The Global Electronics Publication

Daily News Archive
Front Page Articles
Tech-Op-Ed
Tech Watch
People in the News
Business News
Management
EM Services
EM Products
Production
Partnering
Distribution
Industry Articles
Product Preview: SMTconnect, EDS, EWPTE
New Products
Hi-Tech Events
Calendar

home/current issue > industry articles >

Back

NASA Launches mmWave Systems to New Heights

By Greg Rankin

New hybrid circulators are able to transmit greater amounts of data for space applications.

For both space and terrestrial mmWave applications, new hybrid designs enable maximum use of bandwidth while maintaining high isolation. However, the lack of high-performance components in higher mmWave bands (50 to 500 GHz) is limiting the ability to take full advantage of these frequencies.

NASA, for one, has invested a lot of energy in trying to solve the issue. One focus has been on developing a new generation of mmWave circulators suitable for use in spacecraft instrumentation.

Circulators are primarily used in transmit-receive systems such as point-to-point radio and radar. They allow a transmitter and receiver to share a common antenna while simultaneously isolating the transmitter and receiver from each other. Thus, a high-power signal from a transmitter does not damage a sensitive receiver. The greater the isolation, the better.

However, at the higher mmWave frequencies, the state-of-the-art Y-junction circulator is effective only within a very narrow bandwidth. Using a Y-junction circulator can place a severe bandwidth limitation on the entire system.

A new type of circulator, dubbed the "hybrid circulator," can theoretically cover entire waveguide bands with relatively low insertion loss and more than 20 dB of isolation. The hybrid circulator will enable designers to push greater volumes of data through systems operating in the upper regions of the mmWave spectrum.

Stretching the limits

The hybrid circulator is being developed by Micro Harmonics Corporation of Fincastle, Virginia. Their initial prototypes were designed to cover the 150-190 GHz band in WR-5 and were assembled and tested in early 2021. The measured insertion loss was less than 2.2 dB and the isolation was greater than 20 dB across the entire 150 to 190 GHz band.

For comparison, a state-of-the-art Y-junction circulator operating at 160 GHz has a 20 dB bandwidth near 3 GHz and a slightly higher insertion loss than the hybrid. The bandwidth of the hybrid circulator is thus an order of magnitude greater than that of the Y-junction.

The new hybrid circulator gives microwave engineers the option of specifying one component that can operate over multiple bands, making instrument architecture much easier. The hybrid circulators are quickly finding application. NASA's Cloud Radar System group — based at the Jet Propulsion Laboratory (JPL) in California — is currently exploring their use in weather radars.

JPL utilizes circulators in their high-altitude aircraft and high-throughput satellite communication systems for measuring cloud properties and upper atmospheric constituents. Some of these systems operate in the G-band (167 to 175 GHz) with development also planned at frequencies near 240 GHz and beyond. Y-junction circulators are not manufactured at these frequencies due to the extreme sensitivity of the center frequency to small variations in the dimensions of the ferrite core. But the hybrid circulator can easily reach the WR-2.8 band 260 to 400 GHz and possibly beyond.

The Y-junction has been the dominant circulator technology for more than 50 years. The Y-junction circulator comprises a magnetically biased ferrite core located at the convergence of three waveguides. But the hybrid circulator achieves the circulator function in an entirely different way which overcomes the inherent bandwidth limitations in the Y-junction.

Micro Harmonics' patent-pending design combines an orthomode transducer (OMT) with a Faraday rotator. Both the OMT and Faraday rotator are inherently broadband devices. When properly configured, these components interact to create the circulator function over full rectangular waveguide bandwidths.

While opening up mmWave bands for terrestrial applications, hybrid circulators also possess characteristics that qualify them for deep space. Improvements in amplifier technology are allowing higher and higher transmit power levels.

Contact:
Micro Harmonics, 20 S Roanoke Street, Suite 202, Fincastle, VA 24090 ☎ 540-473-9983 E-mail: sales@mhc1.com Web: http://www.microharmonics.com

Back