Switched Capacitor DC-DC Converter

EE5325 VLSI Power Management Circuits

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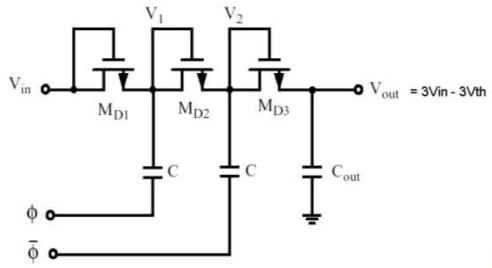
Switched Capacitor (SC) DC-DC Converter

- Works on a principle of charging and delivering the energy through capacitor
- Concept is similar to switched capacitor DAC
- Voltage can be varied by re-arranging the capacitors in series and parallel
- Can be used to implement Buck, Boost or Buck-Boost converters

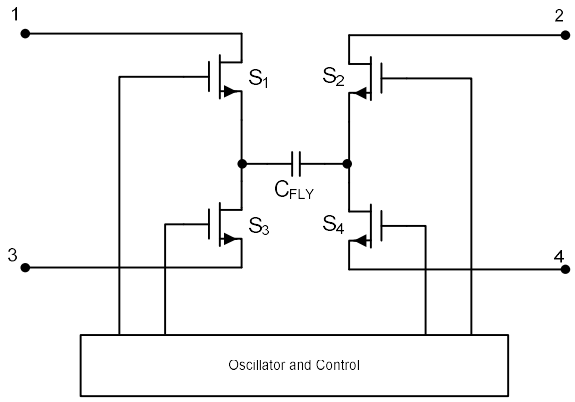
Basic Concept



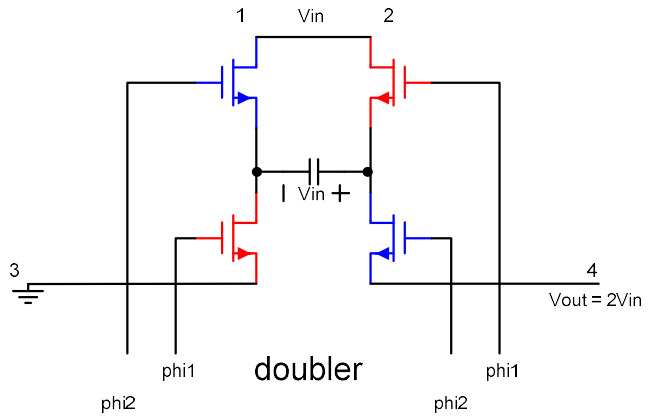
- Step 1- $\phi = 0$
- V1=Vin-Vth
- Step 2- ϕ = Vin
- V1 = 2Vin-Vth
- Step 3- $\bar{\phi} = 0$
- V2 = 2Vin-Vth
- Step 4- $\bar{\phi}$ = Vin
- V2 = 3Vin-2Vth
- **Vout = 3Vin – 3Vth**

H-bridge Topology

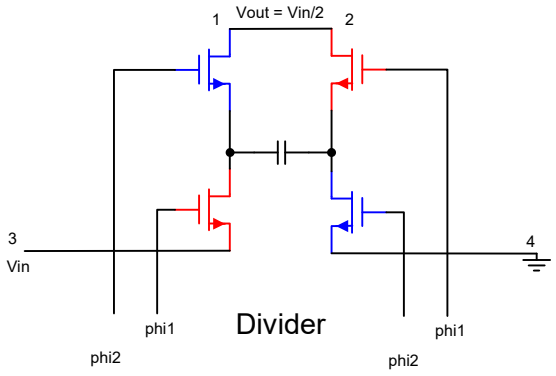
- **Buck, Boost or Inverting functions can be achieved depending upon how input and output connects**



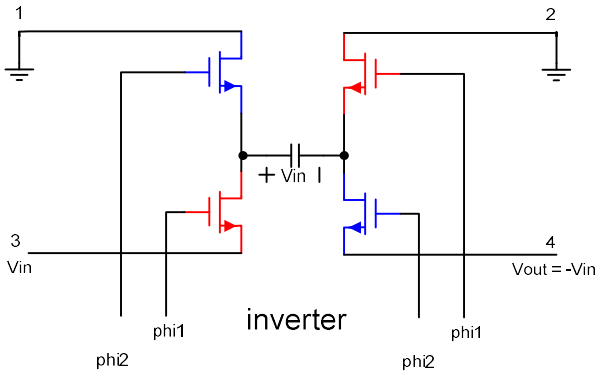
H-bridge Topology - Boost



H-bridge Topology - Buck

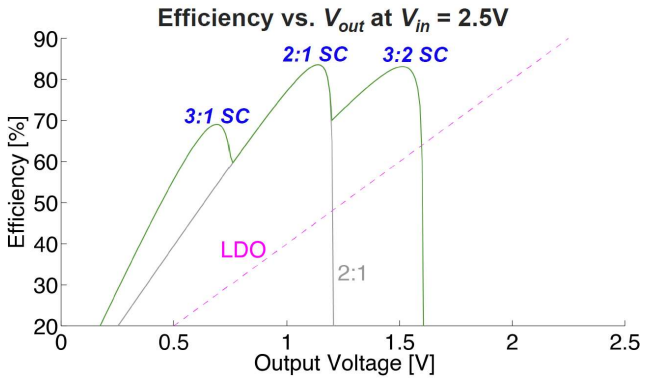


H-bridge Topology - Inverting

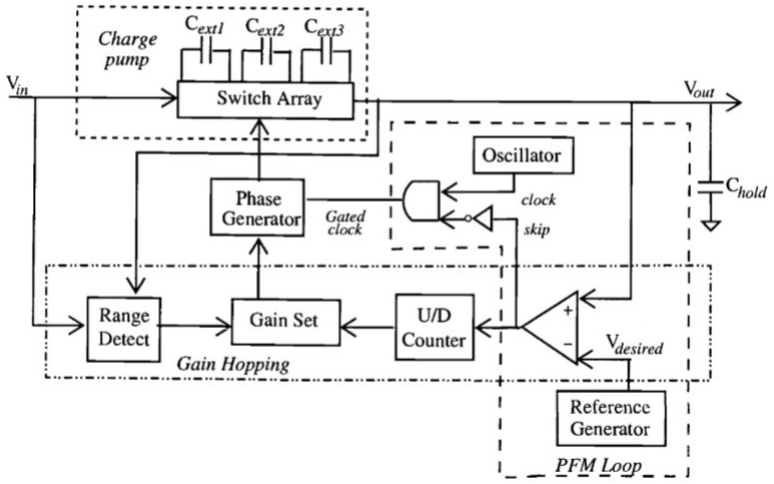


Efficiency of SC DC-DC Converter

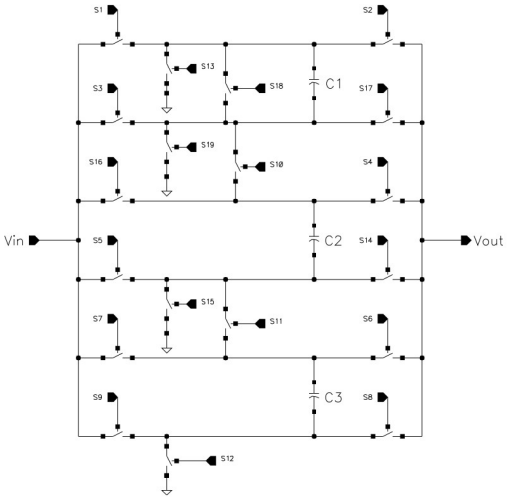
- Efficiency peaks Vo/Vin = Gain
- More gain settings are required to achieve higher efficiency across wide Vo/Vin range → flatter efficiency curve



LM3352 SC Regulator



LM3352 SC Regulator - Switches



Region	Max. Gain	Min. Gain
1	2/3	1/2
2	2/3	1/2
3	3/4	2/3
4	1	2/3
5	1	3/4
6	1	1
7	4/3	1
8	3/2	4/3
9	2	4/3
10	2	4/3
11	2	2

Buck

Bypass

Boost