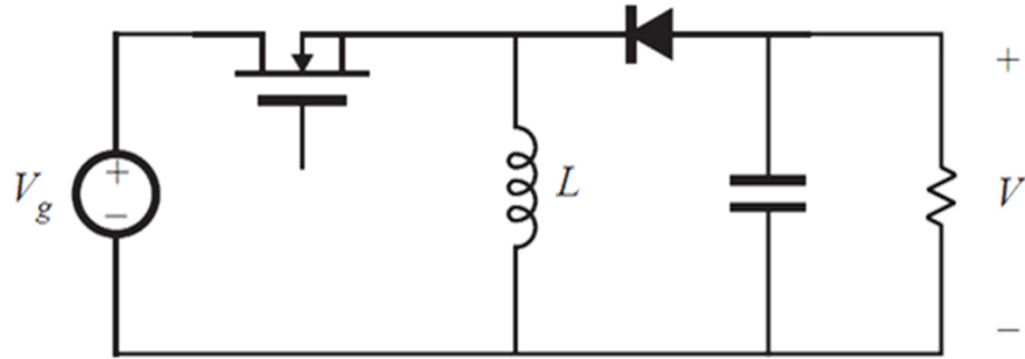


Buck-Boost Converter with Nonideal Semiconductors



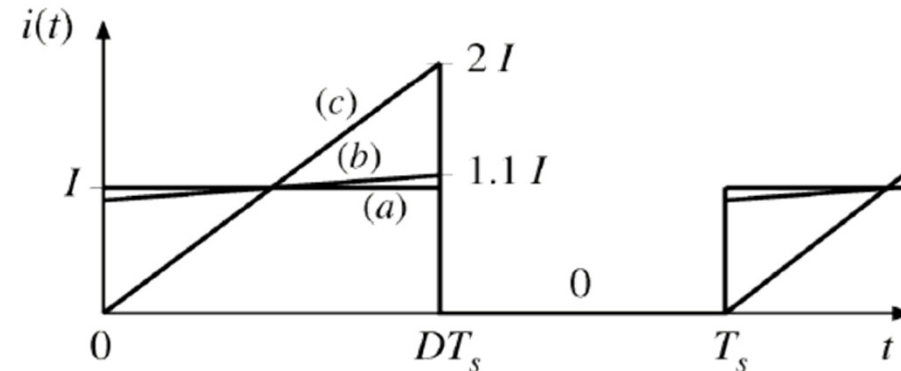
Equivalent Circuit Model

Circuit Solution

Average vs RMS Currents

- Model uses average currents and voltages
- To correctly predict power loss in a resistor, use rms values
- Result is the same, provided ripple is small

MOSFET current waveforms, for various ripple magnitudes:



<i>Inductor current ripple</i>	<i>MOSFET rms current</i>	<i>Average power loss in R_{on}</i>
(a) $\Delta i = 0$	$I \sqrt{D}$	$D^2 R_{on}$
(b) $\Delta i = 0.1 I$	$(1.00167) I \sqrt{D}$	$(1.0033) D^2 R_{on}$
(c) $\Delta i = I$	$(1.155) I \sqrt{D}$	$(1.3333) D^2 R_{on}$

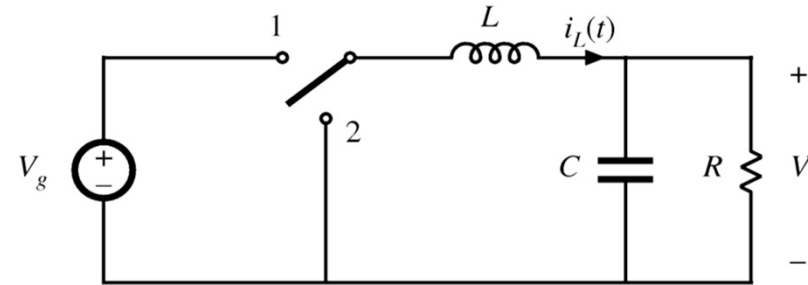
Chapter 4

SWITCH REALIZATION

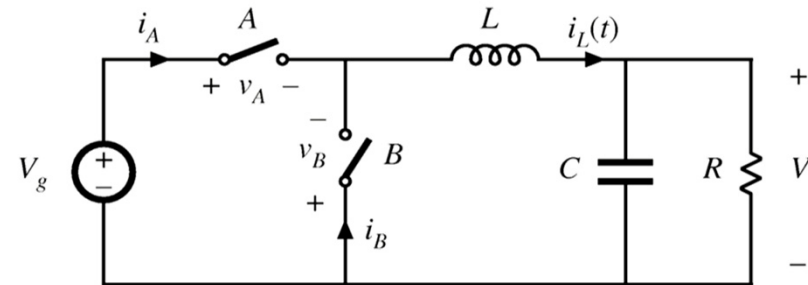
Implementing with SPST Switches

Buck converter

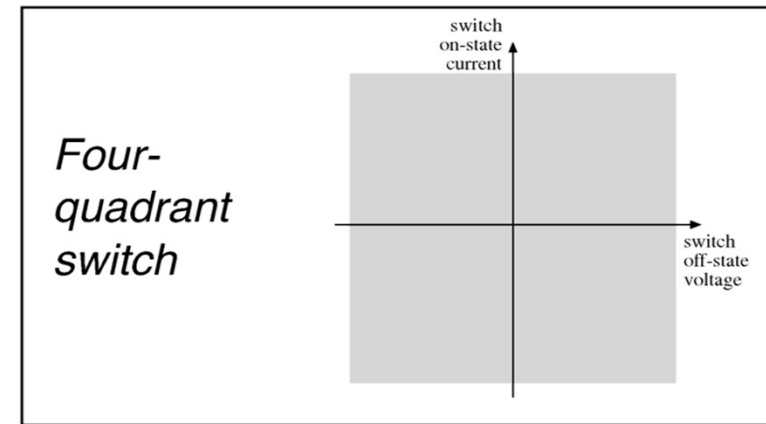
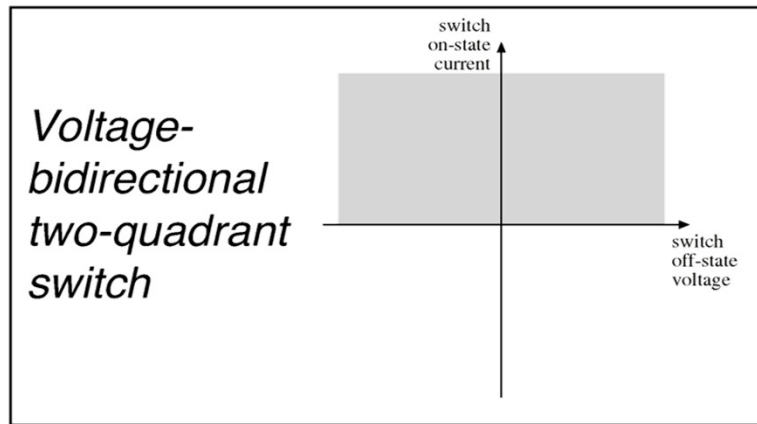
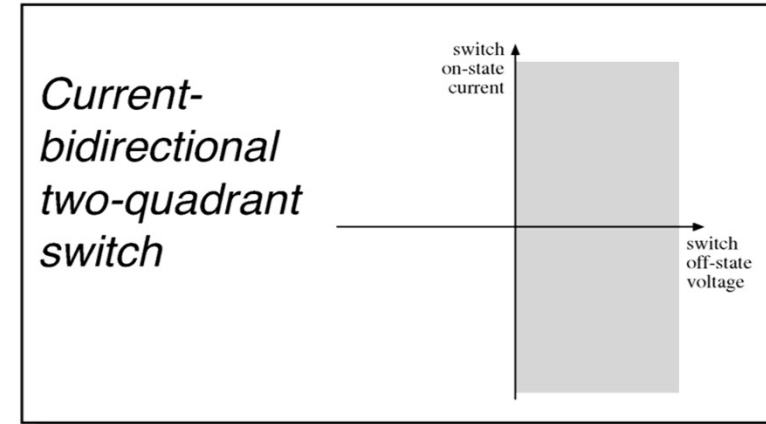
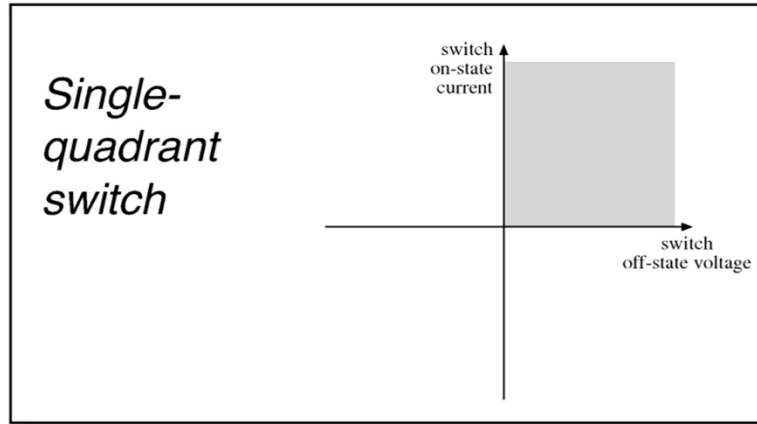
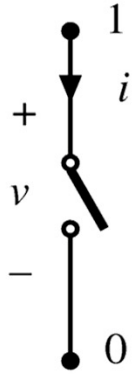
with SPDT switch:



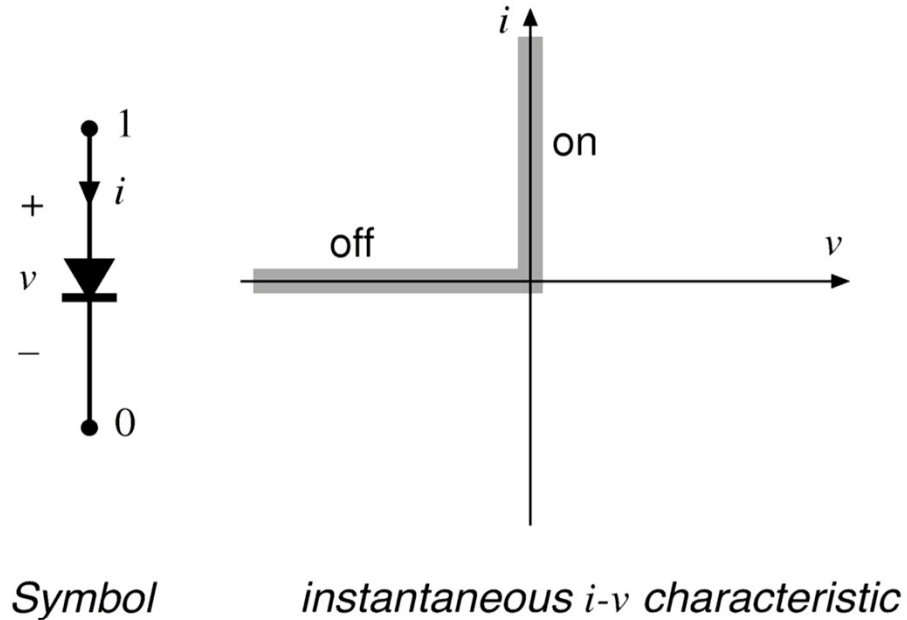
with two SPST switches:



SPST Operating Quadrants

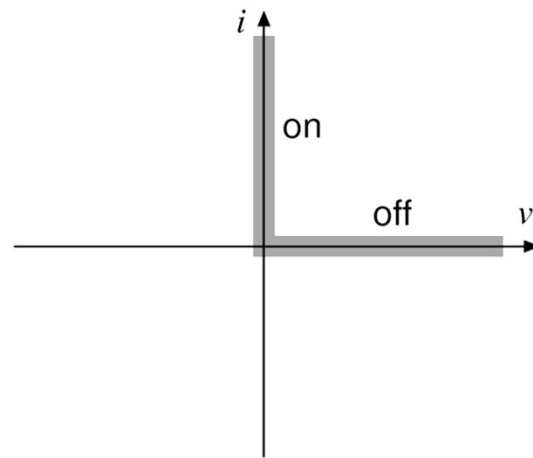
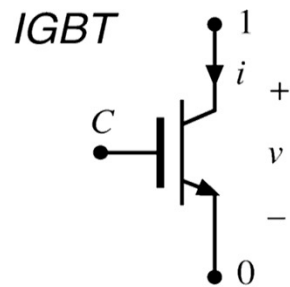
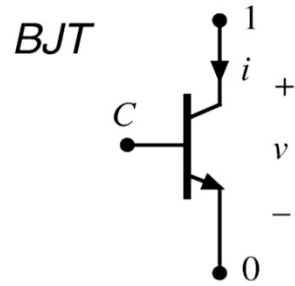


The Diode



- *A passive switch*
- *Single-quadrant switch:*
- *can conduct positive on-state current*
- *can block negative off-state voltage*
- *provided that the intended on-state and off-state operating points lie on the diode i - v characteristic, then switch can be realized using a diode*

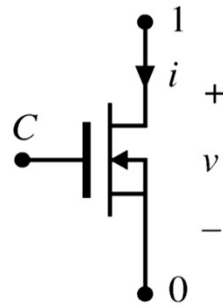
(Insulated Gate) Bipolar Junction Transistor



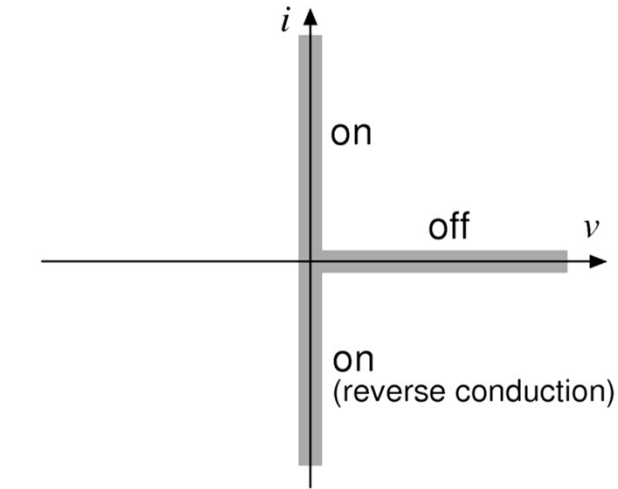
instantaneous i - v characteristic

- An active switch, controlled by terminal C
- Single-quadrant switch:
- can conduct positive on-state current
- can block positive off-state voltage
- provided that the intended on-state and off-state operating points lie on the transistor i - v characteristic, then switch can be realized using a BJT or IGBT

MOSFET



Symbol



instantaneous i - v characteristic

- An active switch, controlled by terminal C
- Normally operated as single-quadrant switch:
- can conduct positive on-state current (can also conduct negative current in some circumstances)
- can block positive off-state voltage
- provided that the intended on-state and off-state operating points lie on the MOSFET i - v characteristic, then switch can be realized using a MOSFET

Buck Converter: Switch Realization

