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Single-Board Plug-And-Play Gate Drivers For 1.2-kV To 2.3-kV Dual IGBT Modules

[Power Integrations'](#) SCALE-iFlex XLT is a family of dual-channel plug-and-play gate drivers for operation of single LV100 (Mitsubishi), XHP 2 (Infineon), HPnC (Fuji) and equivalent semiconductor modules up to 2300-V blocking voltage for wind, energy storage and solar renewable energy installations, targeting power converters in the megawatt range. This single-board driver enables active thermal management of inverter modules for improved system utilization and reduces the bill-of-materials count for increased reliability.

Thorsten Schmidt, product marketing manager at Power Integrations comments, "It's a real challenge to build a single-board gate driver for these "new dual" style IGBT modules. Our compact new SCALE-iFlex XLT gate drivers fit inside the outline of the module, allowing the drivers to be mounted on the module, which gives converter system designers a high degree of mechanical design freedom."

Schmidt observes that one competitor used three stacked boards to build a gate driver for these modules, while another stacked two boards, but then exceeded the outline of the module. "Ours is the most compact," says Schmidt who added that those solutions also have higher part counts, which affects reliability. He also notes that the height requirement for this application is set by isolation requirements within the module. See Fig. 1.

SCALE-iFlex XLT dual-channel gate drivers feature negative temperature coefficient (NTC) data reporting—an isolated temperature measurement of the power module—which allows accurate thermal management of converter systems. This enables system designers to optimize thermal design and obtain a 25% to 30% converter power increase from the same hardware (Fig. 2).

Schmidt comments that gate driver designs that rely on a static temperature reading will limit IGBT junction temperature to 140°C. However, with the real-time temperature readings provided by SCALE-iFlex XLT, the design margin on that can be reduced and a max junction temperature of 170°C can be permitted, leading to increased power output capability.

The isolated NTC readout also reduces hardware complexity as conventional solutions require additional components to perform temperature readout. The isolated NTC readout also eliminates multiple cables, connectors and additional isolation-barrier-crossing circuits.

Schmidt notes that the presence of high voltage on those additional cables creates a reliability risk, so the integrated temperature readout improves reliability too by eliminating that risk as well as by reducing the number of components and cables.

The gate drivers employ Power Integrations' SCALE-2 chip set which minimizes component count, enhancing reliability. The gate driver board also protects the power switches in the event of a short-circuit.

The SCALE-iFlex XLT is the newest member in the company's SCALE-iFlex product line of modular gate-driver solutions. Earlier members targeted railway, power grid, renewables and auxiliary converters as shown in Fig. 3. The XLT family is particularly targeting energy storage systems (ESSs), but also photovoltaic and wind power applications. According to Schmidt, three-level power converter topologies predominate in energy storage with Power Integrations' customers tending to use 1200-V IGBT modules.

Schmidt adds that conformal coating, which is a requirement in railway applications and comes standard with SCALE-iFlex, is not generally required in ESSs. Therefore conformal coating is just an option for SCALE-iFlex XLT, which customers can select if their systems will operate in humid environments.

Fig. 4 documents how SCALE-iFlex XLT meets the creepage requirements of the topologies used in the targeted applications and the driver characteristics that have been optimized for the targeted modules.

SCALE-iFlex XLT plug-and-play gate drivers are available for sampling now. For more information, visit the SCALE-iFlex XLT [page](#). Or for pricing, contact your local [sales representative](#).

Parameter	SCALE-iFlex XLT		Conventional Gate Driver	
Structure	Single PCBA		Stacked boards	
Size	Fits module outline	98 mm x 65.5 mm	Exceeds module outline	108 mm x 68 mm
Height	Low height (1 PCBA)	31.3 mm	High (multiple boards)	>50 mm
Part Count	Low	160	High	>250



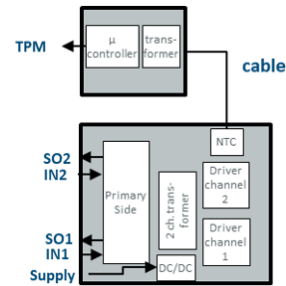
Fig. 1. When compared with conventional gate driver solutions using stacked boards, the SCALE-iFlex XLT single-board gate driver simplifies mechanical design as it fits within the IGBT power module's footprint.

System Level Benefits and Isolated Temperature Read out (NTC)

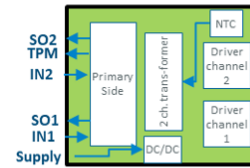
- **Plug-and-play integration of isolation barrier, microcontroller board and cables**
 - ▶ Ready to use - eliminates discrete circuits
- **Improves safety**
 - ▶ Fewer cables reduce risk of arcing
- **25 – 30%¹ more converter power**
 - ▶ Better thermal model using actual temperature data²
 - ▶ Design optimization allows better thermal module utilization
 - ▶ Semiconductor can operate closer to junction temperature³

Notes

1. For same hardware (@ T_j 170 K vs. 140 K)
2. Conventional designs restricted by static thermal calculation
3. Typical design margin is 30 - 50 Kelvin



Conventional solution



SCALE-iFlex XLT

Fig. 2. The gate drivers' NTC temperature readout improves accuracy, increasing reliability and module utilization by up to 30%.

SCALE-iFlex	SCALE-iFlex Single	SCALE-iFlex LT	SCALE-iFlex XLT
<ul style="list-style-type: none"> Excellent parallel switching up to 3.3 kV Digital NTC + DC link monitoring 	<ul style="list-style-type: none"> Highly robust solution for single use of new dual modules (LV100, XHP) 	<ul style="list-style-type: none"> Cost efficient paralleling up to 3.3 kV (EconoDUAL, new dual) 	<ul style="list-style-type: none"> New dual modules up to 2300 V (LV100, XHP 2, HPnC)
<ul style="list-style-type: none"> Railway Power Grid high reliability apps. 	<ul style="list-style-type: none"> Railway Renewables 	<ul style="list-style-type: none"> Renewables Light Rail Auxiliary converters 	<ul style="list-style-type: none"> Energy Storage Systems Photovoltaic converters Wind converters

Fig. 3. Comparing SCALE-iFlex XLT with previously introduced members of this product line.

■ **Wide PCB and transformer creepage - easily meets IEC 61800-5-1**

Voltage Class	2 Level Topology	3 Level Topology
1200 V	Reinforced isolation	Basic Isolation
1700 V	Reinforced isolation	XXX
2300 V	Basic Isolation	XXX



■ **Extended creepage and clearance between primary and secondary side**

- ▶ HiPot test voltage: 6813 VAC
- ▶ PD discharge extinction voltage: 2201 VAC

■ **Optimized driver characteristics**

- ▶ 1 W gate-drive power per channel
- ▶ 15 A / -8 A gate-drive current per channel
- ▶ Short circuit protection by desaturation detection

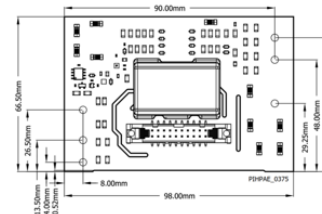


Fig. 4. SCALE-iFlex XLT supports multiple topologies and, according to the vendor, is an industry-first in providing isolation at 2300 V.