App-Note: 005 - Power Indication & relative accuracy in Amplifier's

The purpose & scope of this document is to explain amplifier power indication (metering) and typical variations associated with frequency sensitivity and bandwidth. Exodus amplifiers with our display/controller provide many monitoring & control functions. Customers do appreciate having an idea of what nominal power the amplifier is producing when testing and our display does provide this benefit for both Forward & Reflected power. This feature does not replace an external absolute power measurement (See Exodus App-Note 004). The amplifier display is a reference, an indication of the amplifier power being produced.

Regarding the power indication (accuracy over the band) we will first summarize why there are power indication variations (differences) from the absolute power if measured externally with a calibrated test setup.

Power Indication Circuit Summary:

First, to provide both Forward & Reflected power indication it is necessary to install in the RF output line of an amplifier a dual-directional coupler with an appropriate frequency range, coupling value, and power rating suitable with respect to the amplifier specifications.

Couplers have what is called frequency sensitivity-

The frequency sensitivity or "coupler flatness" is a measurement of how the coupling value varies over the coupler's specific frequency range. Optimizing a coupler design is achieved by centering the design within the specific frequency band of interest. Typical coupling flatness for a coupler operating over an octave band is normally +/-0.75dB. Stronger coupling factors (3, 6 & 10dB) provide greater flatness than weaker coupling factors (40 & 50dB). Also, when operating over frequency bands greater than an octave, the flatness tolerance is relaxed further due to the inherent characteristics of coupler deviation and roll-off in double-octave & extended range couplers.

Further contributing factors to power indication variations would be any additional RF line connections such as cables, filters, switches etc. These all contribute insertion loss and insertion loss varies over the operating frequency bandwidth. Some additional contributing factors would be VSWR and an additional coupler (secondary coupler) off the main-line high power coupled port for providing an RF sample as well as the signal power for the detector indication function.

In very wideband amplifiers the typical cumulative coupling flatness can be +/-1dB with the extended band coupler, secondary coupler and related cables and connectors in the power indication circuit.

See Illustration 1- page, 2

As in all designs, optimal product selection minimizing these factors is considered to provide a very reasonable reporting power indication feature as an application reference.

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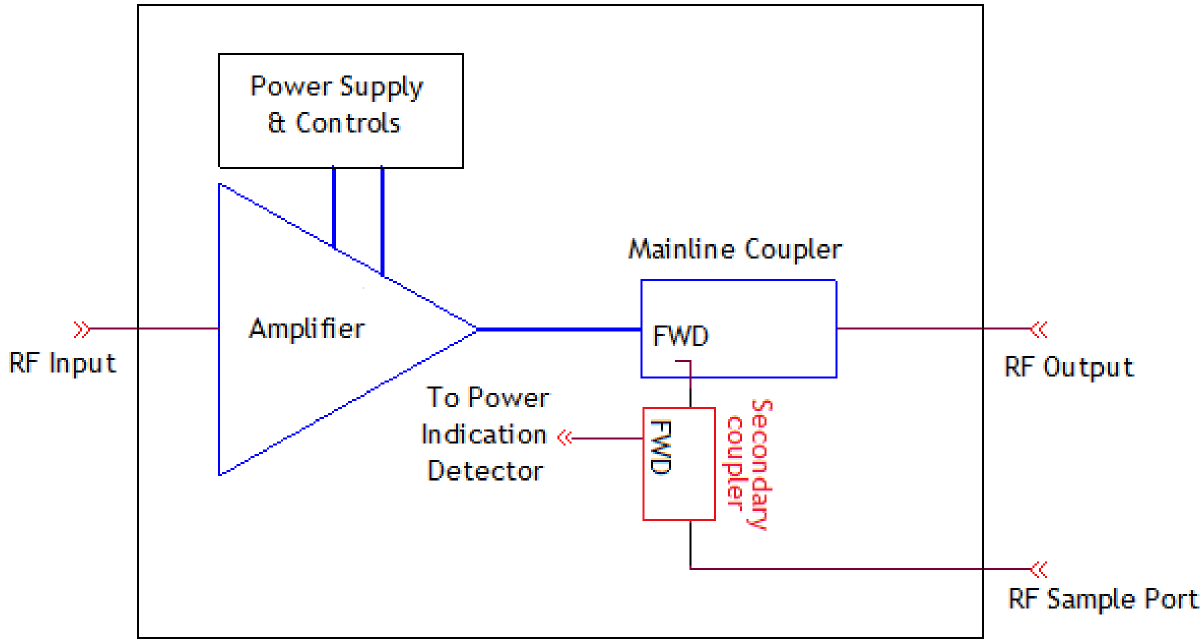
Illustration-1 with directional coupler



Conclusion overview-

Power indication circuits are an excellent feature as a reference point showing the amplifier nominal power. The accuracy over frequency improves as the bandwidth of the amplifier is reduced. Simply stated the coupler and circuit tolerance (difference over bandwidth) improves. If a 2.0-8.0GHz coupler is used for 4.0-5.0GHz the power indication accuracy is improved. In some cases, a (maximally flat) coupler may be available but this is not common. As mentioned before, optimal product selection is considered thereby minimizing coupling deviation to provide a very reasonable reporting power indication feature.

To provide further power indication accuracy a calibration routing is implemented. A transfer curve with correction factors is implemented to normalize the detection circuit deviations and optimize/linearize the power indication on the front panel. The calibration table improves the power indication for the customer application as added value with respect to the application and use of the product.