Directional Couplers

Directional couplers are devices used to measure power transfer through a transmission line such as coax cable. There are various types of couplers and following are descriptions of some:

Directional Coupler: A coupler that has directivity, such that its single measurement port will have a signal proportional to the power flowing in one direction. Most likely this will be used to measure forward power from an amplifier.

Bi-directional Coupler: Less expensive than a dual-directional coupler, the measurement accuracy depends on each port being terminated into 50 ohms. Both forward and reverse power can be measured.

Dual-Directional coupler: Essentially this is a pair of directional couplers in one unit, with one measurement port showing the power flow in the forward direction (incident power) and the other measurement port showing the power flow in the reverse direction (reflected power). This type of coupler is used to determine the efficiency of the transmission line (feedline) as well as the load, which is most often an antenna.

Couplers are rated in terms of power, frequency range, directivity, and coupling factor. The coupling factor is the ratio of the input power to the power at the coupled port, expressed in dB. When making a power measurement, this coupling factor must be added to the value measured at the coupled port. Generally, couplers will have a coupling factor between 20 and 60dB.

When using a coupler with a power meter, it is very important to match the coupling factor of the coupler to the dynamic range of the power sensor. Power sensors are more accurate and can settle quicker if used towards the top of their dynamic range. If a coupler has a 30 dB coupling factor and the maximum signal the power sensor can measure is +20dB, then a maximum power level of +50 dBm (or 100 watts) can be measured. Keep in mind, though, that the coupler has its own power rating that must not be exceeded.

On the other hand, if a coupler has a coupling factor of 50 dB, then the lowest level that can be measured is 50 minus the low end of the power sensor. As was mentioned before, the lower end of the power meter's dynamic range will take longer to measure due to settling time.