

REVOLUTIONARY HIGH-VOLTAGE IGBT DRIVER FAMILY WITH REINFORCED GALVANIC ISOLATION FOR SWITCHING SEMICONDUCTORS UP TO 1200 V

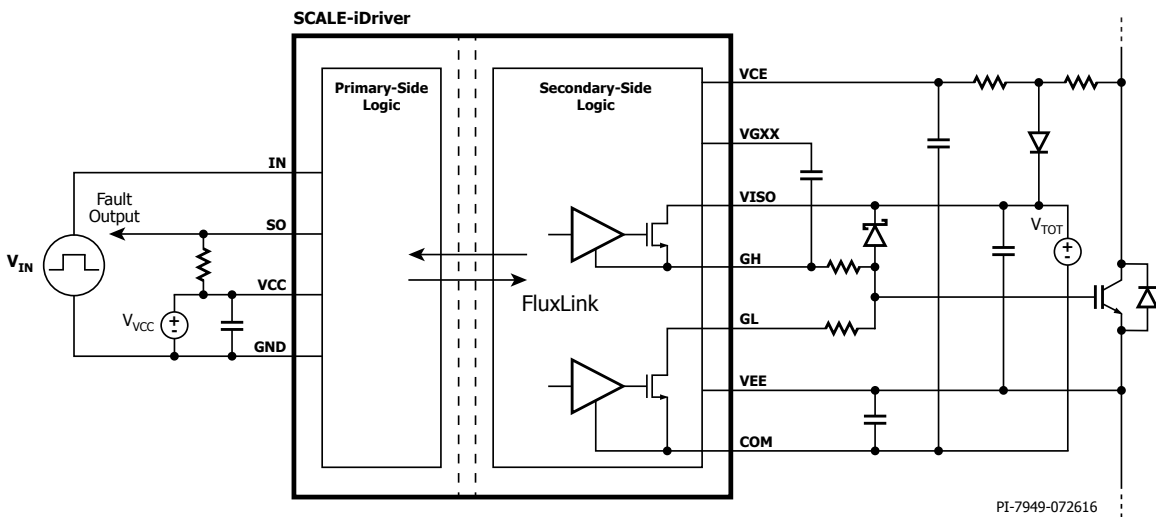
Designing reliable, low and medium voltage electronic power systems has been made easier with the introduction of the SCALE-iDriver™ IGBT and power MOSFET gate driver from Power Integrations. The new drivers incorporate Power Integrations' proprietary FluxLink™, a solid insulator, magneto-inductive coupling, communications technology. The FluxLink interface and eSOP package provide the reinforced galvanic isolation required to meet VDE0884-11 and IEC60747-17, along with very high electromagnetic interference (EMI) and magnetic field immunity, allowing manufacturers to easily comply with IEC61000-4-8 and IEC61000-4-9 standards.

WHITEPAPER



MICHAEL HORNKAMP
SENIOR DIRECTOR OF MARKETING FOR HIGH-POWER PRODUCTS

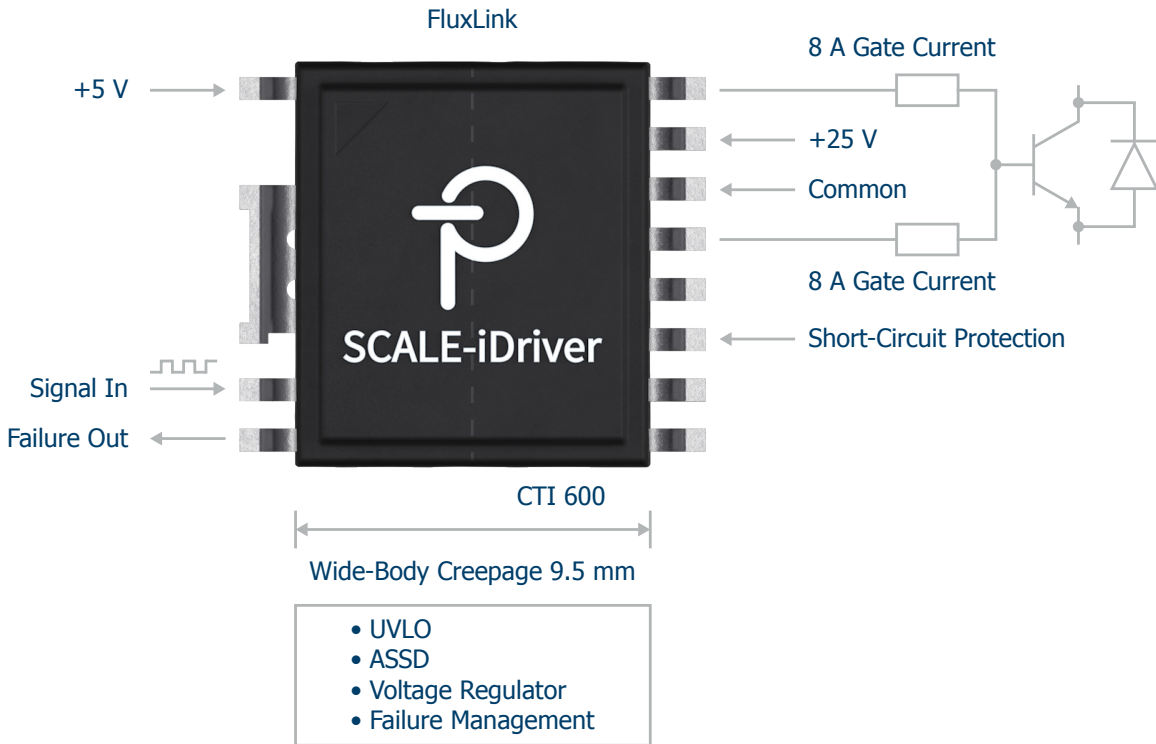
The internal isolation barrier, FluxLink, between the low voltage and high voltage sides of the SCALE-iDriver device replaces traditional optocouplers. This improves reliability, since both input LED and output phototransistor which are parts of the optocoupler solution are generally temperature instable and degrade over time. [1,2,3]. Additionally, FluxLink technology provides full safety isolation in the event of a system failure, caused for example, by an IGBT Collector Gate short. For other driver approaches that do not use FluxLink technology, such failure modes destroy not only the IC function on the secondary side but also compromise the isolation between the primary and secondary sides. The high speed bi-directional communications interface between the high voltage-side and fault monitoring functions (secondary side) and the low voltage control side and interface functions (primary side) has a propagation delay of only 260 nS, allowing the SCALE-iDriver device to reliably switch at up to 75 kHz. The new driver incorporates enhanced safety features, integrating functions previously performed by external components. Therefore the complete driver board can be simplified with a reduced BOM count and enhanced reliability.



The SCALE-iDriver family has a working voltage of up to 950 V and devices are available with three peak output current ratings: 2.5 A (SID1132K), 5.0 A (SID1152K) and 8.0 A (SID1182K). This high peak drive current allows the SCALE-iDriver to directly drive IGBTs with collector currents up to 600 A. For gate drive requirements in excess of 8.0 A, the SID1182K gate driver IC may be used with an external amplifier (current booster) to achieve 15 A or more with full safety functionality. Safety features include short-circuit protection (DESAT), Advanced Soft Shut Down (ASSD), primary side and secondary side Under Voltage Lockout (UVLO) and temperature compensated output impedance.

Power supply design requirements have been simplified; drivers only require a single +5 V supply for the primary side and a single 25 V (typical) unregulated supply for the secondary side. The SID11x2K gate driver has an on-chip power management function which divides the 25 V supply internally: the 15 V rail is stabilised and a negative rail is created as $25\text{ V} - 15\text{ V} = -10\text{ V}$. This architecture only requires the addition of external capacitors to match the requirements of the

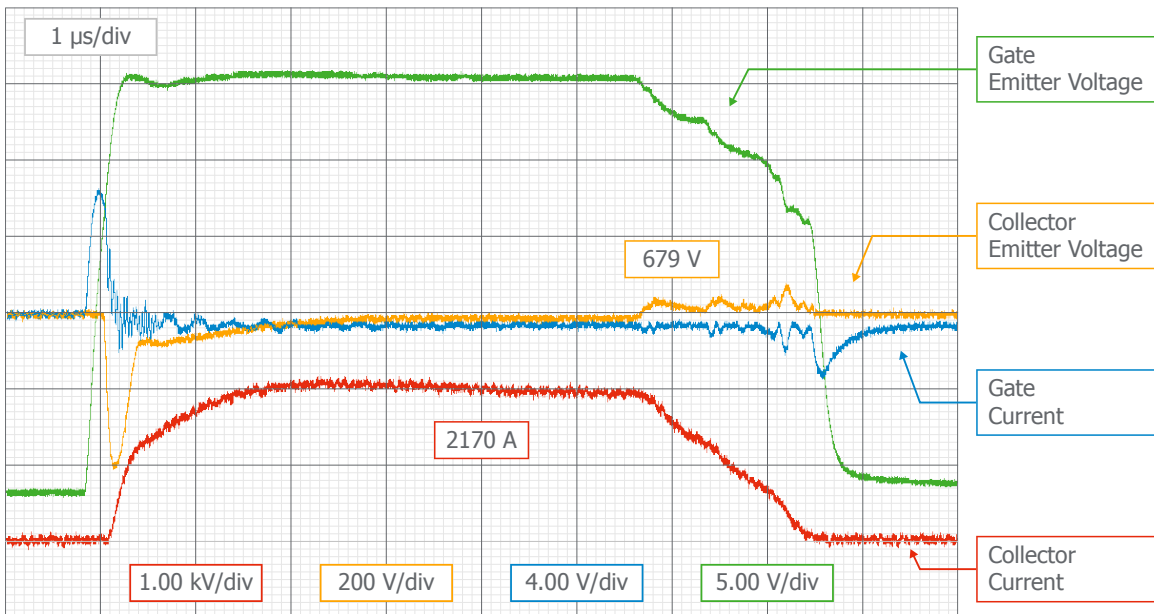
specific IGBT to be driven. Gate drive commands (PWM) from a microcontroller are applied to the input (IN) pin. Drive signals are transferred across the isolation barrier to the gate high (GH) and gate low (GL) pins. This split drive allows different gate turn-on / turn-off resistor values to be used to optimize control semiconductor switching characteristics, without the need of a diode.



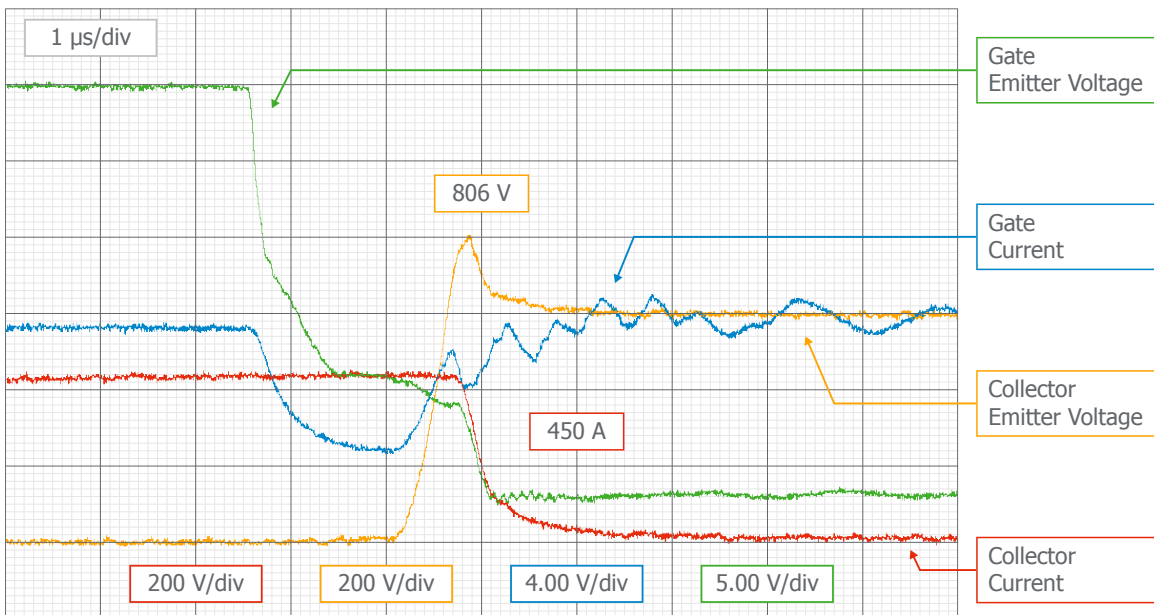
Primary and secondary fault detection and reporting enhances system reliability and safety. If the primary side V_{CC} or secondary side V_{ISO} or V_{EE} falls below the defined UVLO threshold, the output (SO) pin asserts a logic low signal to indicate a fault. This same feature enables safe power-on and power-off, even in the event of a slow supply voltage slew rate. The driver family also corrects any short drive pulses (normally caused by input noise incorrectly asserting the end of a pulse). If the input detects a pulse shorter than the $T_{GE(MIN)}$ threshold on the IN-pin, the driver will automatically extend the duration of the output drive signals on GH and GL to $T_{GE(MIN)}$.

The secondary side also has sophisticated fault monitoring which detects power supply under-voltage and semiconductor short-circuits. Upon detection of desaturation conditions, the controller activates the Advanced Soft Shut Down (ASSD) to protect the power switches, driving the SO pin to ground. A short-circuit on any of the power switching devices is detected using the semiconductor desaturation effect. If the voltage on V_{CE} exceeds a safety threshold (optimized for IGBT applications), the driver turns off the power switches with a controlled collector current-slope, which limits the V_{CE} overvoltage excursion, keeping it below the maximum permissible collector-emitter voltage.

ASSD @ $T_{vj} = 25\text{ }^{\circ}\text{C}$, ISC (2170 A), VDC = 600 V



Switching-off @ $T_{vj} = 25\text{ }^{\circ}\text{C}$, I_c (450 A), VDC = 600 V



SCALE-iDriver products have been developed for high reliability industrial applications where performance and reliability are essential. Power Integrations has also developed an advanced eSOP power package which provides 9.5 mm of creepage and clearance which combined with the reinforced isolation provided by the FluxLink technology makes for an unrivalled reliability. Together

The SCALE-iDriver family of gate drivers enables applications to meet IEC60664-1 specifications; SCALE-iDriver devices are UL and CSA recognized according to UL1577 – file number E358471 - and have been certified to the VDE0884-10 standard. Furthermore, the SCALE-iDriver family has also been designed to meet future standards such as VDE0884-17 and IEC60747-17. All the parts in the family operate up to 125 °C and are 100 % tested during production using both hi-pot and partial discharge techniques along with functionality testing designed to ensure safety.

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- [3] T. Bajenescio, CTR Degradation and Ageing Problem of Optocouplers (IEEE, Conference Proceedings,1995).

WORLDWIDE SALES SUPPORT LOCATIONS

WORLD HEADQUARTERS

5245 Hellyer Avenue
San Jose, CA 95138 USA

Main +1 408 414 9200

Customer Service

Phone +1 408 414 9665
Fax +1 408 414 9765
Email usasales@power.com
info@power.com

ON THE WEB

www.power.com

CHINA (SHANGHAI)

Room 2410, Charity Plaza
No. 88 North Caoxi Road
Shanghai, PRC 200030

Phone +86 021 6354 6323
Fax +86 021 6354 6325
Email chinasales@power.com

CHINA (SHENZHEN)

17/F, Hivac Building, No 2
Keji South 8th Road, Nanshan District
Shenzhen, China 518057

Phone +86 755 8672 8689
Fax +86 755 8672 8690
Email chinasales@power.com

GERMANY

Lindwurmstrasse 114
D-80337 München, Germany

Phone +49 89 5527 39100
Fax +49 89 1228 5374
Email eurosales@power.com

HellwegForum 1
59469 Ense, Germany

Phone +49 2938 64 39990
Email igbt-driver.sales@power.com

INDIA

#1, 14th Main Road
Vasanthanagar
Bangalore-560052, India

Phone 1 +91 80 4113 8020
Phone 2 +91 80 4113 8028
Fax +91 80 4113 8023
Email indiasales@power.com

ITALY

Via Milanese 20
20099 Sesto San Giovanni (MI), Italy

Phone +39 02 455 08708
Email eurosales@power.com

JAPAN

Kosei Dai-3 Building
2-12-11, Shin-Yokohama
Kohoku-ku
Yokohama-shi, Kanagawa
Japan 222-0033

Phone +81 45 471 1021
Fax +81 45 471 3717
Email japansales@power.com

KOREA

RM602, 6FL, 22
Teheran-ro 87-gil, Gangnam-gu
Seoul, 06164, Korea

Phone +82 2 2016 6610
Fax +82 2 2016 6630
Email koreasales@power.com

SINGAPORE

51 Newton Road
#19-01/05 Goldhill Plaza
Singapore 308900

Phone +65 6358 2160
Cust. Svc. +65 6356 4480
Fax +65 6358 2015
Email singaporesales@power.com

TAIWAN

5F, No. 318, Nei Hu. Rd., Sec. 1
Nei Hu Dist.
Taipei, Taiwan 114, R.O.C.

Phone +886 2 2659 4570
Fax +886 2 2659 4550
Email taiwansales@power.com

UNITED KINGDOM

Building 5, Suite 21
The Westbrook Centre
Milton Road
Cambridge
CB4 1YG

Phone +44 0 7823 557484
Email eurosales@power.com

