CONNECTION OF A COAXIAL TRANSMISSION LINE TO A PARTIALLY FILLED RECTANGULAR WAVEGUIDE

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Coaxial—waveguide junctions are used widely in microwave receiving and transmitting channels of communication equipment. Designing of microwave channels on rectangular waveguides partially filled with a dielectric has a number of advantages, the main ones of which are the possibility of increasing the dielectric strength and reducing the dimensions. Such junctions occurs also in that case. The connection of a coaxial transmission line to a partially filled rectangular waveguide (PFRW) is called a CPFRW junction. The purpose of the work was to investigate the input impedance of such a junction, when only dominant types of waves propagate in both transmission lines.

We will examine a PFRW with a dielectric of rectangular cross section not contacting the waveguide walls. Figure 1 shows the equivalent circuit of the CPFRW junction, which we will examine from the side of the coaxial transmission line. The junction in the general case can be asymmetric. The equivalent circuit of the CPFRW junction contains an ideal transformer with a ratio of transformation n_0 and reactance jX_1, which takes into account the reaction of local fields occurring at the joint between the PFRW with wave impedance Z_w and coaxial transmission line with wave impedance Z_t.

The quantities introduced have the following expressions $Z_w = 120\,\pi k_0/\gamma_{10}$, where k_0 is the free-space wave number; γ_{10} is the propagation constant of the dominant wave of the PFRW [1]; $z_t = 60\ln(R_2/R_1)$, where R_2, R_1 are the outside and inside radii of the coaxial transmission line, respectively;

$$n_0 = \int_S \mathrm{E}_{h_{10}} \mathrm{E}_t \, dS, \quad \mathrm{E}_t = (1/\sqrt{2\pi \ln R_2/R_1})(\bar{r}^{\,0}/r),$$

$$\begin{aligned} \mathrm{E}_{h_{10}} = {} & \sqrt{128/ab(64+q^2+p^2+q^2p^2)}\ (1/\kappa_{10}), \\ & \{ [(\pi/a)\sin(\pi x/a) - (p\pi/2a)\sin(\pi x/a)\cos(2\pi y/b) - \\ & - (3q\pi/ba)\sin(3\pi x/a) + (3qp\pi/16a)\sin(3\pi x/a)\cos(2\pi y/b)]\bar{y}^{\,0} + \\ & + [(p\pi/b)\cos(\pi x/a)\sin(2\pi y/b) - (qp\pi/8b)\cos(3\pi x/a)\times \\ & \times \sin(2\pi y/b)]\bar{x}^{\,0} \}, \end{aligned} \tag{1}$$

where E_t is an eigenvector function of the dominant wave of the coaxial waveguide; $\mathrm{E}_{h_{10}}$ is a transverse electrical eigenvector function of the dominant wave of the PFRW represented in a two-parameter approximation; a, b are the wide and narrow walls of the PFRW; q, p are parameters of the PFRW [2]; κ_{10} is the transverse wave number of the dominant wave of the PFRW [2],

$$X_1 = (1/2)\sum_{\upsilon} n_{\upsilon}^2 Z_{\upsilon}, \quad n_{\upsilon} = \int_S \mathrm{E}_{h_{10}} \mathrm{E}_{\upsilon}\, dS,$$

where E_{υ} is transverse electrical eigenvector functions of higher types of waves of the coaxial waveguide [3]; Z_{υ} is the characteristic impedances of higher types of waves of the coaxial waveguide [3]; υ is the index of summation over nonpropagating waves.

In the particular case, if a coaxial transmission line with a thin internal conductor ($k_0R_1 < 0.25$) is present, then the expression for n_0 is as follows:

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