

Highly Flexible and Low-Cost Gate Driver Cores for Voltage Classes of up to 3300V

The cost saving capability of ASIC integration is fully exploited in the design

The highly integrated SCALE-2 chipset allows advanced gate driver core functions to be combined with high application flexibility at low cost. The chipset has been developed on the basis of two independent semiconductor processes while keeping full functional and parameter compatibility. Its competitive advantages of exceptional cost performance and long-term availability options will strongly impact the make-or-buy analysis of this class of gate-drive components.

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The demands made on recent power semiconductor devices and gate drivers such as advanced monitoring, failure protection and support of parallel and series-connected devices may lead to a greater increase in complexity and development effort. Application specific integrated circuits (ASICs) are advantageous here because they reduce system complexity and therefore lower manufacturing costs while increasing reliability and system performance.

Standardizing the link between microcontroller and IGBT

Monolithic integration requires considerable initial cost and development time. So it is obvious that the best price-performance ratio can be achieved by large volume production. However, very few products reach this level of market demand. It is the inherent strength of CONCEPT as an independent and highly experienced gate-driver supplier for medium and high-power applications to overcome the obstacles of monolithic integration in this highly specific market. Broad application coverage and a large combined quantity of drivers delivered to a great variety of customers allow all common functions of a driver to be combined on a platform of dedicated ASICs.

Highly integrated SCALE-2 platform

The SCALE-2 driver chipset integrates the full functionality of a dual-channel gate driver core with a gate capability of 8A and 1W per channel, i.e. DC-to-DC conversion with dedicated startup sequence, bidirectional signal transmission via external transformers, output stages, and advanced protection, monitoring and interface functions.

Fast signal processing, regulation of turn-on gate-emitter voltage, compensation of parameter variances over process and temperature, low drift or divergence and jitter of propagation delay as well as fast and configurable fault feedback also simplify the management of IGBTs in parallel connection or multi-level converter topologies.

Dual-channel driver 2SC0108T for 1700V / 450A IGBTs

The cost saving capability of ASIC integration is fully exploited in the

design of the new 2SC0108T dual-channel IGBT and power MOSFET driver core, see Figure 1, left. The gate capability of 8A and 1W per channel is fully assured by the chipset without the need of external active components.

The single-sided assembly has only 25 components, including transformer and ASICs. The overall component count is reduced by 54 % compared to the 2SD106AI SCALE driver based on the previous chipset.



Figure 1: Dual-channel driver core 2SC0108T engineering sample for voltage classes up to 1700V (45 x 34 x 16mm) and dual-channel driver core 2SC0435T prototype for voltage classes up to 3300V

The DC-DC and signal transformers have been optimized to minimize cost while still maintaining superior performance in terms of long-term reliability, thermal stability, coupling capacitance and signal integrity.

The 2SC0108T is designed to control IGBT modules between 50A/1200V at 75kHz and 600A/1200V or 450A/1700V at 10kHz, and also supports parallel IGBT operation and multi-level topologies. Upon request, the 2SC0108T also features a dedicated MOSFET mode which allows faster switching at reduced gate voltage swing.

Figure 2 shows a performance and function comparison between the new SCALE-2 driver 2SC0108T and the SCALE driver 2SD106AI.

Product	2SC0108T	2SD106AI
Technology	SCALE-2	SCALE
Turn-on gate-emitter voltage	Regulated to 15V +/- 0.45V	Unregulated
Turn-off gate-emitter voltage	typ. -7.5V	typ. -15V
Minimum gate resistance	2.0 Ω	3.2 Ω
Gate current paths	Separated	Combined
Supported max. gate charge	6.3 μ C	6.3 μ C
Switching frequency limit	75kHz	75kHz
Target IGBT ratings	50A/1700V @ 75kHz 250A/1700V @ 20kHz 450A/1700V @ 10kHz 600A/1200V @ 10kHz	250A/1700V @ 13kHz 450A/1700V @ 7kHz 450A/1200V @ 10kHz
Command logic compatibility	3.3V, 5V, 15V CMOS; TTL	5 ... 15V
Command to gate output delay	80ns	300ns / 350ns
Delay jitter	< +/- 3.5ns (direct mode)	< +/- 4.5ns (direct mode)
Support of parallel IGBTs	Yes	No
Support of multi-level converters	Optional	No
Dead-time adjustment	1 ... 4 μ s set by one resistor	Setup by four components
Direct mode	available	available
Supply monitoring	Turn-on/off, MOSFET mode	Turn-on/off
VCE mon. threshold voltage	Adjustable	Adjustable
Fault feedback delay	< 1 μ s	Synchronized with command
Fault feedback outputs	2	2
Immunity against dVce/dt	> 100V/ns	> 100V/ns
Isolation test voltage	4000V RMS	4000V RMS
100% high-voltage test	Yes	Yes
Estimated relative MTBF	175%	100%

Figure 2: Comparison of dual-channel low-cost gate drivers for the main target IGBT rating of 250A / 1700V

SCALE-2 technology pushes costs down to \$10 per channel

The 2SC0108T follows a rigorous low-cost approach while still maintaining full application flexibility. The pricing of the 2SC0108T is very competitive, thanks to the very high integration level achieved with the SCALE-2 chipset.

Moreover, the chipset has been developed on the basis of two independent semiconductor processes while retaining full functional and parameter compatibility. Its competitive advantages of exceptional cost performance and long-term availability options will strongly impact its make-or-buy analysis.

At quantities of 10,000 items, the driver will be priced at \$20 (\$10 per driver channel). It thus compares very favorably with discrete solutions for bidirectional signal transmission, isolated DC-to-DC power and gate drive output. The benefits of high reliability and tried-and-tested SCALE technology are also included. Samples will be available in summer 2009.

Dual-channel driver 2SC0435T for voltage classes up to 3300V

Another new gate driver core (the 2SC0435T) is currently being developed for voltage classes up to 3300V. Its gate capability is specified to 35A and up to 4W per channel. The driver is aimed at IGBT modules up to 3600A/1700V at 4kHz and 1500A/3300V at 4kHz, and also supports parallel IGBT operation, multi-level topologies and dedicated turn-off control such as advanced active clamping and dVce/dt or dIc/dt control.

The single-sided assembly of the prototype has only 31 components, including transformer and ASICs, see Figure 1, right. The overall component count is reduced by 55% compared to the 2SD315AI SCALE driver based on the previous chipset.