

DESIGN

2

PART

Since 1984

A close-up photograph of a worker wearing safety glasses and gloves, focused on working on a large, complex metal part. The worker is using a tool to adjust or inspect a component. The background is dark and industrial, with some blue and red lighting accents.

# DYNAMIC CONTRACT MANUFACTURERS

Why they're on the radar of leading OEMs  
in crucial U.S. industries – *Page 74*

May – June 2023

## IN THIS ISSUE

### DYNAMIC CONTRACT MANUFACTURING

A versatile metal stamping firm deploys new tech to boost part quality, efficiency – *pp. 104, 148*

### 3D PRINTING

Custom robotic heart models could help doctors tailor treatments to individual patients – *p. 70*

### COATINGS

Researchers tested various coatings for their ability to protect stainless steel from corrosion – *p. 150*



## A Gold Rush to D-Band and Beyond

**Advancements in test and measurement equipment are allowing millimeter wave component manufacturers and systems designers to ramp up production at mmWave and THz frequencies**

By Greg Rankin

CHARLOTTESVILLE, Va.—“The D-band is the new E-band” read the shirts worn by Virginia Diodes (VDI) employees at a recent microwave symposium. Covering 60-90 GHz, the E-band is a well-established high-capacity solution for a number of mmWave applications. With radio links that can reach up to 20 Gbps, this band has been an attractive and cost-effective space for design engineers to mine.

However, there is a growing appetite for more, and meeting that ever-increasing demand for greater data transmitted at higher speeds will require the move up to higher frequencies, such as the D-band (110-170 GHz).

Currently, there is simply not enough infrastructure in place to support such a move. The real question is, can that infrastructure be built out within the next 5-10 years when the push up the spectrum will no longer be optional?

In telecom alone, the need to support billions of users at higher data rates will require the utilization of higher and higher frequency bands. Yet, a lack of available millimeter wave (mmWave) components is creating a two-pronged problem.

“First, system designers making active electronics above 100 Gigahertz are going to need millimeter wave components and cost-effective and high-performance equipment for testing,” explained Jeffrey Hesler, Ph.D., and CTO of Virginia Diodes, Inc. (VDI). “However, those of us that make the test and measurement equipment also need those high-frequency components to improve our systems. So, that is something we are constantly battling.”

While not exactly a catch-22, these dependent conditions can slow development down while each incremental step is reached. It is not just telecom that will require the added bandwidth available within the D-band. Industries like military and defense, remote sensing and security, atmospheric science, radio astronomy, and automotive are all racing to unlock these higher frequencies.

“At the D-band, you are looking at 100 Gigabytes per second (Gbps). That is a ton of bandwidth,” added Hesler. “So, everyone is asking the same question, ‘how do we get there?’”

### **Bridging the gap**

The issue extends beyond just the dearth of test and measurement equipment for mmWave and THz frequencies.

“The problem is cost and mobility,” said Hesler. “You’re going to need high-performance test and measurement equipment, and then when you go from design to production, you have to deploy a greater number of these systems, so they need to be smaller and, hopefully, cost less.”

As any system designer knows, it can be quite difficult to move the sensitive and bulky test and measurement equipment used in R&D around a production facility. So, VNA (vector network analyzer) manufacturers have recently introduced a streamlined approach with USB devices that are smaller, portable, and cost much less than the benchtop models. The only issue is that these only operate at microwave frequencies (26.5-75 GHz).

In order to make these small, low-cost VNAs available to higher frequencies, some companies are now releasing custom modules that pair high-performance extender analyzers with the new VNAs.

As an example, VDI manufactures extenders for traditional VNAs that can reach in excess of 1,100 GHz. For the new compact USB VNAs, the company is able to extend the test and measurement capabilities up to the lower end of the THz regime (400 GHz), bridging the gap between low cost and high performance.

### **Seeing is believing**

At the aforementioned microwave symposium, the extender analyzer technology was tested on a patent-pending millimeter wave hybrid circulator (150-190 GHz). Manufactured by Micro Harmonics Corporation (MHC), the new component can theoretically cover entire waveguide bands with relatively low insertion loss and more than 20 dB of isolation. It will enable designers to push greater volumes of data through systems operating in the upper regions of the mmWave spectrum.

“For mmWave component manufacturers like us, this combination of a cost-effective VNA and extender analyzers is a

game-changer,” said David Porterfield, founder and CEO of MHC.

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 to 250 GHz over the course of the next two years.

By providing a major boost to existing test and measurement equipment, VDI is able to piggyback on many of the advancements that VNA manufacturers have developed in the lower microwave frequency. This will allow for more innovation and development within the mmWave spectrum.

### **Incremental steps**

Another huge benefit of utilizing new VNAs at higher frequencies is the ability to generate multiport measurements.

“Typically, we have only been able to get either a one-port measurement or a two-port measurement at a time,” said Porterfield. “Now there are VNAs that can test up to 8 measurements at once. For companies looking to ramp up production, this allows them the ability to greatly increase the rate of testing.”

This is especially important to companies that fully RF test each component using over 1200 data points across the band.

“Micro Harmonics has really been innovative in mmWave and THz regime, having designed a full line of millimeter wave isolators from 50 to 400 GHz,” said VDI’s Hesler. “In fact, it’s those isolators that enable our extender analyzers to operate at those higher frequencies.”

Having a low-cost option for VNAs used in conjunction with the mmWave extender analyzers will allow manufacturers the ability to move the equipment around the production floor much more easily. Additionally, due to the small USB form factor, they can also be deployed in the field.

“We have customers who want a more mobile setup,” said Hesler. “They want to take them up on the roof, move around this system, and do what’s called ‘channel sounding,’ which is essentially looking at how a signal propagates.”

### **The next frontier**

There are a number of issues facing system designers looking at the next frontier of radar and communication systems. Building components at frequencies above 100 GHz becomes increasingly difficult because of the physics. As you move up the electromagnetic (EM) spectrum, the

wavelengths get shorter, requiring the constituent parts to also decrease in size. At mmWave frequencies, the parts are tiny and even the smallest misalignment can significantly degrade performance.

Micro Harmonics' Porterfield believes those challenges can be overcome with the right motivation.

"We are talking about transmitting a billion bytes of data in a single second at

the D-band. That is like catnip," said Porterfield. "So, everyone is looking for ways to make it happen sooner, rather than later." ■

*Greg Rankin is a Houston-based freelance writer.*

## Infinitum Acquires PCB Fabricator Circuit Connect to Scale Production of Electric Motors

**The acquisition supports Infinitum's efforts to rapidly expand production capacity, the company said**

AUSTIN, Texas—Infinitum, creator of an efficient and sustainable air core motor, has acquired Circuit Connect, Inc., a printed circuit board (PCB) fabricator based in Nashua, New Hampshire, the company said in a release.

The acquisition of Circuit Connect is said to support Infinitum's efforts to become more vertical, and immediately enables substantially higher production capacity of PCB stators. It also provides a framework for continuous volume growth, critical to meeting high demand for Infinitum's innovative electric motor technology, the company said.

Infinitum's unique air core motor motors replace heavy iron found in traditional electric motors with a lightweight, printed circuit board (PCB) stator that is reportedly "10 times more reliable." Infinitum motors are 50 percent smaller and lighter, use 66

percent less copper, and consume 10 percent less energy than standard iron core stator motors. The motor's modular design allows the housing, rotors, and stators to be reused multiple times, giving parts a second and third life to serve future generations, according to the release.

Circuit Connect has supplied Infinitum with PCB stators for more than five years, and has been closely involved in developing the manufacturing process and quality product that is at the heart of Infinitum's award-winning motors. The company's 21 employees will join the Infinitum family while continuing to service existing customers via the manufacturing facility in New Hampshire, according to Infinitum.

"Our PCB stator is the heart of our sustainable electric motors and allows us to deliver the efficiency and energy savings

that is so important to our customers and the planet," said Ben Schuler, founder and CEO of Infinitum, in a statement. "Circuit Connect has worked side by side with us advancing and improving how PCB stators are made. Their acquisition will help us ensure consistent delivery of quality stator components as we execute on our hypergrowth phase and scale up manufacturing to meet demand for our motors that can power the world with less energy and waste."

Circuit Connect has consistently served the OEM and electronic manufacturing industry for 30 years, according to the release.

"As a leader in PCB fabrication in the U.S. for more than three decades, Circuit Connect's dedication to customer success aligns well with Infinitum's mission to build motors with reliability and extended life," said Circuit Connect Founder Rick Clutz, in the release. "We look forward to continuing to serve our customers and are excited about the next chapter as we ramp up production to help create motors that can have such a lasting and positive impact on the environment." ■

## Production CNC Machining & Assembly



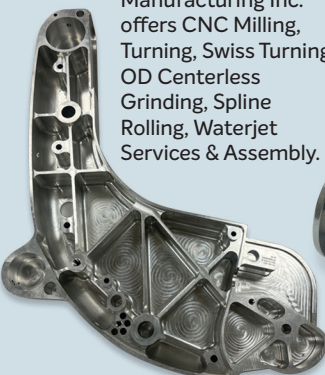
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