

RF Components and Basic Concepts

1.5 - Antenna

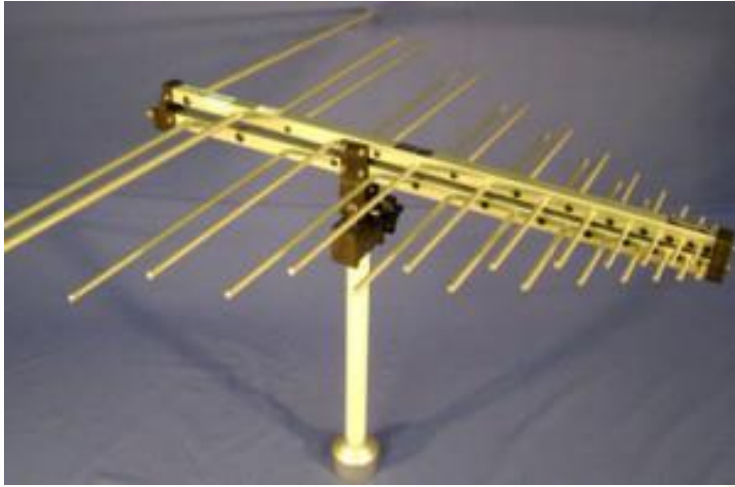
Antenna

- An antenna is a device (usually metallic) for sending or receiving electromagnetic waves.
- The antenna has to be tuned to the right frequency or the radio waves can neither be emitted nor captured efficiently.
- In transmission, a radio transmitter applies a radio frequency to the terminals of the antenna and then the antenna radiates the energy from the antenna as electromagnetic waves.
- In reception, an antenna intercepts some of the power of an electromagnetic wave to produce a radio frequency at its terminals that is applied to a receiver in order to be amplified and demodulated.

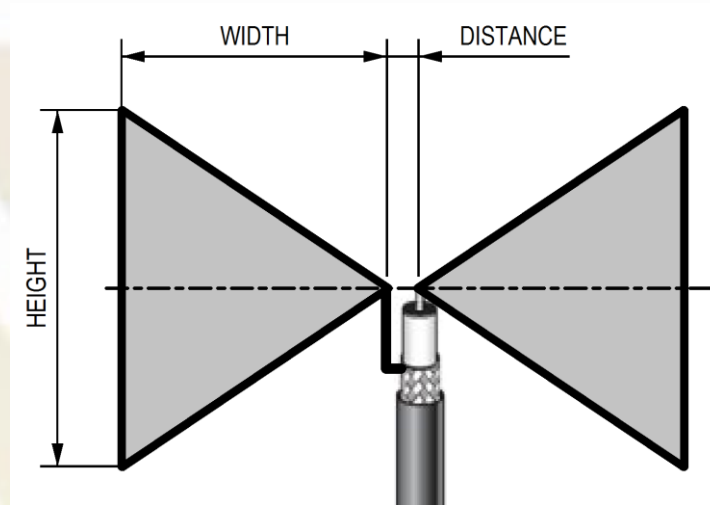
Types of Antennas

Log-Periodic Antennas

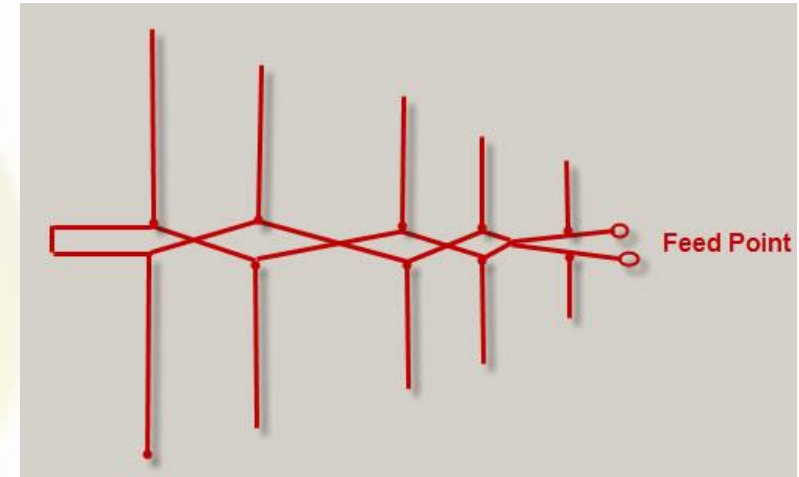
- A log-periodic antenna is also named as a log periodic array.
- It is a multi-element, directional narrow beam antenna that works on a **wide range of frequencies**.
- This antenna is made of a series of dipoles placed along the antenna axis at different space intervals of time followed by a logarithmic function of frequency.
- Antenna acts as a **resonator**, with radio currents traveling in both directions



Log Periodic Antenna



Bow-Tie Antennas



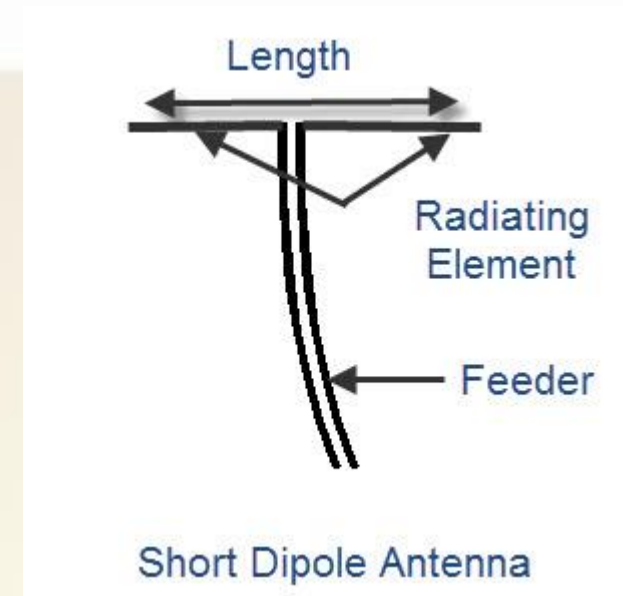
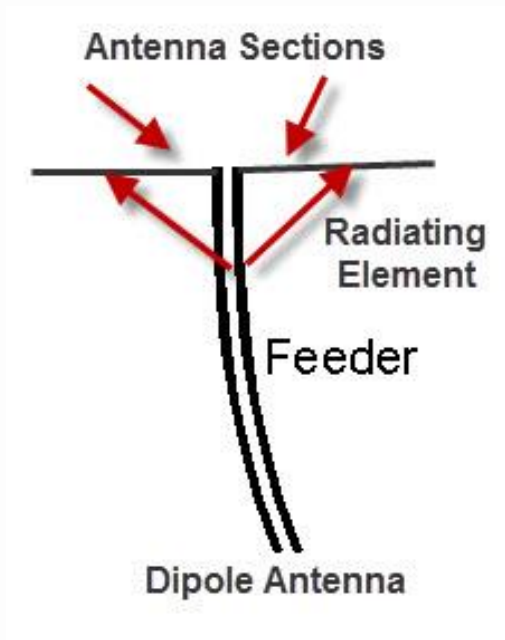
Log-Periodic Dipole Array

The most common type of antenna used in wireless communication technology is a log-periodic dipole array fundamentally comprises a number of dipole elements.

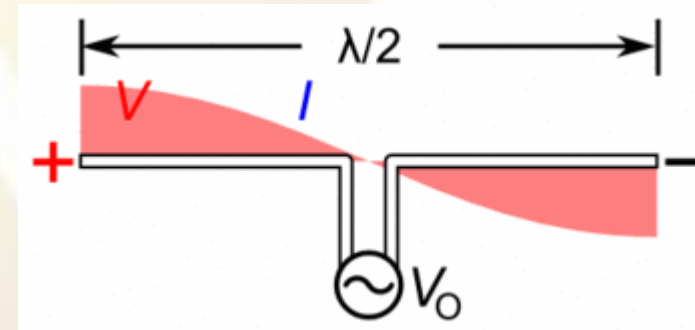
Types of Antennas

Wire Antennas

- Wire antennas are also known as linear or curved antennas.
- These antennas are very simple, cheap and are used in a wide range of applications.
- These antennas are further subdivided into four as explained below.

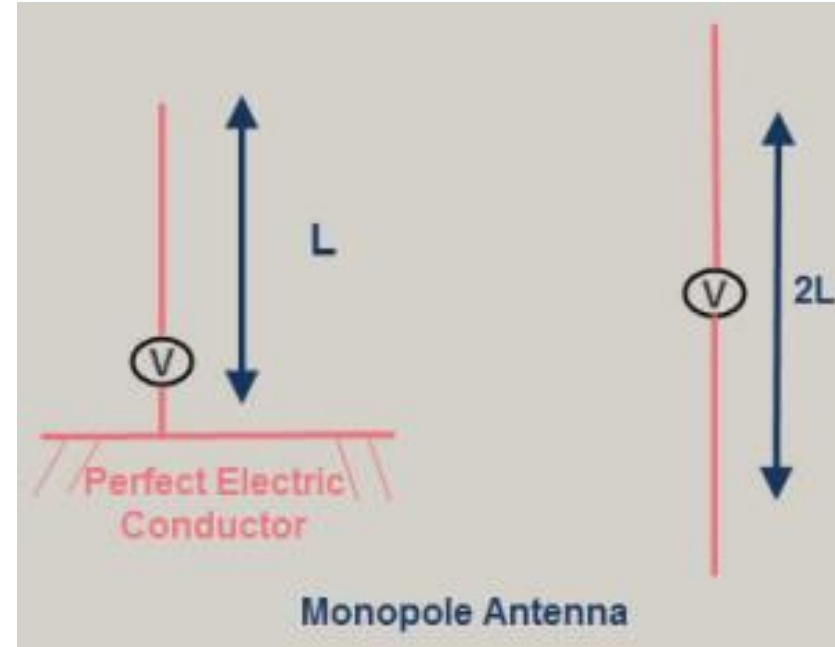


- The dipole antenna consists of **two metallic** rods through which current and frequency flow.
- The antenna consists of a radiating element that splits the rods and make current flow through the center by using a feeder at the transmitter out that takes from the receiver.





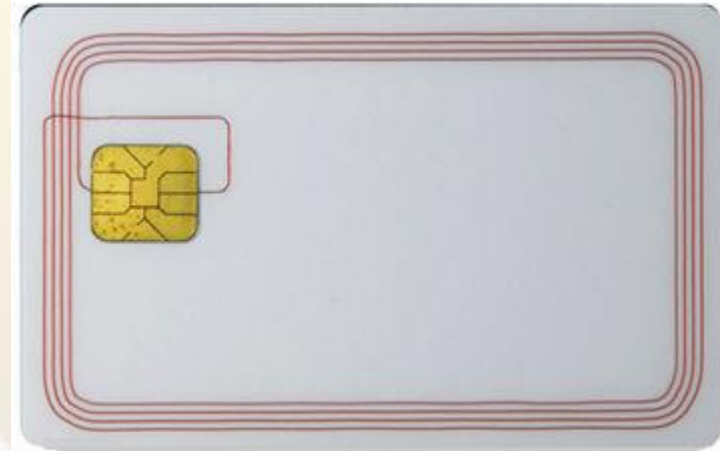
Monopole Antenna



A monopole antenna is half of a simple dipole antenna located over a grounded plane as shown in the figure.



- Loop antennas are available in different shapes like circular, elliptical, rectangular, etc.
- The fundamental characteristics of the loop antenna are independent of its shape.
- They are widely used in communication links with the frequency of around **3 GHz**. These antennas can also be used as electromagnetic field probes in the microwave bands.



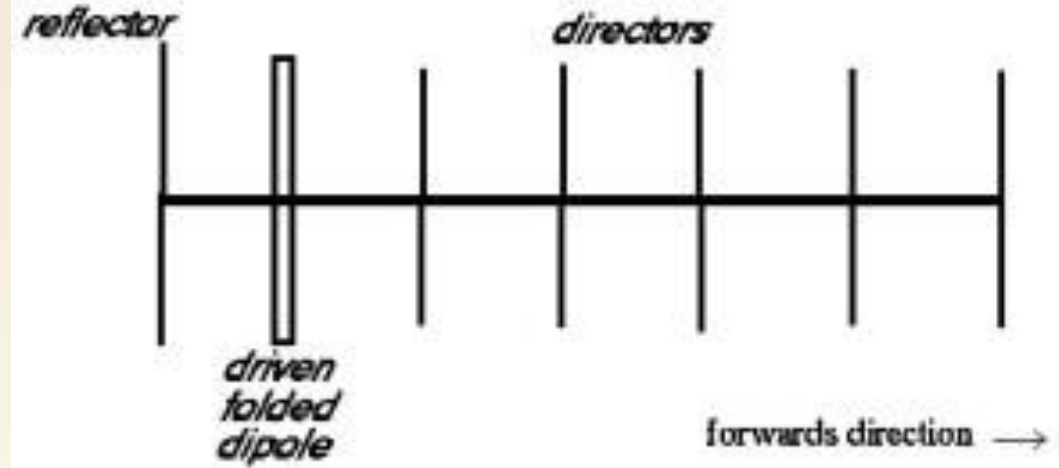
Types of Antennas

Travelling Wave Antennas

- A class of antenna that use a traveling wave on a guiding structure as the main radiating mechanism.
- Their distinguishing feature is that the radio-frequency current that generates the radio waves travels through the antenna in **one direction**.
- This is in contrast to a resonant antenna, such as the monopole or dipole, in which the antenna acts as a **resonator**, with radio currents traveling in both directions, bouncing back and forth between the ends of the antenna.



- **Helical antennas** are also known as helix antennas. They have relatively simple structures with one, two or more wires each wound to form a helix, usually backed by a ground plane or shaped reflector and driven by an appropriate feed.

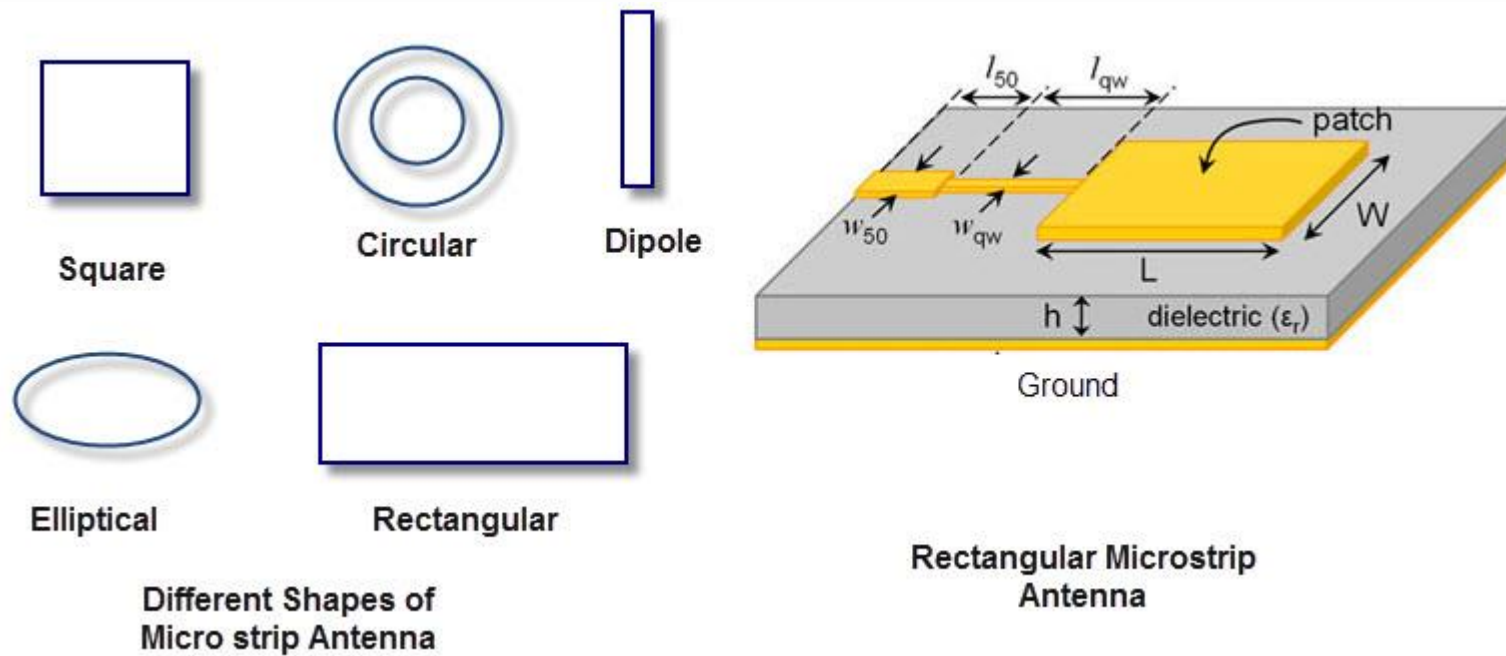


Another antenna that makes use of passive elements is the **Yagi-Uda antenna**. This type of antenna is inexpensive and effective. It can be constructed with one or more reflector elements and one or more director elements.

Types of Antennas

Microwave Antennas

The antennas operating at microwave frequencies are known as microwave antennas. These antennas are used in a wide range of applications.



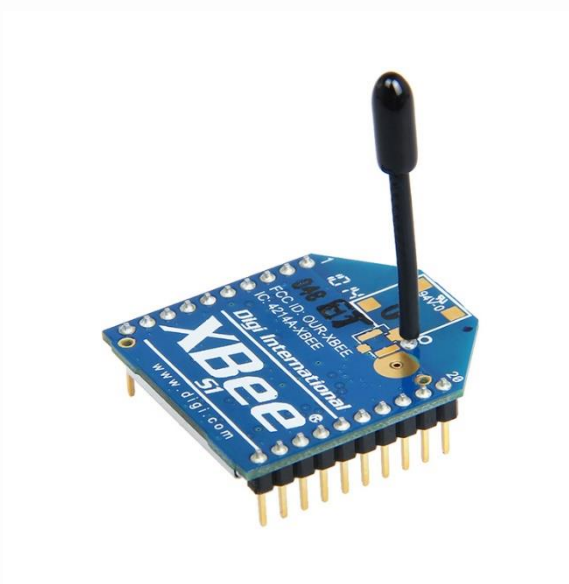
- For spacecraft or aircraft applications.
- These antennas are known as rectangular microstrip antennas or patch antennas.
- they only require space for the feed line which is normally placed behind the ground plane.
- The major **disadvantage** of using these antennas is their inefficient and **very narrow bandwidth**, which is typically a fraction of a percent or, at the most, a few percent.

Example Bluetooth antenna

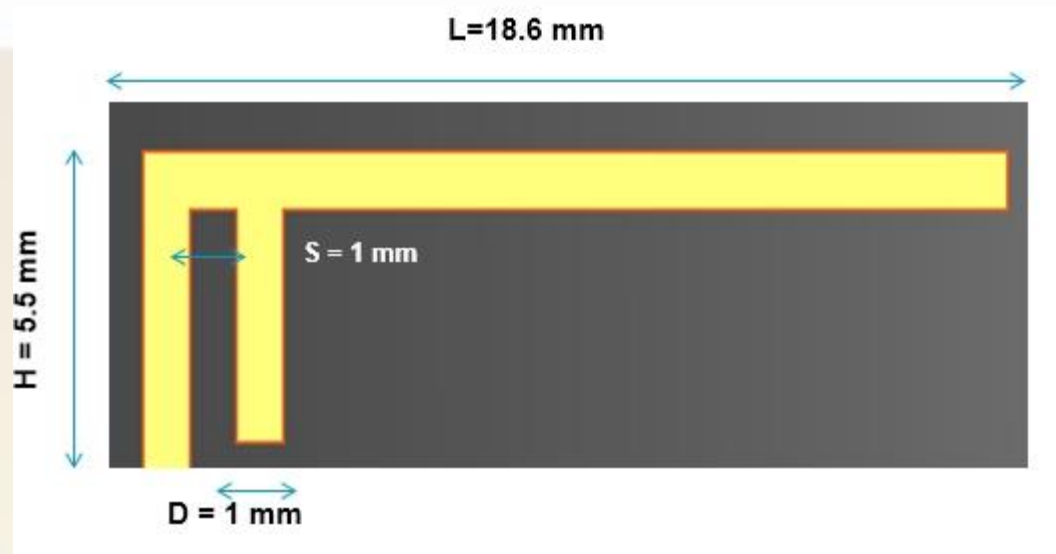
- Variety of antennas can be used, and they are application-specific.

Some common types are:

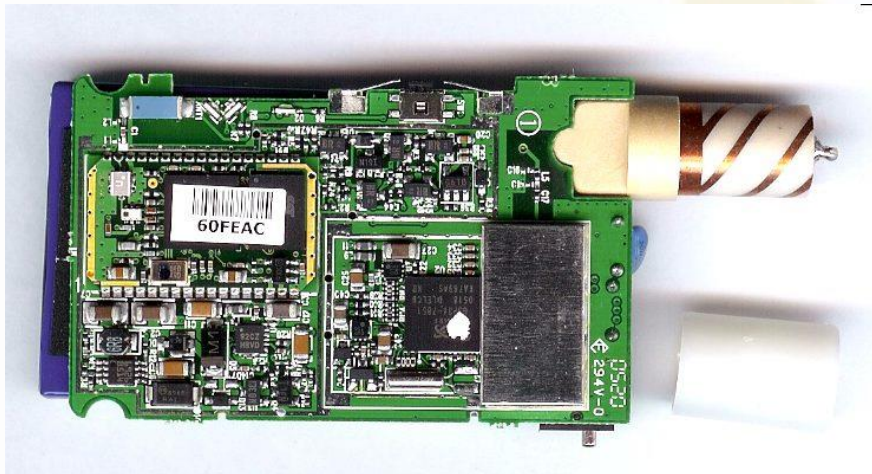
- **Wire Monopole** — This consists of a simple wire soldered at one end from which it is fed against a ground plane. It is trimmed to be resonant at 2.45 GHz and provides good performance and high efficiency. The disadvantage of this antenna is that it is not low profile because it **projects above the PCB**.
- **PIFA** — The Printed Inverted F Antenna is like a monopole printed on a PCB, but it has a ground point and feed point along the main resonant structure.
- **Helix** — Similar to the wire monopole, except that it is coiled around a central core (usually air) making the physical dimensions smaller. It provides excellent performance, **but projects above the PCB**.
- **Ceramic** — Surface mount dielectric antennas are the **smallest** types of antennas available, because they are printed on a high-dk ceramic slab, which makes the electric field concentrated allowing the antenna to be made small while keeping a high resonant frequency.



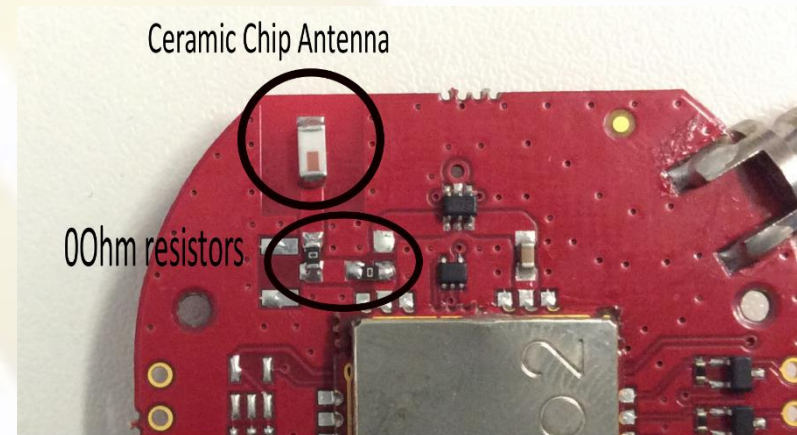
Wire Monopole



The Printed Inverted F Antenna



Helix



Ceramic

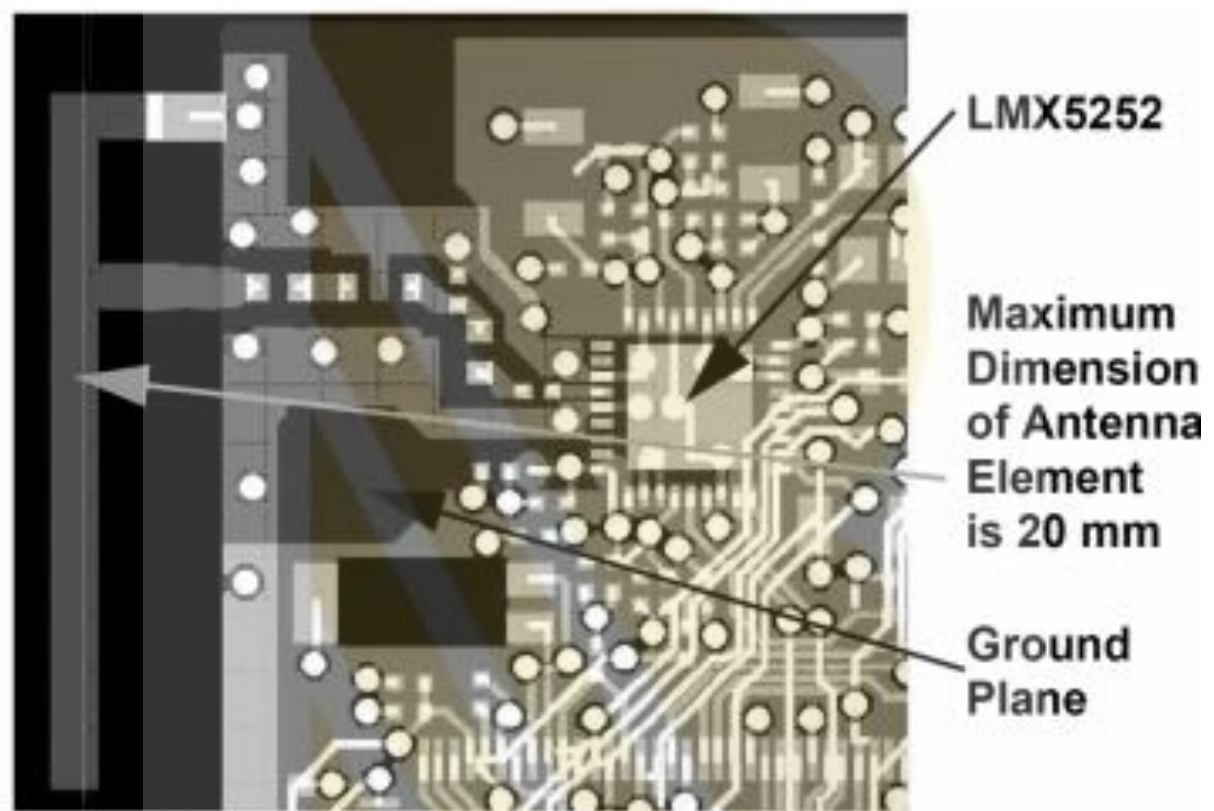


Figure 11. LMX5252 PIFA Antenna