Antenna RF Diplexer Tutorial

- the antenna diplexer or RF diplexer splitter / combiner used for combining and splitting RF feeders so they can be used by multiple transmitters or receivers and possibly on different frequencies.

An antenna diplexer or RF diplexer is a unit that in one application can be used to enable more than one transmitter to operate on a single RF antenna.

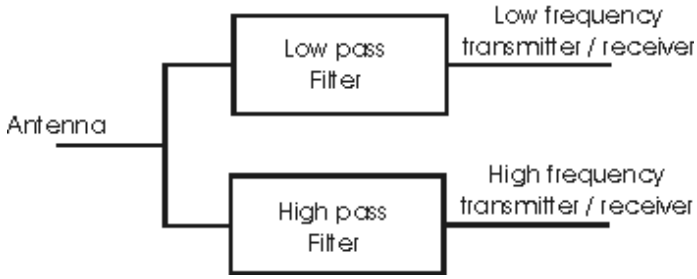
Sometimes these units may be called antenna duplexers. Typically an antenna diplexer would enable transmitters operating of different frequencies to use the same antenna. In another application, an antenna diplexer may be used to allow a single antenna to be used for transmissions on one band of frequencies and reception on another band.

Antenna diplexers find many uses. In one common example an antenna diplexer or RF diplexer is used in a cellular base station to allow it to transmit and receive simultaneously. The antenna diplexer enables the same antenna system to be used while preventing the transmitted signal from reaching the receiver and blocking the input. In another application a diplexer may be used by a broadcast station transmitting on several different frequencies at the same time using the same antenna. The use of the diplexer enables a single antenna to be used, while preventing the output from one transmitter being fed back into the output of the other.

Small antenna diplexers may be used in domestic environments to allow several signals to run along a single feeder. In one application this may allow a single feeder to be used for television and VHF FM radio reception, or to allow terrestrial television signals and this from a satellite low noise box (LNB) to pass down the same lead. These RF diplexers are normally relatively low cost as the specifications are not nearly as exacting as those used for professional RF diplexer installations.

Basic antenna diplexer concepts

There are a number of ways of implementing RF diplexers. They all involve the use of filters. In this way the paths for the different transmitters and receivers can be separated according to the frequency they use. The simplest way to implement a diplexer is to use a low pass and a high pass filter although band-pass filters may be used. In this way the diplexer routes all signals at frequencies below the cut-off frequency of the low pass filter to one port, and all signals above the cut-off frequency of the high pass filter to the other port. Also here is no path from between the two remote connections of the filters. All signals that can pass through the low pass filter in the diplexer will not be able to pass through the high pass filter and vice versa.



Basic concept of a high / low pass filter diplexer

A further feature of an RF diplexer is than it enables the impedance seen by the receiver or transmitter to remain constant despite the load connected to the other port. If the filters were not present and the three ports wired in parallel, neither the antenna nor the two transmitter / receiver ports would see the correct impedance.

RF diplexer filter requirements

When designing an antenna diplexer a number of parameters must be considered. One is the degree of isolation required between the ports labelled for the high and low frequency transmitter / receiver. If the diplexer is to be used purely for receiving, then the requirement for high levels of isolation is not so high. Even comparatively simple filters give enough isolation to ensure each receiver sees the right impedance and the signals are routed to the correct input without any noticeable loss. Even levels of isolation of 10 dB would be adequate for many installations. For diplexers that are used to split and combine television and VHF FM radio along a single line, te levels of isolation are likely to be very low.

The next case is when the diplexer is to be used for transmitting only. It will be necessary to ensure that the levels of power being transferred back into a second transmitter are small. Power being fed into the output of a transmitter in this way could give rise to intermodulation products that may be radiated and cause interference. It is also important to ensure that the transmitters see the correct impedance, and that the presence of the second transmitter does not affect the impedance seen by the first. Typically levels of isolation between the transmitter ports of 60 - 90 dB may be required.

The final case is where one of the ports is used for transmitting, and the other for receiving simultaneously. In this instance very high levels of isolation are required to ensure that the minimum level of the transmitter power reaches the receiver. If high levels of the transmitter signal reach the receiver, then it will be desensitised preventing proper reception of the required signals. Levels of isolation in excess of 100 dB are normally required for these applications.

Band pass filters

Under some circumstances band pass filters may be used. These may be used where comparatively narrow bandwidth is required for either or both of the transmitter / receiver ports. Sometimes a very high Q resonant circuit may be used. By using this approach high degrees of rejection can be achieved. Often repeater stations which receive on one channel and transmit on another simultaneously use diplexers that utilise this approach.

Summary

Although antenna diplexers are mainly used in specialised applications, allowing a single Rf antenna to be used by more than one transmitter or receiver, they are nevertheless a crucial element of many installations. For example cellular technology would be significantly different if they could not be used and the cellular RF antennas for base stations would be considerably more complicated. Similarly antenna diplexers are used in many broadcast applications allowing a single large RF antenna to be used by more than one transmitter.

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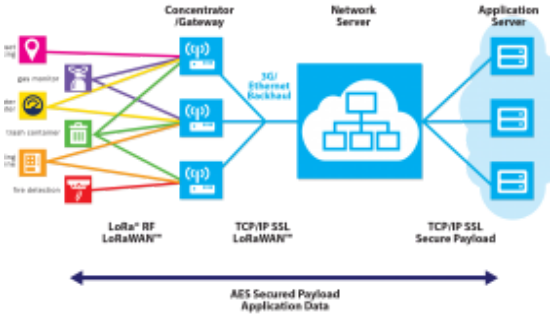

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