- Circuit 4: Now add 10,000 uF capacitor with initial charge of 200 V (resulting in 400V pole to ground voltage).

Output voltage: Note that it starts at 400V due to charge on capacitor. Then it falls as capacitor discharges into 10 ohm resistor. The voltage starts to rise when the diode begins to conduct and provides energy from the inductor.
Voltage sourced converters (VSC)

(inverter) - (VSI)

(rectifier) (VSR) - Rarely used

Inverter: power/energy from dc to ac

Rectifier: power/energy from ac to dc

Converter: bidirectional flow

Voltage source $\Rightarrow \frac{DC}{\text{current/DC}} \rightarrow \text{AC}$

Current source $\Rightarrow \frac{AC}{\text{current/AC}}$
Current source converter

\[ \text{current} \quad \text{stiff} \quad \text{conv} \quad \text{AC} \quad \text{voltage} \quad \text{stiff} \]
motor drive

Diode Rectifier

Variable

V
Current source converter

DC → Uni-directional current

Reversible voltage

AC or DC
DC side

Polarity doesn't change - or at least not quickly

Current can go either direction

DC - AC converter

DC - DC

S1 + S2 - Need to carry current in either direction

- Only need to block voltage in one direction
1. Case 1: Unidirectional Current

\[ i = \frac{1}{L} \int V(t)dt \]

\[ V_o < V_{dc} \]

$S_1$ closed, $S_2$ open

$S_1$ closed, $S_2$ close
CASE 2: DC/DC with bidirectional current

\[ L_2 = \frac{V_0}{t_2} \]

\[ \text{Conduction time for } S_1 \]

\[ i_L(t) = \left( \frac{V_{dc} - V_0}{L} \right) t + t_i \]
$V_+(t)$

$V_{dc}$

$S1$

$D \cdot T$

$S2$

$(1-D) \cdot T$

$I_{ave}$

$t$

$t$

$V_{dc} - V_o$

$0 - V_o$

$T = \text{switching period for 1 cycle}$

$D = \text{Duty ratio} \leftarrow \text{control to regulate output}$
To regulate current, control D to regulate current L. 

Average current instantaneous.