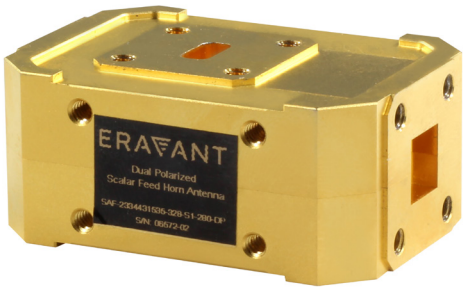

23 to 44 GHz OMT Supports 5G FR2 Bands

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Antennas serve a crucial role in any radar and communication system. In the 5G mmWave bands, they will be used to simultaneously transmit and receive data from millions of connected devices in dense urban environments. Duplexers are usually required to minimize signal contamination and crosstalk between the transmit and receive channels, and the orthomode transducer (OMT) is a device capable of providing high isolation and cross-polarization rejection for the duplexing function.

Eravant's new OMT, the SAT-343-28028-S1, is well-suited for antennas operating within the 5G frequency range 2 (FR2) spectrum from 24.25 to 52.6 GHz. The unit has 0.5 dB insertion loss, 40 dB port isolation, 35 dB cross-polarization rejection and 15 dB port return loss from 23 to 44 GHz. It is the latest addition to Eravant's comprehensive OMT product catalog, which includes full band standard products, narrow band custom products and broadband solutions from 8.2 to 170 GHz.

The SAT-343-28028-S1 OMT is based on a modified Bøifot junction proposed by Narayanan and Erickson[1] (see ***Figure 1***). The antenna port is a 0.280 in. square waveguide that can receive or transmit linear polarized or circular/elliptical polarized signals. The horizontal port is a standard WR28 rectangular waveguide, and the vertical port is a round-cornered rectangular waveguide, which is designed to provide a perfect impedance match to standard WR28 waveguide, with flexible machinability. The OMT separates a circular/elliptical waveform received from the antenna port into a horizontal polarized signal that exits the horizontal port and a vertical polarized signal that exits the vertical port. Converse-

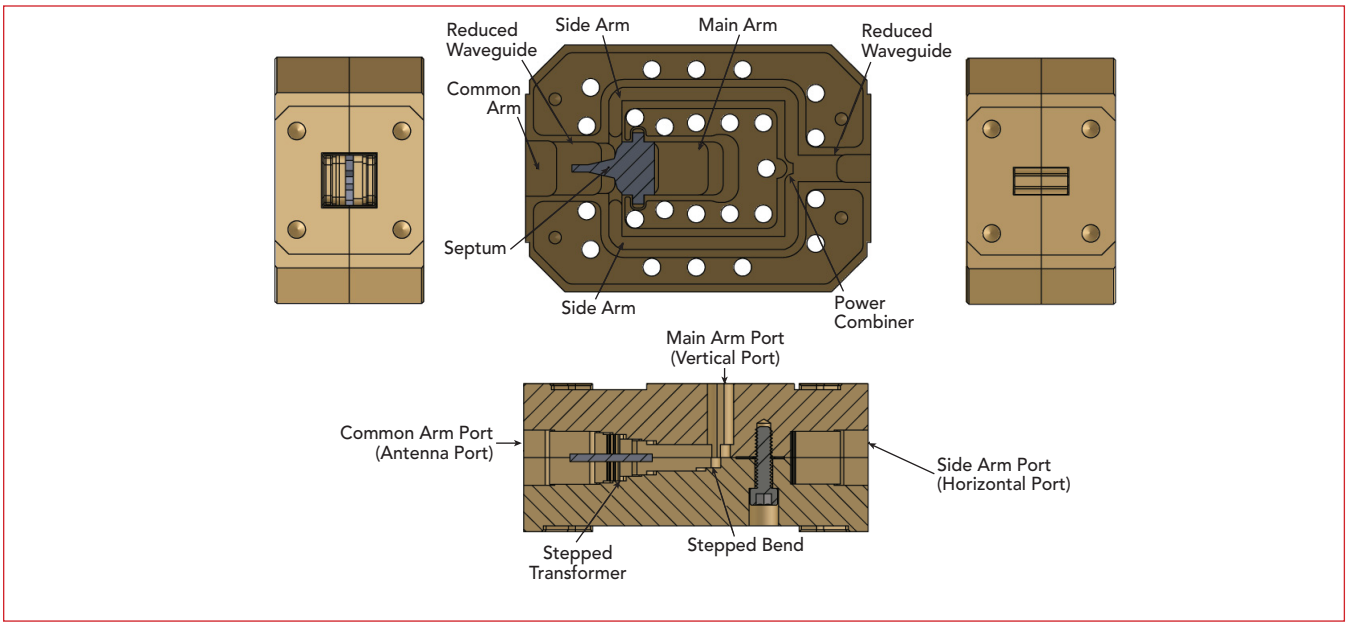


Fig. 1 Cross-section views of the OMT.

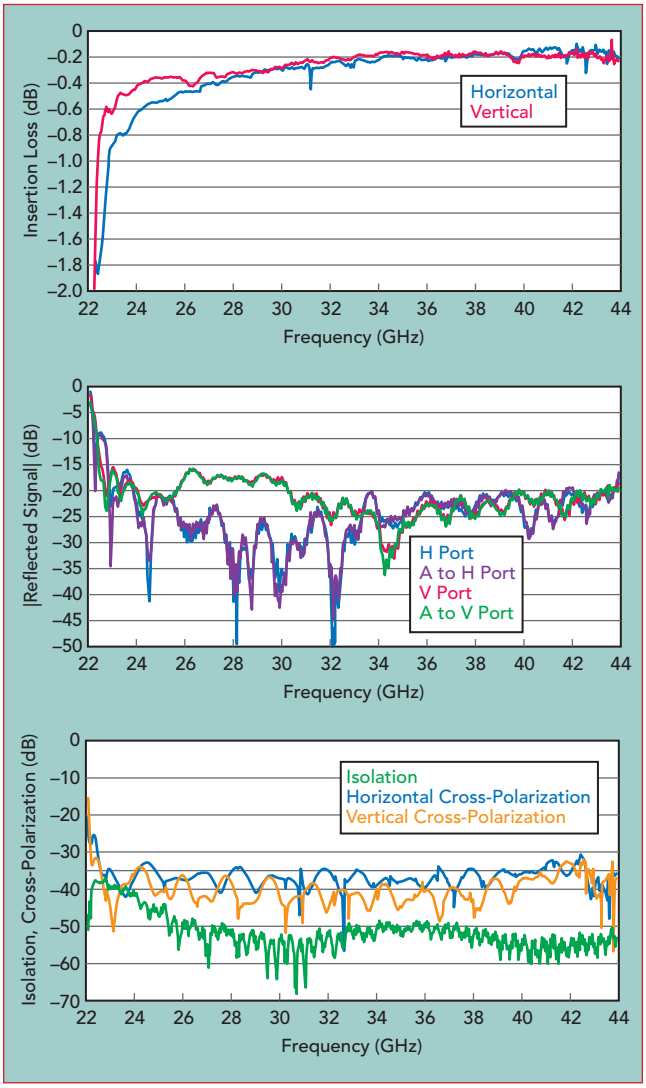


Fig. 2 Measured performance of the OMT from 22 to 44 GHz.

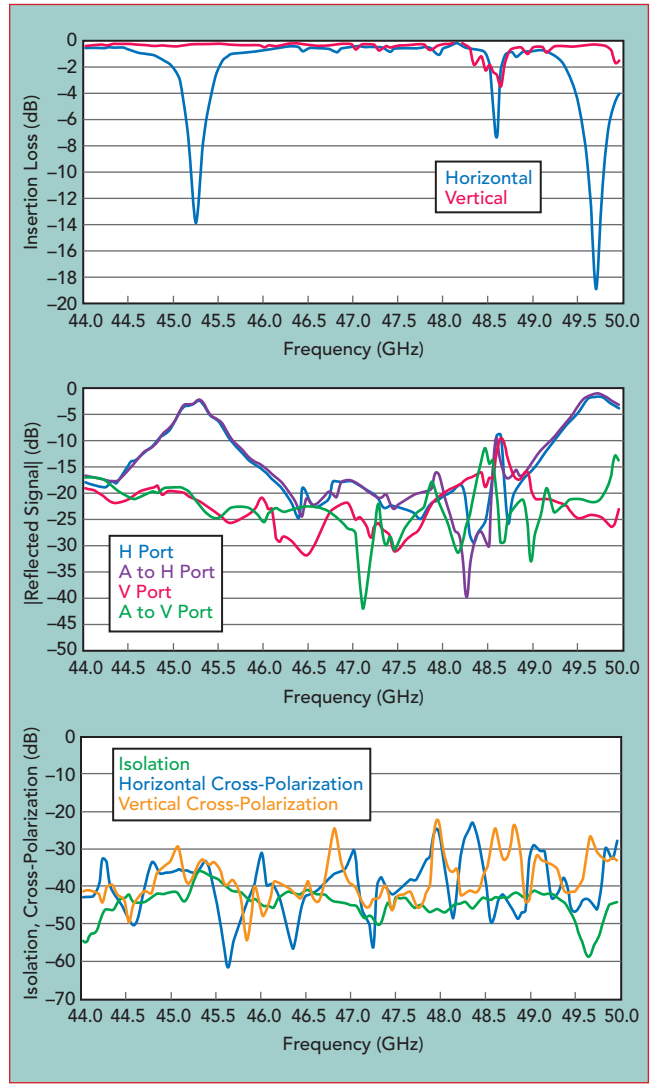


Fig. 3 Measured performance of the OMT from 44 to 50 GHz, above the designed frequency band.

ly, horizontal and vertical polarized signals can be fed through their respective ports and combined into a circular/elliptical polarized waveform with a proper phase setting. In an antenna system, the horizontal and vertical ports can be used as the transmitting and receiving ports, respectively. Since the two linear polarized signals are orthogonal, the OMT provides high isolation and cross-polarization rejection between the transmit and receive ports.

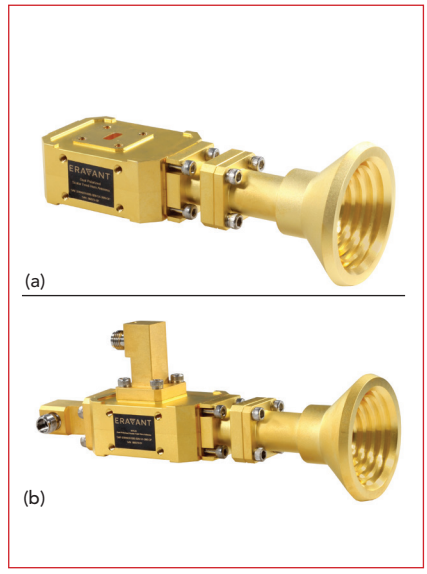
The SAT-343-28028-S1 is Eravant's third OMT model in Ka-Band. The first base model, SAT-FA-28028-S1-1, was derived from a scaled version of Wollack's K-Band OMT design,[2] which uses metal wires to tune the performance and was only suitable for the standard WR28 bandwidth, from 26.5 to 40 GHz. The difficulty assembling the tuning wires, the bulky package size and increasing demand for 5G coverage led to the development of a second base model with high volume producibility. The second model, SAT-333-28028-S1, implemented Narayanan and Erickson's OMT design, replacing the tuning wires with machined transformer steps and increasing the septum thickness. These two changes resulted in a faster, easier, more consistent assembly process, and the overall package size was reduced by 3x. To support the initial 5G mmWave applications, the frequency range was extended to cover 24 to 42 GHz by incorporating reduced waveguides to suppress higher-order modes. The SAT-333-28028-S1 covers nearly all the currently licensed FR2 bands: n257 (26.5 to 29.5 GHz), n258 (24.25 to 27.5 GHz), n260 (37 to 50 GHz) and n261 (27.5 to 28.35 GHz).

The third model, SAT-343-28028-S1, is an optimized version of the second model, extending the bandwidth to cover 23 to 44 GHz, fully covering the n259 band (39.5 to 43.5 GHz) and the other 5G FR2 bands. The package size was not changed, enabling customers using the second model to upgrade to the third. Approximately 50 units have been built, tested and delivered, and they cover 22 to 44 GHz with consistent results (see ***Figure 2***). Insertion loss is nominally 0.5 dB, although it measures 0.3 dB across much of the band. Return loss is nominally 15 dB, typically measuring 20 dB or better. The OMT is rated for 40 dB isolation, typically measuring 50 dB or better. The cross-polarization rejection typically measures 35 dB, with a few units 40 dB or higher. The performance degradation at the lower edge of the band, from 22 to 24 GHz, is due to the WR28 cutoff frequency of around 21 GHz.

To support systems in the recently auctioned 47.2 to 48.2 GHz FR2 band, the OMT was tested from 44 to 50 GHz (see ***Figure 3***). The results show significant insertion loss dips at 45.25, 48.6 and 49.7 GHz in the horizontal polarized path. The vertical polarized path is smoother, with a dip around 48.6 GHz. The isola-

tion and cross-polarization rejection are decent across the extended bandwidth, with typical values of 35 and 25 dB, respectively. Because the dips are outside the 47.2 to 48.2 GHz FR2 band, this OMT can be used for this 5G band and other applications within 44 to 44.5 GHz and 46 to 48.5 GHz.

The SAT-343-28028-S1 is designed and manufactured as a standalone OMT for integration in any antenna system. It is also offered as a high performance, dual-polarized antenna package for convenient system integration. One such configuration, the SAF-2334431535-328-S1-280-DP shown in ***Figure 4a***, comprises the OMT, a compact square-to-circular mode transition (SWT-280328-SA-C-QC) and a 15 dBi gain, broadband, scalar feed horn antenna (SAF-2234431535-328-S1). The scalar horn can easily



▲ **Fig. 4 Dual-polarized antenna integrated with the OMT with waveguide (a) and coaxial (b) interfaces.**

be swapped with higher gain models or different antenna types. The antenna system's waveguide interface can be converted to a coaxial interface (see ***Figure 4b***) by adding broadband waveguide to 2.4 mm coax adapters (model SWC-2434431505-282F-R1 and/or SWC-2434431505-282M-R1). The coaxial configuration is a complete system for immediate use in 5G mmWave labs and antenna ranges. Other dual-polarized antenna systems are available.[3]

References

1. G. Narayanan and N. R. Erickson, "A Novel Full Waveguide Band Orthomode Transducer," Thirteenth International Symposium on Space Terahertz Technology, March 2002, pp. 505-514.
2. E. Wollack, "A Full Waveguide Band Orthomode Junction," *Electronics Division Internal Report*, National Radio Astronomy Observatory, No. 303, May 1996.
3. "Dual-Polarized Antennas from Eravant," *Eravant*, January 2019, www.eravant.com/dual-polarized-antennas-from-eravant.

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