

A High-Voltage Cable-Fed Impulse Radiating Antenna

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Ultra-Wideband (UWB) radar systems show great promise for identifying and locating non-cooperative targets. However, existing systems are clumsy to use since they require separate antennas for the transmit and receive channels. Because the two antennas may be quite large, it is challenging to mount both of them onto a single vehicle. What is needed is a UWB radar that will allow the use of a single antenna for both transmit and receive. Such a compact UWB radar system can be built using a single Impulse Radiating Antenna (IRA), along with a customized high-voltage UWB directional coupler.

In support of the above UWB radar system, we describe a 1.52 m (5 ft.) diameter IRA, with a focal length of 0.56 m ($F/D = 0.37$). In such a system, it is not possible to use a sharpening switch at the apex to handle high voltages, so we investigate using higher voltages on a standard IRA with a splitter balun. This antenna, designated the IRA-6, has the feed arms positioned at $\pm 45^\circ$ to the vertical, and is manufactured from a spun aluminum reflector. The IRA-6 is designed to operate at 30 kV. To prevent flashover at this voltage level, we introduce a number of new features, including a larger-diameter 100 ohm cable, cable stubs at the feed point (apex), and gaps filled with high-voltage silicon grease in the splitter balun. These features lead to somewhat higher reflections in the TDR and somewhat reduced gain, especially at higher frequencies. However, the realized gain is satisfactory as high as 4 GHz, which covers the frequencies of interest. We test the antenna at low, medium and high voltages, for which we provide results. The peak gain on boresight is 20 dBi at 3.1 GHz and the effective height is approximately 0.187 m. The peak measured E field at 20 m on boresight of the IRA-6 is 600 V/m when driven by a 4.5 kV pulser, and 2.8 kV/m with a 25 kV pulser.