A HIGH-VOLTAGE UWB COUPLED-LINE DIRECTIONAL COUPLER

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Most UWB radar systems currently use two separate antennas for transmit and receive. If a single antenna could be used for both functions, a more compact and convenient radar system could be realized. We report here on the development of such a directional coupler.

The directional coupler developed here is based on two coupled parallel transmission lines. The four ports of the directional coupler are designated the Source, Through, Coupled, and Isolated Ports. When the Source Port is driven by a pulser, the Isolated Port sees, in theory, no signal until the backscattered signal returns. In practice, there is always leakage, so one goal of this design is to minimize the leakage from the Source Port to the Isolated Port. The signal at the Coupled Port is, in theory, a faithful replication of the returned signal for the round-trip transit time of the coupled lines.

The bandwidth of the coupler is determined by two factors. At the high end, the bandwidth is determined by the diameter of the coupled lines. At the low end, the bandwidth is determined by the length of the coupled lines.

We begin by providing the time domain equations that describe the circuit. We then demonstrate how to optimize the design to obtain the largest voltage into the scope.

We then built and tested two prototype designs that should be able to handle a short transient signal of 50 kV. We tested these two devices at low voltage, and found that they operated about as expected. The leakage signal at the Isolated Port was down by about 20 dB from the source signal driving the Source Port. In future designs we would hope to reduce the leakage signal to 40 dB down from the source signal.

We then used these one of these couplers in a radar measurement, using a fast low-voltage pulser, an IRA-3 antenna, and a fast sampling oscilloscope. We found that the field scattered from a corner reflector was readily apparent in the received signal.

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2. E - Electromagnetic Noise and Interference

3. (a) High Power Electromagnetics

4. C - Contributed Paper, Program chair: Ira Kohlberg

5. No special instructions