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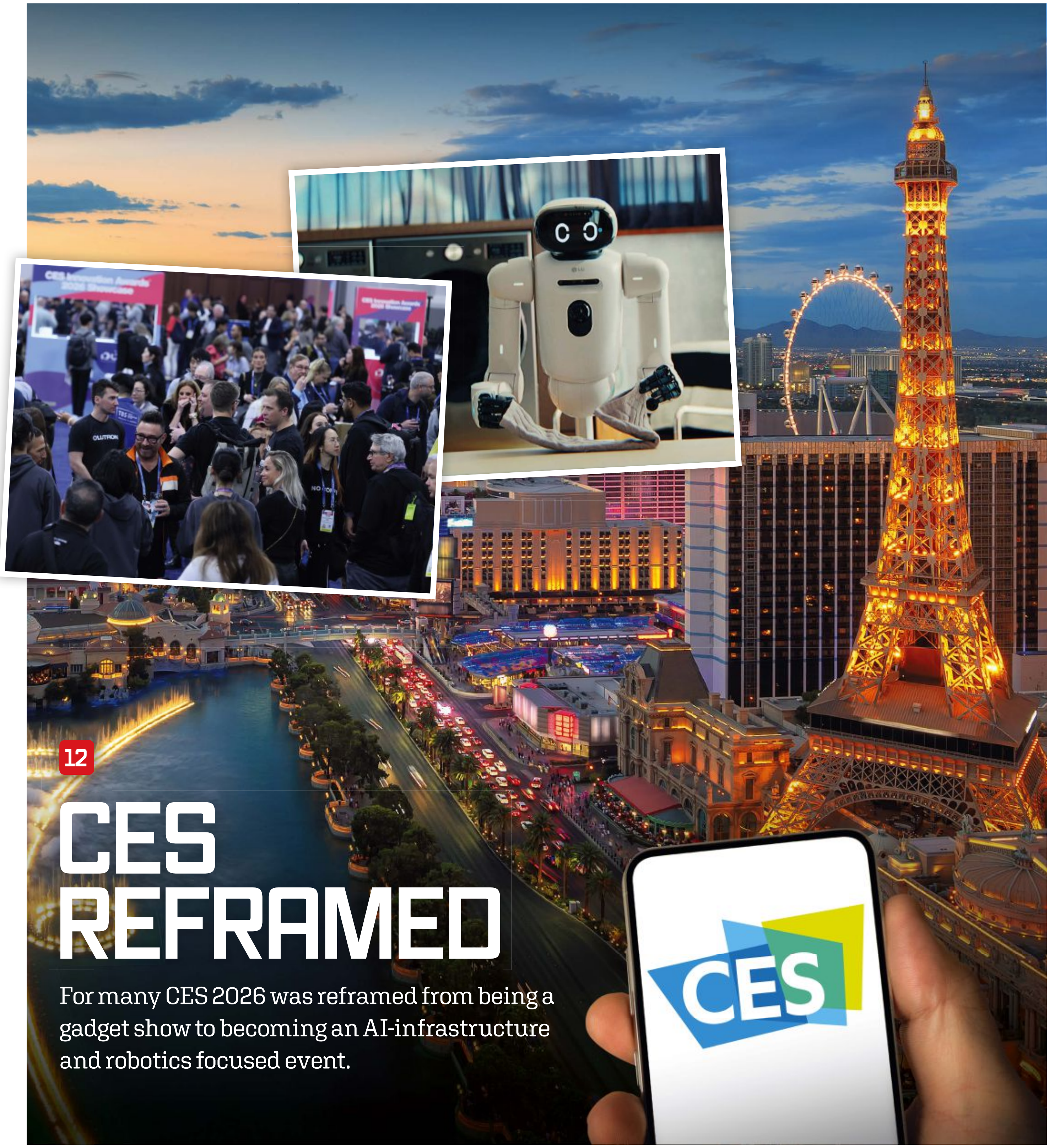

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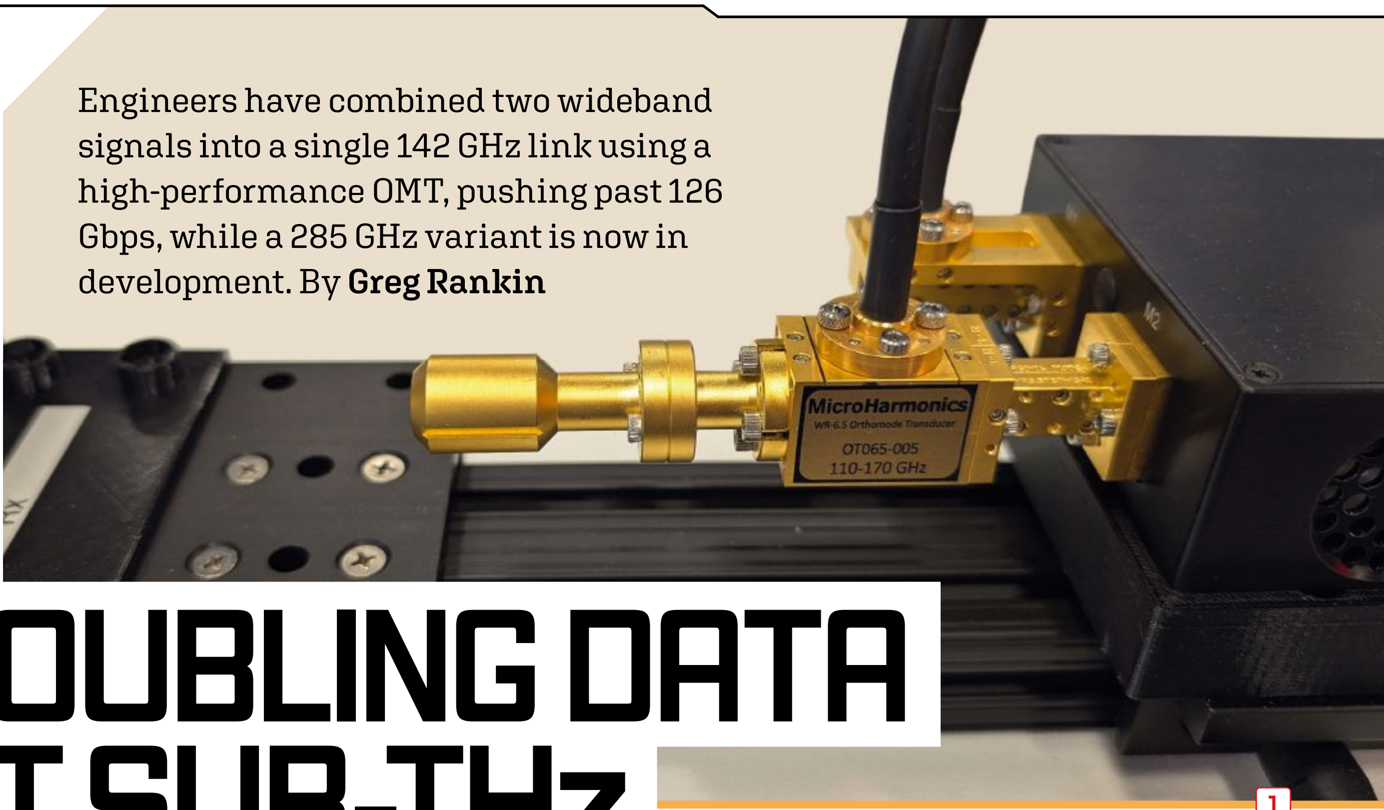
CES REFRAMED

For many CES 2026 was reframed from being a gadget show to becoming an AI-infrastructure and robotics focused event.

Engineers have combined two wideband signals into a single 142 GHz link using a high-performance OMT, pushing past 126 Gbps, while a 285 GHz variant is now in development. By **Greg Rankin**



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DOUBLING DATA AT SUB-THz

The promise of the sub-terahertz (THz) region of the electromagnetic spectrum, roughly 100 to 300 GHz, is well understood, offering vast swaths of underutilised spectrum and the ability to transmit data at rates far beyond what is possible at lower frequencies.

While much of the development in this range remains at the R&D stage, recent breakthroughs are already expanding how far, and how fast, this new frontier can propagate.

With the potential to exceed 100 Gbps - more than 500 times faster than current 5G networks - the move into the THz regime could accelerate a range of advanced applications. These range from phased-array radar and autonomous vehicles to fixed wireless backhaul and ultra-high-capacity data centre links. Today, researchers are exploring the most efficient ways to achieve such high data throughput with real-world hardware.

As part of that pursuit, engineers in a recent live demonstration successfully transmitted two independent, wideband signals, each on an orthogonal polarisation, through a single spatial link at 142 GHz. By combining both signals into one beam using a high-isolation, low-loss orthomode transducer (OMT), the system effectively doubled the throughput of a point-to-point connection. A follow-up demonstration at 285 GHz is already in development, with the potential to push data rates even higher.

1. By combining two wideband signals, each occupying 20 GHz, into a single spatial path without interference requires a clean separation between the signals throughout the entire transmission and reception process.

The effort was led by Virginia Diodes (VDI) and Keysight Technologies, with Micro Harmonics providing the enabling OMT.

While the breakthrough hinges on polarisation multiplexing, it is the result of a much broader integration effort that brings together ultra-wideband mixers, sharp image rejection filters, high-frequency amplifiers, and tightly engineered passive components, all of which have been optimised for operation deep into mmWave and sub-THz bands.

PUSHING PERFORMANCE

One of the central engineering challenges in sub-THz communication is the limited availability of hardware and the underlying components required for it to operate reliably at these frequencies. VDI's contribution focused on overcoming that barrier: upconverting extremely wideband signals (20 to 40 GHz) to higher carrier frequencies using custom diode-based mixers, then amplifying and refining those signals through carefully tuned image rejection filters and gain stages, all optimised for linearity and minimal loss.

The objective was straightforward: deliver clean, high-power, wideband signals at 142 GHz and beyond that could be transmitted and received with precision.

However, wide bandwidth alone was not the full story. In earlier demonstrations, the team had already shown that two independent links at 142 GHz and 285 GHz could operate in parallel, each moving large volumes of

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data over separate beams. That setup effectively doubled throughput by doubling the number of physical links. The next step was to achieve the same throughput using just one beam.

That meant combining two wideband signals, each occupying 20 GHz, into a single spatial path without interference, requiring clean separation between the signals throughout the entire transmission and reception process. This is where polarisation multiplexing became critical, and where Micro Harmonics' OMT proved essential to the success of the demonstration.

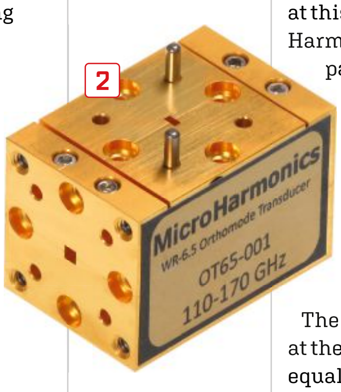
WHY THE OMT MATTERED

An OMT is a three-port waveguide component. Two of its ports support single-mode propagation, typically rectangular waveguides, while the third, known as the common port, supports two orthogonal modes simultaneously. One is horizontally polarised, the other vertically. It is this ability to cleanly separate or combine polarisation states that makes the OMT so powerful in RF systems.

Polarisation multiplexing itself is not new. It is a well-established method for doubling capacity in communication and sensing systems at lower frequencies. However, implementing it at sub-THz frequencies, especially with ultra-wideband signals, is far more difficult.

"There are very few off-the-shelf OMTs at these frequencies, and even fewer that can maintain the isolation and bandwidth we needed," said Cliff Rowland, RF engineer and head of business development at VDI. "You can't have signal leakage between the vertical and horizontal polarisations, or you'll get distortion, and you can't afford much insertion loss either, especially at these frequencies where every dB matters."

Micro Harmonics, which has been developing a complete series of millimetre-wave OMTs across all standard waveguide bands from WR-15 (50–75 GHz) to WR-3.4 (220–325 GHz), supplied the component that made this demonstration possible. Their OMT combined high polarisation isolation with low insertion loss, two critical requirements for sending dual-polarised signals through the same physical channel without degradation. In this case, it enabled the system to carry 40 GHz of combined bandwidth over a single link.



2. An OMT is a three-port waveguide component. Two of its ports support single-mode propagation, typically rectangular waveguides, while the third supports two orthogonal modes simultaneously.

That setup delivered aggregate data rates exceeding 126 Gbps, and importantly, the performance held up under full system integration.

"We've made OMTs before in the lab, but never as a standalone component at this level," Rowland added. "Micro Harmonics brought a high-performing part and worked closely with us on the mechanical integration. Form factor, flange compatibility, port layout, all of it had to come together cleanly for this to work."

FROM MIXERS TO MODULATION

The signal chain did not end at the OMT. Keysight's role was equally critical, bringing the digital signal generation, calibration, and demodulation tools needed to drive and evaluate the link. Their instrumentation enabled the creation of high-speed, wideband modulated signals, along with the post-transmission measurement and analysis tools required to validate performance across both polarisations.

Between Keysight's digital capabilities and VDI's analogue hardware, the demonstration formed a complete testbed for sub-THz communication using polarisation multiplexing. The result was not just a lab experiment, but a working end-to-end system capable of transmitting and recovering complex signals at over 100 Gbps.

The 142 GHz demonstration marks an inflection point which will continue with the development of similar architecture at 285 GHz. The team is also exploring whether dual-frequency, dual-polarisation signals could eventually be combined into a single spatial path: effectively quadrupling throughput. That goal remains theoretical for now, but it is on their radar.

In the near term, the most immediate applications are in fixed wireless systems that demand extreme capacity, particularly for backhaul and infrastructure links where fibre may be impractical. High-speed, low-latency interconnects in data centres are another target, especially in modular or reconfigurable environments where over-the-air links offer flexibility.

Looking ahead, joint communication and sensing systems, next-generation automotive radar, and high-resolution imaging all stand to benefit as well, if the hardware continues to advance in step with system demands. With each leap forward, demonstrations like this are helping to define not just what is possible at sub-THz frequencies but how close it is to becoming practical. NE

Mechanical Specifications

Parameter	Description
Flange | H-Port and V-Port	WR-3.4 UG-387/UM
Flange | A-Port	0.034" square UG-387/UM
Weight (Oz [g])	0.54 [15.2]
Specification Temp (°C)	22
Operation Temp (°C)	-40 to +85

- Lowest insertion loss
- High cross-polarization and isolation
- Anti-cocking waveguide flanges

Electrical Specifications

Parameter	Value	Units
Frequency	220-330	GHz
Insertion Loss | H-Port	0.8	dB, max
Insertion Loss | V-Port	0.8	
Insertion Loss | H-Port	0.5	dB, avg
Insertion Loss | V-Port	0.5	
Cross-Polarization | H-Port to A-Port, V-Pol	35	dB, typ min
Cross-Polarization | V-Port to A-Port, H-Pol	35	
Isolation | H-Port to V-Port	45	dB, typ min
Return Loss | H-Port	16	dB, typ min
Return Loss | V-Port	16	
Return Loss | A-Port, H-Pol	16	
Return Loss | A-Port, V-Pol	16	