

Batch: A2 Roll No.: 1601032204
Experiment / assignment / tutorial No. 6
Grade: AA / AB / BB / BC / CC / CD / DD

Signature of the Staff In-charge with date

21/10/25

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.

Comparison between theoretical and simulated results:

Parameters	Example 1		Example 2	
	Theoretical	Simulated	Theoretical	Simulated
Distance d	0.184λ	0.182λ	0.222 0.018λ	0.285 0.0183λ
Length L	0.375λ	0.374λ	0.7152 0.183λ	0.2836 0.213λ

Signature of faculty in-charge

Theoretical Calculations:

Ex1

$$Z_L = 120 + j85 \Omega$$

$$Z_0 = 50 \Omega$$

$$Z'_L = \frac{Z_L}{Z_0} = \frac{120 + j85 \Omega}{50 \Omega}$$

$$\therefore Z'_L = 2.4 + j0.7 \Omega$$

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

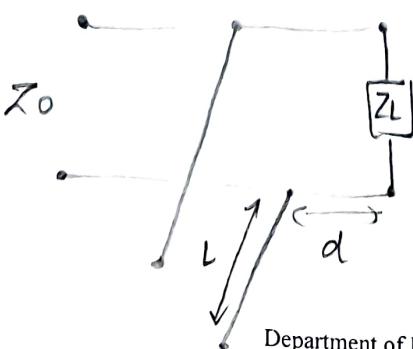
$$Y_1 = 1 + j1 \Omega \quad Y_2 = -j1 \Omega$$

$$d = 0.162 - 0.478 \\ = -0.136 + 0.5$$

$$d = 0.184\lambda$$

$$L = 0.375\lambda$$

Final stub matching Circuit diagram:



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Ex2

$$Z_L = 60 + j25 \Omega$$

$$Z_0 = 50 \Omega$$

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

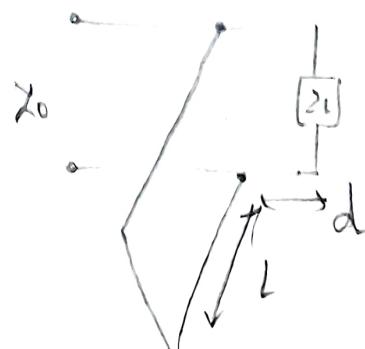
$$\therefore Z'_L = 1.2 + j0.5 \Omega$$

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

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

$$d = 0.140 - 0.422 \\ = -0.288 + 0.5 \quad 0.858 - 0.34$$

$$d = \cancel{0.222} \quad \cancel{-0.018} \\ L = \cancel{0.196} \quad \cancel{0.213\lambda}$$



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.

Post Lab Subjective Questions in transmission line

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.

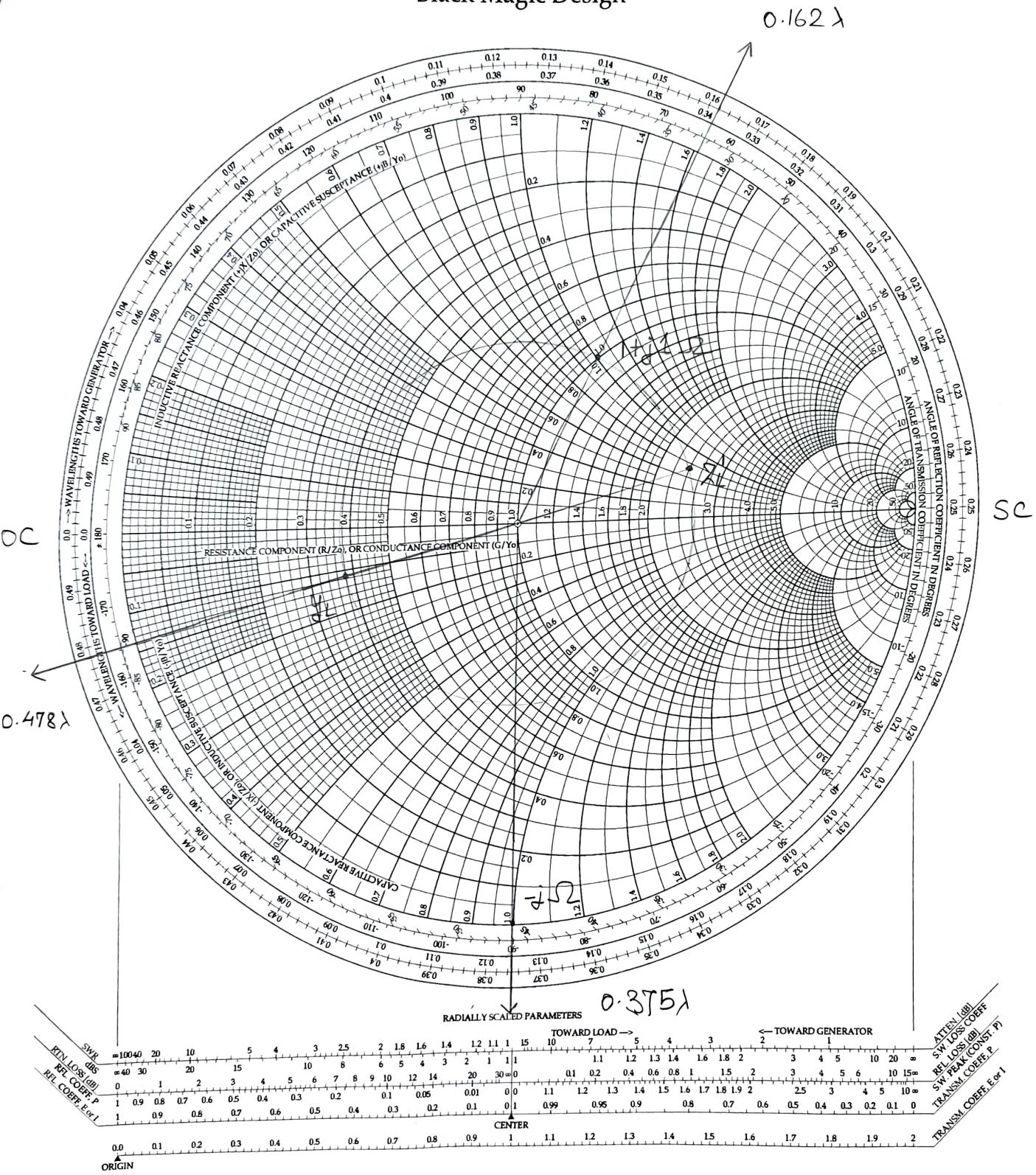
Still can't match all possible load impedance.

Single stub open circuit

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The Complete Smith Chart

Black Magic Design



$$Z_L = 120 + j35 \Omega$$

$$Z_0 = 50 \Omega$$

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

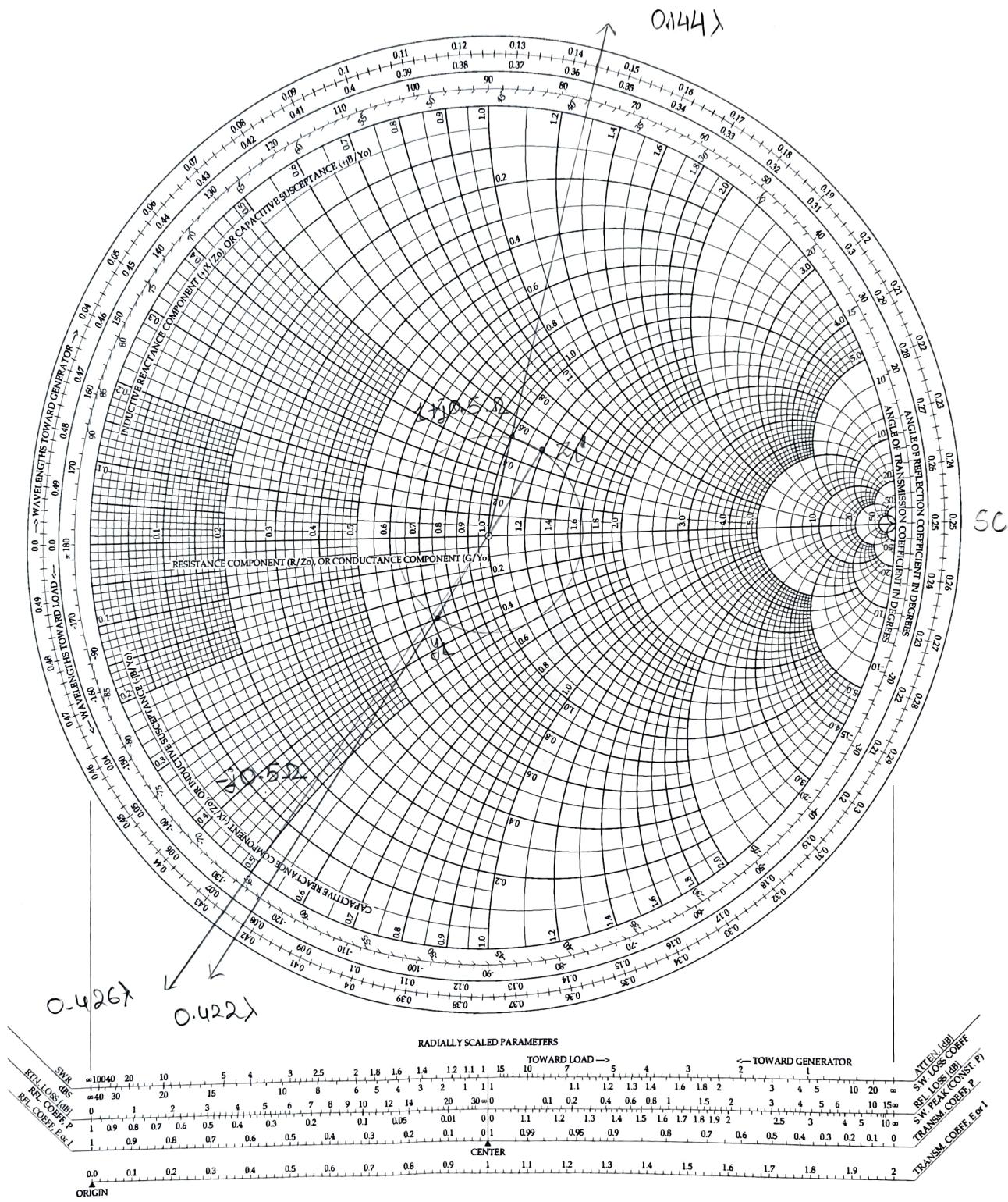
$$= 2.4 + j0.7 \Omega$$

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Single stub short circuit

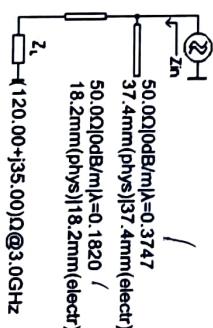
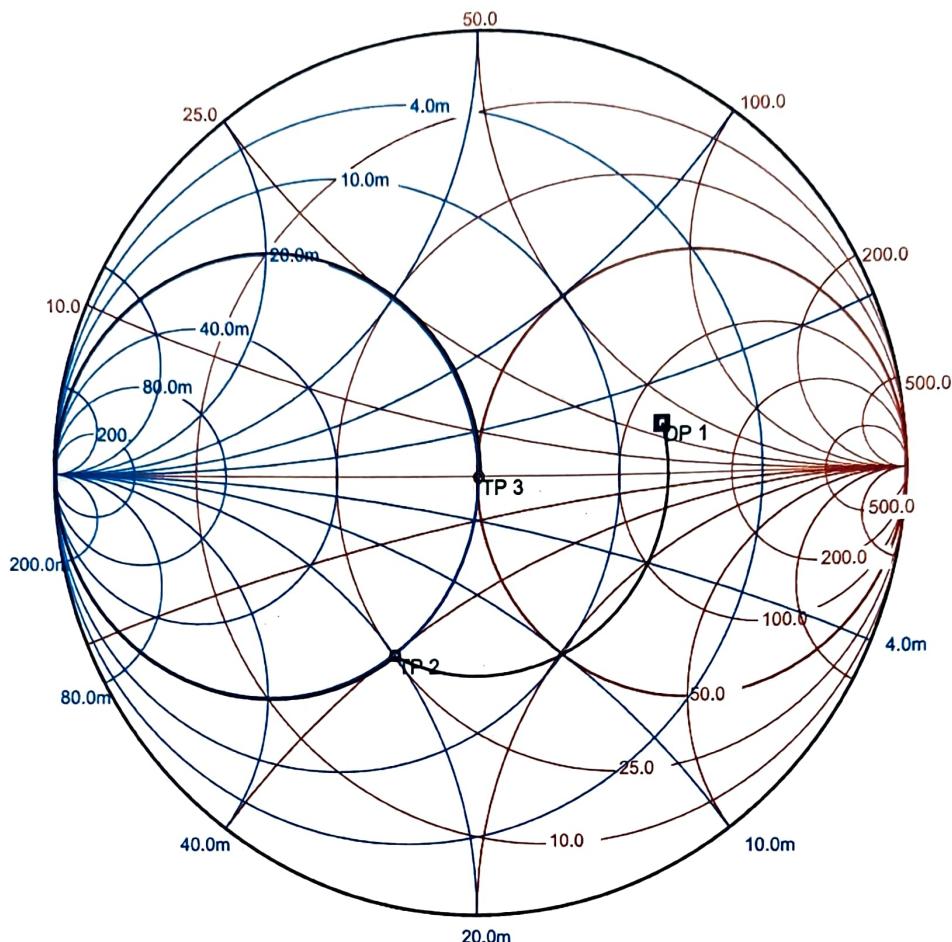
The Complete Smith Chart

Black Magic Design



Ex 1

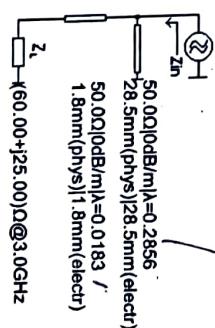
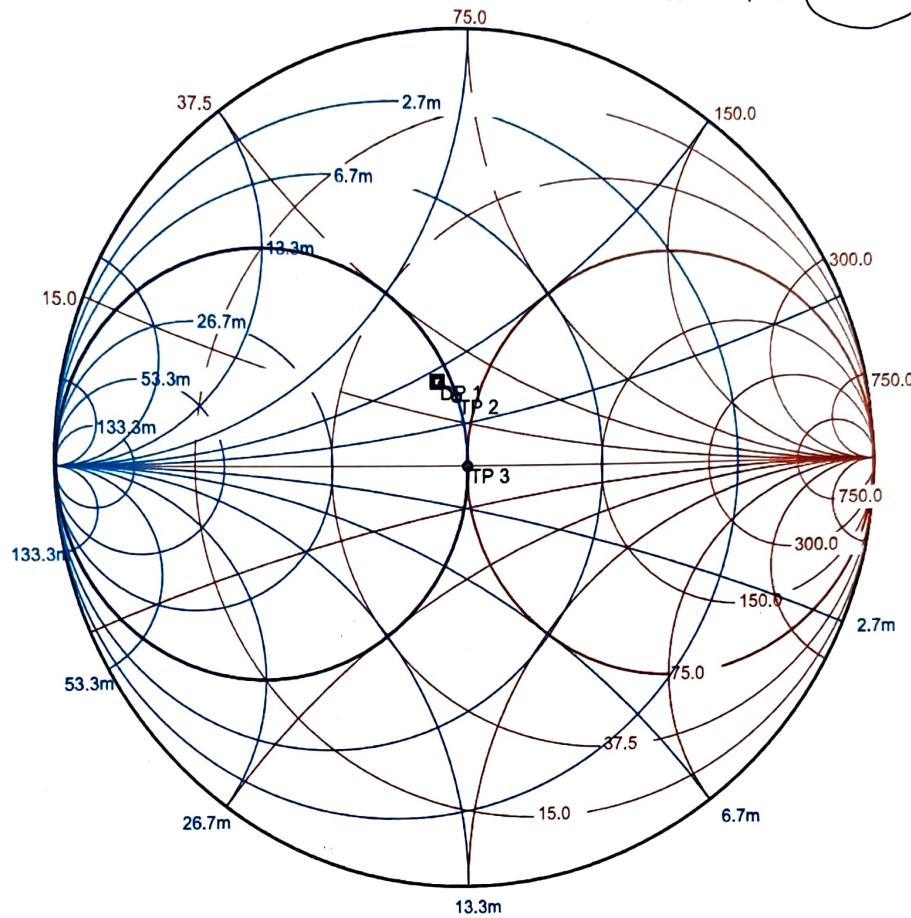
SINGLE STUB SHUNT OPEN CIRCUIT



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

SINGLE STUB SHUNT SHORT CIRCUIT

Ex (2)



DP 1
 TP 2
 TP 3

$$\begin{aligned}
 & (60.00 + j25.00) \Omega \\
 & (67.022 + j22.806) \Omega \\
 & (74.782 - j0.000) \Omega
 \end{aligned}$$

$Q=0.417$	3.000GHz
$Q=0.340$	3.000GHz
$Q=0.000$	3.000GHz