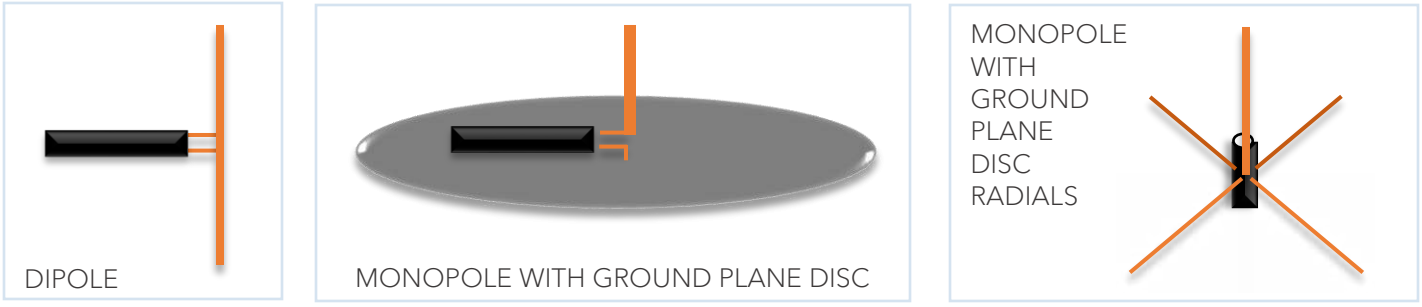
Adding Grounding Radials to Surface Mount Antennas

The surface mount quarter wave antenna is a popular antenna used in wireless communication systems. Most surface mount antennas are variations of quarter wave monopoles. A Monopole Antenna is essentially a half dipole antenna that is mounted vertically to the center of a ground plane and fed by a coaxial cable (see Fig 1). Radio signals transmitted by a radio transmitter radiate waves through the coaxial cable and ground plane surface to the top half of the antenna.

Most quarter wave antennas used in wireless applications are mounted to a metallic surface such as the roof of a vehicle or the wall of a metal enclosure. The metal in the mounting surface acts as a ground plane. However, some vehicle and enclosures are made of fiberglass or other non-metallic material. In this case, a full circular metallic disc or four horizontal radials that extend out from the base of the antenna must be added for the antenna to function properly. The radials emulate a circular ground plane and can be made of the same rod shape material as the vertical antenna (see Fig 1 Below).

Fig 1. Dipole Antenna and Half Dipole Antennas Mounted to Ground Planes



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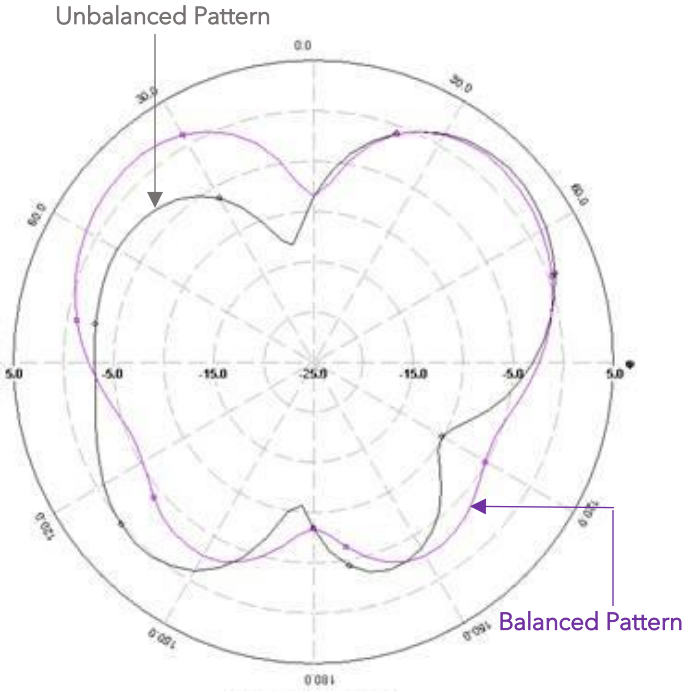

Fig 2. Balanced & Unbalanced Antenna Patterns

An antenna's transmitting signal field is most uniform when a large ground plane is used. However, the antenna will function properly on a ground plane that measures half the wavelength of the lowest operational frequency. This is because radial conductor's length is dependent on the operating frequency of the antenna and hence the length of the conductors. It's important that radials be equal in length to maintain a balanced pattern. The antenna pattern will be unbalanced, if one of the radials is shorter than the other (Fig 2). The standard formula 11808/frequency over MHz can be used to convert a radio wavelength to inches. The chart in in Figure 3 shows common half wave frequency measurements.

Fig 3. Common Half Wave Frequency Measurements

MHz	450	617	750	824	895	1710	1880	1990	2400	3400	4400	4400+
Inches	13	9.50	8	7.25	6.5	3.50	3	3	2.50	1.75	1.25	1.25

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Another acceptable, and less known, approach for emulating an antenna ground plane is to use two strips of metallic foil that are taped down to a non-conductive surface. Common HVAC tape maybe used. The two strips of metallic foil must be equal in length and crisscross about the center of the vertical antenna base (see Fig 4). The foil strips may fold over vertical surfaces, if there isn't enough space on the horizontal surface (see Fig 5). Mount the antenna as directed by the manufacturer through the mounting hole ensuring the mounting nut makes contacts to the metallic strips of tape. As mentioned previously, it's important the two foil strips be equal lengths from the center of the hole. The foil tape approach is a cost-effective method and easy way to emulate a ground plane for use on non-metallic surfaces.

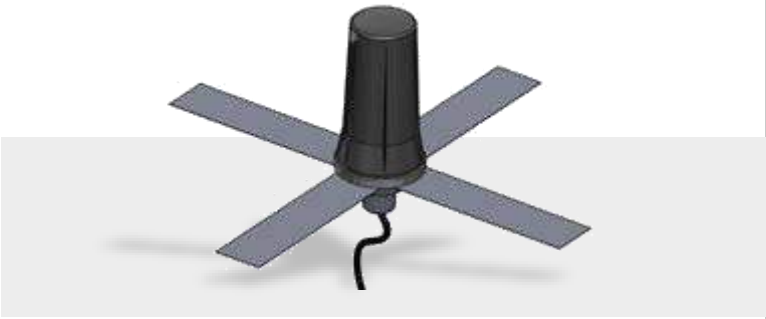

Fig 4. Antenna Mounted Over Foil Radials

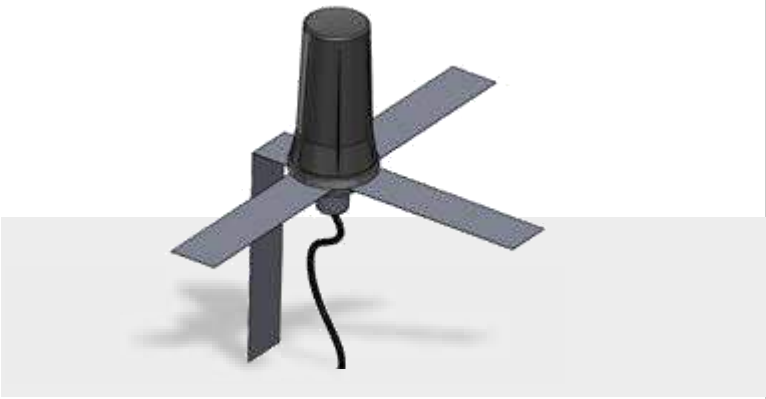

Fig 5. Radial Foil Folded Over Vertical Surface

By Randy Posluszny,
Project Engineer

Mobile Mark, Inc. designs and manufactures site, mobile and device antennas for 30 MHz – 6 GHz. Applications include GPS Tracking & Fleet Management, Cellular 4G LTE & 5G Ready, Wi-Fi, RFID, Public Safety FirstNet, M2M & IoT, Smart City Networks and Autonomous & Connected Cars. Engineering and custom design services are available. Mobile Mark's global headquarters, research facilities and manufacturing plant, are located near Chicago, IL. An additional manufacturing and sales facility is located near Birmingham, UK.

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