

# Multi-Level Inverter



[www.vishaldevdhar.org](http://www.vishaldevdhar.org)

**Vishal D Devdhar**

**Lecturer**

**Electrical Engineering Department**

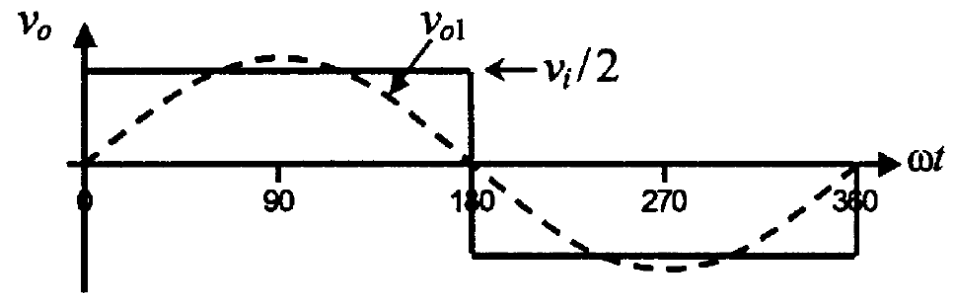
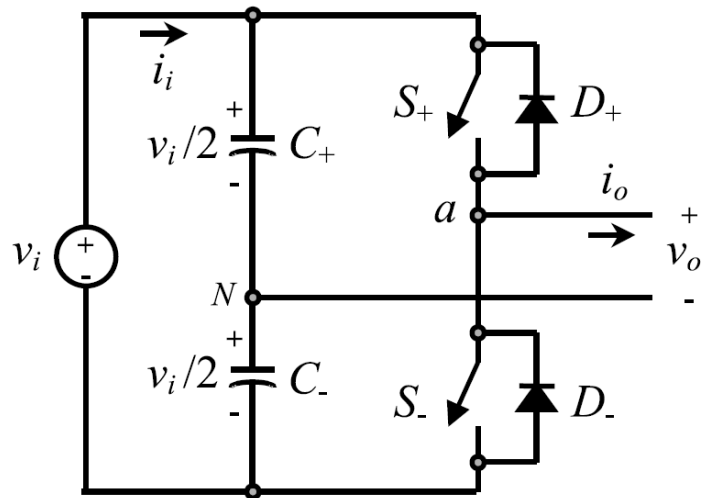
**Government Polytechnic, Rajkot**

# Contents

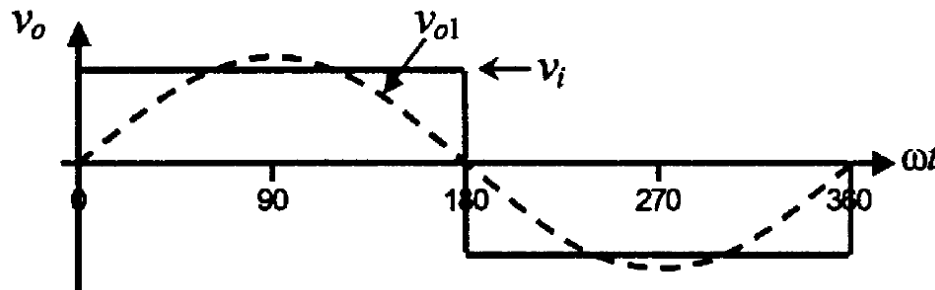
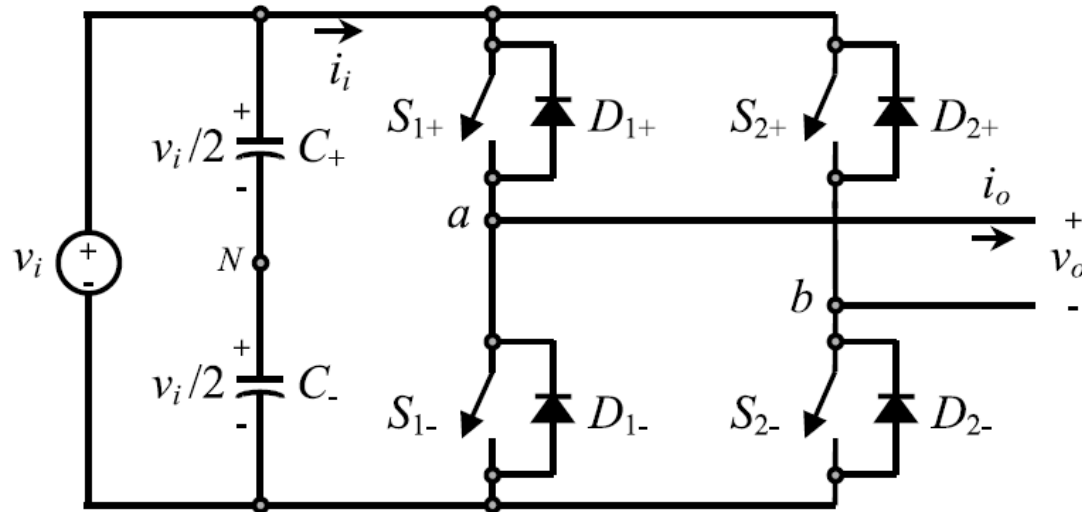
---

- ❑ Bridge inverters
- ❑ Need for multi-level inverters
- ❑ Concept of multi-level,
- ❑ Topologies for multi-level:
  - Diode Clamped,
  - Flying capacitor
  - Cascaded H-Bridge
- ❑ Comparison
- ❑ Switching device currents;
- ❑ DC-link capacitor voltage balancing,
- ❑ features of multilevel converters,
- ❑ Applications

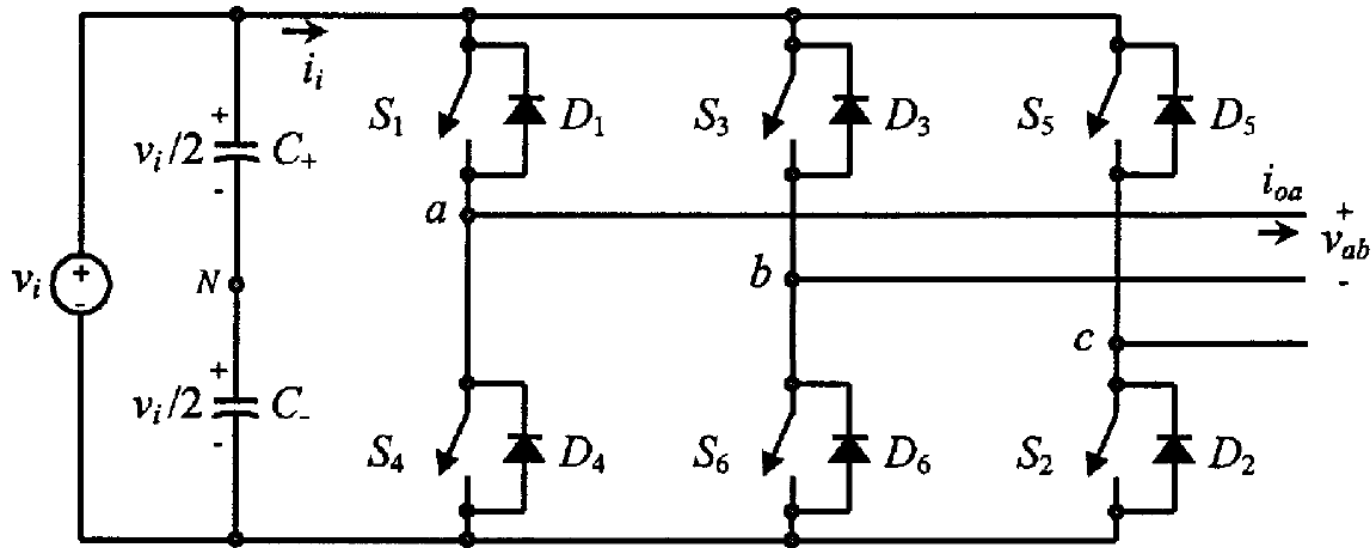
# Half Bridge Inverter



# Full Bridge Inverter



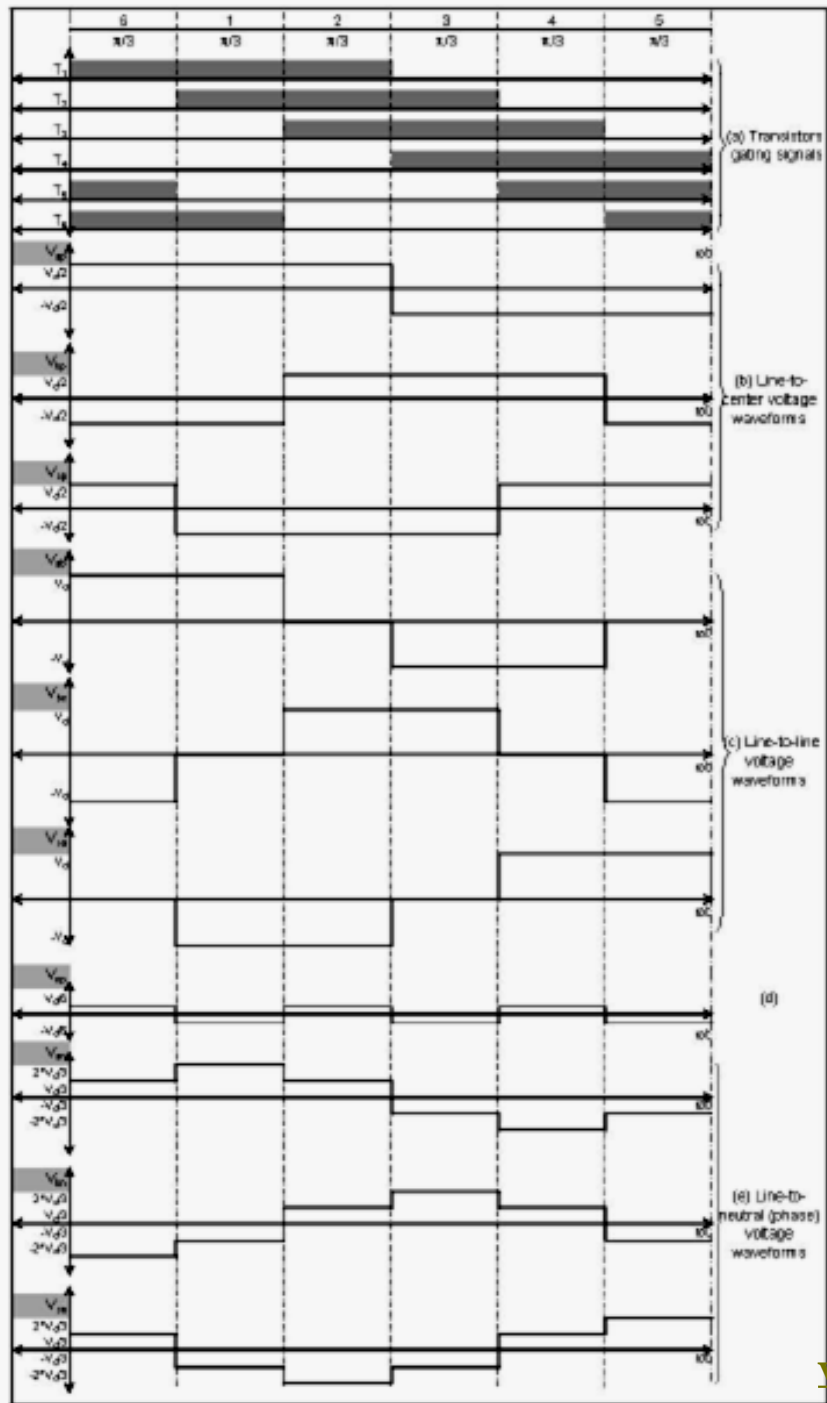
# 3-Phase Inverter



# 180° Conduction

---

<i>Interval</i>	<i>Duration</i>	<i>Conducting Devices during interval</i>							
1	$\pi/3$	$T_1$	$T_2$	$T_3$					
2	$\pi/3$		$T_2$	$T_3$	$T_4$				
3	$\pi/3$			$T_3$	$T_4$	$T_5$			
4	$\pi/3$				$T_4$	$T_5$	$T_6$		
5	$\pi/3$					$T_5$	$T_6$	$T_1$	
6	$\pi/3$						$T_6$	$T_1$	$T_2$

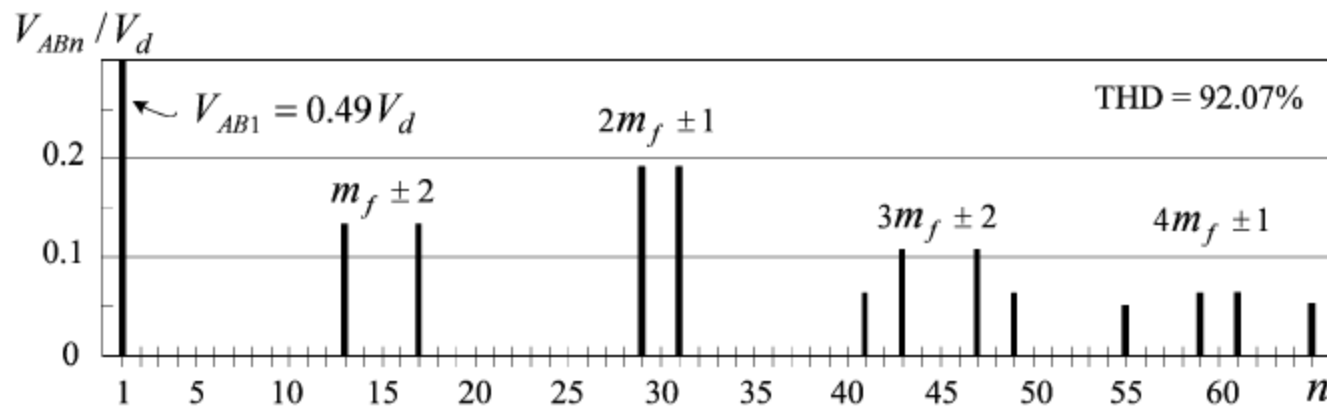
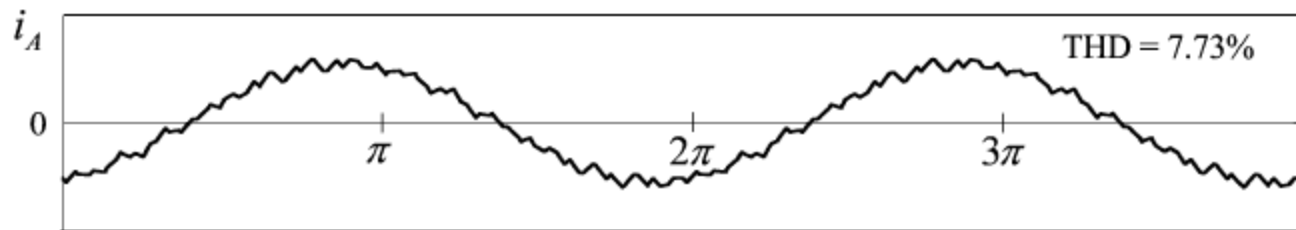
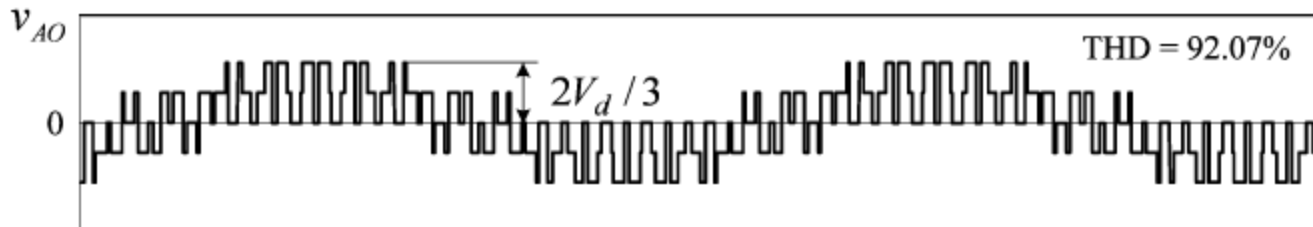
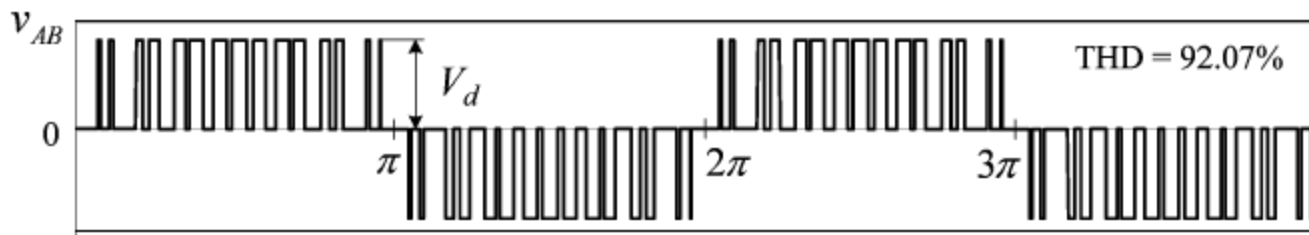


# Need for multi-level inverters

---

- ❑ Two level inverters produce pulsed output voltage waveform which contain harmonics.
- ❑ Harmonic components are centered on switching frequency and its multiple.
- ❑ Higher switching frequency is desirable to filter out the harmonic component easily.
- ❑ Higher frequency causes
  - Switching losses
  - Electromagnetic interference (EMI)



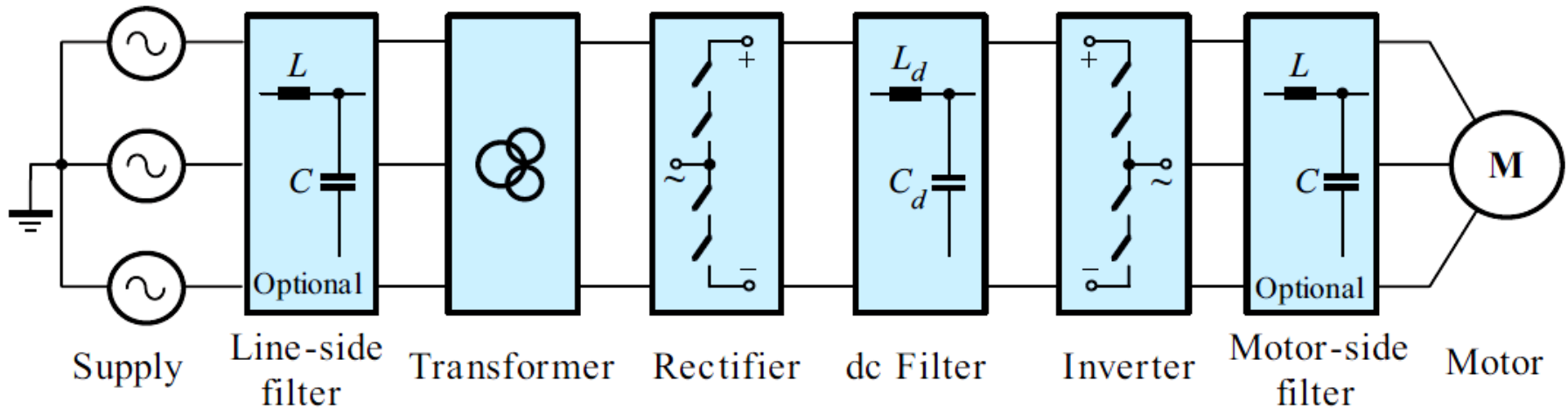


# Need for multi-level inverters

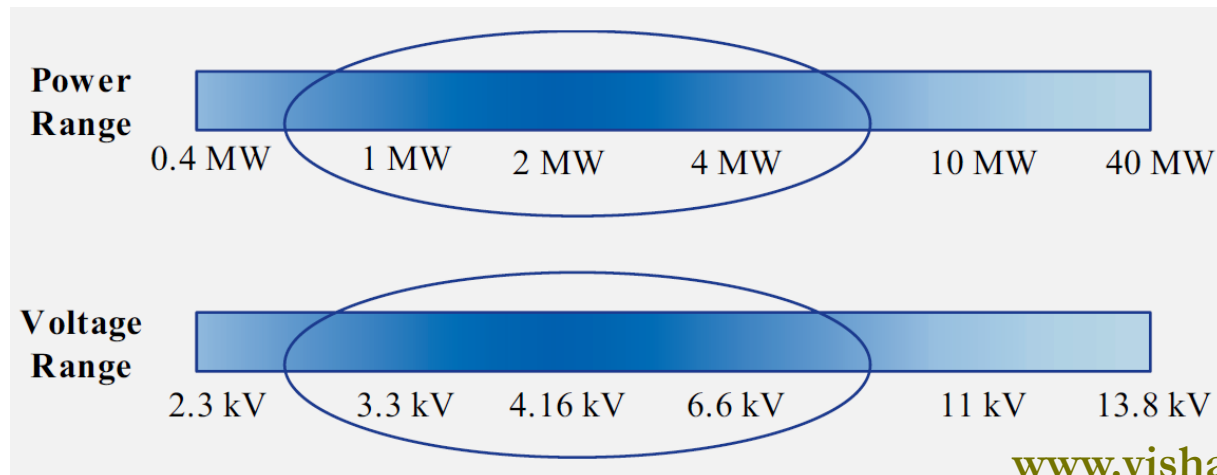
---

- Two level inverters produce large voltage change rates ( $dv/dt$ ).
- Large ( $dv/dt$ ) causes
  - Additional EMI
  - Increase stress on insulation
  - Generate common mode voltage (CMV)
- Each device has to block entire DC Link voltage
- Conventional two-level inverter is restricted to low and medium power applications.

# Medium voltage ASD



**General block diagram of the MV drive**



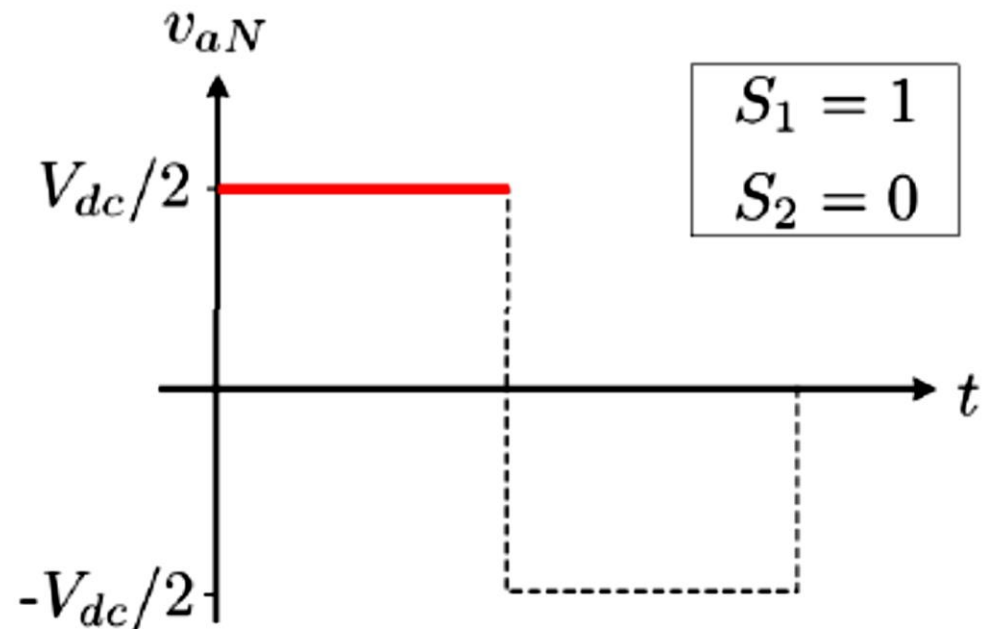
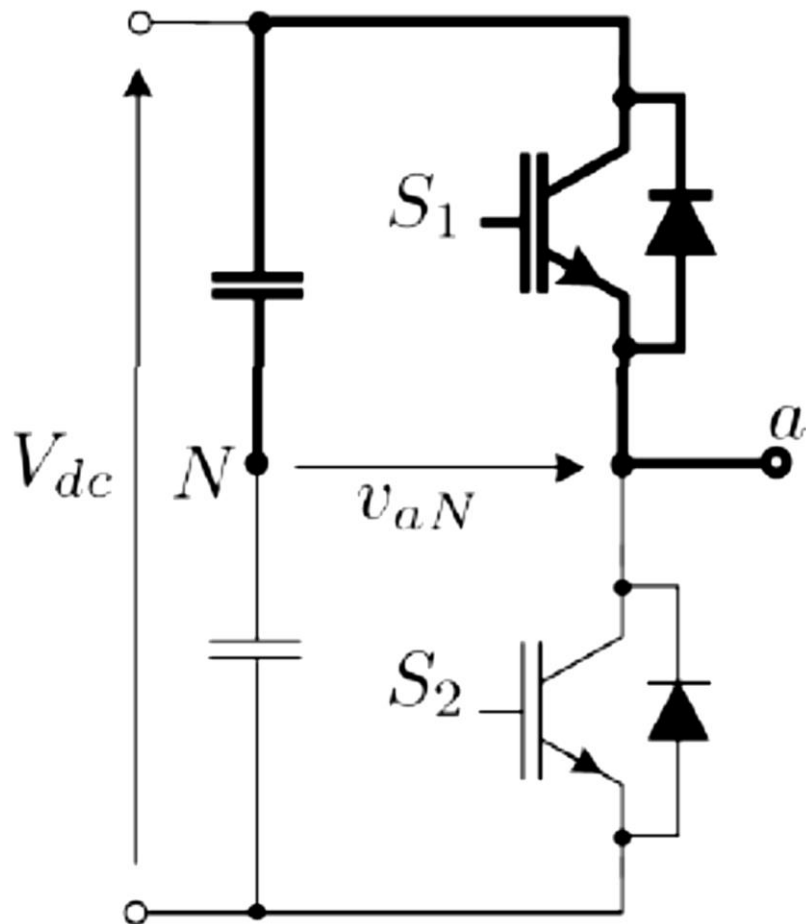
# Concept of multi-level inverters

---

- What is the number of levels of an Inverter?
  - It is the number of steps in the voltage of the output terminal with respect to any arbitrary internal reference point.
  
- Multi level inverters are realized from a number of smaller discrete voltage sources
  
- They generate the output voltage waveform with smaller magnitude.

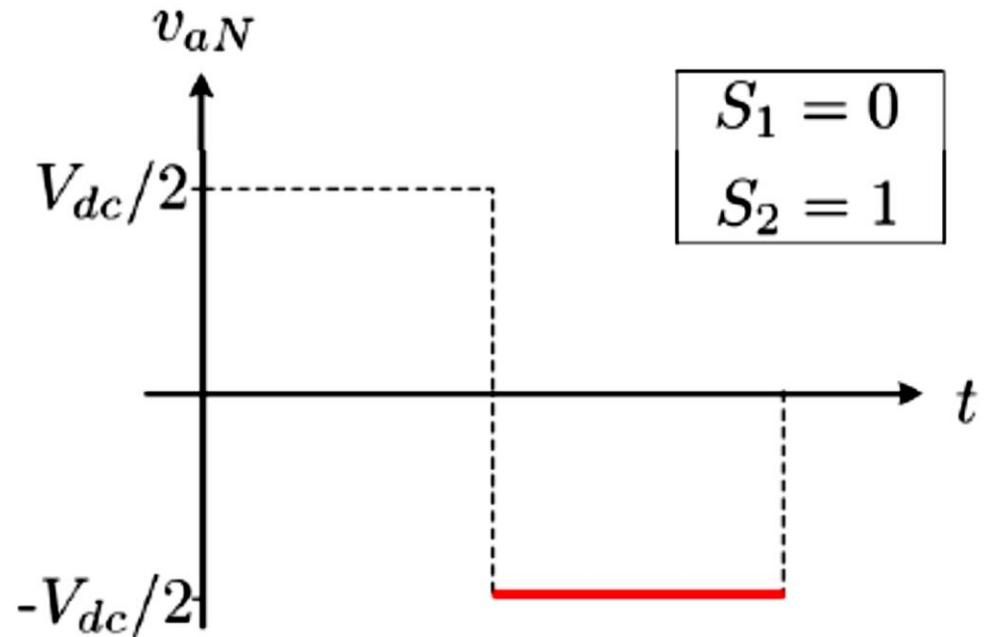
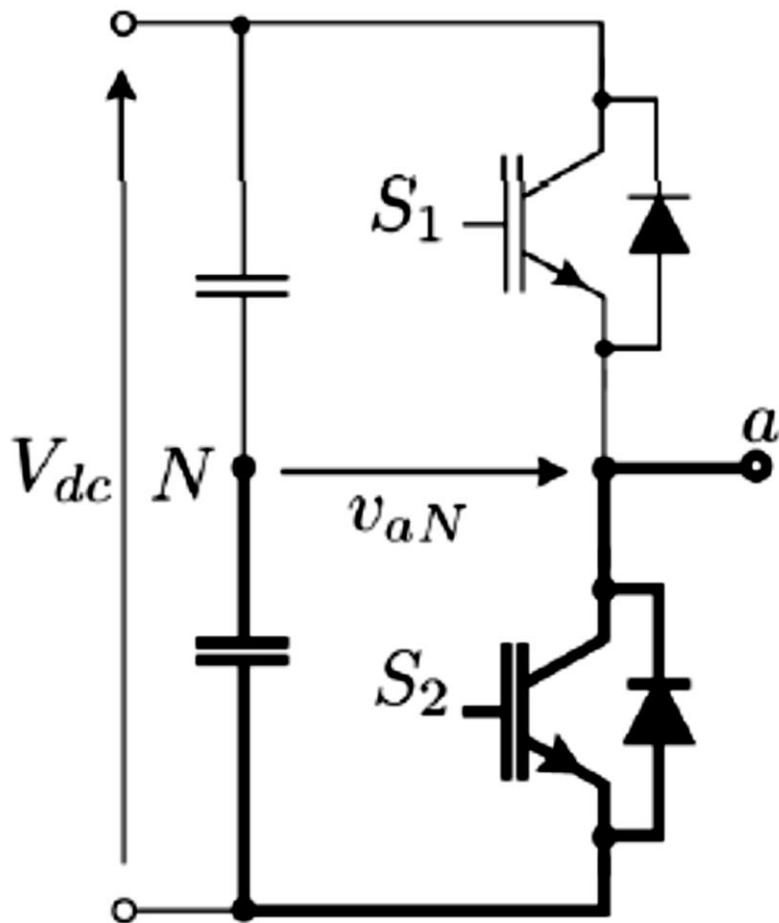
# Concept of multi-level inverters

## Two Level Inverter



# Concept of multi-level inverters

## Two Level Inverter



# Concept of multi-level inverters

---

## Definition of Multilevel Inverter:

“ Multilevel inverters are power converters composed by an array of semiconductors and capacitor voltage sources, that when properly controlled, can generate stepped waveform output voltages with adjustable frequency and amplitude ”

# Applications

---

- **High Voltage, High power applications**
  - Industrial
  - Marine
  - Traction
  - Laminators
  - Mills
  - Conveyors
  - Pumps
  - Blowers
  - Compressors



# Thank

---

# You

[www.vishaldevdhar.org](http://www.vishaldevdhar.org)