1837038 钱思远

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1. 解：介质填充系数 $q=\frac{1}{2}\left[1+\left(1+\frac{12d}{W}\right)^{-\frac{1}{2}}\right]=0.689$

等效介电常数 $\varepsilon_e=1+q(\varepsilon_r-1)=1+0.689(9-1)=6.633$

特性阻抗 $Z_0=\frac{120\pi}{\sqrt{\varepsilon_e}\left[\frac{W}{d}+1.393+0.667\ln\left(\frac{W}{d}+1.444\right)\right]}=34.7\Omega$

2. 解：(1) ① $(Z_0')_1=Z_0\sqrt{\varepsilon_r}=50\sqrt{9.6}=155\Omega$

由图可知，$q=0.61$

那么有等效介电常数 $\varepsilon_{e1}=1+q_1(\varepsilon_r-1)=1+0.61(9.6-1)=6.25$

② $(Z_0')_2=Z_0\sqrt{\varepsilon_{e1}}=50\sqrt{6.25}=125\Omega$

由图可知 $q_2=0.64$

那么 $\varepsilon_{e2}=1+q_2(\varepsilon_r-1)=1+0.64(9.6-1)=6.50$

误差 $\frac{|\varepsilon_{e2}-\varepsilon_{e1}|}{\varepsilon_{e2}}=\frac{6.50-6.25}{6.50}=3.8\%>1.5\%$，需继续

③ $(Z_0')_3=Z_0\sqrt{\varepsilon_{e2}}=50\sqrt{6.50}=127.5\Omega$，由图有 $q_3=0.64$

$\varepsilon_{e3}=1+q_3(\varepsilon_r-1)=1+0.64(9.6-1)=6.50$

误差 $=0<1.5\%$

④ 取 $\varepsilon_e=\varepsilon_{e3}=6.50$，得 $Z_0'=Z_0\sqrt{\varepsilon_e}=127.5\Omega$

查得 $\frac{W}{d}=0.98$，那么 $W=0.98$

(2) $\lambda_g=\frac{\lambda_0}{\sqrt{\varepsilon_e}}=\frac{3.2}{\sqrt{6.50}}=1.26cm$

由 $\frac{t}{d}=0.02$，$\frac{W}{d}=0.98$ 查图可得 $\frac{\alpha_c Z_0 d}{R_s}=4.2dB$

$R_s=2.6\times10^{-7}\sqrt{f}\Omega=2.6\times10^{-7}\sqrt{\frac{3\times10^8}{0.032}}\Omega=0.025\Omega$

$\Rightarrow \alpha_c=\frac{4.2\times0.025}{50\times0.1}=0.021dB/cm$

$\alpha_d=27.3\frac{\varepsilon_e-1}{\varepsilon_r-1}\frac{\varepsilon_r}{\varepsilon_e}\frac{\tan\delta}{\lambda_g}=27.3\frac{6.50-1}{9.6-1}\frac{9.6}{6.50}\frac{0.2\times10^{-3}}{1.26}=0.004dB/cm$

因为 $\alpha=\frac{1}{2L}\frac{P_L}{P_0}=\alpha_c+\alpha_d$，可求得传输 2cm 后的平均耗力 $\frac{P_L}{P_0}=2L(\alpha_c+\alpha_d)=0.1=10\%$