SKYPROBES™ Inc.

The long range antenna specialists for Handhelds, FCC Part 15 & other RF devices.

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Applications Note: What really is a "Rubber Duck Antenna?

A 'rubber duck antenna" is a physically and electrically short antenna. It was invented because the standard one-quarter wavelength antenna was too long and it got in the way in some applications. A ¼ wavelength antenna at 170 Mhz. is 17.36". This long of an antenna would be a problem if the handheld radio was carried on your belt as it is in many applications.

The rubber duck antenna became the antenna of choice for many portable radio devices, including handhelds and portable transceivers, scanners, GPS receivers, and any other device where safety and robustness over long or inflexible whips, takes precedence over antenna capabilities.

The typical VHF (150 to 170 Mhz.) antenna before the rubber duck was usually 18" to 24" long and was a metal telescoping unit which was retracted when not in use. When it was retracted its range was severely restricted, so it was constantly being extended or left extended for use. This could and would cause problems to the antenna, radio and people standing nearby.

This created the need for shorter antennas to be used. These electrically shorter antennas have a large capacitive reactance. (Capacitive reactance is an opposition to the change of voltage across an element. It is inversely proportional to the signal frequency.) So to make the antenna match the handheld for maximum power transfer (impedance match) an inductor is added. The inductor has the opposite characteristic of the capacitive reactance. **(**Inductive reactance is an opposition to the change of current on an inductive element. Inductive reactance is proportional to the signal frequency.)

An inductor value is chosen so that these reactance's cancel each other out. This is called the resonant frequency. The inductor, or loading coil as it is commonly called, is in series with the antenna. These antennas that have the coil built into their bases are called base loaded antennas.

The rubber duck antenna is an electrically short antenna in which the inductor, instead of being in the base, is built into the antenna itself. The antenna is made of a metal spring,

which functions as the needed inductor. The springy wire is flexible, making it less prone to damage than a stiff antenna. The spring antenna is further enclosed in a plastic or rubber-like covering to prevent it from catching on things. Rubber duck antennas are typically 15% to 25% of the length of a standard quarter-wave whip. This antenna is inherently inferior to standard size antennas due to its dramatically shortened length.

As with many monopole antennas, the Rubber Duck antenna requires a ground-plane or counterpoise with which to complete its electrical circuit. With handheld transceivers, this ground-plane is often only a small internal shield or the jackets of internal batteries. Modern construction techniques using nonconductive plastics for transceiver cases further reduce the effectiveness of this antenna by eliminating a conductive path to the user, which could have provided an effective ground-plane or counterpoise.

The original rubber duck design used 4 wires connected to the metal case which made the antenna very efficient. Modern versions have eliminated this counterpoise, using the electrically resonant spring only for convenience. This often reduces the usefulness of this antenna to where it is barely adequate for its intended use.

With antennas, length is the one of the key factors for long range communication. With the shortness of the rubber duck antenna it has no gain and actually has a loss. Plus because it is designed with a particular resonant frequency it suffers from narrow bandwidth. Outside of this narrow bandwidth the rubber duck antenna has even more loss.

Many handhelds are supplied with a rubber duck antenna with no indication of what its operating or resonant frequency is. The handheld itself can operate from 136 to 174 MHZ. In actual practice there should be 18 to 30 rubber duck antennas available for optimum operation with the handheld. It can be used but the radios performance will be compromised and its range dramatically reduced.

To get long range and reliable communication it is necessary to use “long” whip antennas that have at least a 36” length at VHF frequencies. At 170 Mhz. an antenna of 36” to 41” is needed to have gain. A broad banded antenna is also needed so you will not lose the signal when you need to change frequencies in a multi-user handheld environment.

The SkyProbes SSP series can give bandwidths of ±3 Mhz and larger. Whips choices are 36” telescoping whips, highly flexible 36”Titanium whips and stainless steel cable plastic encapsulated whips. You will get the long range reliable communications that you need.

If you have any questions about your antenna needs please call us at 1-602-293-6844

or email us at skyprobes1964@yahoo.com