

Explaining “Gain” in Signal Boosting Systems

If you’ve been researching cellular signal boosting systems, you’ll be aware that antenna and amplifiers are the primary components. You may have also come across the term “gain”. Technical jargon can be confusing at first - however, in this post we’ll show you that gain is a simple concept, and that it can be easily understood.

In purely physical terms, **gain is a measure of an electronic circuit’s ability to increase the power of a signal from input to output.**

Gain is in fact the ratio of output to input – if the output signal of a system is stronger than the input, then the gain has a value greater than one. Conversely, if the input is greater than the output, then the gain is less than one.

An increase in power requires an increase in energy, which means that for a circuit to have positive gain, it needs an external power supply.

The Gain of an Amplifier: How Much Energy it Adds

An amplifier is simply a device that takes an input signal and makes it stronger. Thus, the gain of an amplifier is the ratio of the power of the outputted signal to the input signal.

Amplifiers always have a gain value of more than one – they take a signal, add energy to it, and the output is always greater than the input.

In fact, any electronic circuit with a gain of more than one is *by definition* an “amplifier”, as it amplifies the signal power.

When talking about amplifiers in signal boosting systems, amplifiers will have their gain listed in their specification, and it will be reported in decibels. The degree of gain you need from your amplifier will depend on your specific situation and how much you need to boost the signal strength by.

Manufacturers are constantly looking for ways to develop amplifiers with greater gain, and high-gain devices tend to have higher price points.

The Gain of an Antenna: How Well It Converts Signal

The gain of an antenna is somewhat different from the gain of an amplifier.

There are two main types of antennae – transmitting and receiving.

A receiving antenna picks up a radio signal from a certain source and convert it into an electric current. In a signal boosting system, the external receiving antenna is connected to the transmitting internal antenna, which converts the electric current back into a radio signal in the air, in the place where it’s needed.

Antenna gain, like amplifier gain, is a measure of how much signal strength is increased. However, antennae do not add energy to the signal from a power supply like an amplifier.

For a **receiving antenna**, gain is a measure of how well the antenna picks up the scattered radio waves in the air and concentrates them into an electrical signal.

Conversely, for a **transmitting antenna**, antenna gain refers to how well the antenna converts electrical input into the radio waves it transmits.

Trade-offs: Higher Gain with a Directed Signal

One thing to bear in mind is that external antenna can either receive signal from one direction or from multiple directions. These types of antenna are termed “Yagi” and “Omni”, respectively. Directional Yagi antenna will generally be able to receive a signal from further away than a multi-directional Omni antenna with the same gain value.

If you determine that you need a large boost to your signal strength, you’ll be looking at higher gain setup, which may require the directional Yagi.

Often, when you see the term “high-gain antenna”, it’s referring to a directional Yagi antenna – because they’re focused on receiving signal from one direction.

However there are also high-gain Omni antennae that receives signal from all directions. An antenna’s gain depends not only on its ability to receive radiowaves, but also on how efficient it is at converting them into electrical signals.

Gain – A Recap

In summary: the gain of an amplifier represents how much the amplifier can enhance the strength of the signal. The greater the gain of the amplifier, the weaker the signal you can receive and still turn it into an acceptably strong one.

Likewise, the gain of an antenna represents how well the antenna converts radio waves into electrical signal or vice versa, depending on whether it’s receiving or transmitting.

High-gain devices are generally higher end products, specifically designed and optimized to boost signal strength by large amounts.

If you’re looking at purchasing a signal boosting system, it’s worth doing a site survey to determine the combination of antenna and amplifier that would boost your signal to an acceptable level in the place where you need it.