電子電路實驗 6: Power Amplifiers (PA): Class-B Output Stage

實驗預報

B02901178 江誠敏

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1 Objectives

1. To familiarize with the characteristics of class-B output stages of power amplifiers.
2. To comprehend the method of eliminating the Crossover Distortion of a class-B output stage.

2 Procedures

2.1 Differential Mode Small Signal Analysis

1. Use $100\,\Omega$ cement resistance for R_L in Fig 6.
2. Provide voltage source $V_{CC} = +15V$, and $-V_{CC} = -15V$ to the circuit.
3. Function generator ▷Press the FUNC button ▷Set FREQ = 1 kHz, SIN wave ▷ATTN 0dB.
4. Oscilloscope ▷Press the CH1 and CH2 MENU ▷Coupling ▷AC.
5. Oscilloscope ▷Press the DISPLAY button ▷Format ▷YT mode.
6. Oscilloscope ▷Press the Measure button ▷Observe $V_{i(p-p)}$ in CH1.
7. Using function generator to generate the input small signal V_i and make sure that $V_i = v_{ac}\sin(2\pi ft), 2v_{ac} = 6V_{(p-p)}, f = 1kHz$ is measured from the breadboard by using CH1 of oscilloscope to observe.
8. Keep the previous adjustment of V_i constantly, and do not adjust the amplitude tuner in function generator any further.
9. Oscilloscope ▷Press the DISPLAY button ▷Format ▷XY mode.
10. Adjust VOLTS/DIV of CH1 to change the X-axis scale and of CH2 to change the Y-axis scale, Observe whether it appears the crossover distortion in the VTC (Voltage Transfer Curve) at the screen of oscilloscope.

11. If there is no crossover distortion in the VTC shown at oscilloscope or the curve doesn' t seem to resemble the diagram shown in Fig. 2, try to troubleshoot the bugs in your circuit.
    ※ Note: The bugs often result from the abuse of components in the circuit, the corruption of the transistors, and incorrectly connections of the circuit.
12. Record the value of V_{BB} by measuring how many divisions the crossover distortion occupies in X-axis at the screen of oscilloscope.

2.2 Common Mode Small Signal Analysis

1. Use $R_L = 100\,\Omega$ cement resistance, $R_E = 1\,\Omega, 1\,\text{k}\Omega$ resistance for R_a, R_1, R_2, and $1\,\text{k}\Omega$ variable resistance for R_b , in Fig. 7.
2. Before applying the power supplier in the circuit, MAKE SURE the layout in your bread board is correct. Otherwise, the resistance R_E will easily be burned and corrupted because of the huge amount of the current generated by the power BJTs.
3. Provide voltage source $V_{CC} = +15V$, and $-V_{CC} = -15V$ to the circuit.
4. Keep the previous adjustment of V_i in step 7. constantly.
5. Oscilloscope ▷Press the DISPLAY button ▷Format ▷XY mode.
6. Adjust VOLTS/DIV of CH1 to change the X-axis scale and that of CH2 to change the Y-axis scale ▷Observe whether it appears the crossover distortion in the voltage transfer curve in the screen of oscilloscope.
7. If the curve shown in the screen of oscilloscope looks weird or ridiculous, try to seriously get back to step (11)-(14) and find the bugs in the circuit.
8. Adjust the R_b until the crossover distortion disappears and the curve of VTC is just a straight line.
9. Record the value of $V_{CE3}, V_{REN}, V_{REP}, R_b, V_{BB}$
10. Use an $8\,\Omega$ speaker for R_L. Adjust big-signal input $V_i = v_{ac}\sin(2\pi ft)$, $2v_{ac} = 2V_{(p-p)}$.
11. Try to identify what the different sound is as the crossover distortion is occurring and it is just eliminated.
12. Adjust the frequency f in the function generator in $2\,\text{Hz}$~$20\,\text{kHz}$ and listen what will happen.
13. Write them down in your homework report.