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Jones chopper employs class D commutation to switch off the main thyristor. This process involves switching a charged capacitor with an auxiliary thyristor to turn off the main thyristor. In comparison to Morgan's chopper, Jones's chopper replaces the saturable reactor core with a tapped autotransformer. The autotransformer ensures reliable commutation and eliminates the problem of commutation failure. The Jones chopper circuit consists of two thyristors (T1 and TA), where T1 is the main thyristor and TA is the auxiliary thyristor. The commutation circuit includes a capacitor (C), diode (D), and autotransformer (L1 and L2). Initially, the capacitor is fully charged to the supply voltage with the upper plate positive and lower plate negative. The operation of the Jones chopper can be explained in two modes: **Mode I:** * The main thyristor T1 is triggered at an instant t1 by providing a gate signal. * Once T1 starts conducting, the load current flows through Vdc+ → T1 → L1 → motor → Vdc–. * At the same time, the charged capacitor discharges current IC through C+ → T1 → L2 → D → C–. * Due to the flow of capacitor current, it starts charging in the reverse direction with lower plate positive and upper plate negative. **Mode II:** * The auxiliary thyristor TA is triggered at instant t3. * Now the load current flows through Vdc+ → C → TA → L1 → motor → Vdc–. * The capacitor starts discharging the current through C → TA → T1 → C. * Due to the discharge of the capacitor, a reverse voltage appears across T1 from t3 to t4 and hence the T1 gets turned OFF. The cycle repeats when the main thyristor T1 is again triggered. The various circuit parameters in this mode are given as: VT1 = Vdc, IT1 = 0, If = increases, ITA = IL, VC = decreases Jones Chopper Circuit Design Considerations The autotransformer plays a crucial role in designing a Jones chopper circuit, particularly during the turn-OFF time of thyristor T1. As T1 switches off, the stored energy in inductor L1 is released and transferred to capacitor C, causing the capacitor voltage to drop to zero from VC. The basic principle of DC Chopper is presented in Figure 1 (b). The switching devices like BJT, SCR or GTO can act as series switches S. Typically, a freewheeling diode D is connected across the load for free circulation of current when the device is turned OFF. If the load is resistive, then a freewheeling diode D is also required. As shown in Figure 1 (b), the DC Chopper configuration involves a series switch S that is turned ON and OFF at high frequency to obtain a square pulse train. The average voltage can be controlled by varying the ratio of turn-ON and turn-OFF periods. The operation of the DC Chopper involves two main steps: the charging phase and the freewheeling phase. During the charging phase, the switch S is turned ON, causing the load current to rise exponentially. When the switch S is turned OFF, the load current circulates through the freewheeling diode D. The average voltage of the DC Chopper is given by: V_o = (t_on / T) * V_s where: - V_o is the output voltage - t_on is the turn-ON time - T is the time period of chopping - α is the duty cycle of a pulse - V_s is the supply voltage By controlling the duty cycle α, the load voltage can be controlled from 0 to Vs. DC choppers can be broadly classified into several types based on various criteria such as input/output voltage levels, directions of output voltage and current, circuit operation, and commutation methods. Given text: When both choppers are switched ON simultaneously, the load is directly connected to the source and the output voltage Vo becomes equal to the source voltage Vs. The current flows from the source to the load in this case, resulting in a positive output voltage and current. In contrast, when both choppers are made OFF simultaneously, the current through the load does not suddenly drop to zero due to its inductive nature. Instead, it decays gradually, inducing a huge amount of voltage in the inductor in the reverse direction, making diodes D1 and D2 forward biased. As a result, the load becomes connected to the source again, but with the current flowing from the source to the load. This changes the polarity of Vo, resulting in a negative output voltage while keeping the load current positive. The operation of the Class-D chopper can be divided into four quadrants: first (positive output voltage and current), second (negative output voltage), third (positive output voltage), and fourth (negative output voltage). The average value of the output voltage Vo depends on the duty cycle, which is the ratio of the ON time to the total time. When the duty cycle is greater than 0.5, Vo is positive, while when it's less than 0.5, Vo is negative. If the duty cycle equals 0.5, Vo becomes zero. The average load current Io remains always positive, regardless of whether the choppers are ON or OFF. The waveform of the source current is defined as iCH1 or iCH2. Observing the waveform of the source current reveals that it becomes negative when both CH1 and CH2 are turned off. Additionally, when diodes D1 and D2 conduct, the source current also becomes negative. This indicates that there is a flow of current into the source, as discussed in Case-2.

Function of dc chopper. Chopper dc dc converter. Class d chopper operates in which quadrant. Chopper class. Chopper circuit in power electronics.