

SSRs Shrink Design Size, Improve Reliability And Safety In 800-V EVs

[Texas Instruments'](#) new portfolio of solid-state relays include automotive-qualified isolated drivers and switches that are said to deliver industry-leading reliability to help make electric vehicles (EVs) safer. The isolated solid-state relays (SSRs) also provide the smallest solution size while reducing the bill-of-materials (BOM) cost of powertrain and 800-V battery-management systems, according to the vendor.

The TPSI3050-Q1 isolated switch driver with an integrated 10-V gate supply and the TPSI2140-Q1 1400-V, 50-mA isolated switch both integrate power and signal isolation across a single barrier (see Fig. 1) using a unique approach that is said to improve reliability, while significantly reducing solution size and cost compared to existing electromechanical relays and solid-state photorelays.

Note however, that the two parts use different technologies to create their isolation barriers. The TPSI3050-Q1 uses magnetic (transformer) isolation (see Fig. 2), while the TPSI2140-Q1 uses capacitive isolation (see Fig. 3). These devices are described as the first in a new solid-state relays portfolio that will also include ICs designed for high-voltage industrial applications.

"High-voltage systems are becoming more prevalent, especially with the increased adoption of EVs. At TI, we are strongly focused on finding new ways for system designers to solve complex isolation challenges, such as ensuring reliable and safe vehicle operation as the industry transitions to 800-V batteries, while also reducing solution size and cost," said Troy Coleman, vice president and general manager of Power Switches, Interface and Lighting at Texas Instruments.

"By integrating more functionality within our isolation technology, our new solid-state relays enable engineers to reduce the size, cost and complexity of high-voltage power supplies while maintaining the safety of next-generation automotive and industrial systems," added Coleman.

The new solid-state relays can disconnect and connect loads through a single isolation barrier in microseconds—compared to milliseconds for electromechanical relays—to enable safer operation of high-voltage automotive systems. The TPSI3050-Q1, which offers reinforced isolation up to 5 kV_{RMS}, also provides an operating lifetime that's 10 times higher than electromechanical relays, which can degrade over time. Additionally, the TPSI2140-Q1 offers basic isolation up to 3.75 kV_{RMS}, enabling it to achieve more than four times higher time-dependent dielectric breakdown reliability than solid-state photorelays.

The solid-state relays integrate power and signal transfer in a single chip while also eliminating at least three components from their designs, significantly reducing solution size while cutting BOM costs by as much as 50%. The TPSI3050-Q1 reduces solution size up to 90% compared to mechanical relay solutions by integrating the functions of an isolated power supply, digital isolator and gate driver. The TPSI2140-Q1 reduces solution size by as much as 50% compared to traditional solid-state photorelay solutions by integrating a signal field-effect transistor and resistors, and eliminating the need for a reed relay.

Designed for high-voltage measurements and insulation monitoring, the TPSI2140-Q1 works with a battery-pack monitor such as the BQ79631-Q1 to detect insulation faults in 800-V battery-management systems faster and with higher accuracy than solid-state photorelays. The TPSI2140-Q1 enables the use of <1-M Ω resistors and withstands over 300% more avalanche current than traditional photorelays to help enable safer human-system interaction.

The TPSI3050-Q1 and TPSI2140-Q1 are available in pre-production, 1,000-unit quantities only on TI.com at \$1.99 and \$2.75, respectively. Engineers can evaluate these products using the TPSI3050Q1EVM and TPSI2140Q1EVM evaluation modules, available on TI.com for \$49 each. For more information, including data sheets, see the [TPSI3050-Q1](#) page and the [TPSI2140-Q1](#) page.

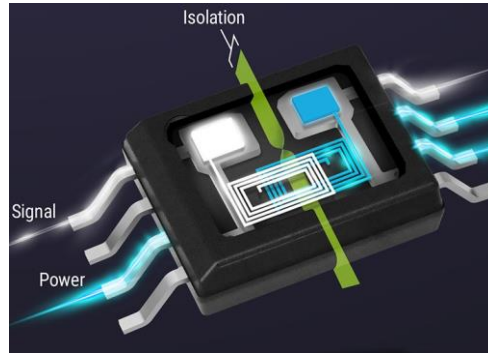


Fig. 1. TI's new solid-state relay portfolio integrates power and signal transfer in a single chip, helping engineers eliminate components from their designs and reduce solution size and cost. According to the vendor, this integration eliminates at least three components from designs and reduces solution size by up to 90% and cost by as much as 50% compared to competing solutions.

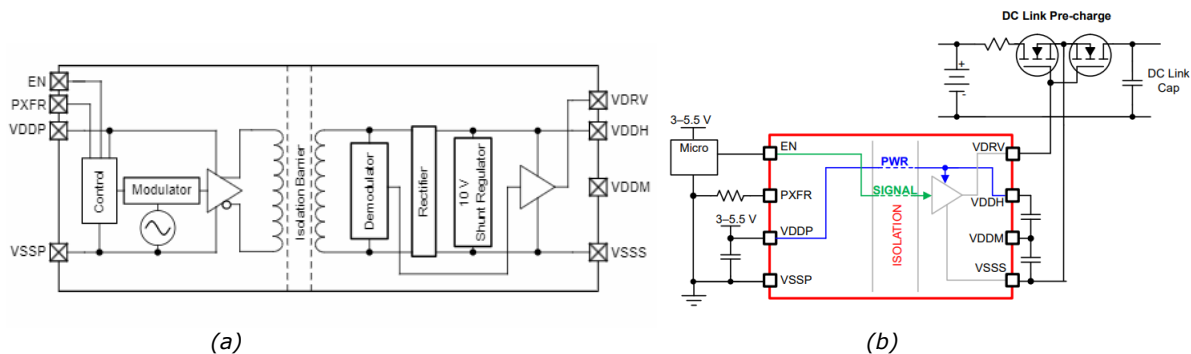


Fig. 2. The TPSI3050-Q1 is an automotive reinforced isolated switch driver with integrated 10-V gate supply. When combined with an external power switch, the IC forms a complete isolated solid state relay. According to TI, the TPSI3050-Q1's operating lifetime is 10-times that of electromechanical relay solutions and it offers reinforced isolation up to 5 kVRMS. A block diagram is shown in (a) and a simplified application schematic is shown in (b).

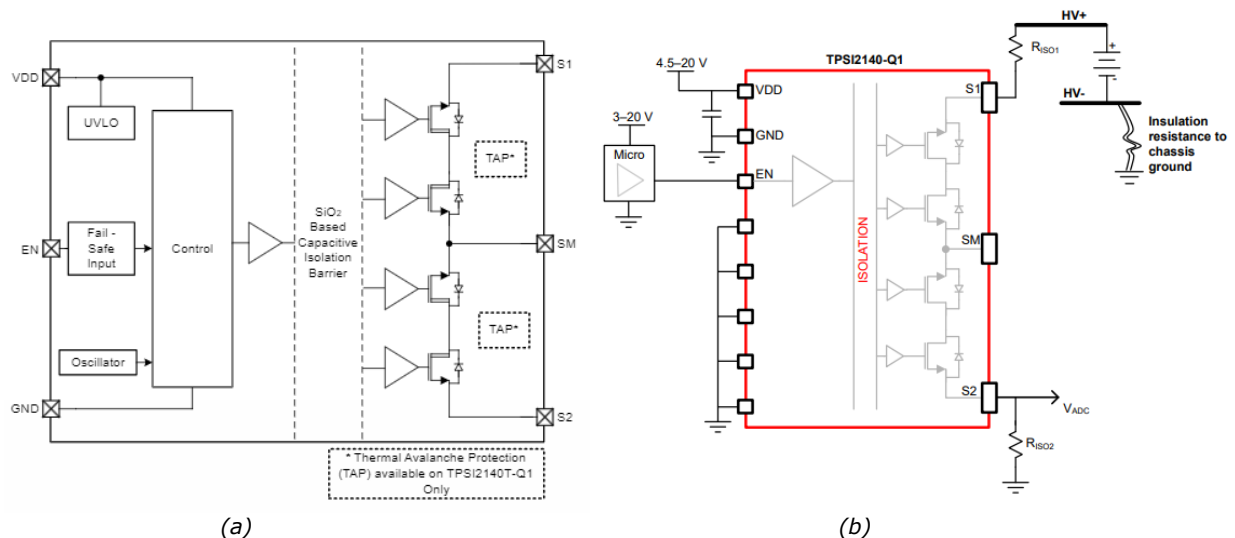


Fig. 3. The TPSI2140-Q1 is a 1400-V, 50-mA, automotive isolated switch with 2-mA avalanche rating. Unlike the '3050, this part is an isolated SSR by itself. It uses TI's capacitive isolation technology in combination with internal back-to-back MOSFETs to form a completely integrated solution requiring no secondary-side power supply. This SSR helps detect faults faster and improve safety in high-voltage battery management systems, with higher reliability than photorelays. A block diagram is shown in (a) and a simplified application schematic is shown in (b).