



National Aeronautics and  
Space Administration



## TECHNOLOGY SOLUTION

### Communications

# Solid-State Microwave Power Module

Single module provides highperformance radar, communications, and navigation

Innovators at NASA's Glenn Research Center have developed a microwave power module to power radar, communications, and/or navigation interchangeably. This high-efficiency, all-solid-state microwave power module (MPM) is based on a multi-stage distributed-amplifier design, which is capable of very wideband operation. This MPM is extremely durable and can last a decade or longer. Already more compact and lightweight than conventional designs, Glenn's patented technique offers further size reduction by eliminating the need for either a traveling-wave tube amplifier or its accompanying kV-class electronic power conditioner. The performance of this MPM is exceptional, with much higher cut-off frequency and maximum frequency of oscillation than metal-semiconductor-field-effect-transistors offer, and the distributed amplifier's wide bandwidth also results in much faster pulse rise times. Finally, Glenn's design allows the module to operate in both pulsed and continuous wave modes, so it can singlehandedly drive exceptional performance for radar, navigation, and communications.

#### BENEFITS

- Wide bandwidth: Amplifies signals over the 2 to 20 GHz and 20 to 40 GHz radio frequency (RF) ranges
- High efficiency: Operates in both pulsed and continuous wave modes
- High output power: Enables reliable performance in high RF ranges
- Reduced payload: Comprises compact and lightweight all-solid-state materials
- Radiation resistance: Uses gallium nitride (GaN), a wide bandgap semiconductor, which is inherently radiation-hard



## THE TECHNOLOGY

Typically, microwave power modules (MPMs) are useful only for radar and navigation purposes because they lack the linearity and efficiency required for communications. In standard configurations, conventional MPMs require both a solid-state amplifier at the front end and a microwave vacuum electronics amplifier at the back end. By contrast, Glenn's design features a wideband multi-stage distributed amplifier system. The low-power stage is a high-efficiency gallium arsenide (GaAs) pseudomorphic high-electron-mobility transistor (pHEMT)-based monolithic microwave integrated circuit (MMIC) distributed amplifier. The medium-power stage is configured to pick up and amplify the low-power signal. This stage can be either another high-efficiency GaAs pHEMT or a gallium nitride (GaN) HEMT-based MMIC distributed amplifier, depending on the need. The high-power stage, configured to pick up the signal from the second amplifier, is a high-efficiency GaN HEMT-based MMIC distributed amplifier, which supplants the traveling-wave tube amplifier found in most microwave power modules.

In Glenn's novel MPM, the radar functions as a scatterometer, radiometer, and synthetic aperture imager. The high-speed communications system down-links science data acquired by Earth-observing instruments. The navigation system functions like a transponder for autonomous rendezvous and docking, and estimates the range information. Glenn's MPM gives systems the versatility to use a single power module to drive not only radar and navigation but also communications systems.



Phased array antennas, such as this one at the National Severe Storms Laboratory in Norman, Oklahoma, can use radar to conduct important weather research



Satellites and radar are essential to the U.S. military for intelligence-gathering, navigation, and communication

## APPLICATIONS

The technology has several potential applications:

- Commercial and military satellite communications
- Military radar systems
- Phased-array antenna systems
- Aerospace (radar, communications, navigation)

## PUBLICATIONS

Patent No: 8,476,979; 9,041,469

U.S. Pat # 9,041,469 (expired)

[technology.nasa.gov](http://technology.nasa.gov)

**More Information**

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