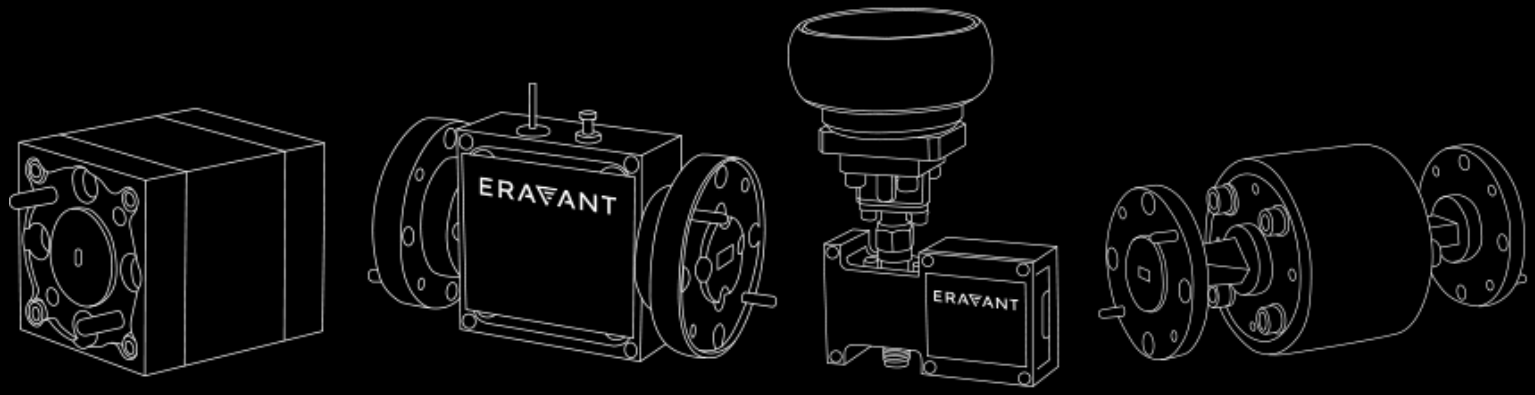
WEMA46



ERAVANT

Dual-Polarized Antennas: Applications and Configurations for 5G

Speaker: Allison Metz

4 to 6, August 2020, IMS MicroApps

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DUAL-POLARIZED ANTENNA APPLICATIONS

- **Applications:** 5G, UWB System, PCS (personal communication system), EMC (electromagnetic compatibility), OTA (Over the Air) Testing, Automotive ……

Quad-ridge Based Dual Pol Antenna

OMT Based Dual Pol Antenna

- **Characteristics:**
  - Vertical port only receives/transmits linearly polarized vertical waveform
  - Horizontal port only receives/transmits linearly polarized horizontal waveform
  - The left-hand circular polarization (LHCP) or right-hand circular polarization (RHCP) waveform can be transmitted/received via equal amplitude and proper phase different fed.
  - When the antenna is in transceiving mode, utilizing the polarization to separate the transmitting and receiving signals, it is known as a diplexer.
  - No need to rotate antenna physically in the measurement system.

UNIQUENESS OF QUAD RIDGE AND OMT BASED DUAL-POL ANTENNAS

Item	Quad-ridge Based	OMT Based
Antenna Type	Circular or rectangular horn	All horns: rectangular, circular, lens, scalar, choke flange, dish, Cassegrain etc.
Operating Bandwidth	Ultra-broad, such as 2 to 18 GHz	Waveguide bandwidth in general
Gain	Low in general, such as 10 to 20 dBi	Wide range, 10 to 50 dBi
Side Lobe Levels	High, 10 to 20 dBi	Wide range, antenna type dependent
Beamwidth	Limited range	Wide range, antenna type dependent
Crosspol	Low, 25 dB typical	High, 40 dB typical
Port isolation	Low, 20 dB typical	High, 40 dB typical
Port Type	Coax	Waveguide or Coax

OMT-BASED DUAL POLARIZED ANTENNAS OVERVIEW

Dual Polarized Antenna Types	Features
OMT + Conical Horn (SAC Series)	Full waveguide band performance, gain is limited to 25 dBi, high side lobe level, lower cost
OMT + Pyramid Horn (SAR Series)	Full waveguide band performance, gain is limited to 25 dBi, high side lobe level, lower cost
OMT + Choke Flange Horn (SAH Series)	Full waveguide band performance, broader beamwidth and low gain, low side lobe level, lower cross-polarization, moderate cost
OMT + Scalar Feed Horn (SAF Series)	Full waveguide band performance, broader beamwidth and gain up to 17 dBi, low side lobe level, lower cross-polarization, moderate cost
OMT + Lens Corrected Horn (SAL Series)	Full waveguide band performance, narrow beamwidth and high gain depending on the dish size selection, low side lobes, moderate cost
OMT + Gaussian Antenna (SAG Series)	Full waveguide band performance, narrow beamwidth and high gain depending on the aperture size selection, low side lobes, lower cross-polarization, high cost
OMT + Cassegrain Antenna (SAY Series)	Full waveguide band performance, narrow beamwidth and high gain depending on the dish size selected, lower cross-polarization, high cost

DUAL POLARIZED SCALAR HORN ANTENNA, 24 to 42 GHz

Model:

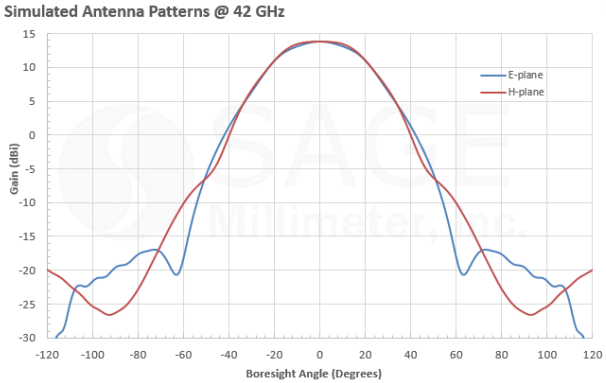
SAF-2434231535-328-S1-280-DP

Features:

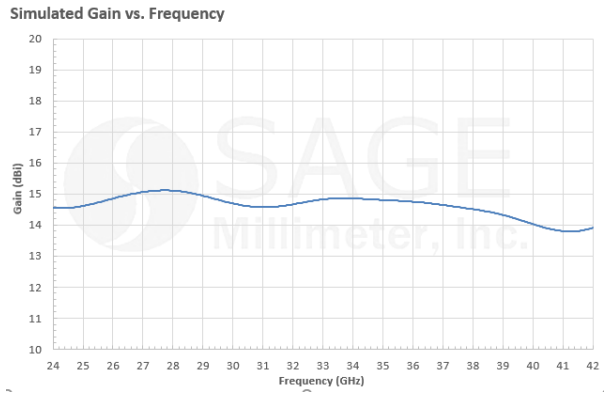
- 24 to 42 GHz, wide bandwidth
- Flat Gain 15 dBi
- Equal 3 dB Beamwidth in E- and H-Plane
- Dual Polarized
- 4.10” (L) x 1.60” (W) x 0.75” (H)

Electrical Specifications:

Parameter	Minimum	Typical	Maximum
Frequency	24 GHz		42 GHz
Gain		15 dBi	
3 dB Beamwidth, E-plane @ 33 GHz		35°	
3 dB Beamwidth, H-plane @ 33 GHz		35°	
Sidelobe Levels		-25 dB	
V and H Port Isolation		35 dB	
Cross Polarization Rejection		35 dB	
Port Return Loss		15 dB	
Specification Temperature		+25 ˚C	
Operating Temperature	-40 ˚C		+85 ˚C



Equal Beamwidth



Flat gain

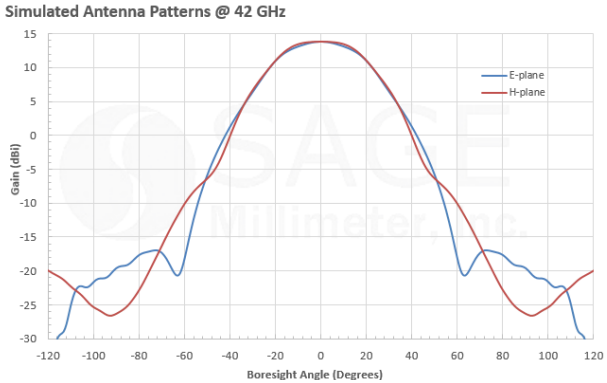
SCALAR HORN ANTENNA, 24 to 42 GHz

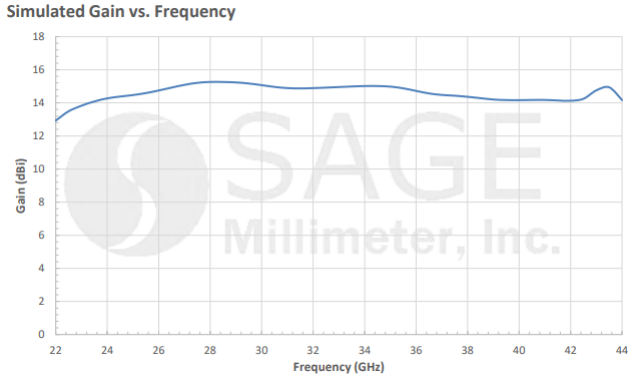
Model:

SAF-2434231535-328-S1

Features:

- 24 to 42 GHz, wide bandwidth
- Flat Gain 15 dBi
- Equal 3 dB Beamwidth in E- and H-Plane
- Dual Polarized
- 1.70” (L) X 1.60” (Ø)



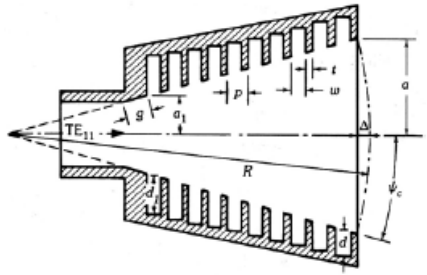


Electrical Specifications:

Parameter	Minimum	Typical	Maximum
Frequency	24 GHz	33 GHz	42 GHz
Gain		15 dBi	
3 dB Beamwidth, E-plane		35°	
3 dB Beamwidth, H-plane		35°	
Side Lobes, E-plane		-25 dB	
Side Lobes, H-plane		-25 dB	
Return Loss		15 dB	
Specification Temperature		+25 °C	
Operating Temperature	-40 °C		+85 °C

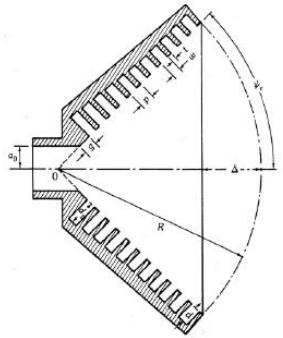
CORRUGATION TYPE

Small flare angle

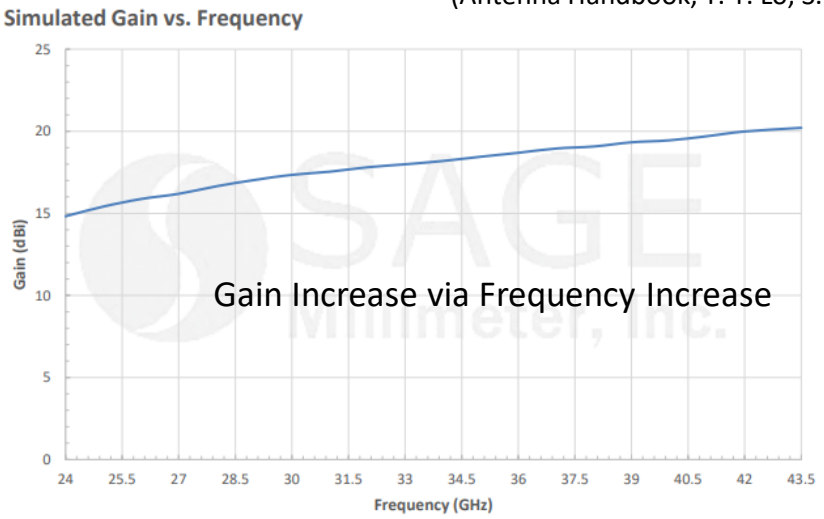


(Antenna Handbook, Y. T. Lo, S.W. Lee)

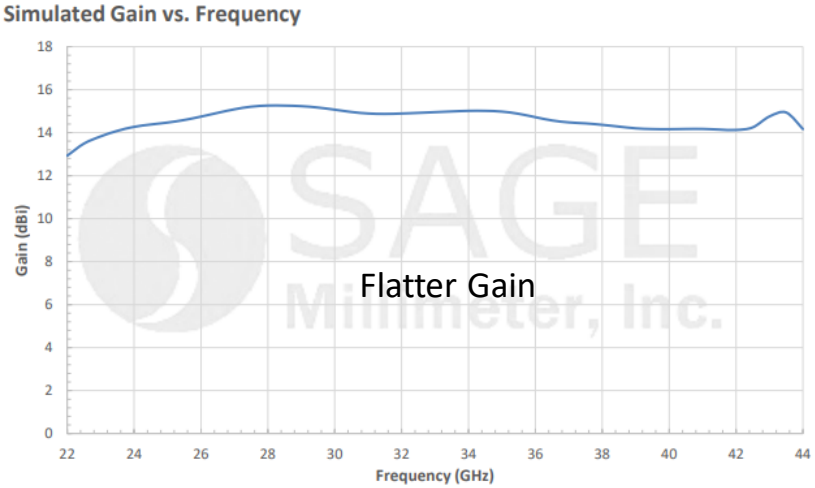
Large flare angle



(Antenna Handbook, Y. T. Lo, S.W. Lee)



Gain Increase via Frequency Increase



Flatter Gain

The gain flatness versus frequency is desired in any antenna measurement systems. Therefore, large flare angle is selected in this design.

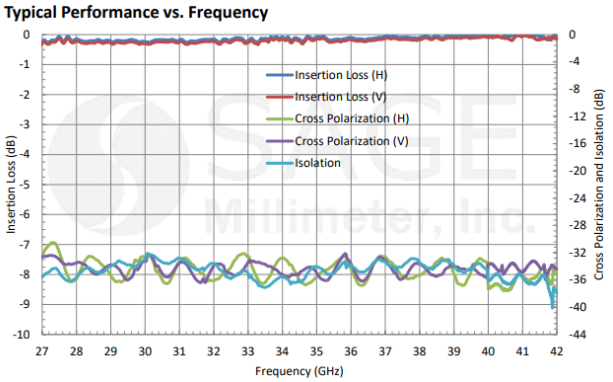
OMT , 24 to 42 GHz

Model:

SAT-333-28028-S1

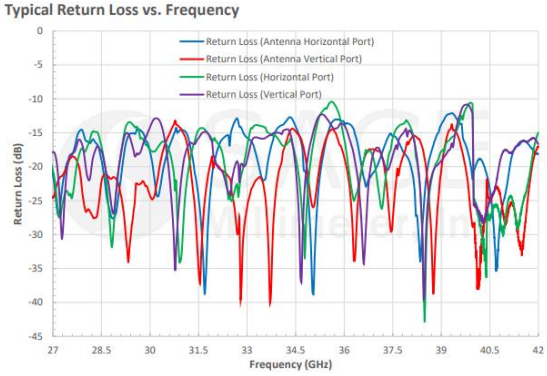
Features:

- 24 to 42 GHz, wide bandwidth
- Isolation 35 dB
- Cross Polarization 35 dB
- Insertion Loss 0.5 dB
- 1.70” (L) x 1.25” (W) x 0.75” (H)

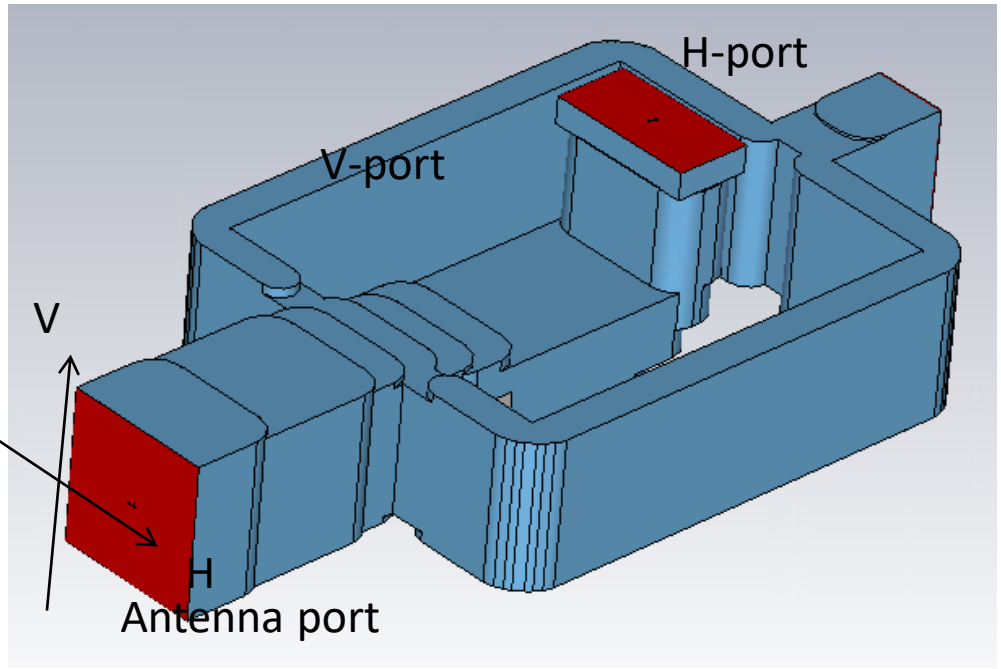


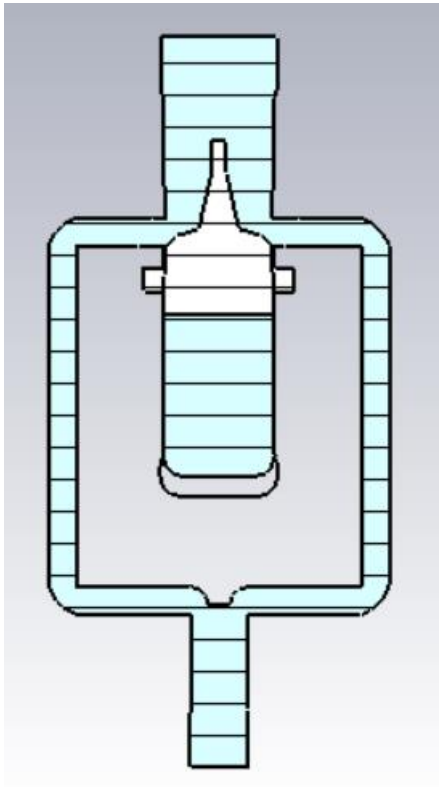
Electrical Specifications:

Parameter	Minimum	Typical	Maximum
Frequency Range	24 GHz		42 GHz
Insertion Loss (A to V Port)		0.5 dB	
Insertion Loss (A to H Port)		0.5 dB	
Isolation (V to H Port)		35 dB	
Cross Polarization (A to V Port)		35 dB	
Cross Polarization (A to H Port)		35 dB	
Return Loss (H Port)		15 dB	
Return Loss (V Port)		15 dB	
Return Loss (A Port, Vertical)		15 dB	
Return Loss (A Port, Horizontal)		15 dB	
Specification Temperature		+25 ˚C	
Operating Temperature	-40 ˚C		+85 ˚C



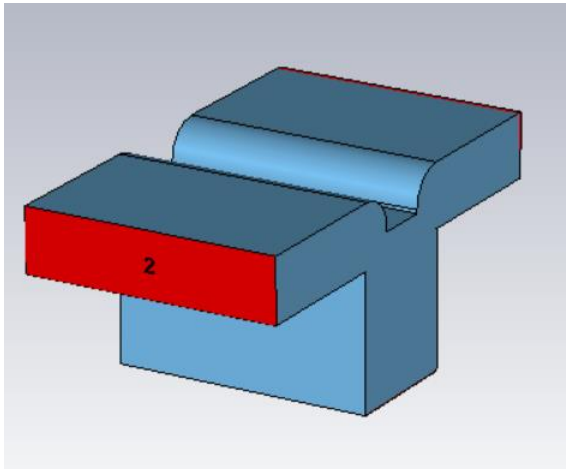
OMT DESIGN USING BOIFOT JUNCTION



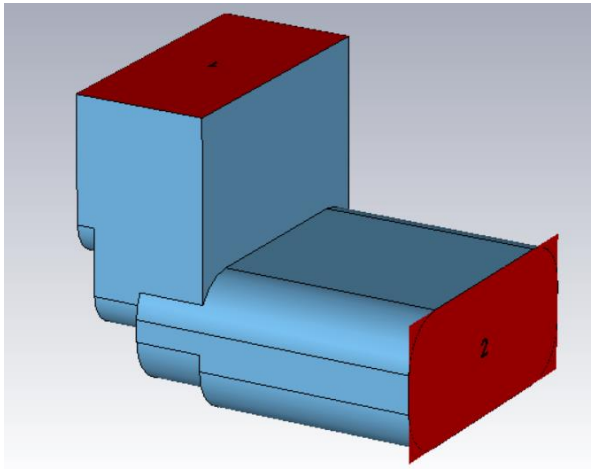


- Filets are used in the corner to ease the machining
- Shim thickness and shape is optimized

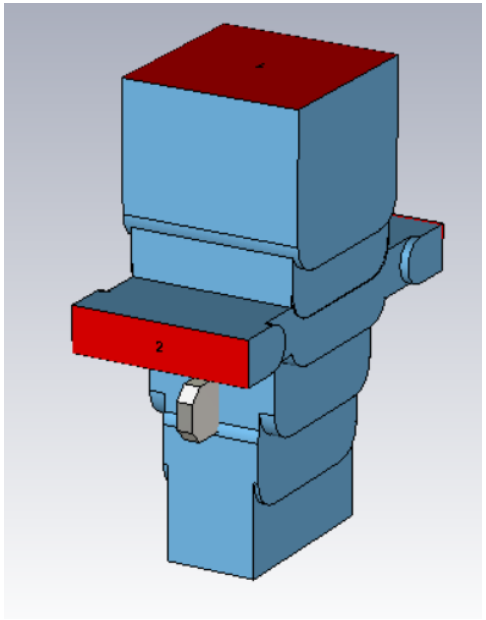
OMT DESIGN USING BOIFOT JUNCTION



E-plane Divider



Stepped Bend



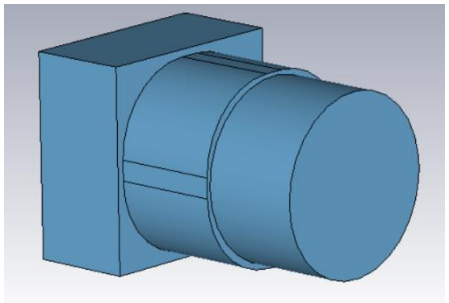
Boifot Junction

COMPACT MODE TRANSITION

Tapered Transition

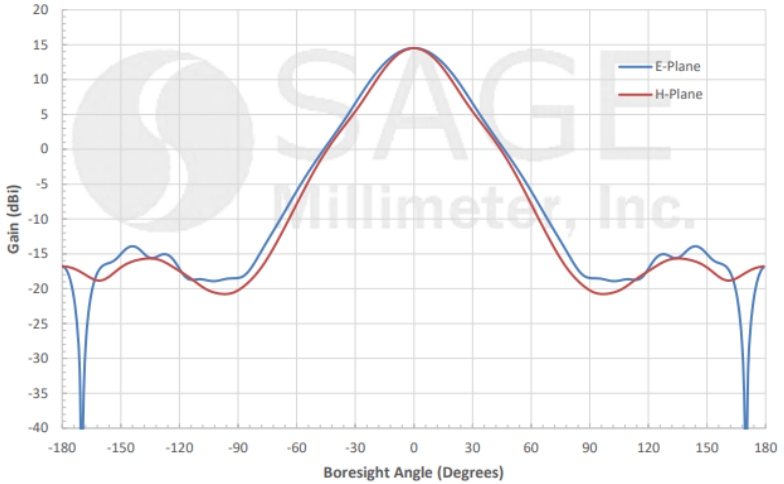
Compact Transition

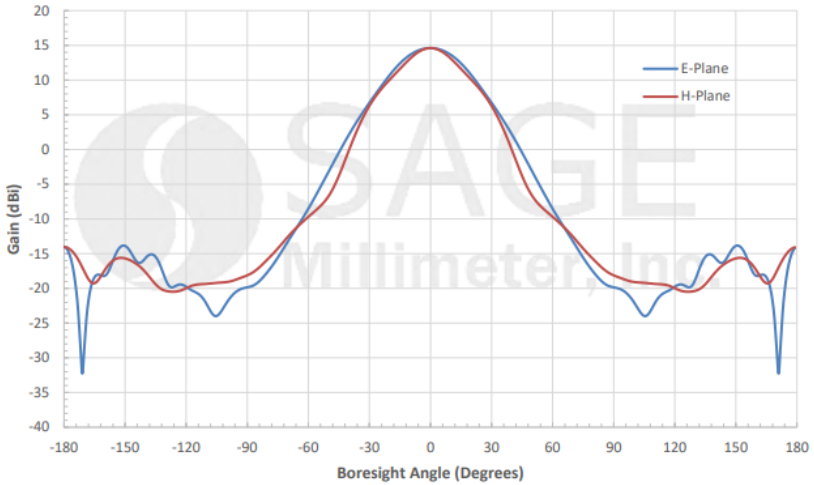
- The antenna port of the OMT is in square waveguide.
- A waveguide mode transition is required to integrate the scalar horn antenna with the OMT.
- A compact transition is designed.

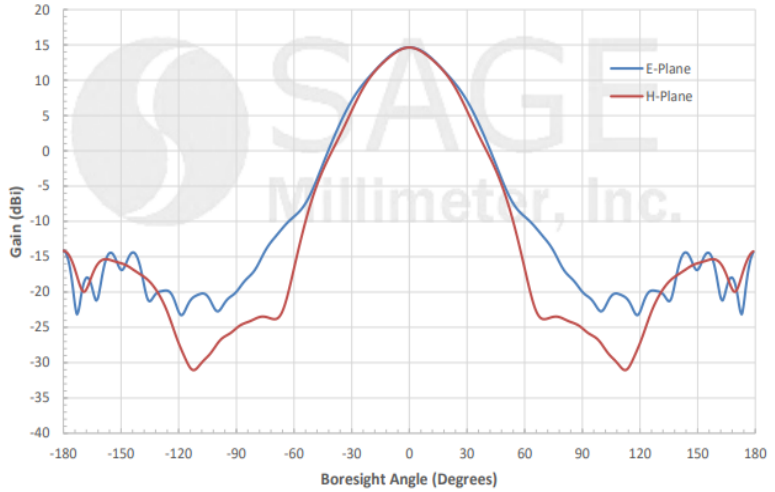


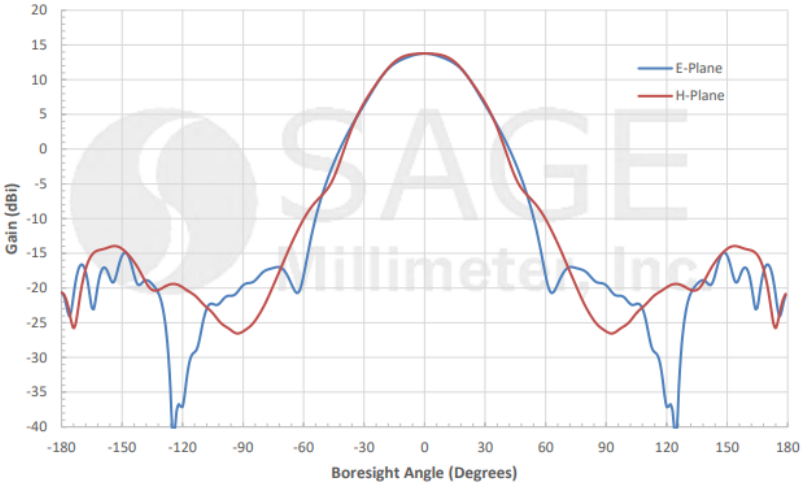
Compact Transition

ANTENNA PERFORMANCE

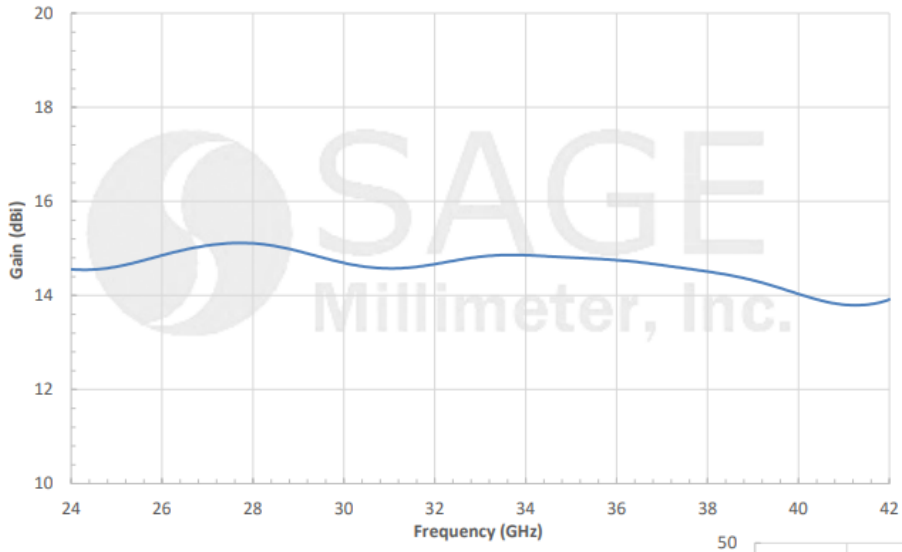






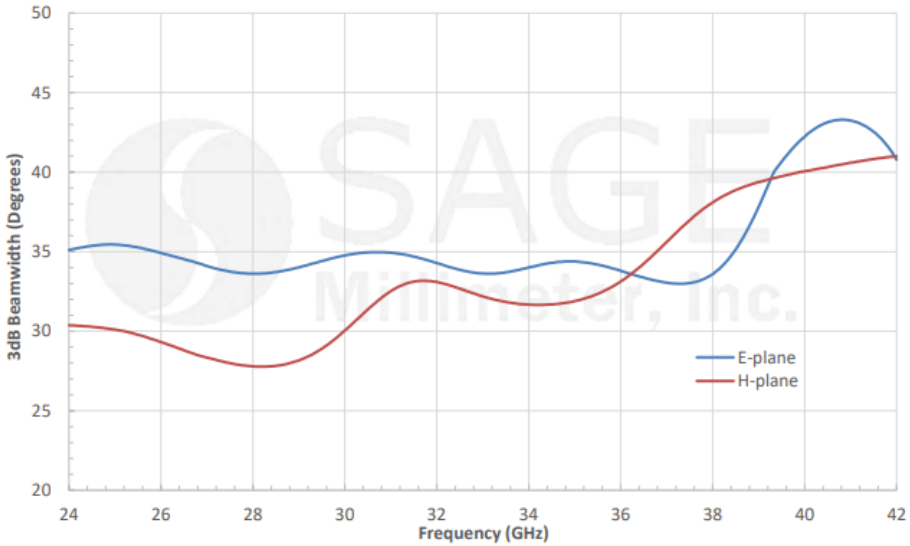


ANTENNA PERFORMANCE



Near Constant Gain cross the Full Operating Bandwidth

Near Equal 3 dB E- and H-plane Beamwidth cross the Full Operating Bandwidth



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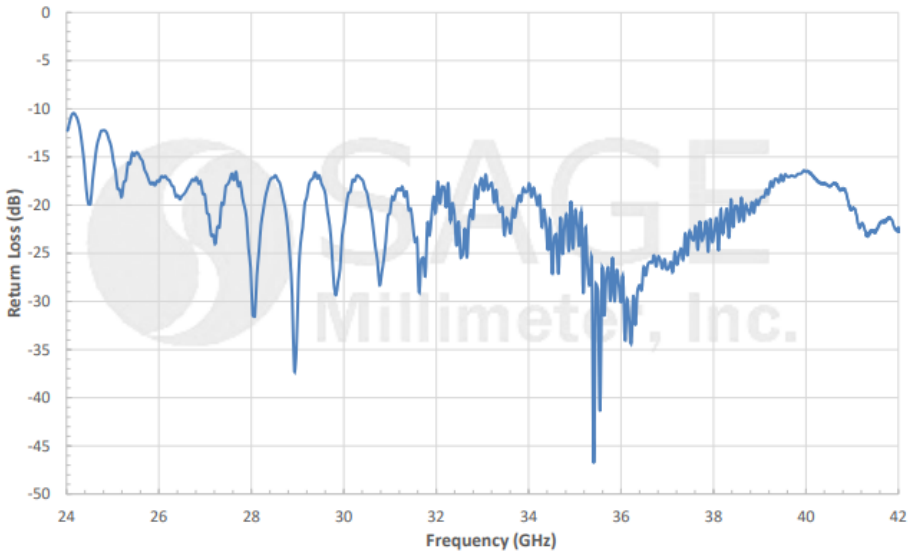
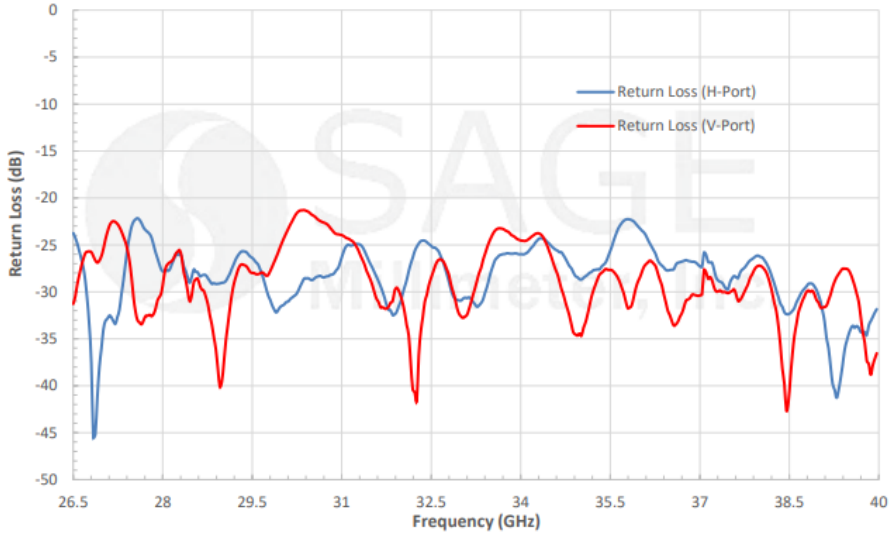
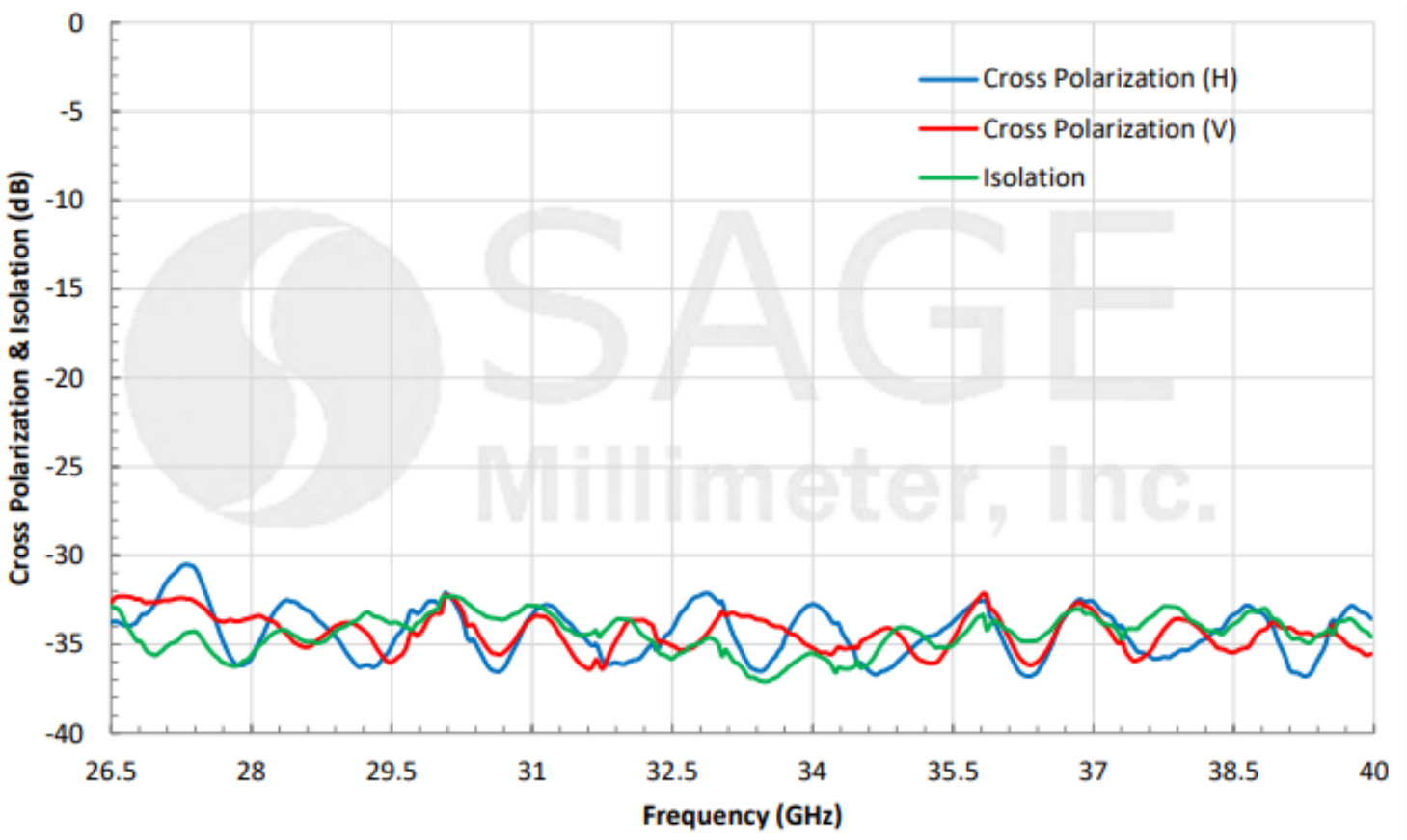


Antenna Port Return Loss cross the Full Operating Bandwidth

V- and H- Port Return Losses cross the Full Operating Bandwidth



ANTENNA PERFORMANCE



Port Isolation and Cross-polarization cross the Full Operating Bandwidth

CONCLUSIONS

- This presentation introduces a dual polarized horn based on OMT technology, which covers the most common 5G mmWave frequency band, namely, 24-42 GHz.
- This dual-polarized antenna is composed of one custom designed scalar feed horn with large flare angle, one OMT using Boifot junction, and one compact mode transition. The basic design and performance of each part are discussed and shown.
- Due to the OMT in the assembly, this dual polarized antenna demonstrates high performance in port isolation and cross-polarization, both are desirable for any higher performance systems.
- Dual-polarized antenna, which covers 24-42 GHz, has been designed and fabricated in ERAVANT. Many of them are implemented in high end antenna ranges and 5G systems.