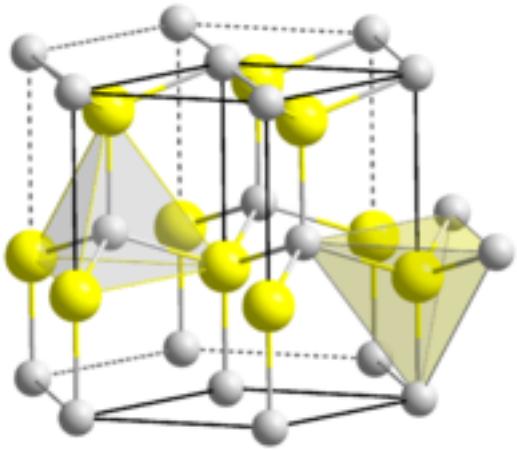
# New Gallium Nitride (GaN) RF MMIC Process Technologies to Enable Lower Cost, Higher Performance Telecommunication and Radar Systems

*Higher Power GaN-on-SiC Processes Allow Telecom System Operators and Military System Providers to Leverage GaN Efficiency for Operational Cost Savings.*

Cree, Inc.announces the qualification and production release of two new GaN processes: G40V4, a 0.25µm process with operating drain voltage up to 40V, and G50V3, a 0.4µm process with operating drain voltage up to 50V. The increased operating voltage and RF power density of these new processes enable smaller die and more compact, higher efficiency amplifiers than possible with conventional technologies. Both technologies are compatible with Cree’s proven GaN MMIC technology on 100mm-diameter SiC wafers with a full complement of passive circuit elements and non-linear models.



The new processes are now available for development and full-rate production. With these processes, Cree offers numerous foundry service options to facilitate the rapid development of custom circuits, including full and dedicated mask sets. The G40V4 process has been qualified at both 28V and 40V operation with RF power densities up to 6W/mm of FET periphery with operation up to 18GHz. The G50V3 process has been qualified for 50V operation and RF power densities up to 8W/mm with operation through 6 GHz. Both of these processes are derivatives of Cree’s previously released G28V3 28V, 0.4µm process that has been in production since 2006 and exhibits one of the lowest field failure rates of any microwave technology in the industry (Failure in Time rate of 9 device failures per billion hours of operation).

Cree estimates that for a typical 3-sector, multi-band LTE/4G telecom remote radio head (RRH) installation, simply switching to GaN from conventional transistor

technology could reduce RRH power consumption by up to 20 percent. This translates directly into lower operating costs and reduced energy consumption. Beyond operational cost savings, there can also be a significant savings in the initial cost of the system. The GaN benefits of higher voltage and higher efficiency allow smaller heat sinks and enclosures, less complex RF amplifiers and lower- cost AC-to-DC and DC-to-DC converters. Systems that previously required large fans to cool can now be air cooled. All of these improvements can reduce the system bill of material cost by up to 10 percent resulting in significantly lower system acquisition costs.

Similar benefits are seen for military radar systems where the improved efficiency from Cree's GaN processes can not only reduce operational power consumption but also dramatically improve system life cycle cost via reduced maintenance. The G40V4 and G50V3 processes can operate at a junction (channel) temperature of 225ºC with a median life time of over two million hours (228 years). This outstanding reliability can dramatically lower the cost of radar system repair and upkeep over its operating life.

"Our customers have been asking for a reliable, higher-frequency process to exploit the advantages of GaN for applications greater than 6 GHz, including Satcom, radar and electronic warfare markets, and we believe our new G40V4 process successfully satisfies their needs," said Jim Milligan, director of RF and microwave, Cree. "To address our customers' need for lower cost GaN solutions, the 50 volt operating voltage of our new G50V3 process has been specifically engineered to provide an extremely low price in terms of dollars per watt of RF output power. The cost-performance of our G50V3 process is designed to rapidly accelerate the adoption of GaN in extremely cost-sensitive markets such as telecom infrastructure where GaN can now provide performance advantages not realizable in silicon LDMOS."

"The higher operating voltage and higher efficiency possible with these new processes are key to rapid adoption," said Dr. Cengiz Balkas, vice president and general manager power and RF, Cree. "Switching to GaN for upcoming LTE/4G macro-cell base stations could save telecom operators over $2 billion annually in reduced energy costs. Fortunately, the telecom industry is beginning to recognize these potential savings. Cree is targeting to deliver more than 75 million watts of GaN transistors into telecom base stations this calendar year." At 40 volt operation, Cree's G40V4 process exhibits up to 6 Watts/mm PSAT at 18 GHz. Typical device characteristics at 10 GHz are 65 percent power added efficiency (PAE) and 12 dB of small signal gain. At 50 volt operation, the G50V3 process demonstrates up to 8 watts/mm PSAT at 6 GHz. Typical device performance at 3.5 GHz is 70 percent PAE with 12 dB of small signal gain. Both GaN processes are qualified for maximum operating channel temperature of 225ºC with a median time to failure of greater than 2E6 hours. In addition, Cree is releasing MMIC design kits with proprietary scalable non-linear HEMT models suitable for operation with Agilent's Advanced Design System (ADS) and AWR's Microwave Office simulator platforms. The design kits also contain a full suite of passive components—resistors, capacitors, spiral inductors and substrate ground vias that can be used to simulate full MMIC performance and provide significantly reduced design cycle times.

To learn more about the new Gallium Nitride RF MMIC process technologies please visit the Cree RF team at booth 2125 at the 2012 IEEE International Microwave Symposium held June 17 – 22 in Montreal, Canada. For additional information about the new process technologies and foundry services please visit www.cree.com/rf [1].

www.cree.com [2]

Posted by Sara Cohen, Editorial Intern

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