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GaN Devices Provide Broadband Power

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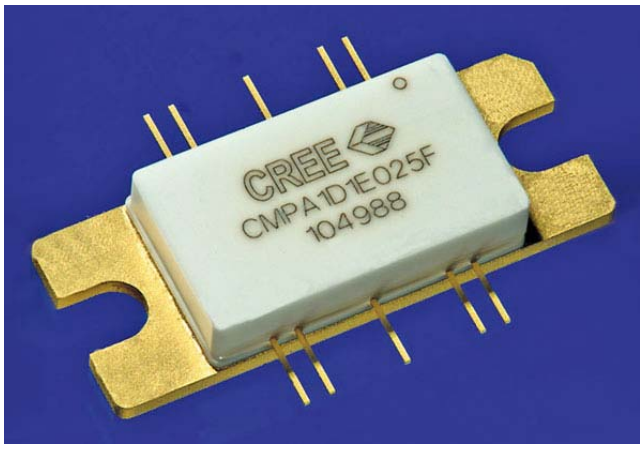
Available in chip and packaged formats, these high-power GaN amplifiers are suitable for CW and pulsed applications through 14.5 GHz.

Gallium-nitride (GaN) solid-state devices continue to gain in power at increasing frequencies, supporting a growing number of applications for radar, test, and communications systems for both continuous-wave (CW) and pulsed signals. The latest line of GaN devices from Cree provides generous output power levels at frequencies through 14.5 GHz, ideal for use in radars and satellite-communications (satcom) systems that require efficient signal amplification. Designers have numerous options in terms of specifying chip or packaged devices.



The lowest-frequency device in the product line is an impedance-unmatched GaN transistor, model CGHV40050, intended for CW applications from DC to 4 GHz. The GaN high electron mobility transistor (HEMT) is designed for +50-VDC supplies and can provide as much as 50 W output power across the frequency range. It can be supplied in one of two package styles: a two-lead flange package or a pill package. Examples of the performance possible with this transistor based on a reference design for 800 MHz to 2.5 GHz include 17.6-dB gain at 800 MHz with 65 W saturated output power and 63% drain efficiency (PAE). The gain remains high at 1.4 GHz, at 17.7 dB, with 63 W saturated output power and 60% PAE. At 2 GHz the gain drops somewhat, to 14.8 dB, although the saturated output power is still 60 W and the PAE is 52%.

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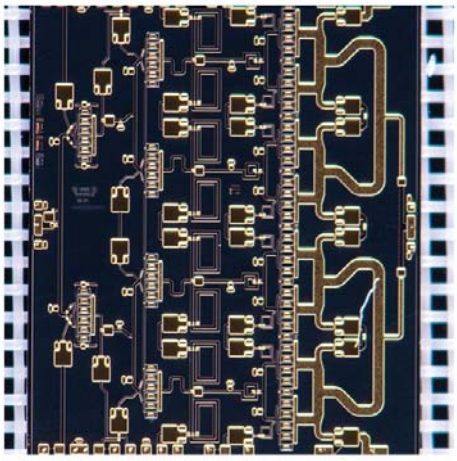
For those who prefer an impedance-matched device, model CMPA1D1E025F is a Ku-band GaN monolithic-microwave-integrated-circuit (MMIC) amplifier on silicon-carbide (SiC) substrate that delivers 25 W modulated output power from 13.75 to 14.50 GHz *(Fig. 1)*. The frequency range is well suited for use in satellite-communications (satcom) uplink equipment. The output power was measured with orthogonal quadrature phase-shift-keying (OQPSK) modulation and a +40-VDC supply.

This MMIC amplifier is supplied in a 10-lead 25 × 9.9 mm metal/ceramic flanged package. It is capable of small-signal gain of 26 dB at 13.75 GHz, 27 dB at 14.25 GHz, and 26 dB at 14.50 GHz. The linear output power is 19 W at 13.75 GHz, 20 W at 14.25 GHz, and 18 W at 14.50 GHz, while the PAE is 18% at 13.75 GHz, 17% at 14.25

z, and 16% at 14.50 GHz.



Model CMPA1D1E030D is a GaN MMIC amplifier chip on a SiC substrate *(Fig. 2)*. It can provide 30 W output power from 13.5 to 14.5 GHz when running from a +40-VDC supply. The amplifier, which is well suited for CW amplification in satcom uplinks, achieves small-signal gain of 27 dB at 13.5 GHz and 25 dB at 14.5 GHz, with saturated output power of 33 W at 13.5 GHz and 30 W at 14.5 GHz. It boasts PAE of 24% at 13.5 GHz and 22% a 14.5 GHz when measured with +26-dBm input power.

For more broadband pulsed applications at lower frequencies, the model CMPA601CO25D GaN MMIC chip on SiC substrate is capable of 30 W saturated output power from 6 to 12 GHz. Suitable for jamming amplifiers, radar amplifiers, and test equipment amplifiers, it operates with small-signal gain of 40 dB at 6 GHz and 36 dB at 12 GHz.

When evaluated with a 10-µs pulse at 0.1% duty cycle and powered with +19-dBm input power, the MMIC amplifier chip delivers +48-dBm output power at 6 GHz and +47.3-dBm output power at 12 GHz. With the same +19-dBm input signal, the PAE is 33% at 6 GHz and 32% at 12 GHz. The MMIC amplifier is designed for use at +28 VDC. It measures 0.172 × 0.239 × 0.004 in. in chip form.

Essentially the same amplifier, model CMPA601C025F is available in a 10-lead ceramic package for use from 6 to 12 GHz and +28 VDC. When measured with CW signals, it provides small-signal gain of 35 dB at 6 GHz and 31 dB at 12 GHz. When fed with a +22-dBm input signal, the output power is +42 dBm at 6 GHz and +34 dBm at 12 GHz, with PAE of 27% at 6 GHz and 25% at 12 GHz. The packaged amplifier can deliver as much as 35 W typical saturated output power.

These amplifiers and devices represent the latest GaN devices from Cree but only a sampling of what the firm has accomplished with this technology, with and without SiC substrates for enhanced thermal management. GaN is a solid-state technology that is gaining ground in many higher-power pulsed and CW higher-frequency applications, and these devices provide a glimpse of the performance capabilities of this technology.

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