OPTIMAL MICROSTRIP T-JUNCTIONS

J.W. Bandler, M.A. Ismail and D.G. Swanson, Jr.

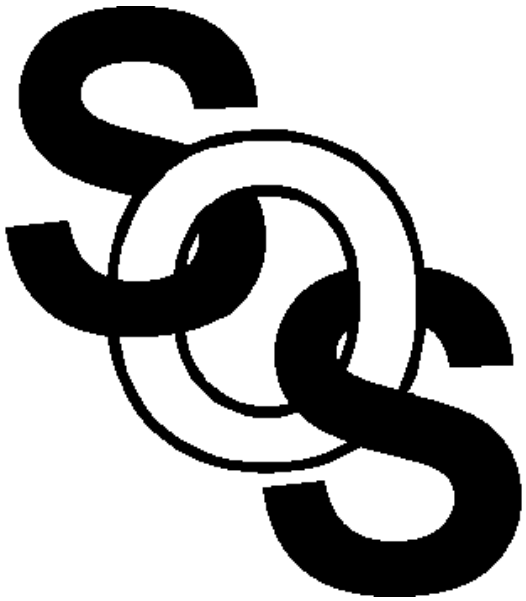
SOS-98-20-V

August 1998

OPTIMAL MICROSTRIP T-JUNCTIONS

J.W. Bandler, M.A. Ismail and D.G. Swanson, Jr.

Simulation Optimization Systems Research Laboratory
and Department of Electrical and Computer Engineering
McMaster University, Hamilton, Canada L8S 4L7



presented at

SOS Research Laboratory Meeting, Hamilton, August 17, 1998

Introduction

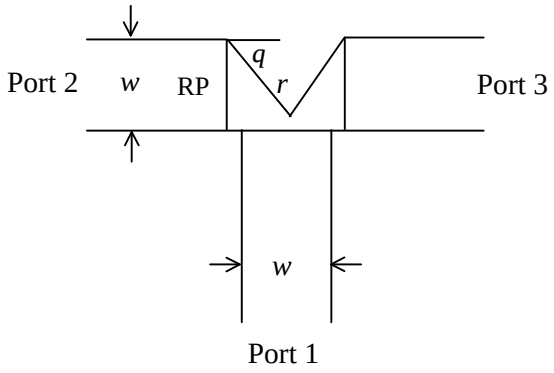
this work presents a comparison between different configurations to compensate discontinuities in T-junctions

the comparison is done by applying direct optimization to the different configurations of the T-junctions

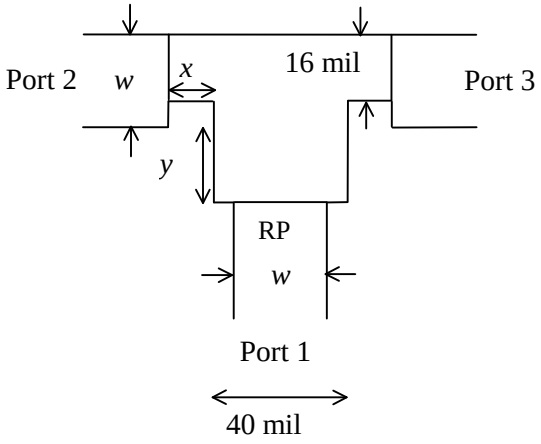
the target of optimization is to achieve the possible minimum mismatch at the three ports

the T-junction considered here is symmetric and is connected to 50 Ω transmission lines

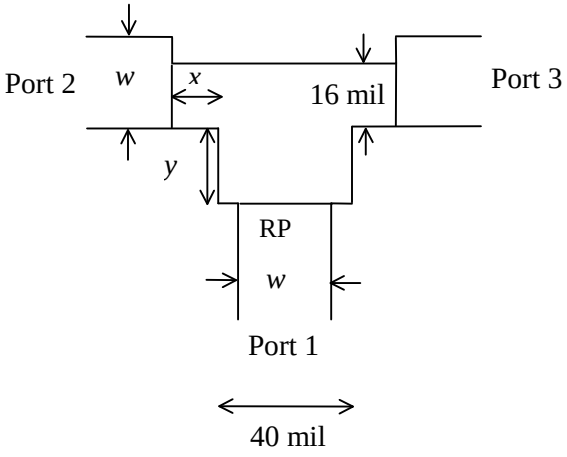
Introduction



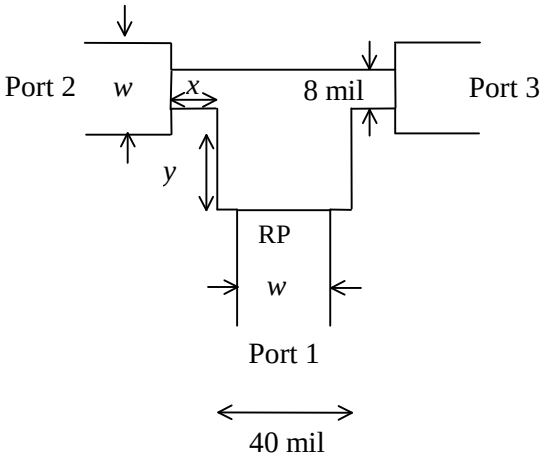
(a)
(*Gupta et al.*, 1982)



(b)
(*S. Wu et al.*, 1990)



(c)
(*Proposed here*)

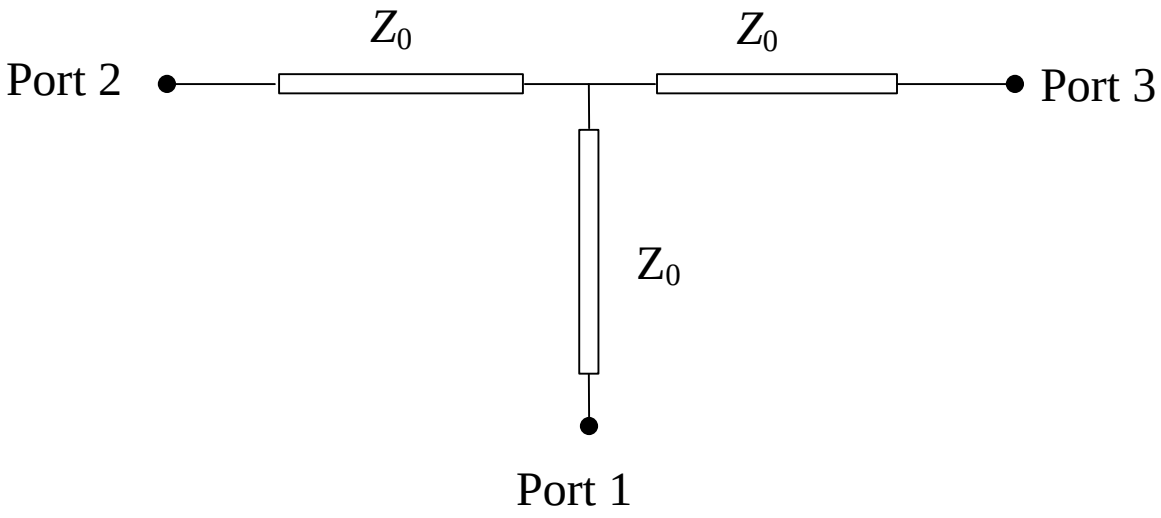


(d)
(*M. Dydyk*, 1977)

w = 24 mil, h =25 mil and e_r = 9.9

Design Specifications

what are the ideal values of the reflection coefficients at the three ports of the T-junction?



$$S_{11} = S_{22} = S_{33} = \left.\frac{V_1^-}{V_1^+}\right|_{V_2^+ = V_3^+ = 0} = \left.\frac{Z_L - Z_0}{Z_L + Z_0}\right|_{Z_0 \text{ on ports 2 and 3}}$$

$$= \frac{Z_0/2 - Z_0}{Z_0/2 + Z_0} = -\frac{1}{3}$$

Design Specifications

the specifications considered here are

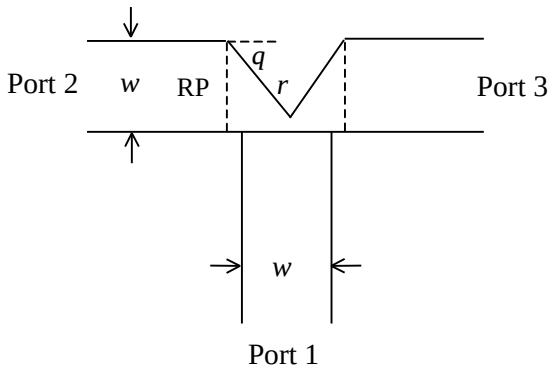
$$|S_{11}| \le \frac{1}{3}, \quad |S_{22}| \le \frac{1}{3},$$

in the frequency range 2 GHz to 16 GHz

the width *w*, the height *h* and the relative dielectric constant e_r are fixed during optimization

three tools are exploited here to apply direct optimization, Sonnet's ***em*** simulator, the minimax optimizer in OSA90/hope and Empipe

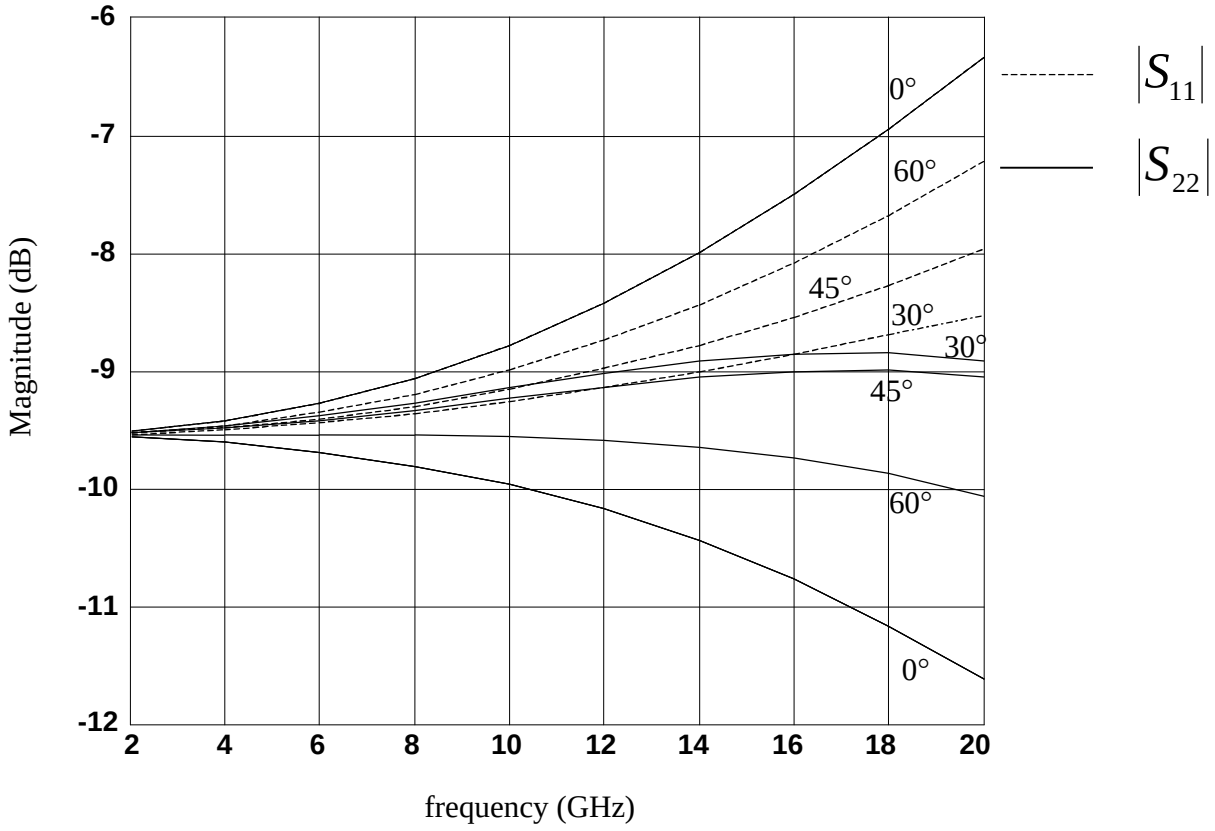
Optimization Results



q	The optimal value of r
30°	1.556 w
45°	1.355 w
60°	1.158 w

Optimization Results

the response of the T-junction in (a) with q = 0°, 30°, 45° and 60°



Optimization Results

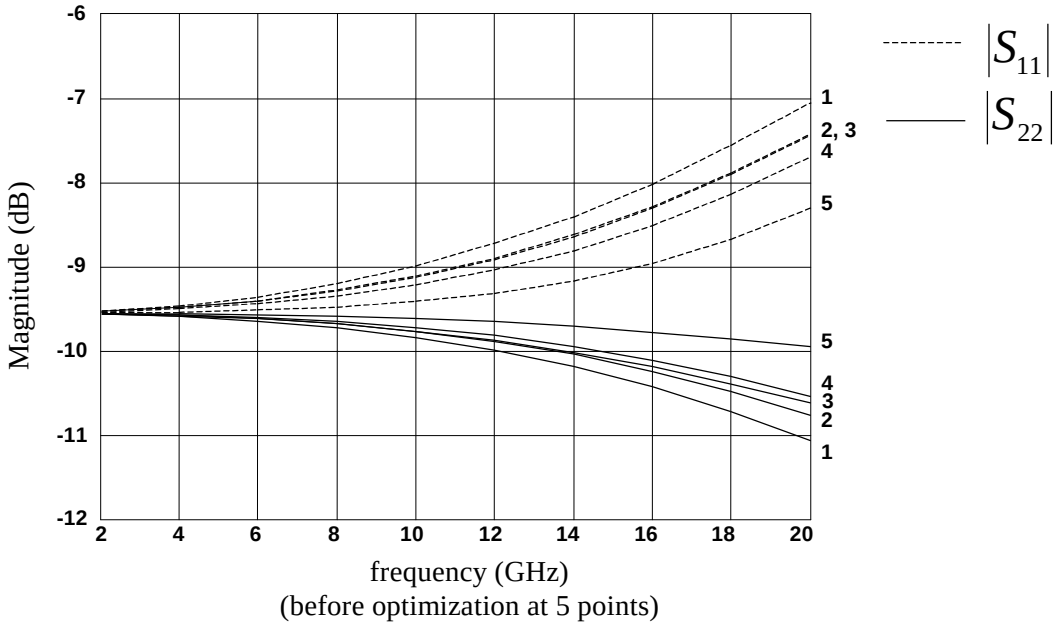
the T-junctions in (b), (c) and (d) were optimized for minimum mismatch at the three ports

the optimization variables are x and y

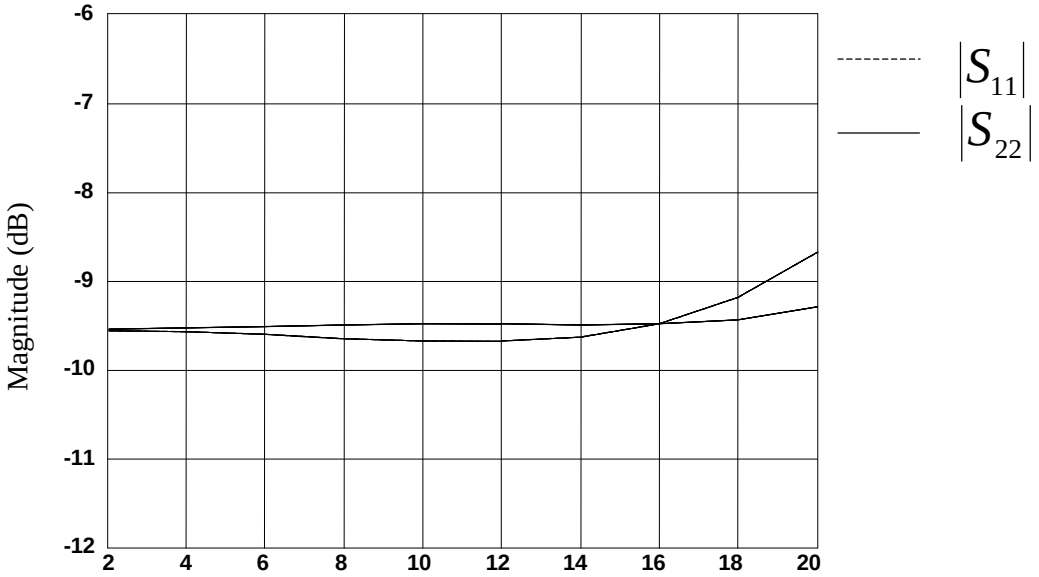
T-junction	Optimal value of x	Optimal value of y
T-junction in (b)	0.9250 w	0.583 w
T-junction in (c)	0.7271 w	0.7917 w
T-junction in (d)	0.1 w	0.9167 w

Optimization Results

the T-junction in (b)



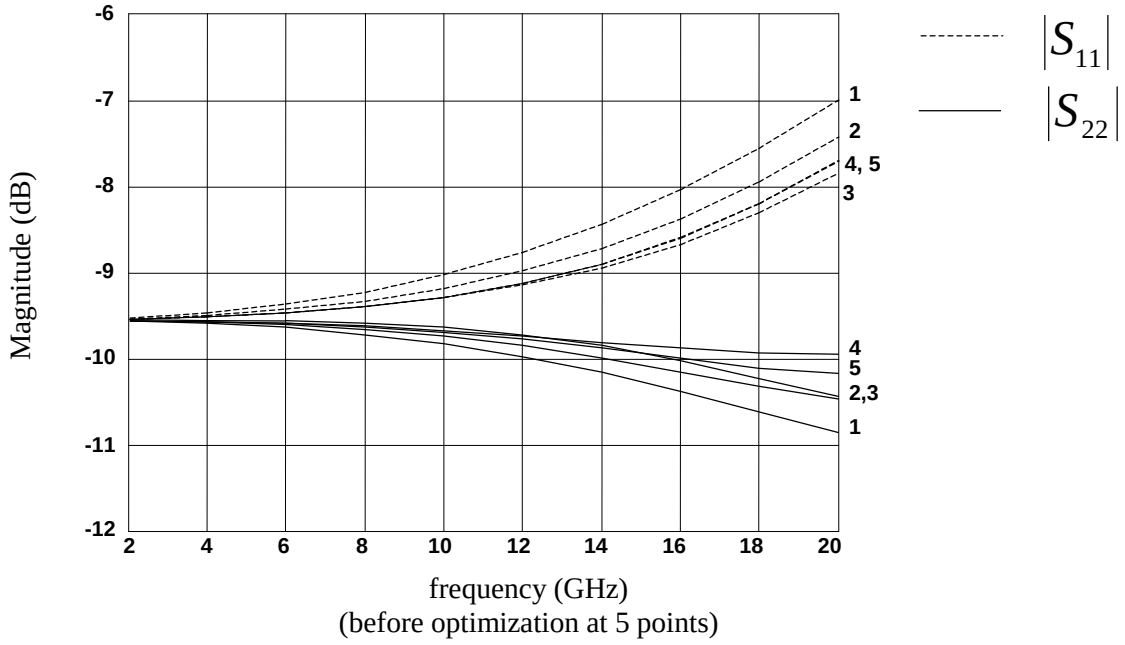
(before optimization at 5 points)



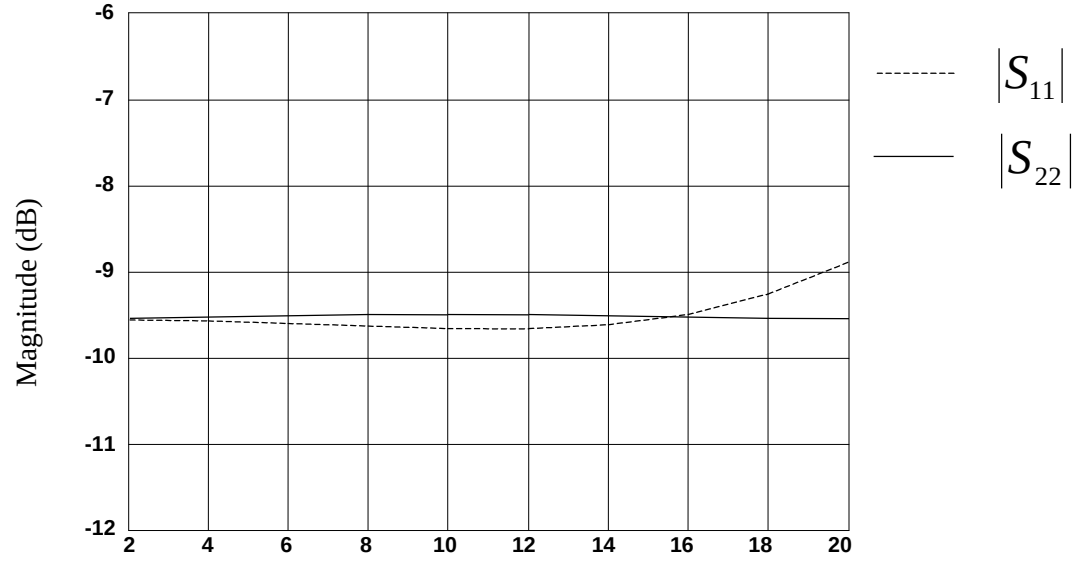
(after optimization)

Optimization Results

the T-junction in (c)



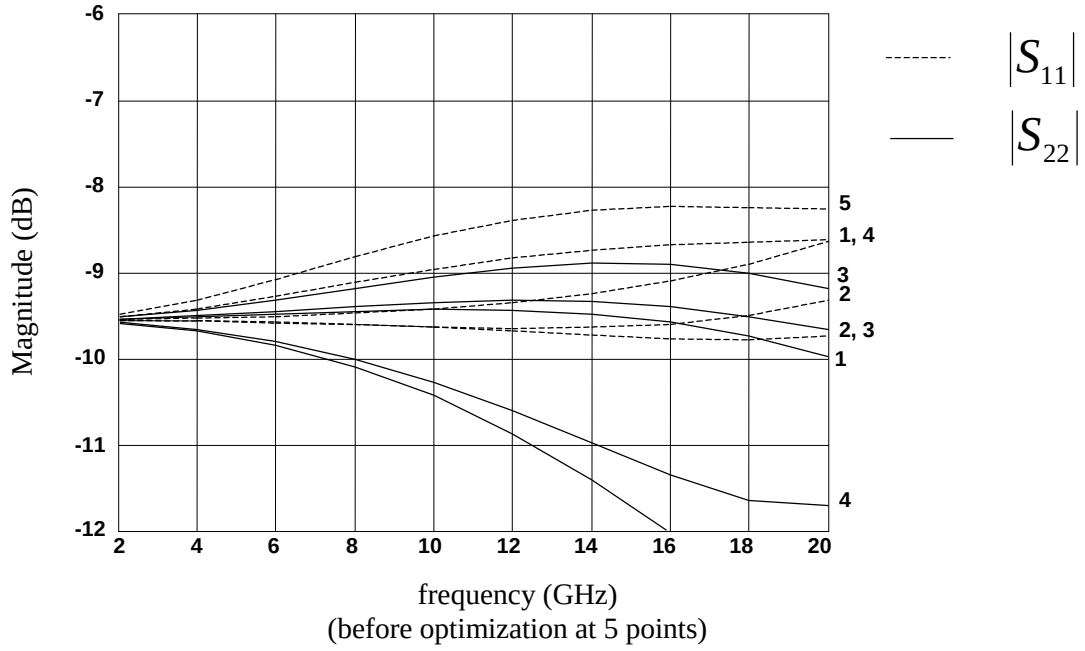
(before optimization at 5 points)



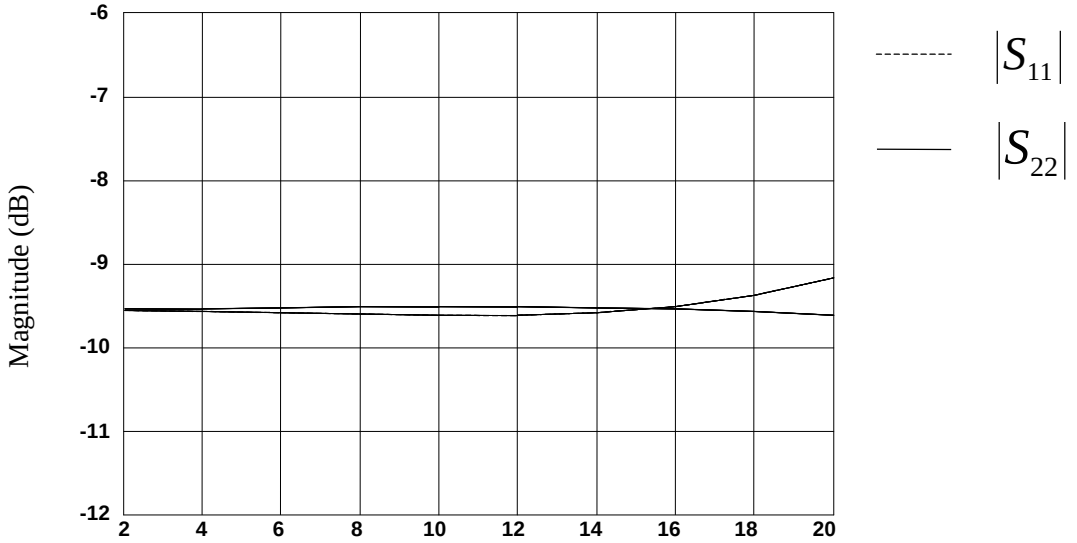
(after optimization)

Optimization Results

the T-junction in (d)

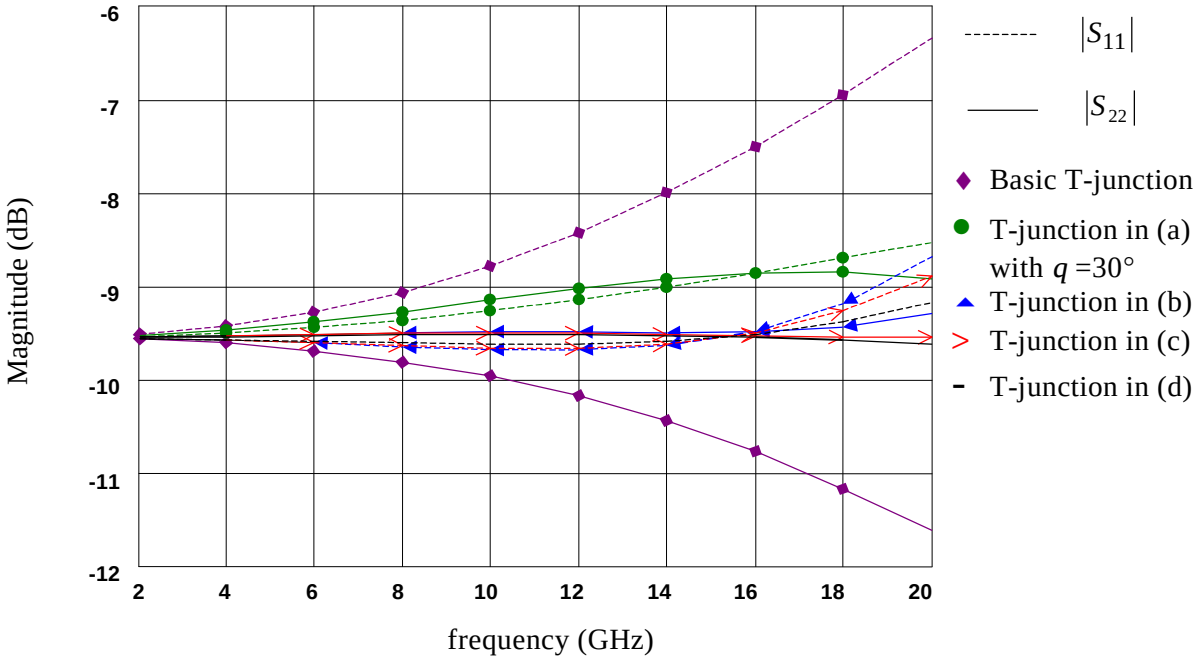


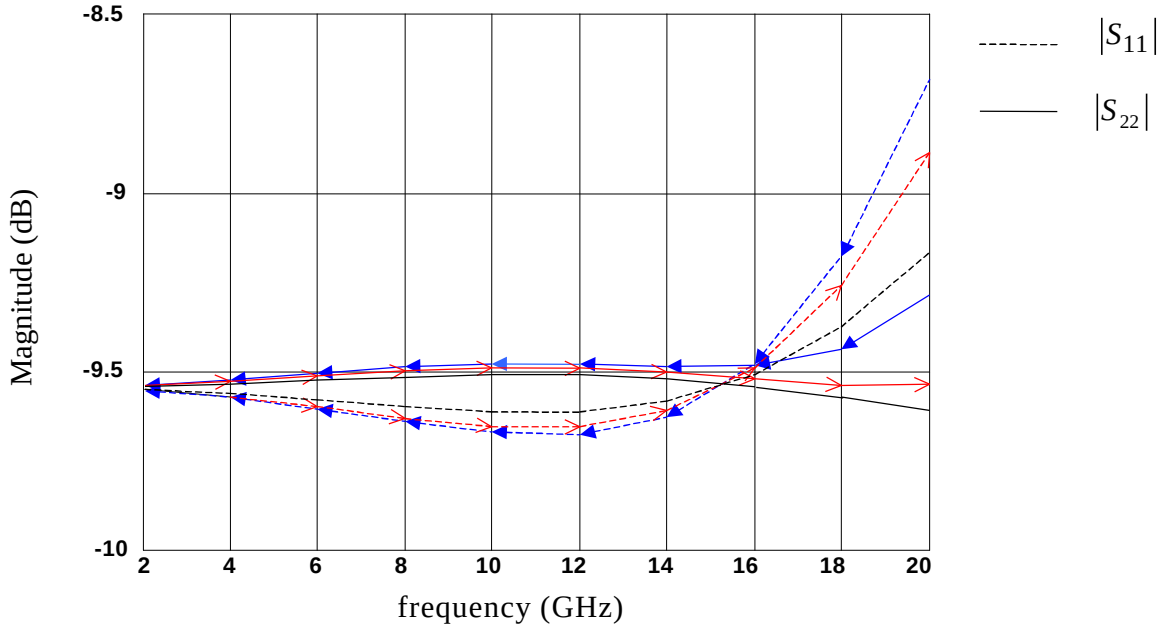
(before optimization at 5 points)



(after optimization)

Optimization Results





Conclusions

the T-junction in (a) with q equal to 30° gives the worst results since $|S_{11}|$ and $|S_{22}|$ are very far from the ideal value of –9.54 dB

the T-junctions in (b), (c) and (d) give satisfactory results with almost minor differences among their responses