

R A Q ' s

Rarely Asked Questions

Strange but true stories from the call logs of Analog Devices

Replacing optocouplers with digital isolators (or how a midnight ride could have been avoided)

Q. *Can transformer-based isolators replace optocouplers? Won't there be problems with dc signals, magnetic fields and size?*

A. Yes, transformer-based isolators can replace optocouplers with considerable power saving—and no, there won't be problems.

Paul (one if by land, two if by sea) Revere knew of the drawbacks of optical signaling. Lanterns use more energy than telephones, and two flickering lanterns followed by a midnight ride make them even slower. Had the telephone been invented in 1775¹ the news would have made it to Lexington and Concord quickly, and Paul (and his horse) would have been spared a long ride on a cold night. He could have made a silver teapot instead.²

Digital isolators send digital signals across potential differences of hundreds or thousands of volts. Optocouplers signal with infrared, but LEDs and photo-detectors are not very efficient, and fast optocouplers require a lot of power. Magnetic signal coupling, like the (magnetic) telephone that poor Paul didn't have, is faster, and uses less power.

Windings for micro-transformers can be printed on a silicon chip and separated by a 20 μm layer of polyimide that will withstand over 5 kV. Multichip bonding lets us make a single IC package containing two or more multichannel chips that communicate through the printed transformers. Unlike optocouplers they can be made bidirectional. The same technology allows us to make a 50 mW isolated power supply in the same IC package, which removes a major problem of optical isolators—powering the isolated circuitry.

Micro-transformers work only at HF, and no transformer works at dc. Nevertheless simple internal logic allows digital isolators to transmit dc and LF logic signals reliably, and send



fast signals with minimal jitter. Their small size and lack of magnetic materials makes them almost immune to external magnetic fields.³

At LF digital isolators use only about one percent of the power of an optocoupler and at 50 Mbps, the top speed for optocouplers (digital isolators can work at over 100 Mbps), it's about 20 percent. Lower power also makes them more reliable.

Digital isolators comply with most international standards on safe isolation and are certified to UL, CSA and VDE standards. Paul would have loved them.

¹ Francisco de Salva proposed an electrical telegraph in Spain in 1775—but the idea had not reached Massachusetts by April 18.

² When not revolting, Paul Revere's day job was as a silversmith. Visit the Museum of Fine Arts in Boston (<http://tinyurl.com/ygdyc9>) to see some of his work.

³ Digital isolators are unaffected by 500A at 1 MHz flowing in a wire just 5 mm from the device.

**To learn more about
digital isolation,
Go to: <http://rbi.ims.ca/4941-100>**



Contributing Writer
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