## **MULTISIM DEMO 2.5 A STUDY OF DEPENDENT SOURCES**

Dependent sources are one of the critical components in creating models of electrical systems, especially devices like transistors. Multisim allows users to implement dependent sources in several different ways. Demos 2.5 and 2.6 will focus on how to create dependent sources.

As you've learned from the textbook, there are four general categories of dependent sources:

- Current-Controlled-Current Source
- Voltage-Controlled-Current Source
- Current-Controlled-Voltage Source
- Voltage-Controlled-Voltage Source

To access the dependent voltage sources,

- 1. Open the Select a Component window.
- 2. Under Group, select: Sources
- 3. Under Family, select: CONTROLLED\_VOLTAGE\_SOURCES
- 4. Under Component, select either:
  - a. CURRENT\_CONTROLLED\_VOLTAGE\_SOURCE
  - b. VOLTAGE\_CONTROLLED\_VOLTAGE\_SOURCE

To get to the dependent current sources,

- 1. Open the Select a Component window.
- 2. Under Group, select: Sources
- 3. Under Family, select: CONTROLLED\_CURRENT\_SOURCES
- 4. Under Component, select either:
  - a. CURRENT\_CONTROLLED\_CURRENT\_SOURCE
  - b. VOLTAGE\_CONTROLLED\_CURRENT\_SOURCE

When you place the component into the schematic, it should look like the appropriate component shown in Fig. 2.5.1 below.





Controlled Source	Multiplier
Voltage-Controlled-Voltage Source	Voltage Gain (V/V)
Voltage-Controlled-Current Source	Transconductance ( $\mathbf{U}$ or $\mathbf{S}$ )
Current-Controlled-Current Source	Current Gain (A/A)
Current-Controlled-Voltage-Source	Transresistance ( $\Omega$ )

 Table 2.5.1 Dependent sources and their corresponding multipliers.

Note that Transconductance is symbolized by the upside-down  $\Omega$  in Multisim (to represent the backwards spelling of Ohm...the Mho.). Officially using SI notation, Transconductance is measured in Siemens (S), but Mhos are just much more enjoyable to use.

To change the value of the multiplier on any of the dependent sources:

- 1. Double click on the component to bring up its Property window shown in Fig. 2.5.2.
- 2. Make sure the Value tab is selected.
- 3. Change the value to whatever you want.



Note: Multisim does NOT allow negative values for the Transconductance and Transresistance. Voltage Gain and Current Gain values can, however, be negative. In order to overcome this problem, you have to flip the "sensing wires" on the dependent source. See the examples on the next few pages.

Voltage-Controlled-Voltage Source





If we wanted to change this circuit such that the gain of the dependent source was -5 V/V, (as in we wanted to measure  $-V_a$  in the schematic in Fig. 2.5.3), then all we would have to do is double-click on the source, and add a negative sign in front of the gain. Simple.

*Current-Controlled-Voltage Source* 





If we wanted to change this circuit such that the transresistance was  $-5\Omega$ , (as in we wanted to measure  $-I_A$  in the schematic in Fig. 2.5.5), we could not simply type in "-5 $\Omega$ " in the property window. Instead, we would have to flip the directions wires attaching to the current sensor. In Fig. 2.5.6, this means that wire 2 would attach to the left side of R1, while wire 3 would attach to the 12 VDC source.

## Voltage-Controlled Current Source





If we wanted to change this circuit such that the transconductance was -5  $\mho$ , (as in we wanted to measure  $-V_a$  in the schematic in Fig. 2.5.7), we could not simply type in "-5  $\mho$ " in the property window. Instead, we would have to flip the directions wires attaching to the voltage sensor. In Fig. 2.5.8, this means that the "+" side of the sensor would attach to the right side of R1, while "-" side of the sensor would attach to the left side of R1.

Current-Controlled Current Source





If we wanted to change this circuit such that the gain of the dependent source was -5 A/A, (as in we wanted to measure  $-I_A$  in the schematic in Fig. 2.5.9), then all we would have to do is doubleclick on the source, and add a negative sign in front of the gain. Simple. We do not need to flip the connecting wires to implement a negative gain.