

Podium Session at PCIM Europe Marks New Chapter in GaN Power Device Adoption

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Over the years, GaN power has been sarcastically described as “the technology of the future...and always will be.” While silicon carbide devices have been gaining a stronger beachhead in displacing IGBTs in higher voltage applications, the evolution of GaN as a cost-effective alternative to Si MOSFETs in applications from 200V up through 600V was, in many instances, moving at a glacial pace. This year’s podium

session, hosted by Bodo’s Power Systems, entitled “GaN – Volume, Production and Cost” made it clear that this is no longer true.

Senior representatives GaN power manufacturers (EPC, Transphorm, GaN Systems, Infineon and Navitas) presented details of their significant developments in moving the technology into mainstream, volume applications. Based on the information presented in the five talks, there are three significant reasons to expect dramatic growth in adoption of GaN power devices.

The first of these is qualification testing. Long term reliability data, by definition, takes time. Process enhancements by the early participants in this sector - EPC, Transphorm and GaN Systems - have all demonstrated that, once the GaN on Silicon process challenges have been met, the intrinsic reliability of the devices is without question. Industry committees are now working on solidifying the JEDEC-style quality and reliability standards for GaN devices.

The second key ingredient is production volume. There are now five GaN wafer fabs in operation. All of the major players, including the three previously mentioned plus Infineon have active lines in place. GaN Systems is working with tsmc, EPC with EPISIL. Transphorm now has dedicated use of Fujitsu’s GaN facilities, plus a R&D fab in the US. GaN systems projects a 10X expansion of capacity in 2016. EPC projects its current capacity to fully exceed market forecasts through 2020. And Transphorm announced that it has actually produced over one million production devices in the past 12 months.

The third, and clearly the most significant reason, is adoption of the technology by volume manufacturers. Applications described that are either in early production stages or will soon be announced include plug-in and wireless charging, on-board EV chargers, solar inverters, data center power supplies and industrial motor drives.

The areas where there are still vast differences in approach to this nascent market are topology and packaging.

In terms of topology, both GaN Systems and EPC and Infineon (IR) have adopted an eMode topology. Transphorm have developed their devices using a cascode topology. All four of these utilize a separate gate driver. Navitas, the latest entrant to the GaN discussion, is developing an eMode GaN power IC with integrated driver. At this point, it would appear that an important trade-off between the two topologies, eMode vs. cascode, is switching speed vs. driver compatibility. eMode devices can operate at higher frequencies but have very tight limits on driver input voltage; cascode mode devices are limited in operating frequency but can use any power MOSFET driver.

Packaging is the other differentiator. One end of the spectrum, EPC has taken the position that no packaging is the best answer. In its target markets, it is delivering chip-scale devices. On the other end of the spectrum, Transphorm is packaging some of its devices in traditional TO-220 and TO-247 packages to satisfy their customers’ requirements.

Finally, the idea of costs, when compared with Si solutions was discussed by several of the presenters. EPC made a chip-by chip comparison that claimed eGaN FET costs to be lower than MOSFETs (at the chip level).

GaN Systems, Transphorm and Navitas viewed this question from the perspective of final system cost. According to GaN Systems, “it’s not the cost of the part. It’s what you get for your money.” Transphorm reinforced this by presenting an example of a server power supply PFC with a 10% lower parts cost using GaN compared to Si. In addition, the overall 1.35% loss of the totem pole design is nearly a 40% improvement over the silicon solution power loss of 2.2%. Finally, Navitas is projecting its GaN IC to have a lower system cost per Watt than all other solutions.

In summary, the conversation about GaN has clearly changed. It is no longer a question of if or even when GaN power devices will start to impact the power conversion industry. GaN is the technology of the future...and the future is now.

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