R. Ludwig and G. Bogdanov
"RF Circuit Design: Theory and Applications"
2nd edition

Figures for Chapter 8

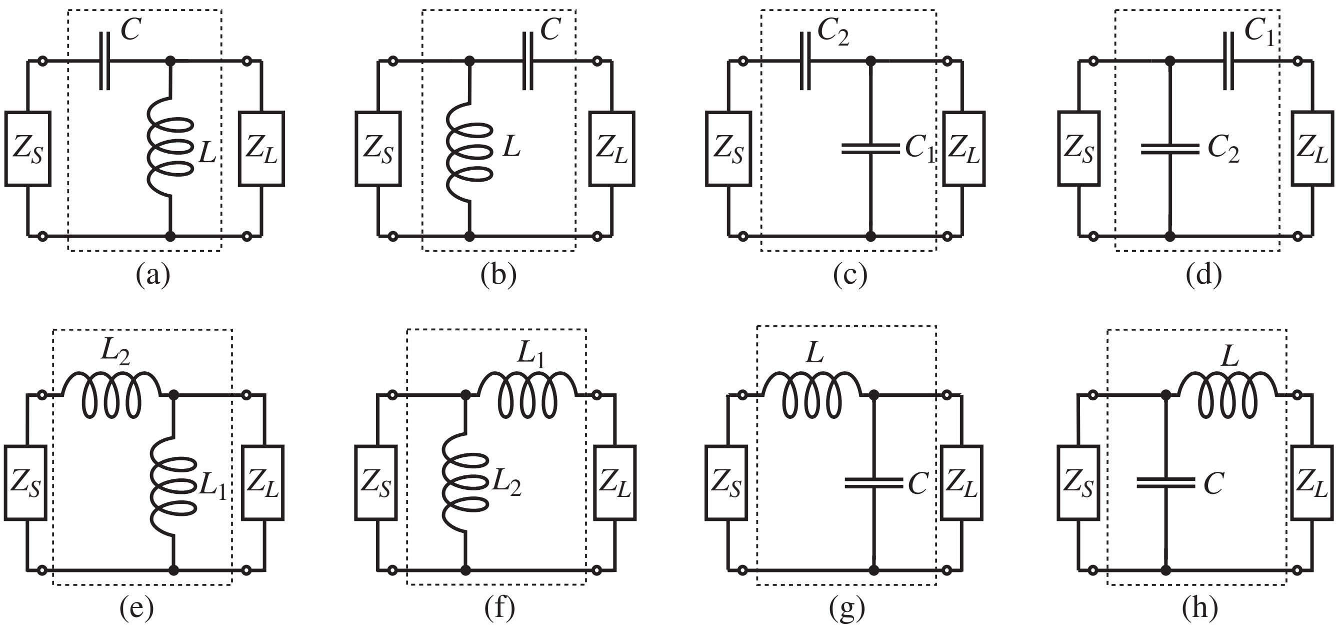


Figure 8-1 Eight possible configurations of discrete two-component matching networks.

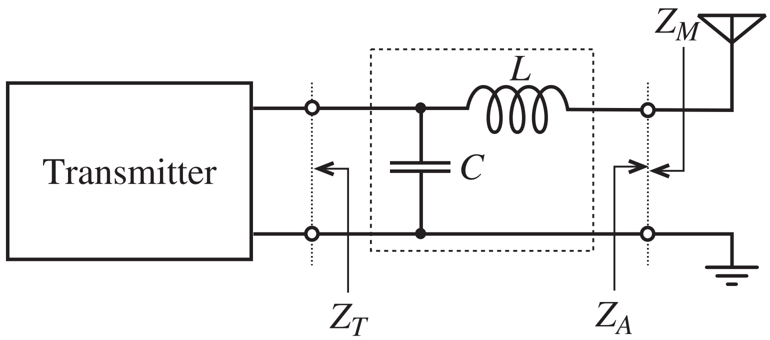


Figure 8-2 Transmitter to antenna matching circuit design.

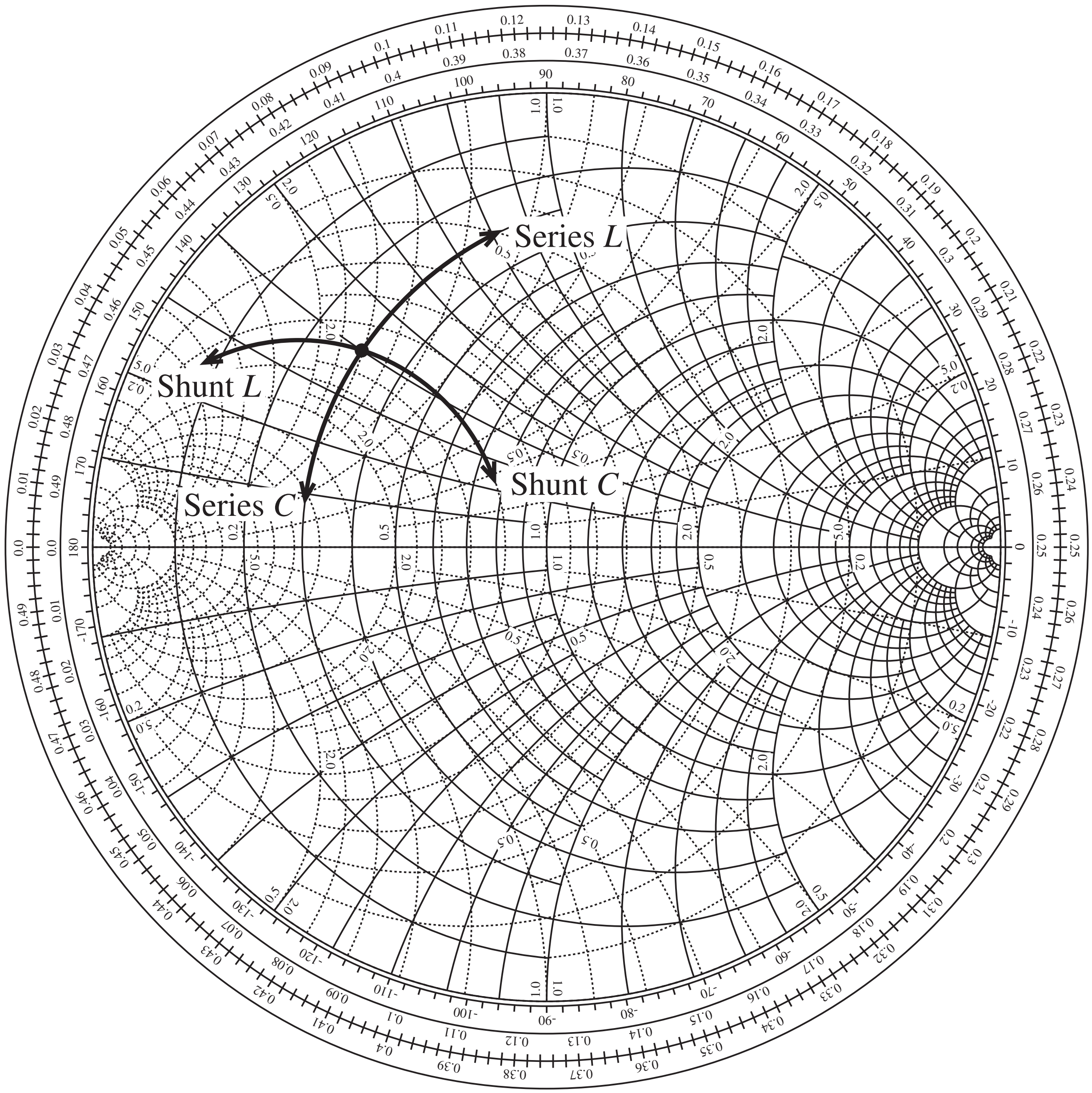


Figure 8-3 Impedance effect of series and shunt connections of *L* and *C* to a complex load in the Smith Chart.

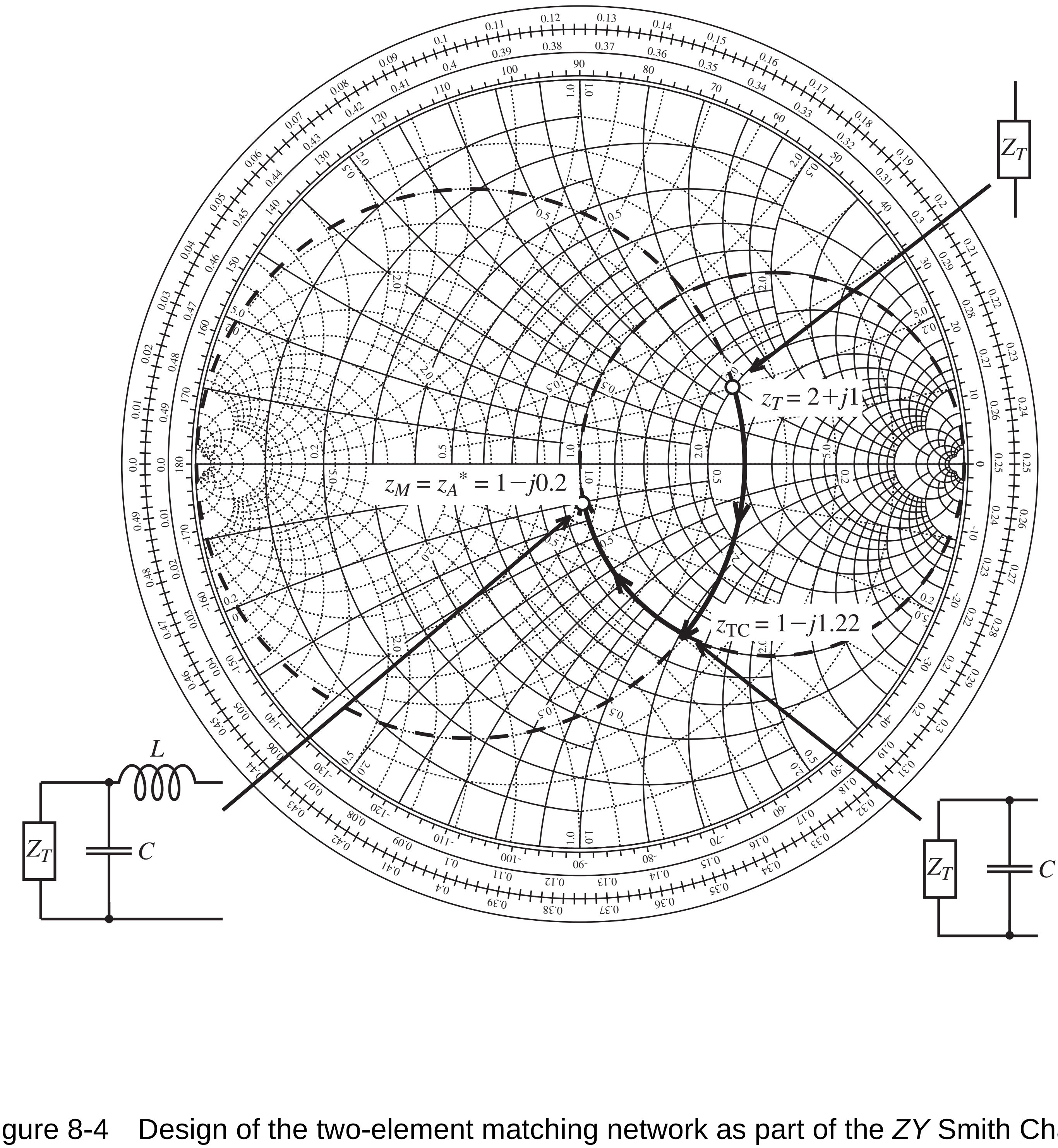


Figure 8-4 Design of the two-element matching network as part of the *ZY* Smith Chart.

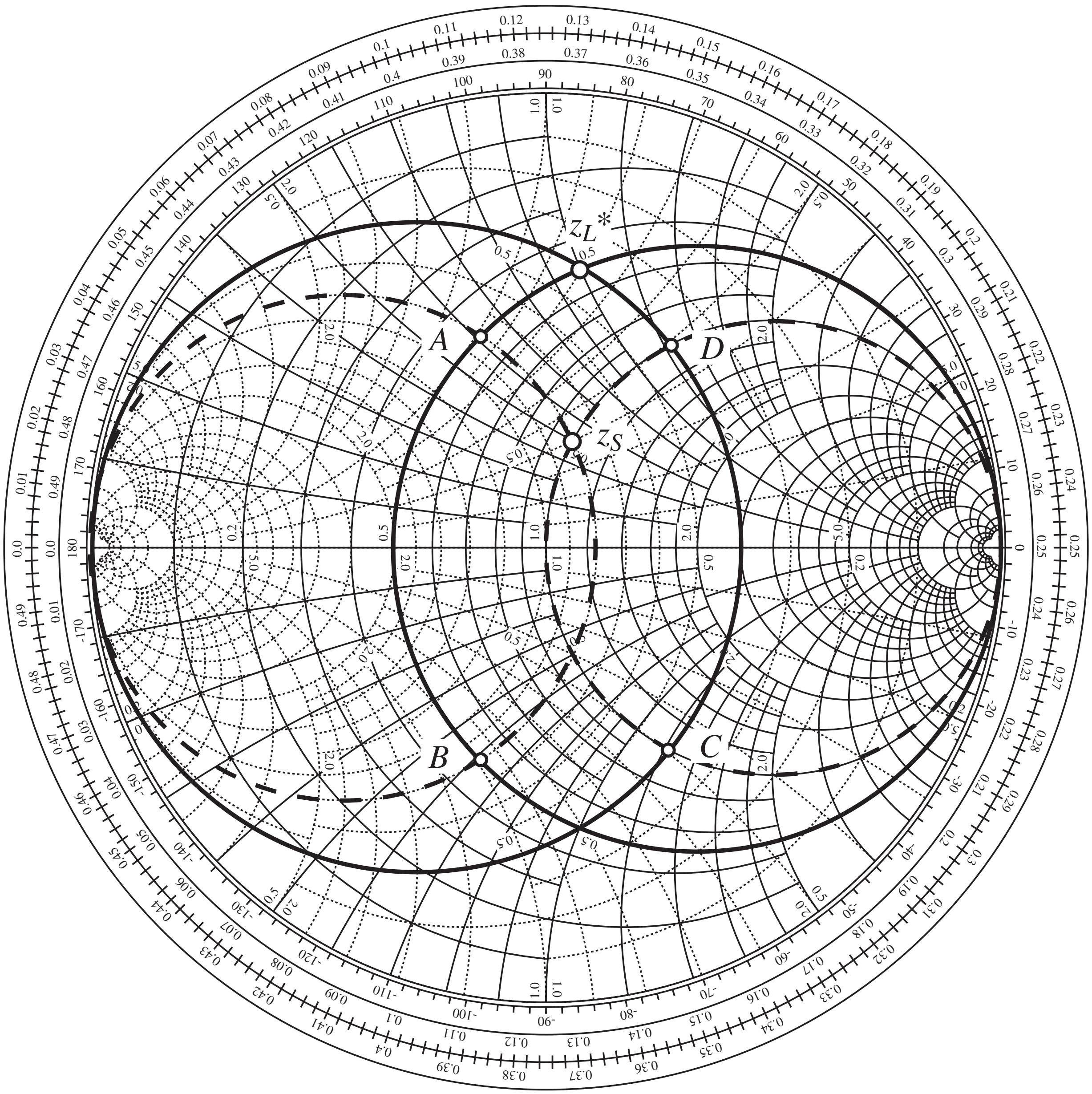


Figure 8-5   Design of a matching network using the Smith Chart

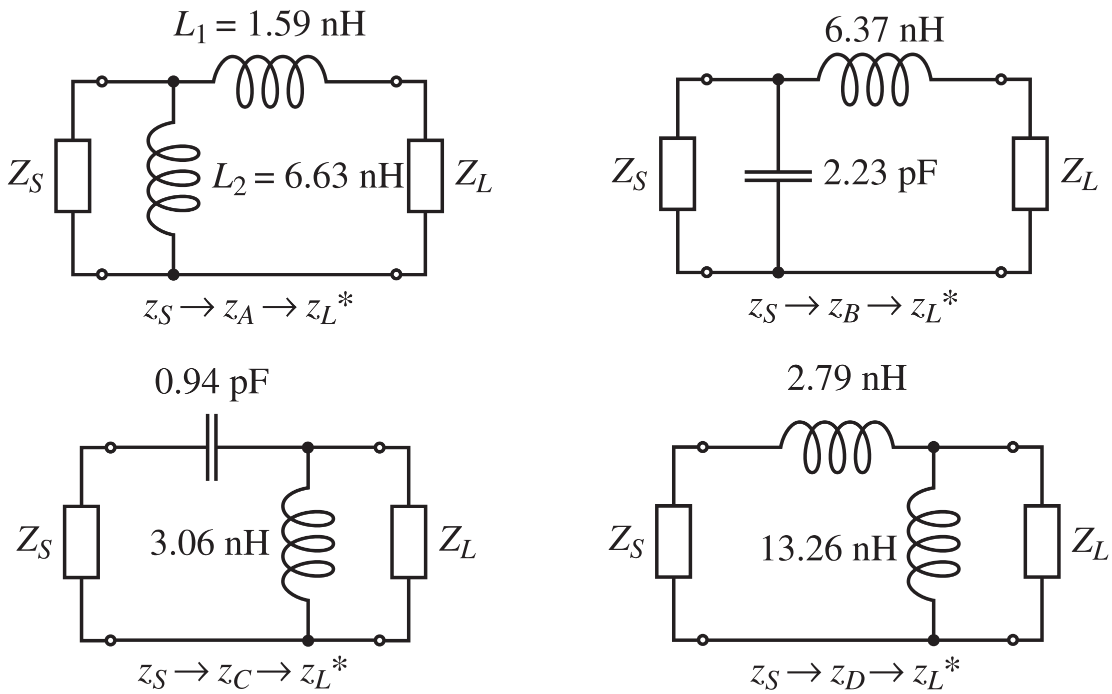


Figure 8-6 Matching networks for four different paths in the Smith Chart.

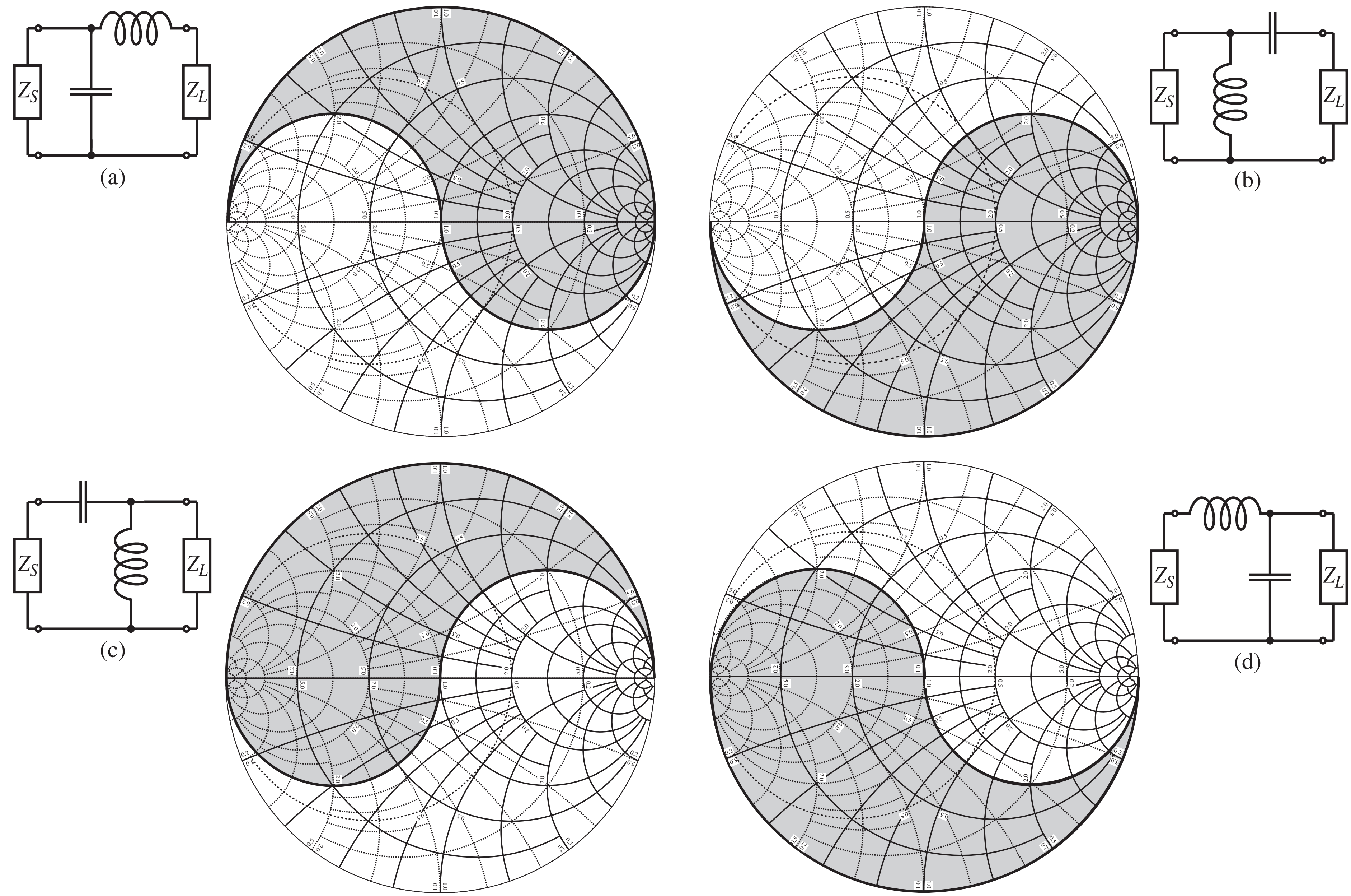
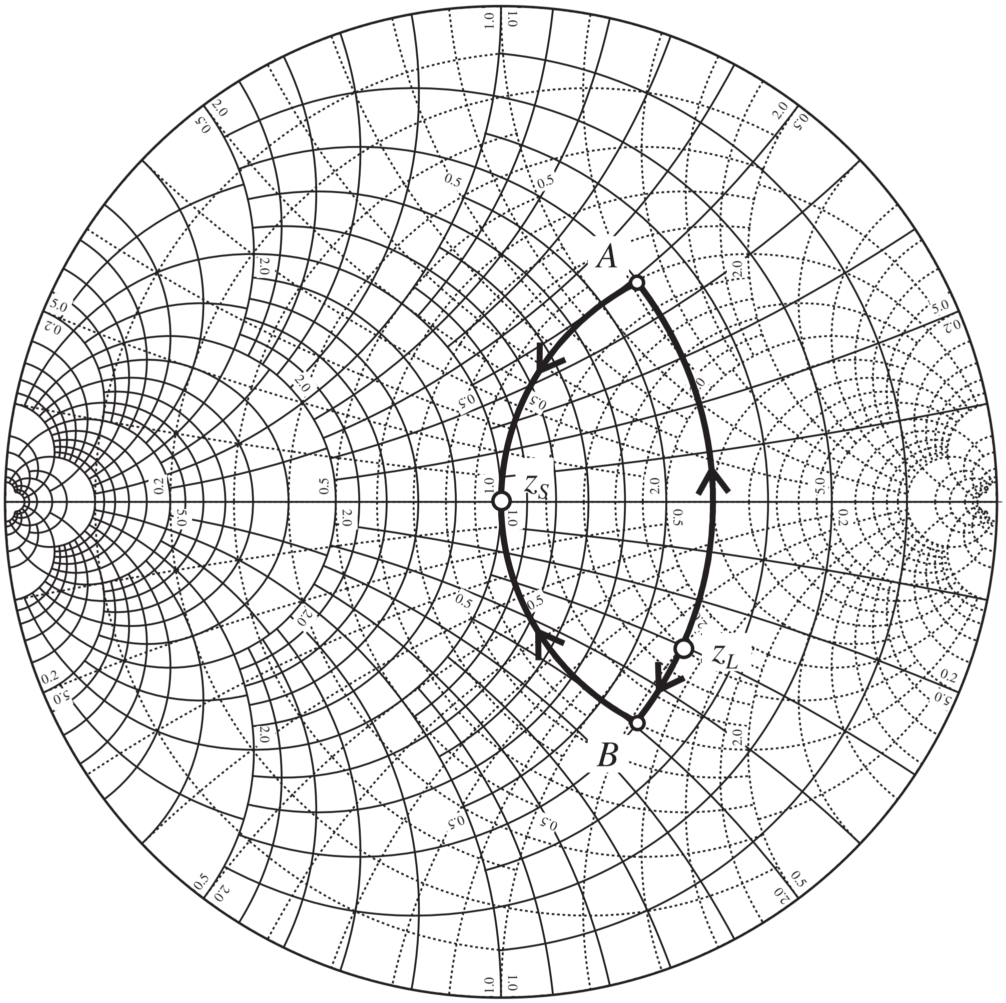
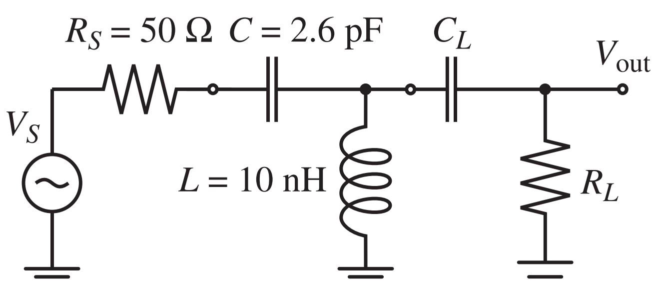


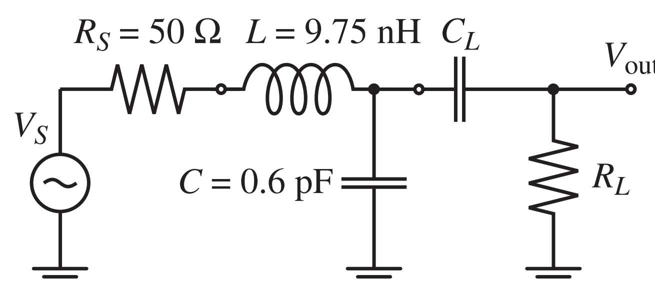
Figure 8-7   Forbidden regions for L-type matching networks with $Z_S = Z_0 = 50\ \Omega$.



(a) Impedance transformations displayed in Smith Chart

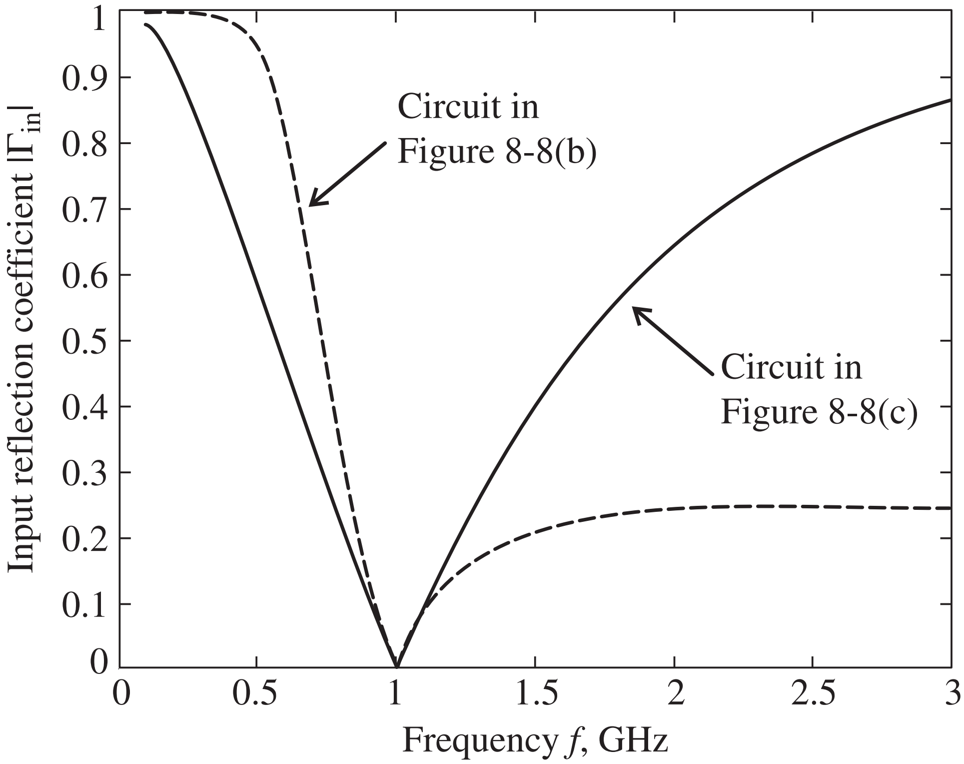


(b)

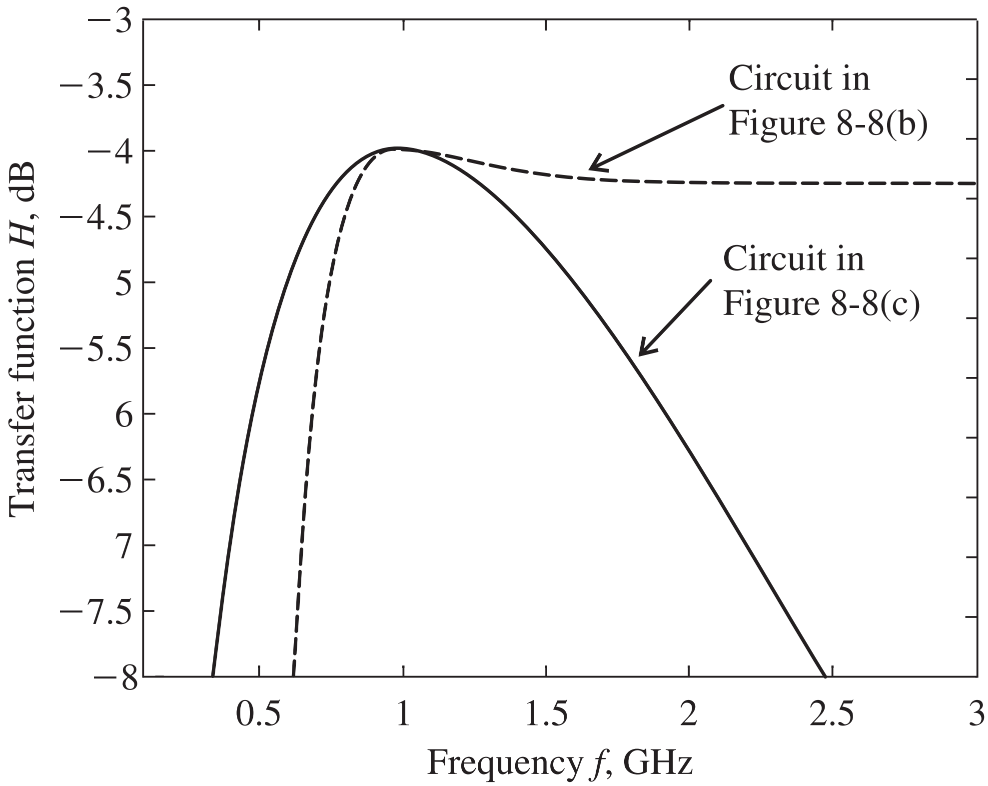


(c)

Figure 8-8 Two design realizations of an L-type matching network.

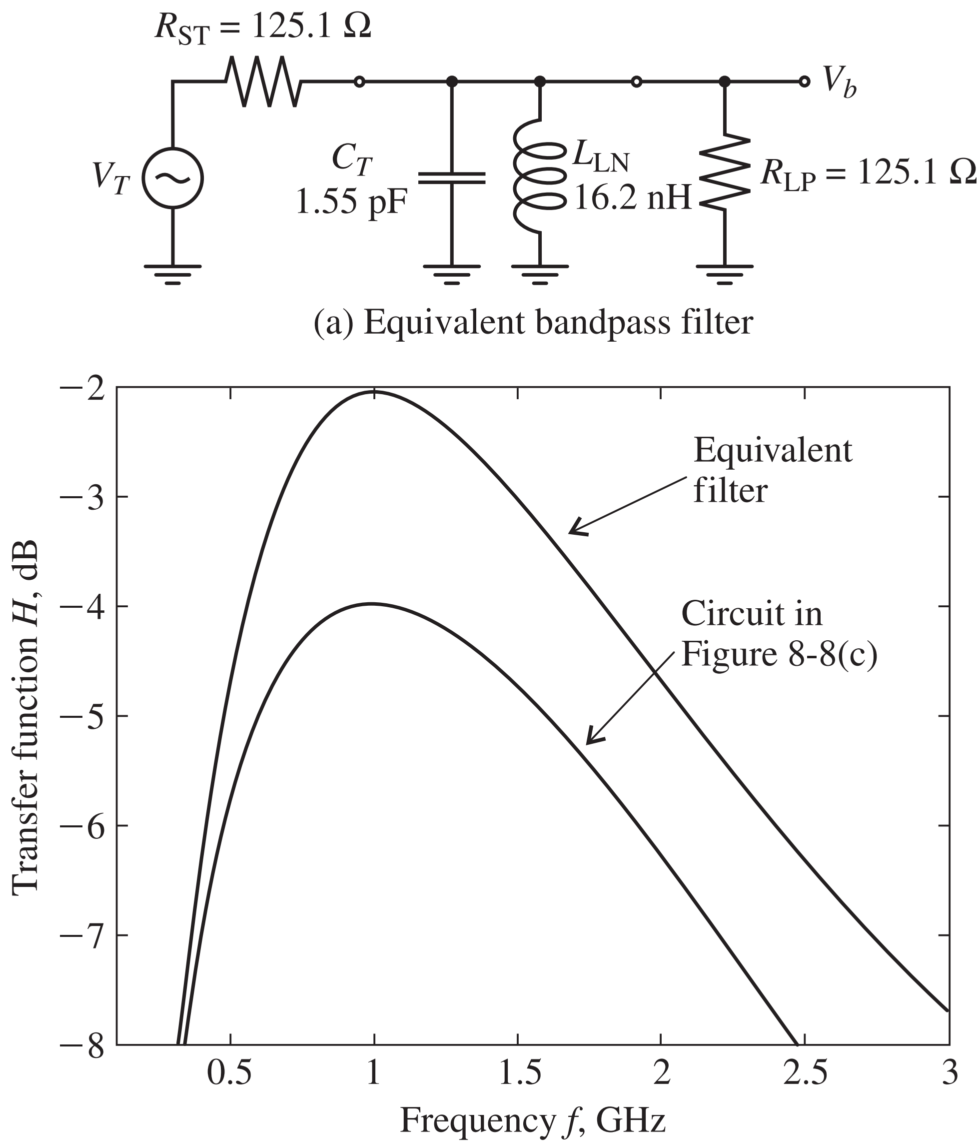


(a) Frequency response of input reflection coefficient



(b) Transfer function of the matching networks

Figure 8-9 Frequency response of the two matching network realizations.



(a) Equivalent bandpass filter

(b) Frequency response of the matching network compared to the equivalent filter response

Figure 8-10 Comparison of the frequency response of the L-type matching network and an equivalent bandpass filter.

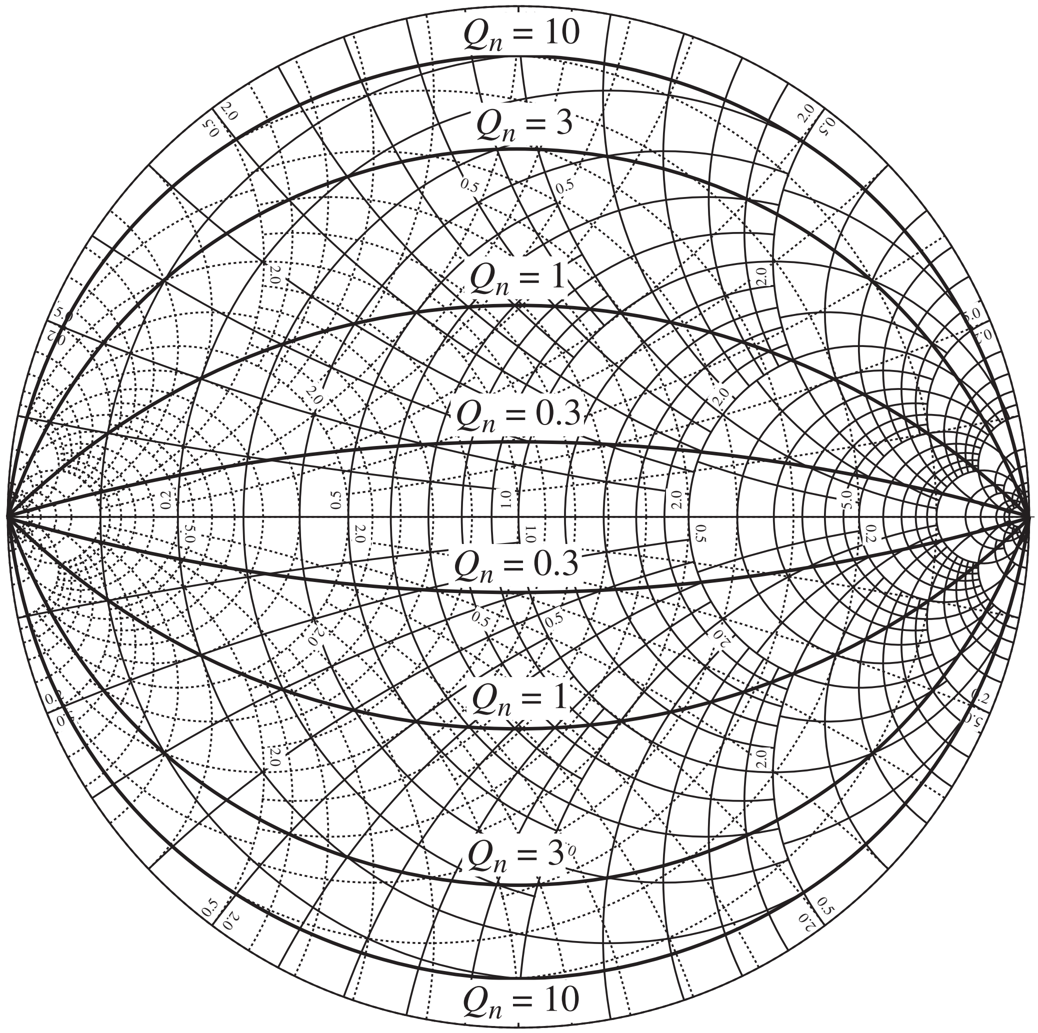
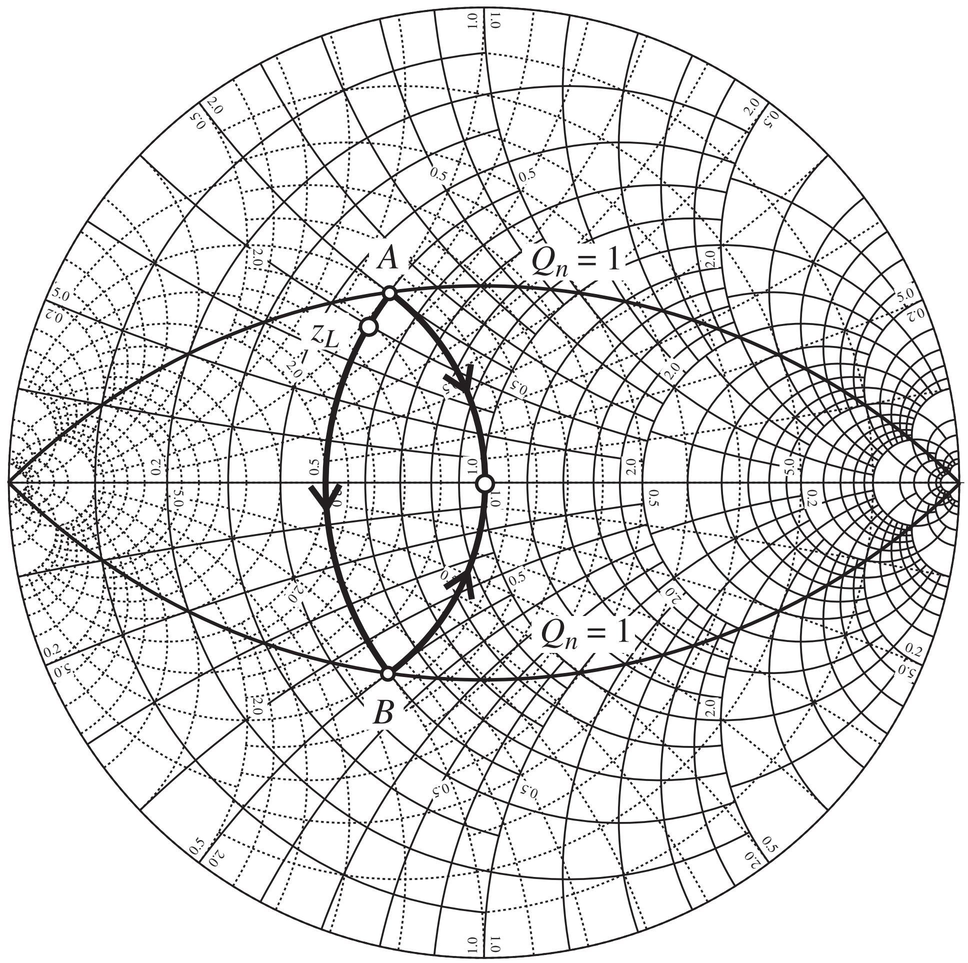
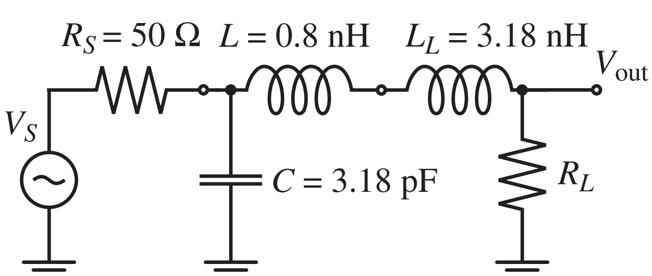


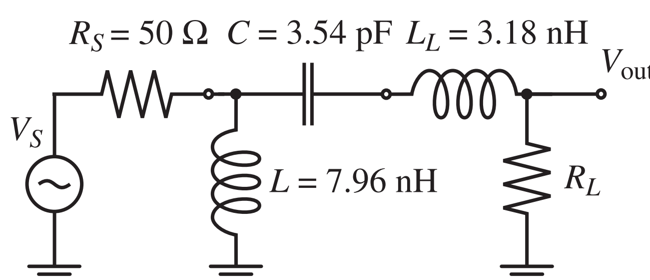
Figure 8-11 Constant Q_n contours displayed in the Smith Chart.



(a) Impedance transformation in the Smith Chart



(b)



(c)

Resulting matching networks

Figure 8-12 Two L-type matching networks for a 50 Ω source and a $Z_L = (25 + j20)\Omega$ load impedance operated at a frequency of 1 GHz.

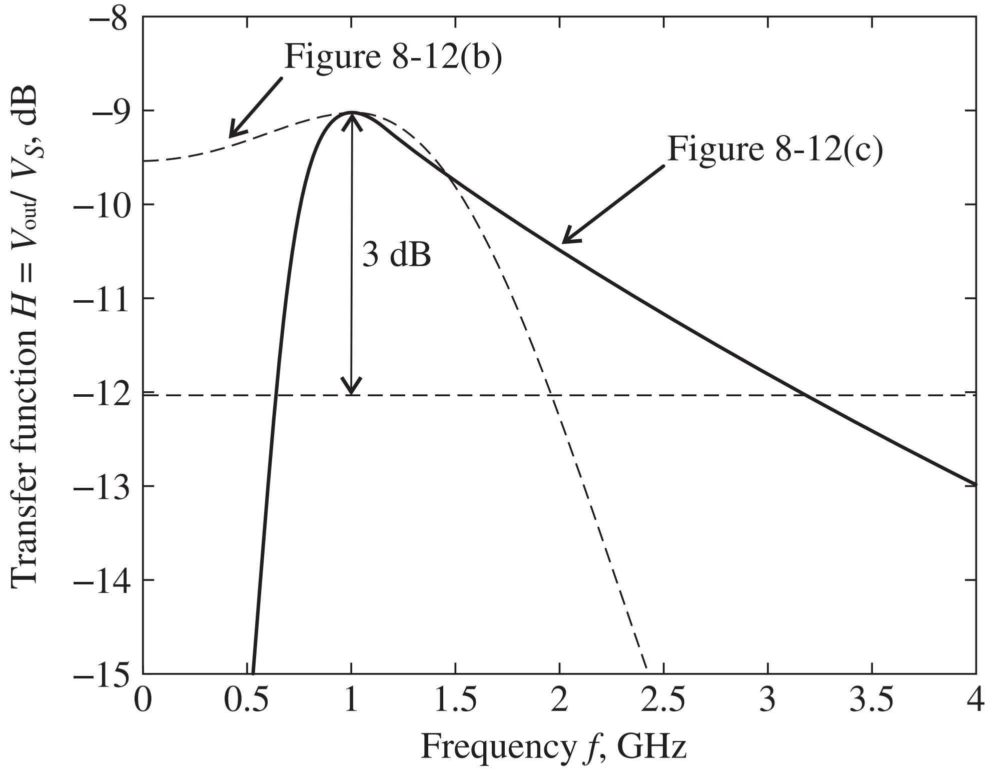


Figure 8-13 Frequency responses for the two matching networks.

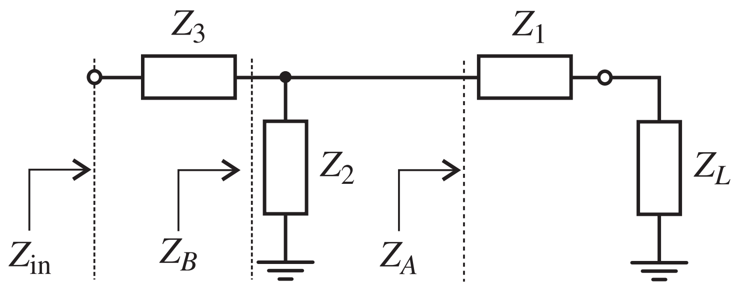


Figure 8-14 General topology of a T-type matching network.

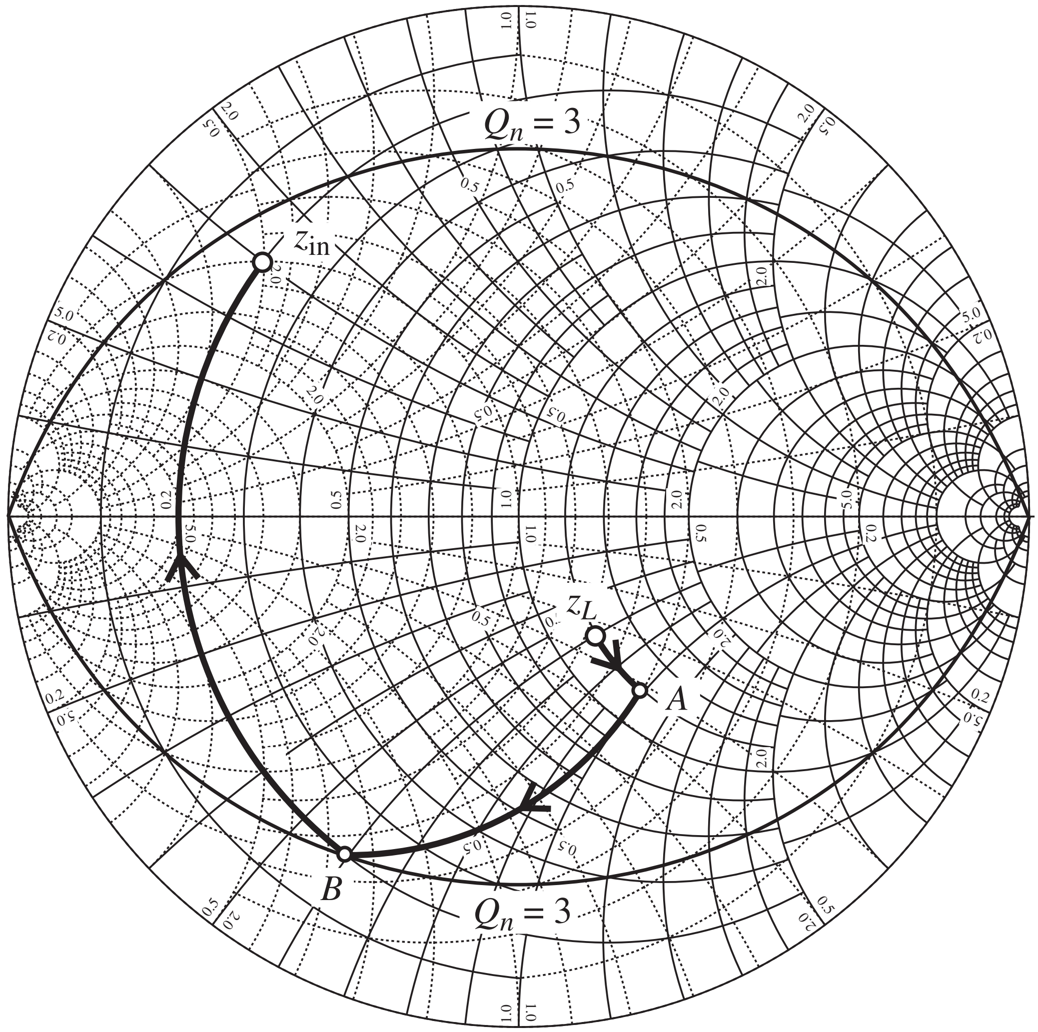


Figure 8-15 Design of a T-type matching network for a specified $Q_n = 3$.

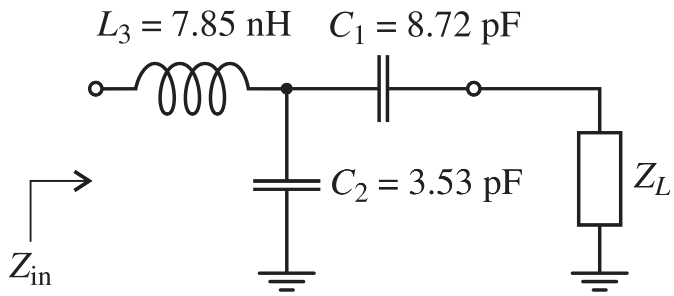


Figure 8-16 T-type matching network circuit schematics.

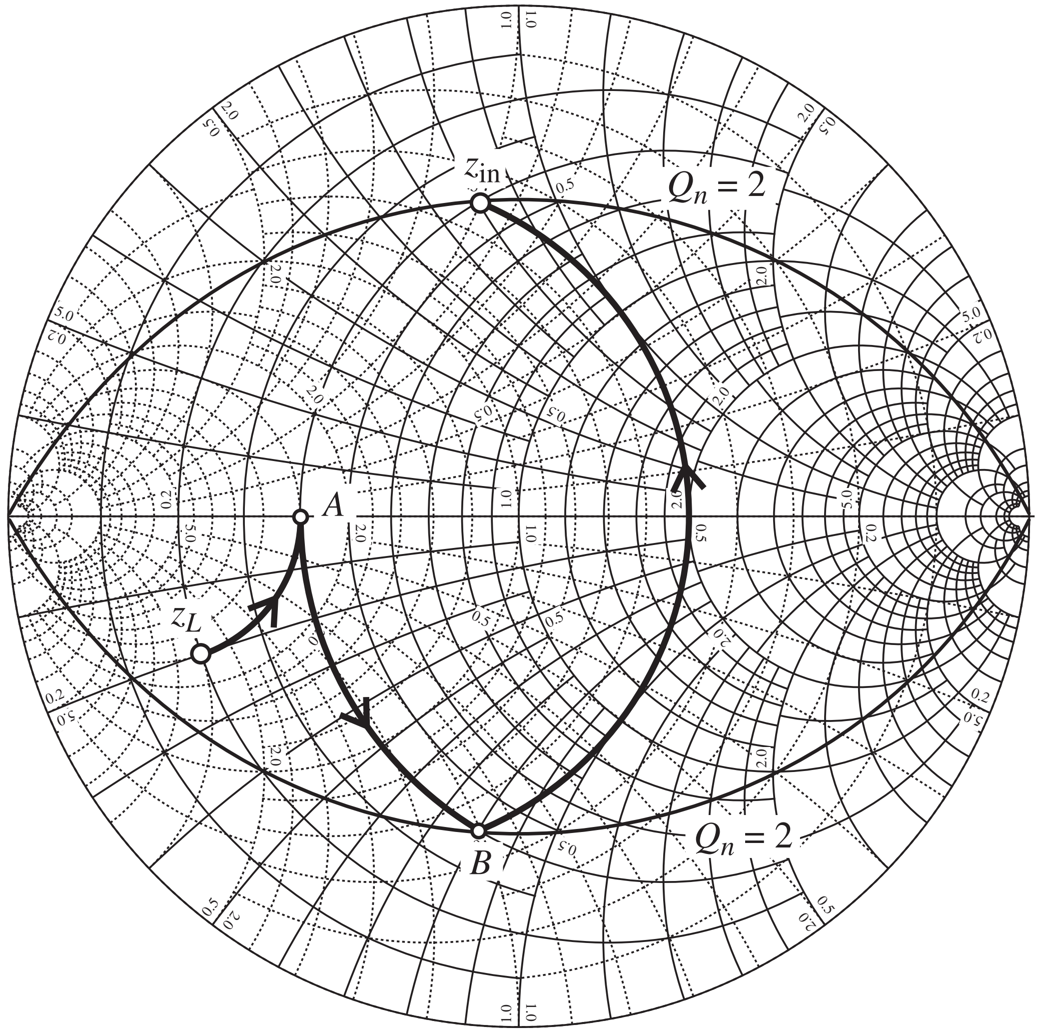


Figure 8-17 Design of a Pi-type matching network using a minimal Q_n.

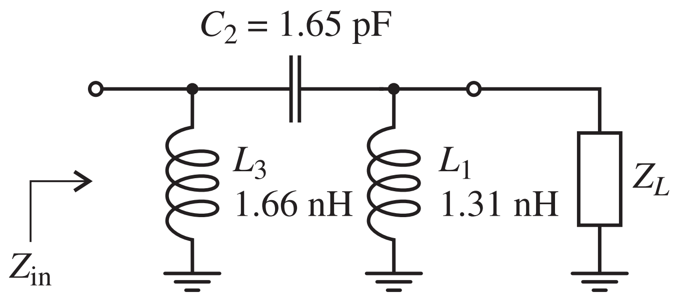


Figure 8-18 Pi-type matching network configuration.

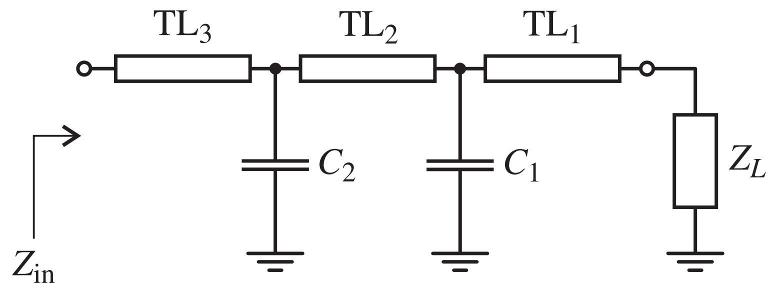


Figure 8-19 Mixed design of matching network involving transmission line sections (TL) and discrete capacitive elements.

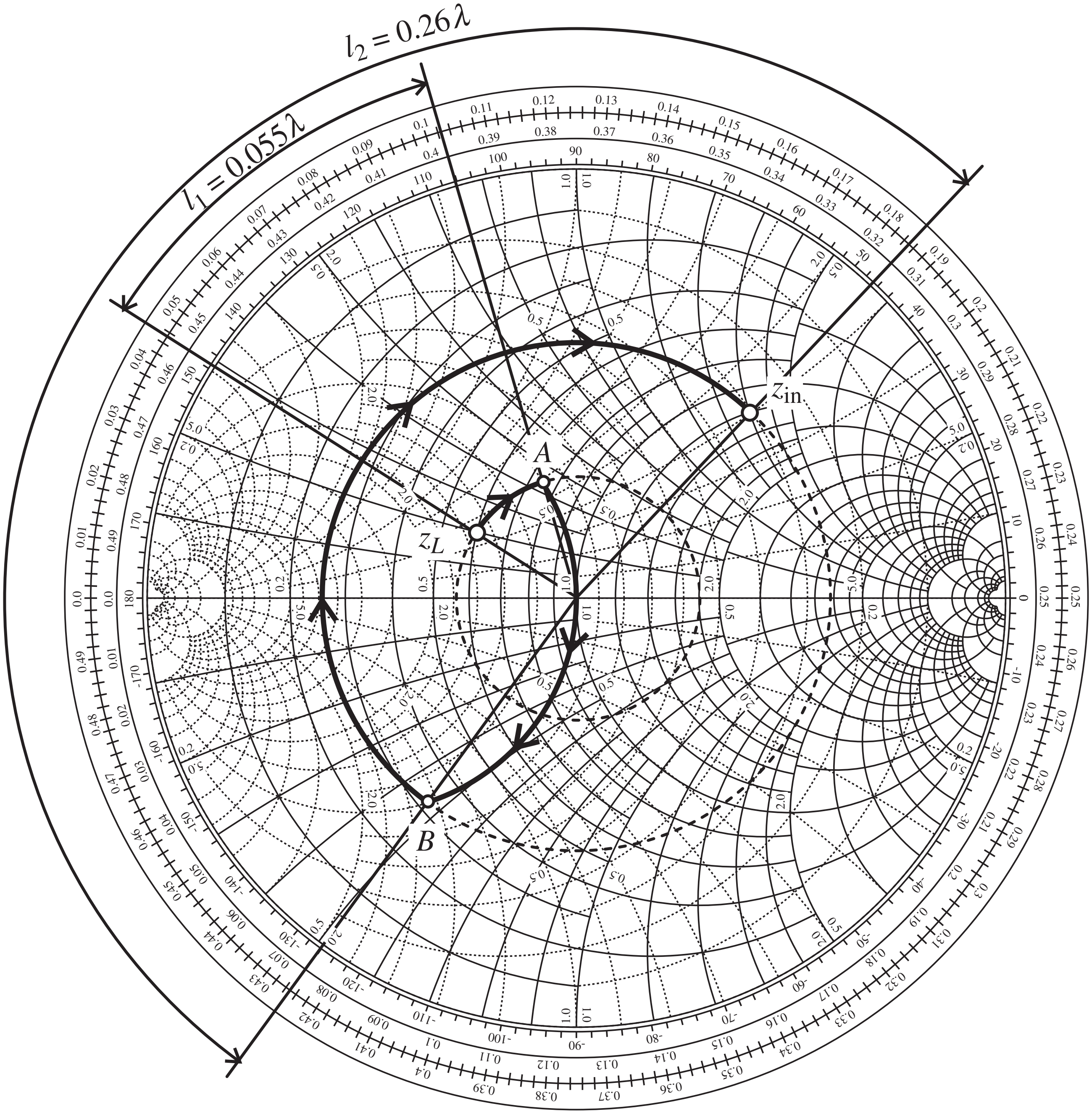


Figure 8-20 Design of the distributed matching network for Example 8-7.

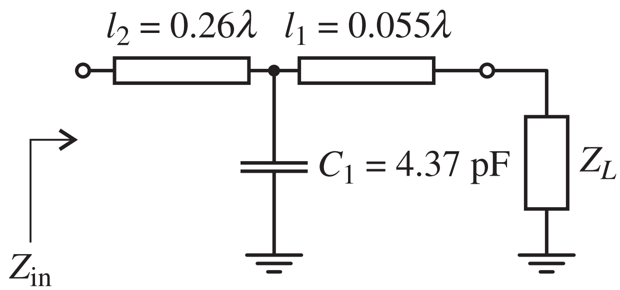


Figure 8-21 Matching network combining series transmission lines and shunt capacitance.

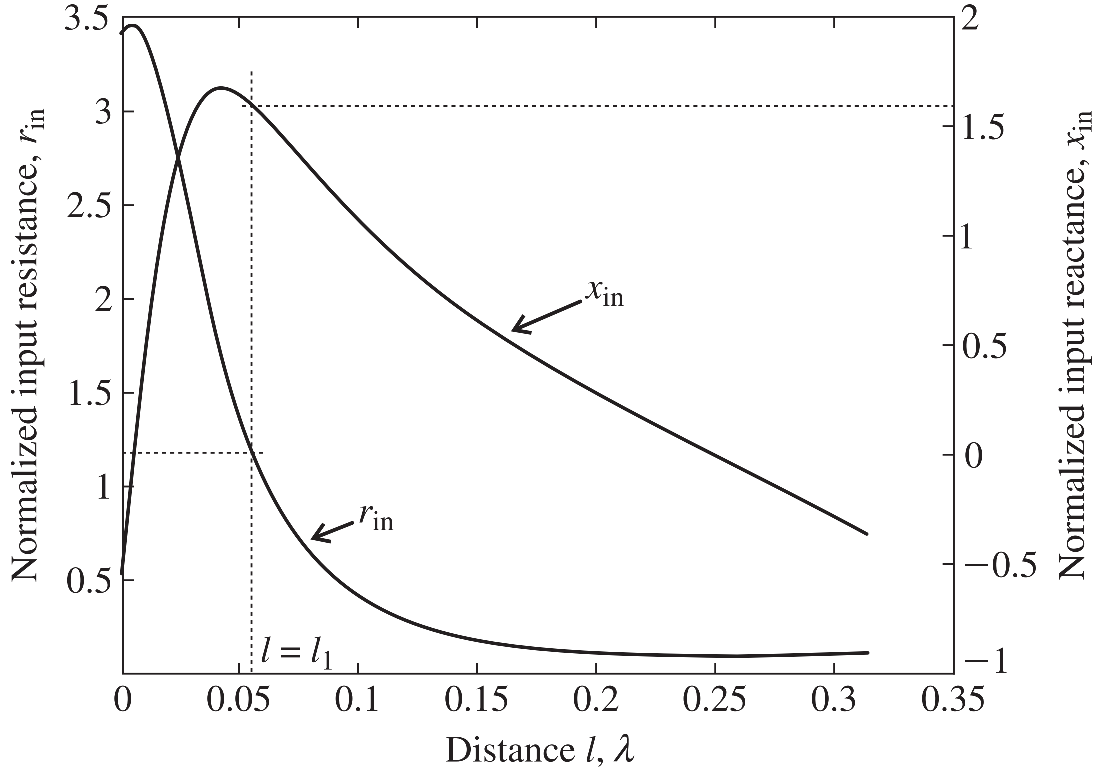


Figure 8-22 Input impedance as a function of the position of the shunt capacitor in Example 8-7.

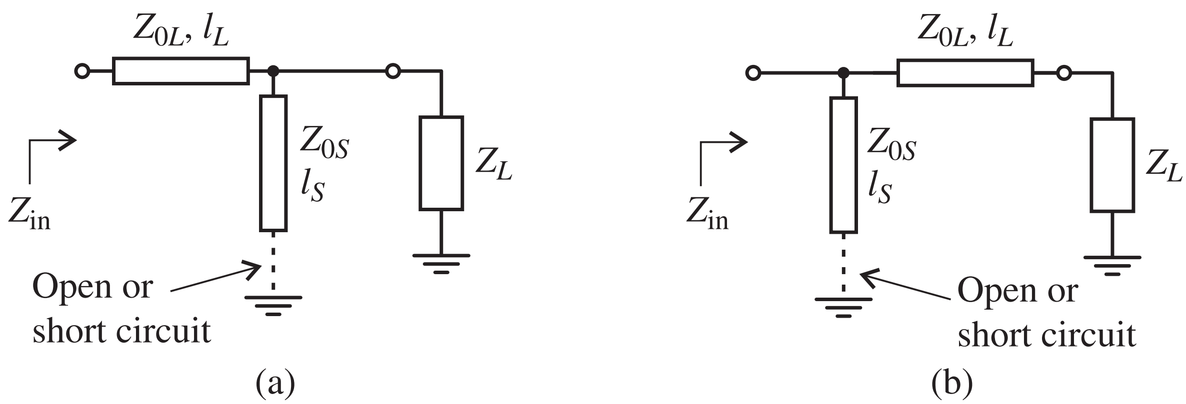


Figure 8-23 Two topologies of single-stub matching networks.

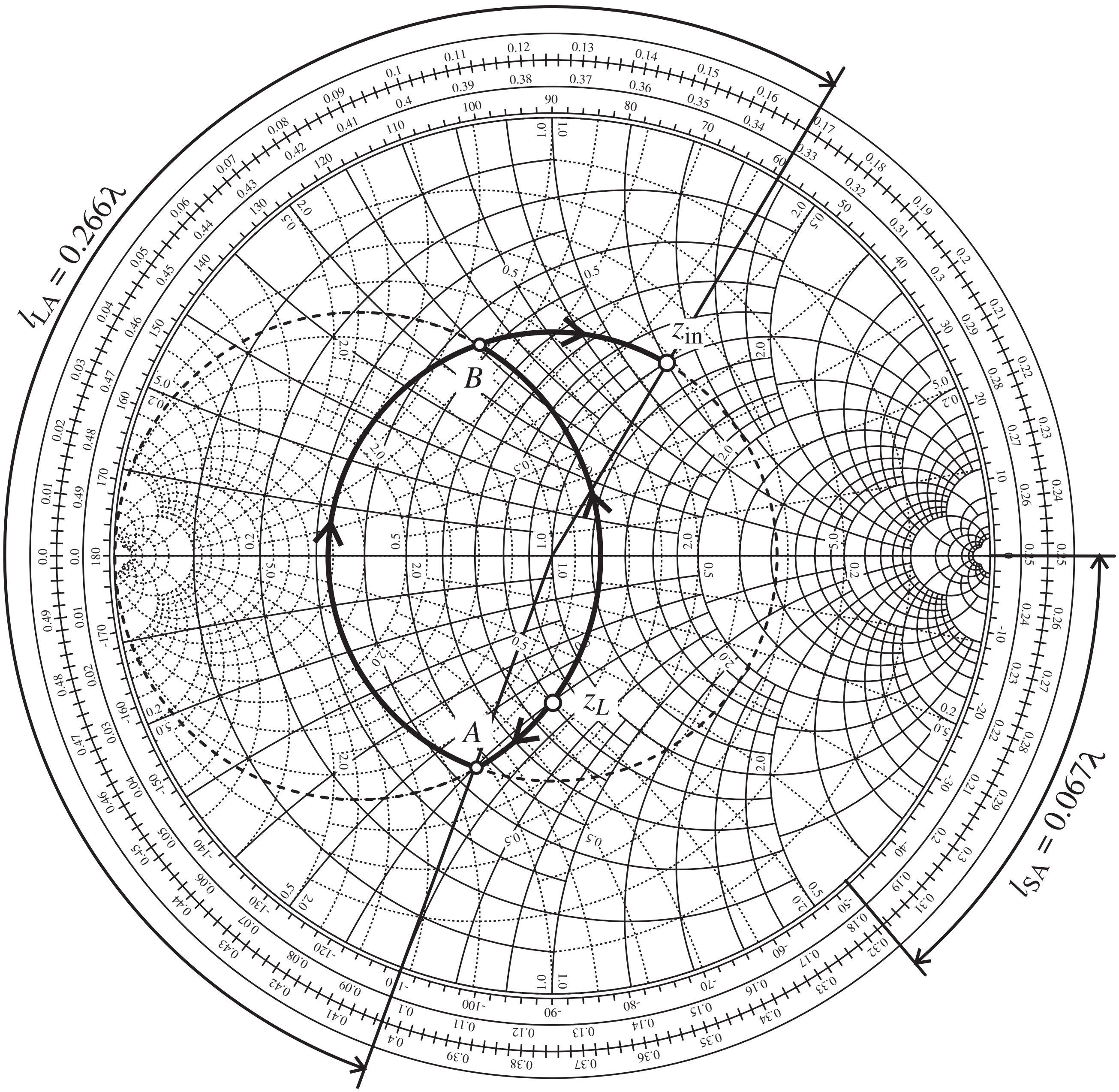


Figure 8-24 Smith Chart design for the single-stub matching network based on Example 8-8.

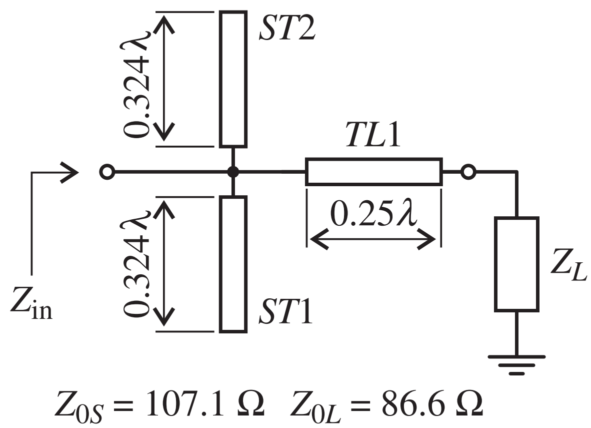


Figure 8-25 Balanced stub design for Example 8-9.

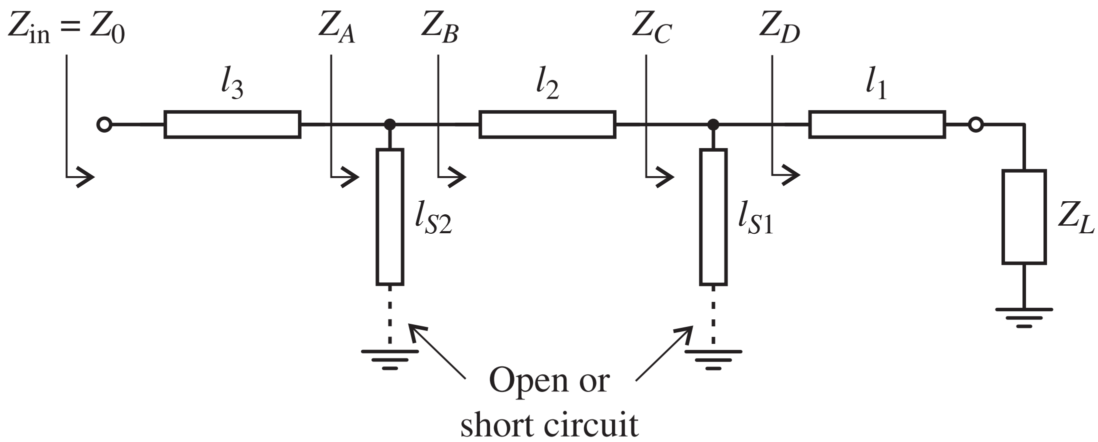


Figure 8-26 Double-stub matching network arrangement.

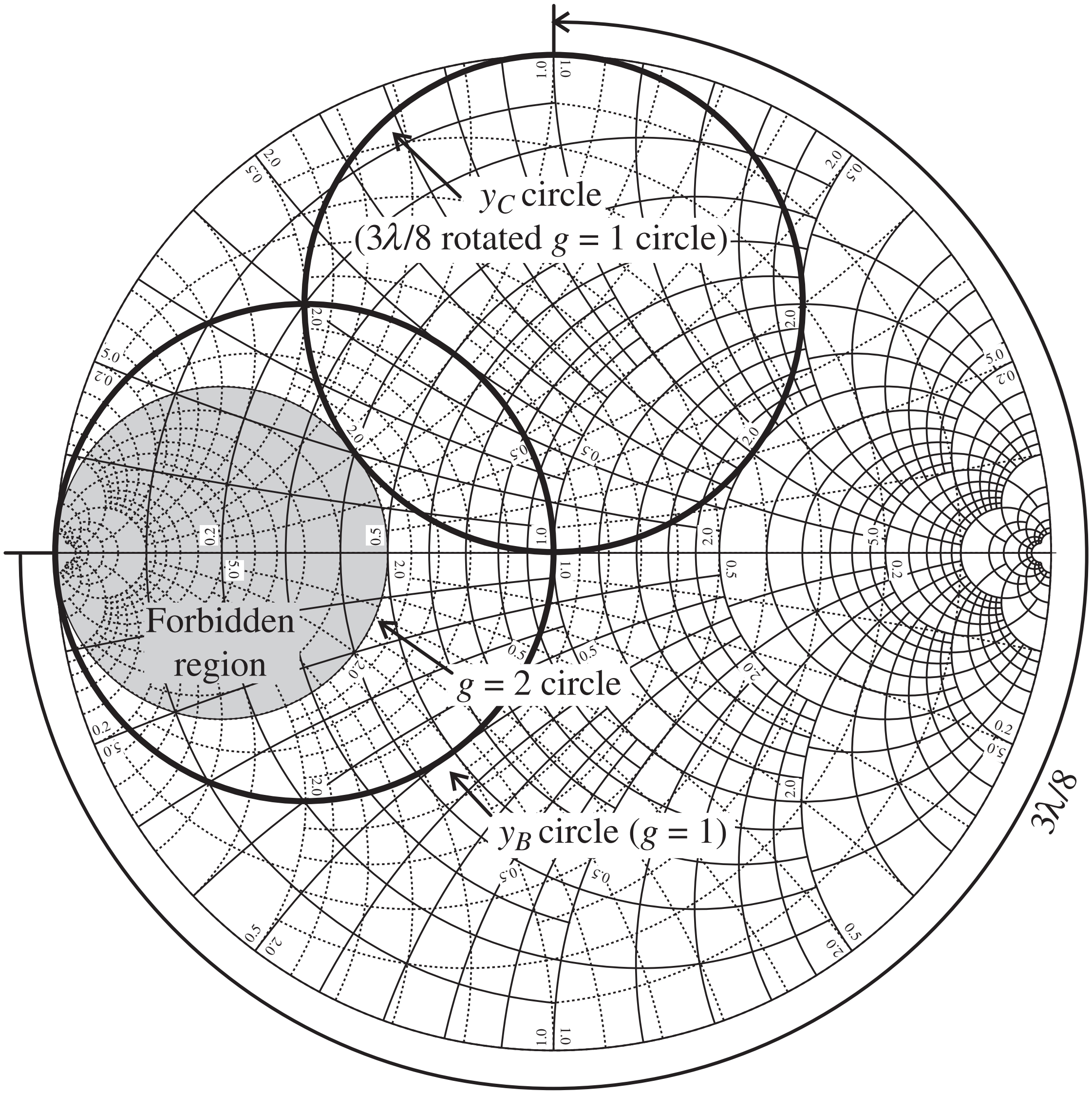


Figure 8-27 Smith Chart analysis of a double-stub matching network shown in Figure 26.

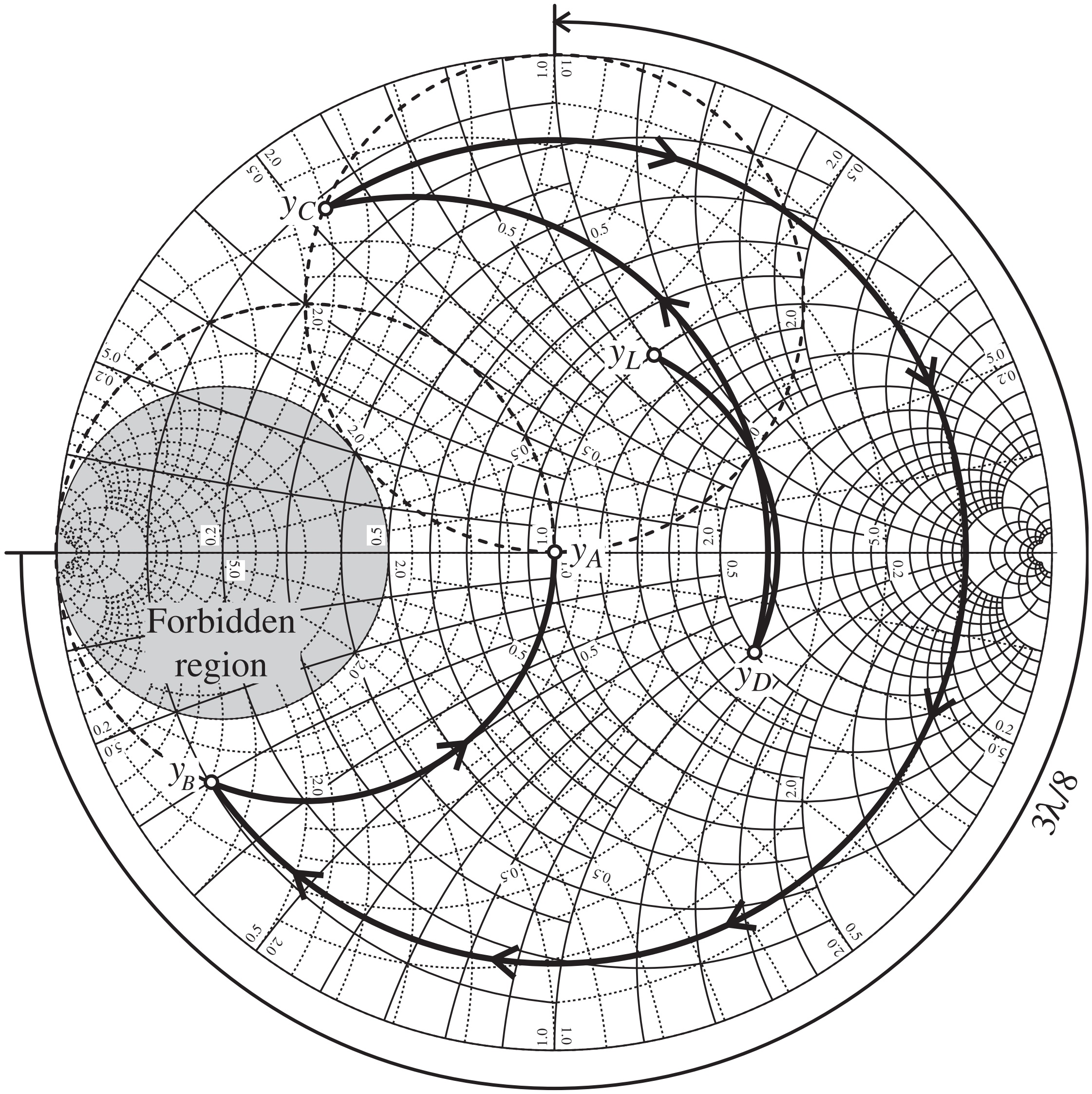


Figure 8-28   Double-stub matching network design for Example 8-10.

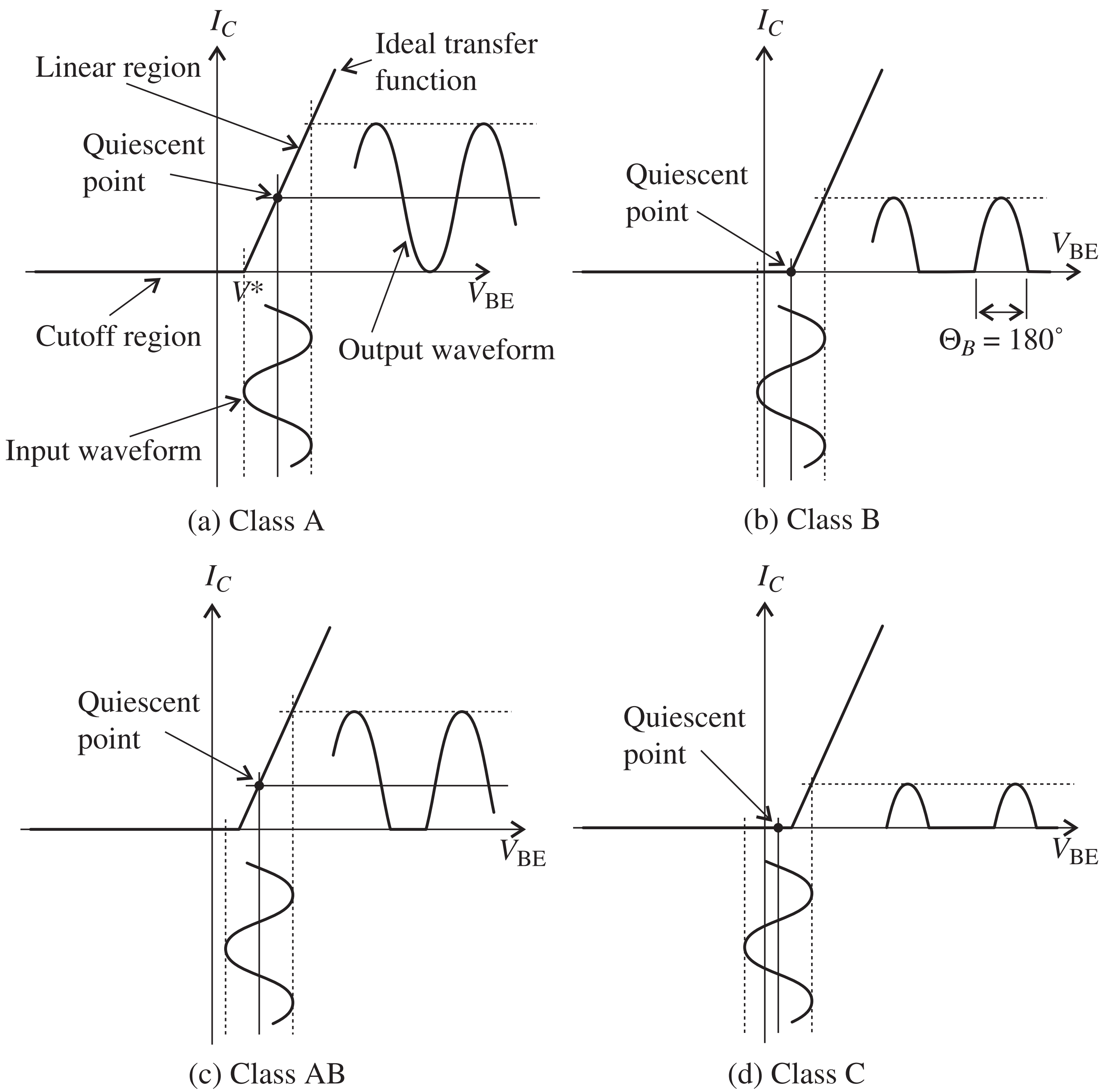
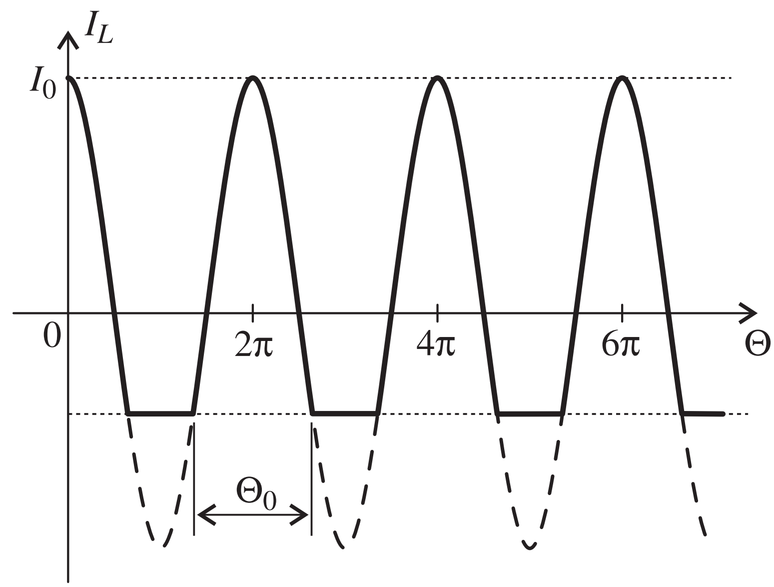
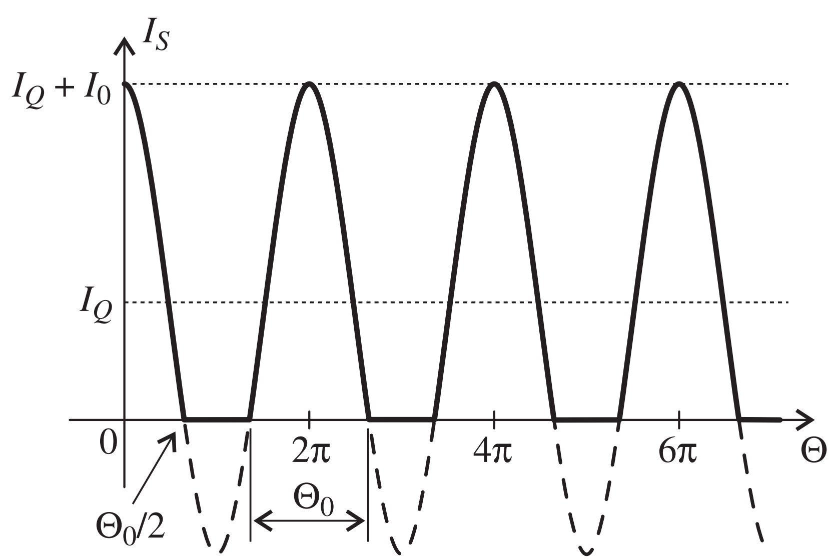


Figure 8-29 Various classes of amplifier operation.



(a) Load current waveform at the output of the transistor



(b) Corresponding power supply current waveform

Figure 8-30 Load and power supply current waveforms as a function of conduction angle.

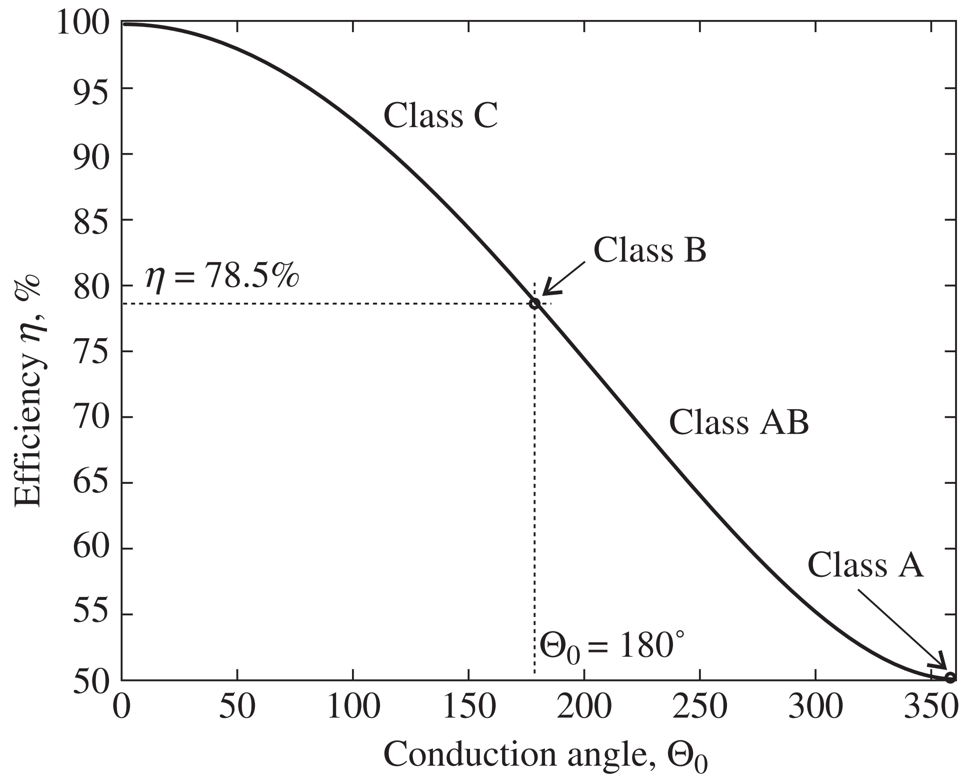


Figure 8-31 Maximum theoretical efficiency of an ideal amplifier as a function of conduction angle.

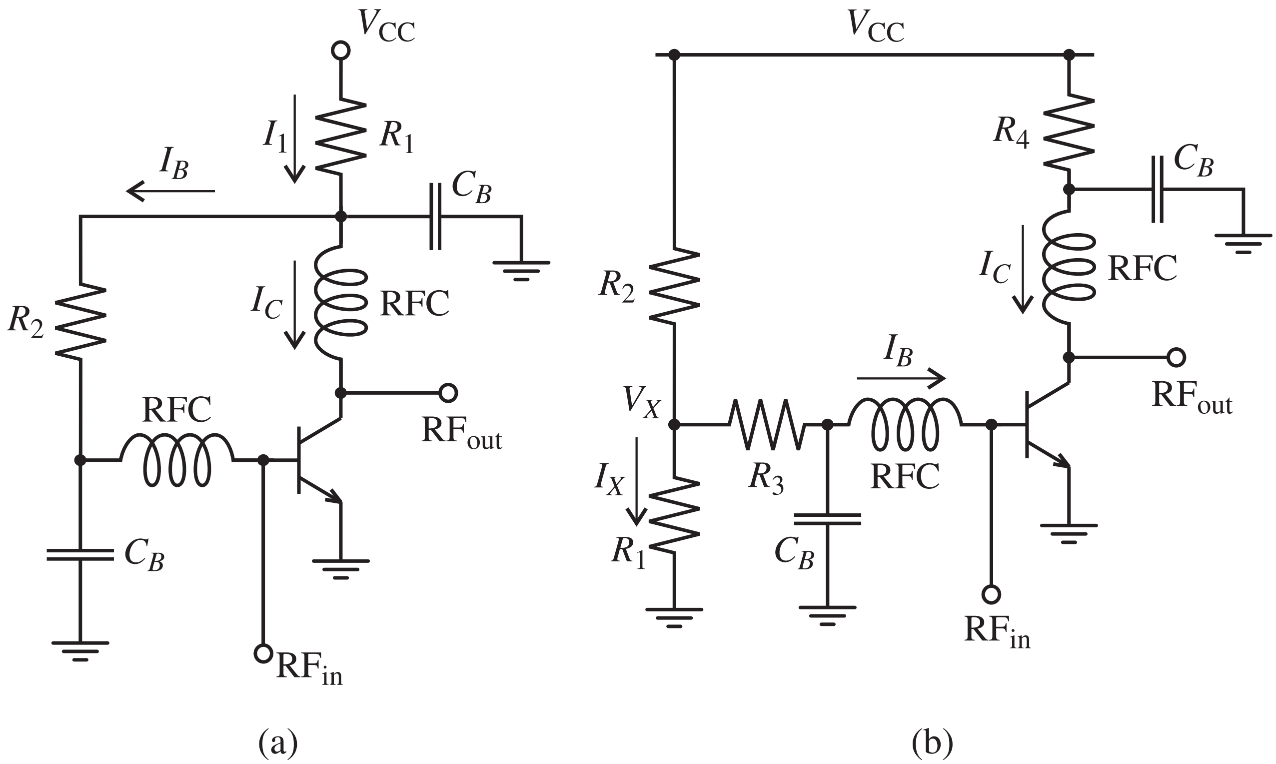


Figure 8-32 Passive biasing networks for an RF BJT in common-emitter configuration.

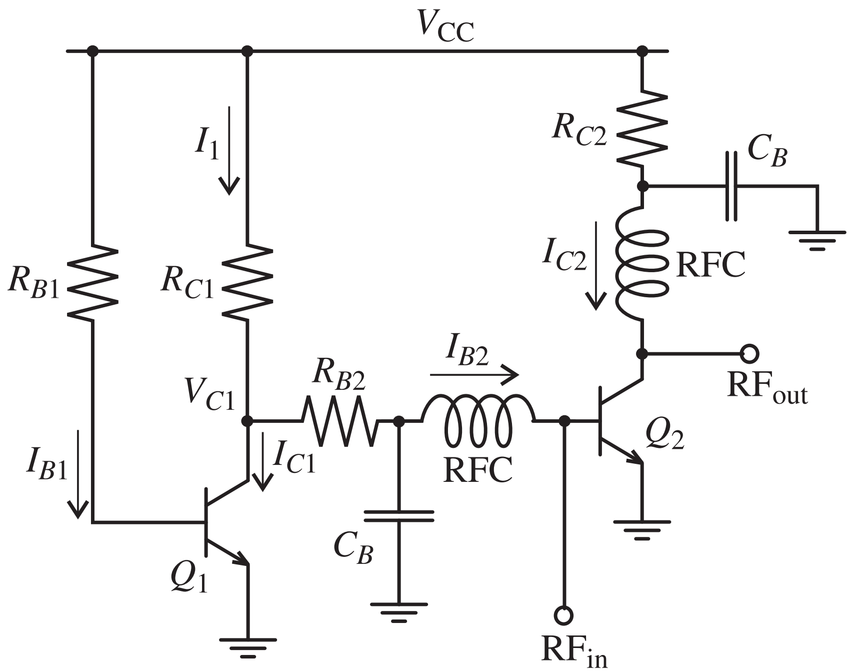


Figure 8-33 Active biasing network for a common-emitter RF BJT.

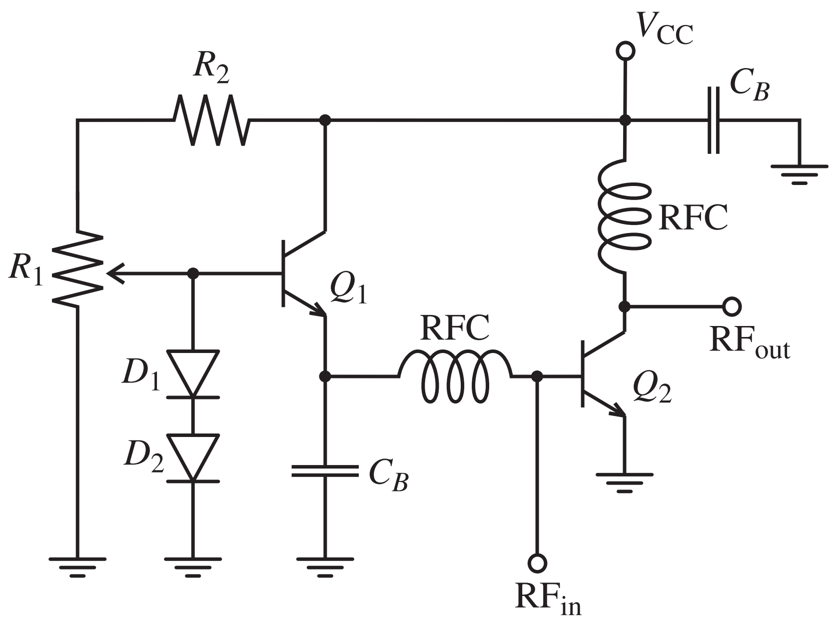


Figure 8-34 Active biasing network containing low-frequency transistor and two diodes.

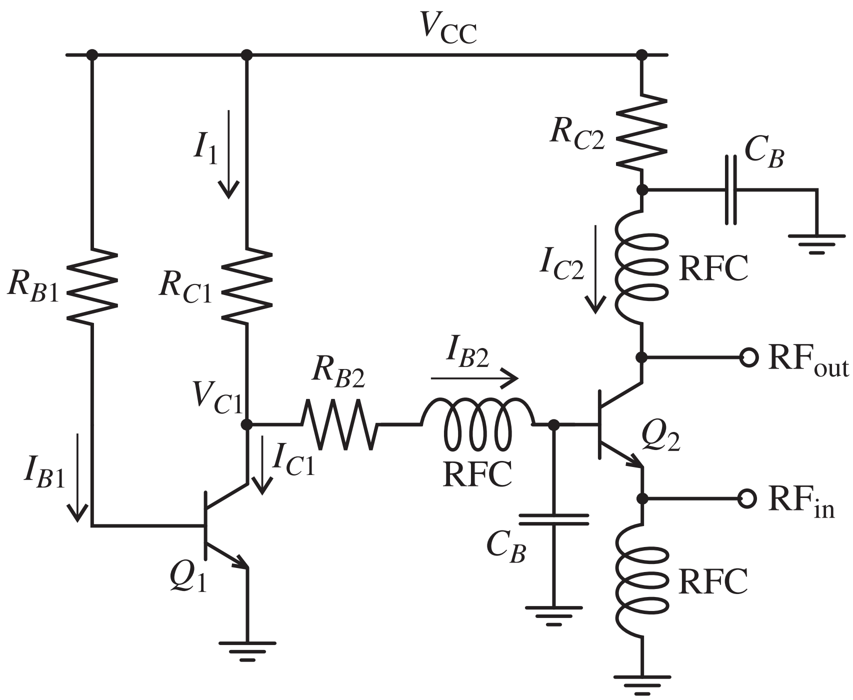


Figure 8-35 Modification of the active biasing network shown in Figure 33 for common-base RF operation.

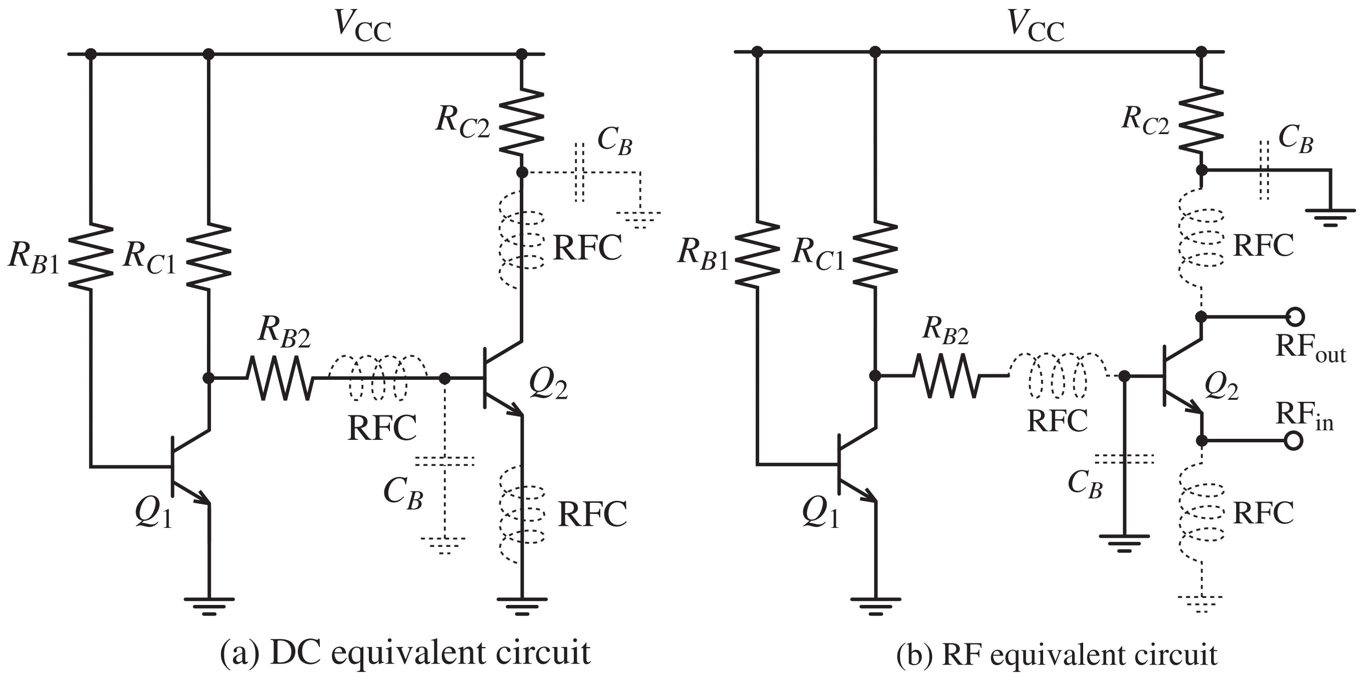


Figure 8-36 DC and RF equivalent circuits for the active biasing network in Figure 35.

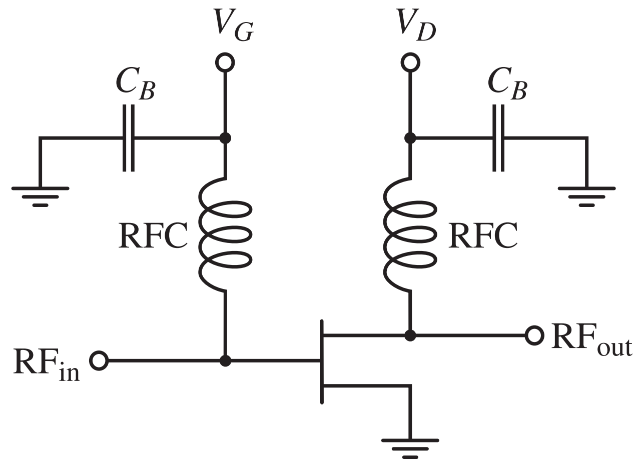


Figure 8-37 Bipolar passive biasing network for FETs.

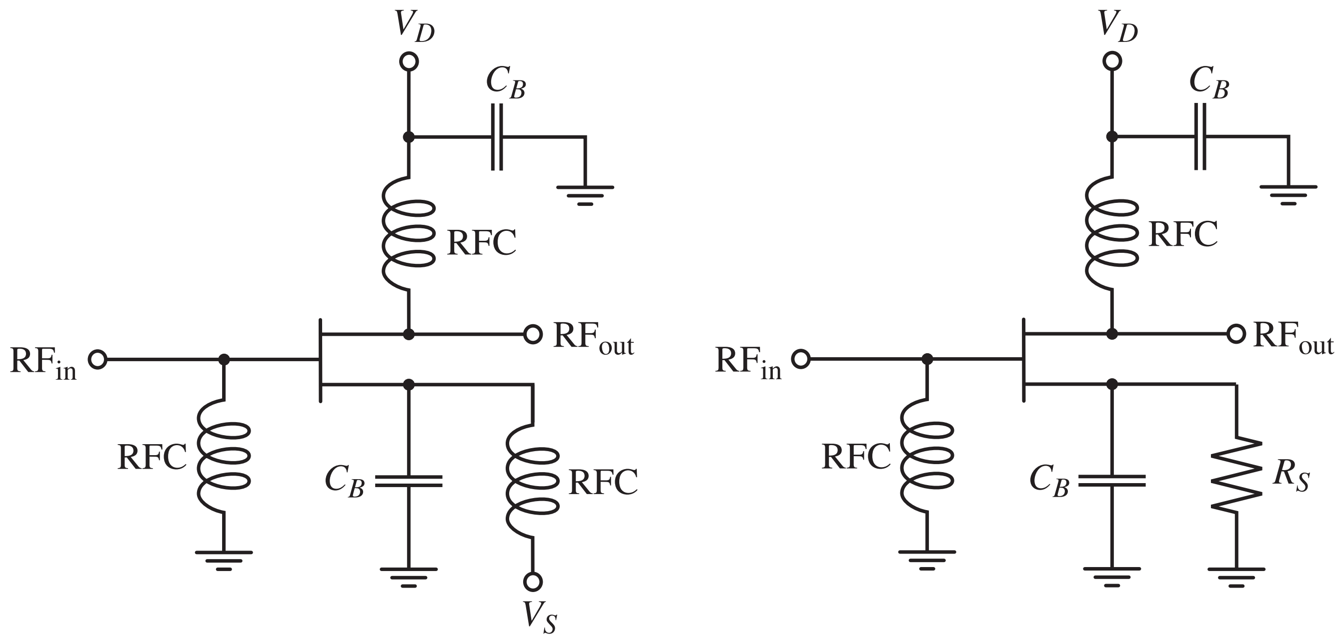


Figure 8-38 Unipolar passive biasing networks for FETs.

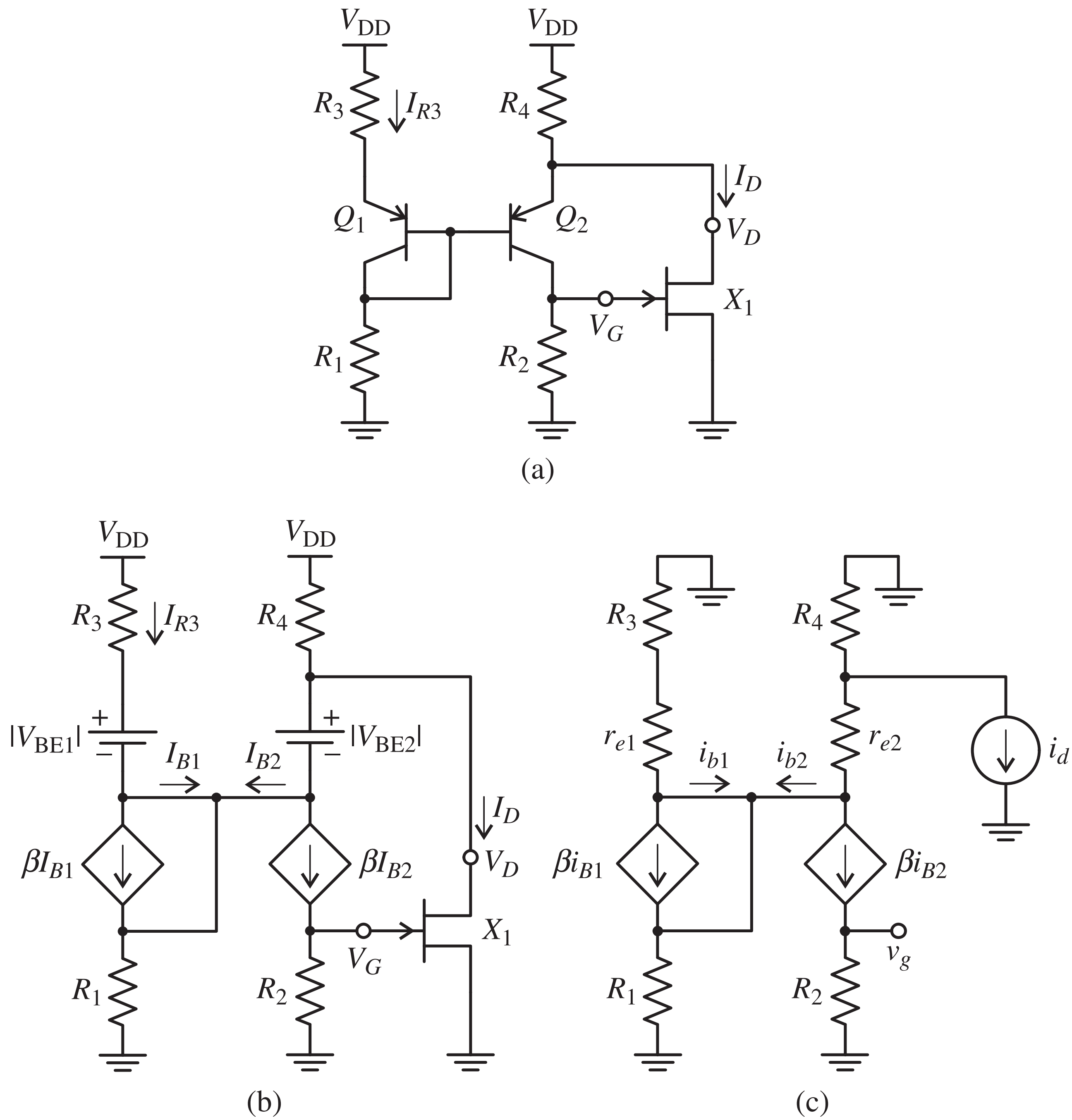


Figure 8-39 E-pHEMT biasing network: (a) DC bias circuit, (b) DC model, (c) low-frequency small-signal model.

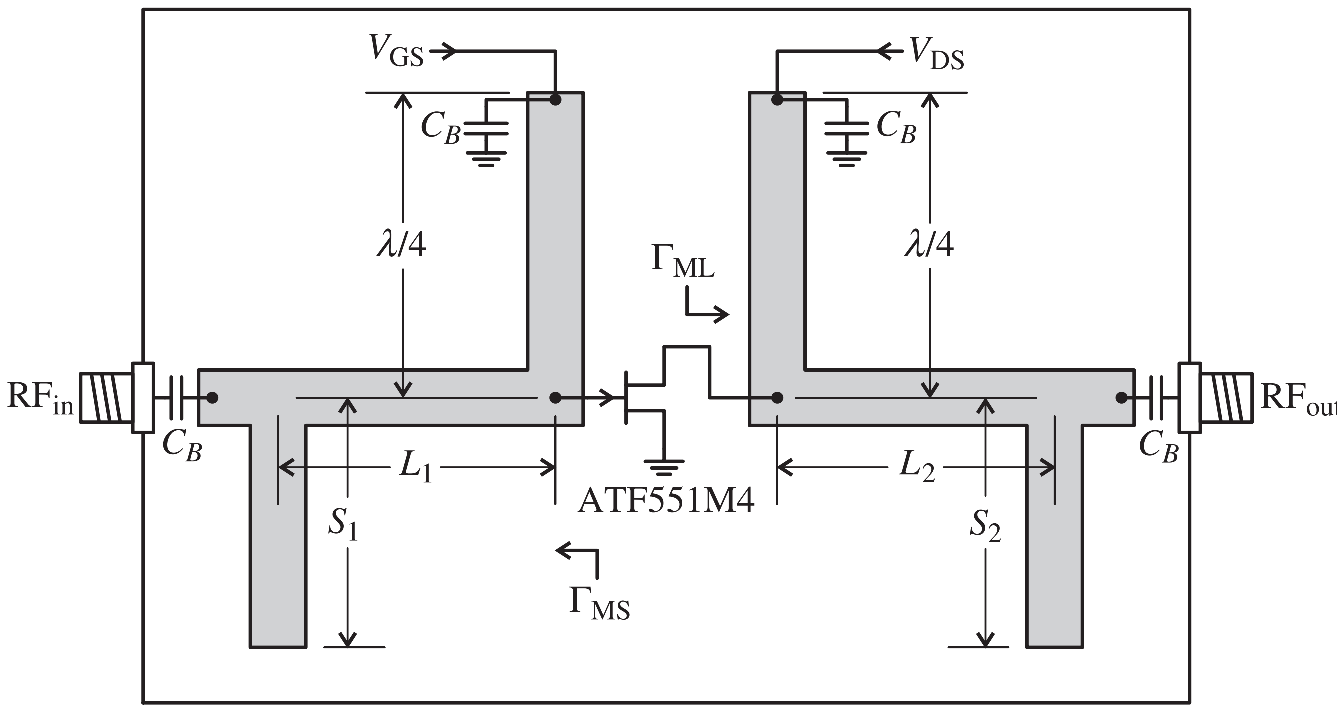


Figure 8-40 Conceptual PCB layout of the 7 GHz amplifier, showing the biasing filters and matching networks implemented with microstrips.

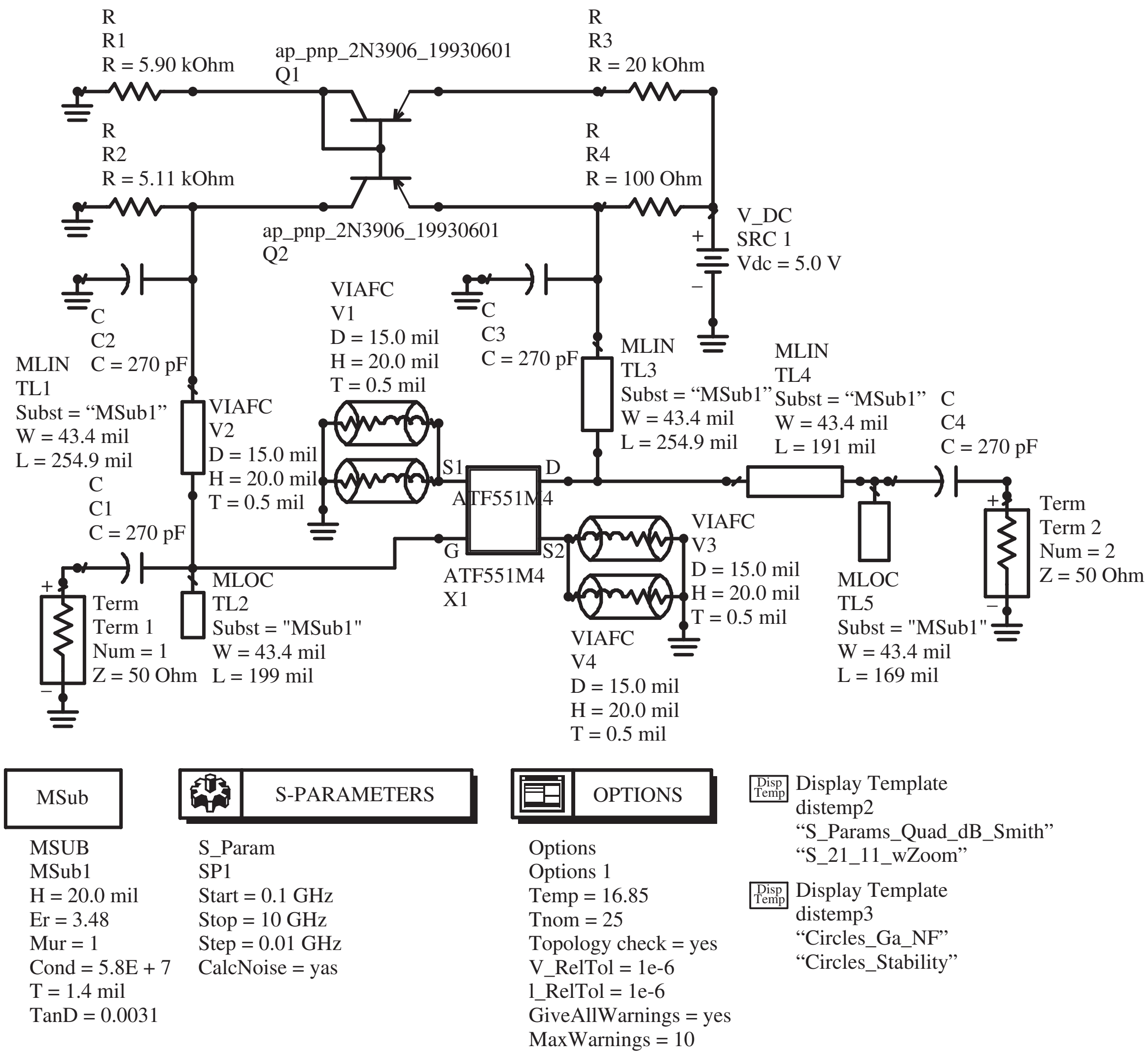
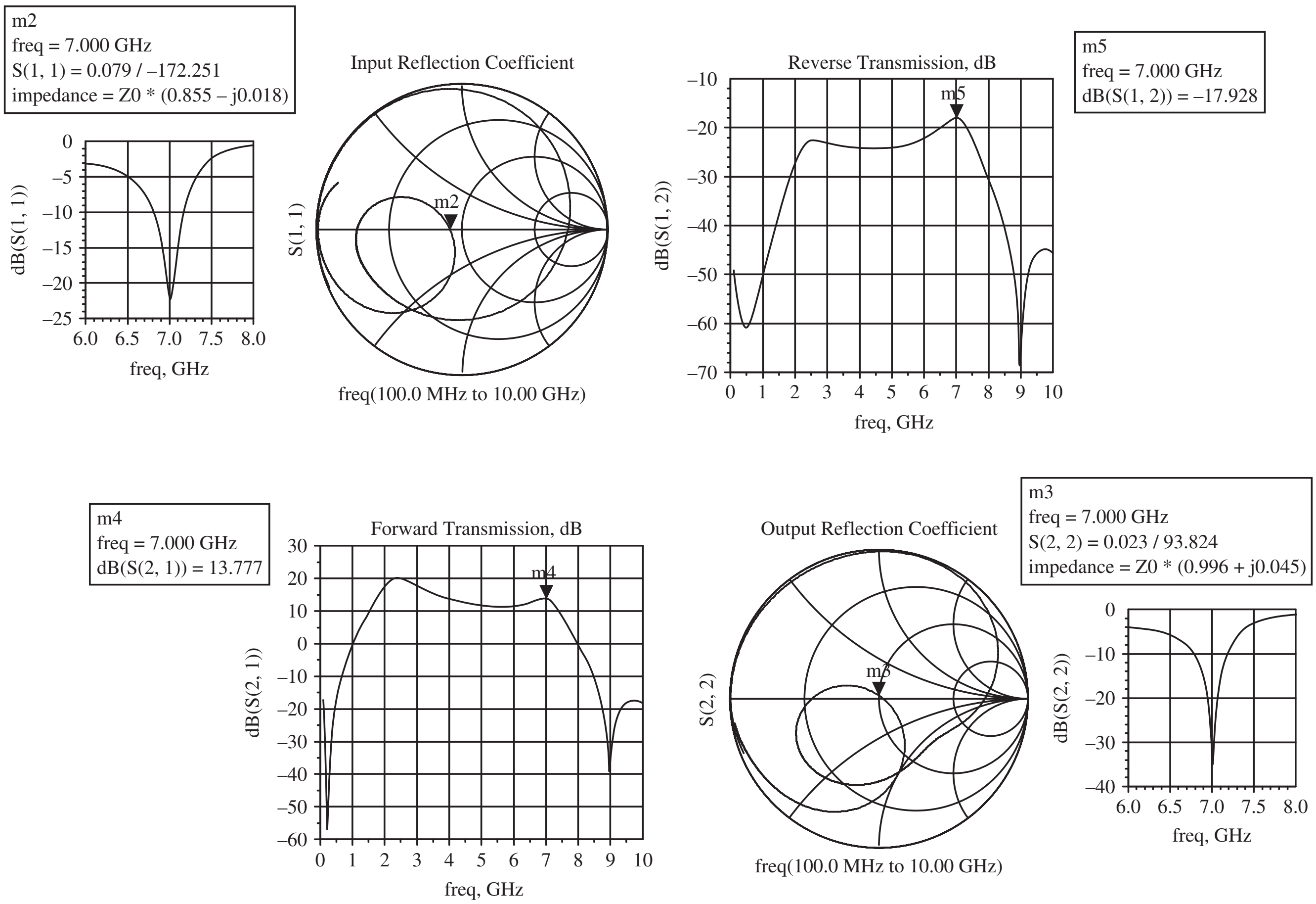


Figure 8-41 Schematic of the designed 7 GHz amplifier including the PCB substrate description and the *S*-parameter simulation setup.



freq[690]	S[690](1, 1)	S[690](1, 2)	S[690](2, 1)	S[690](2, 2)
7.000 GHz	0.079 / –172.251	0.127 / –143.730	4.885 / –129.286	0.023 / 93.824

Figure 8-42 Simulated *S*-parameters of 7 GHz amplifier.