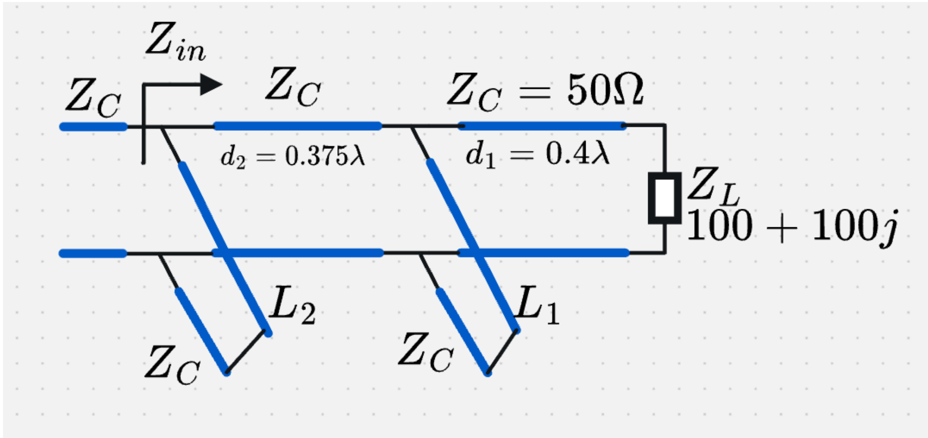
<u>Two Stubs Example</u>

in this example we will find L_1 and L_2 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. Roate the load a distance of d_1 towards the generator. Rotation towards the generator is done by inserting $d_1 < 0$ and it rotates Z_L clockwise.
5. Since we are dealing with a parallel connection working with admittance is easier. For that mirror the impedance by 180 degrees to get $Y_{L,rot}$.
6. Go along the circle for $Y_{L,rot}$ until you hit the real axis, mark this point as A.
7. The point on the right edge of the real axis represents a short circuit, mark this point as B. from the middle point between A and B, draw a circle with radius $0.5(B - A)$. As a sanity check the points A,B and $Y_{L,rot}$ should be on that circle.
8. Locate the unity circle of 1 + Aj and rotate it a distance d_2 towards the load, rotation towards the lock is counter clockwise. This is done by inserting $d_2 > 0$. Mark the two intersection points of the circles as Y_{int1} and Y_{int2}.
9. Calculate the difference $Y_{dif} = Y_{L,rot} - Y_{int}$. Since they are on the same circle the result should be purely imaginary.
10. Find the location of Y_{dif} and calculate its arc length from point B, that lies on the right edge of the chart, that is the value for L_1
11. Rotate the unity circle of $1 + Xj$ with the points Y_{int} back to its original place. The negative of the imaginary value of Y_{int} is the value of the admittance.
12. Same as step 10.

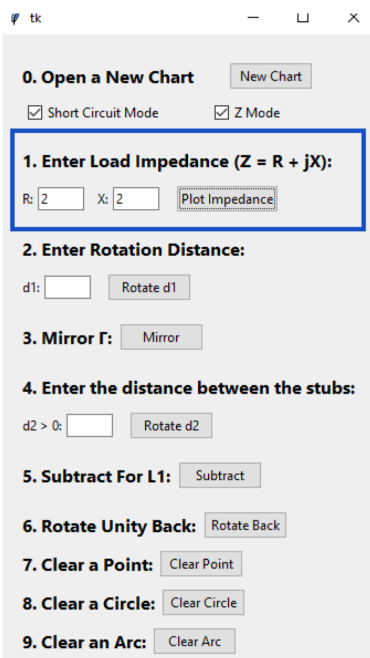
Steps One, Two and Three

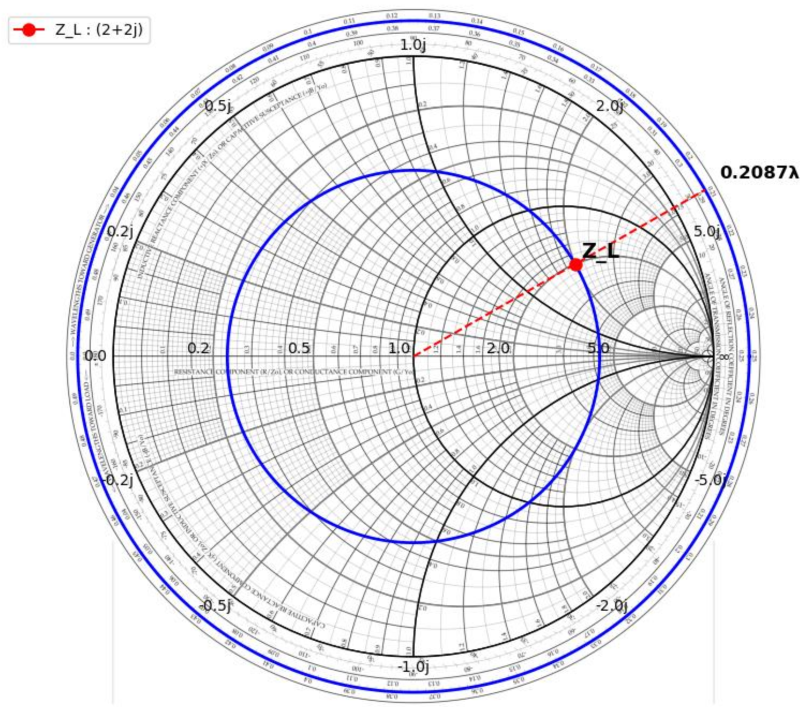
Step one: normalize the load

$$\bar{Z}_L = \frac{Z_L}{Z_C} = \frac{100 + 100j}{50} = 2 + 2j$$

Step two and three:

Plot Z_L and a circle around the origin with Z_L as its radius.

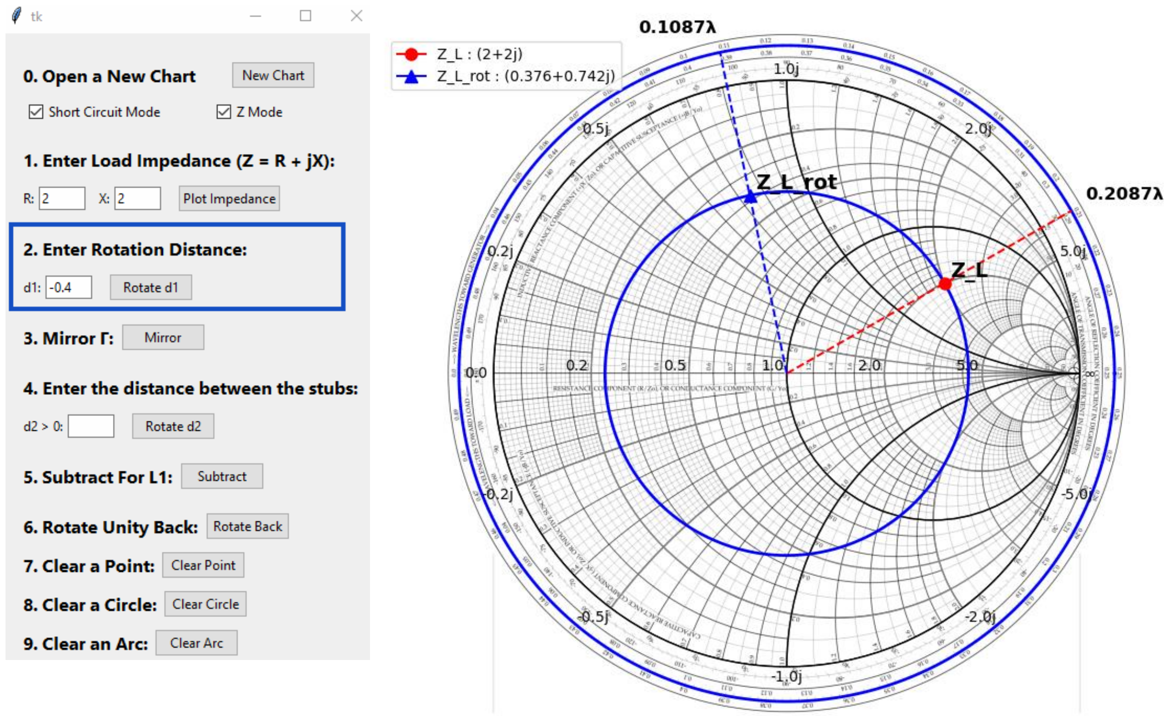




Step Four

Step four:

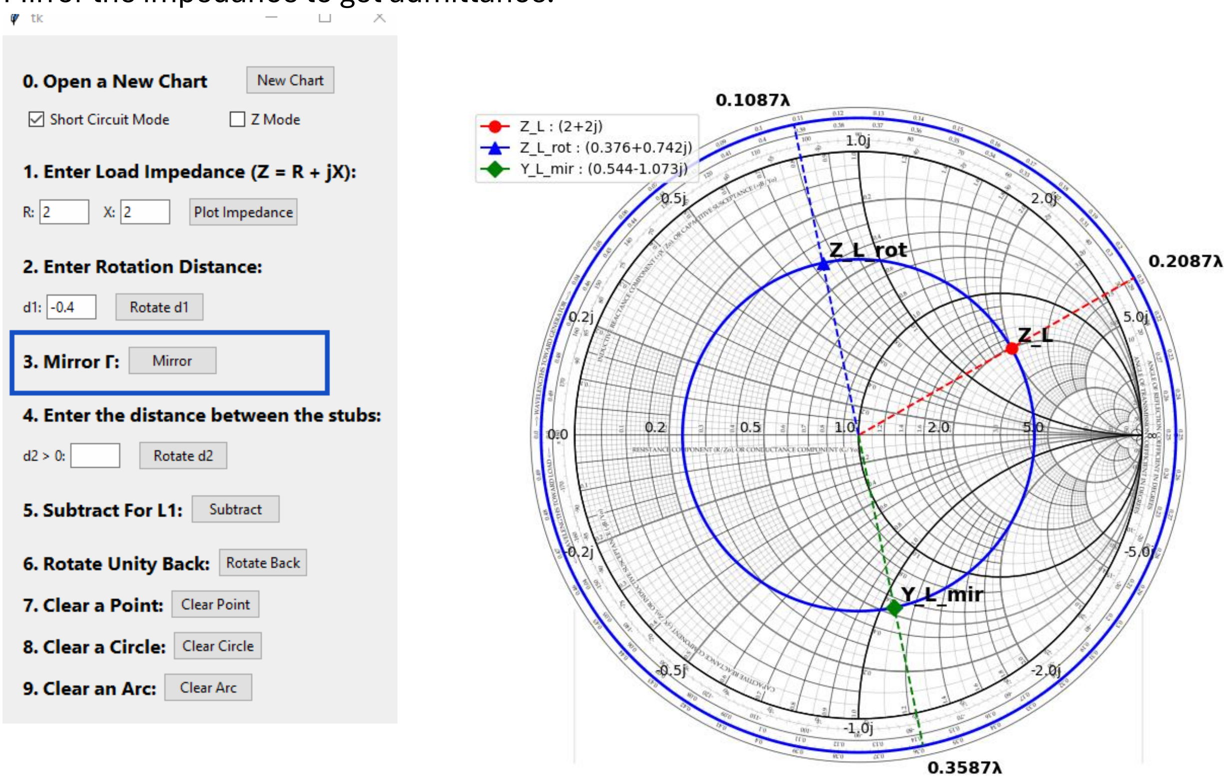
Rotate the load a distance of $d_1 < 0$ towards the generator.



Step Five

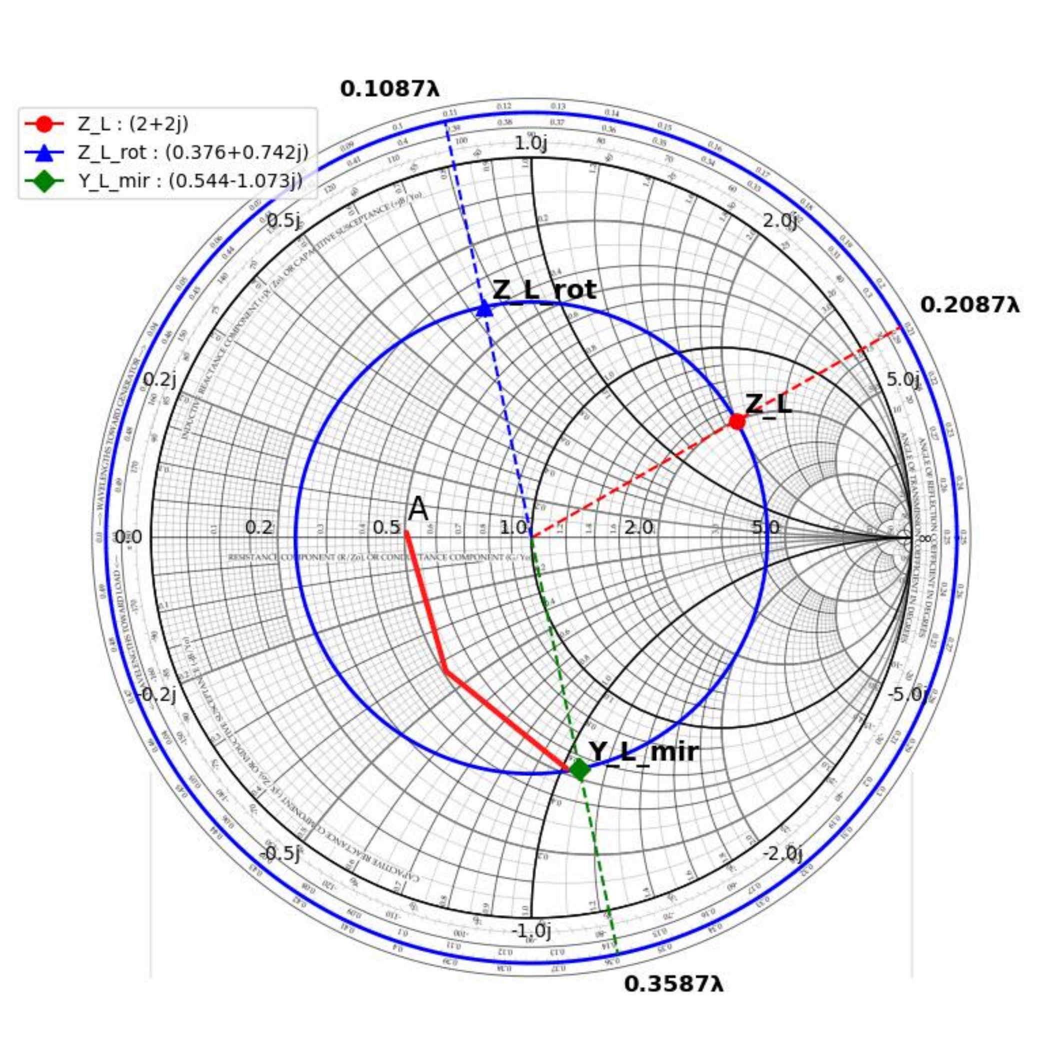
Step four:

Mirror the impedance to get admittance.

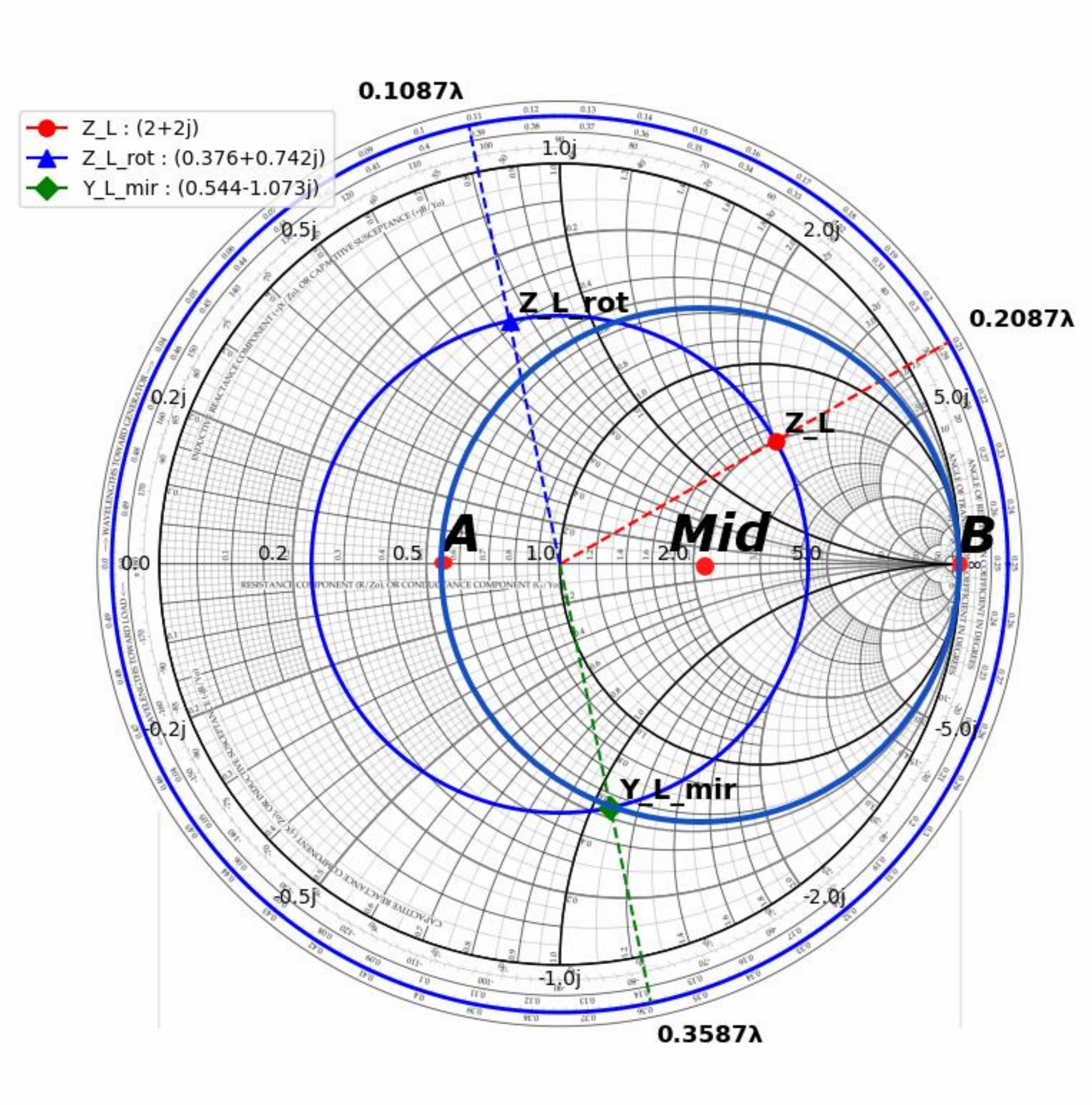


Steps Six and Seven

The python code does steps 6,7 and 8 automatically. Let's start with step six. From $Y_{L,mir}$ move along the arc until you have hit the real axis, mark this point as A



For step seven locate the point of infinite conductance, i.e. a short circuit at the right edge of the chart and mark this point as B. from the middle of the road from A to B, draw a radius with length equals to half the distance between A and B.

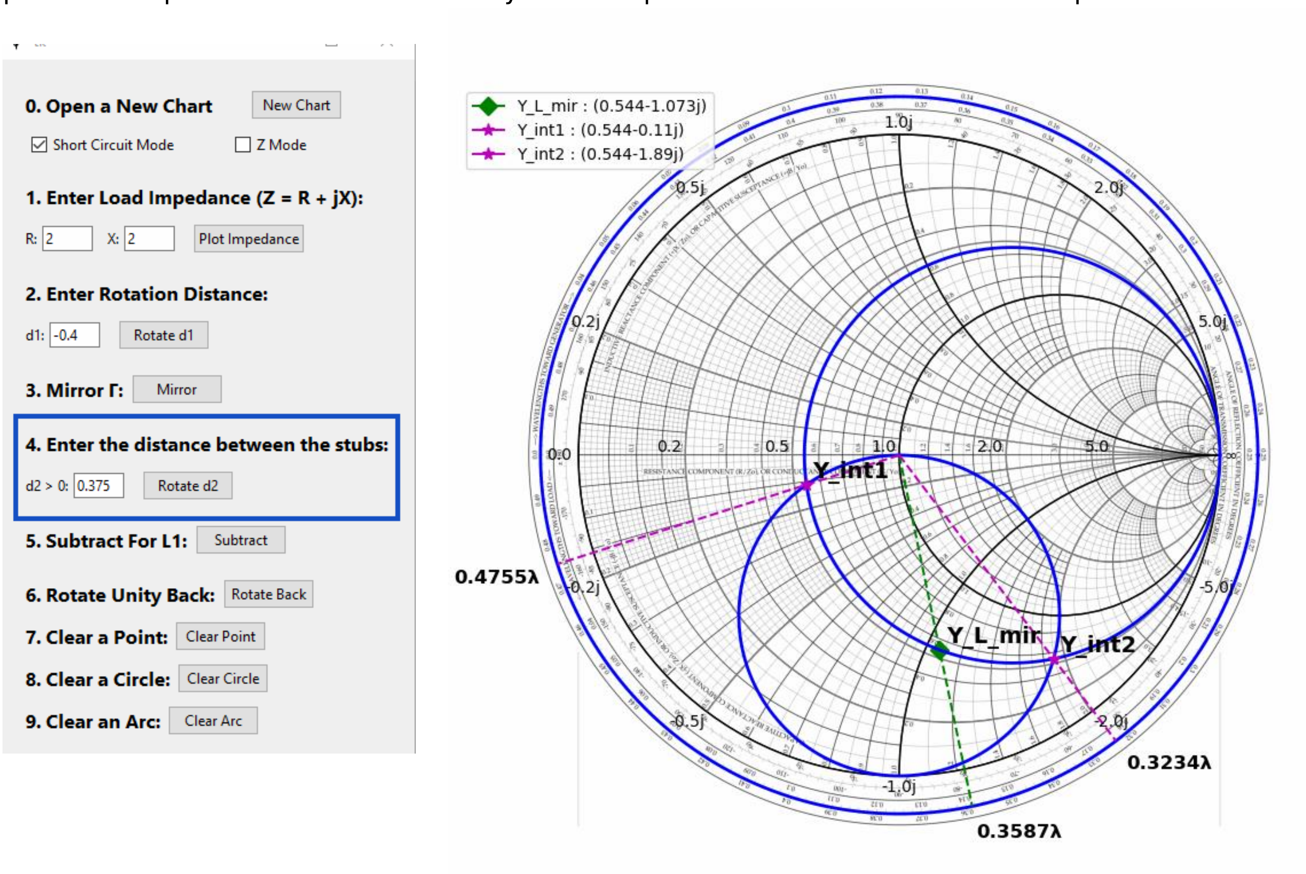


Steps Eight

Step eight:

Locate the unity circle of 1 + Aj and rotate it a distance d_2 towards the load, rotation towards the lock is counter clockwise. This is done by inserting $d_2 > 0$. Mark the two intersection points of the circles as Y_{int1} and Y_{int2}.

At this point I highly recommend clearing the chart using remove circle or remove points. It is also possible to open a new chart and directly click on option 4 to continue from the same place.



Write down the intersection points they will be needed for later use.

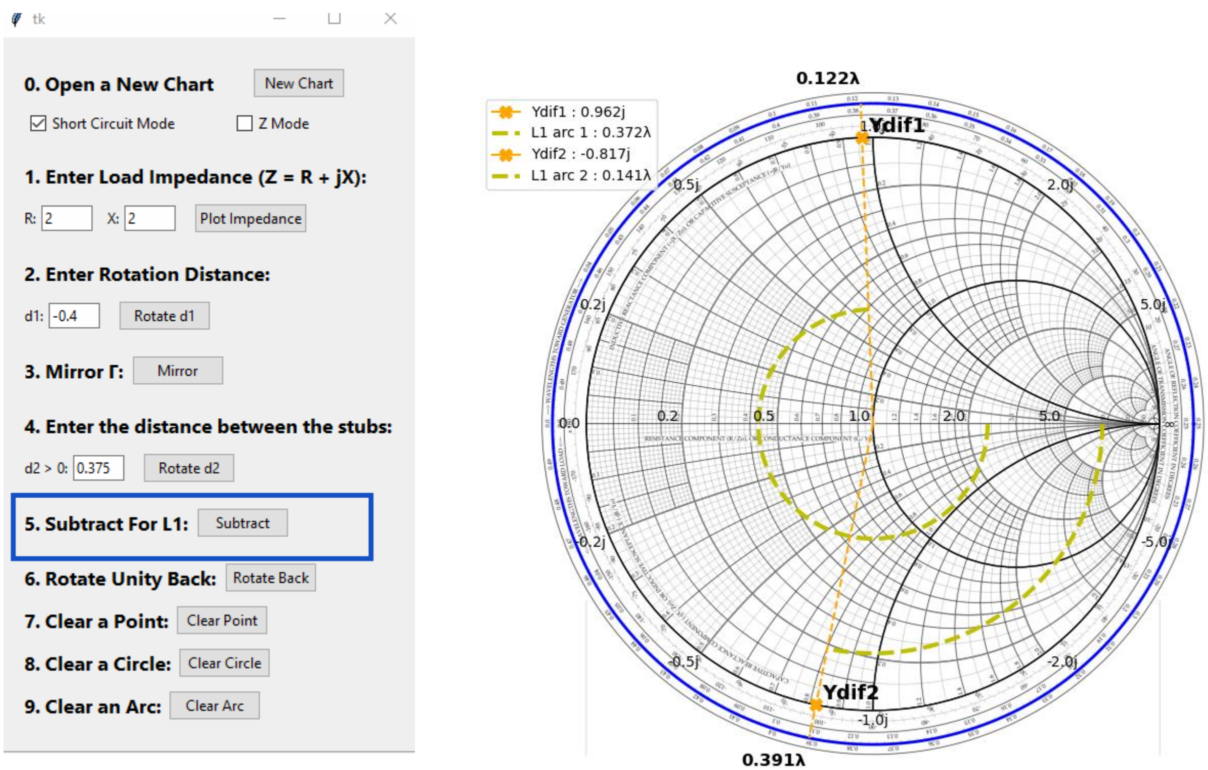
$$Y_{int1} = 0.544 - 0.11j$$

$$Y_{int2} = 0.544 + 1.89j$$

Steps Nine and Ten

For step nine and ten find the difference between $Y_{dif} = Y_{L,rot} - Y_{int}$. Since they are on the same circle the result should be purely imaginary.

Find the point on the chart with the value Y_{dif}, the clockwise arc from point B to Y_{dif} is the length of the short circuit stub. This is the length of the first stub.



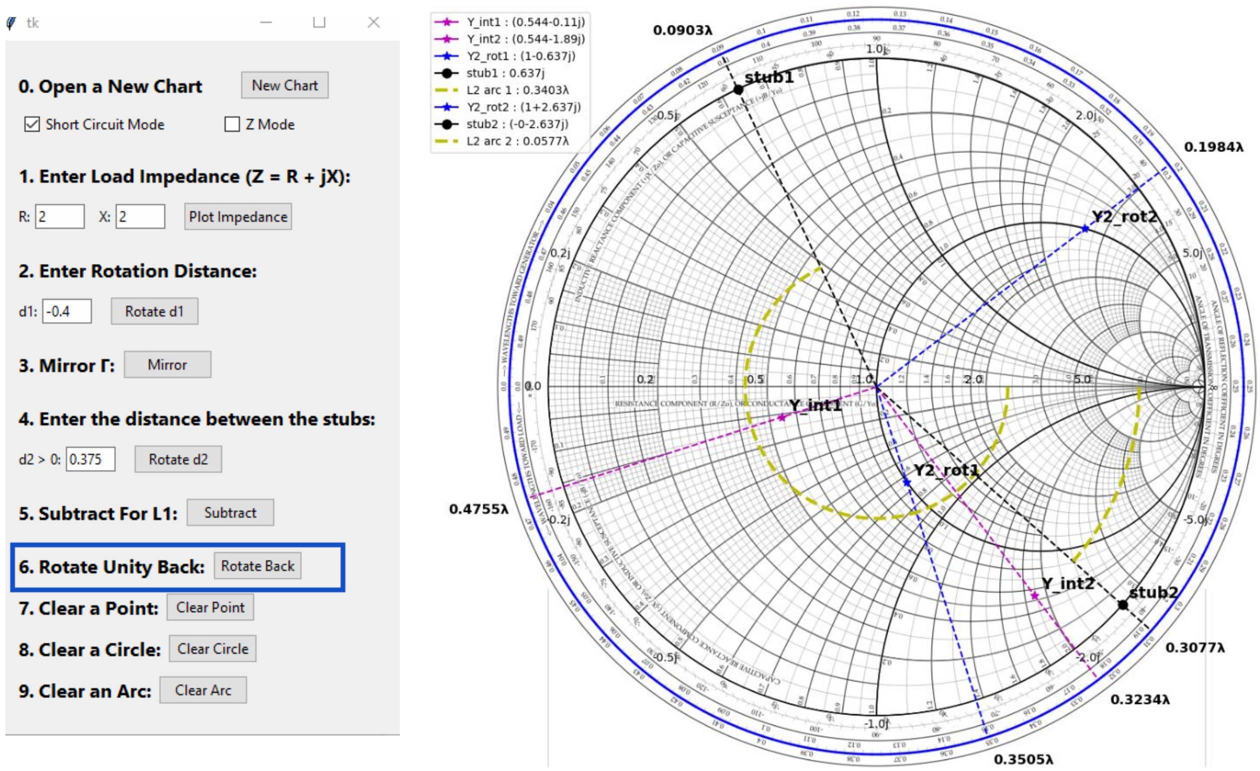
$$Y_{dif1} = 0.962j \Longrightarrow L_1 = 0.372\lambda$$

$$Y_{dif2} = -0.817j \Longrightarrow L_1 = 0.141\lambda$$

Steps Eleven and Twelve

For the two last steps rotate the unity circle with the two intersection points Y_{int} back to its original place. Fina the negative of the imaginary of the rotated points on the chart.

The clock wise arc from point B, on the right edge, the this value is the length of the second stub.



$$L_2 = 0.34\lambda \; or \; 0.0577\lambda$$

And that’s it. Another note is that sometimes matching with the two stubs isn’t possible.

Usually, it’s when the points land inside the $2 + Bj$ circle , when in admittance mode.

That means there is no combination of short circuits that will get us to a match.