IMPEDANCE MATCHING METHODS

Tonight I will examine several circuits used for impedance matching.

First, do you really need an antenna tuner?

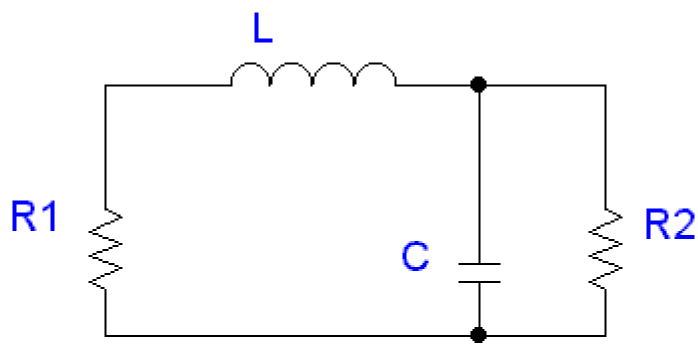
If you are using a dipole cut for the frequency at HF, probably not. Most transceivers can handle SWR up to about 2:1 without ill effects or folding back the power. This is achieved with the dipole operated through a large section of the band it is cut for. 75/80 meters is an exception, being so wide that a dipole cut for 80 may present a very high SWR on 75 Phone. Walter Maxwell W2DU does not recommend one for mobile installations.

If you are running VHF/UHF and think that you need one, something is wrong. Tuners are manufactured for these frequencies, but you will have considerable loss in the feed line. You are better off repairing or replacing the antenna.

If you need to run very wide bandwidth on HF- more than one band per antenna, a large band on one antenna, feed your antenna with balanced line, or have antenna with “weird” or non-standard (non 50 ohm) impedance, a tuner is the thing for you.

The tuner or transmatch will convert the impedance of the antenna system to one that is a good match for the transmitter.

The “L” section network is the simplest, especially with the equations that define the parameters of the components.



R1 < R2 and 1<Q<5

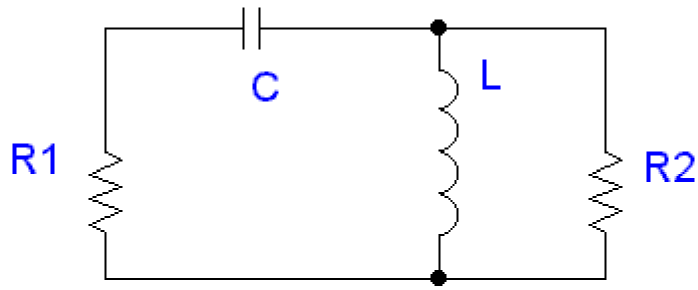
$X_L = 2\pi FL = Q \times R1$

$$Q = \sqrt{\frac{R2}{R1} - 1}$$

$$Q = \frac{X_L}{R1} = \frac{R2}{X_C}$$

Note that X_L is dependent on frequency, the constant 6.28 (2 times Pi) and the value of R1 and the Q of the circuit. The last equation implies that $R1R2 = X_L X_C$. These are the parameters for a matched condition. What good does this do? It will help you decide what size of a capacitor you may need for a given inductor.

The next circuit is also designed for R1 to be less than R2, or in other words, for driving a higher impedance load.



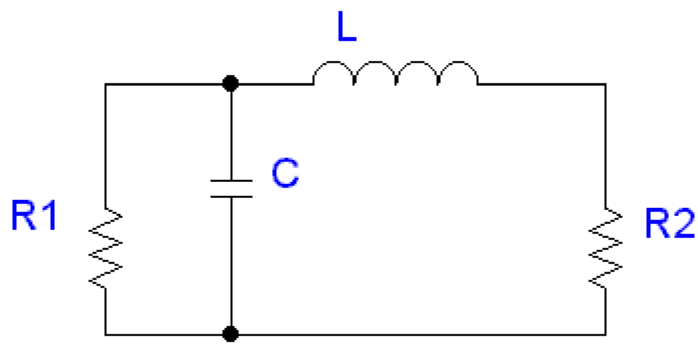
R2 > R1

$X_L = R2 \sqrt{R1 / (R2 - R1)}$

$X_C = X_L$

Notice that X_L can be defined in terms of R1 and R2.

The last L section is designed to match a transmitter to a lower impedance.



R1 > R2 and 1 <Q<5

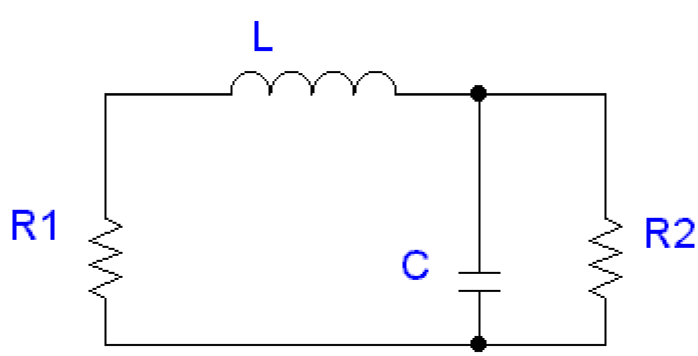
$X_L=2\pi FL= \sqrt{R1R2-R2}$

$$X_C= \frac{1}{2\pi FC} = \frac{R1R2}{X_L}$$

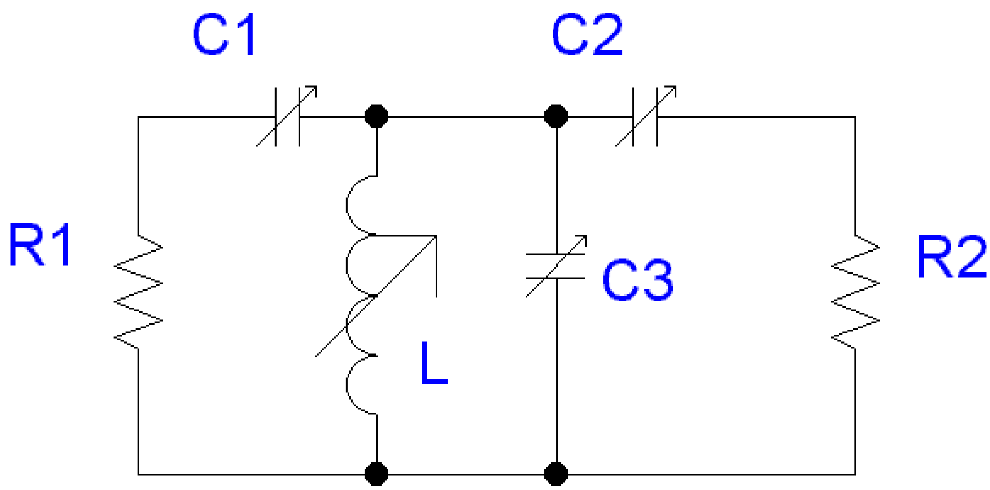
$$C = \frac{1}{2\pi F\, X_C}$$

$$L = \frac{X_L}{2\pi F}$$

The most common network in use is the T – Network.
It was not popular with older equipment, as it is configured as a high pass filter. This is usually no problem with modern equipment.



The last circuit is a modified T network- this improved transmatch provides harmonic suppression.



HOW TO ADJUST YOUR TRANSMATCH

There are two methods I have found-

1. The quick and easy method.

Adjust both capacitors to their mid range setting.
Adjust the inductor for maximum noise in the receiver set at the desired frequency.
Alternately adjust the two capacitors for lowest SWR.

2. The slow and very tedious method.

1. Adjust the capacitor on the transmitter side for maximum.
2. Alternately adjust the inductor and load capacitor for best match.
3. If a good match cannot be found, reduce the setting on the transmitter capacitor slightly, then alternately adjust the inductor and load capacitor for best match.
4. Continue step 3 until there is a good match.

The point of this method is that the tuner will operate most efficiently when the transmitter side capacitor is adjusted to the maximum possible capacitance. If there is a log scale on the adjustments, you may want to consider writing down the settings for future reference.