

Further Developments in High-Voltage UWB Directional Couplers

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Directional couplers in Ultra-Wideband (UWB) High-Voltage (HV) radar systems allow the possibility of using a single antenna for both transmission and reception. Here we continue the development of a HV UWB coupled-line directional coupler reported earlier in (L. M. Atchley, *et al*, A High-Voltage UWB Coupled-Line Directional Coupler, Sensor and Simulation Note 489, April 2004). We investigate smoothing the impedance profile, increasing the directivity, and reducing the transmission loss, while maintaining high voltage standoff.

Previously, we built two oil-filled coupled-line directional couplers, in which we achieved a directivity of 20 dB, and a transmission loss of 1.5 to 1.9 dB below the expected values. Furthermore, the impedance profiles ranged from 30 Ω to 75 Ω , for a 50 Ω input impedance. Here, we investigate three new prototypes in an effort to smooth the impedance profile, increase the directivity, and reduce the transmission loss.

We describe here the fabrication and testing of three new prototypes. First we built Prototype 3, which is an air-filled design based on the symmetrical version described previously, with tuning screws added at the junctions between the feed sections and the coupled lines. We had intended that the tuning screws could be used to tune out discontinuities, but after experimenting with various settings, we found the tuning screws had little effect. We therefore proceeded with another approach.

To eliminate a source of impedance discontinuities, we next built a simplified air-filled design that eliminates the feed sections completely. We refer to this as Prototype 5, and we report here on the performance of this design. We also report on a closely related design, Prototype 6, which is a higher voltage design filled with oil. For all three designs, we provide directivity, transmission loss, impedance profile, and estimated voltage standoff.

As a result of our modifications, we have reduced the transmission loss by between 0.5 and 1.0 dB, we have increased the directivity to 33 dB (from 20 dB), and we have smoothed the impedance profile significantly. We have also demonstrated that our directional couplers can tolerate 25 kV for very short (3 ns) pulses.