

Antennas for WLAN

An Overview

The antennas used have a major influence on the range and the transmission quality in WLAN communication. Different antennas are required depending on the environment and area of use.

This Application Note is not provided as operating instructions but rather as a guide and overview of this important aspect of WLAN technology. The reason for this is the general problem of WLAN and high frequency technology: whilst cable-based communication allows relatively accurate information about lengths, the different environmental conditions occurring with wireless transmission means that general range information cannot be given.

Factors:

Generally a range between 30m and 100m in free space is assumed for the use of standard devices. This range is impaired when a visual connection is obstructed by trees, walls, and it should be noted here that radio waves are dampened by different degrees depending on the materials involved. Moving objects or changing environments and reflections in particular can have an unpredictable effect on the range.

Other interference may be produced by devices operating in the same frequency band such as Bluetooth, ZigBee, microwaves, interference from electric motors, and low-quality power supplies.

A wide range of antenna shapes and types are available, which are used according to the application at hand. Omnidirectional antennas are used for connections to several receivers and with mobile applications, whereas directional antennas are used for stationary point-to-point connections over large distances.

In Germany, for example, there are even self-built antennas for which no special license is required. Only the maximum transmitted power must be observed:

An antenna has the property of boosting the electromagnetic waves. In Germany, license-free frequency bands for WLAN operation are available which do not have to be registered. However, the operator is solely responsible for not exceeding the permissible “effective isotropic radiated power” for WLAN antennas of 100 mW (= 20 dBm). This requirement may vary in different countries.

By “effective isotropic radiated power” (EIRP) is meant the transmitted power that would have to be emitted by an isotropic antenna to produce the same power density as a directional antenna does in its main direction of transmission. It is calculated as follows:

$$\text{Radiated power} = \text{Transmitted power} - \text{Attenuation (cable/plug)} + \text{Antenna gain}$$

The above equation shows that cables and connectors can have a negative effect on the power. The longer the cable, the greater the attenuation. Therefore if an antenna is to be located at some distance away, the use of high quality antenna cable with a low attenuation is recommended.

The connectors also have loss ratings. Different connector types are available, with the most commonly used being SMA, reverse SMA, TNC, MCX and U.FL.

The FK61-WL01 from Beck IPC, for example, is supplied as standard with SMA connectors and corresponding antennas. So-called “pigtailed” are available for the use of reverse SMA antennas. A pigtail is a short cable adapter between two different plug connectors. On the IPC@CHIP WL01 a small Hirose U.FL connector is provided on the board due to the miniaturised design. Pigtails are therefore available for conversion to SMA and reverse SMA.

Antenna diversity

By antenna diversity is meant the simultaneous operation of two antennas on a terminal where the two antennas are used alternately for receiving and for sending.

A direct radio wave can be superimposed with a reflected radio wave (interference). If they are not synchronised and a phase shift is produced, the waves may amplify each other or cancel each other out. By using several receiver antennas, it is possible to increase the likelihood that an antenna receives radio waves that are not affected by signal fading.

In certain circumstances the use of two antennas with different antenna gain is effective. In this case, one antenna is used exclusively for reception whilst the other one is used solely for sending. In this way, a receiver antenna can be used that would exceed the output during sending.