MILITARY MICROWAVE DIGEST
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MPD MICROWAVE PRODUCT DIGEST

RF TO LIGHT
MARCH 2023

2 to 20 GHz SP6T Switch

The P6T-2G20G-55-T-SFF is an absorptive, single pole, six throw pin diode switch that operates from 2 to 20 GHz with minimum isolation of 55 dB, insertion loss of 4.5 dB, a VSWR of 2:1, and switching speed of 30 ns. Maximum RF input power is +20 dBm, video leakage is less than 1.3 VDC, and requires a power supply of +15 VDC at 200 mA and -5 VDC at 100 mA. The switch integrates a TTL-compatible driver with female SMA connectors.

QUANTIC PMI

26.5 to 40 GHz SSPA

The AMP4066B-LC is a 12U solid-state RF power amplifier that operates from 26.5 to 40 GHz and is designed for EMI/RFI, EW, and communication applications. Saturated RF output power is 250 W, and gain is at least 53 dB +/-4 dB adjustable over a range of 20 dB. Harmonic suppression is -20 dBc and spurious suppression is -60 dBc. It operates from a 180 to 260 VAC supply drawing 5 kW at rated output power, has an operating temperature range of 0° C to +50° C, measures 19 x 20 x 31 in., and weighs 99 lb.

EXODUS ADVANCED COMMUNICATIONS

890 to 960 MHz Yagi Antenna

The SY426 Yagi directional antenna is designed for operation between 890 and 960 MHz and provides 10 dBi of gain. The horizontal beamwidth is 52 degrees, vertical beamwidth is 45 degrees, and maximum input power is 150 W. The antenna's front-to-back ratio is 20 dB and its impedance is 50 ohms. Rugged aluminum construction allows the antenna to withstand strong wind, heavy ice, and other harsh conditions.

SINCLAIR TECHNOLOGIES

GaN RF Power Amplifier

The BBM2E4AFL is a GaN RF power amplifier that delivers 30 W CW from 20 to 1000 MHz in Class AB operation. It can handle an RF input power of +3 dBm, has gain of 44 dB +/-1.5 dB, small-signal gain flatness of +/-1.5 dB, a third-order intercept point of 52 dBm and a 10 dB noise figure. Harmonic suppression is -30 dBc and spurious suppression is -60 dBc. It includes control, monitoring, and protection circuits and operates from 26 to 30 VDC supply and draws 2.8 Amps.

EMPOWER RF SYSTEMS

A Gold Rush to D-Band and Beyond

by Greg Rankin

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

"**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).

However, 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?

Figure 1: "The D-band is the new E-band" t-shirts worn by Virginia Diodes (VDI) employees at a recent microwave symposium

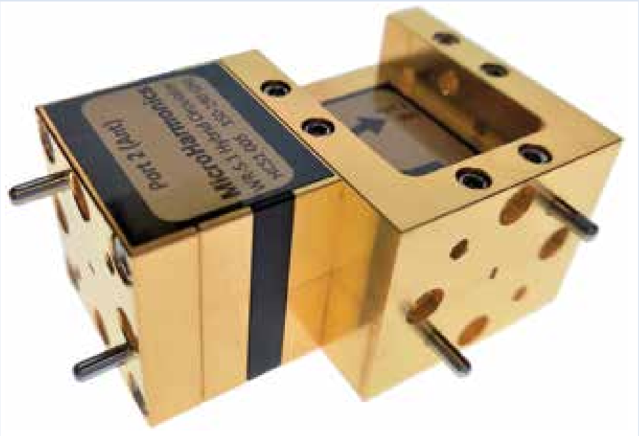

Figure 2: Hybrid circulators can cover an entire waveguide band with relatively low insertion loss and more than 20 dB of isolation, enabling designers to push greater volumes of data through systems operating in the upper regions of the mmWave spectrum

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," explains Jeffrey Hesler, Ph.D., 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 & 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," adds 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," says 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 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.

Figure 2: Virginia Diodes VNA extenders can now be used with new streamlined USB VNA devices that are smaller, portable and cost much less than the benchtop models, extending the test and measurement capabilities up to 400 GHz.

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," 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 50-250 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," explains 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 the mmWave and THz regime, having designed a full line of millimeter wave isolators from 50 to 400 GHz," adds 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," adds 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," concludes Porterfield. "So, everyone is looking for ways to make it happen sooner, rather than later."

For more information, contact Micro Harmonics Corporation, www.MicroHarmonics.com

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