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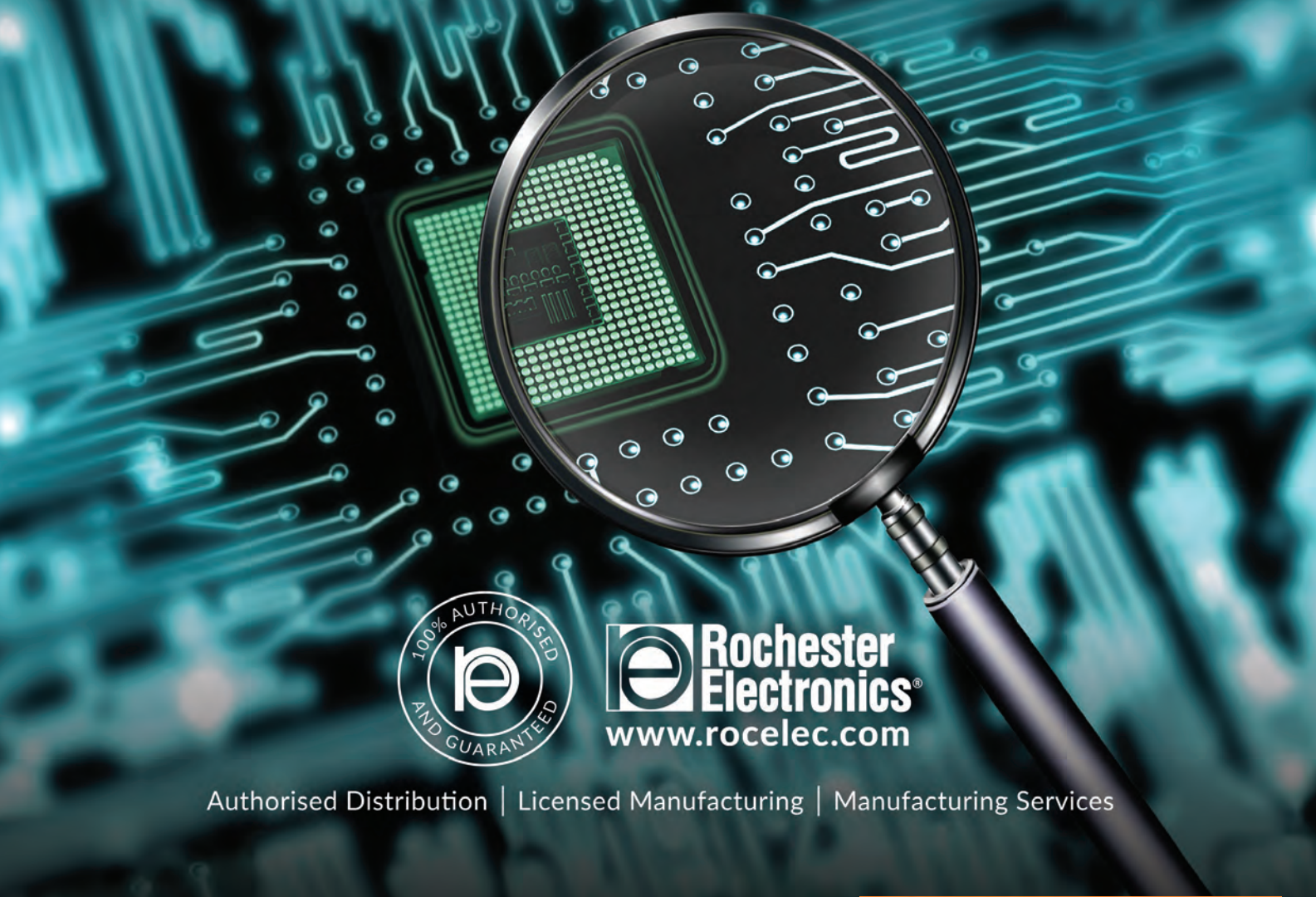
## Component Management

Begin before the end





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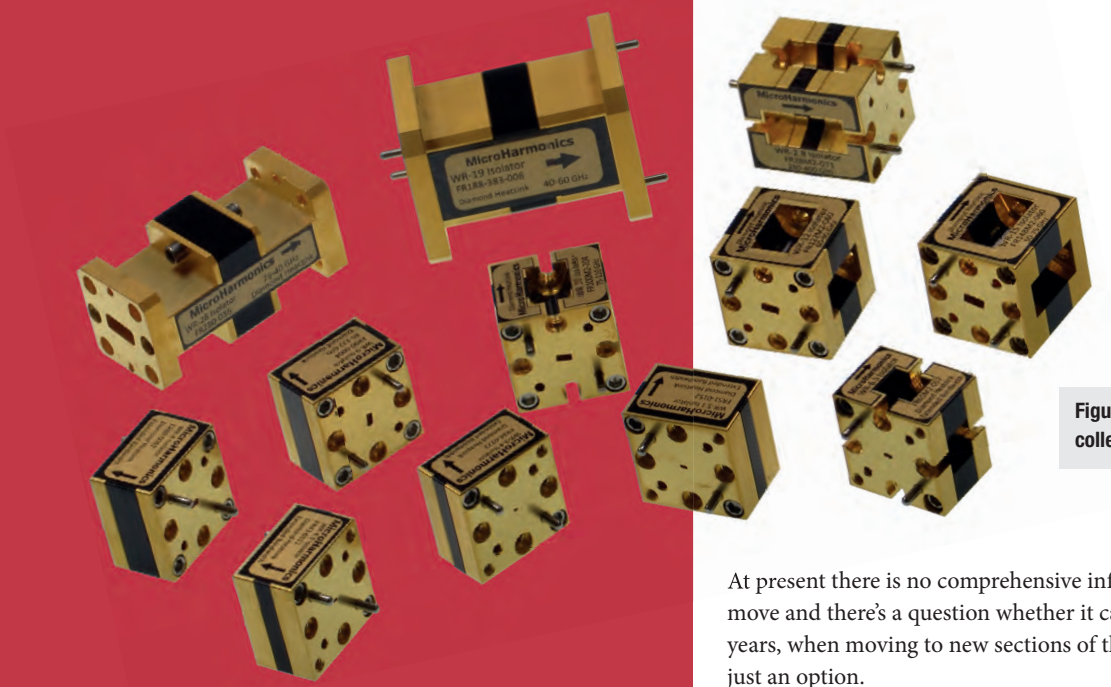


Figure 1: Isolator collection

# A gold rush to D-band and beyond

By Jeffrey Hesler, Chief Technology Officer, Virginia Diodes

"The D-band is the new E-band" stated the shirts worn by Virginia Diodes (VDI) employees at a recent microwave symposium.

Covering 60-90GHz, the E-band is a well-established high-capacity solution for mmWave applications. With radio links to 20Gbps, this band has been an attractive and cost-effective space for design engineers to turn to. However, as we all know in the industry, there is need for more spectrum, which means moving to higher frequencies in the D-band (110-170GHz) and beyond.

At present there is no comprehensive infrastructure to support this move and there's a question whether it can be built in the next 5-10 years, when moving to new sections of the spectrum is no longer just an option.

In telecoms alone, supporting billions of users at higher data rates requires ever-higher frequency bands. Also, it is not just the telecoms sector that needs this additional bandwidth, but others like the military and defence, remote sensing and security, atmospheric science, radio astronomy and automotive, to mention just a few. Yet, lack of available millimetre-wave (mmWave) components is creating a two-pronged problem: First, system designers developing active electronics above 100GHz will need mmWave components. Second, they will also need cost-effective and high-performance equipment for testing those components, which, in a catch-22 situation, will also be needed for that equipment, too. These interdependent conditions slow developments, with only incremental steps being made at best.

## Bridging the gap

The problem extends beyond just the dearth of test and measurement equipment for mmWave and THz frequencies, there's also the problems of cost and mobility. When moving from the design to the production stage, more of these systems will be needed, so to be affordable in larger quantities, they must be smaller and cheaper.

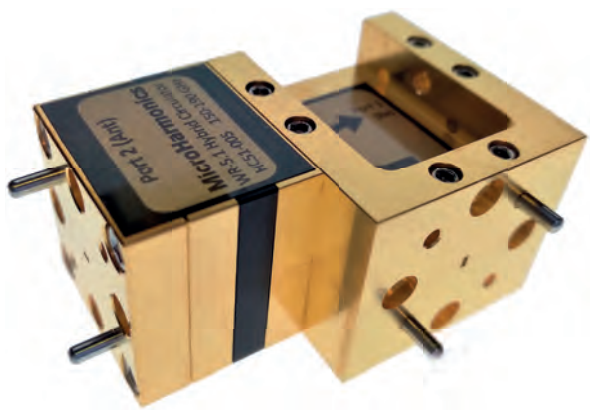


Figure 2: Hybrid circulator


Figure 3: VDI VNA extender

As any system designer knows, it can be quite difficult to move sensitive and bulky T&M equipment around a production facility. Vector network analyser (VNA) manufacturers have already responded with streamlined USB-type devices that are smaller, more portable and cheaper than their benchtop counterparts; the problem is that they only operate at microwave frequencies (26.5-75GHz).

To make these systems smaller, some companies are now releasing custom modules that pair high-performance extender analysers with the new VNAs. At VDI we manufacture these extenders (see Figure 3), which can reach over 1,100GHz. For the new compact USB VNAs, the company has extended its T&M capabilities to the lower end of the THz band (400GHz), bridging the gap between low cost and high performance.

## Seeing is believing

At a recent microwave symposium, the extender analyser technology was tested on a patent-pending mmWave hybrid circulator (150-190GHz). Manufactured by Micro Harmonics, the new component can theoretically cover entire waveguide bands, with relatively low insertion loss and over 20dB of isolation. This allows greater volumes of data throughput in systems operating in the upper regions of the mmWave spectrum.

It has already paid dividends for Micro Harmonics, which under a two-phase Small Business Innovation Research (SBIR) contract awarded by NASA, is developing a complete line of hybrid circulators operating in every standard waveguide band from 50-250GHz.

By providing a major boost to existing T&M equipment, VDI is using many of the advancements VNA manufacturers have developed in the lower microwave bands, which will spur more innovation and development in this higher-frequency space.

## Incremental steps

Another huge benefit of new VNAs that operate at higher frequencies is the ability to generate multi-port measurements.

"Typically, we have only been able to get either a one-port or two-port measurement at a time," said David Porterfield, Founder and CEO of Micro Harmonics. "Now there are VNAs that can make up to eight measurements at the same time. For companies looking to ramp up production, these VNAs greatly increase the rate of testing."

This is especially important to companies that fully RF-test each component at more than 1200 data points across a band.

Micro Harmonics is really innovative in the mmWave and THz fields, having designed a full line of mmWave isolators from 50-400GHz; it is these that enable our extender analysers to operate at the very high frequencies.

Having a low-cost option for VNAs used in conjunction with mmWave extender analysers will allow developers to move equipment around more easily. Additionally, due to the small USB form factor, they can also be used in the field, since many more customers are now looking for mobile setups. They want to take the equipment on building roofs, to perform so-called "channel sounding" to analyse a signal's propagation.

## The next frontier

There are several challenges facing system designers looking at the next frontier of radar and communication systems. The physics restricts building components at frequencies above 100GHz. As we move up the electromagnetic spectrum, the wavelengths get shorter, requiring the constituent parts to decrease in size. At these frequencies the parts are tiny, so even the smallest misalignment can significantly degrade performance.

Micro Harmonics's Porterfield believes those challenges will be overcome: "We are talking about transmitting a billion bytes of data in a single second at the D-band. That is like catnip – so, everyone is looking for ways to make it happen sooner, rather than later." EW

Figure 4: WR 28 isolators