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sured FBW is ~22.5 percent (~740 MHz), from 2.96 to 3.7 GHz for a VSWR less than 3:1, and 18 percent (~600 MHz), from 3 to 3.6 GHz for a VSWR less than 2:1.

Table 3 summarizes the radiation parameters in the array environment measured in a planar near-field test measurement facility. The variation observed between the measured and the simulated parameters are attributed to the variation in h, due to the bonding of two layers of the substrate using a Rogers 3001 bonding film to achieve the desired thickness. The set targets are met from 3.1 to 3.5 GHz, showing G_e is greater than 8.4 dBi, the efficiency η_{RE} is greater than 95.2 percent (see Equation 23), cross-polarization is less than -22 dB and the HPBW is greater than 90 degrees in both principal planes except near the upper edge of the frequency band.

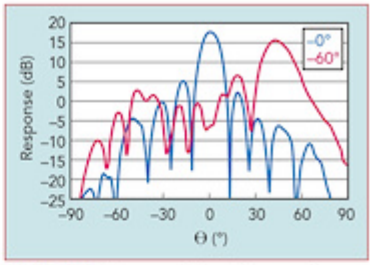
$$\eta_{RE} = 100.\ G_e / D_o \quad (D_o \text{ is the directivity}) \qquad (23)$$

Table 4 compares SIW CBMSA performance with the prior work.[33,42,27,25,43] Comparable performance with better efficiency, η_{RE} greater than 93.9 percent and FBW of ~22 is shown. ***Figure 14*** plots the measured co- and cross-polarized normalized radiation patterns in the array environment over the band, in the φ = 0- and 90-degree planes. A HPBW greater than 90 and 100 degrees in the two planes with cross-polarization less than -23 dB at boresight and better than -12 dB at extreme scan angles is demonstrated (see Table 3). The ripple level in the gain plots is less than ±0.5 dB.

Figure 15 shows the measured radiation pattern of a 64-element, uniformly fed array scanned to 0- and 45-degree angles. G_e decreases 1.15 dB from the peak value of ~17.6 dBi at 0 degrees with no visible GLs, validating wide scan performance.

CONCLUSION

A simple design strategy based on TCM to design a broadband, broad beamwidth SIW CBMSA is presented. TCM provides insight into propagating CMs and shows that the choice of CM propagation in the constituent parts of the antenna helps achieve broadband performance. The resultant antenna design is validated in a 64-element array environment. The fabricated antenna's measured performance agrees with the simulation and shows broad bandwidth and broad beamwidth. The results complement the existing literature and show promising applications to phased array antennas for various applications. ■



▲ Fig. 15 **Measured radiation pattern of the 64-element, uniformly fed array at center frequency.**

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