New Isolation Technologies Close The Gap With Optos On Compliance

by Kevin Parmenter, Chair, and James Spangler, Co-chair, PSMA Safety and Compliance Committee

In power electronics applications, isolation serves two purposes. It enables designs to meet safety requirements and it also is needed to make certain switching power supply topologies work as in certain gate drive circuits for power MOSFETS and IGBTs. This year, the subject of isolation received special attention at APEC 2018 in San Antonio, where we were honored to chair *two* industry sessions on isolation technologies and approaches to achieving system level isolation. Attendees of the conference were also treated to a lively rap session where the merits of various isolation approaches including magnetic, capacitive and the incumbent optical were debated.

One of the key takeaways from these sessions was that, thanks to their slow but steady advances, alternative technologies are supplanting optocouplers in new designs. This message was reinforced by what we saw or rather didn't see in the APEC expo. If you've not paid much attention to the new isolation technologies up until now, you might want to take another look because the technologies are changing and the suppliers are sending not-so-subtle messages about which isolation products have their attention.

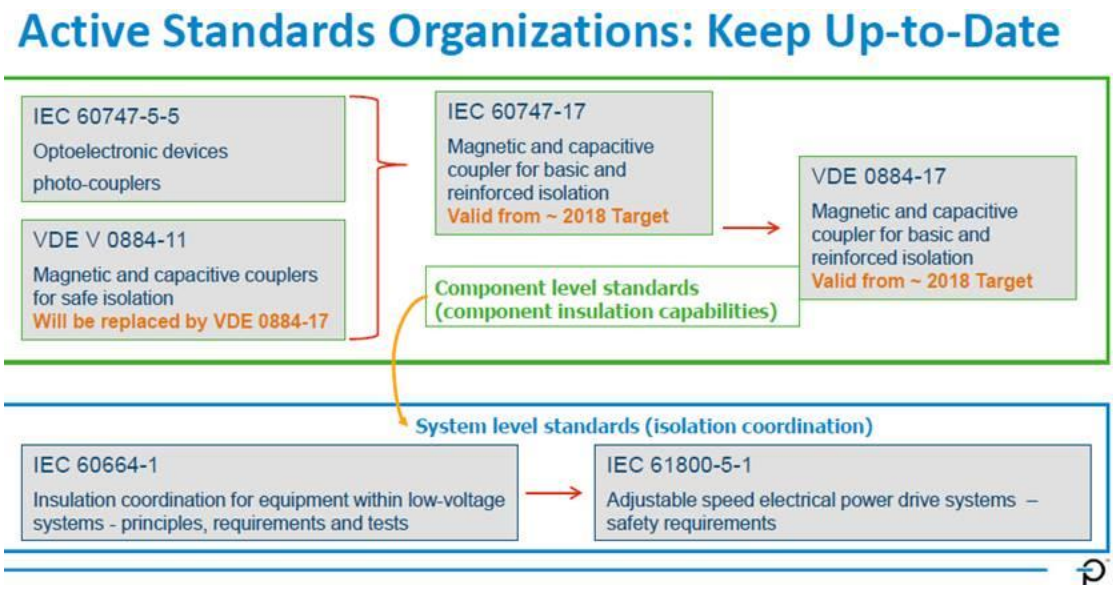
For a long time, designers of power electronics had no other option for isolation other than optocouplers and some magnetic approaches. As we know, optocouplers have drawbacks. These include the CTR—current transfer ratio—which varies with time and temperature. The more current driven through the optocoupler LED light source, the more current can be driven on the output. But as more current is driven, the optocoupler ages faster, which in turn demands that the optcoupler be driven with even more current to achieve a given output leading to still faster aging. As this trend goes on the device's activation energy increases until the device finally wears out.

Another issue is that optocouplers are historically very non-linear and need some clever circuit techniques to make them useful for our everyday intended purposes if linearity is needed. However, in some applications this is not really a problem. For example, optocouplers work very well when isolating a digital switch or a digital signal as might be done in isolated V/F converters or I/O switching or status indication for power supplies. There are a number of power supply signals that can use optoisolation such as fan fail, power good, ac fail, inhibit-enable lines and so on. In all these types of applications, optocouplers work great and will probably have a long operating life.

But still there are many applications where the drawbacks mentioned above matter and the new isolation technologies address these problems increasingly well. Every year we see more and more alternative isolation devices released by the heavy hitters (i.e. well known semiconductor companies). Some of these devices use embedded magnetic isolation and not just to create the isolation barrier but also to transfer power to make both sides of the isolator work. We also see new isolation devices using capacitive technologies.

Besides enabling better isolation performance, these new technologies support integration of the isolation barrier with other IC functions even beyond simple gate drivers. This trend has advanced to the point where we can now envision complete integrated power converters which incorporate the isolation barrier as part of the controller section for an isolated feedback loop. It's as if the controller has taken in the traditional TL431 and isolator.

Moreover, one of the obstacles to replacing optocouplers is being removed. Optocouplers have long been available with a plethora of safety approvals, while the challengers among the new isolators lacked them. But this is becoming less and less of an issue as one by one the suppliers of magnetic and capacitive isolation devices collect the safety agency certifications. The figure below identifies some of the applicable standards and notes where the new isolation devices have made inroads. The PSMA Safety and Compliance committee tracks these standards and issues notices whenever these standards change. You don't have to be a PSMA member to receive these notifications—you can sign up to receive them at no cost. (See www.psma.com to sign up.)



While performance, reliability and approvals all play a role in the choice of isolation devices, it's also hard for designers to ignore supply chain considerations, especially when looking ahead on new designs. So in addition to what we heard in this APEC's industry sessions and rap session, we have also observed some trends in the APEC exhibition that give us pause.

In recent years it seems that suppliers of optoisolation technology are either not coming out with new products or the traditional suppliers have exited the market. As a result, the companies who make optocouplers and exhibit at APEC do not do anything to draw attention to their optocoupler technology in the exhibits. And then there are also the traditional optocoupler companies that don't even exhibit at APEC.

This lack of optocoupler products in the APEC expo is notable because over the years the exhibition has grown to the point where just about every type of component used in power supplies is represented in the exhibits. Since no one is showing up at APEC to defend the 800-pound gorilla that is decades of entrenched optocoupler designs, you can infer that some of these designs in gate driver and analog isolation are being replaced by capacitive and magnetic isolation technologies, which have equal safety specifications and better electrical performance over time and temperature.

Common sense would dictate that if the slow decline of optocouplers in some applications were not "on purpose" and if superior technologies were available the top optoisolation providers would be screaming from the rooftops that they offer cheaper, faster, better performing parts and technologies for these applications.

The silence from the optocoupler suppliers is deafening. Perhaps, they are unaware of the competition. Maybe they are simply unable or unwilling to respond to it by offering superior technology of their own. Another possibility is that optocouplers are simply viewed as a commodity and vendors see no value in investing resources to further develop them. In this case, manufacturers may have adopted a harvest strategy—sell what you have and don't invest in development of anything new.

It also appears that some traditional suppliers of optoisolation products mean to slowly obsolete them. A recent search of an online distributor inventory for a 4N35 returned messages like "obsolete—not recommended for new designs". Nevertheless, several manufacturers do still offer them.

There are other signs that optos are on the way out. For instance, I'm not aware of any semiconductor companies which offer optical isolation as well as alternatives such as capacitive or magnetic. If anything, these companies are helping to get rid of optocouplers. A prime example would be their development of primary-side-regulated controllers, which of course use the existing magnetics required for processing isolated power as part of the regulator-sensing thus eliminating the optocoupler and TL431.

Many such designs are targeted for charger-adapters and LED lighting applications where long life, low cost and stability over time and temperature are required. Safety and compliance are also paramount in the applications. Because a transformer can be easily safety certified, it becomes convenient to use it for both isolation and feedback sensing.

Although we have shared our observations from the technical discussions and the APEC expo, a comprehensive analysis of the isolation device market is beyond the scope of this article. However based on the information presented this year at APEC and the behavior of the exhibiting companies, it appears that magnetic and capacitive isolation is slowly but surely encroaching on the designs long dominated by optoisolation. While we expect that optoisolation will hang around for a long time, it's getting harder and harder to ignore the new isolation technologies.

About The Authors

Kevin Parmenter is an IEEE Senior Member and has over 20 years of experience in the electronics and semiconductor industry. Kevin is currently vice president of applications engineering in the U.S.A. for Excelsys, an Advanced Energy company. Previously, Kevin has served as director of Advanced Technical Marketing for Digital Power Products at Exar, and led global product applications engineering and new product definition for Freescale Semiconductors AMPD - Analog, Mixed Signal and Power Division based in Tempe, Arizona.

Prior to that, he worked for Fairchild Semiconductor in the Americas as senior director of field applications engineering and held various technical and management positions with increasing responsibility at ON Semiconductor and in the Motorola Semiconductor Products Sector. Kevin also led an applications engineering team for the start-up Primarion where he worked on high-speed electro-optical communications and digital power supply semiconductors.

Kevin serves on the board of directors of the PSMA (Power Sources Manufacturers Association) and was the general chair of APEC 2009 (the IEEE Applied Power Electronics Conference.) Kevin has also had design engineering experience in the medical electronics and military electronics fields. He holds a BSEE and BS in Business Administration, is a member of the IEEE, and holds an Amateur Extra class FCC license (call sign KG5Q) as well as an FCC Commercial Radiotelephone License.

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For many years, he worked as a field applications engineer (FAE) for Motorola Semiconductor, On Semiconductor, Cirrus Logic, and Active Semiconductor, assisting customers in using semiconductors. He published numerous application notes and conference papers at a variety of conferences: APEC, ECCE, IAS, and PCIM. Topics included power factor correction, lighting, and automotive applications. As an FAE, he traveled internationally giving switch-mode power supply seminars in Australia, Hong Kong, Taiwan, Korea, Japan, Mexico, and Canada.

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