μMaxPak Scalability to EV & Locomotive Traction

This past year, I explored μMaxPak scalability to higher voltages & currents, and was delighted to find it feasible for EV & Locomotive Traction. Although 650V & 1200V SiC μMaxPak packages are ready for prototyping, the Electric Vehicle & Locomotive Traction μMaxPak packages will require some design & process development.

Starting with the μMaxPak concept that Near Chip-Scale SMD packages are design for Power WBG (GaN & SiC) as an ideal packaging solution

The Leadless & wire bondless packages virtually eliminate package parasitics that limit full power WBG performance, speed & efficiency. They reduce thermal resistance (Rjc) and can eliminate power switch screw terminals, and accommodate parallel die switches, and multiple switch products like half-bridges & full bridges.

This approach was applied to Light-Industrial μMaxPak HB (15mm x 8mm x 1mm) targeting to 400A/600V & 200A/1200V

They can be pre-tested & pre-yielded before handling and surface mounted into planar Inverter assembly. QFN μMaxPaks have single-piece leadframe with bottom-side cavities for power WBG die. These structures are a sub-set of proprietary architecture in SPS patent US9,214,416.

Our 2019 focus was SiC μMaxPak Scalability for EV & Locomotive Traction switches

Scalability solutions enable larger die with less CTE mismatch, when soldered to AlN/DBC or Si_3N_4/AMB substrates, and internal leadframe stress-relieved when soldered to power die. Putting HV & LV pads on opposite sides of μMaxPak accommodates higher voltages (to 3.3Kv) and larger pads for higher currents (to 750A). Traction products will be operated at higher temperatures (Tj), requiring newer die attach technology, like Ag-sintering. Also higher temperature, voltage and flow molding compounds.

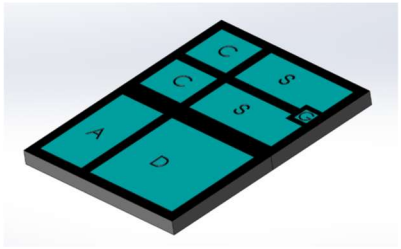

Figure 1: EV μMaxPak HB Top-Side Pad View to output bus. (Bottom hi-side D/A pads to positive bus & lo-side S/C pads to negative bus are not shown.)

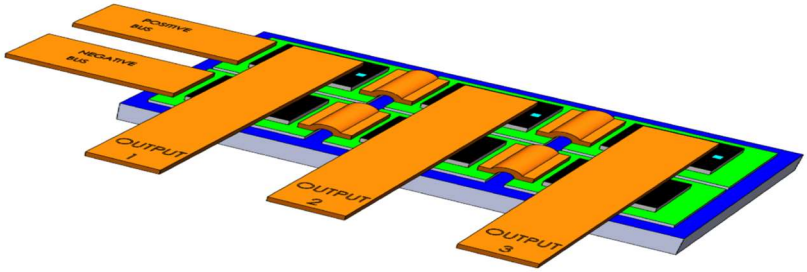

Figure 2: Locomotive Inverter with Six μMaxPak SS. (**Color Codes: Al-SiC Cold-Plate, DBC/AMB, μMaxPak, Cu Leads.**)

EV & Locomotive Traction Drives

can be self-contained & sealed, with only two DC & three Output external power terminals. Internal power connections can be soldered or welded, except possibly the DC-link capacitor. SMD μMaxPak SS or HB switches enable Planar 3ϕ Inverters, increasing Drive performance & power density, and reducing parasitics, size, weight & cost.

See references for more detail & insight:

1) "Scalability of SiC Near Chip-Scale Packages for Electric Vehicle & Locomotive Traction" by Courtney Furnival, Bodo's Power Systems February 2020
2) "Inevitability of Near Chip-Scale SMD Packaging for GaN & SiC" by Courtney Furnival, Bodo's Power Systems July 2018
3) Additional μMaxPak references at www.anagenesis-inc.com

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"Inevitability of Near Chip-Scale High Power GaN & SiC Packages Replacing Even New WBG Traditional Modules" will be presented at the 3D-PEIM Symposium, Osaka, Japan on June 21-23, 2021 http://3d-peim.org/

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