MACOM™
Partners in RF & Microwave

High Power GaN in Space Saving Plastic: A New Standard for RF Power Transistors for Radar and Communications Systems

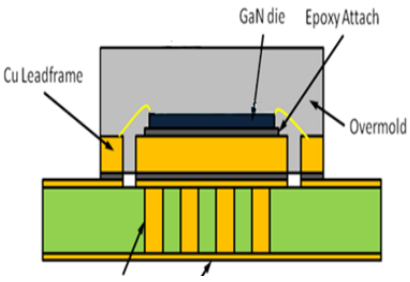
New advancements in packaging and thermal management innovation position M/A-COM Technology Solutions (MACOM) at the forefront of GaN commercialization

Radar and communications system designers are continuously challenged to strike the optimal balance of size, weight, and power profiles for their unique radar system designs, from military applications spanning ground/air surveillance and target tracking, to civilian radar systems including air traffic control and weather observation. The ever exacting performance, reliability and ruggedization requirements associated with this new generation of mobile radar systems are straining the limits of conventional silicon and GaAs-based power transistor components.

Radar Photo: Lockheed Martin.

The acute and enduring challenge facing radar system designers – accommodating higher power with smaller components – is accelerating the pace of innovation in power transistor packaging technology. But with each incremental gain in component power density, the resulting thermal management issues grow increasingly problematic.

ACHIEVING THE PROMISE OF GaN



MACOM's Plastic Packaging Approach

The recent emergence of Gallium nitride (GaN) based high electron mobility transistor (HEMT) power amplifiers is equipping radar system designers to achieve high power operation using smaller power transistors. Scaling to a higher voltage minimizes power loss, enhancing power efficiency and simplifying pulsed energy storage requirements.

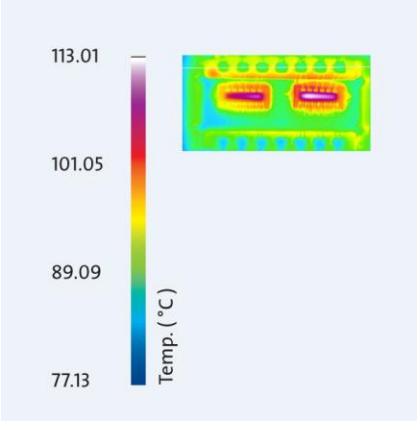
GaN-based power transistors enable system designers to use smaller energy storage capacitors, and maintain the same number of power amplifiers when increasing the overall transmit power. This new GaN-driven capability is

yielding a new generation of more agile, ruggedized radar systems optimized for increasingly demanding performance requirements and environmental conditions.

To date, most vendor approaches to applying GaN to power amplifiers have relied on packaging techniques found in earlier generation devices like Si laterally diffused metal oxide semiconductors (LDMOS) and Si bipolar junction transistors (BJT).By replacing the silicon material in these packages with GaN, improvements in power density and efficiency have been achieved. But this approach, and the continued reliance on conventional ceramic packaging, hasn't yielded meaningful reductions in component size or weight.

BREAKTHROUGH INNOVATION WITH GaN IN PLASTIC

MACOM is leading the RF semiconductor industry in GaN power transistor packaging technology with the introduction of its advanced GaN in Plastic power transistor portfolio for high-performance military and civilian radar and communications applications. Building on MACOM's rich heritage in semiconductor process innovation, proprietary design expertise and deep understanding of customer and end-user applications, its GaN in Plastic-packaged power transistors set a new standard for harnessing high power in small enclosures.



93W Output Power Shows 113°C Junction Temperature

Scaling to power levels up to 90W –the industry's highest power for this product category – in standard 3 x 6mm dual-flat no leads (DFN) packaging, MACOM's breakthrough GaN in Plastic-based power transistors defy the power, size and weight limitations of competing GaN-based offerings to enable a new generation of high power, ultra compact radar systems for use in traditional and next-generation fixed-installation and mobile radar applications.

To achieve this new standard, MACOM has pioneered sophisticated, proprietary thermal dissipation techniques to ensure that its GaN in Plastic power amplifiers offer comparable reliability to conventional ceramic-packaged GaN-based offerings. MACOM's approach optimizes the transistor die layout and uses advanced heat sinking and die attachment methods. Utilizing some of the most stringent thermal imaging testing methodologies in the semiconductor industry, MACOM's GaN in Plastic

power transistors have demonstrated less than 115°C junction temperature (80°C base-plate) for a pulsed power output of 93W, using a 100uS pulse, 10% duty cycle. These transistors operate at 50V drain bias resulting in outstanding power density and performance, higher efficiency, and smaller impedance matching circuits due to improved device parasitics. The high voltage operation also benefits overall system design with smaller energy storage capacitors and lower current draw.

MACOM's GaN in Plastic-based power transistors are also extremely lightweight compared to ceramic-packaged GaN-based offerings. Measured in aggregate across the hundreds of power amplifiers within a typical modern radar system, this can reduce overall system weight considerably. The resulting weight reduction ensures greater ease of movement for mobile radar systems.

MACOM LEADING IN GaN COMMERCIALIZATION

The first entries in MACOM's GaN in Plastic power transistor product portfolio include 90W, 50W and 15W transistors, all of which are available in standard 3 x 6mm DFN packaging. The devices can be mounted on PCBs via ground/thermal arrays. Internal stress buffers allow these devices to be reliably operated at up to 200°C channel temperature. The newest product in this family is a 5W device in an even smaller standard small outline transistor (SOT-89) package, measuring just 2.5 x 4.5 mm. All of these transistors are capable of operating at frequencies up to at least 3.5GHz.

MACOM's GaN in Plastic 90W, 50W, 15W in 3x6mm DFN packaging

A NEW GENERATION OF HIGH-PERFORMANCE RADAR SYSTEMS

MACOM's unrivaled innovation in high power GaN in space saving plastic is enabling radar system designers to take full advantage of GaN technology and achieve new levels of power density while reducing system size and weight significantly. Utilizing sophisticated packaging and thermal management techniques to maximize design efficiency and component reliability, MACOM is helping designers overcome challenging development hurdles and pioneer a new generation of high-performance, rugged radar systems that transcend the capabilities of systems based on conventional ceramic-based power transistors.

For more information about MACOM's GaN in Plastic power transistor portfolio and/or to order product samples, visit www.macomtech.com/GaN.