Latest Generation IGBT Modules for Efficient, Reliable & Power Dense Systems

The ever-changing landscape of the power electronics market is increasing the need for efficient, reliable and power-dense systems across industries. The demand for such systems is encouraging designers worldwide to rapidly embrace new IGBT-based technologies. Dynex has responded to this industry wide requirement with its new generation of high-power IGBT modules, covering the 3.3kV to 6.5kV voltage range.

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Efficient systems

A thorough understanding of the operating conditions of the end application is the key to developing highly targeted IGBT specifications. At Dynex, system level optimisation is central to the IGBT design process. By offering up to three chips at every rated voltage and current level, Dynex is able to hit the sweet spot of every operating window within the end application. A more detailed explanation on this topic can be found at https://www.dynexsemi.com/assets/downloads/BPs_12-18_web-42-44.pdf. This targeted approach for design and development has resulted in Dynex's next generation IGBT modules providing class-leading system level efficiency. Simulation performed under typical operating conditions on the 3.3kV, 1500A module confirms the superior performance of Dynex modules: please refer to figures 1, 2 and 3. Similar results are observed with 4.5kV and 6.5kV modules.

Reliable systems

The key reliability parameters from an IGBT module perspective are 1) Maximum operating junction temperature, 2) IGBT SOA, 3) Anti-parallel diode's reverse bias safe operating area (RBSOA), and 4) ability to withstand high transient, i.e. high di/dt capability. While the information regarding points 1, 2 & 3 are readily available in datasheets from all manufacturers, point 4 is given indirectly, as a recommended value at which the typical switching measurements are shown. During switching of the IGBTs in half bridges, faster turn on and turn off times result in lower switching losses; however there is a trade-off: faster turn on and turn off times result in abrupt disruptions of current flows (high di/dt) through the IGBT, which - when coupled with circuit inductance and the parasitic inductance of the modules themselves - will result in high transients (high dv/dt). These transients have a deteriorating effect on the modules and in some extreme cases result in immediate failures. Often, the di/dt related failures are due to the non-uniform distribution of current flow in the antiparallel diodes. With a thorough understanding of this problem, the designers at Dynex made significant improvements to the uniformity of current distribution in the anti-parallel diodes. With the new generation IGBT modules, Dynex is not only offering a class leading RBSOA, but also 150°C operation for the trench gate modules.

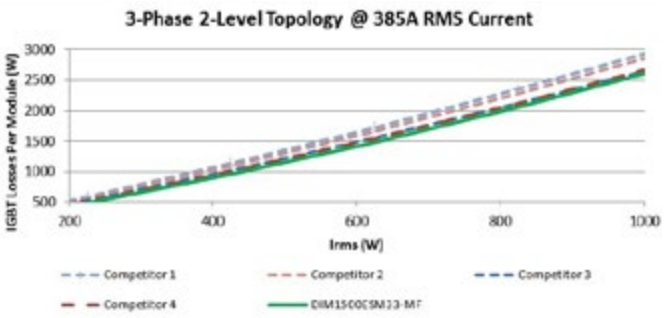

Figure 1: 3-Phase 2-Level Topology @ 385A RMS Current

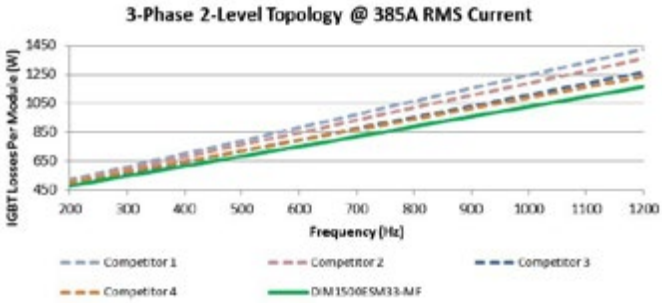

Figure 2: 3-Phase 2-Level Topology @ 385A RMS Current

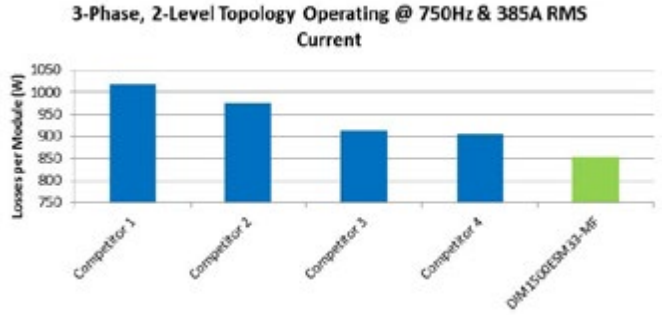

Figure 3: 3-Phase, 2-Level Topology Operating @ 750Hz & 385A rms Current

DYNEX
Dependable Power through Innovation

Industry-Leading Next Generation IGBT Modules

Reliability . Efficiency . Operating Performance

- Demonstrable **lowest total losses** of any module on the market
- **150ºC operating junction temperature** for greater durability
- The **most robust** module package
- **3 chip options** for performance optimization
- Latest Generation Dynex-proprietary **LOCOS Trench Gate designs**

1800A **3.3kV,** 1500A **4.5kV,** 1000A **6.5kV**

DMOS & TRENCH GATE

Power dense systems

Power density at the 'module level' and at the 'system level' is at the heart of the development process at Dynex. While the ability to put more current through the module increases the current density of the module, the ability to switch at high frequencies results in smaller sized magnetics in end systems. Often, switching frequency is limited by the semiconductors and the parasitic inductances in the circuits. With the new generation chips and packages, Dynex is targeting to improve the power density at the module and system level. The new generation E2 module brings down the module inductance by 40%, while the trench gate chip design enables up to 30% increase in the current density of the modules across the voltage ratings.

Design tool to assist system designers with module selection and power loss simulations

The data, similar to that used for the graphs presented in this article, can be generated using Dynex's unique design tool. It offers a quick and a simple way for system designers to try various modules under popular circuit topologies, to identify the optimum module and simulate losses in the modules under their system conditions. Within a matter of minutes, designers can generate output graphs and power loss profiles of the modules at various positions in the circuit. The design tool can be accessed at www.dynexsemi.com under the design support tab.

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