

# One Inverter Leg

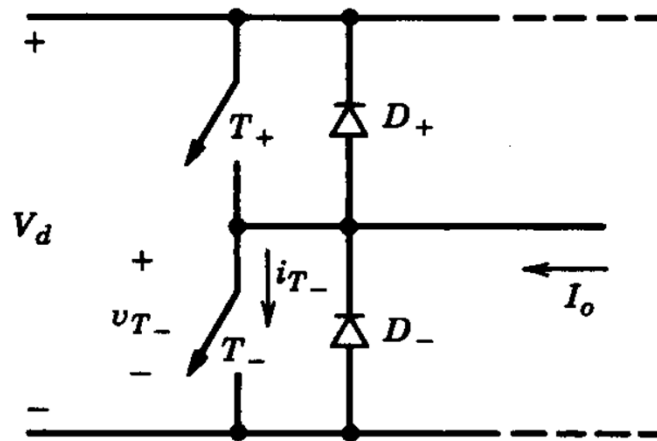
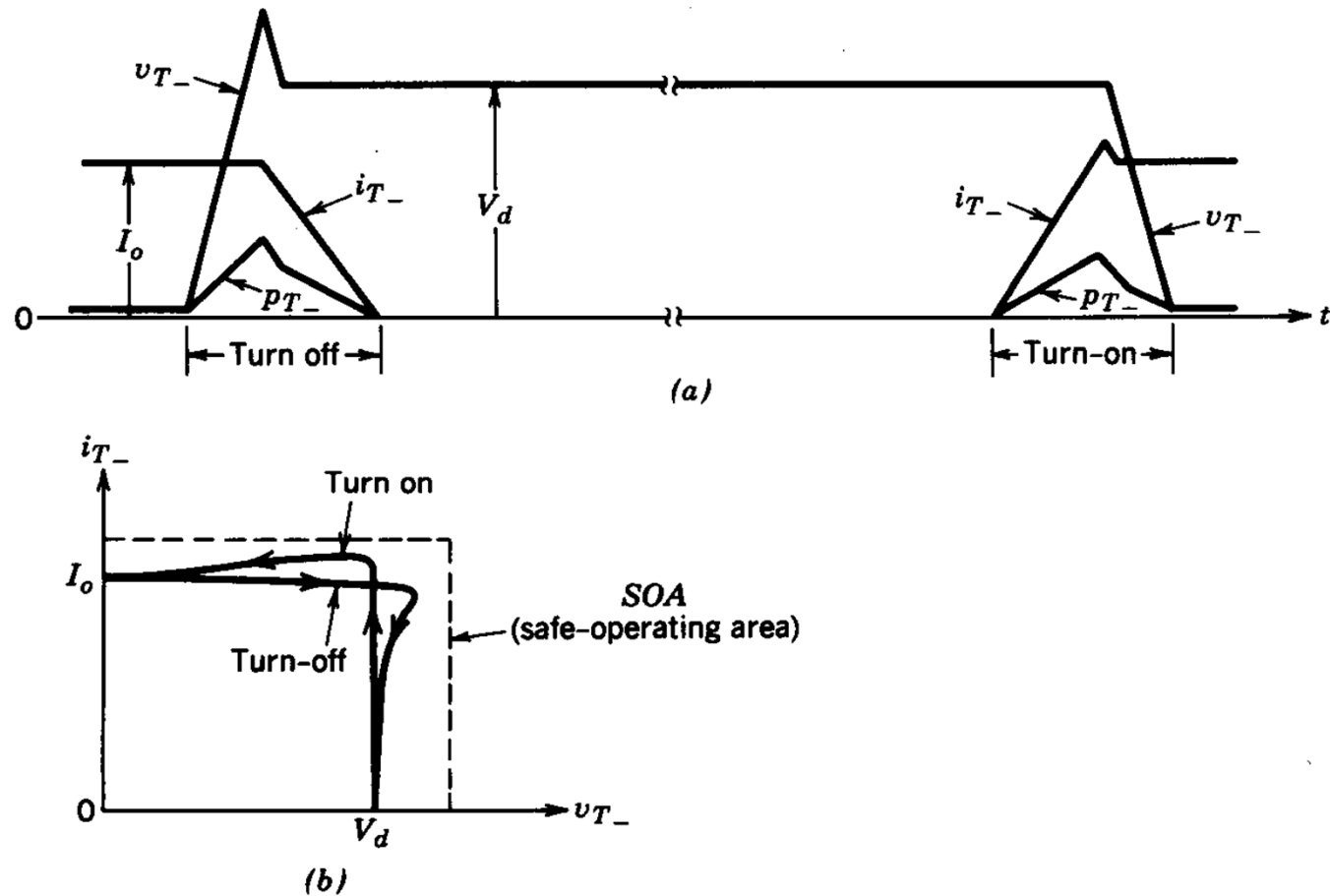


Figure 9-1 One inverter leg.

- The output current can be positive or negative

# Hard Switching Waveforms



**Figure 9-2** Switch-mode inductive current switchings.

- The output current can be positive or negative

# Turn-on and Turn-off Snubbers

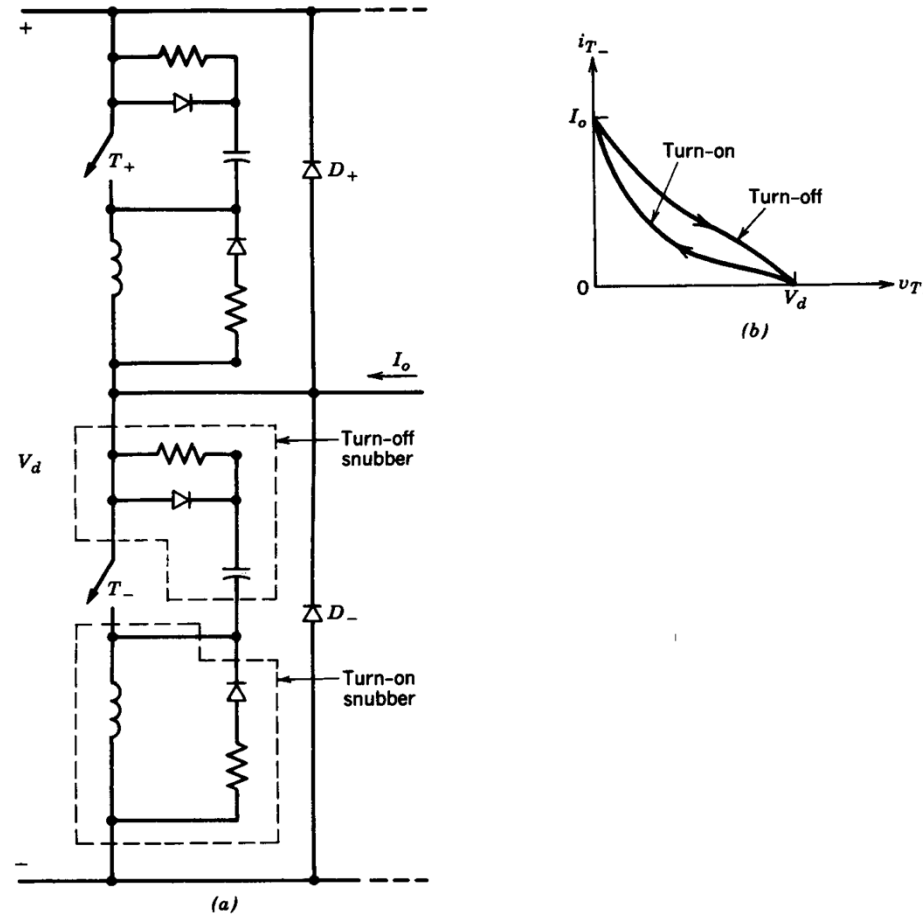
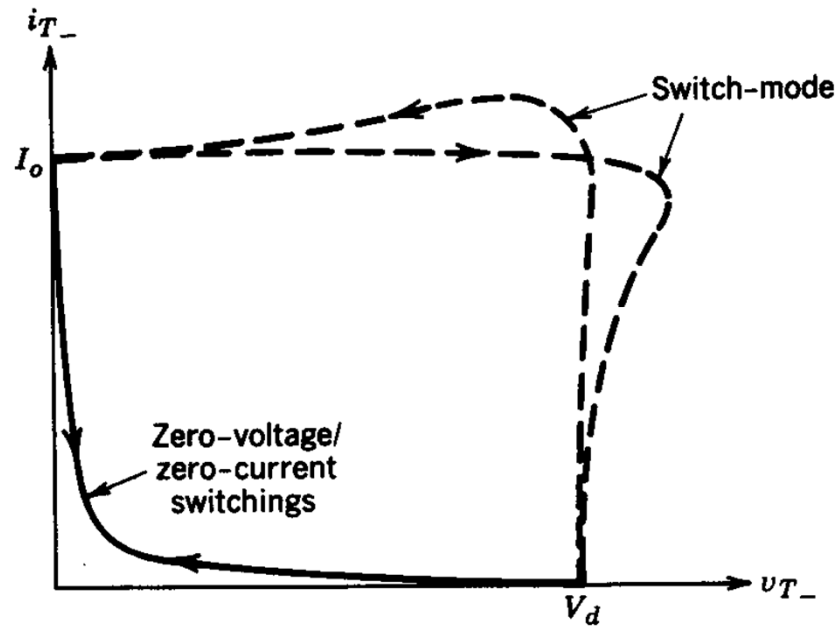


Figure 9-3 Dissipative snubbers: (a) snubber circuits; (b) switching loci with snubbers.

- Turn-off snubbers are used

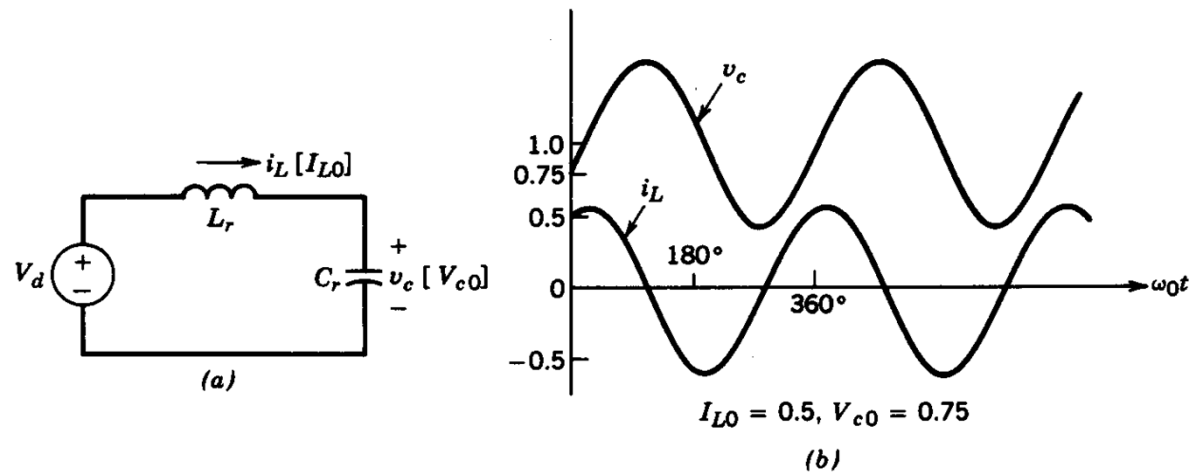
# Switching Trajectories



**Figure 9-4** Zero-voltage/  
zero-current-switching loci.

- Comparison of Hard versus soft switching

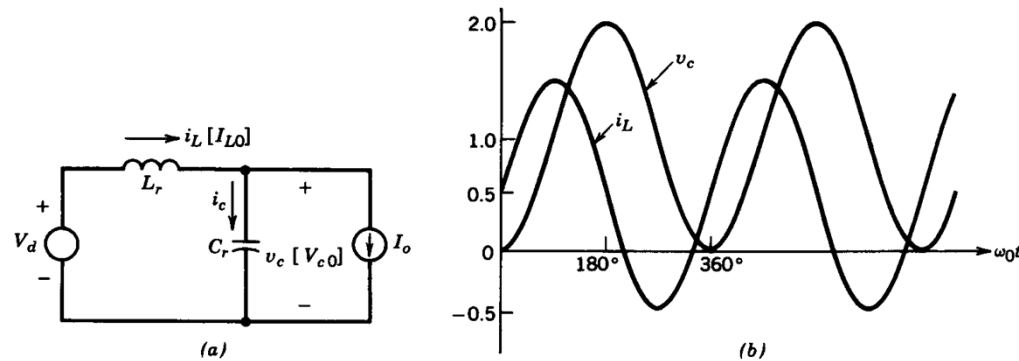
# Undamped Series-Resonant Circuit



**Figure 9-5** Undamped series-resonant circuit;  $i_L$  and  $v_c$  are normalized: (a) circuit; (b) waveforms with  $I_{L0} = 0.5$ ,  $V_{c0} = 0.75$ .

- The waveforms shown include initial conditions

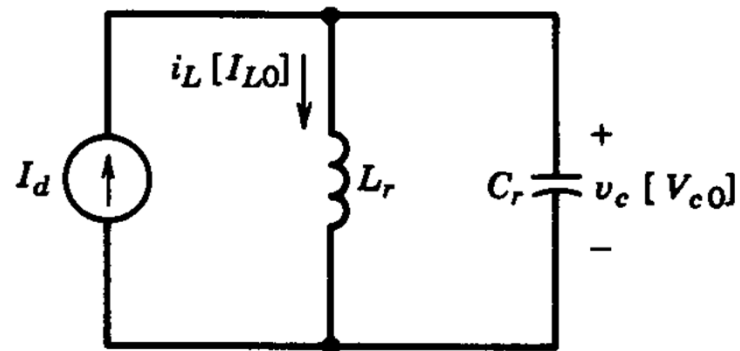
# Series-Resonant Circuit with Capacitor-Parallel Load



**Figure 9-6** Series-resonant circuit with capacitor-parallel load ( $i_L$  and  $v_c$  are normalized):  
(a) circuit; (b)  $V_{c0} = 0$ ,  $I_{L0} = I_o = 0.5$ .

- The waveforms shown include initial conditions

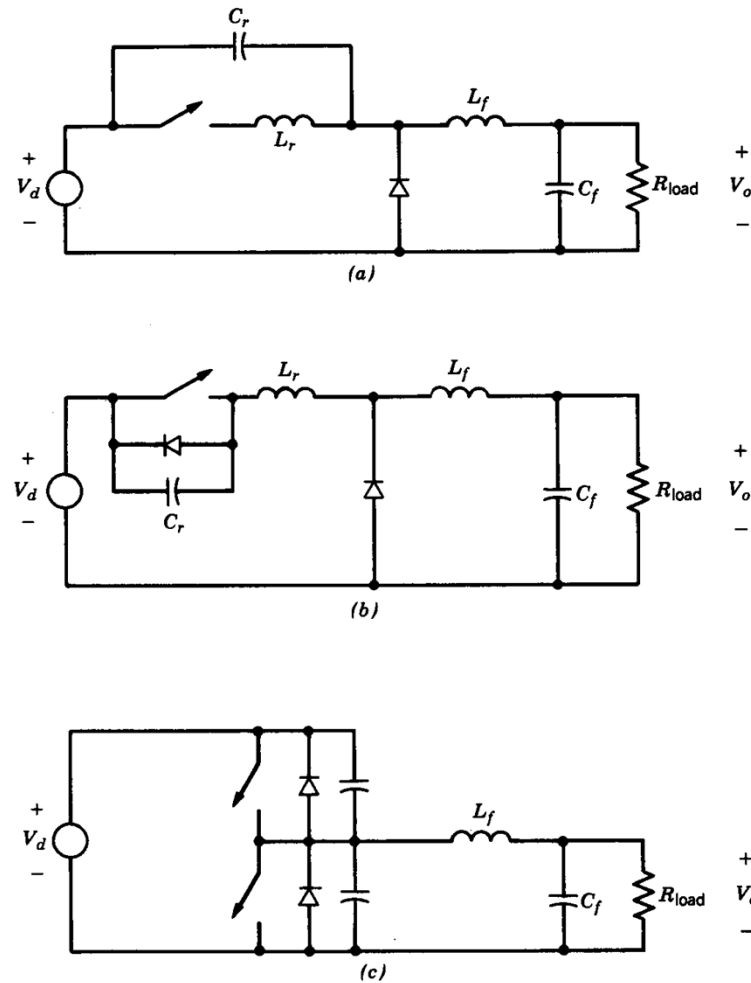
# Undamped Parallel-Resonant Circuit



**Figure 9-8** Undamped parallel-resonant circuit.

- Excited by a current source

# Resonant Switch Converters



**Figure 9-27** Resonant-switch converters: (a) ZCS dc-dc converter (step-down); (b) ZVS dc-dc converter (step-down); (c) ZVS-CV dc-dc converter (step-down).

## Classifications



# ZCS Resonant-Switch Converter

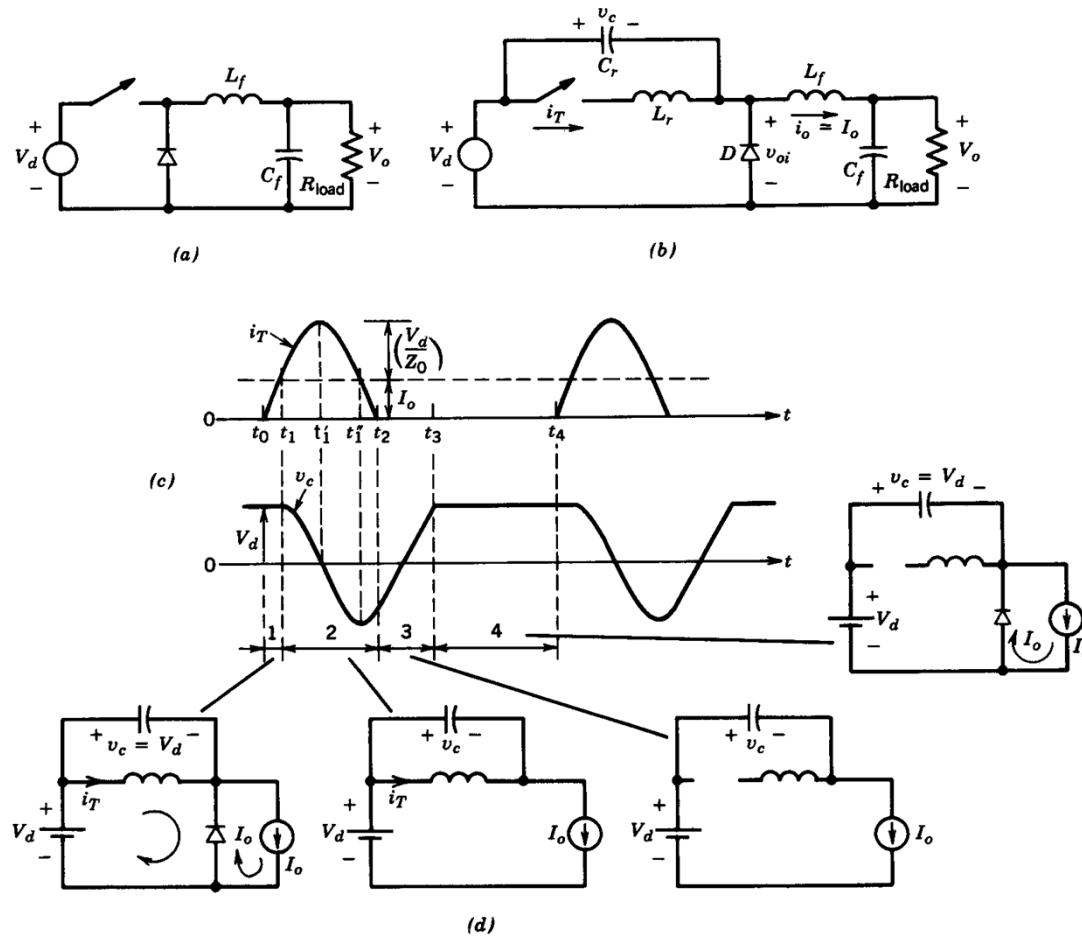
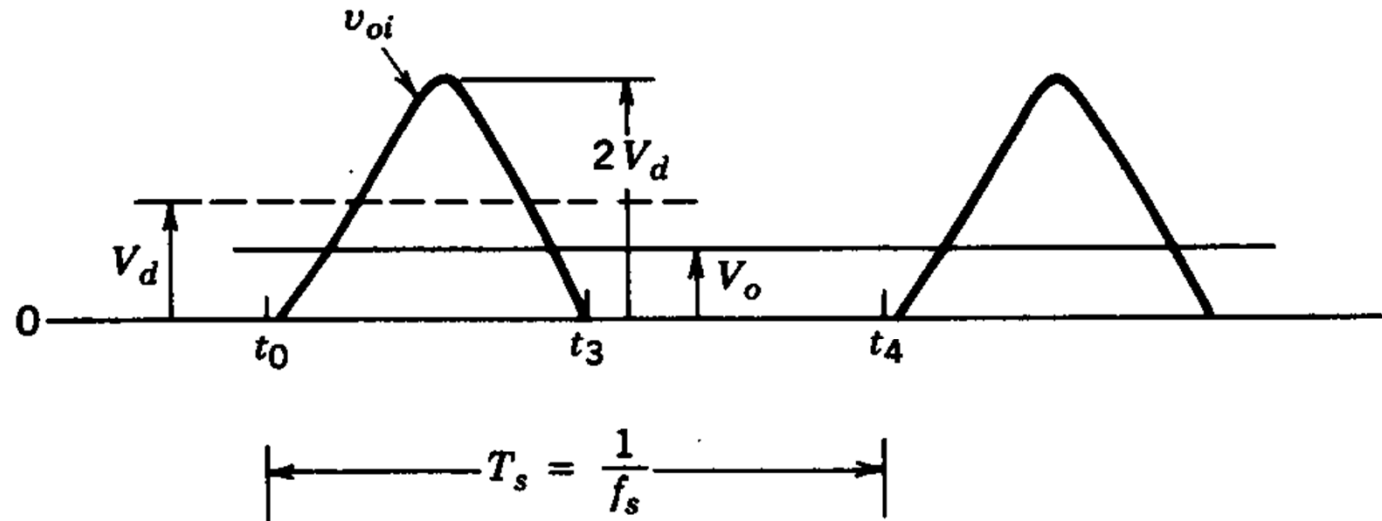


Figure 9-28 ZCS resonant-switch dc-dc converter.

- One possible implementation

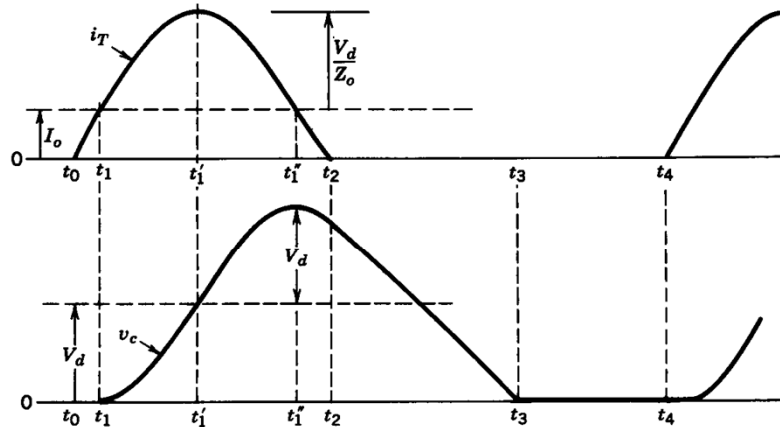
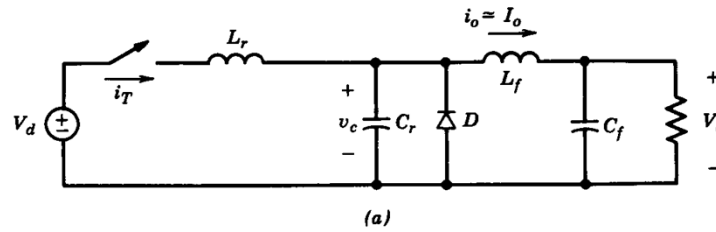
# ZCS Resonant-Switch Converter



**Figure 9-29**  $v_{oi}$  waveform in a ZCS resonant-switch dc-dc converter.

- Waveforms; voltage is regulated by varying the switching frequency

# ZCS Resonant-Switch Converter



- A practical circuit

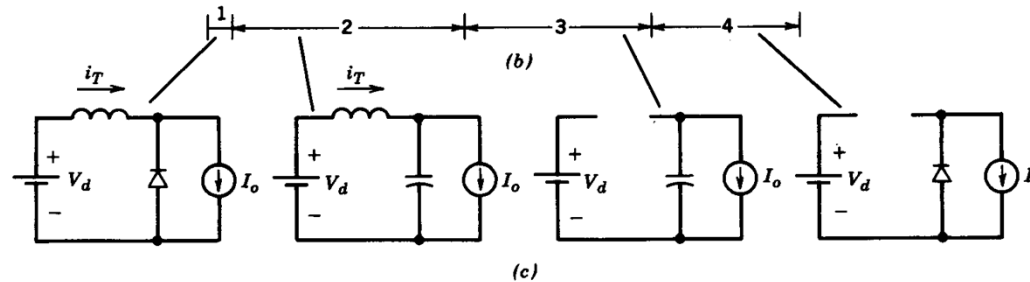
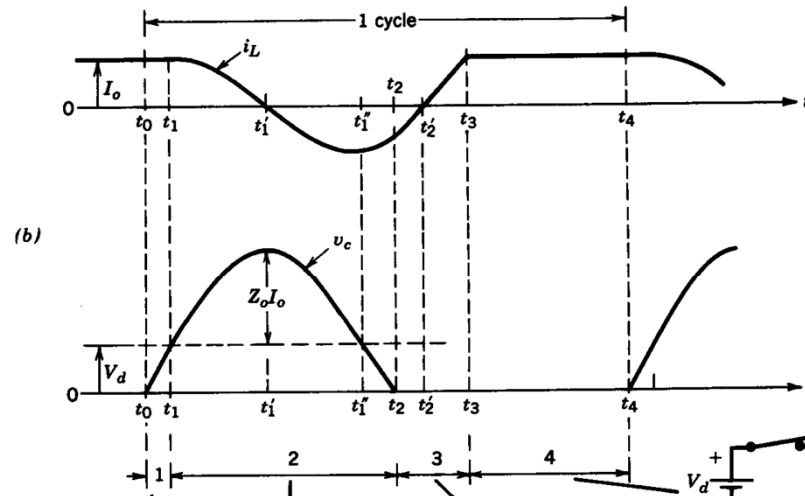
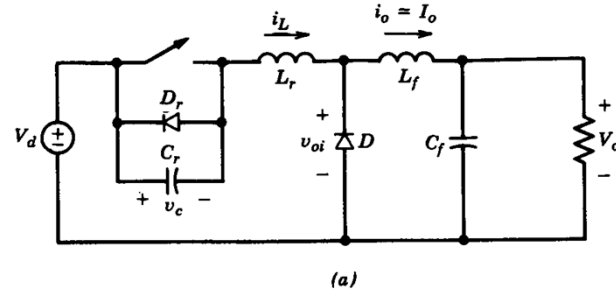


Figure 9-30 ZCS resonant-switch dc-dc converter; alternate configuration.

# ZVS Resonant-Switch Converter



- Serious limitations

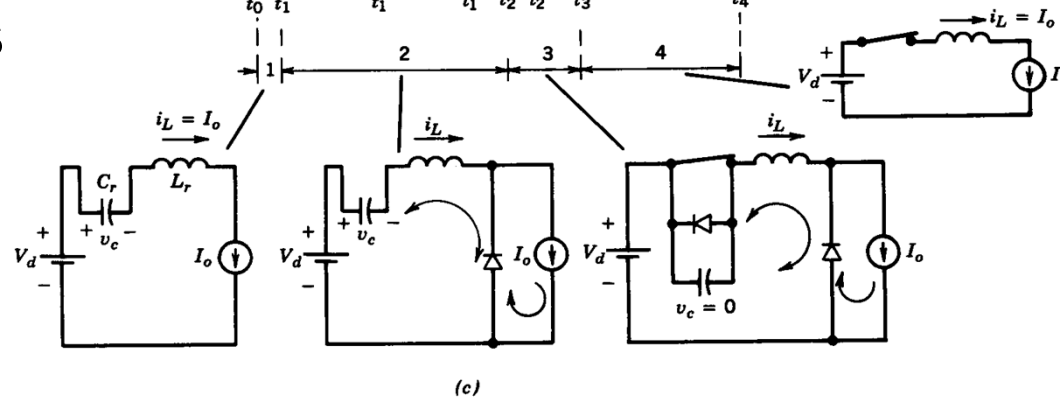
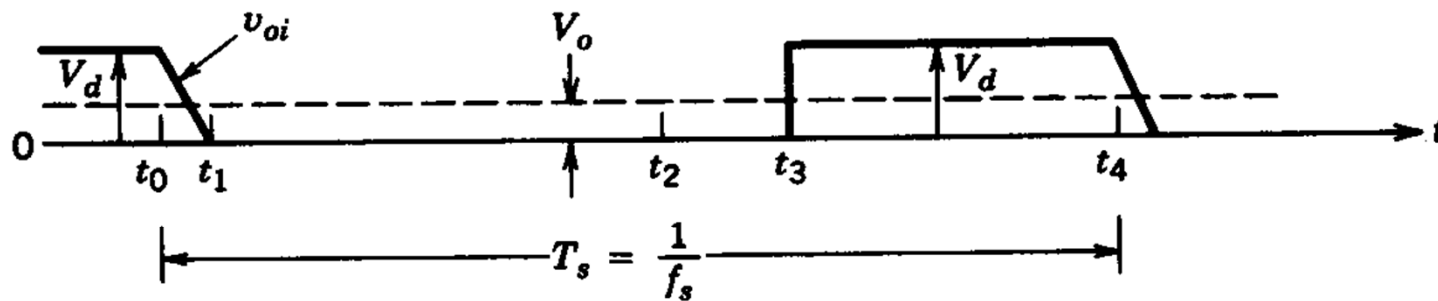


Figure 9-31 ZVS resonant-switch dc-dc converter.

# ZVS Resonant-Switch Converter



**Figure 9-32** The  $v_{oi}$  waveform in a ZVS resonant-switch dc-dc converter.

- Waveforms