ADMITTANCE AND EFFECTIVE HEIGHT OF BURIED ANTENNAS*

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Abstract

Explicit expressions are presented for the input admittance and effective height of several buried metal antennas, namely: (i) prolate spheroidal; (ii) spherical; (iii) oblate spheroidal; (iv) parallel plate; (v) parallel plate with protruding dielectric in the same plane of the plates; (vi) parallel plate with protruding dielectric in a plane normal to that of the plates (H-shaped antenna).

Expressions are given to several degrees of approximations: 1. The environment is assumed to be homogeneous and infinite and computations are carried out in the zero-frequency limit for cases (i) through (vi). 2. The frequency limitation is partly removed, the antennas being assumed small with respect to the field wavelength in the environment. Computations are carried out for cases (i) through (iii), thus clarifying the limits of approximation 1. 3. The frequency limitation is totally removed for case (ii), thus clarifying the limit of approximation 2.

It is concluded that in all practical situations of "small" antennas approximation 1 is almost always appropriate. Computations were carried out for bare antennas, the extension to insulated ones being, however, straightforward.

Although a rigorous theory of the antenna performance in a realistic semi-infinite conductive medium has not been developed, the results quoted should also be applicable when antennas are a few skin depths below the earth's surface. In particular, for the evaluation of radio-links under up-over-and-down operating conditions, the antennas can be replaced by dipoles of length equal to the effective height.

Since the antenna's parameters are given in analytical form, it is also possible, by using Laplace transform techniques, to compute the transient response of the antenna. The transient is described by pole (short-time behavior) and branch-cut contributions (large time behavior). For these last terms, an asymptotic evaluation is possible,

so obtaining closed form expressions for the response at large observation times, which is closely related to the dispersion characteristic of the environment.