General Description:

Many applications require power to be routed in multiple paths. The simplest way this can be done is by using a reactive power divider/combiner. Power dividers are reciprocal devices. They can also be used to combine power from output ports into the input port. Below is an explanation of reactive power divider/combiners.

Reactive power divider/combiners come in many forms and serve a broad range of frequency bands. They can have multiple output ports, but those with odd number of output ports are usually referred to as N way power dividers. They can be designed using waveguide, stripline, microstrip, and other technologies. One of the advantages of using reactive power divider/combiners is they are “lossless”. Table 1 gives the number of output ports and the loss that is associated with them. A explanation is given on the Wilkinson type in detail. Some parameters and considerations when incorporating these devices into a design, are explained. Figure 1 shows the general layout of a 2-Way divider. Higher order devices like (4, 6, 8 way etc.) are usually designed by cascading the 2 way in various configurations.

Wilkinson Power Divider/Combiner

At frequencies (above 500 Mhz) these devices are usually designed as a microstrip or stripline Wilkinson design. All $P_3$ power divider/combiners are Wilkinson types. Figure 1 shows a 2-Way Wilkinson power divider. Being a lossless reciprocal three port network, its properties state that this type of divider/combiner circuit cannot have all the ports simultaneously matched. To solve this an isolation resistor is placed between the two output ports (or input ports), since no RF flows through the resistor, the isolation resistor does not contribute to any loss. This makes an ideal Wilkinson 100% efficient. The resistor also provides isolation even when the device is used as a combiner. Other properties of the Wilkinson divider/combiner is that it is constructed using quarter wavelength sections. This device is useful for limited bandwidth applications, to obtain wider bandwidths the use of multi-section Wilkinson designs are used which is shown in Figure 2. The wider the bandwidth more sections may be added to the design. By using this design approach it will increase the size of the device and more importantly it will become increasingly lossy as more sections are added. These combiner/dividers may be designed for octave and decade bandwidths (or more) and are sometimes cascaded to form a higher number of ports. Shown in Figure 3 is a multi-octave, multi-section cascaded design to achieve a 8-way divider/combiner.