1 Tapped-C transformer

1.1 Introduction

This code returns the Tapped-c matching network's elements' values:

–> Q: the required loaded Q of the resonant circuit
–> Xp: either the inductive or capacitive reactance. They are equal at resonance
–> Rp: the equivalent shut resistance of the inductor (Ω)
–> C1: Tapped-C transformer's C1 capacitor (F)
–> C2: Tapped-C transformer's C2 capacitor (F)
–> L: Tapped-C transformer's L inductance (H)
–> IL_: insertion loss of the network (dB)

For getting the above values, it requires the following inputs:
–> fc: center frequency of the wanted resonant circuit (Hz)
–> B: bandwidth of the wanted resonant circuit (Hz)
–> Rs: source resistance
–> RL: load resistance
–> Qp: the Q of the inductor

So, the function call is,

» [Q,Xp,Rp,C1,C2,L,IL_dB] = tapped_c(fc,B,Rs,Rl,Qp);

It displays the results in the command window, and it saves them a txt in the same folder it has been executed.

1.2 Example:

Here is an example of a FM band mixer's tapped c transformer:

» fc = 98e6;
» B = 20e6;
» Rs = 50:
» RL = 1.5e3;
» Qp = 75;

» [Q,Xp,Rp,C1,C2,L,IL_dB] = tapped_c(fc,B,Rs,Rl,Qp);

************************** Tapped-C resonant matching network **************************
|
| Initial data:
|
| Center frequency (fc): 98.00 MHz
| Bandwidth (B): 20.00 MHz
| Serial resistance (Rs): 50.00 Ω
| Load resistance (Rl): 1.50 kΩ
| Inductor Q at 98.00 MHz (Qp): 75
|
|
| The Tapped-C transformer's characteristic equations are the following:

|
| Rs' = Rs (1+C1/C2)exp(2) (1)
| CT = C1C2/(C1+C2) (2)
|
| Where
|
| CT is the equivalent capacitance that resonates with L|
|
| First we clear C1/C2 from (1) and we will use (2) in advance to get C1 and C2
|
| Let the system:
|
| Qp = Rp/Xp (3)
| Q = R_total /Xp (4)
|
| Resolving the proposed system,
|
| Xp: 143.06 Ω
| Rp: 10729.59 Ω
|
| Knowing that:
|
| C1 = (C1/C2) * C2 (5)
| Ct = C1||C2 (6)
|
| Then, solving the system above by replacing (5) in (6),
|
| ——————
| | L : 232.34 nH |

| | C_1: 62.18 pF |
| | C_2: 13.89 pF |
| ——————
|
| Finally, we calculate the insertion loss of the network,
|
| IL = 20log10(VL_resonant/VL_noResonant) (7)
|
| Solving (7)...
|
| IL = 20log10((ZL*Zc1*(RL + RS))/(RL*RS*ZL + RL*RS*Zc1 + RL*RS*Zc2 + RL*ZL*Zc1 + RS*ZL*Zc1 + RS*ZL*Zc2 + RL*Zc1*Zc2 + ZL*Zc1*Zc2))
|
|
| ——————-
| | IL(dB) : 8.84 |
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