H PD front end delivers 600mA.

and generate secondary voltages from it. Or, to maximise total system efficiency, designers may choose to have multiple primary side converters. Finally, they may opt to have both multiple primary side converters and still drive some small power loads from secondary regulators.

Over the horizon is the promise of work by the IEEE P802.3at Task Force. This standards body is developing a standard that one day will allow high-end IP cameras to operate with standards-complaint PSEs. This standard is still at least a year

away. In the meantime, the only choice for IP cameras whose features grow to consume more than 13W is to reach beyond the standard and utilise high power over Ethernet PDs.

Conclusion

The wired Ethernet/IP camera is a rapidly growing segment of the security camera market. Due to the variety of power options available to design engineers, numerous decisions and choices must be made for creating power supplies appropriate for their applications. Regardless of the many

choices designers need to make, the proper components are readily available today.

References

www.power.ti.com
www.ti.com/sc/device/tps2376-h
www.ti.com/sc/device/tps23750

About the author

Michael McCormack is the business development manager for Power over Ethernet products at Texas Instruments. In addition to his product duties, Michael was editor for the original IEEE Std

802.3af drafts, and currently chairs the P802.3at Task Force which is revising the IEEE PoE standard.

Notes:

1. *Figure insertion points are marked only as a guide to the context. They are not mandatory.*
2. *Try to have the figures easy on the eyes by fitting them over 3-4 columns.*
3. *Can we use a symbol like magnifying lens or a globe with the Indian subcontinent marking the hyper links? Alternatively, we should go for the regular underlined blue text for hyper links.]*