INVERTERS

Inverters

- DC to AC Conversion
- Applications : Adjustable speed ac drive , Induction heating, stand by air craft power supplies , UPS, HVDC Transmission lines etc
- Forced Commutated Inverters , Line commutated Inverters , Load Commutated Inverters , Voltage Source Inverter , Current Source Inverter

Inverters

Inverters are also classified depending upon the connection of commutating components with the main circuit.

- Series Inverter
- Parallel Inverter
- Bridge Inverter

Classification

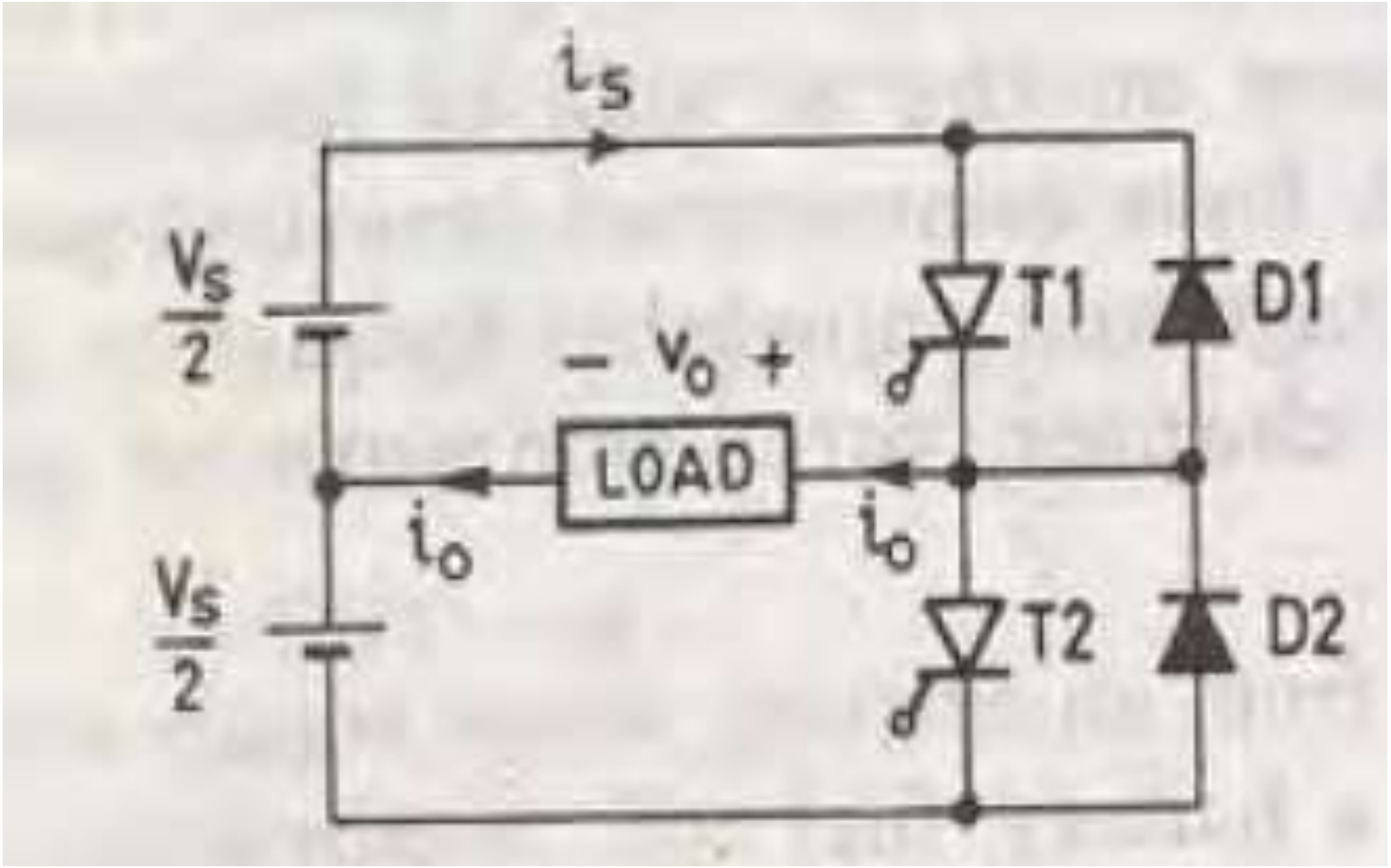
- Broadly categorized into :

  - Voltage Source Inverter (VSI) or Voltage fed Inverters (VFI)

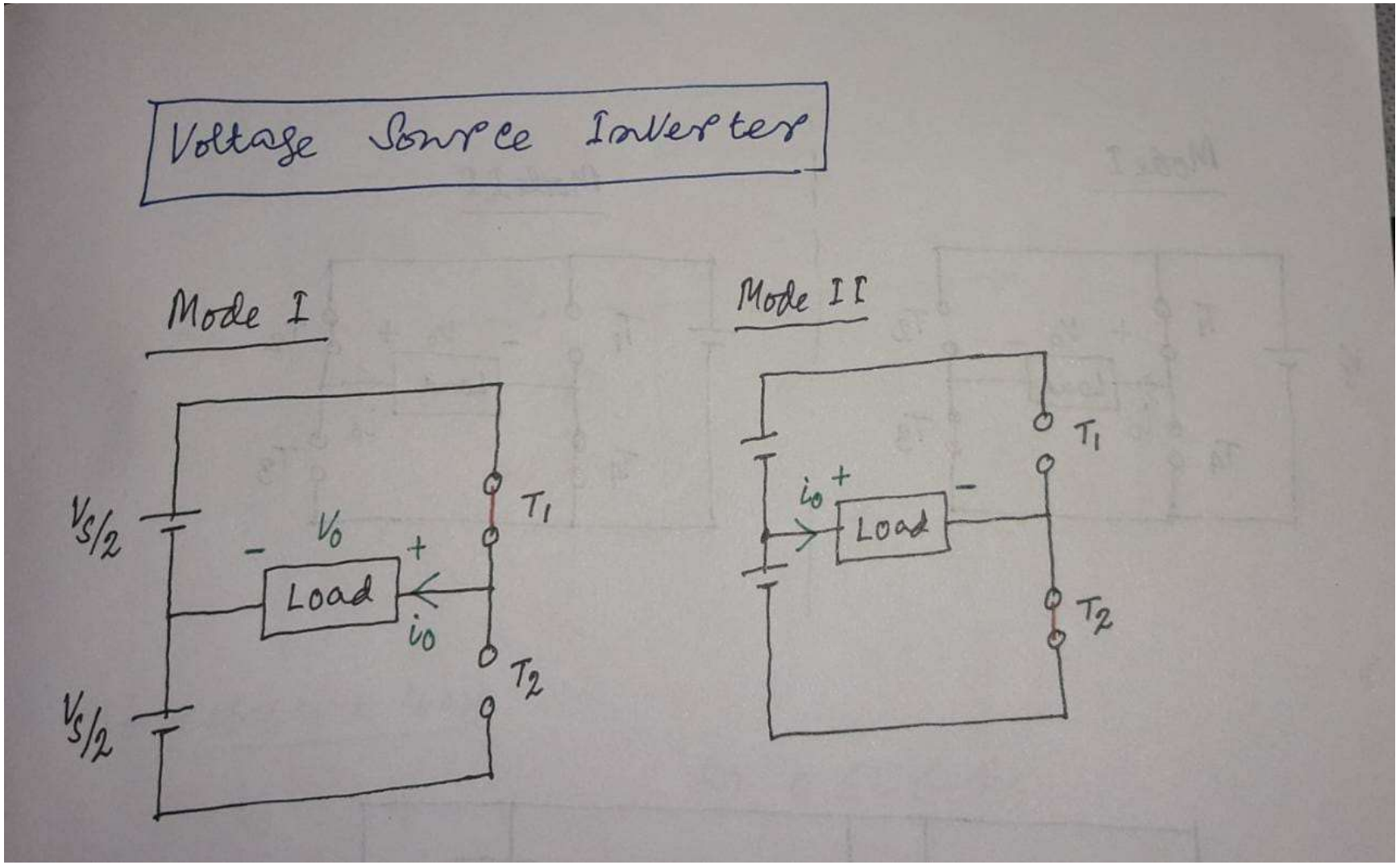
  - Current Source Inverter (CSI) or Current fed Inverters (CFI)

---- Impedance of VSI and CSI are as per Voltage Source and Current Source

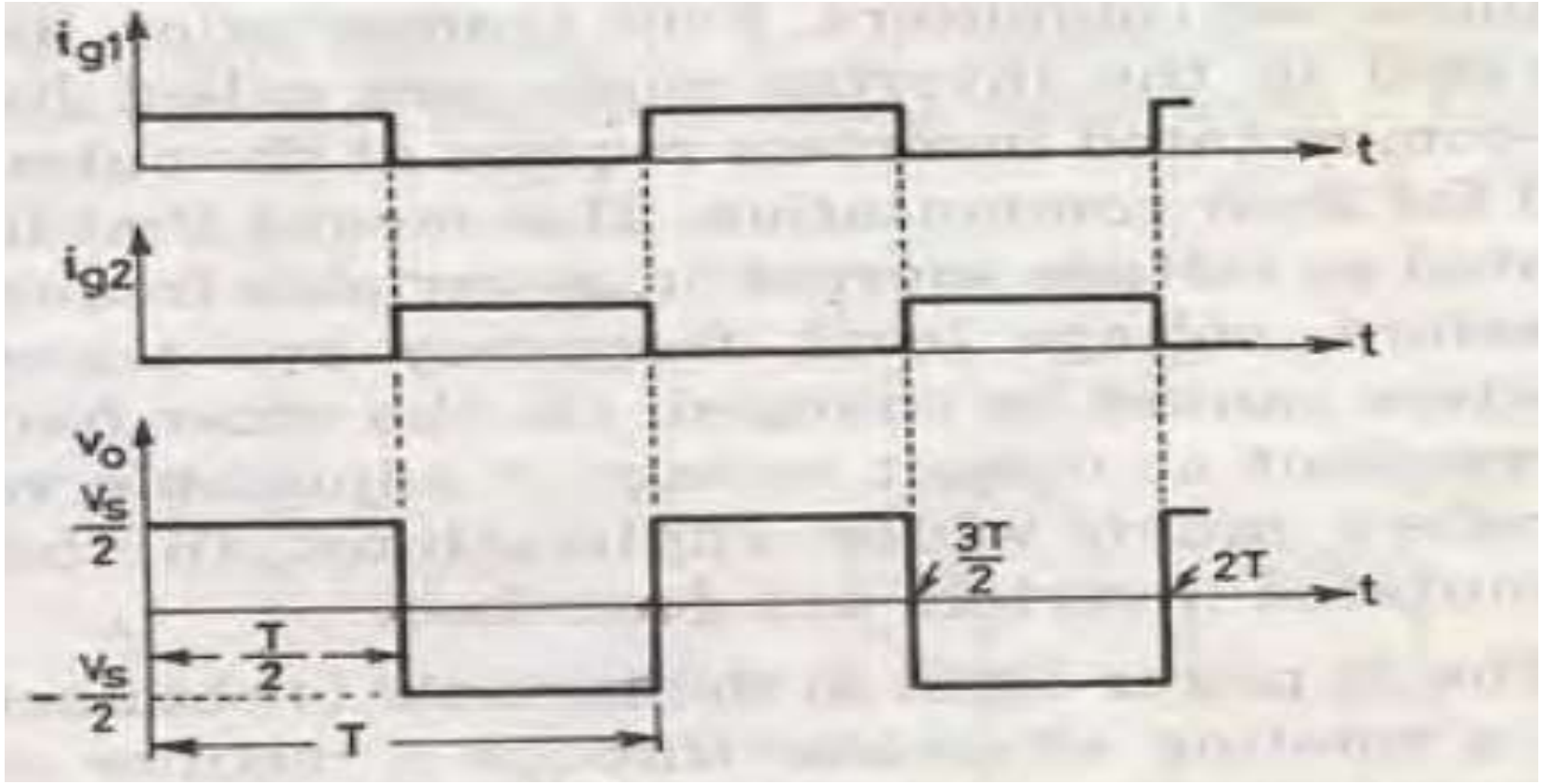
Single Phase Voltage Source Inverter



Single Phase VSI



Single Phase Voltage Source Inverter



Half Bridge Configuration

Half Bridge VSI

For resistive load

$$V_o = \frac{V_s}{2} \quad \text{.... for } 0 \le t \le T_o/2$$

$$V_o = -\frac{V_s}{2} \quad \text{.... for } T_o/2 \le t \le T_o$$

$$I_o = \frac{V_o}{R} = \frac{V_s}{2R} \quad \text{... for } 0 \le t \le T_o/2$$

$$I_o = \frac{V_o}{R} = -\frac{V_s}{2R} \quad \text{... for } T_o/2 \le t \le T_o$$

$$V_{ORMS} = \left[\frac{1}{T_o/2} \int_0^{T_o/2} \left(\frac{V_s}{2}\right)^2 dt \right]^{1/2}$$

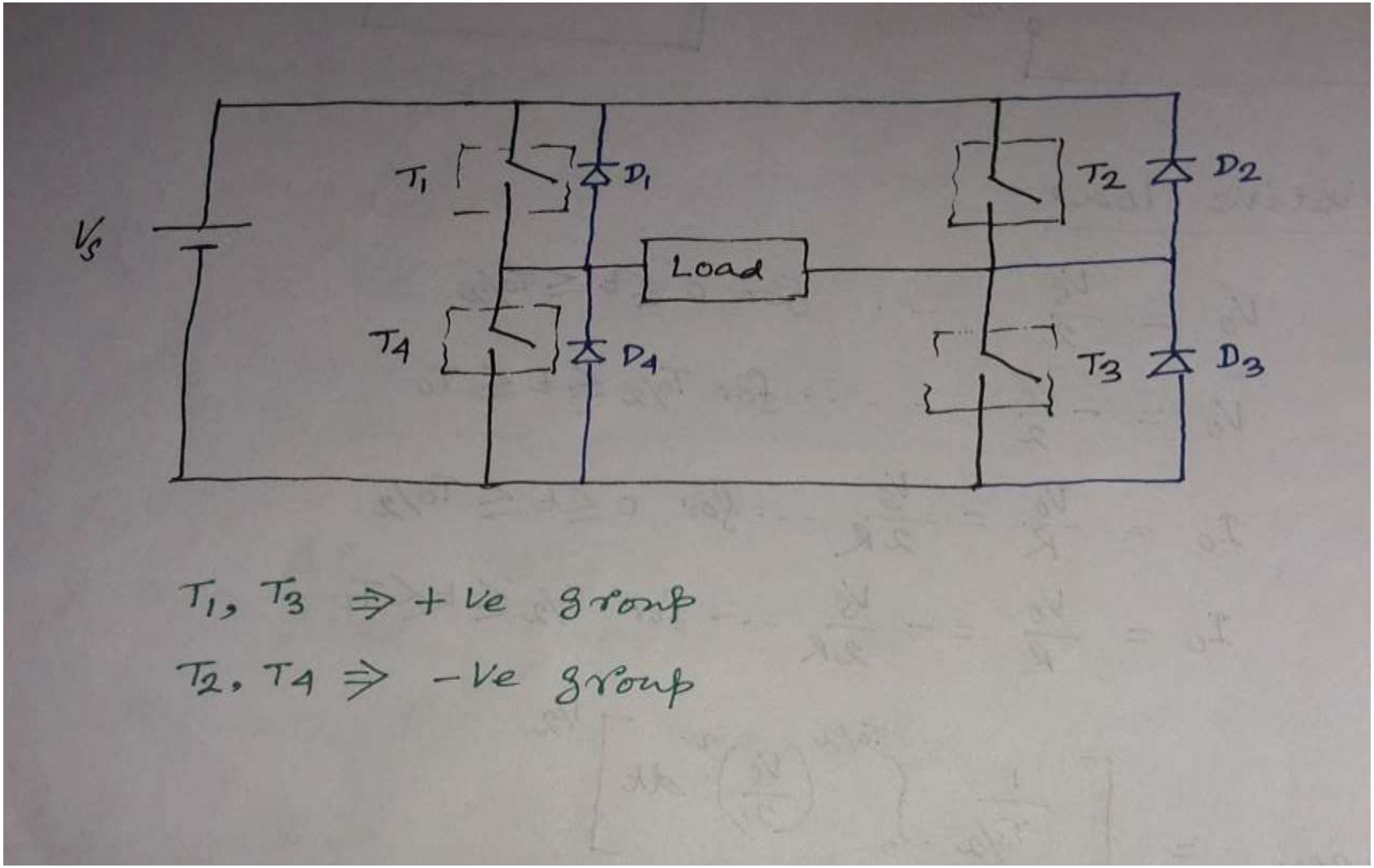
$$= \frac{V_s}{2}.$$

$$I_{ORMS} = \frac{V_s}{2R}.$$

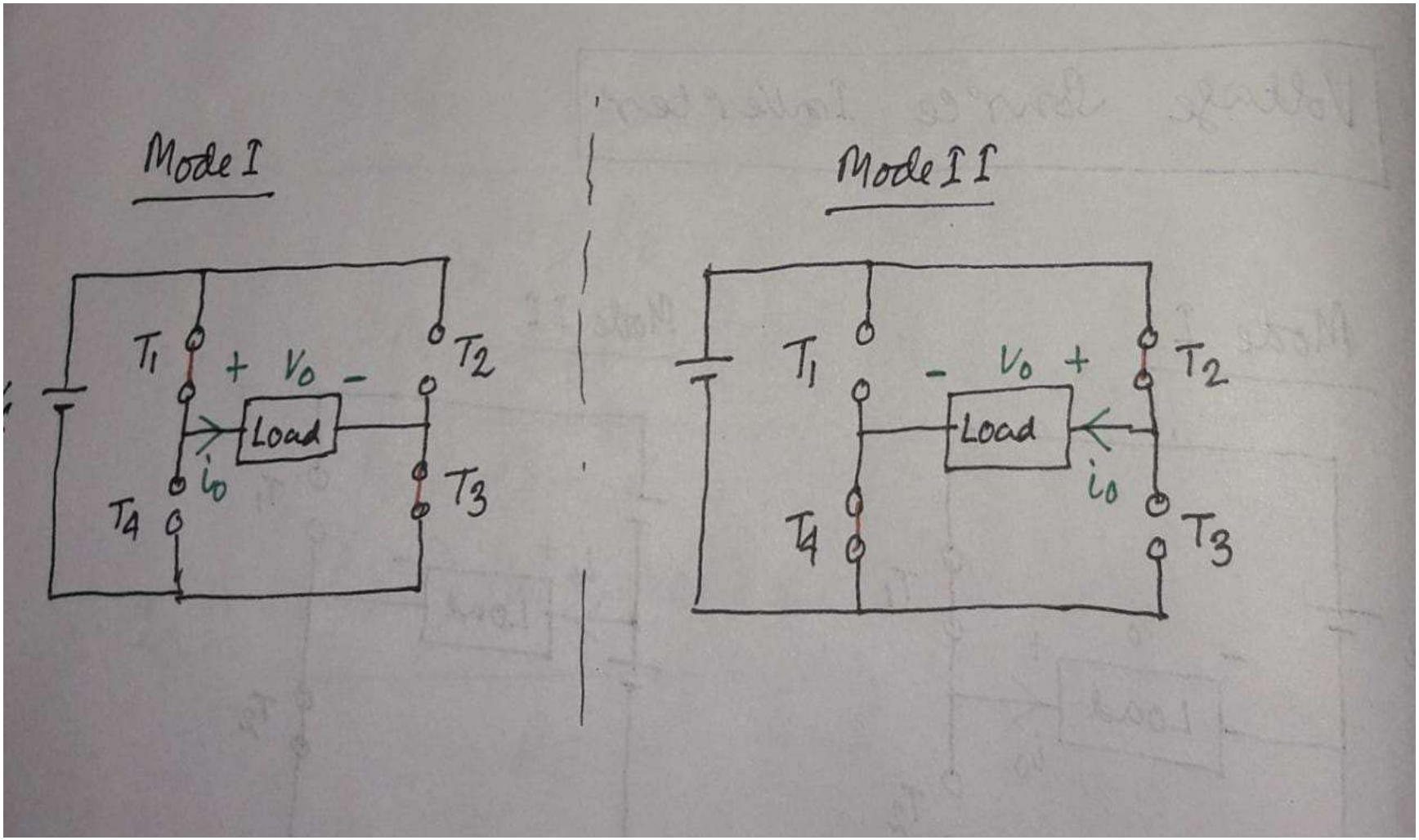
Limitations

- Requirement of 3 terminal DC Power Supply
- Output voltage is using half of the total voltage
- Full Bridge configuration eliminates the limitations
- Output nature is square wave.

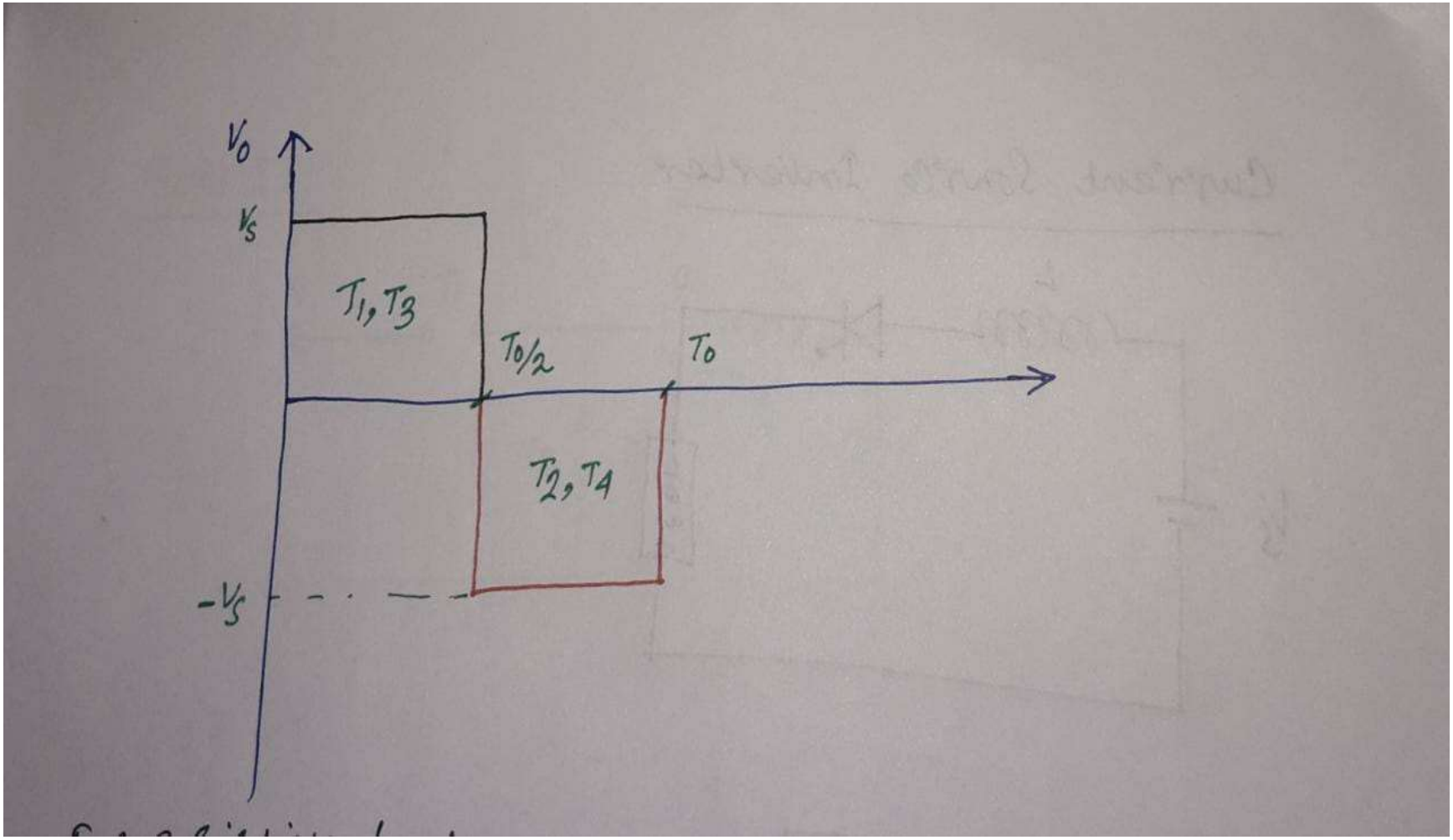
Full Bridge VSI



Full Bridge VSI



Full Bridge VSI



Full Bridge VSI

For resistive load

$V_o = V_s$ ---- for $0 \le t \le T_o/2$

$V_o = -V_s$ ---- for $T_o/2 \le t \le T_o$

$I_o = \frac{V_s}{R}$ ---- for $0 \le t \le T_o/2$

$I_o = -\frac{V_s}{R}$ ---- for $T_o/2 \le t < T_o$

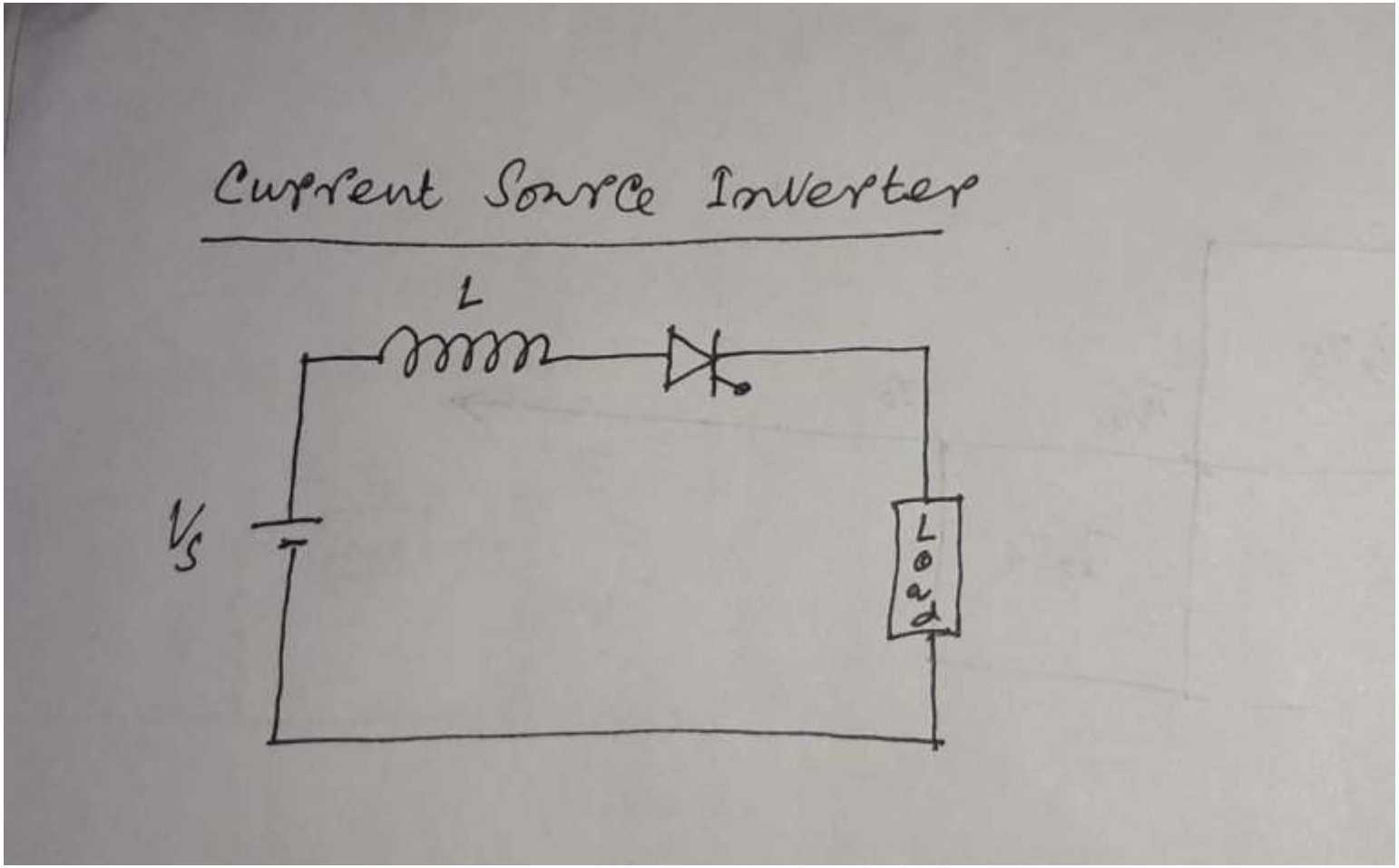
RMS O/P Voltage

$$V_{ORMS} = \left[\frac{1}{T_o/2} \int_0^{T_o/2} V_s^2 \, dt \right]^{1/2}$$

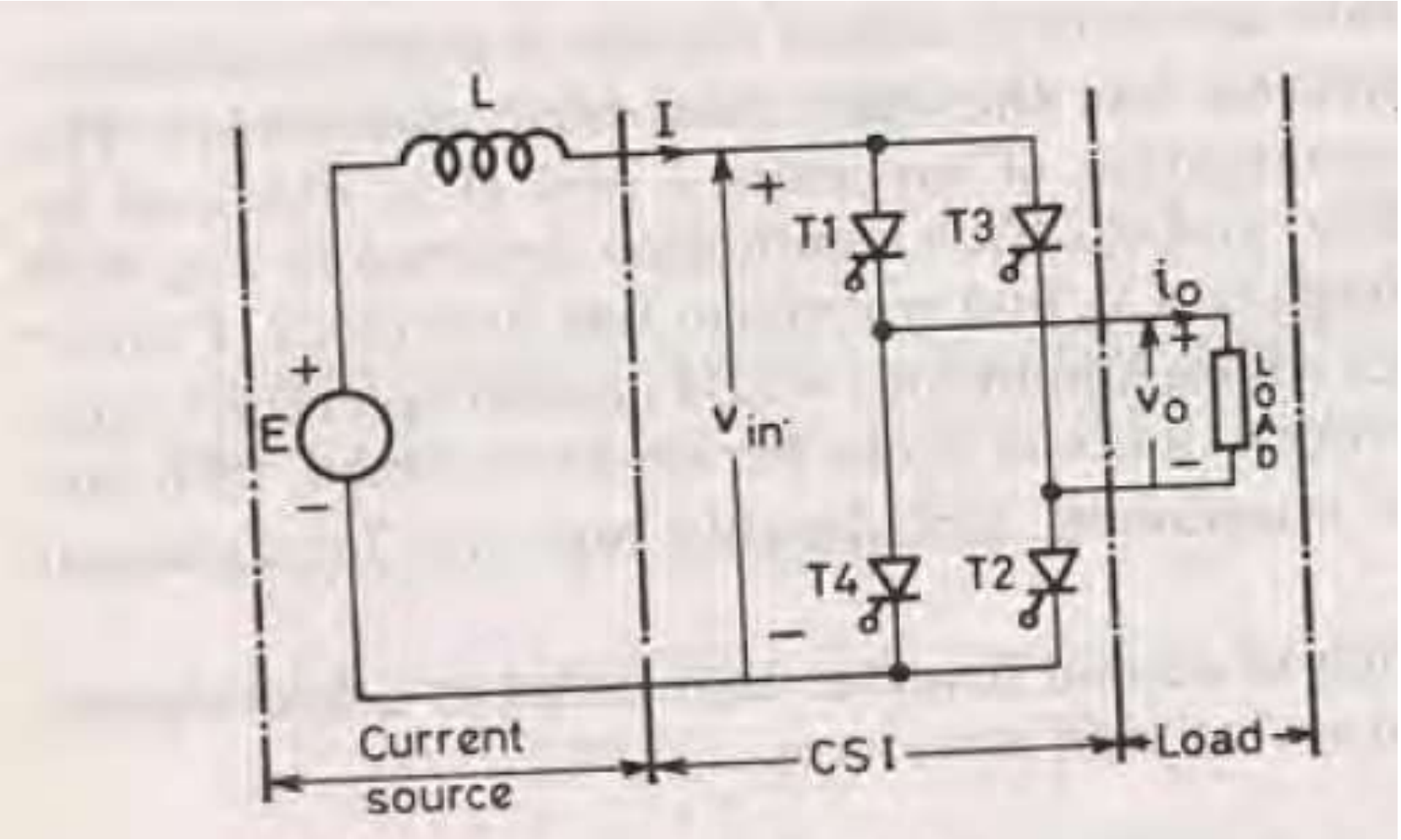
$$= V_s$$

$$I_{ORMS} = \frac{V_s}{R}$$

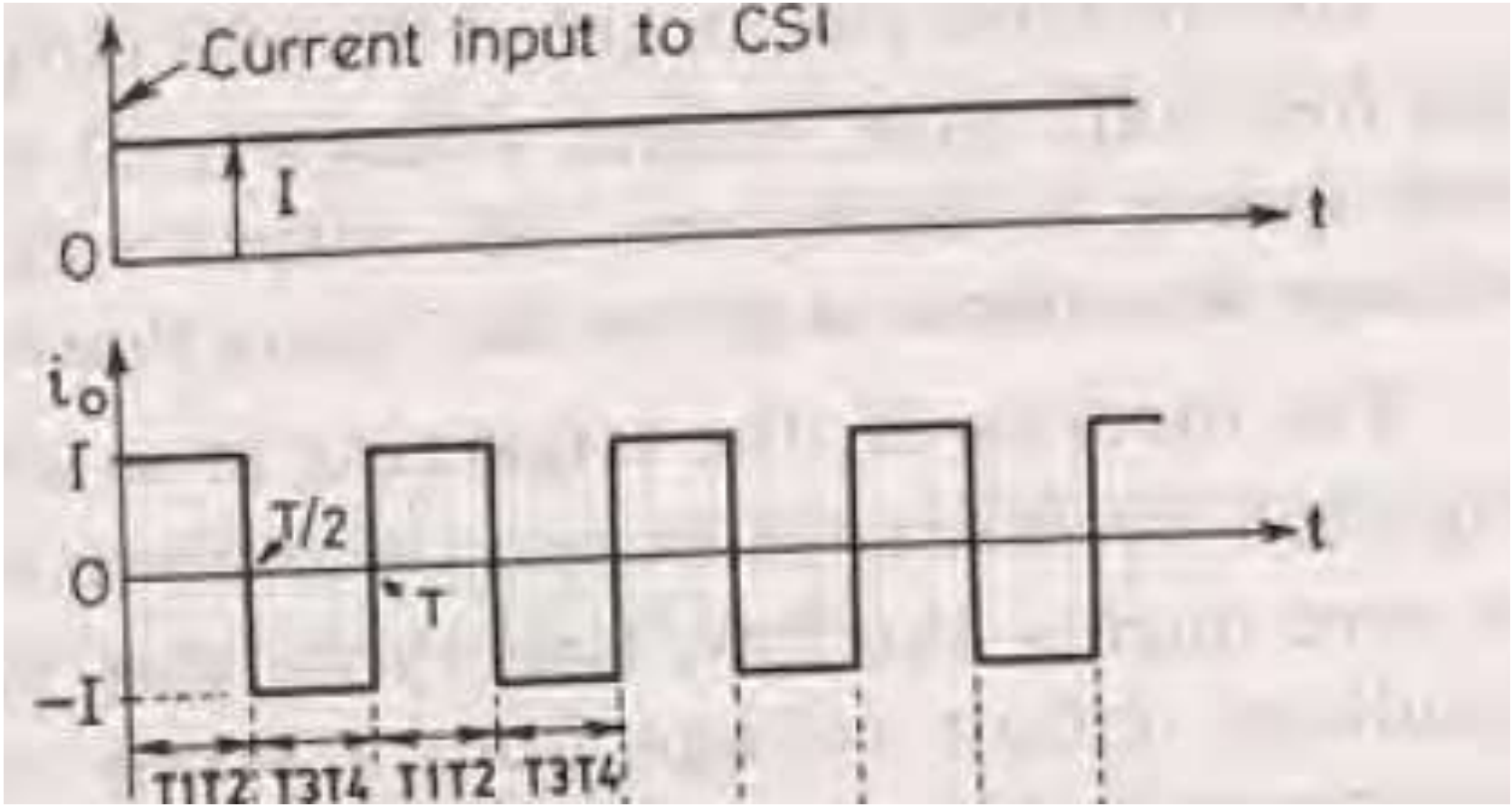
Current Source Inverter (CSI)



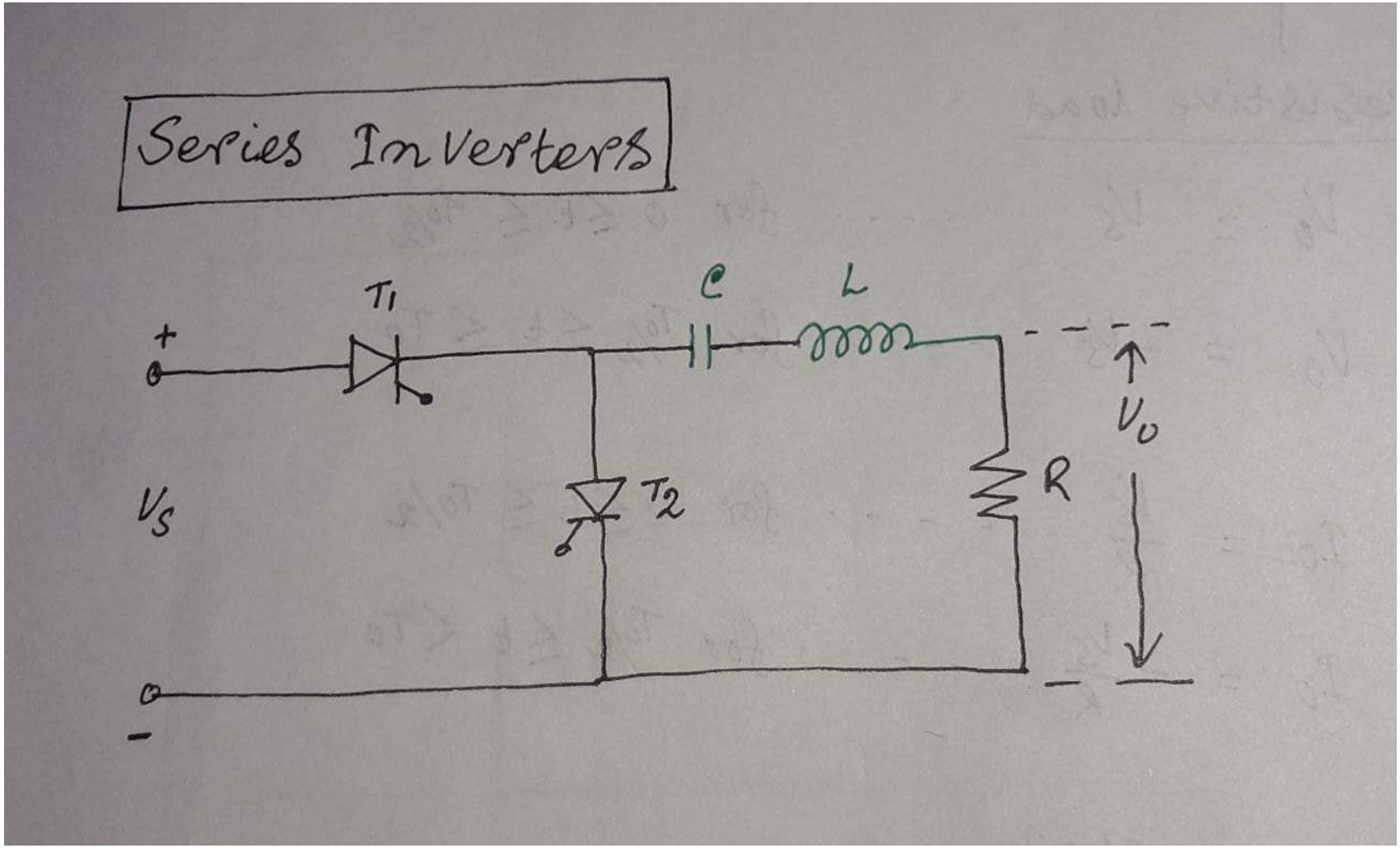
Current Source Inverter



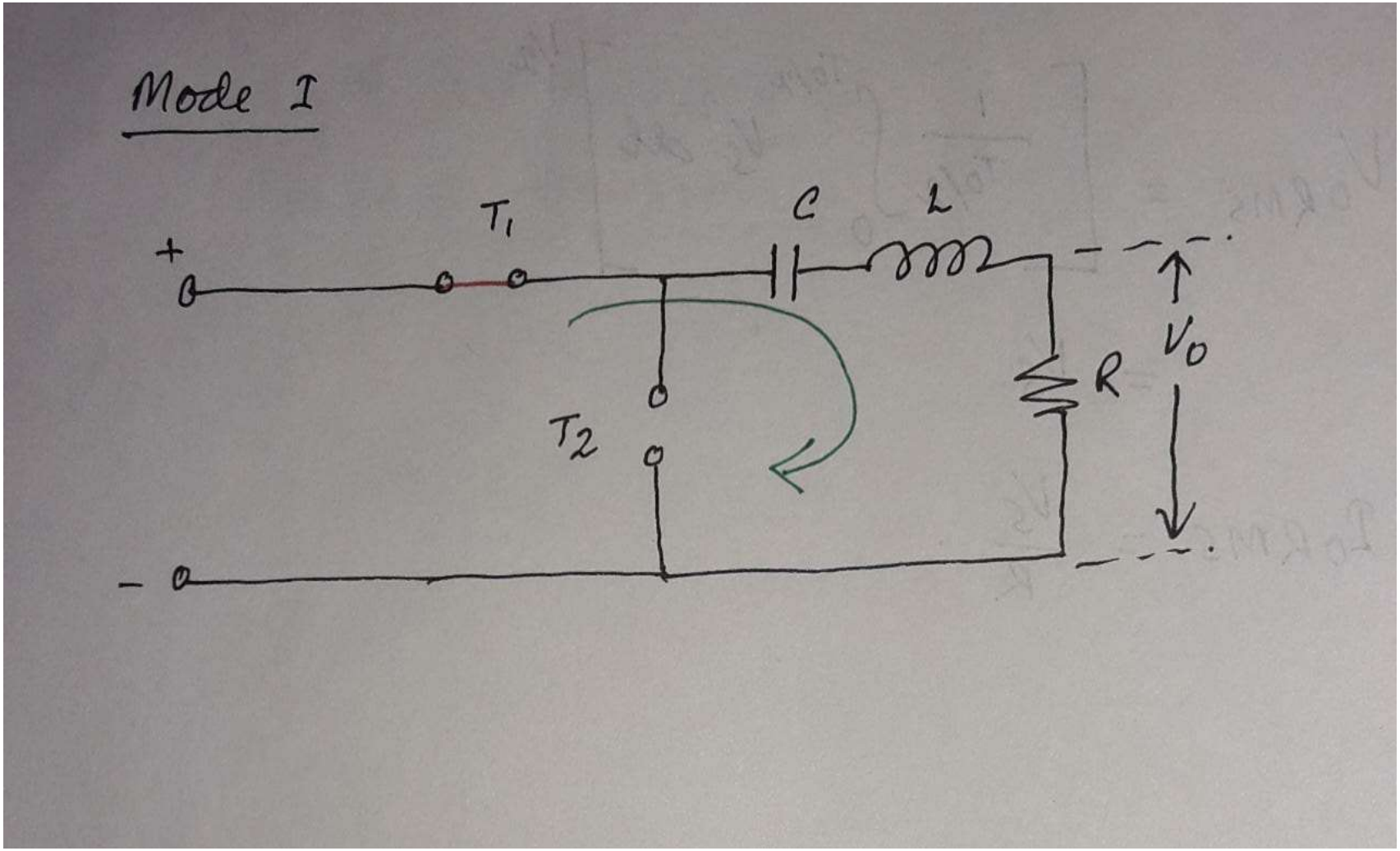
Current Source Inverter



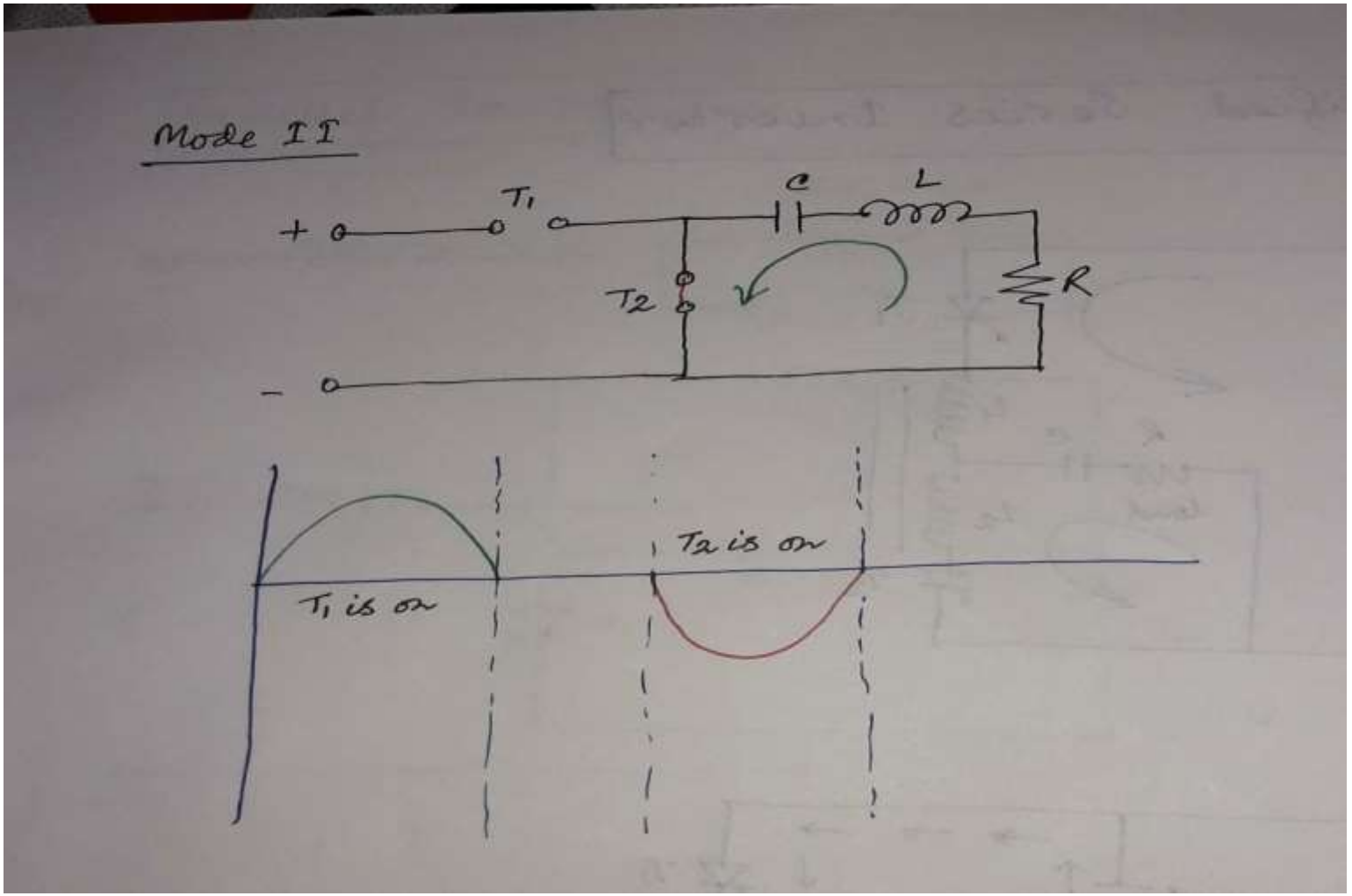
Series Inverter



Series Inverter



Series Inverter

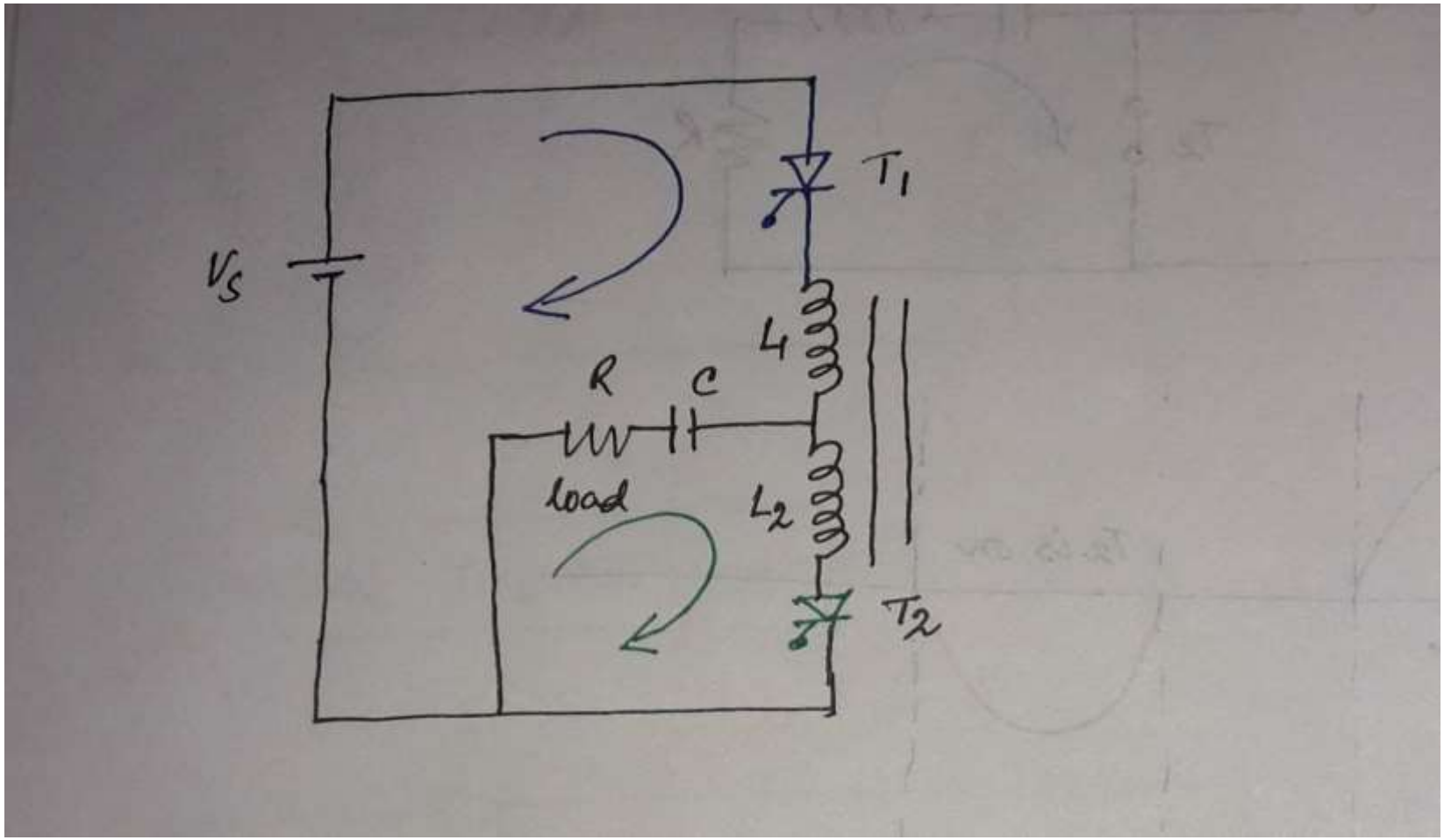


Series Inverter

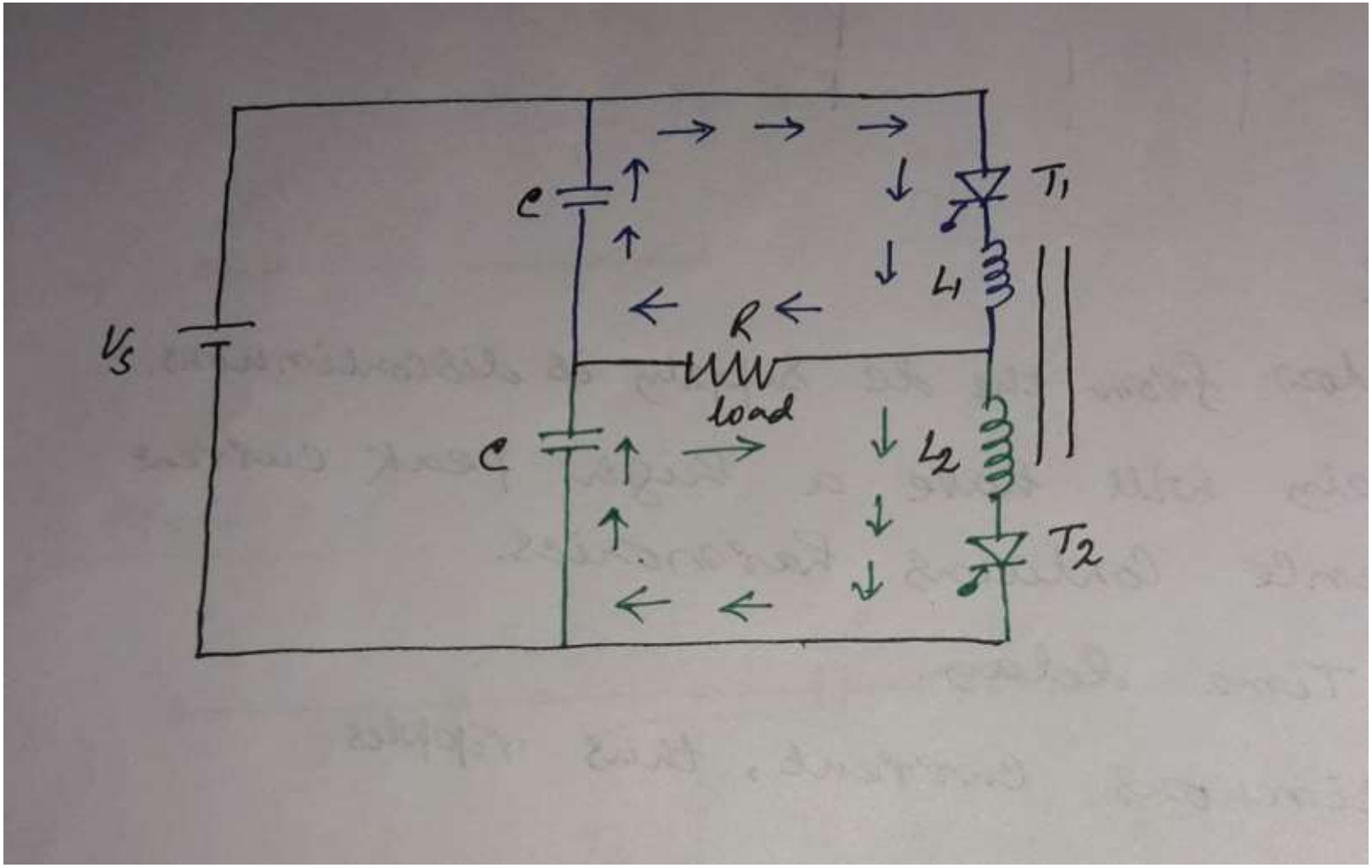
Drawbacks

1. Power flow from the dc supply is discontinuous.
2. DC supply will have a high peak current and hence contains harmonics.
3. Proper Time delay.
4. Discontinuous current, thus ripples
5. Poor o/p regulation
6. Rating of the commutation components are high.

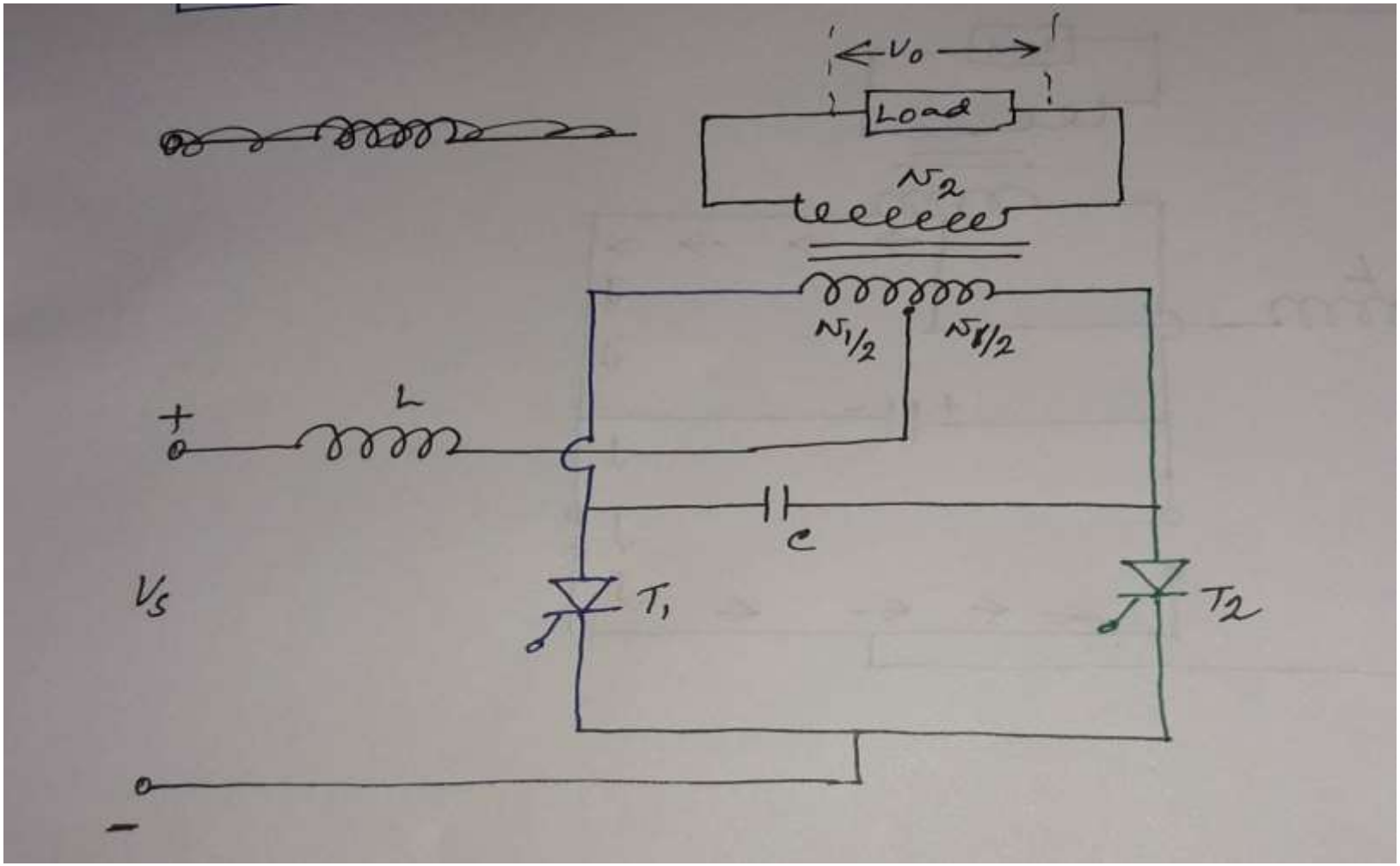
Modified Series Inverter



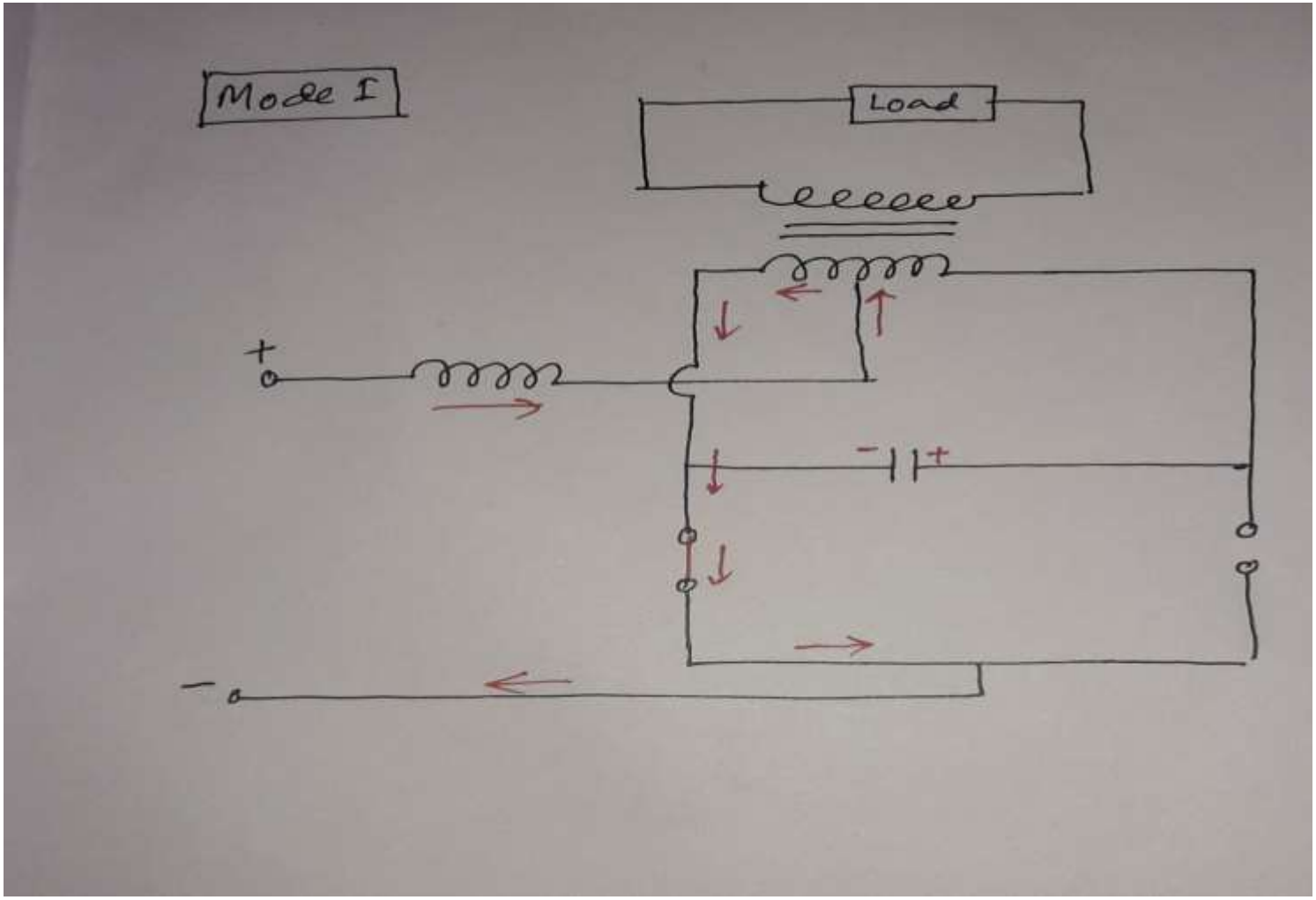
Modified Series Inverter



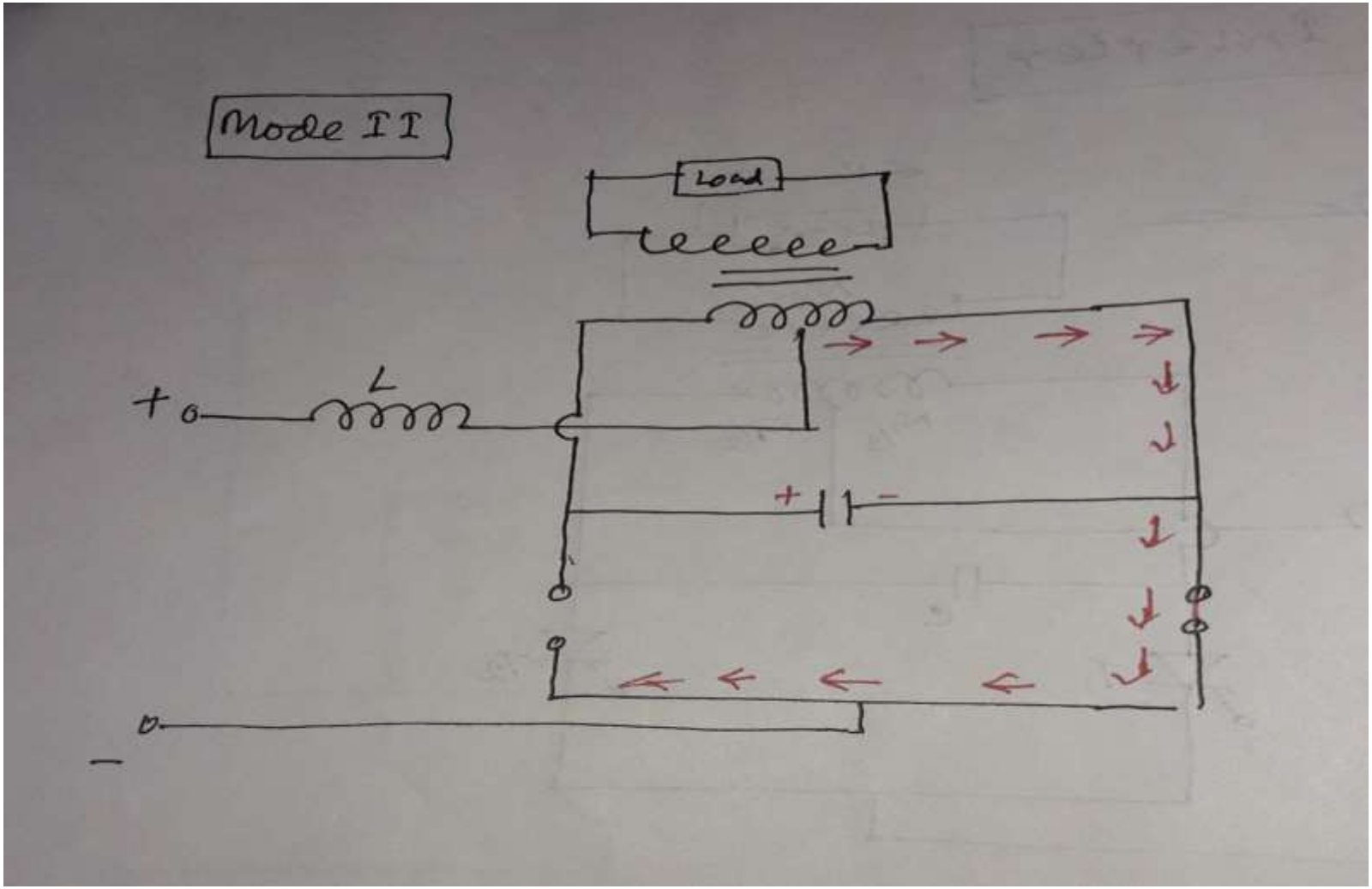
Parallel Inverter



Parallel Inverter



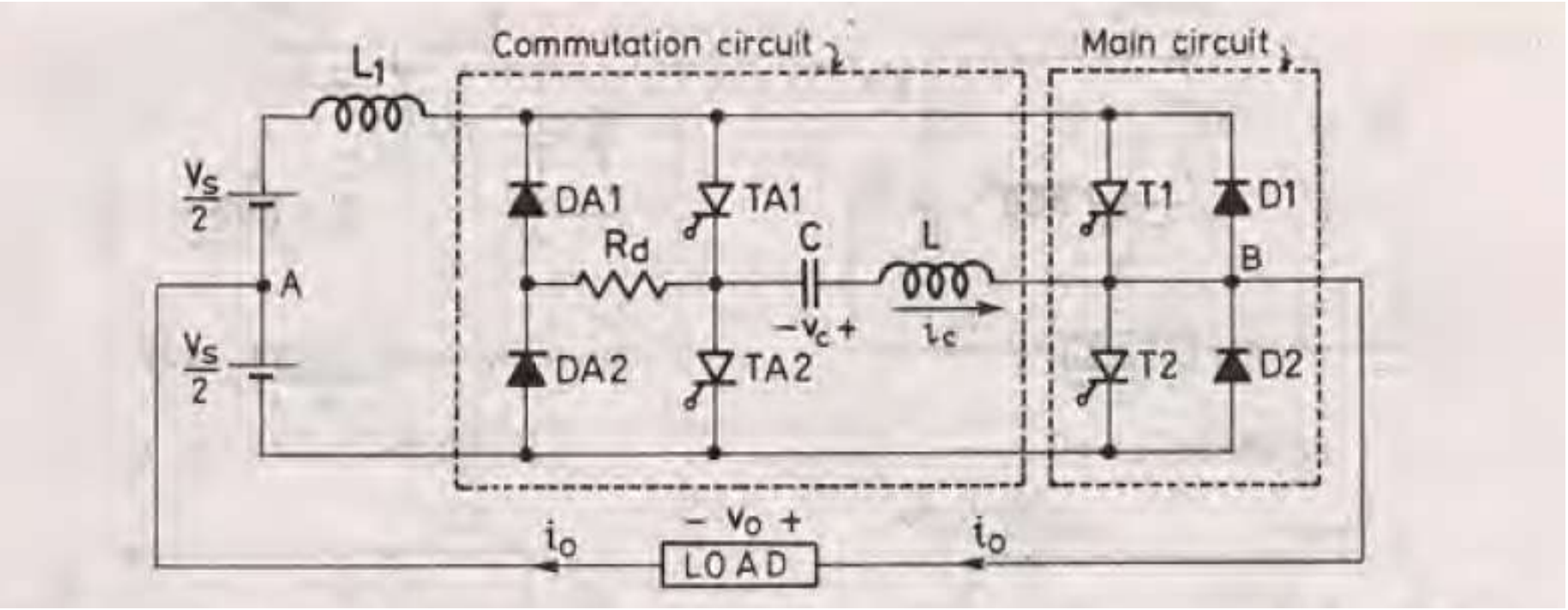
Parallel Inverter



A few questions

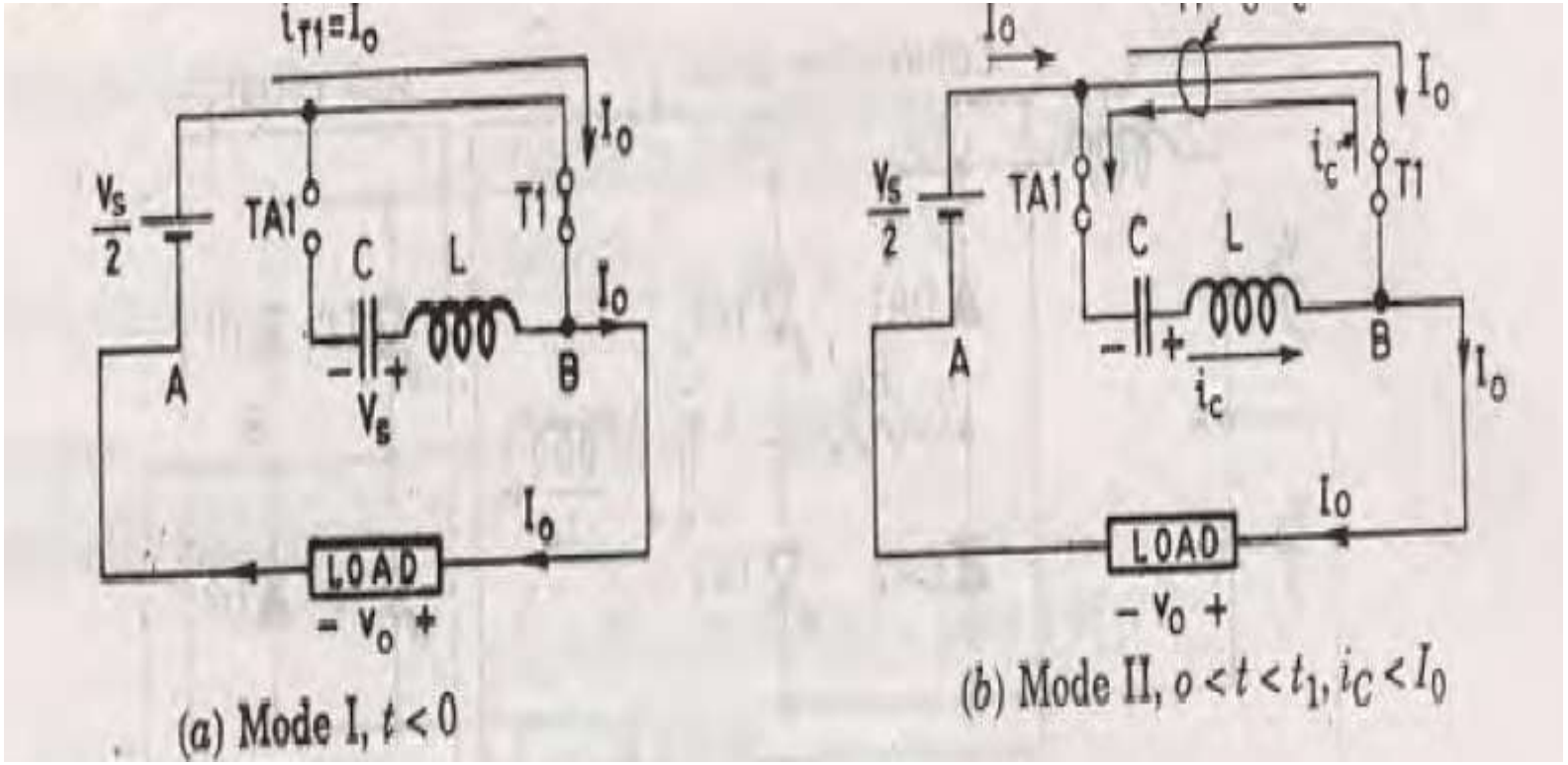
- Applications of INVERTER
- What are the limitations of half bridge VSI ?
- Compare VSI & CSI
- Features of Series Inverter
- Features of Parallel Inverter

Forced Commutated Thyristor Inverter

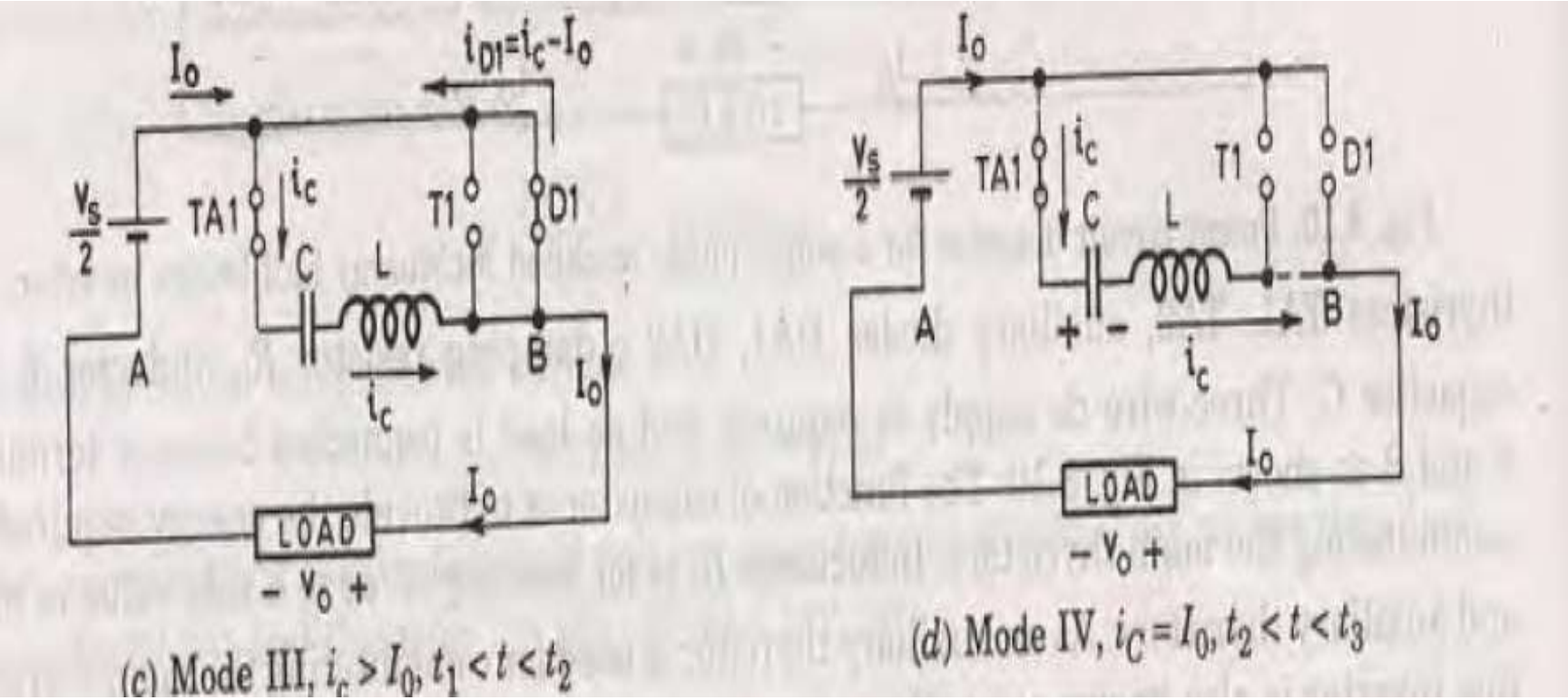


Modified McMurray Half Bridge Inverter

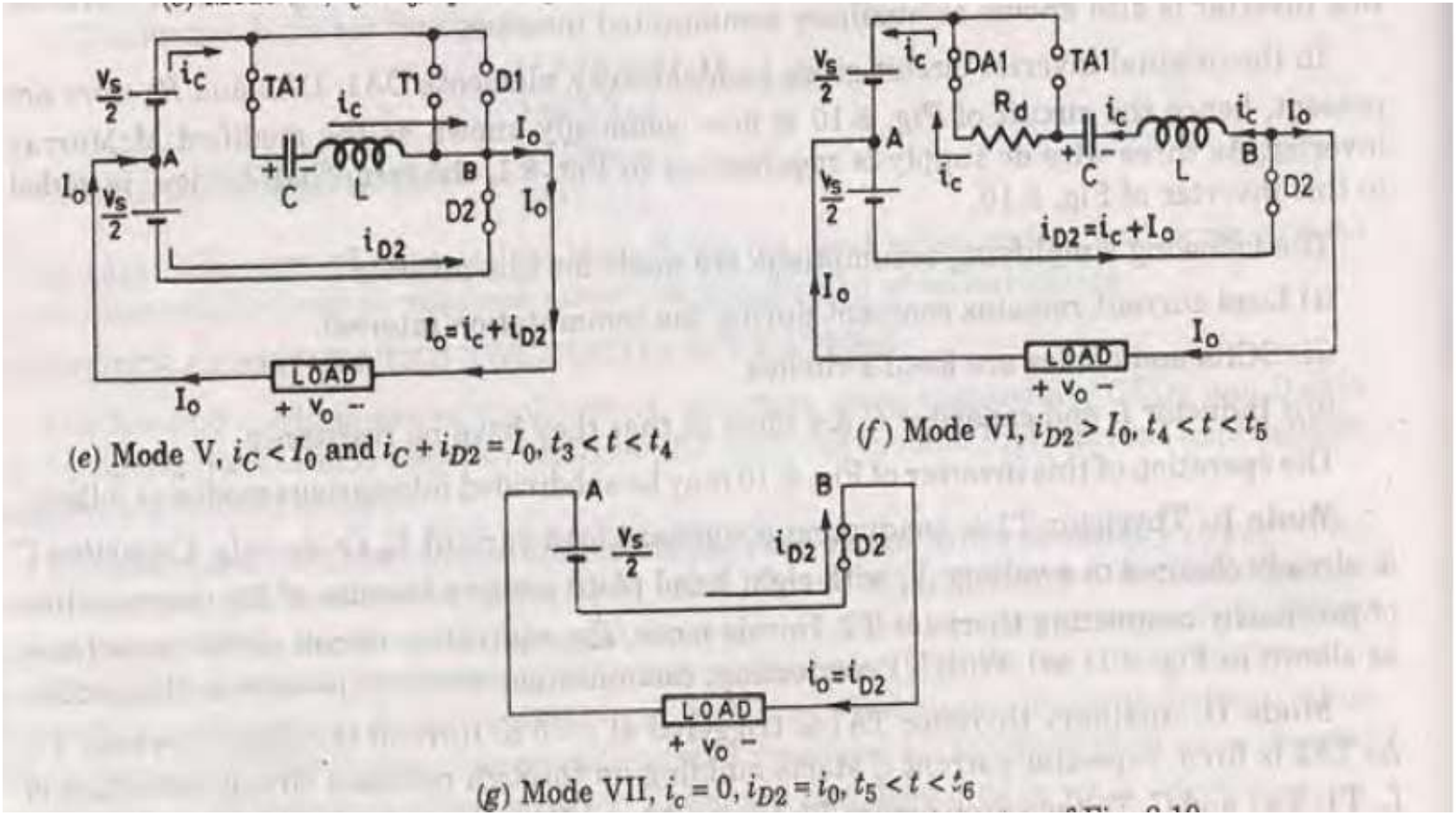
Understanding the operations



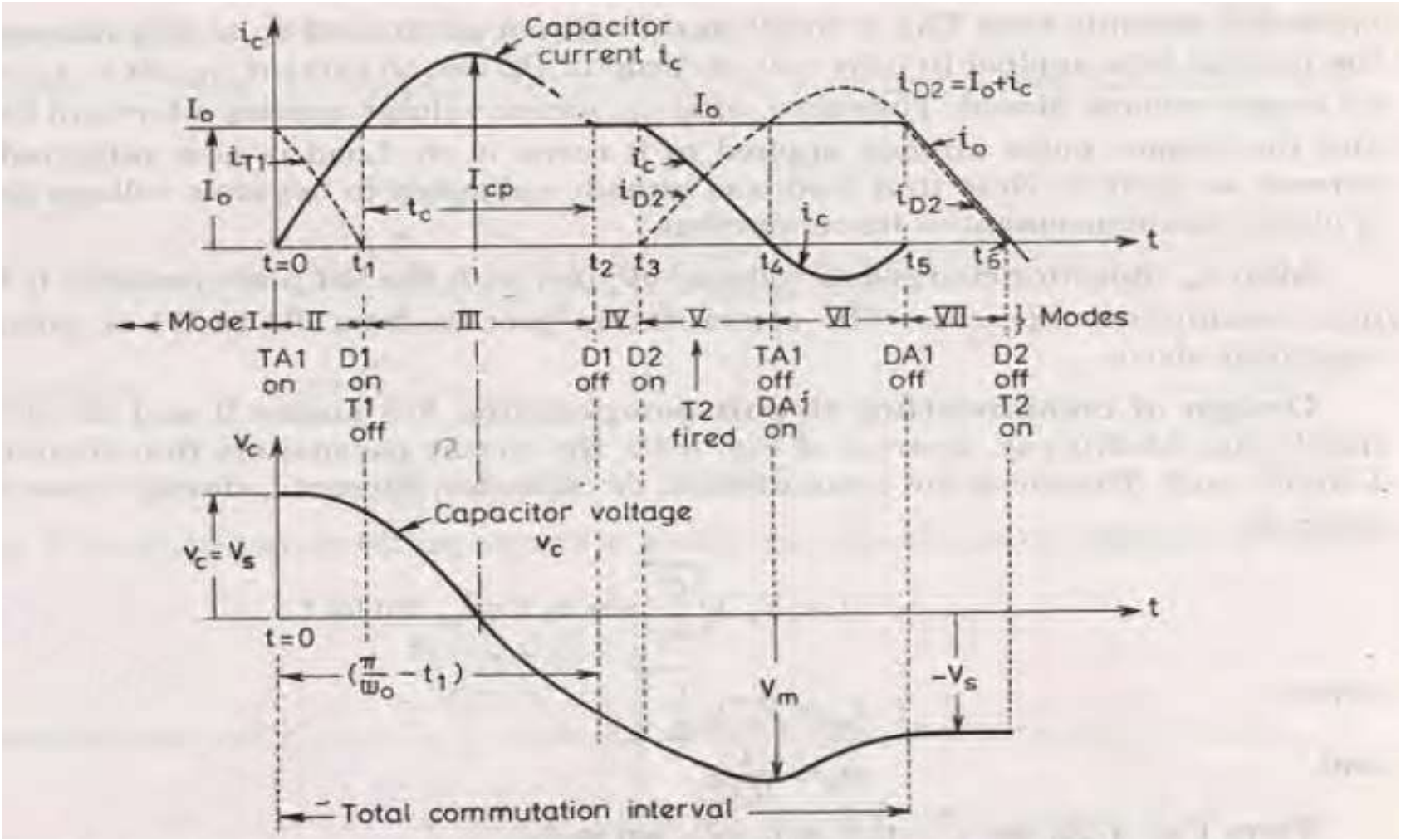
Understanding the operations



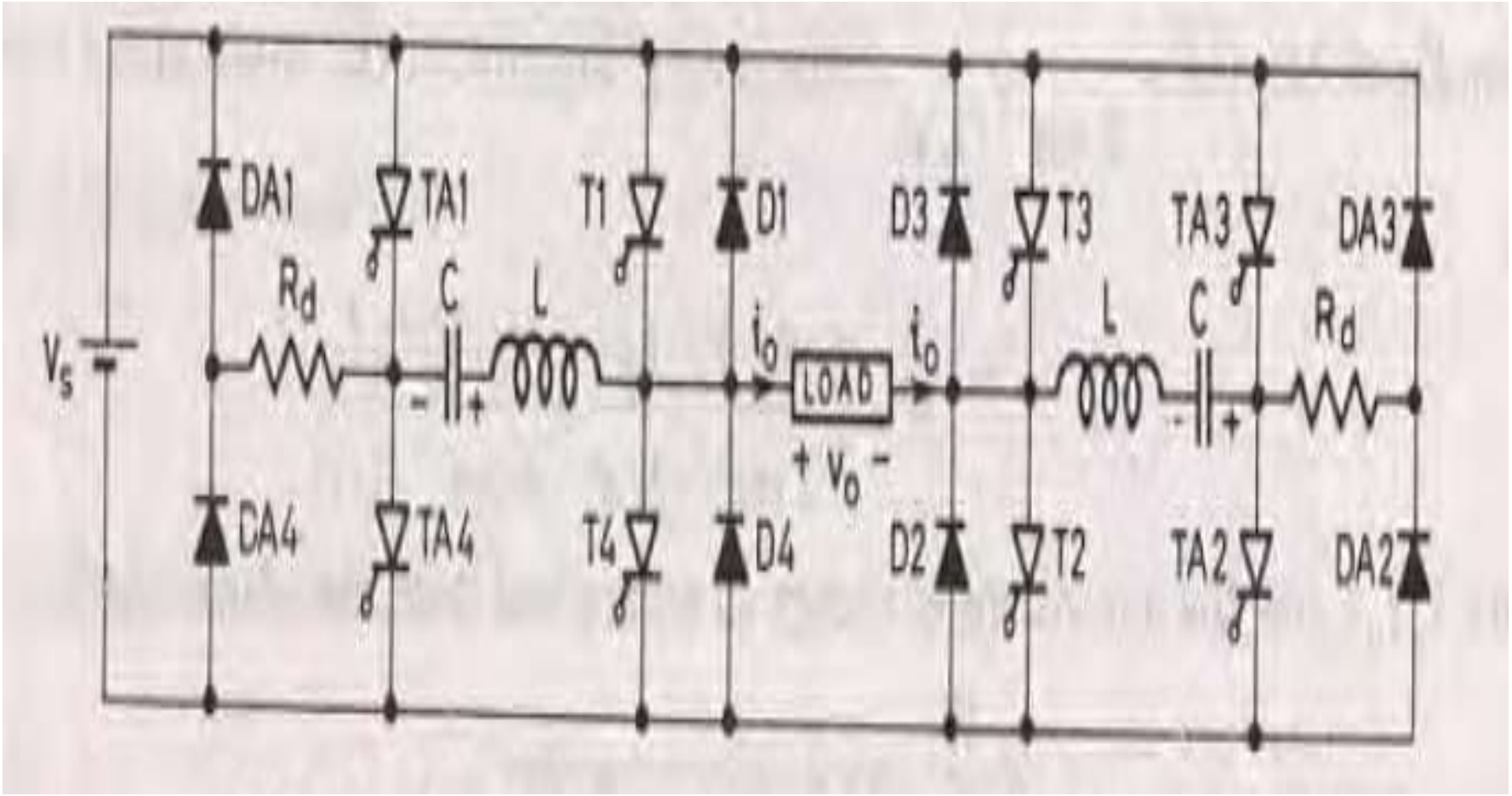
Understanding the operations



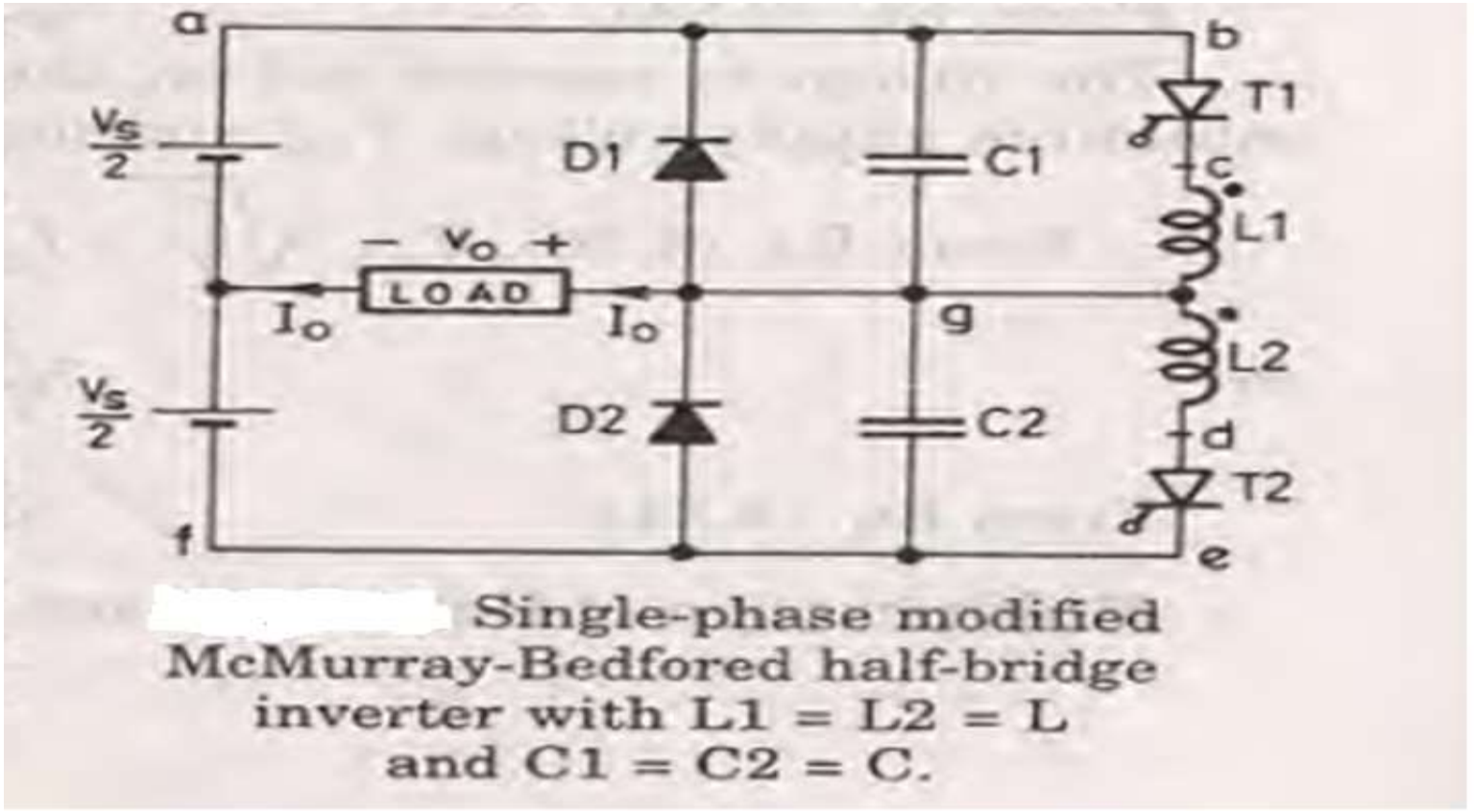
Waveforms


i_c
Capacitor current i_c
I_o
i_{T1}
I_o
I_{cp}
t_c
$i_{D2}=I_o+i_c$
I_o
i_o
i_c
i_{D2}
i_{D2}
i_c
t
t=0
t_1
t_2
t_3
t_4
t_5
t_6
Mode I
II
III
IV
V
VI
VII
Modes
TA1 on
D1 on T1 off
D1 off
D2 on
T2 fired
TA1 off DA1 on
DA1 off
D2 off T2 on
v_c
Capacitor voltage v_c
$v_c=V_s$
t
t=0
$(\frac{\pi}{\omega_o}-t_1)$
V_m
$-V_s$
Total commutation interval

Single Phase modified McMurray Full Bridge Inverter

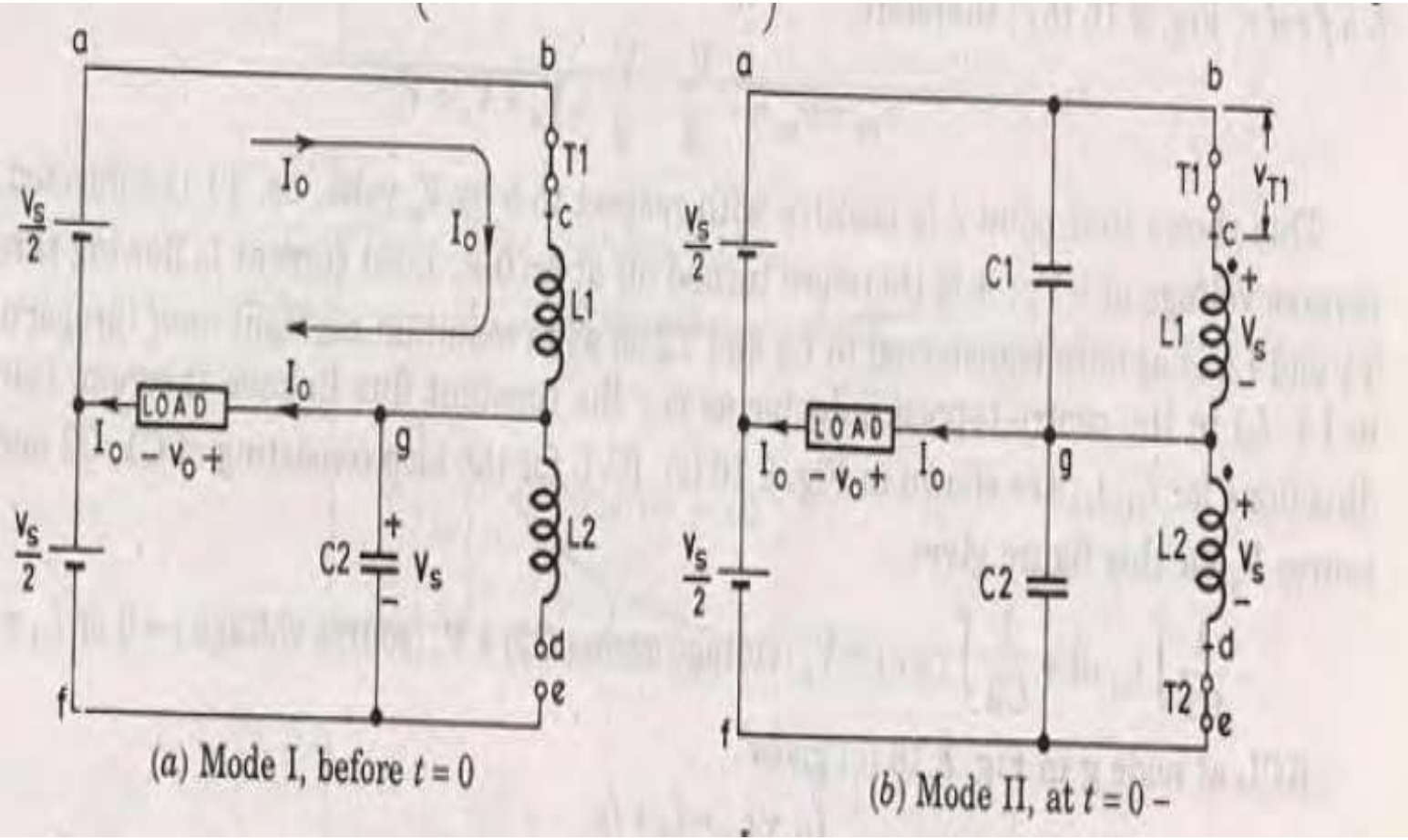


Single Phase modified McMurray Bedford Half Bridge Inverter

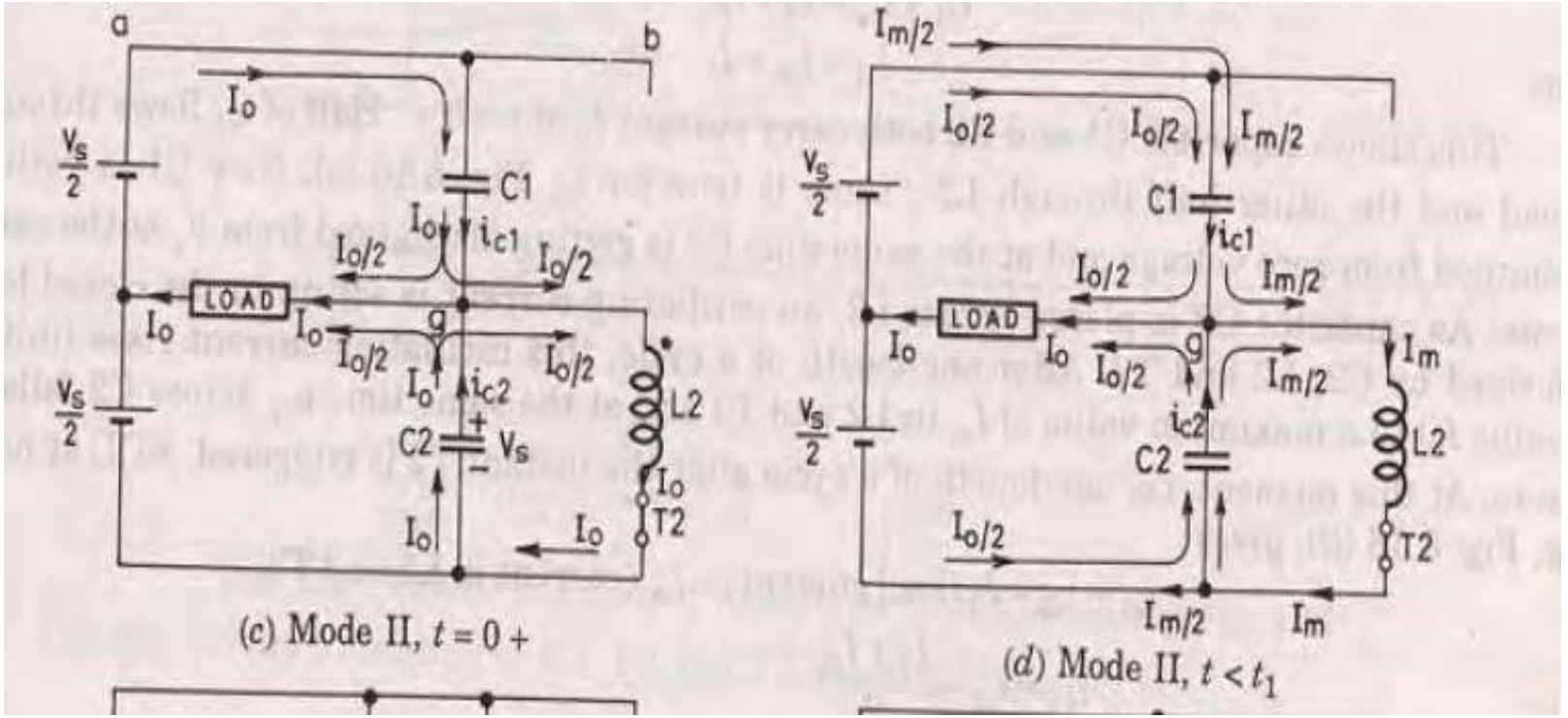


Single-phase modified McMurray-Bedfored half-bridge inverter with L1 = L2 = L and C1 = C2 = C.

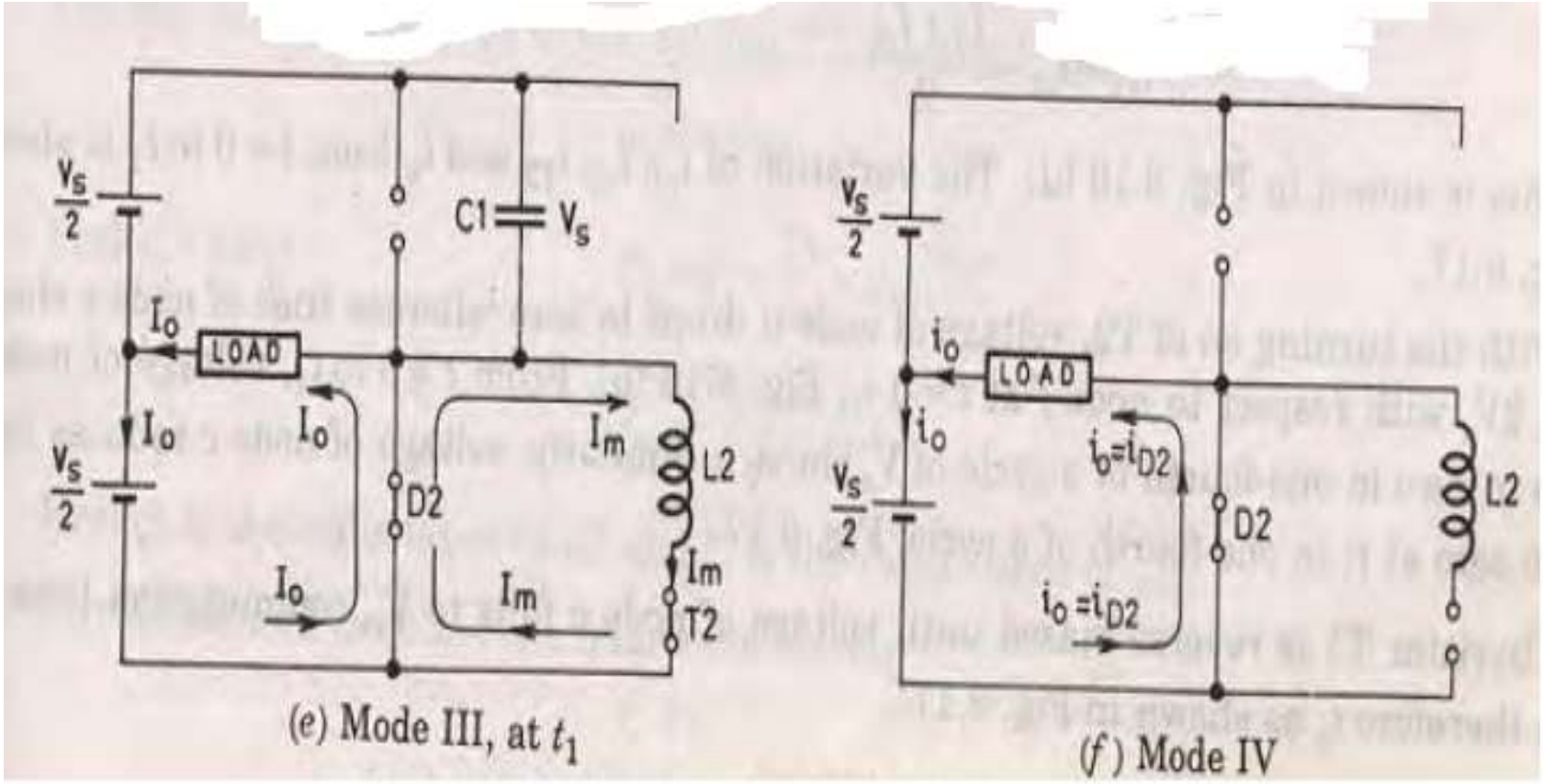
Understanding the concepts



Understanding the Concepts



Understanding the Concepts



Modified McMurray Bedford Full Bridge Inverter