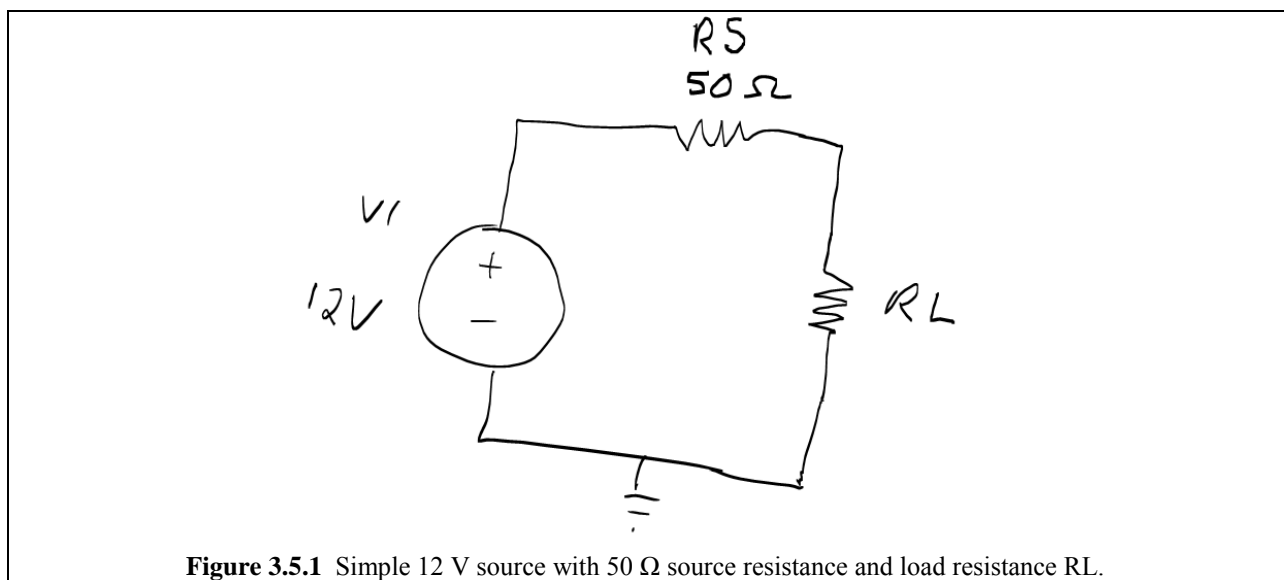


### MULTISIM DEMO 3.5\*: PLOTTING POWER TRANSFER IN MULTISIM

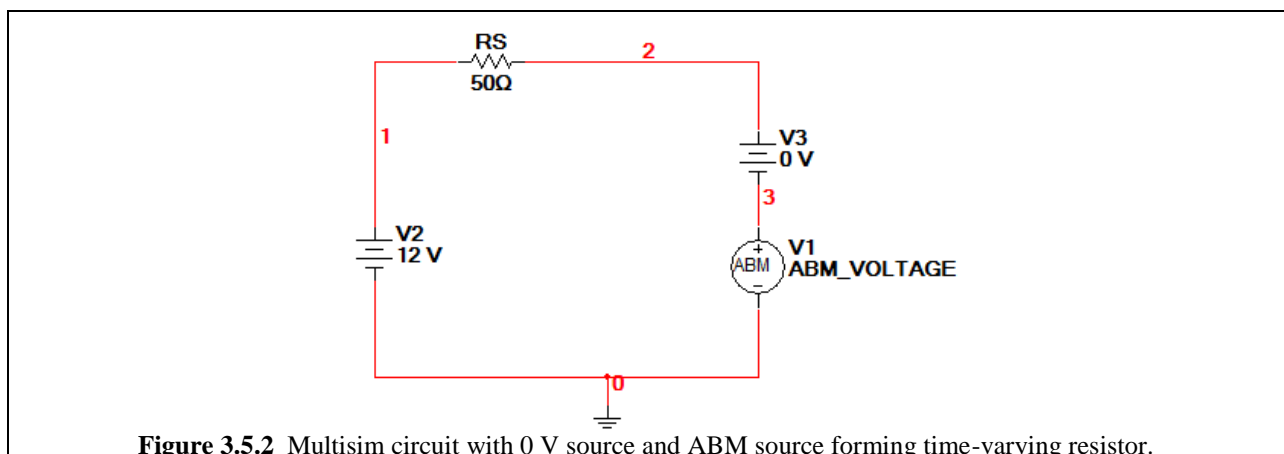
*Multisim doesn't allow the plotting of a particular DC output as the device parameter is varied. Instead, when doing a DC Operating Point Analysis in conjunction with a Parameter Sweep Analysis, the output will be printed in a table. This table can then be exported to an external application, although formatting issues can arise. An easier way is needed.*

This Demo will show how to use a Transient Analysis to sweep resistance values, effectively becoming a parameter sweep. Since we can run a Transient Analysis in the “official” Parameter Sweep Analysis, we now have the potential to run a nested parameter sweep! From the circuit theory perspective, this demo will show graphically that power is maximized in the source resistor  $R_S$  in Fig. 3.5.1 when  $R_S = R_L$  for varying values of  $R_S$ .



**Figure 3.5.1** Simple 12 V source with 50 Ω source resistance and load resistance  $R_L$ .

What we want to do is make a resistive component which varies with time. Then we can run a Transient Analysis which will effectively sweep through a resistance value. This can be done with the ever-versatile ABM\_VOLTAGE source. Build the circuit shown in Fig. 3.5.2 below.



**Figure 3.5.2** Multisim circuit with 0 V source and ABM source forming time-varying resistor.

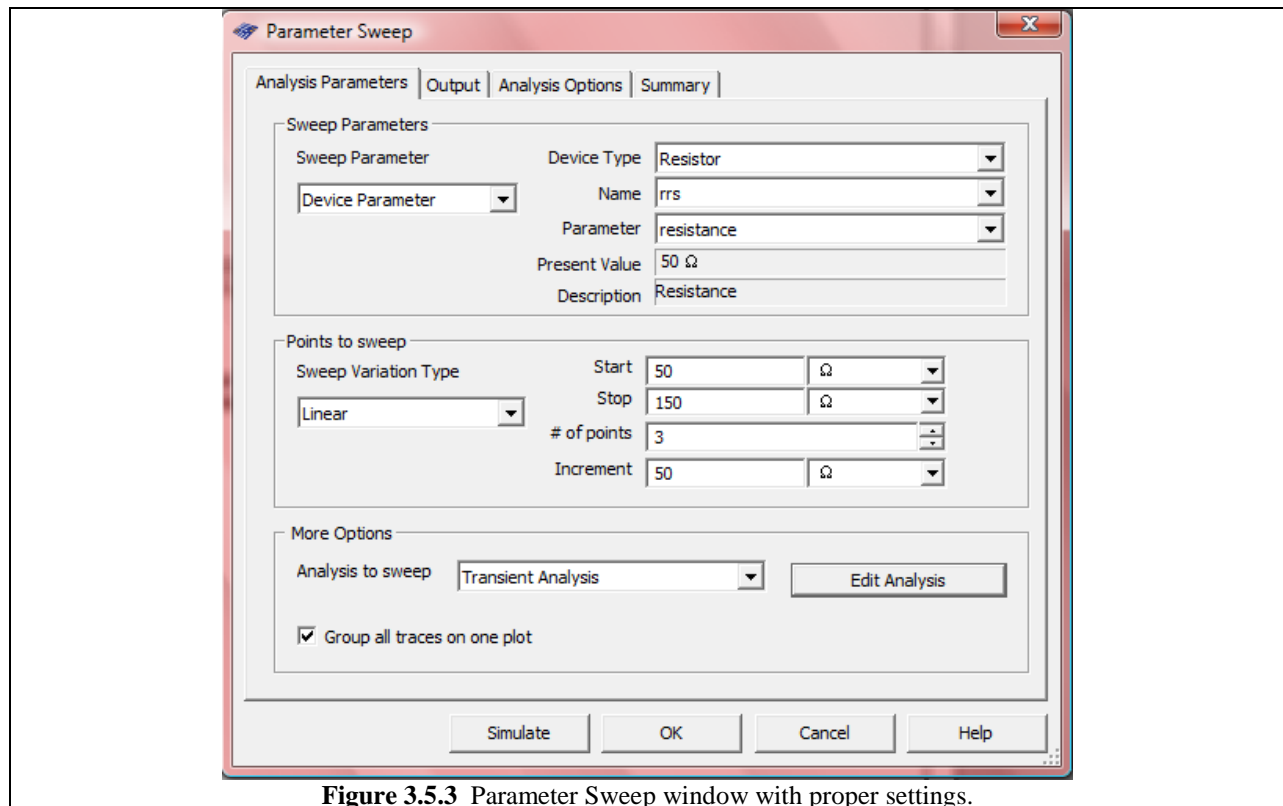
So how do we make this 0 V source and ABM\_VOLTAGE source into a time-varying resistor? Double-click on the ABM source to bring up its properties window. In the Voltage value field type:  $I(vv1)*1*TIME$ .

What we've just done is set this circuit such that the voltage at V(3) (and consequently V(2)) is a linear function of the current going into this portion of the circuit. The voltage is dictated by:  $V = I \cdot R(t)$  where  $R(t)$  is the simple linear ramp function  $R(t) = 1 \cdot t$ . The units of the "1" component are  $\Omega \cdot s^{-1}$  and the units of  $t$  are s, so when they multiply together the seconds cancel out and we are left with just  $\Omega$ !

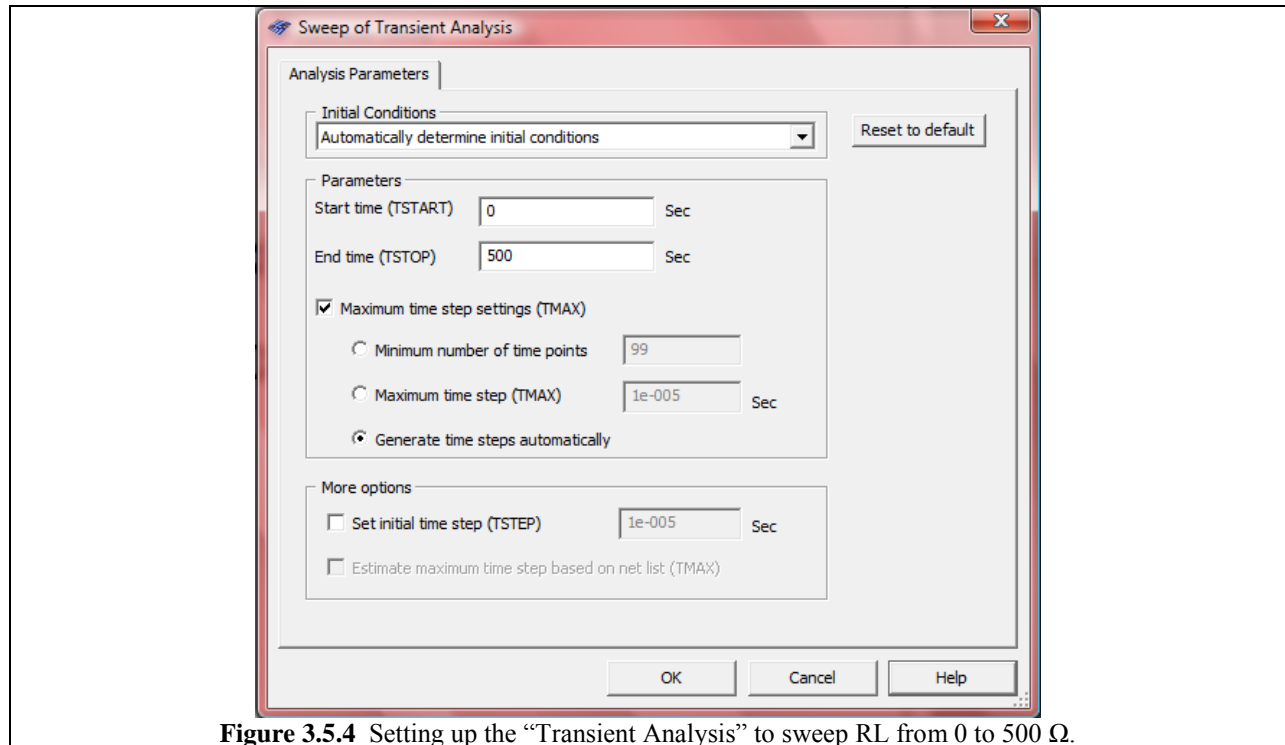
So we've just made a time-varying resistor.

Now let's run a Parameter Sweep on the load resistor in Conjunction with a Transient Analysis. However, remember that because of our time-varying resistor we've "hijacked" the Transient Analysis and turned it into another Parameter sweep (where we sweep the source resistor's value).

So open up the Parameter Sweep window and fill in the values as shown in Figure 3.5.3 below. Additionally for the Transient Analysis which we want to run inside the Parameter Sweep, set it to the values shown in Fig. 3.5.4 on the next page.

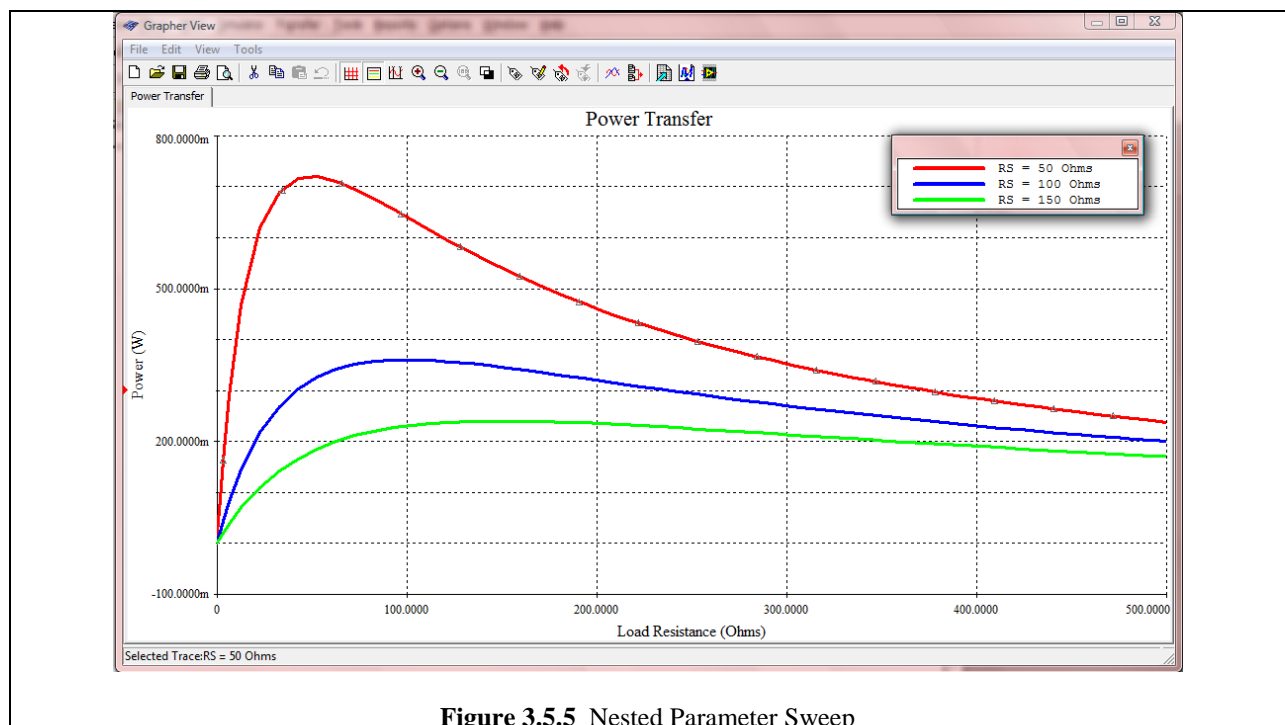


**Figure 3.5.3** Parameter Sweep window with proper settings.



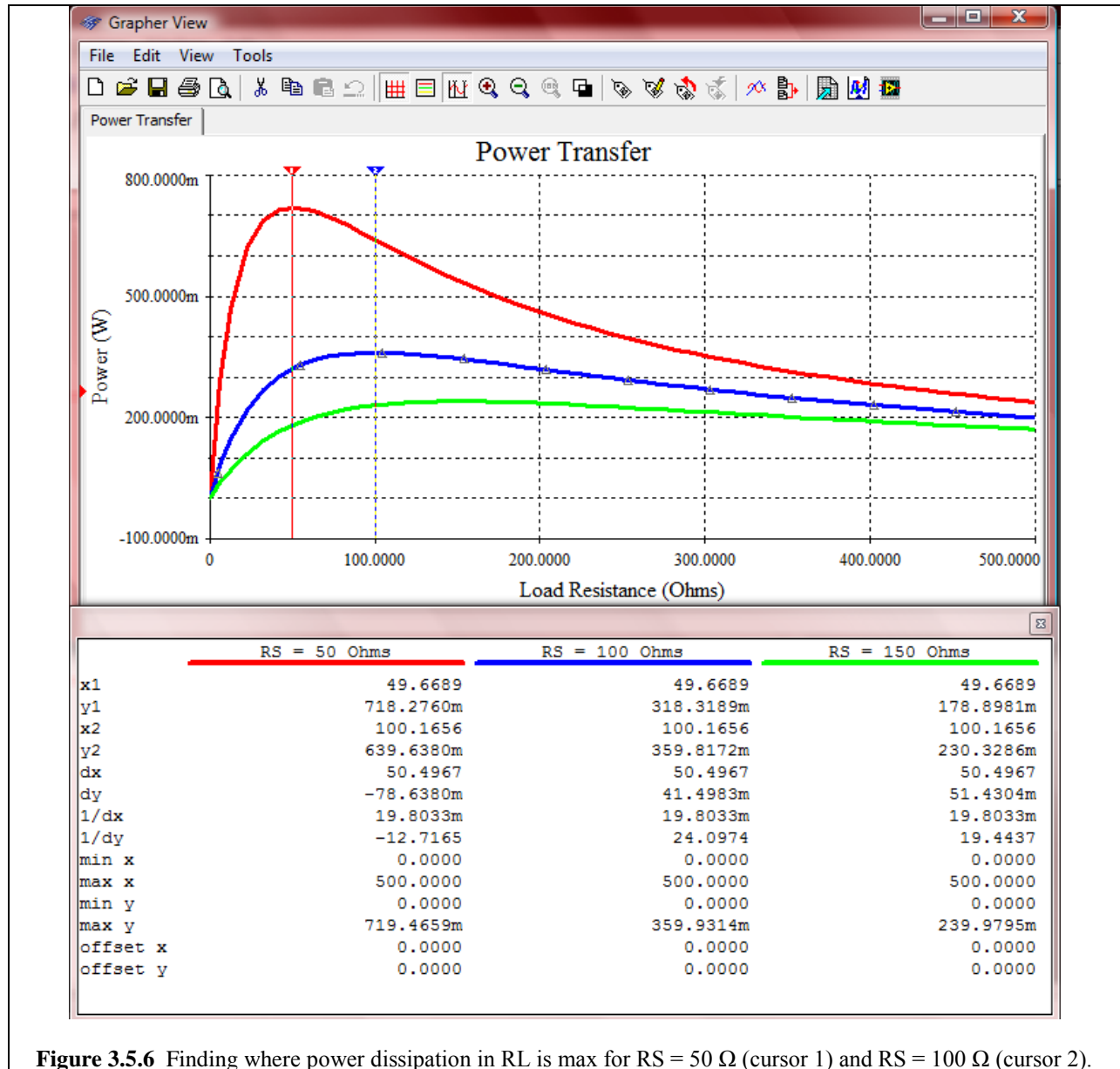
**Figure 3.5.4** Setting up the “Transient Analysis” to sweep RL from 0 to 500  $\Omega$ .

Now we need to have something to plot. Under the Output tab of the Parameter Sweep window set it up so that the equation  $V(2)*I(v3)$  will be plotted (the power dissipated in the load resistor, RL) by clicking on the Add Expression button and entering the equation. Press Simulate and you should get the plot shown in Fig. 3.5.5. (Note that several of the fields have been renamed in order to ensure clarity in reading the plots.)



**Figure 3.5.5** Nested Parameter Sweep

Using the cursors as shown in Fig. 3.5.6 below, we can see that when  $R_S = 50 \Omega$ , power is maximized when  $R_L = 49.67 \Omega$ , when  $R_S = 100 \Omega$ , power is maximized when  $R_L = 100.17\Omega$ , and when  $R_S = 150 \Omega$ , power is maximized when  $R_L = 149.88 \Omega$ .



**Figure 3.5.6** Finding where power dissipation in  $R_L$  is max for  $R_S = 50 \Omega$  (cursor 1) and  $R_S = 100 \Omega$  (cursor 2).