Low-Cost Binary Phase-Shift Keyed Microstrip Patch Antenna for System Power Reduction

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An in-antenna phase modulation technique that relies on the radiated field polarization vector is presented. This modulation technique can be applied to many antenna types, and has the advantage of potentially reducing transmitter complexity and power consumption.

As an illustration, the paper discusses the basis for producing phase modulation, specifically binary phase shift keying (BPSK), using the polarization state of a microstrip patch antenna. The design of a simple prototype BPSK-modulated patch antenna is presented. The antenna requires only two PIN diodes and a few passive components to produce BPSK directly in the antenna, and can eliminate a mixing stage and compensating amplifier in certain transmitter designs.

The impedance bandwidth, radiation patterns, and modulation performance of the prototype modulated patch antenna are presented. A comparison is made between the modulated prototype element and a nearly identical, single-feed patch with respect to operating band and efficiency.

Results indicate a 1.5 dB peak gain implementation loss of the modulated element relative to the single-feed version, with essentially no difference in radiated power pattern shape. The BPSK constellation produced matches that derived from a signal generator. The PIN diode modulation network can operate with as little as 360 micro-amps of current at a bias of 0.72 V, producing a -10dB input return loss bandwidth of 100 MHz at 2.35 GHz.

Extensions to the basic technology are proposed, including implementations of much more significant modulation formats such as quadrature phase shift keying (QPSK). Modulating the antenna after the final power amplifier (PA) stage will allow for a significant reduction in the required PA linearity for non-constant modulation formats such as QPSK.