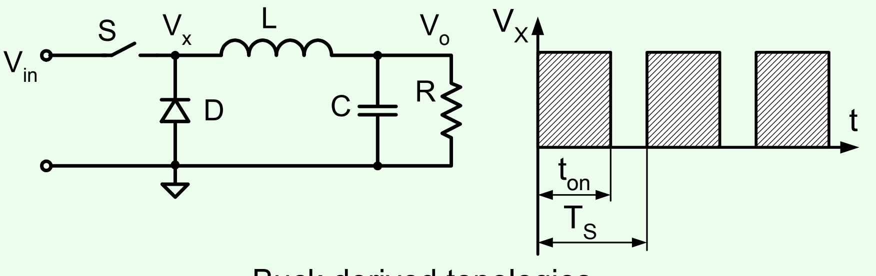
Half Bridge, Full Bridge, Push-Pull, Cuk, SEPIC

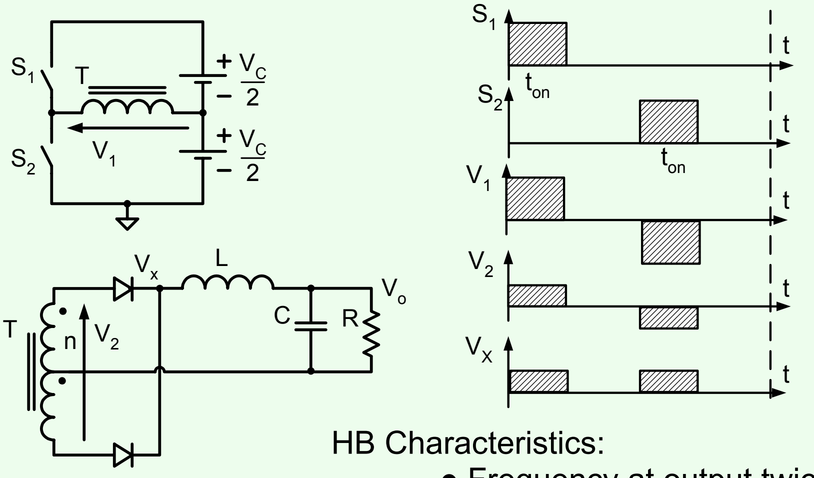
Buck topology



Buck derived topologies

- Forward - one switch
- Half Bridge HB - two switches
- Full Bridge FB - four switches

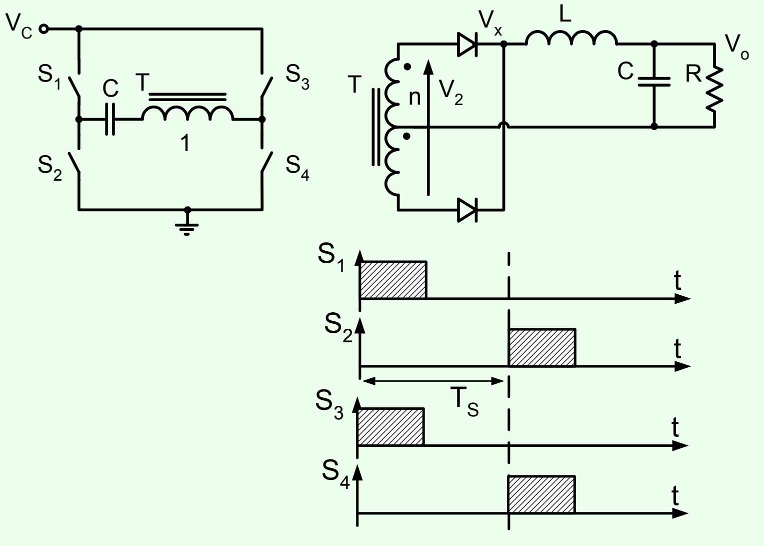
Half Bridge HB



HB Characteristics:

- Frequency at output twice f_s
- Output section: Buck

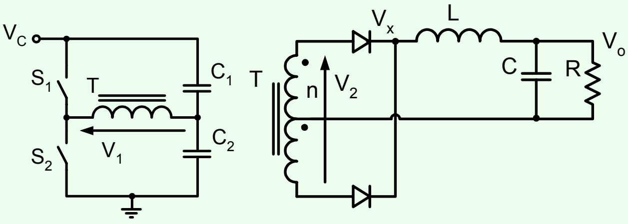
Full Bridge FB



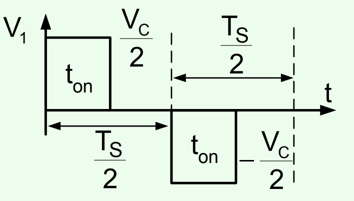
Reset of Forward, HB, FB

- Forward - auxiliary winding
- HB,FB - Natural

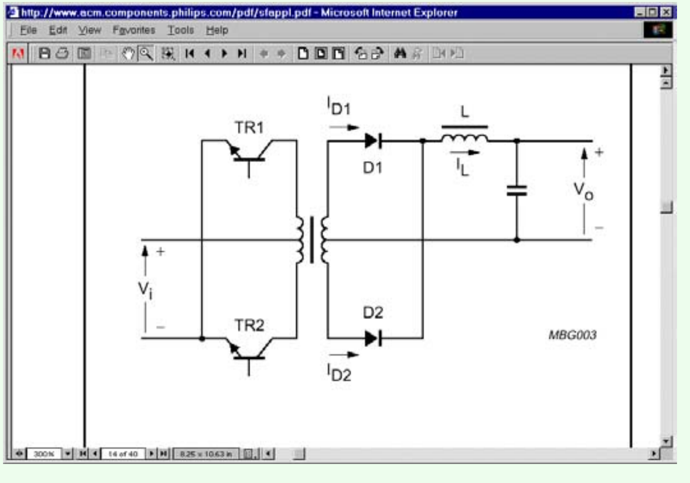
Example HB



- C_1, C_2 capacitor divider



Push-Pull



Forward, HB, FB, PP

I_L ripple for same L

- Forward: ΔI
- HB, FB, PP: $\frac{\Delta I}{2}$

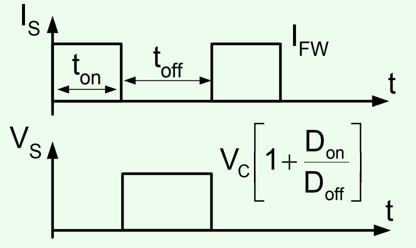
Switch Utilization

Important consideration: V_s(off), I_s(on)

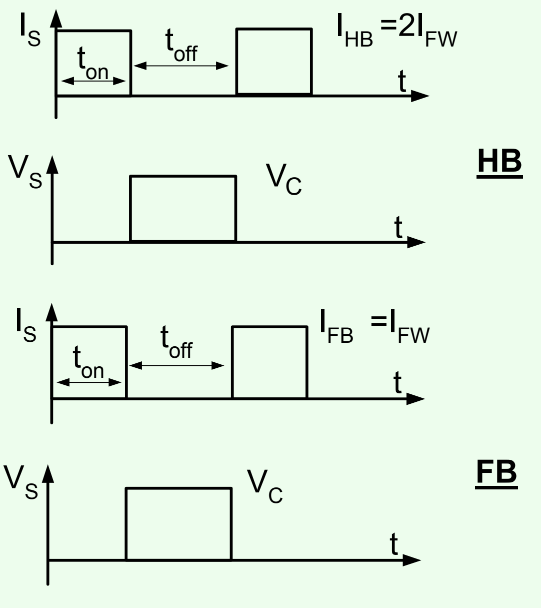
Assumption:

- Same input and output power
- Same input voltage

FORWARD



Waveforms

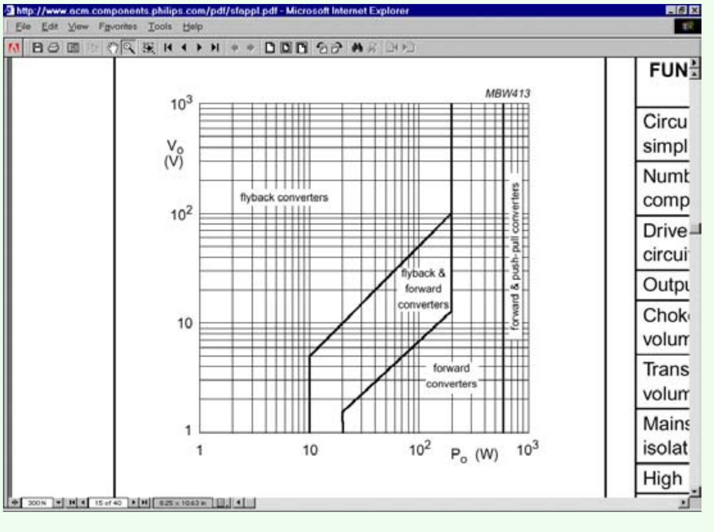


Stresses

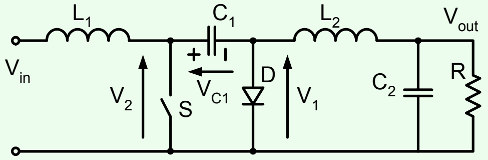
	I_S	V
FW	1	$1+\frac{Don}{Doff}$
HB	2	1
PP	1	2
FB	1	1

- Power conversion capability: FW<HB<FB

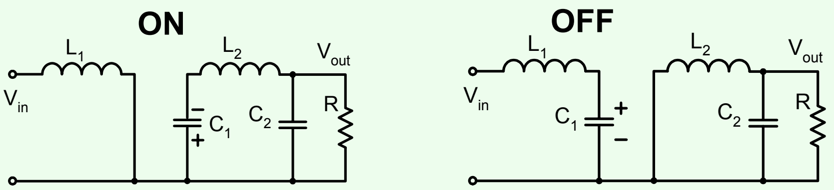
Topology selection



Cuk Converter



- Voltage of $C_1 \approx$ constant



$$\overline{V}_1 = V_o$$

$$\overline{V}_2 = V_{in}$$

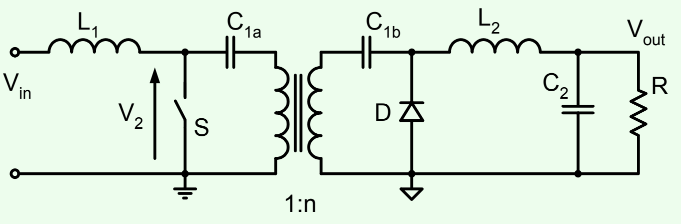
$$\overline{V}_{c1} = V_{in} - V_o$$

$$V_o = -V_{c1} \cdot D_{on} \quad \text{(buck)}$$

$$V_o = -(V_{in} - V_o) \cdot D_{on}$$

$$\frac{V_o}{V_{in}} = -\frac{D_{on}}{D_{off}}$$

Cuk with isolation



- Any polarity
- Any voltage ratio

$$\frac{V_o}{V_{in}} = \pm \frac{D_{on}}{D_{off}} n$$

Cuk advnatages and disadvantages

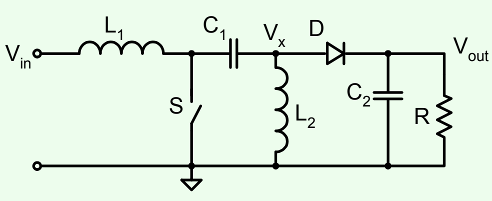
Advantages

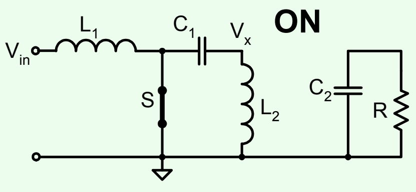
- Continuos input **and** output currents
- Single switch
- Step-up and step-down

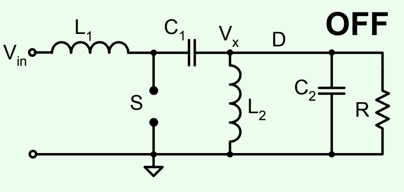
Disadvantages

- Two inductors
- Extra capacitor (of high rms current)
- Difficult to stabilize
- High voltage on switch $|V_{in}| + |V_{out}|$

SEPIC Converter







$$\overline{V}_{L1} = 0$$

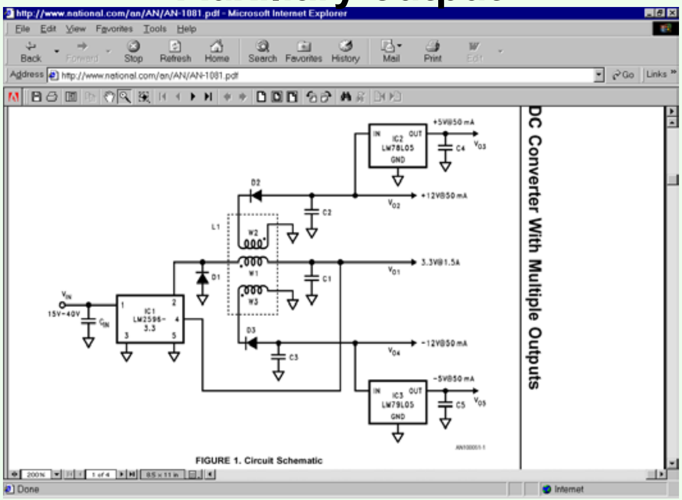
$$\overline{V}_{L2} = 0$$

$$\overline{V}_{C1} = V_{in}$$

$$\overline{V}_{x} = V_o \cdot D_{off} - V_{in} \cdot D_{on} = 0$$

$$\frac{V_o}{V_{in}} = \frac{D_{on}}{D_{off}}$$

Auxiliary output



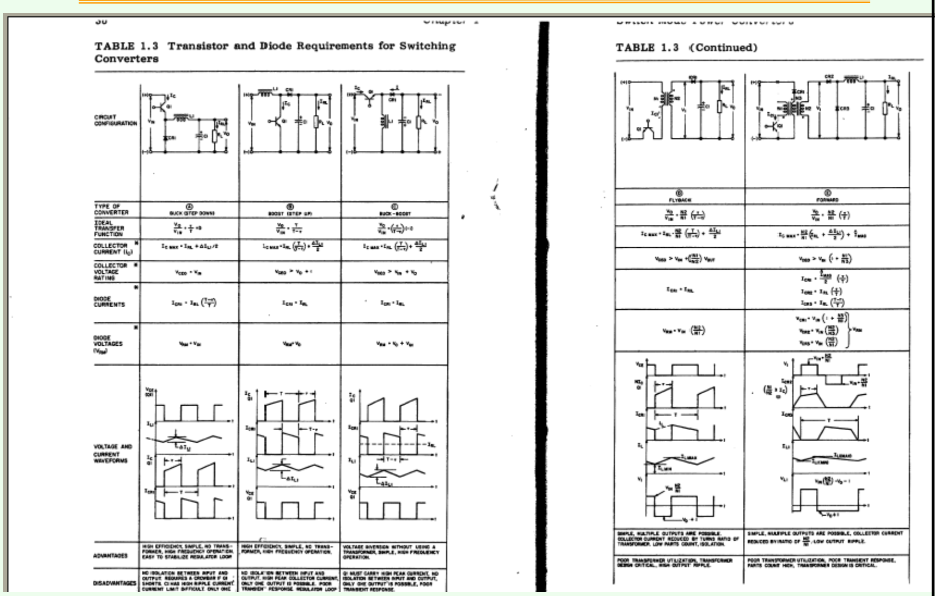


TABLE 1.3 Transistor and Diode Requirements for Switching Converters

TABLE 1.3 (Continued)

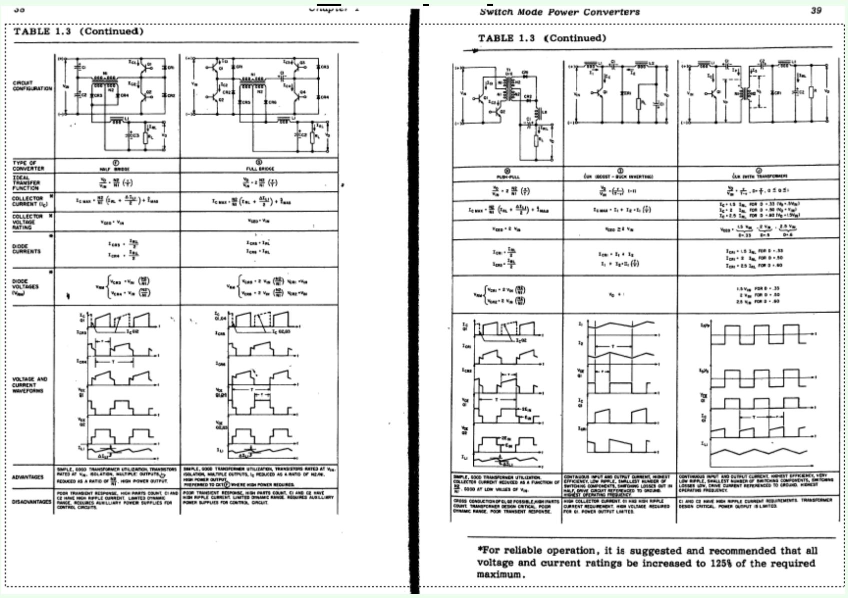
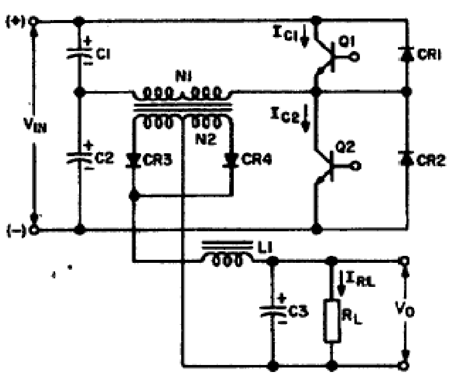


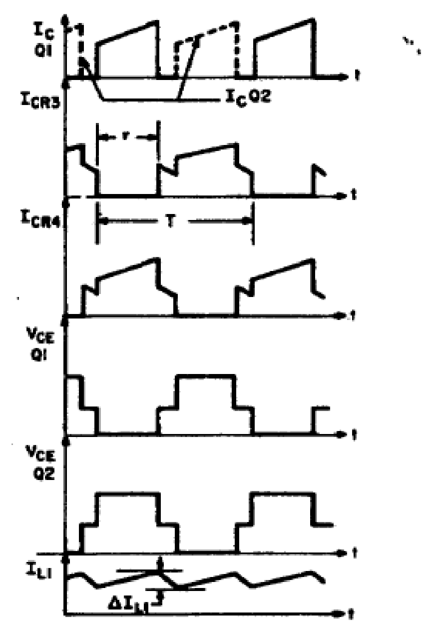
TABLE 1.3 (Continued)

Switch Mode Power Converters 39

TABLE 1.3 (Continued)

*For reliable operation, it is suggested and recommended that all voltage and current ratings be increased to 125% of the required maximum.





VOLTAGE REGULATION MODULE (VRM)

- Synchronous rectifier