SKYWORKS®

APPLICATION NOTE

No. 1009: Computer Simulation of Coaxial Resonators*

Skyworks' coaxial resonators are a ceramic filled transmission line with a reflecting termination. Some electronic simulation programs will support round coaxial transmission line models, however, Skyworks' coaxial resonators have a square outer conductor and have been successfully modeled using the following:

If the part is a quarter wavelength and shorted on one end, use Short-Circuited Physical Transmission Line (TLPSC) with the following parameters:

$$Z = \text{characteristic impedance} = Z_0 = \frac{60}{\sqrt{\varepsilon_R}} \ln\left(1.079\ \frac{W}{d}\right)$$

Characteristic Impedance vs. Profile and Material

Profile	1000	2000	8800	9000	Tab Inductors
HP	25.3 Ω	18.1 Ω	13.1 Ω	8.6 Ω	1.8 nH
EP	22.5 Ω	16.1 Ω	11.7 Ω	7.7 Ω	1.0 nH
SP	18.3 Ω	13.1 Ω	9.5 Ω	6.3 Ω	1.0 nH
LS	18.4 Ω	13.1 Ω	9.5 Ω	6.3 Ω	0.9 nH
LP	27.4 Ω	19.6 Ω	14.2 Ω	9.4 Ω	1.0 nH
SP	25.7 Ω	18.4 Ω	13.3 Ω	8.8 Ω	0.6 nH
SM	18.4 Ω	13.1 Ω	9.5 Ω	6.3 Ω	0.6 nH

$$L = \text{length} = \frac{\lambda_G}{4} = \frac{C}{4 f_0 \sqrt{\varepsilon_R}}$$

$K = \varepsilon_R$ = dielectric constant
(8800 = 38.6 ± 1.5), (9000 = 88.5 ± 3.0)
(1000 = 10.5 ± 0.5), (2000 = 20.6 ± 1.0)

$$A = \text{attenuation} = \alpha\ \frac{\beta}{2Q} = \frac{2\pi\lambda_G}{2Q} = \frac{8.68\pi\sqrt{\varepsilon_R} f_0}{cQ}$$

Simulation Example

To model Skyworks' SR8800KLPQ1200BY,

$Z = 14\ \Omega$

$$L = \frac{11803}{4\ 1200\ \sqrt{38.6}} = 0.396 \text{ inches}$$

$K = 38.6$

$$A = \frac{8.68\sqrt{\varepsilon_R f_0}}{cQ} = \frac{8.68\pi\sqrt{38.6}\ 1200}{11803\ \ 407}$$

Q specification = 354, Q typical = 407

Therefore the circuit file would read:

TLPSC n1 n2 Z = 14 L = 0.396 K = 38.6 A = 0.04 F = 1200

*These products are produced by Trans-Tech (a wholly-owned subsidiary of Skyworks Solutions, Inc.)

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