1200 V Gate Driver ICs Featuring FluxLink

Power Integrations has introduced a new family of IGBT and Power MOSFET drivers which incorporates its unique FluxLink™ isolation barrier communications technology. First used on the InnoSwitch™ AC/DC controller products and now in volume production, FluxLink provides the reinforced isolation required for switching applications up to 1200 V. **Michael Hornkamp; Senior Director Marketing High Power, Power Integrations, Ense, Germany**

Power Integrations has married high-voltage CMOS and packaging technologies with gate driver expertise and ASIC chip design to develop a new family of isolated gate drivers with class-leading peak output current and safety features. These new SCALE-iDriver™ products benefit from the company's extensive expertise in delivering SCALE™-2 gate drivers. By incorporating the galvanic isolation within the IC package, temperature-limited optocouplers traditionally used in conjunction with an IGBT gate driver can be eliminated, improving reliability and performance and reducing board area. The IC package mould compound has a Comparative Tracking Index (CTI) value of 600, which, combined with the eSOP package with creepage and clearance distances of 9.5 mm, provides a robust reinforced galvanic isolation barrier well suited to industrial and automotive applications which require highest levels of reliability (Figure 1).

FluxLink technology

The FluxLink technology is a high speed bi-directional communications link that sits across the isolation gap. Using a robust signalling protocol, it provides very high EMI and magnetic field immunity and exceeds the standards IEC61800-4-8 and IEC61800-4-9 in all three axes. It features a very low propagation delay and a very low jitter of only +/-5ns. This link not only isolates the low voltage input control side of the device but also communicates back any fault conditions measured on the high voltage side of the device back across the barrier to a microcontroller responsible for control and monitoring the device operation. The input pins (IN) and output pins (SO) use 5 V CMOS logic levels. The secondary side only needs a single, unregulated, unipolar 25 V supply which the SCALE-iDriver regulates internally to generate the drive voltages, simplifying the power supply design. Gate driver commands are transferred to gate driver pins GH and GL, allowing the user to turn on and turn off the IGBT with separate independent gate resistors, optimizing the maximum turn on and turn off currents. If both resistors have the same value, then the GH and GL pins can be connected together. Return status feedback is provided via the SO output pin as an open collector output.

Because of the low propagation delay and accurate switching performance, a switching frequency of up to 250 kHz can be used, enabling SCALE-iDriver ICs to address high frequency power switching applications.

All SCALE-iDriver parts are suitable for use with 600 V, 650 V and 1200 V IGBTs and MOSFETs. Devices are available with different peak output gate drive current ratings of 2.5 A, 5.0 A and 8.0 A. If a peak output drive current in excess of 8 A is required, the SCALE-iDriver SID11x2K IC can be used with an external amplifier (current booster) to achieve 15 A or more.

The SCALE-iDriver IC family meets IEC60664-1 and devices are UL and CSA recognised according to UL1577 – file number E358471. Certification is in progress for the latest VDE0884-10 standard and the parts have been designed to meet future standards like VDE0884-17 and IEC60747-17. All the parts in the family operate up to 125 °C and are 100 % tested during production, both Hi-Pot and Partial Discharge, before being functionally tested to ensure zero failures. FluxLink technology delivers a real isolation barrier separate and away from the ICs. IC destruction tests prove that reliable isolation is maintained.

SCALE-iDriver application

Figure 2 illustrates a design using two SID1182K devices and a single isolated power supply (the large rectangular block between the SCALE-iDrivers). The small package and high temperature operation make the SCALE-iDriver parts ideal for use where a compact high power density solution is required such as automotive, motor drive, renewable energy and other industrial applications.

To ensure reliable operation, the gate driver must protect the high voltage switching elements against voltage transients and faults. SCALE-iDriver ICs work with an external booster and

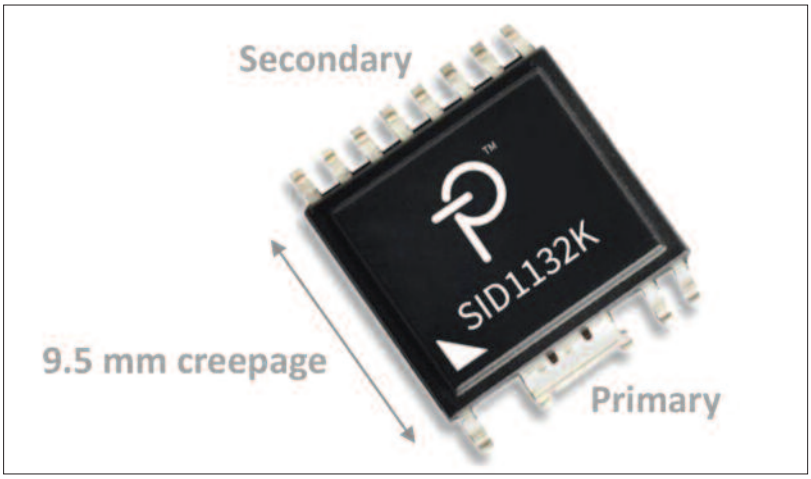


Figure 1. **SCALE-iDriver using IC design methodologies incorporating FluxLink isolation barrier**

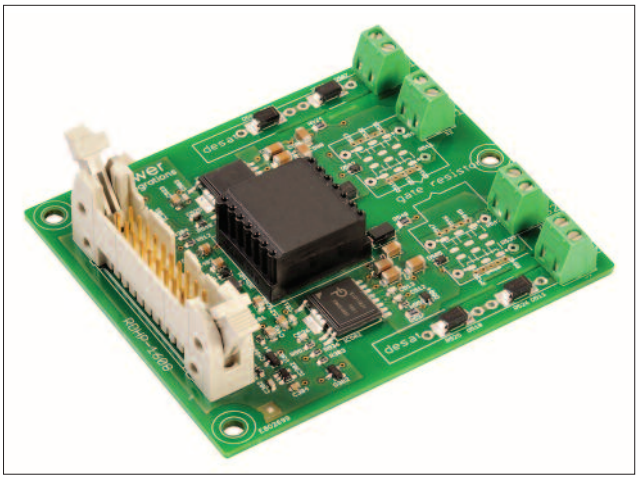
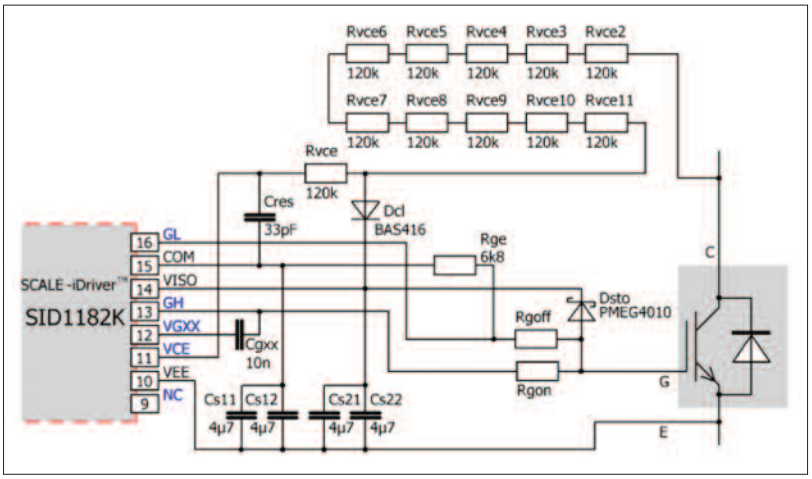


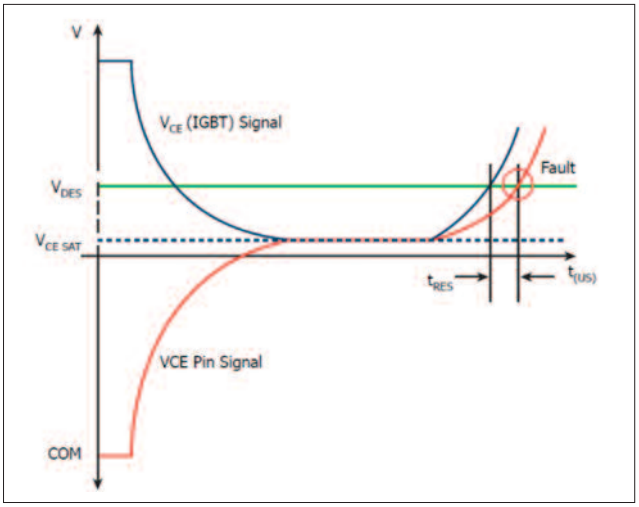
Figure 2. **A design using two SID1182K devices and a single isolated power supply**

Advanced Soft Shut Down (ASSD) functionality. An external booster enables full soft shut down to be employed, while ASSD is a mechanism automatically triggered by monitoring desaturation levels that protects the power semiconductor switch in the event of a short circuit without requiring any extra components.

Many gate drivers address the problem of short circuits via a desaturation technique and blank time measurement implemented using high voltage diodes. Unfortunately, this technique can be over-sensitive, causing unnecessary shut downs due to noise rather than short circuits. Taking a different approach that is implemented using a simple resistor chain, SCALE-iDriver ICs rely on response time measurement, ensuring that shut down is implemented only if there really is an actual short circuit. During the off-state, the VCE pin is internally connected to the COM pin and resistor chain Rvcex, highlighted in Figure 3, is discharged (red curve in Figure 4 represents the potential of the VCE pin). When the power switch receives a turn-on command, the collector-emitter voltage (V_{CE}) decreases from the off-state level to a normally much lower on-state level (see blue curve in Figure 4) and C_{RES} begins to be charged up to the V_{CE} saturation level (VCE SAT). C_{RES} charging time depends on the resistance of R_{VCEX}, DC-link voltage and C_{RES} value.

The V_{CE} voltage during on-state is continuously observed and compared with an internal reference voltage, V_{DES}. The V_{DES} level is optimized for IGBT applications. As soon as $V_{CE}>V_{DES}$ (red circle in Figure 4), the gate driver turns off the power semiconductor switch with a controlled collector current slope (ASSD), limiting the V_{CE} overvoltage excursions to below the maximum collector-emitter voltage (V_{CES}). Turn-on commands during this time and during tsu are ignored, and the SO pin is connected to GND. The response time t_{RES} is the C_{RES} charging time and describes the delay between VCE asserting and the voltage on the VCE pin rising (see Figure 4). Response time should be long enough to avoid false-tripping during semiconductor turn-on and is adjustable via or R_{VCE} and C_{RES} (Figure 3) values. ASSD is activated after a short circuit is detected. It protects the switching element by ending the turn on state and limiting the current slope in order to keep momentary V_{CE} overvoltages below V_{CES}.





ABOVE Figure 3. **Using a simple resistor chain, SCALE-iDriver ICs rely on response time measurement ensuring reliable shut-down**

LEFT Figure 4. **Turn-off of the power semiconductor switch with a controlled collector current slope (ASSD)**

Conclusions

The SCALE-iDriver family includes many technical innovations which provide a wealth of benefits for designers of high power systems that prioritize safety and reliability. The FluxLink isolation combined with the eSOP package provides rugged, reinforced isolation. Optocouplers are eliminated. In combination with a simple unregulated DC/DC converter, SCALE-iDriver ICs enable component count to be minimized and simplified, such that only a basic two layer PCB is required. The design is fast and predictable. With their high output peak drive current the SCALE-Driver ICs can be used with power semiconductors rated up to 450 A, or even higher with an external current amplifier. Built-in protection features like short circuit detection, primary and secondary under-voltage lockout and Advanced Soft Shutdown provide the increased reliability required in modern industrial and automotive applications such as motor drives, solar inverters, medical power supplies, welding and plasma cutting equipment and commercial vehicles.

Literature

'Efficiency Revolution in Auxiliary and Standby Power Supplies', PEE 6/2015, pages 22-24

'Clever Ideas Succeed in the Market', PEE 2/2016, pages 7-8