# Square-Law Theory Lesson

**Lesson Topic:** Square-Law Theory

**Objective of Lesson:** A little bit of exposure to the current-voltage models used for MOSFETs.

**Reading Assignment:** Section 17.2.2

**Homework:** None

**Discussion Questions:**

1. Why must one assume a very long channel for the square-law theory to be valid?

**What do you need to know for the exam?**

1. None

**Summary**
The square-law theory is so named because of the structure of the final equation that is derived to model a MOSFET. This lesson discusses briefly the assumptions needed to derive the $I_D$-$V_D$-$V_G$ characteristic that is called the square-law theory.

**MOSFET Square-Law Theory**
All derivations we have developed so far in this course have been dealing with minority carriers. A MOSFET is a majority carrier device.

The discussion in the text of the square-law theory begins with a series of assumptions or conditions that limit its applicability. They are:

1. Long-channel device.
2. $V_G >= V_T$.
3. Drain voltages below pinch-off.
4. Diffusion of carriers is negligible.

The steps are clear enough in the text to follow. The result for one example is plotted in Figure E17.2. This is the basic structure that we associate with the MOSFET $I_D$-$V_D$-$V_G$ characteristic. With today's devices, of course, the first assumption is totally invalid, but the others are valid. There are inherent assumptions built into the discussion surrounding the capacitor model that leads to the final equation. The next lesson will discuss how those assumptions create inaccuracies in the final model.