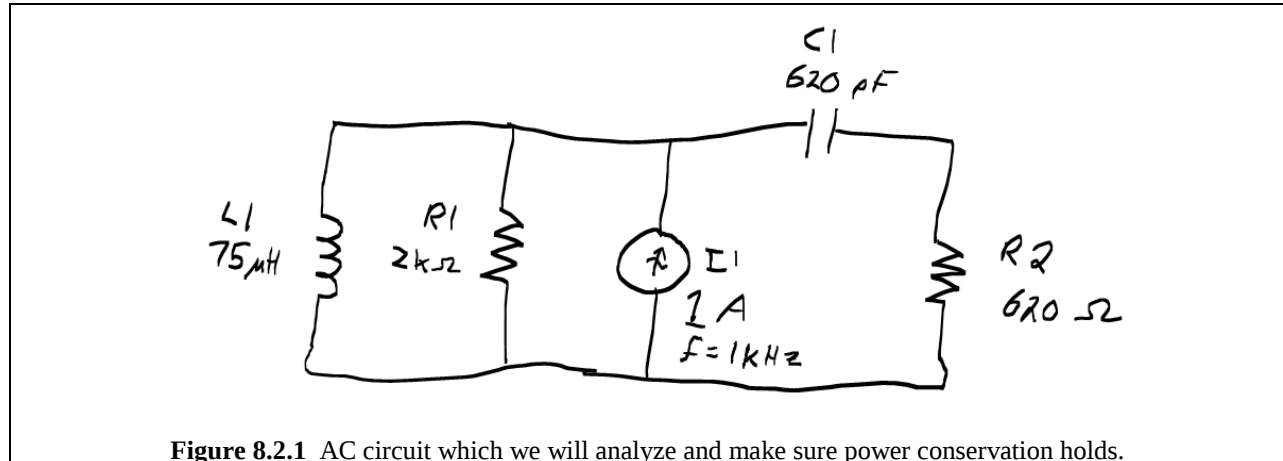


MULTISIM DEMO 8.2: AC POWER USING AC ANALYSIS

In the last brief section, we learned how to measure RMS voltage, current and average power dissipated (or supplied). However, as we know, AC power is much more...complex than that (yes, that is a pun). Complex power is the focus of this section. We are going to see how to measure and analyze complex power in using the AC Analysis.

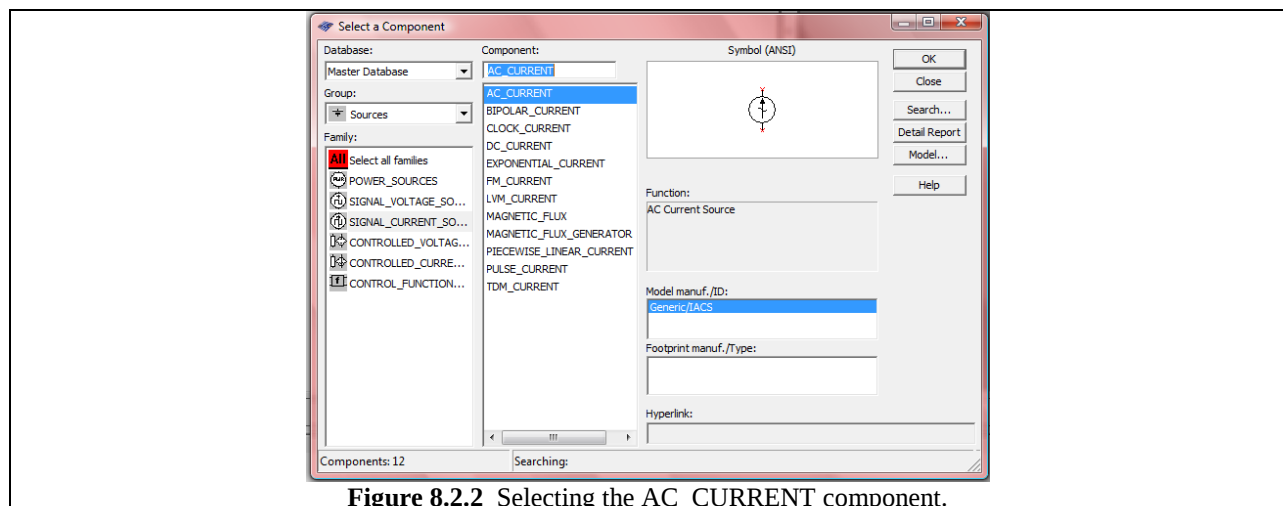
We will analyze the circuit found in below in Figure 8.2.1 and verify the conservation of complex power at 1.5 MHz.



The only component which may be unfamiliar to you is the AC_CURRENT which the schematic calls for. This can be obtained under:

Group: Sources
 Family: SIGNAL_CURRENT_SOURCES
 Component: AC_CURRENT

(See Fig. 8.2.2 below for reference).



We'll keep the AC_CURRENT components parameters at their default settings, although if you want to change them down the line it is pretty intuitive, especially if you've been following along in the all of the Multisim Demos.

Since we will be calculating and measuring power, we need to remember to insert 0 V sources in branches where we have no other way of measuring the current. Keeping this in mind, the circuit, once completely assembled in Multisim should resemble Fig. 8.2.3 below.

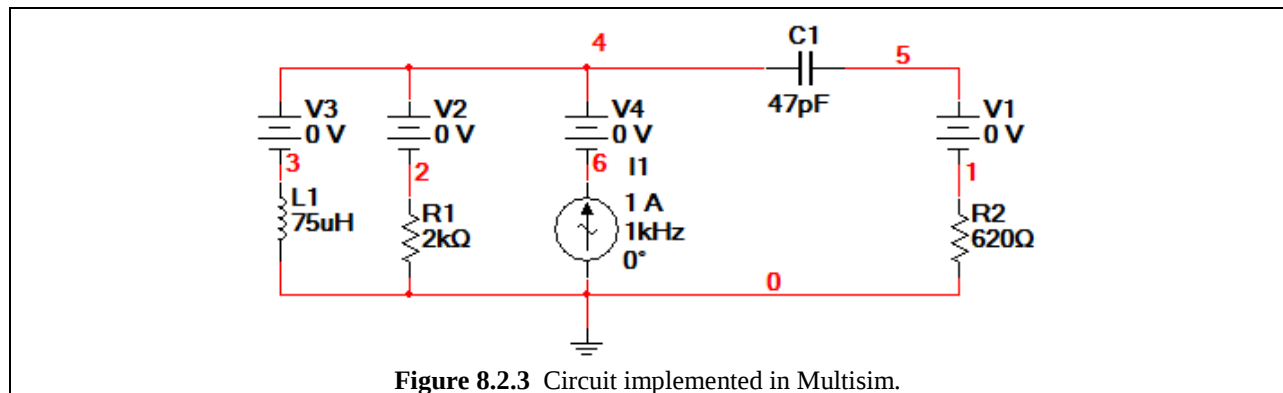


Figure 8.2.3 Circuit implemented in Multisim.

So now onto the Analysis part of this Demo...

As mentioned in the text, Multisim does not have a simple complex conjugate function. Instead we must use the equation $\text{real}(X), -\text{imag}(X)$ to obtain the complex conjugate of a variable, X . As a result when we want $S = 0.5 \cdot I \cdot V$, we utilize the formula $0.5 \cdot (\text{real}(I), -\text{imag}(I)) \cdot V$. Where I and V are the appropriate variables needed for measuring power.

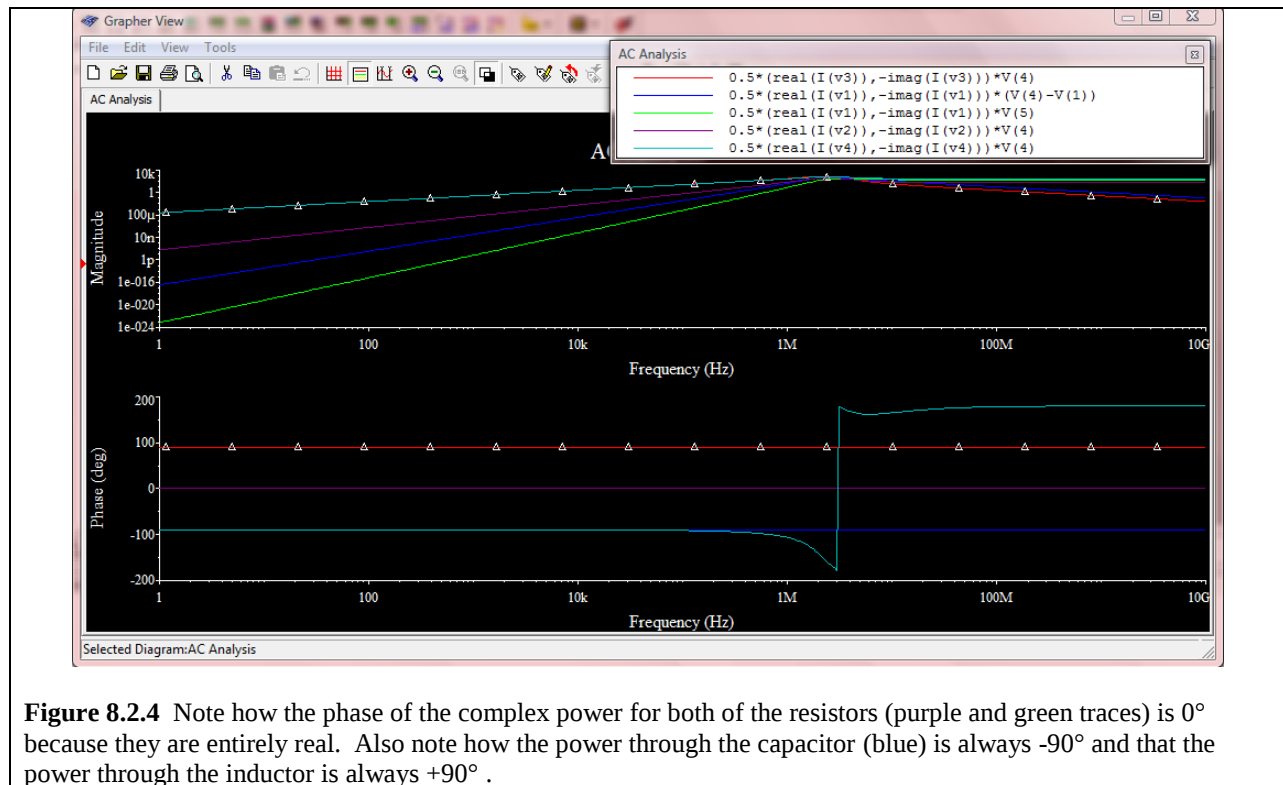
From the circuit in Fig. 8.2.3, the appropriate equations for the power in each component are as follows:

Power I1: $0.5 \cdot (\text{real}(I(v4)), -\text{imag}(I(v4))) \cdot V(4)$
 Power Inductor: $0.5 \cdot (\text{real}(I(v3)), -\text{imag}(I(v3))) \cdot V(4)$
 Power Capacitor: $0.5 \cdot (\text{real}(I(v1)), -\text{imag}(I(v1))) \cdot (V(4) - V(1))$
 Power Resistor R1: $0.5 \cdot (\text{real}(I(v2)), -\text{imag}(I(v2))) \cdot V(4)$
 Power Resistor R2: $0.5 \cdot (\text{real}(I(v1)), -\text{imag}(I(v1))) \cdot V(1)$

Verify that these all make sense to you. We will use these equations in an AC Analysis. Bring up the AC Analysis window and set FSTART to 1 Hz, FSTOP to 10 GHz, Sweep type to Decade, Number of points per decade to 50, and Vertical Scale to Logarithmic.

Under the Output tab, insert the equations for power listed above. Make sure that you pay attention to your parentheses since these can easily mess you up!

Once you are ready, press Simulate. You should generate a plot similar to that shown in Fig. 8.2.4 below. Each one of the colored traces indicates the magnitude (top plot) and angle (bottom plot) of the complex power in a given component.



Using the cursors, at 1.5099 MHz, you should get the following values (approximately):

Inductor: 516.6485 angle(90°) VA
 Capacitor: 152.3243 angle(-90°) VA
 Resistor R2: 42.1237 W
 Resistor R1: 183.8298 W
 Current Source I1: 428.7222 angle(-121.8005°) VA

When these are added up, we get a total of:

0.053 angle(-51.92°) VA

This value is basically 0. As a result we can say that we demonstrated power conservation at 1.5 MHz. However we should be able to do it at any frequency if we choose to.