Conclusions: We have demonstrated the feasibility of using a silicon micromachined waveguide with a simple diagonal horn structure. The radiation patterns were very similar to those obtained with a conventional diagonal horn. However, to obtain good patterns, the micromachined waveguide was modified by eliminating the outer wafer near the horn. The copolarised radiation patterns were not sensitive to the amount of undercut modelled for the isotropically etched surfaces. We also saw a significant reduction in the on-axis cross-polarisation response when the flared section had flat walls. This result could be used to design an improved improved waveguide-to-horn transition for conventionally manufactured diagonal horns. Furthermore, at 110GHz a large die area will be required for silicon inserts. Hence this technique will be better suited for higher frequencies where area is needed.

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References


Magnetically scannable microstrip antenna employing a leaky gyromagnetic microstrip line

Kuen-Fwu Fuh and Ching-Kuang C. Tzuan

**Indexing terms:** Microstrip antennas, Chiral materials, Strip lines

Rigorous full-wave spectral-domain analyses of a magnetically scannable gyroscopic microstrip leaky-wave antenna are presented. Varying the DC magnetic bias field by -6.5%, the maximum radiation angle of the leaky-wave antenna, measured from the horizon, shifts from zero to almost 90°.

Introduction: Ferrite-loaded microstrip patch antennas have been widely investigated [1-4], owing to their abilities for DC magnetic bias control of beam scanning, antenna pattern, radar cross-section, etc. In contrast to these patch antennas which radiate at the resonance modes, a new travelling-wave antenna is presented. The new antenna, as shown in the inset of Fig. 1, employs the concept of leaky-wave propagation of the first higher-order mode on gyroscopic microstrip line. Recently, many such leaky-wave antennas integrated on isotropic dielectric substrates have been reported [5-7]. The aim of this Letter is to study the feasibility of the new scannable gyroscopic leaky-wave antenna by employing the rigorous full-wave spectral domain approach (SDA) based on the dyadic Green impedance formulation.

![Image](image-url)

Fig. 1 Bias-dependent leaky characteristics of first higher-order mode at 14.9GHz

Fig. 2 shows the bias-dependent leaky-mode properties of the first higher-order mode at 14.9GHz. Notice that the normalised propagation constant β decreases from 1 to almost 0 by only varying the normalised DC magnetic bias field H2/M2 from 2.9 to 3.1. This indicates that the maximum beam angle, measured from the z-axis and approximated by θc = cos⁻¹(β/H2), can be tuned from 0 to almost 90° by adding a smaller tunable magnetic field to a fixed magnetic bias field H2 = M2. For millimetre-wave application, the fixed bias field may be replaced by the internal field of anisotropy of hexagonal ferrite. By extending the results given in Fig. 2, Fig. 3 shows that the beam angle θc on the z-x plane scans almost linearly up to 80° when H2 is changed by 6.5%. Under different DC magnetic bias conditions, the normalised radiation patterns are plotted in Fig. 4 by employing the Huygen magnetic current source. Since the magnetic currents on the two apertures beneath the edges of microstrip differ by a small amount, the direction of the main beam will slightly depart from the z-x plane. The gyroscopic leaky-wave antenna is assumed to be five free-space wavelengths long and properly terminated. The maximum beam...
angles on the Z-x plane for various DC magnetic bias conditions are mapped to Fig. 3. The results show that the angle of maximum radiation agrees well with the approximate equation and the discrepancy at low bias field is caused by the insufficient length of microstrip. Referring to Fig. 2, the attenuation constant α increases as the DC magnetic bias field increases, resulting in the observed widened beam width in Fig. 4.

Fig. 3 Bias-dependent beam angle θz on Z-x plane

Fig. 4 Theoretic bias-dependent radiation patterns on Z-x plane

The length of the microstrip line is assumed to be five free-space wavelengths at 14.9 GHz and the terminal is matched.

Conclusion: A new gyromagnetic microstrip leaky-wave antenna capable of DC magnetic bias control of beam scanning is presented and validated by a rigorous spectral domain approach. The results show that the proposed antenna is a viable approach for beam scanning applications.

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Single-layer single-patch wideband microstrip antenna

T. Huynh and K.-F. Lee

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A coaxially-fed single-layer single-patch wideband microstrip antenna in the form of a rectangular patch with a U-shaped slot is discussed. Measurements showed that this antenna can attain 10–40% impedance bandwidth without the need of adding parasitic patches in another layer or in the same layer.

Introduction: Microstrip antennas offer the advantages of thin profile, light weight, low cost, and conformability to a shaped surface and compatibility with integrated circuitry. In addition to military applications, they have become attractive candidates in a variety of commercial applications such as mobile satellite communications, the direct broadcast (DBS) system, global positioning system (GPS), remote sensing and hyperthermia. This is due in large measure to the extensive research aimed at improving the impedance bandwidth of microstrip antennas in the last several years.

The basic form of the microstrip antenna, consisting of a conducting patch printed on a grounded substrate, has an impedance bandwidth of 1–2%. One way of improving the bandwidth to 10–20% is to use parasitic patches, either in another layer [1] (stacked geometry) or in the same layer [2, 3] (coplanar geometry). However, the stacked geometry has the disadvantage of increasing the thickness of the antenna while the coplanar geometry has the disadvantage of increasing the lateral size of the antenna. It would therefore be of considerable interest if a single-layer single-patch wideband microstrip antenna could be developed. Such an antenna would better preserve the thin profile characteristics and would not introduce grating lobe problems when used in an array environment. In this article, we report the experimental results of a rectangular patch with a U-shaped slot which appears to have wide bandwidth characteristics.

Experimental results: The rectangular patch antenna with a U-shaped slot used in our experiment is shown in Fig. 1. The patch has dimensions 8.65 ° × 4.90 °. The dielectric medium between the patch and the ground plane is air. The patch is fed at the centre by a 50Ω coaxial probe, the outer and inner diameters of which are