antenova

2024 GUIDE

Wireless Antennas: The Comparison Guide

Introduction

Selecting an antenna is one of the most critical aspects of the design process for internet of things (IoT) projects. The right choice is often the difference between a good product and a great one. But even with a huge range of antennas now available, the selection process does not need to be overwhelming.

Brand new antennas are enabling devices to shrink in size, introduce additional functionality and become more 'intelligent'. But finding the right wireless solution requires careful consideration, as engineers need to strike a balance between cost, performance and physical size. In this guide, we will shed light on the types of antennas available, highlight their major design implications and help you select the right one for your project.

Terminal Antennas

Devices that employ terminal antennas are normally very easy to spot. Sometimes known as external antennas, terminals connect to devices at a single fixed point, which is typically outside of the product's enclosure.

The fixture that connects the device and antenna varies, as they can connect to a host PCB via a cable, a swivel connector and even fixed 90-degree connections. However, consumer perceptions of terminal antennas have changed. They once represented the cutting-edge of technology: think early mobile/cell phones. The stylish, ultra-thin smartphones we use every day seem incredibly advanced by comparison. But this movement towards embedded solutions has not diminished the utility of terminal antennas.

Terminal antennas are still relied upon in many industrial, scientific and medical settings. Essentially, where substance matters much more than style, the enhanced RF performance provides end-users and engineers with several key advantages:

Enhanced performance. Terminal antennas generally outperform embedded solutions across all key RF parameters;

Better efficiency. They provide higher levels of efficiency (typically above 10% greater than comparable embedded solutions);

Immunity from self-generated noise. As they are fixed externally to the product housing, they provide greater immunity from self-generated noise (caused by components).

WiFi6E applications

See Nitida, a waterproof/IP67 external antenna for WiFi6E/7 suitable for outdoor applications.

Find out more

Yet it's not merely a choice between performance and style when it comes to selecting an external antenna over an embedded solution. There are some other factors which add extra dynamics to the decision:

1. Terminal antennas are susceptible to damage

Like any slim, externally protruding component, terminal antennas are susceptible to damage. Not all terminal antennas are equally disposed to breakages, however. Antennas attached via a swivel connection are obviously better adapted to accidental knocking than purely fixed connections. However, regular tactile use (and misuse) presents inevitable reliability issues which can be anticipated and, as far as possible, mitigated within the design.

2. Using external solutions adds to manufacturing complexity

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3. Terminal antennas often prove more expensive

As well as the increased manufacturing cost, many terminal antennas have a higher unit cost than embedded antennas. Simply, this is due to their larger form factor and a higher bill of materials. If you determine an external solution is best suited to your project, then consider an antenna that provides great performance levels and provides easy integration. Antenova's range of terminal antennas, including Draco – our most recent external offering–have been designed with ergonomics and performance in mind. By adopting a stylish blade-like design the antenna performs excellently in free space and provides a better-looking solution than other comparable terminal antennas.

DATASHEET

Download the Draco datasheet →

Embedded Antennas

New innovations in embedded antenna solutions have helped drive the dramatic growth in the internet of things (IoT), Many of the most innovative projects in recent years just wouldn't have been the same without embedded antennas.

Embedded solutions are housed within the enclosure of the device, as the name suggests. However, this does not necessitate that the antenna is fixed to the circuit board – they come in a variety of forms and sizes, with various performance parameters:

Form factor – there are a wide range of options, from individual antennas designed to be surface mounted (SMDs), through to onboard modules offering complete solutions. And, from antennas capable of being mounted onto surfaces of the product housing, to flexible printed circuits ideal for wearables. There are also tiny ceramic antennas, too.

Sizes – embedded antennas can range from just a few millimetres wide (for the ceramic antennas) to larger antennas with a built-in ground plane. The minimum size of any device is often determined by the requirements stipulated in the antenna guidelines.

Performance parameters – the range of different antennas available means most performance requirements can be met. However, the efficiency of the antennas can be significantly affected by the product design, so meeting these performance parameters is as much a question of good design practices as it is the selection of the right antenna.

There's now a staggeringly vast variety of embedded solutions available. Without a doubt, there is much more design flexibility afforded to engineers now than there has ever been before. At Antenova, we strongly advocate considering your antenna requirements first. Antennas are highly sensitive components, which operate in challenging 'noisy' environments. If these environments are considered from the outset, then other components can be laid out mindful of the antenna's requirements. An optimally designed internal operating environment paves the way for a high performing, efficient product.

ANTENNAS

View the different Antenova ranges →

Surface-mount devices (SMD)

Antennas that mount directly to the printed circuit board are called surface-mount devices (SMD). These antennas are available in numerous materials and come in a plethora of shapes and sizes.

The most commonly chosen materials are high-grade dielectric constant laminate substrates and ceramic. Their usage comes with four core advantages:

- SMD antennas are small (measuring just a few mm in some cases).
- They have a **low part cost**
- They are **easy to assemble** using pick and place machinery
- They offer **high levels of performance** when internal operating environment is optimised

Due to their small size, it is critical that the overall product design complies with the recommended ground plane requirements – hence why taking an antenna-first approach to product design always pays dividends.

Care must also be taken when attempting to miniaturise products. SMD components are commonly used to reduce the size of a device. However, in addition to the correct ground plane size, SMD antennas have specific design requirements. "Keep out" areas are one such requirement, which should be observed in order to optimise wireless performance.

Modular solutions

Modules are hugely useful resources. Modules are generally comprised of several key components, which are preassembled and already optimised for a specific function.

For example, Antenova's modular RADIONOVA range of antennas offer a ready-made antenna solution for GNSS. As these antennas are pre-assembled, it saves vital time in integration and testing, which enables products to get to market quicker and more seamlessly, and at a lower cost. Modules can be complete RF solutions, incorporating not just the antenna but also SAW filters and LNA for low power satellite signals.

The fact the radio and antenna are colocated means modules have a reduced space requirement. This makes it perfect for tracking applications, personal safety, navigation systems and small, portable devices. However, whilst modular solutions are time-saving, the typical antenna integration rules still apply.

Product case-mounted antennas

Case-mounted antennas are an interesting alternative to the surface-mount devices (SMD) previously discussed. They can solve several issues faced in many wireless projects, such as size, space and they even reduce the impact caseworks have on wireless efficiency.

Sometimes, the size requirements of a product provide insufficient space for an antenna and a sizeable enough ground plane. In other scenarios, it's the physical material of the case impacting on antenna performance. For both situations, case mounted antennas are designed to work on all surfaces, including metal ones, thereby providing a novel solution.

In particular, metallic surfaces make for challenging RF environments. Antenova's award-winning and patented REFLECTOR series series of antennas can operate on metal surfaces. It has a small footprint and is just 1.6mm thin, which means it can be mounted directly onto a product housing and very easily hidden.

This gives designers the option of mounting a low-profile antenna externally, providing an interesting alternative to a terminal antenna as it is more a robust and compact solution. The REFLECTOR series series is a unique solution for tracking objects (such as bicycles) and smart city applications. For compact devices which require rugged, metal housings, then a multilayer antenna may be a more aesthetically pleasing compromise between a terminal and an embedded solution.

Surface-mount devices

View Sinica

Modular solutions

View GNSSNOVA

Case-mounted antennas

View Reflector

Flexible printed circuit (FPC) antennas

Flexible printed circuit (FPC) antennas use a layer of flexible polymer film and a patterned conductive material that combines the functionality of a circuit board with extreme thinness and malleability.

Due to this increased flexibility provided, they are incredibly well suited to applications where space is limited, and their connection via a cable allows for a wide range of placement options.

These unique features enable give FPC a unique set of advantages, including:

1. Space-saving

They require little additional space on the PCB.

2. Low profile

With our Mitis antenna (for LTE and MIMO technologies) measuring just 0.15mm in height.

3. Flexible

The self-adhesive antenna can be fixed to the inner casing of a device on any clean surface.

4. Design flexibility

Our antennas are tuned specifically to be fixed on plastic surfaces.

5. Easy integration

FPC antennas connect to many wireless modules with a UFL connection and have less restrictive design guidelines to follow.

If maximum design flexibility is an objective of yours, then FPCs fix easily onto contoured surfaces – even for more complex housings. This has made these type of antennas popular in wearables and small handhelds.

As with all other wireless integrations, placement is still an important consideration; any FPC antenna still needs to be free of obstruction. Care should be paid to any minimum clearance requirements, which should be defined within the datasheet of your chosen solution. Pay particular respect to metallic items, components or RF blocking objects to retain high levels of wireless efficiency. Additionally, it is not advised to run the coax in close contact or in parallel with metal surfaces.