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Half-Bridge Drivers Enhance Design Of 12-V to 48-V Automotive Hybrid Powertrains

Renesas Electronics' ISL784x4 family of automotive-grade 100-V, 4-A half-bridge n-channel MOSFET drivers is said to be the first to combine gate-sensed adaptive deadtime control with independent source/sink pins for slew-rate control. These drivers are well suited for high-current dc-dc applications like the 12-V to 48-V converter for 48-V mild hybrids, 12-V to 24-V bidirectional dc-dc converters and other high-current buck or boost applications.

The family features three devices: the ISL78424 and ISL78444 with single tri-level PWM input for controlling both gate drivers, and the ISL78434, which has dual independent inputs that separately control the high-side and low-side drivers (Fig. 1). The ISL784x4 drivers complement Renesas' ISL78224 four-phase bidirectional controller, enabling it to provide up to 3 kW of power and greater than 95% efficiency in 12-V to 48-V converters used in mild hybrid vehicles (Fig. 2).

Designers can add a Renesas RH850 microcontroller to provide ASIL safety monitoring, system control and vehicle communication. The ISL78424 and ISL78444 can also be combined with the ISL78225 4-phase controller or ISL78220 6-phase controller to create an automotive audio amplifier power supply.

The ISL784x4 drivers simplify driving high-current MOSFETs by offering independent sourcing and sinking MOSFET gate-drive pins. This makes it easy for designers to use external gate resistors to tune the slew rate of the rising and falling dc-dc switch-node transitions, thereby reducing electromagnetic interference (EMI). The ISL784x4 also provide adaptive deadtime control to ensure accurate break-before-make switching operations that prevent shoot-through currents.

Additionally, the ISL78424 and ISL78434's adaptive deadtime function is able to sense at the gate of the MOSFETs. This eliminates potential errors introduced by voltage drops across the external gate resistors controlling the switching node slew rate.

The ISL784x4 drivers are a great fit in high-current dc-dc applications like the 12-V to 48-V converter for 48-V mild hybrids. They improve efficiency by delivering robust gate drive with 3-A peak sourcing current and 4-A peak sinking current. Strong gate drive allows them to rapidly switch high current MOSFETs with large gate capacitance, which reduces switching losses.

The half-bridge MOSFET drivers' adaptive deadtime control minimizes excess deadtime to reduce conduction losses and further increase dc-dc conversion efficiency. In addition, the ISL784x4 drivers offer voltage ratings that are ideal for 48-V automotive systems with the switching node tolerating 70 V dc and up to 86 V for infrequent transients. Similarly, the high-side driver's bootstrap node can tolerate 86 V dc and up to 100 V during transients.

All three half-bridge drivers—the ISL78424, ISL78434, and ISL78444—and their evaluation boards are available now. Each device comes in a 14-lead HTSSOP package priced at $1.70 USD in 1000-piece quantities. For more information, see the ISL78424 page, the ISL78434 page and the ISL78444 page.

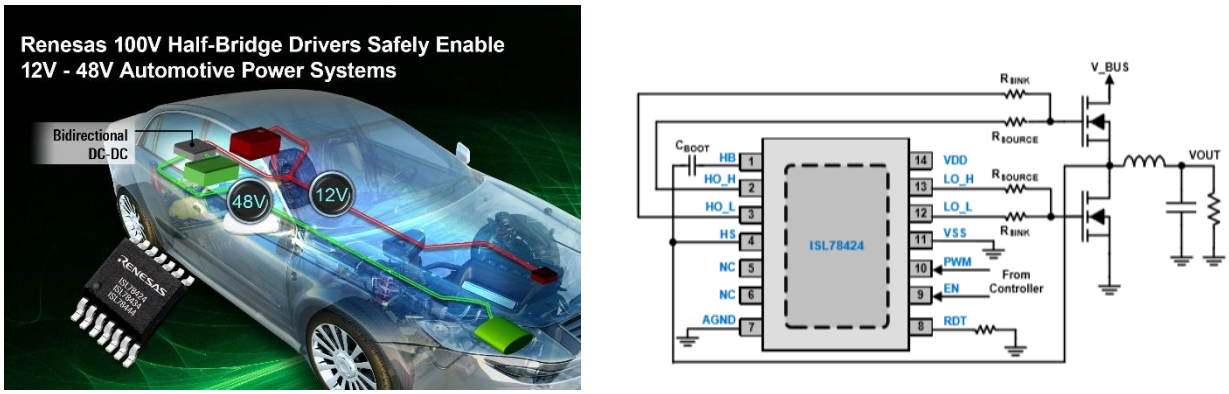

Fig. 1. Renesas has expanded its support for automotive powertrain design with a new family of automotive-grade 100-V, 4-A half-bridge n-channel MOSFET drivers. Designed for efficiency, the ISL784x4 family is the first to combine gate-sensed adaptive deadtime control with independent source/sink pins for slew-rate control, according to the vendor. A typical application circuit for the ISL78424 is shown on the right.

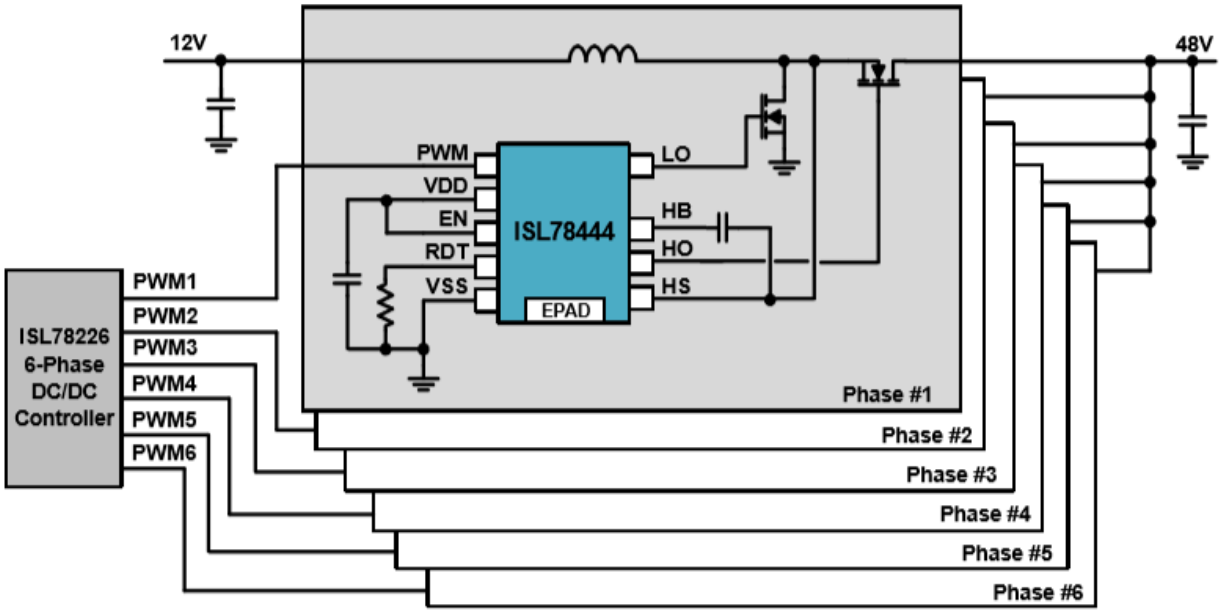

Fig. 2. Application of the ISL78444 NMOS half-bridge driver in a 12-V to 48-V bidirectional dc-dc converter.