

Batch: A2 Roll No.: 16010322014
Experiment / assignment / tutorial No. 36
Grade: AA / AB / BB / BC / CC / CD / DD

Signature of the Staff In-charge with date

TITLE: Design of single stub matching network

AIM: To design of single Stub matching networks for given load using smith software.

OUTCOME: Analyse and design microwave transmission lines and matching circuits.

Example 1

Design a single stub matching network for a load of $120 + j35 \Omega$ load using single open circuit shunt stub.

Assume characteristic impedance of transmission line & stub as 50Ω

Example 2

Design a matching network for microstrip antenna connected to coaxial cable, whose characteristic impedance is 50Ω input impedance for antenna is $60 + j25 \Omega$.

Design single stub using shunt short circuit stub.

Somaiya Vidyavihar University
K J Somaiya School of Engineering

Comparison between theoretical and simulated results:

Parameters	Example 1		Example 2	
	Theoretical	Simulated	Theoretical	Simulated
Distance d	0.184λ	0.182λ	0.222λ 0.018λ	0.285λ 0.183λ
Length L	0.375λ	0.374λ	0.213λ	0.183λ 0.2856λ

Signature of faculty in-charge

Theoretical Calculations:

Ex1

$$Z_L = 120 + j35\Omega$$

$$Z_0 = 50\Omega$$

$$Z_L' = \frac{Z_L}{Z_0} = \frac{120 + j35\Omega}{50\Omega}$$

$$\therefore Z_L' = 2.4 + j0.7\Omega$$

$$(Y_L = 1/Z_L)$$

$$Y_L = 0.4 - j0.11\Omega$$

$$Y_1 = 1 + j1\Omega \quad Y_2 = -j1\Omega$$

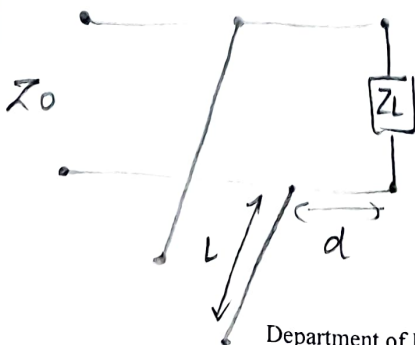
$$d = 0.162 - 0.478$$

$$= -0.136 + 0.5$$

$$d = 0.184\lambda$$

$$L = 0.375\lambda$$

Final stub matching Circuit diagram:



Ex2

$$Z_L = 60 + j25\Omega$$

$$Z_0 = 50\Omega$$

$$Z_L' = \frac{Z_L}{Z_0} = \frac{60 + j25\Omega}{50\Omega}$$

$$\therefore Z_L' = 1.2 + j0.5\Omega$$

$$Y_L = 0.71 - j0.3\Omega$$

$$Y_1 = 1 + j0.5\Omega \quad Y_2 = -j0.5\Omega$$

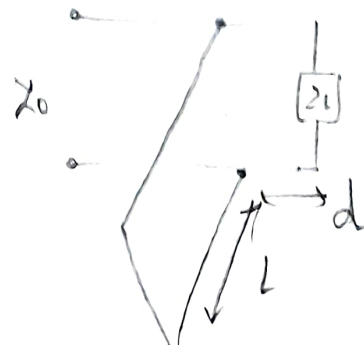
$$d = 0.149 - 0.422$$

$$= -0.273 + 0.5 \quad 0.858 - 0.34$$

$$d = 0.222\lambda$$

$$L = 0.196\lambda$$

$$0.213\lambda$$



Department of Electronics and Telecommunication Engineering

Conclusion:

The experiment successfully demonstrated the design of single stub matching network using Smith chart and Smith software. Proper placement & length of the stub achieved impedance matching, ensuring max. power transfer & reduced reflections in transmission line.

Post Lab Subjective Questions

1. List advantages, applications and limitations of double stub matching.

* Advantages

Provides more flexibility than single stub matching for impedance matching.

Can match a wider range of complex impedances.

Easier to implement when the exact load position is not adjustable.

* Applications

Widely used in microwave circuits for impedance matching.

Matching in waveguides & transmission lines.

Used in antenna feed systems to minimize reflections.

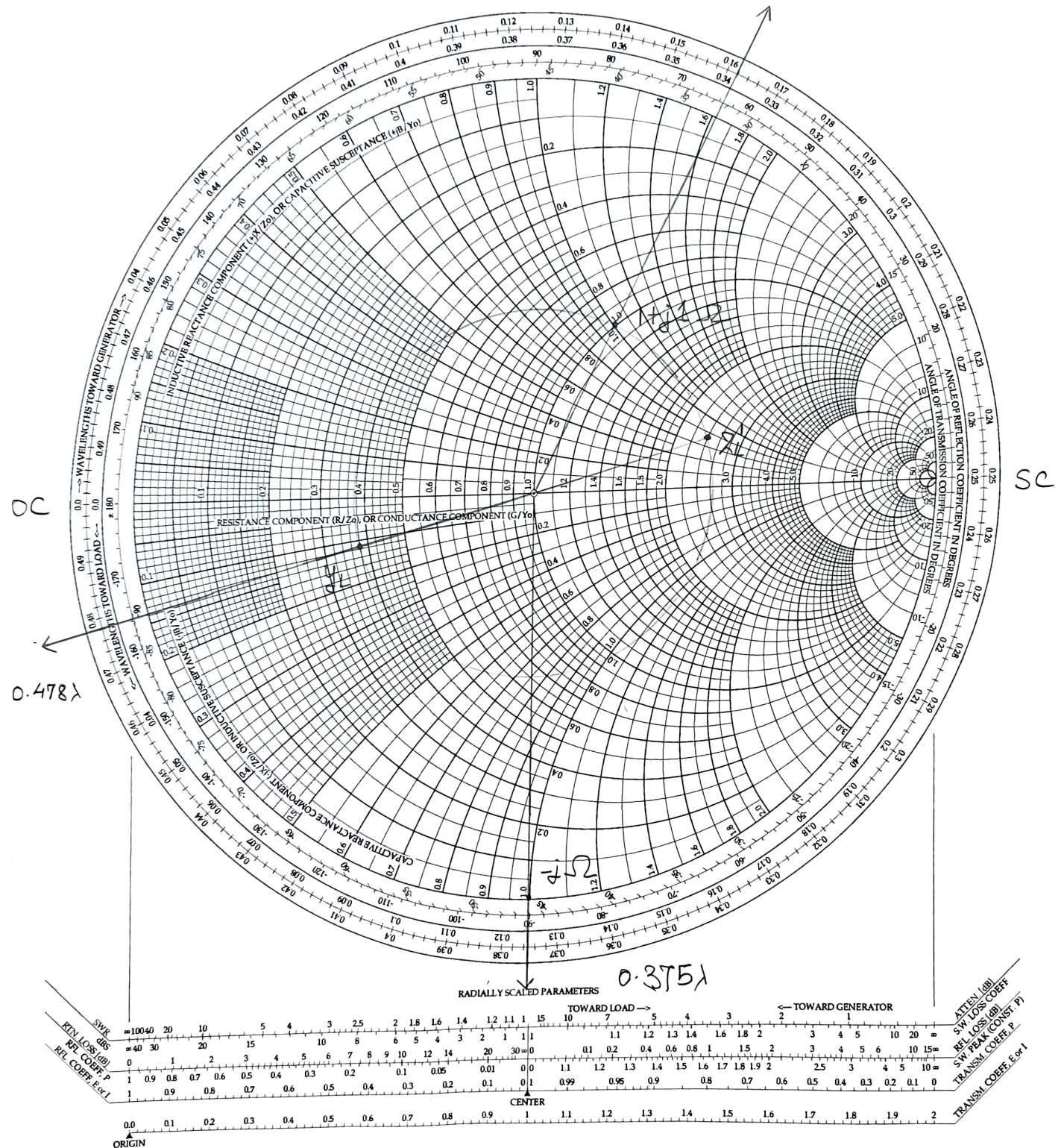
Applied in RF communication systems & microwave devices.

* Limitations

Requires two stubs, making circuit more complex & bulky
Precise tuning of both stubs is necessary, which can be time consuming.

Still can't match all possible load impedance.

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 0.162λ 

$$Z_L = 120 + j35 \Omega$$

$$Z_0 = 50 \Omega$$

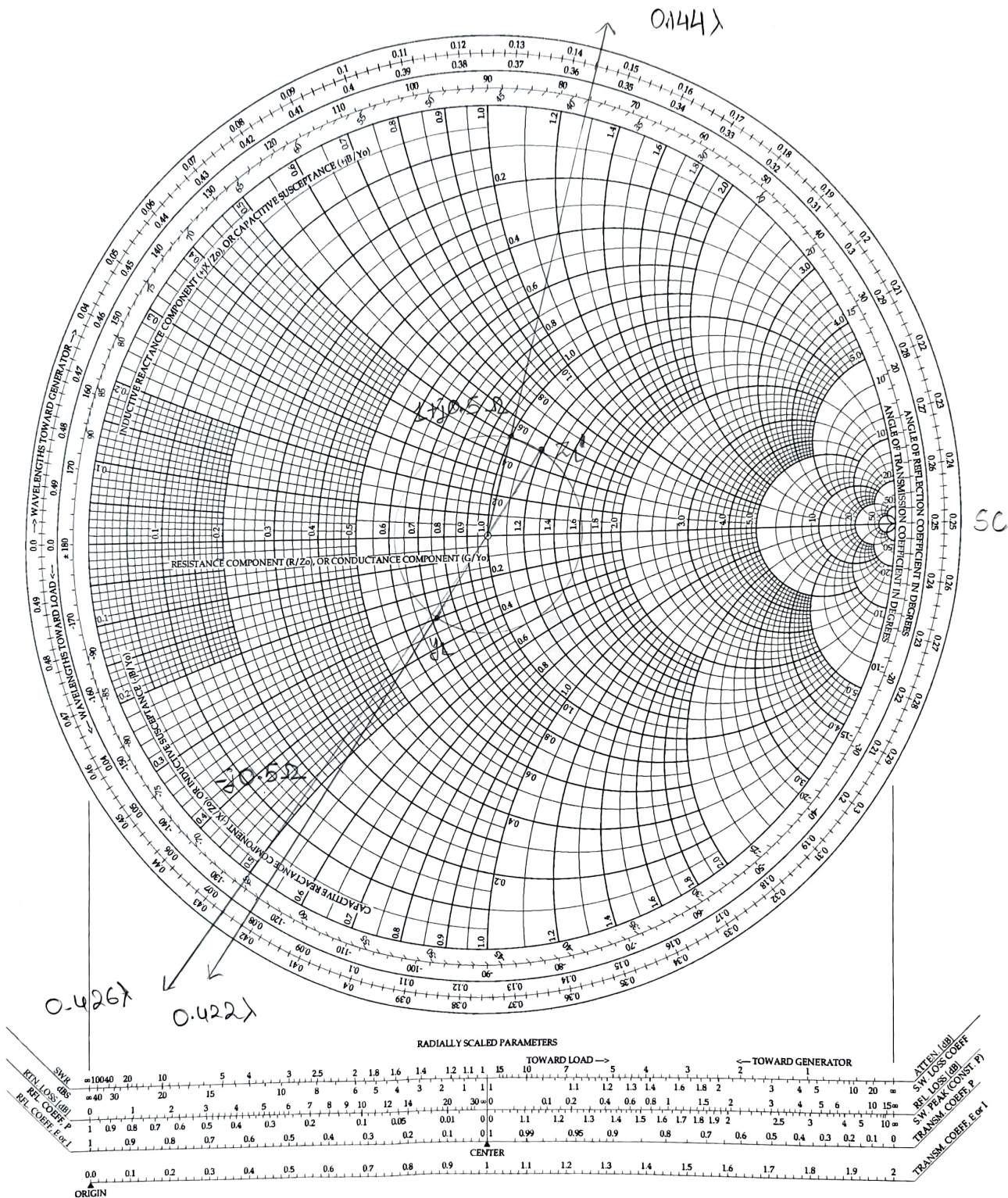
$$Z_L' = \frac{Z_L}{Z_0} = \frac{120 + j35 \Omega}{50 \Omega}$$

$$= 2.4 + j0.7 \Omega$$

Single stub short circuit

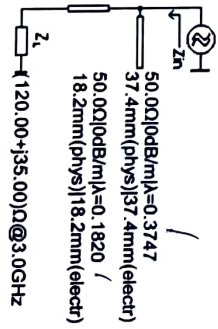
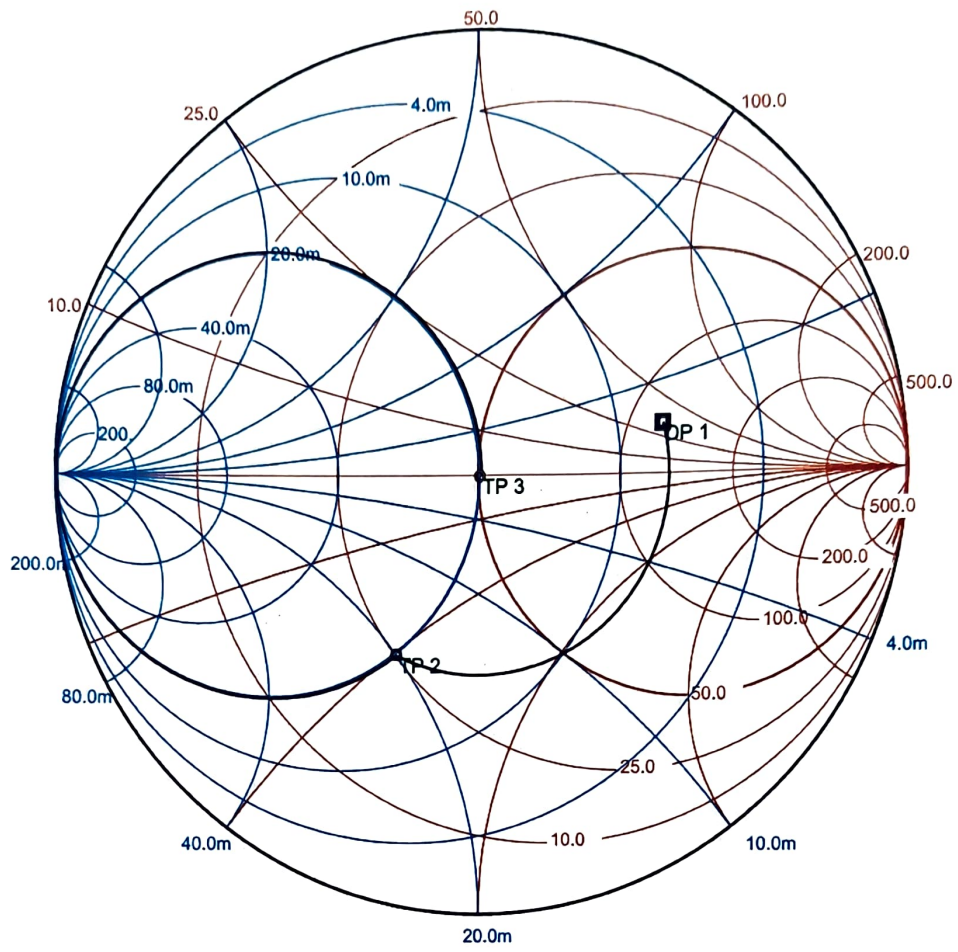
The Complete Smith Chart

Black Magic Design



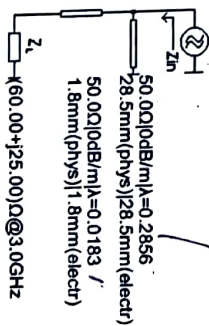
Ex 1

SINGLE STUB SHUNT OPEN CIRCUIT



DP 1	$(120.000 + j35.000) \Omega$	$Q=0.292$	3.000GHz
TP 2	$(24.888 - j25.293) \Omega$	$Q=1.016$	3.000GHz
TP 3	$(50.593 + j0.000) \Omega$	$Q=0.000$	3.000GHz
SP 1	$(50.593 + j0.000) \Omega$	$Q=0.000$	3.000GHz

Ex (2)



DP 1	$(60.000 + j25.000) \Omega$	Q=0.417	3.000GHz
TP 2	$(67.022 + j22.806) \Omega$	Q=0.340	3.000GHz
TP 3	$(74.782 - j0.000) \Omega$	Q=0.000	3.000GHz