4.7 CHAPTER SUMMARY

- A voltage-dependent current source can form an amplifier along with a load resis tor. Bipolar transistors are electronic devices that can operate as voltage-dependen current sources.
- The bipolar transistor consists of two *pn* junctions and three terminals: base, emitte and collector. The carriers flow from the emitter to the collector and are controlle by the base.
- For proper operation, the base-emitter junction is forward-biased and the base collector junction reverse-biased (forward active region). Carriers injected by th emitter into the base approach the edge of collector depletion region and are swep away by the high electric field.
- The base terminal must provide a small flow of carriers, some of which go to the emitter and some others recombine in the base region. The ratio of collector current and base current is denoted by β.
- In the forward active region, the bipolar transistor exhibits an exponential relationship between its collector current and base-emitter voltage.
- In the forward active region, a bipolar transistor behaves as a constant current source.
- The large-signal model of the bipolar transistor consists of an exponential voltage-dependent current source tied between the collector and emitter, and a diode (accounting for the base current) tied between the base and emitter.
- The transconductance of a bipolar transistor is given by $g_m = I_C / V_T$ and remains independent of the device dimensions.
- The small-signal model of bipolar transistors consists of a linear voltage-dependent current source, a resistance tied between the base and emitter, and an output resistance.
- If the base-collector junction is forward-biased, the bipolar transistor enters saturation and its performance degrades.
- The small-signal models of *npn* and *pnp* transistors are identical.