L- AND KA-BAND ANTENNAS
SHARE THE SAME PATCH

BY PLAYING TO the strengths of both the L- and Ka-bands, a shared-aperture communications antenna could operate at a high data rate in good weather without completely losing its connection in inclement weather. In collaboration with Cobham Satcom, researchers from the Technical University of Denmark—Thomas Smith, Ulrich Gothelf, Oleksiy Kim, and Olav Breinbjerg—have developed a shared aperture antenna array. It leverages a cost-effective printed-circuit-board (PCB) substrate for multiband antenna operation. Using a frequency-selective surface as the groundplane of the Ka-band reflectarray structure enables a compact structure. The L-band patch antenna array sits directly behind the reflectarray.

A concentric, dual split-loop element is designed for the Ka-band reflectarray with a concentric, dual-loop groundplane of equal trace width (0.2 mm). Adjustment of the split-loop elements changes the reflection phase. It also can be used to adjust the center frequencies over a nearly 10-GHz range.

The Ka-band reflectarray was validated in the DTU-ESA Spherical Near-Field Antenna Test facility. It performed with receive and transmit aperture illumination efficiencies of 56% and 41%, respectively. A commercial L-band patch-array antenna was used to demonstrate the Ka-band translucence of the Ka-band reflectarray. It displayed only minor degradation of the L-band patch array's performance. The measurements for that patch array were conducted from 1500 to 1700 MHz with a varying directivity of ±0.15 dB and maximum cross polarization below ±2.5 dB.

See "An FSS-Backed 20/30 GHz Circularly Polarized Reflectarray for a Shared Aperture L- and Ka-Band Satellite Communication Antenna," *IEEE Transactions on Antennas and Propagation*, Feb. 2014, p.661.

GAN MMICS FOR SMALL CELLS
GET A DOHERTY POWER BOOST

USING A 0.25-μM gallium-nitride-on-silicon-carbide (GaN-on-SiC) process, a monolithic-microwave-integrated-circuit (MMIC) power amplifier (PA) promises to meet the power, size, and cost considerations of small-cell applications. With support from the IT R&D Program of MSIP/KEIT, Republic of Korea, Cheol Ho Kim, Seunghoon Jee, Gweon-Do Jo, Kwangchun Lee, and Bumman Kim designed and tested the 2.14-GHz hybrid-Doherty PA. To achieve low part count and reasonable efficiencies in a compact package, the team used an unconventional power-splitting technique.

For the nonsymmetrical configuration, different-sized PAs were used. The peak amplifier was sized larger than the carrier amplifier for greater backoff characteristics, resulting in a higher peak-to-average power ratio (PAPR). This helped the PA achieve a higher data rate capable of supporting 4G and LTE requirements. To further reduce size, low-loss chip inductors were placed around the MMIC die. They reduced the inductor circuit footprint by a factor of 10.

Exhibiting a high drain efficiency of 52.7%, the PA provided output power to +22.2 dBm. It achieves an adjacent power leakage rate of –49.6 dBc for an LTE signal. The peak-to-average power ratio (PAPR) reached 7.1 dB after the digital-predistortion linearization. See "A 2.14-GHz GaN MMIC Doherty Power Amplifier for Small-Cell Base Stations," *IEEE Microwave and Wireless Components Letters*, April 2014, p. 263.

RF SENSORS BIODEGRADE
UNDER PRESSURE

WHEN TEMPORARY WIRELESS sensors are used for medical applications, multiple surgeries are needed to install and remove the sensor. If a wholly biodegradable sensor were used, the removal surgery would become unnecessary. To save patients a costly and potentially painful second surgery, Mengdi Luo, Adam Martinez, Chao Song, Florian Herrault, and Mark Allen from the Georgia Institute of Technology explored materials to create an RF biodegradable pressure sensor.

SPolyactic acid (PLLA) and polymer liquid crystal (PLC) biodegradable plastics were used to construct the films that operate as the sensor substrate. The conductor materials for the inductor coils and capacitor plates for the sensor were formed from zinc and iron. The coils and plates were electrodeposited on the film using a standard plating bath. The metallic structures and insulating layers were deposited on a flat film that is folded to produce the multi-layer pressure sensor.

Several tests were performed to characterize the biodegradability of the components and the structure. A 0.9% saline solution was used to immerse the metallic pressure-sensor components in a heated mechanical vibration chamber. After a 300-hr. test, the iron oxides were the only remaining material that was not dissolved in the solution. In resonant-frequency testing in saline and air, a similar decline in resonant frequency to increased applied pressure is observed. There is a marked shift in resonant frequency between the air and saline environments. See "A Microfabricated Wireless RF Pressure Sensor Made Completely of Biodegradable Materials," *Journal of Microelectromechanical Systems*, Feb. 2014, p. 4.