DC CHOPPER CIRCUITS

Object :

- To study the triggering circuit of a single phase DC chopper circuit.
- To study the operation of a class A commutation chopper circuit.
- To study the operation of a class B commutation chopper circuit.
- To study the operation of a class D commutation chopper circuit.

Apparatus :

1. Experimental set-up.
2. Double trace oscilloscope.
4. 0-30V, 2A Regulated D.C. power supply.
5. 0.1 ohm standard Resistance.
6. Rheostat and Inductance.

Procedure :

i) Study of triggering circuit.

1. Plug-in the mains power chord on to a 230V A.C supply. Switch on S1, S2 Can be kept off.
2. Connect probe one across common and pin 2 of the first 555 IC with ground lead clipped to common. Observe waveforms at various points (A,B,C,D) with the other probe. Sketch them on a graph paper, with the display in the first trace as the reference. Vary the pulse width and frequency controls and observe the variation in the above waveforms.
3. Connect one probe on the input (primary) of a pulse transformer and the other on its output, the ground of the second probe being on the cathode point (k). Switch on S2. Plot the output voltages of the points below waveforms noted earlier. (Note : Two GND can be connected here as the two sides are isolated). Switch off S1 and S2.
1. Connect up the power circuit as shown in fig. Select an electrolytic capacitor and any one of the inductor coils provided on the panel. Set frequency of trigger circuit to minimum (can be checked from any of the Pulse Transformer output). Pulse width adjust has no function in a class A chopper. Connect the rheostat as the load and the voltmeter across the load terminals.

2. Set the regulated power supply to give an output of 15V and set current limit to minimum. Connect the power supply to chopper and switch-on the supply and then S1 and S2 on the panel.

3. Observe voltage waveform across Th1, L and C. Measure the chopper frequency and read off the output voltage both from the analog meter and the electronic multimeter. Plot the waveforms with time phase relation.

4. Increase trigger frequency and tabulate.

<table>
<thead>
<tr>
<th>$V_{in}$</th>
<th>Frequency</th>
<th>$V_{out}$ (M.C)</th>
<th>$V_{out}$ (Digital)</th>
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For at least five values of frequencies, over a wide variations of the output voltage increase current limit of power supply, if necessary.

5. With the frequency kept constant, decrease the load resistance till communication fails, (Th1 does not turnoff). Measure the current and voltage reading from the power supply meters. Switch off S1 and S2 and supply.
Class B Chopper

1. Connect the power circuit as in the fig. with the capacitance and inductance used in A. Repeat steps A-2 through A-5. Note the frequency and load current (average and peak instantaneous) for which failure occurs in the communication circuitry.

2. From the voltage waveform across the capacitor calculate the frequency of oscillation of the undamped L – C circuit from the value of C (4 μfd) calculate L, $\sqrt{C/L}$. Relate the last quantity to the peak of the current at which failure occurred due to overload, check the class A failure also with the L and C determined here.

3. Connect an inductance in series with the rheostat. Repeat the observation. Note specially the peak voltage across C. At the frequency for which overload failure occurred, check for overload failure again.

**Questations**

1. Explain the performance of the class B chopper in step 3.
2. How the inductances in the communication circuits should be constructed for the most efficient operation.
Class D chopper

1. Connect the circuit as in fig. set current limit of power supply low, and the voltage to 15 volt. Switch S2 on panel off. Switch - on power supply and S1. (S1 on panel).
2. Connect the C. R. O probe across C. and check whether it has charged to about the supply the supply voltage with the dot as positive. Set pulse – width and frequency to minimum. Switch –on S2. The chopper goes into operation with a humming noise.
3. Observe on the C. R. O. the charge on the capacitor oscillates. Observe voltage waveform across Th1 , Th2 , C, L and the load. Observe also the current waveforms through Th1 , C and load using the 0.1 standard resistance. Plot all of them on a graph paper in time phase relation with the reference. Note the turn off time offered by the circuit to Th1. Change pulse width and frequency, one-at-a-time and note variations in the waveforms. Note the input and output meter reading also.
4. With the C. R. O. displaying the Th1 turn-off, increase loading of the chopper till failure occurs. Repeat, now with the probe connected across C. Note the minimum turn-off time for which commutation does not fail and the rate of charging of the capacitor at the instant.
5. Connect an inductance in series with the rheostat and observe voltage waveform across C and the load with a F.W.D across the R-L load repeat the observations. (Note : In case of commutation failure, switch-off power supply and S2 switch-on power supply and S2 in that order). If the fault persists, look for the fault and switch on as above. Tabulate for Resistive and Inductive loads.

<table>
<thead>
<tr>
<th>Load Type</th>
<th>$V_{DC}$ in</th>
<th>Duty ratio of trigger pulses</th>
<th>$V_{DC}$ Out (M.C)</th>
<th>$V_{DC}$ Out (Digital)</th>
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