Alternate Method for Performance Measurement of Antenna Balun

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It is of interest to know whether or not a balun design provides an intended amount of balance over some required frequency range. Several methods are presently in wide use. One method for determining balance is to integrate the balun with the desired antenna system and acquire a pattern for the antenna. This assumes that a balanced antenna pattern is known *a priori*. A comparison between the acquired pattern, incorporating the balun, with that of the expected pattern is then made. Many times, for various reasons, it is desirable to characterize the balun directly without integration into a system. The second method accomplishes this goal by considering the balun as a two or three-port device and taking measurements using a vector network analyzer. An example of a three-port balun would be a 180° hybrid. The input port accepts the unbalanced signal and produces two output signals that have the same magnitude but phases differing by 180°. In this case, the output currents are balanced in comparison to one another. This type of balun can be measured in a straightforward manner as a three-port device. The amount of balance can be determined by looking at the magnitudes and phases of S_{21} and S_{31}. For balance we expect $|S_{21}| = |S_{31}|$ and $|\theta_{31} - \theta_{21}| = 180°$. Impedance issues are also easily considered.

In contrast, a two-port balun accepts an unbalanced signal at the input port and produces a single balanced signal at the output port. This poses a problem in terms of output port measurement because most measurement instruments are connected to the device under test using a length of coaxial cable, which is inherently unbalanced. To overcome this issue a standard practice has been to directly connect two of the baluns to be measured such that the balanced output port of one feeds into the balanced port of the other, leaving the unbalanced port on the output side to connect to the unbalanced line from the measurement device. This arrangement is known as a back-to-back measurement.

This work will investigate the details of a standard back-to-back measurement for extraction of critical balance information. A method is proposed for increasing the amount of information acquired to help determine a more accurate measure of balance, across some specified bandwidth. This method, called direct-invert, requires two back-to-back measurements such that the orientations with respect to the balanced port terminals are switched between the two measurements. The back-to-back methodology will be compared to the three-port measurement approach.