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Balanced and Unbalanced Mode Analysis in a Practical Balanced Dipole Antenna Using Mixed-mode S-parameter

Nozomu Ishii and Junki Hayakawa
Graduate School of Science and Technology, Niigata University, Japan

Abstract

The balanced antennas are often used in the radio communication devices. The unbalanced current on the antennas or devices is undesired and needed to be eliminated. Therefore, the input impedance/admittance for the balanced/unbalanced modes and the mode coupling should be accurately measured. The input impedance of the balanced antennas can be estimated by using not only 180 degree hybrid coupler/balun but also S-parameter method, where S parameters are measured between two ports attached to the symmetrical antennas. In this paper, first, S-parameter method can be derived by using the theory of the mixed-mode S parameter, where the normal S parameters are transformed into redefined S parameters for the balanced and unbalanced modes. Since the effect of the unbalanced mode in the practical balanced antennas, the input admittance for the unbalanced mode and CMRR (common-mode rejection ratio) can be also derived using the theory of the mixed-mode S parameter. By evaluating CRMM at the resonance of the balanced dipole antenna, we can find that the amount of the reflection for the balanced mode is reduced, CMRR is minimized, and the relatively large excitation for the unbalanced mode can be observed. Second, the validity of our derivation can be proven by some experiments using the 180 degree hybrid coupler. To correct the imperfect 180 degree hybrid coupler, we measure its S parameters and evaluate the input impedance or admittance for the balanced or unbalanced modes of the balanced antennas using the S parameters. In this paper, three ways of measuring the input impedance/admittance for the balanced/unbalanced mode of the balanced antennas are examined. To reduce the measurement time, one port reflection measurement with the other port matched or normal way of the balanced mode excitation using the 180 degree hybrid coupler is examined.