Values for Discrete Component Coupler

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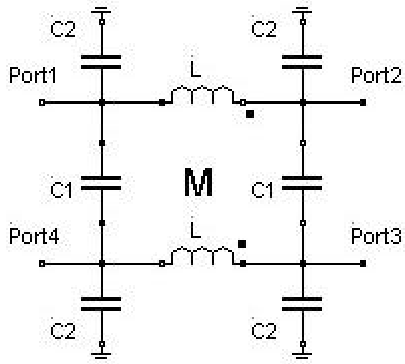
This page calculates the component vales for a 90 degree discrete component directional coupler. The circuit is shown below. The equations are from "Improved Planar Spiral Transformer Theory..." IEEE MTT, April 1997, p543 and from hand notes from Ole Kiel Jensen at Aalborg University.



$\text{Freq} := 2\cdot 10^{9}\,\text{Hz}$

$c := -10, -12 .. -20$ Coupling in dB from port 2 to 3.

$\text{Zo} := 50\,\text{ohm}$

$\text{nH} := 1\cdot 10^{-9}\,\text{H}$

$$\text{Zoe}(c) := \text{Zo}\cdot\left[\left[\frac{\left(1+10^{\frac{c}{20}}\right)}{\left(1-10^{\frac{c}{20}}\right)}\right]\right]^{0.5} \qquad \text{Zoo}(c) := \text{Zo}\cdot\left[\left[\frac{\left(1-10^{\frac{c}{20}}\right)}{\left(1+10^{\frac{c}{20}}\right)}\right]\right]^{0.5}$$

$$\text{C1}(c) := \left(\frac{1}{\text{Zoo}(c)} - \frac{1}{\text{Zoe}(c)}\right)\cdot\frac{1}{4\cdot\mathbf{p}\cdot\text{Freq}} \qquad \text{C2}(c) := \frac{1}{\text{Zoe}(c)}\cdot\frac{1}{2\cdot\mathbf{p}\cdot\text{Freq}} \qquad L(c) := (\text{Zoo}(c)+\text{Zoe}(c))\frac{1}{4\cdot\mathbf{p}\cdot\text{Freq}}$$

$$M(c) := \frac{(\text{Zoe}(c)-\text{Zoo}(c))\cdot 1}{2\cdot\mathbf{p}\cdot\text{Freq}}$$ Mutual Inductance

$$k(c) := \frac{\text{Zoe}(c)-\text{Zoo}(c)}{\text{Zoe}(c)+\text{Zoo}(c)}$$ Inductor Coupling

c =	Zoo(c) = (ohm)	Zoe(c) = (ohm)
−10	36.038	69.371
−12	38.681	64.632
−14	40.845	61.207
−16	42.614	58.666
−18	44.056	56.746
−20	45.227	55.277

c =	C1(c) = (pF)	C2(c) = (pF)	L(c) = (nH)	k(c) =	M(c) = (nH)
−10	0.531	1.147	4.194	0.316	2.65
−12	0.413	1.231	4.111	0.251	2.07
−14	0.324	1.300	4.061	0.200	1.62
−16	0.255	1.356	4.030	0.158	1.28
−18	0.202	1.402	4.011	0.126	1.01
−20	0.160	1.440	3.999	0.100	0.80

Simulations of a 10dB coupler