

Current Source Inverter

Single-phase Current Source Inverter

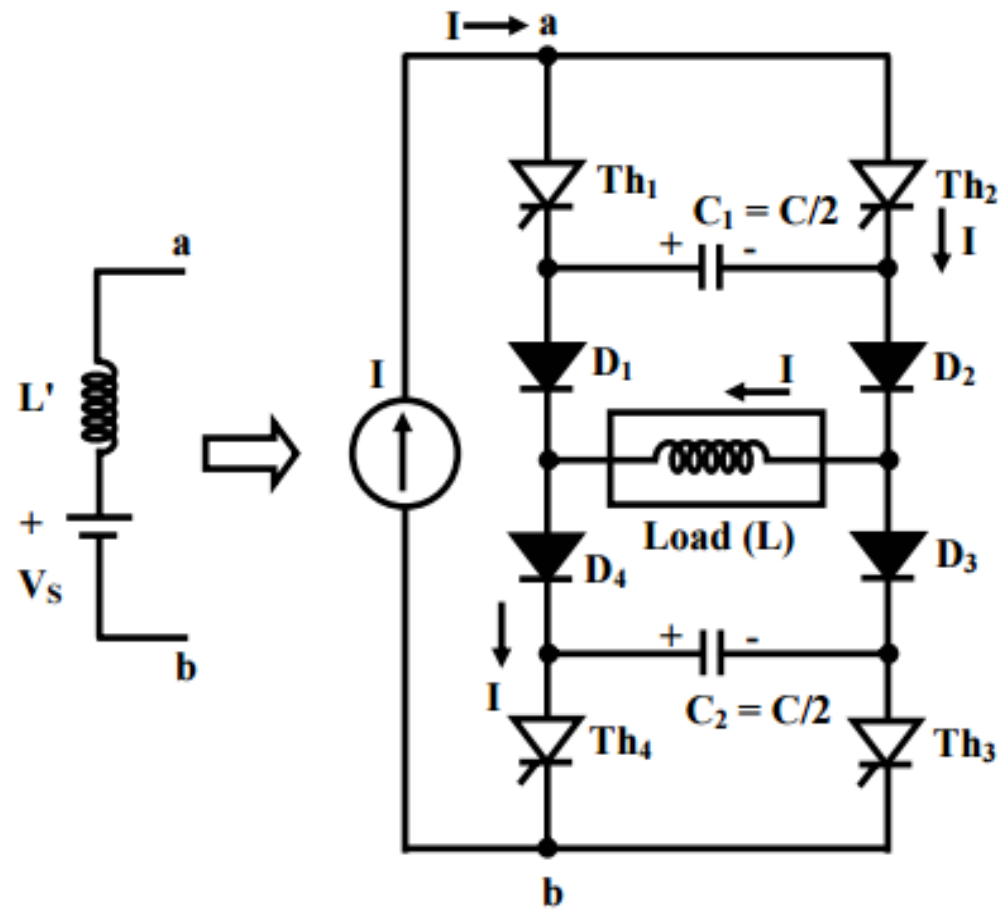
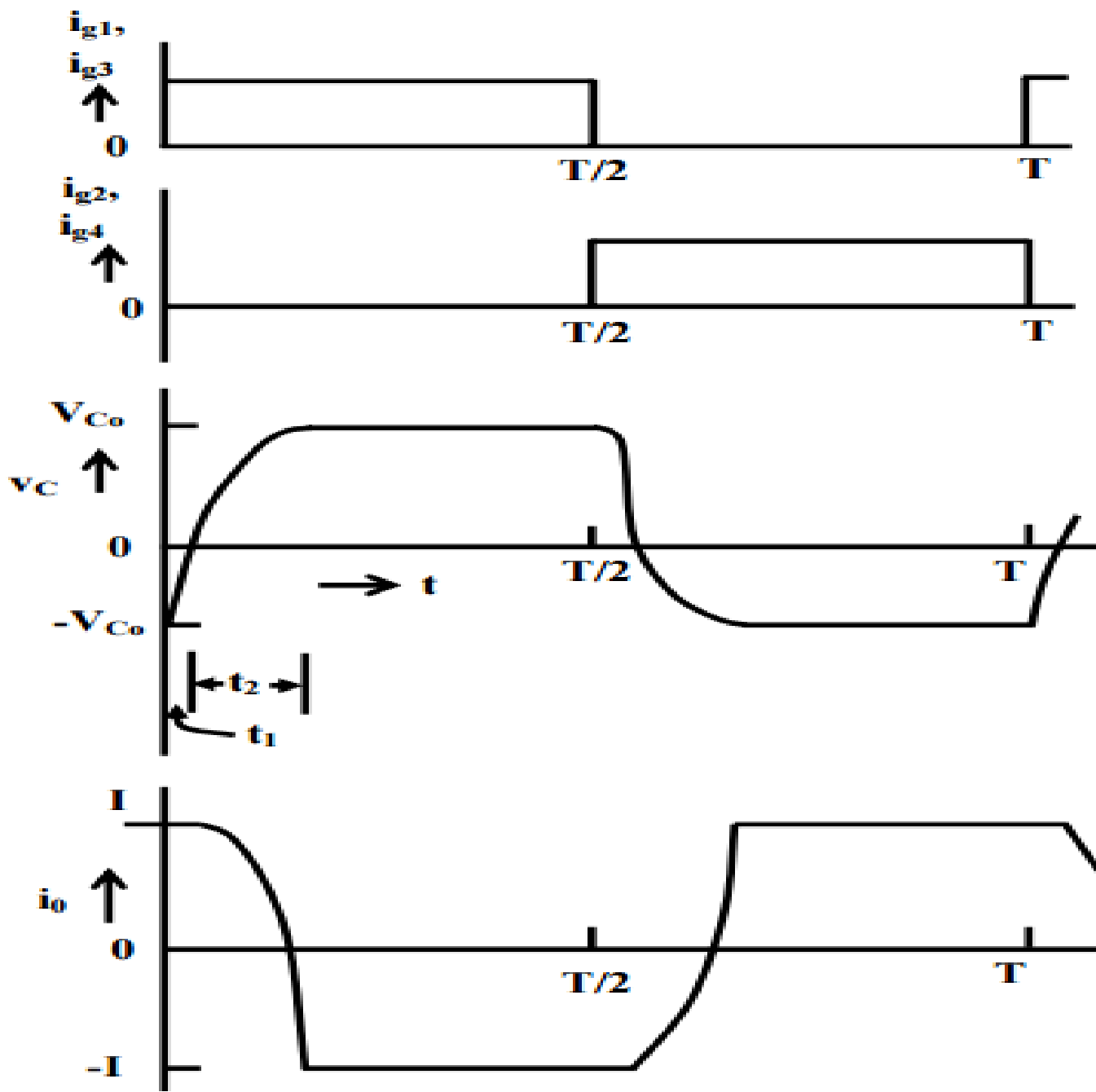


Fig. : Single phase current source inverter (CSI) of ASCI type.

The circuit of a Single-phase Current Source Inverter (CSI) is shown in Fig. . The type of operation is termed as Auto-Sequential Commutated Inverter (ASCI). A constant current source is assumed here, which may be realized by using an inductance of suitable value, which must be high, in series with the current limited dc voltage source. The thyristor pairs, Th_1 & Th_3 , and Th_2 & Th_4 , are alternatively turned ON to obtain a nearly square wave current waveform. Two commutating capacitors – C_1 in the upper half, and C_2 in the lower half, are used. Four diodes, D_1 – D_4 are connected in series with each thyristor to prevent the commutating capacitors from discharging into the load. The output frequency of the inverter is controlled in the usual way, i.e., by varying the half time period, $(T/2)$, at which the thyristors in pair are triggered by pulses being fed to the respective gates by the control circuit, to turn them ON, as can be observed from the waveforms . The inductance (L) is taken as the load in this case, the reason(s) for which need not be stated, being well known. The operation is explained by two modes.



Mode I: The circuit for this mode is shown in Fig. . The following are the assumptions. Starting from the instant, $t = 0^-$, the thyristor pair, Th_2 & Th_4 , is conducting (ON), and the current (I) flows through the path, Th_2 , D_2 , load (L), D_4 , Th_4 , and source, I . The commutating capacitors are initially charged equally with the polarity as given, i.e., $v_{C1} = v_{C2} = -V_{C0}$. This means that both capacitors have right hand plate positive and left hand plate negative. If two capacitors are not charged initially, they have to pre-charged.

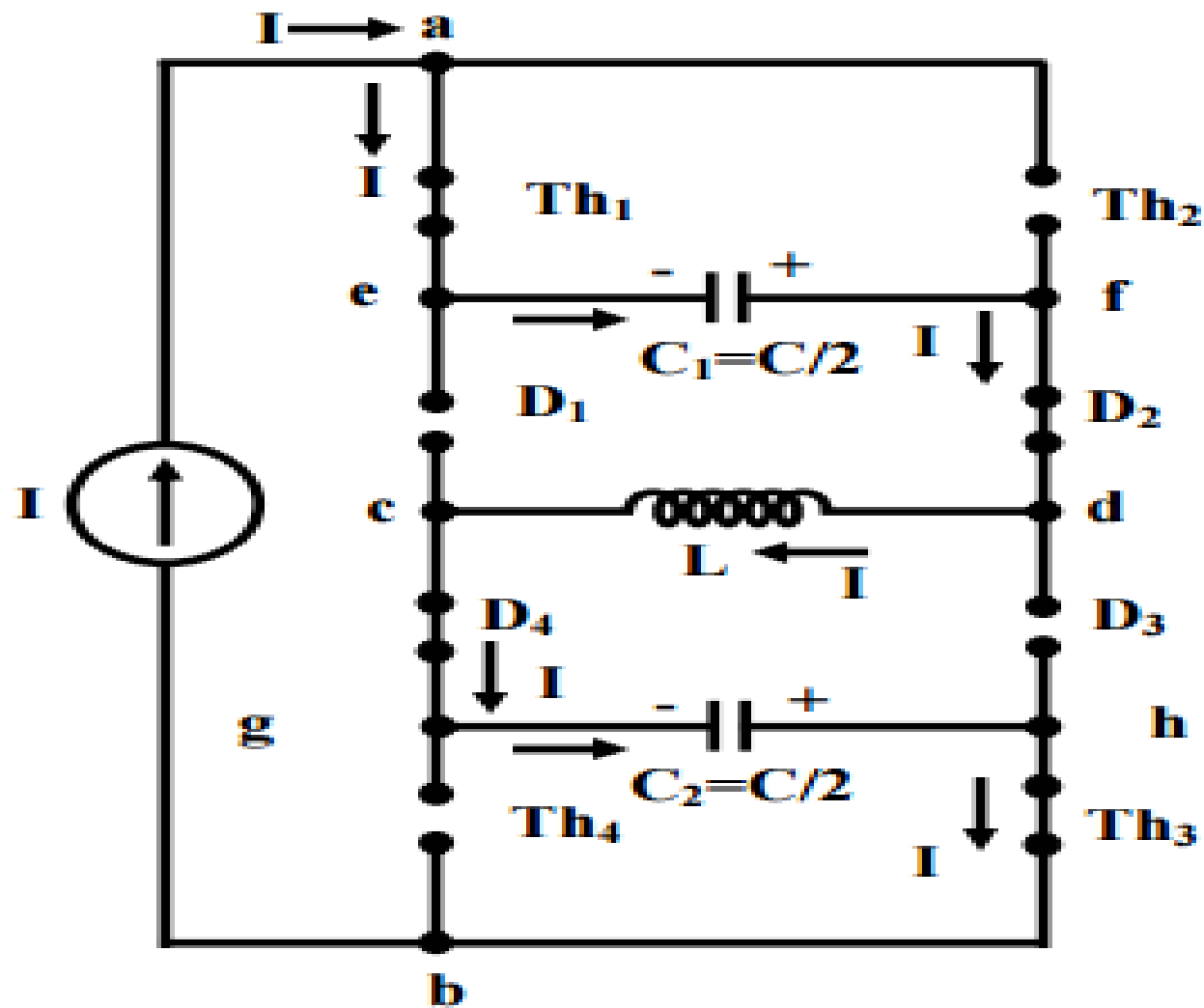
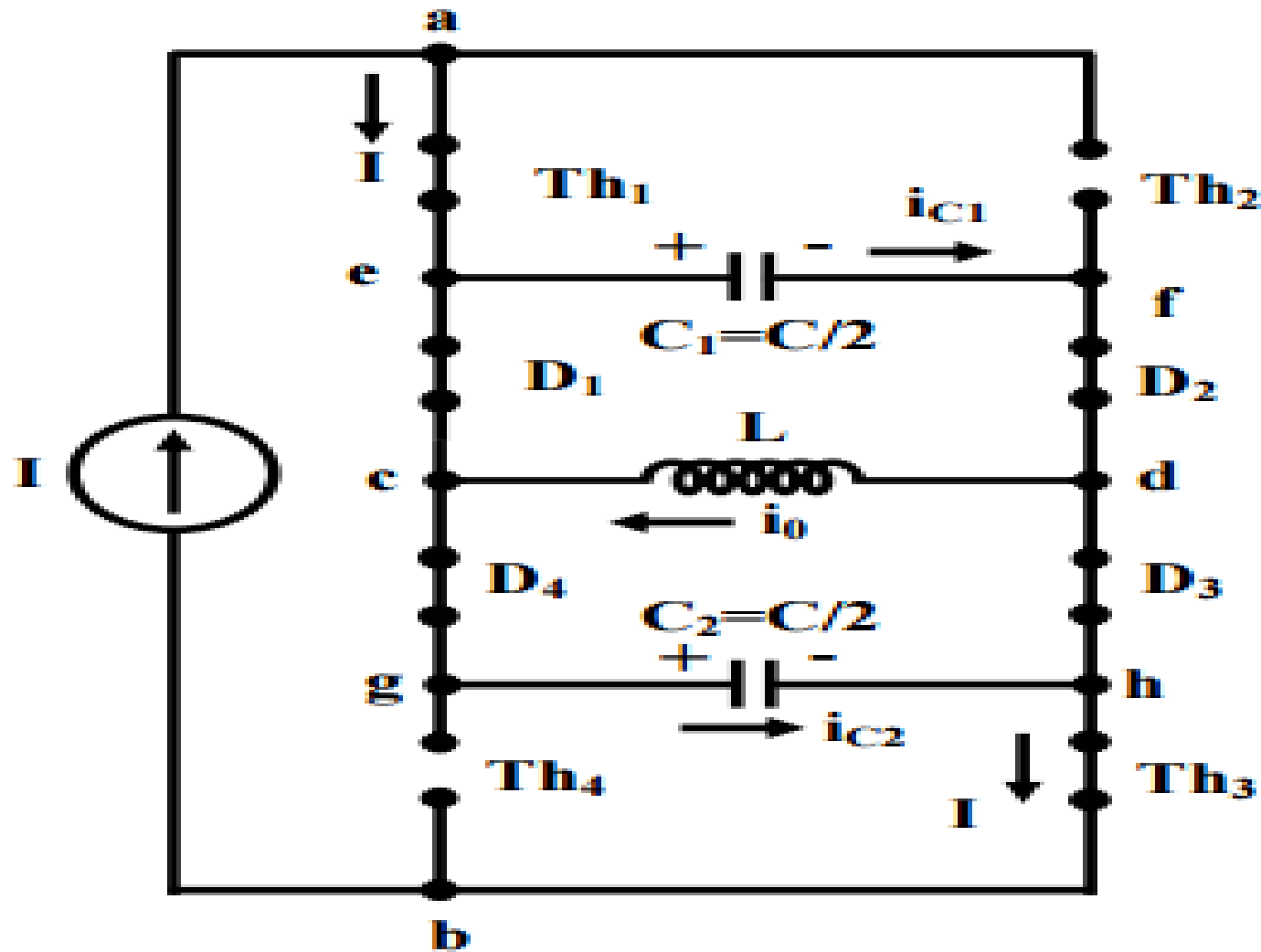


Fig. Mode I (1 phase CSI)

At time, $t = 0$, thyristor pair, Th_1 & Th_3 , is triggered by pulses at the gates. The conducting thyristor pair, Th_2 & Th_4 , is turned OFF by application of reverse capacitor voltages. Now, thyristor pair, Th_1 & Th_3 , conducts current (I). The current path is through Th_1 , C_1 , D_2 , L , D_4 , C_2 , Th_3 , and source, I . Both capacitors will now begin charging linearly from $(-V_{co})$ by the constant current, I . The diodes, D_2 & D_4 , remain reverse biased initially. The voltage, v_{D1} across D_1 , when it is forward biased, is obtained by going through the closed path, abcda as $v_{D1} + V_{co} - (1/(C/2)) \cdot \int I \cdot dt = 0$. It may be noted the voltage across load inductance, L is zero (0), as the current, I is constant. So, $v_{D1} = -V_{co} + (2/C) \cdot \int I \cdot dt$

Mode II: The circuit for this mode is shown in Fig. Diodes, D_2 & D_4 , are already conducting, but at $t = t_1$, diodes, D_1 & D_3 , get forward biased, and start conducting. Thus, at the end of time t_1 , all four diodes, D_1 – D_4 conduct. As a result, the commutating capacitors now get connected in parallel with the load (L). For simplicity in analysis, the circuit is redrawn as



Mode II (1-phase CSI)