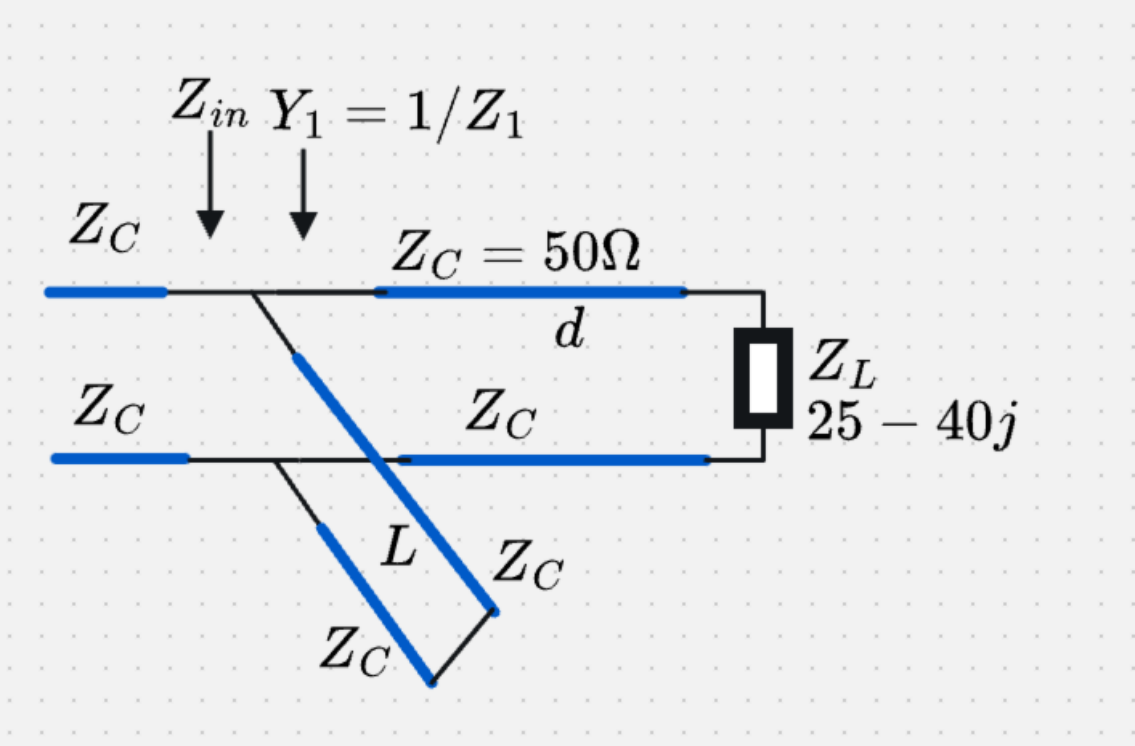
Single Stub Example

in this example we will find L and d that our load will be matched with Z_{in}



Solution Steps:

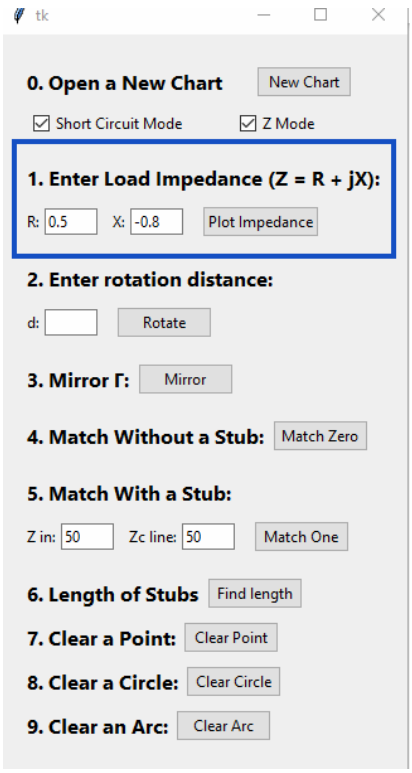
1. Normalize the load impedance, $\bar{Z}_L = Z_L/Z_C$. We will drop the bar notation from now on.
2. Plot the normalized load on the smith chart. The real part lies on the circles and the imaginary on the arcs. Their intersection is our load.
3. Draw a circle from the origin of the smith chart with Z_L as its radius.
4. Since we are dealing with a parallel connection working with admittance is easier. For that mirror the impedance by 180 degrees to get Y_L.
5. Move on the circle towards the generator until you hit the circle of $1 + Xj$, this matches the real part. Mark the intersection points as Y_{int1} and Y_{int2}.
6. The distance from the load, d is given by the arc from Y_L to Y_{int}.
7. At the point Y_1 the admittance is $Y_{stub} + 1 + Xj$. We would like it to be equal to impedance of the line $Y_C = 1/Z_C$. Since Y_C is real and the stub only donates an imaginary part we will choose $Y_{stub} = -Xj$.
8. The arc from the point of short circuit to the point $-Xj$ is the required length of the stub, L. and the matching is complete.

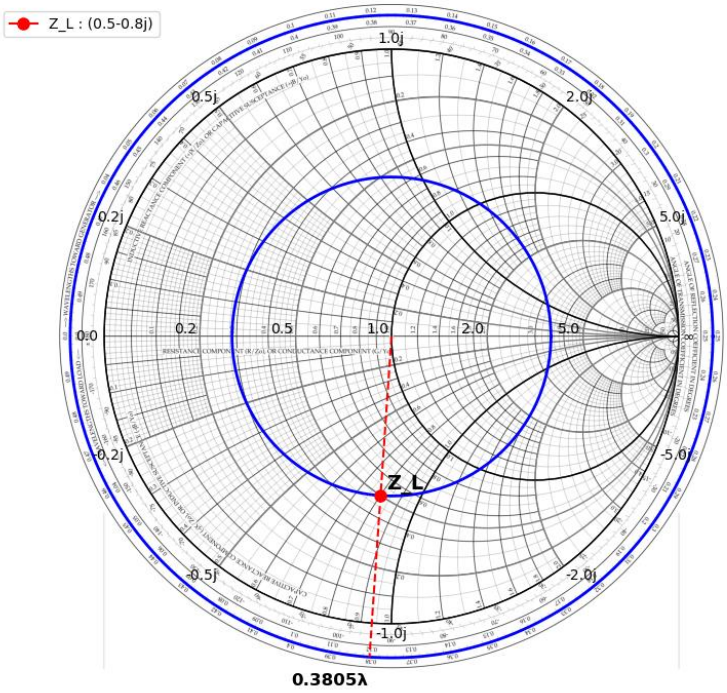
Steps 1,2 ,3

Step one: Normalize the load

$$\bar{Z}_L = \frac{Z_L}{Z_C} = \frac{25 - 40j}{50} = 0.5 - 0.8j$$

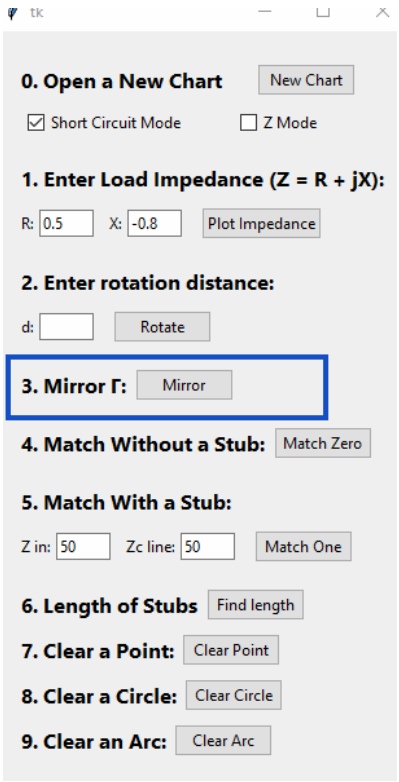
Steps Two and Three: plot Z_L and draw a circle with radius Z_L

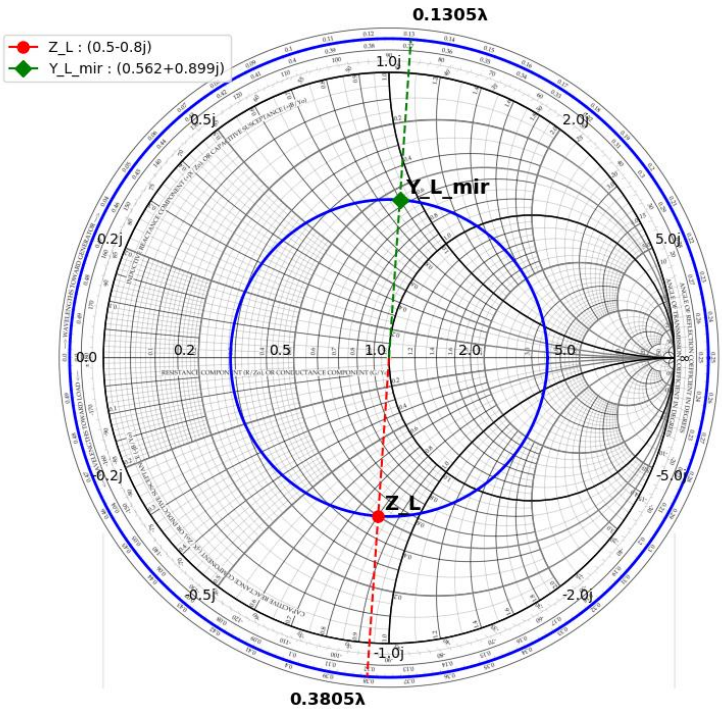




Step Four

Step four: mirror to get $Y_L = 0.562 + 0.899j$

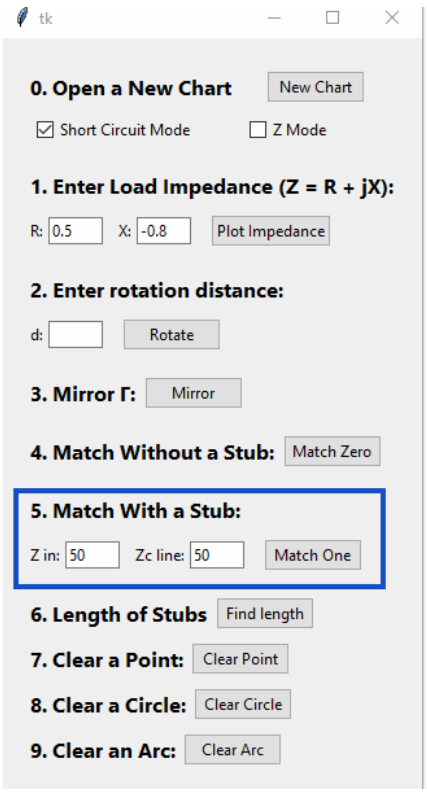


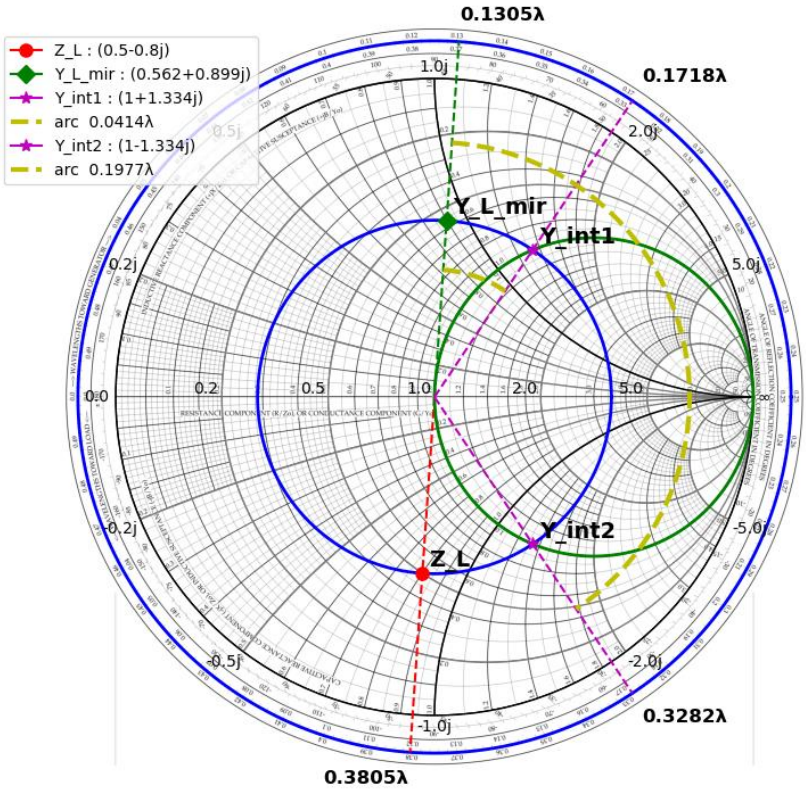


Steps Five and Six

Step five: from Y_L towards the generator until you hit the $1 + Xj$ circle (in green).

Write the intersection points.





Step six:

First option for d:

$$Y_{int1} = 1 + 1.33j, \Longrightarrow\ d = 0.1718\lambda - 0.1305\lambda = 0.0413\lambda$$

Second option for d:

$$Y_{int2} = 1 - 1.33j, \Longrightarrow\ d = 0.3282\lambda - 0.1305\lambda = 0.1977\lambda$$

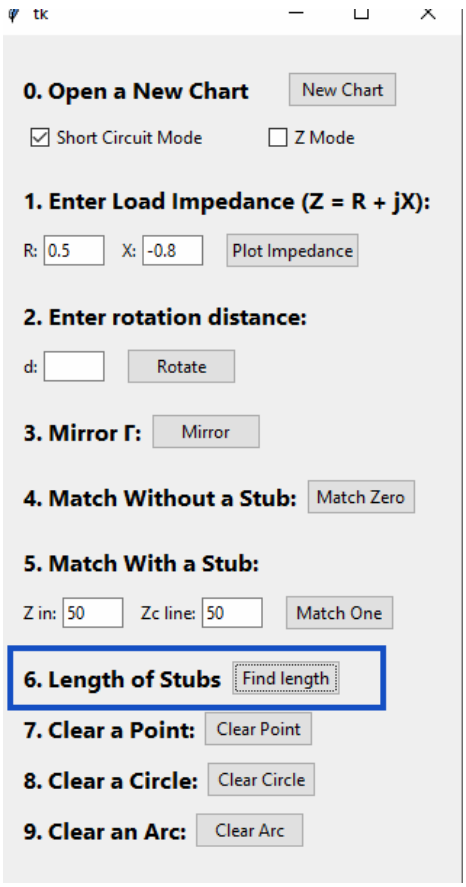
Steps Seven and Eight

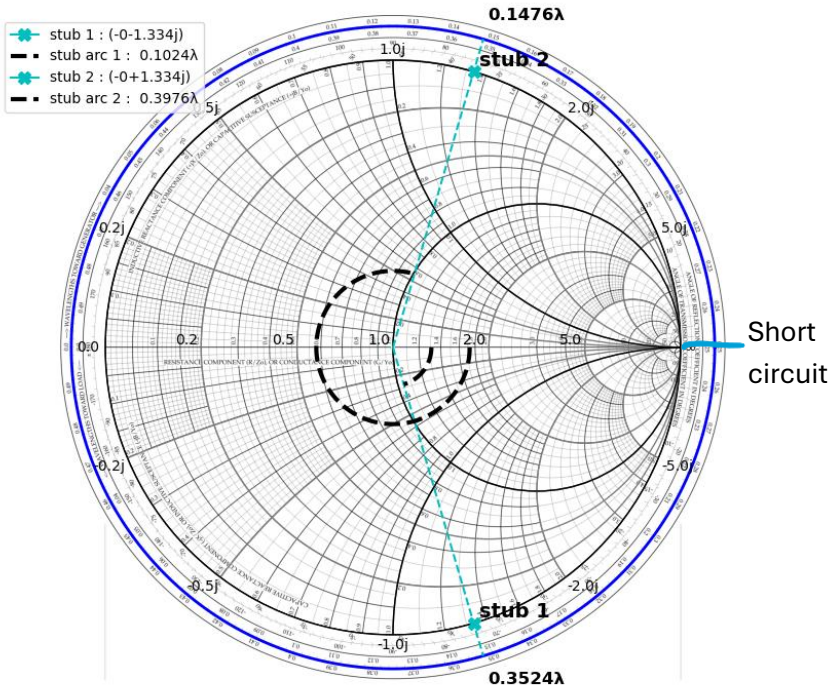
Step seven:

Find the imaginary part of the stub

For the first option $Y_{stub} = -1.33j$ and for the second option $1.33j$

find the admittance location on the chart.





Step eight:

The length of the stub L is given by the arc length from the short circuit to the stub

First option:

$$L = Y_{stub1} - Y_{SC} = 0.3525\lambda - 0.25\lambda = 0.1025\lambda$$

Second option:

$$L = 0.5\lambda - (0.25\lambda - 0.1476\lambda) = 0.3976\lambda$$