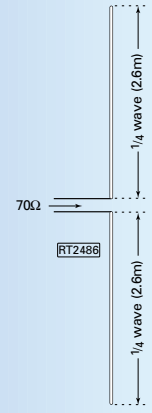
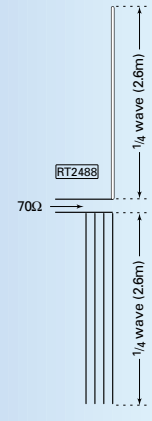
Antenna Questions

We received a letter recently asking, what is a quarter wave, half wave, five eighths wave type of antenna and their advantages and shortcomings? Here's the answer for all those who'd like these terms explained





All radio signals have a wavelength. In days gone by, radio dials were calibrated in wavelength (if you're old enough, you'll remember the radio announcer on long wave saying the the transmission was on a wavelength of 1500 metres!). Interestingly, even though Britain once used imperial rather than metric measurements, wavelengths were always quoted in metres.

Let's talk more about wavelength. To do this it is useful to think of the string of a guitar. When plucked, the string vibrates at its resonant frequency. As most people know, if you place a finger on one of the frets, the length of the string is effectively shortened; a shorter wavelength if you like. When you do this the frequency (pitch) of the sound produced increases. Obviously there is a direct relationship between wavelength and frequency.

Unlike a musical instrument, when it comes to transmitting a radio signal it is possible to use an antenna that is any fraction of a wavelength (or any number of wavelengths) long. However, when you delve into the technicalities, you soon discover that there are problems associated with connecting a transmitter to an antenna that is either non resonant or many wavelengths long.

At this point, we have to introduce the technical term **impedance**. Impedance is similar to resistance, but it is the term used when alternating (radio type) signals are in use. All antennas have **characteristic impedance**, depending on their length and type.

The basic antenna is a **half wavelength** long, which for CB is about 5.2m. Although it is possible to connect a transmitter to any point along a half wave antenna and make it work, the point at which the feeder is connected also affects the impedance of the antenna.

If you split a half wave antenna into two **quarter waves** and send 50% of the transmitted energy into each half you will have what is known as a **half wave dipole**. The reason why this is a very popular arrangement is that such an antenna has a characteristic impedance of about 70Ω. In reality, a 70Ω antenna is quite close in impedance to the 50Ω of a standard transmitter, which means they can be connected conveniently without complicated electronics to match the impedances.

If you don't split the basic half wave antenna into a dipole, ie you feed it at the end rather than the middle, the impedance of the antenna increases enormously and it immediately becomes necessary to introduce some kind of impedance matching between the transmitter and the antenna.

Introducing Ground Planes

Now imagine we replace one side of a half wave dipole with several wires, each of them the same length as the original. The antenna is still effectively a half wave dipole and it will still work the same.

What we do next is gradually fan out the wires at an angle. As we do it we see the impedance of the antenna start to reduce. If we fan out the wires at 45° the impedance of the antenna reduces to about 50Ω which is perfect for most transmitters because they are designed for 50Ω antennas.

If we fan out the wires at 90° the impedance of the antenna reduces to about 35Ω, which still matches a 50Ω transmitter well.

Antennas that have radial wires or rods beneath a quarter wave vertical radiating element are known as **quarter wave ground plane** antennas.

If we take a ground plane antenna, then increase the length of the radiating element from a quarter wave to a five eighths wave and add a small 'loading' coil, the effect is to increase the impedance back to around 50Ω. Great! but something even better happens here, because the five eighths wave ground plane antenna produces all-round gain by concentrating its energy into a narrower beam (rather than throwing a large percentage straight up into the sky, from which it never returns). This gain works both ways, making both transmitted and received signals stronger. ■

Table 1: Relative merits of simple antennas

	Relative Size	Impedance	Feeder Type	Self-build factor	All-round gain
Half wave dipole	medium	70Ω	balanced*	Easy	No
Half wave end fed	Medium	1000Ω+	coaxial	Difficult	No
Quarter wave ground plane	Small	35 - 50Ω	Coaxial	Medium	No
Five eigths ground plane	Large	50Ω	Coaxial	Medium	Yes