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Why small manufacturers are key to DoD's plans to strengthen its supply base

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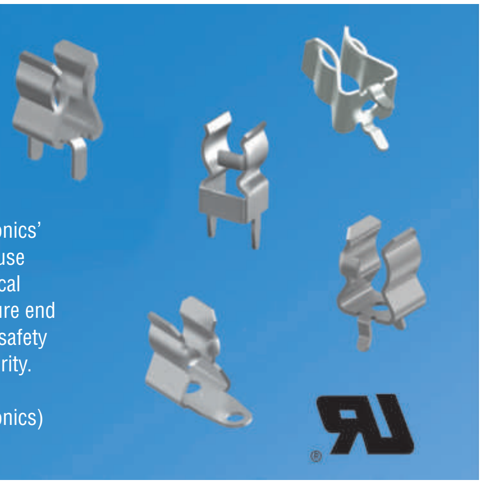
manufacturing capabilities extend across the 5G ecosystem of network service providers, equipment OEMs, and device manufacturers, along with key stakeholders in automotive, consumer, enterprise, industrial, and medical markets, the company said.

UL-Recognized Fuse Clips Designed to Ensure Safety, Ease of Use on PCBs

NEW HYDE PARK, N.Y.—UL-recognized Fuse Clips from Keystone Electronics Corp. are manufactured from brass with tin or nickel plate to ensure low contact resistance and ease of use on PCBs. The fuse clips feature end stops to ensure safety and design integrity and can be used with cylindrical glass fuses ranging in size from 1AG to 8AG, according to a release from Keystone Electronics.



Keystone Electronics' UL-recognized fuse clips for cylindrical glass fuses feature end stops to ensure safety and design integrity. (Photo courtesy Keystone Electronics)

The low profile, space saving fuse clips "can accommodate any product design requiring UL components," the company said, including the use of Solar Protection Fuses (SPF). They are suitable for applications from 6 to 30 Amps in a variety of environments.

Designed to mount easily and retain a stable position during wave soldering, UL-recognized clips are available in "snap-in" and "press-in" through-hole mounting configurations, as well as rivet and surface mounting styles, the company said.

Keystone, a manufacturer of precision electronic components and hardware, said it manufactures a broad selection of fuse clips and holders for a variety of fuse sizes and styles as part of its large family of interconnect components and hardware. The company's capabilities include stamping, machining, assembly, CNC, and injection molding services. Keystone also offers application and engineering team assistance for product modifications and special designs.

Keystone is ISO-9001:2015 certified and RoHS compliant. The company has headquarters in the United States and offices in Canada, Europe, Australia, and Asia.

NASA Gives Boost to 'Hybrid' Circulators, Launching mmWave Systems to New Heights

For space and terrestrial mmWave applications, new hybrid designs enable maximum use of bandwidth while maintaining high isolation.

By Dave Rizzo

When it comes to mmWave systems, science can only progress as far as compatible hardware will allow. This portion of the electromagnetic spectrum will unlock enormous potential for design engineers with the promise of vastly superior data speeds, capacity, and quality, all at low latency. However, the lack of high-performance components in the higher mmWave bands (50 GHz - 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 NASA 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.

In response to this challenge, Small Business Innovation Research (SBIR) Phase I and Phase II contracts were recently awarded by NASA to spur the development of a circulator with significantly higher bandwidth. This effort is paying dividends as a new circulator technology has recently been developed.

This 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 (www.MicroHarmonics.com). The company's 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 150-190 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.

The Jet Propulsion Lab uses circulators in its 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 (167-175 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 260-400 GHz and possibly beyond.

Many industries have a need for wideband circulators at other mmWave frequencies: airport radar, telecommunications satellites, and high-speed point-to-point data links. Defense applications include bio-agent detection, battlefield radar, and nighttime imaging. Commercial applications include 5G (and higher) cellular technology, smart cities, connected vehicles, and other IoT applications.

In radar applications, larger bandwidth makes it easier to discern a target in a given sweep. But for any application, wider bandwidths allow for more data that can be supported because the data rate is directly proportional to the amount of bandwidth around the carrier frequency.

Another problem facing system designers is that few vendors offer standard stock circulators operating in mmWave frequencies. This forces microwave designers to seek custom solutions with narrow bandwidths and long lead times.

However, the development of the hybrid circulator will alter the landscape and open up new possibilities.

In its partnership with NASA, Micro Harmonics plans to develop a full line of hybrid circulators operating in every standard waveguide band from 50-250 GHz over the course of the next two years. Beyond that, the company plans to extend coverage to 400 GHz. These will not be custom solutions but rather off-the-shelf components. This is a case where science is driven by hardware availability.

Overcoming Bandwidth Limitations in Circulator Performance

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.

A new hybrid circulator gives microwave engineers the option of specifying one component that can operate over multiple bands. In its partnership with NASA, Micro Harmonics plans to develop a line of hybrid circulators operating in every standard waveguide band from 50 to 250 GHz over the next two years. (Image courtesy Micro Harmonics)

The Final Frontier

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. But when high-power signals are used in a vacuum, such as seen in space, the problem of "multipaction" can arise.

Multipaction is a phenomenon where charged particles are accelerated by high-power RF signals and strike a conducting surface with high kinetic energy. At low energies, the charged particles are absorbed on the surface. But if the energy is sufficient, additional charged particles are liberated from the surface and an avalanche in the number of particles can occur. Multiple high energy impacts can damage the conductor surfaces and can cause permanent damage to the system.

The designers at Micro Harmonics are using sophisticated simulation tools to determine the power levels at which multipaction may become an issue in the hybrid circulator. To date, the simulations indicate that the multipaction phenomenon may occur in the WR-5 hybrid circulator at power levels exceeding 30 kW. This is far more power than is currently available from sources in the WR-5 band including high-power TWT amplifiers.

As industry obtains greater access to discrete components like hybrid circulators that can perform in the higher mmWave bands, design opportunities arise for microwave applications approaching the Terahertz range. The sky is becoming the limit.

Dave Rizzo is a Phoenix-based freelance writer with more than 25 years of experience writing about microwave and RF technologies, design engineering, and electronics.

Addressing the Microchip Shortage

Georgia Tech expert predicts that America will need to make major changes to the manufacturing and supply chain

ATLANTA, Ga.—This country's semiconductor chip shortage is likely to continue well into 2022, and a Georgia Tech expert predicts that the U.S. will need to make major changes to the manufacturing and supply chain of these all-important chips in the coming year to stave off further effects.

That includes making more of these chips here at home.

Madhavan Swaminathan is the John Pippin Chair in Electromagnetics in the School of Electrical and Computer Engineering at Georgia Tech. He also serves as director of the 3D Systems Packaging Research Center.

As an author of more than 450 technical publications and holder of 29 patents, Swaminathan is one of the world's leading experts on semiconductors and the semiconductor chips necessary for many of the devices we use every day to function.

"Almost any consumer device that is electronic tends to have at least one semiconductor chip in it," Swaminathan explained. "The more complicated the functions any device performs, the more chips it is likely to have."

Some of these semiconductor chips process information, some store data, and others provide sensing or communication functions.

In short, they are crucial in devices from video games and smart thermostats to cars and computers.

Our current shortage of these chips began with the COVID-19 pandemic. When consumers started staying at home and car purchases took a downward turn, chip manufacturers tried to shift to make more chips for other goods, like smartphones and computers.

But Swaminathan explained that making that kind of switch is not simple. Entire production operations have to be changed. The chips are highly sensitive and can be damaged by static electricity, temperature variations, and even tiny specks of dust. The manufacturing environments must be highly regulated, and changes in the process can add months.

The pandemic highlighted another challenge with the semiconductor chip industry, according to Swaminathan.

"There's a major shortage of companies making chips," he said. "If you look worldwide, there are maybe four or five manufacturers making 80-90 percent of these chips, and they are located outside of the United States."

This creates supply chain hiccups with the raw supplies needed to make these chips as well. Add in the fact that many of these companies only design their chips—they don't manufacture them directly.

"American consumers use 50 percent of the world's chips," Swaminathan said, which creates a serious challenge when