CHAPTER 7

CONCLUSIONS AND FUTURE DISCUSSIONS
CHAPTER 7: CONCLUSION AND FUTURE DISCUSSION

Here I am presenting the conclusion of the whole thesis and the possibility to use the circuits as such and after further modifications also. All this is given according to the chapters.

The first problem chapter i.e. third chapter consists of circuits that may be used to produce completely undistorted signal that may be used in communication systems and in many other electronic fields. The undistorted signal is obtained by minimizing odd harmonic components also which is not found in the conventional circuits. The circuit may again be modified using Darlington pair and any other active device to get better and something different. The circuits have wide temperature range which allows it to be used at different temperatures.

Now, the circuits shown in fourth chapter are very much useful in medical field and high frequency applications. Both the circuits defined in the chapter have their unique and very important characteristics. The first one, designed for small signals of nanovolt range, is very much useful in the analysis of signals received from nervous system. The circuit produces a pure undistorted signal which is very much useful in medical field. This circuit may be used as sensor to sense small signals. This circuit may also be used for impedance matching.
This circuit has a very large scope of modification also i.e. the circuit can be modified to produce even more small signals of different frequencies. Large temperature range enables the circuit to be used at different temperatures.

The second circuit is able to work with the signals of THz range which is quite high. This leads the circuit to be used for high frequency communication systems. This circuit is temperature sensitive and gives the best response for the specified temperature for which it is designed. One thing to be noticed is that there is some phase shift between input and output signals. This point may be a matter of investigation in future studies.

Fifth chapter leads to conclusion that our regulator may regulate as well as amplifies the input signal. If the Darlington pair is replaced by feedback pair the output swings to nanovolt range it shows that the circuit may amplify and also regulate the incoming signal.

Now the last problem chapter explains the square wave generator. First circuit produces a square wave which is opposite in phase to the input signal. This point may be analysed in the further studies.

The second circuit may be used to produce various pulse width modulated waves for different parametric values. Also the special feature of the circuit is that at 500 deg cel sine wave is produced by the circuit. So, the circuit may used as a square wave generator and as unity gain amplifier at different temperatures. This circuit has many possibilities of further modification for different temperatures and different parametric values.
So, in this way it may be said that all the circuits analysed in the thesis may be useful in electronic field, in industries and also in medical field. It will be our pleasure if circuits developed during present investigation provide little contribution in the electronic field.
A NEW MODEL FOR DISTORTIONLESS PUSH-PULL AMPLIFIER

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ABSTRACT

In the present investigation the conventional Push-pull amplifier is modified by using some resistors, capacitors and diodes to improve the performance of the circuit. Further the circuit is again modified by using Darlington pair instead of a single transistor which leads the circuit towards the best performance decreasing the numbers of passive devices.

Key words: Push-pull Amplifier, Simulation, Distortion, Temperature variation.

INTRODUCTION

The push-pull amplifier is one of the most versatile and building block used in power amplifiers. These are widely used in communication system and electronics industry and are generally preferred over the variety of power amplifier studies so far because of their high efficiency and low distortions. They are frequently used in the output stage as power amplifier and are studied well by many workers (1,2,3,4,5,6,7).

A great deal of distortion introduced by nonlinearity of the dynamic characteristic may be eliminated by using push-pull amplifier. In the conventional push-pull amplifier the excitations are introduced through a center tapped transformer. Thus, when the signal on the first transistor Q1 is positive, the signal on Q2 is negative by an equal amount. Thus the resultant current flowing through the load only has even harmonic and all odd harmonic component vanishes which reduces distortion due to all even harmonics. In present work an attempt is to design push-pull amplifier circuit having even low distortion using PSPICE simulation. The proposed circuit is shown in fig1 which is further modified for better performance as shown in fig 2 and 3 respectively.

Here computer simulation through PSPICE has been utilised to study the improved behaviour of the proposed circuit and by observing the outputs, it is seen that this circuit minimises the distortion in the output to a large extent. Here temperature variation of the circuit is also studied which shows that the
performance of the circuit is improved for the temperature range of -150 Deg. Celsius to 410 Deg. Celsius.

Proposed Circuit:

![Proposed Push-Pull Amplifier Diagram]

Fig 1: Proposed Push-Pull Amplifier

![Modified Push-Pull Amplifier Diagram]

Fig 2: Modified Push-Pull Amplifier
Fig 3: An improved push-pull amplifier using Darlington Pair

The proposed push-pull amplifier, shown in fig 1 utilises two transistors of type Q break N and Q break P. Combined supply of 5V is given to the transistors. The input resistance $R_1=1\text{milli}\Omega$ and input capacitance $C_1=1\text{milli}	ext{farad}$ are connected to the base of $Q_1$. Similar values are given to $Q_2$ also. $R_3=22\text{ mega}\Omega$ and $C_3=1\text{pf}$ are used as load. Circuit shown in fig 2 is the modified form of the previous circuit in which D1N4002 model of diodes are used to improve the performance. Other component values are clear from the fig.

Simulation Results

Fig 4: Input and Output waveforms of fig1.
Fig 5: Fourier Transform of fig 4.

Fig 6: Input and Output waveforms of fig 2.

Fig 7: Fourier Transform of fig 6.
Fig 8: Input and output signals of fig 3.

Fig 9: Fourier transform of fig 8.
Fig 12: Temperature variation of fig 3.

Fig 3: Decrease in output voltage of fig 3 with rise in temperature.
For fig 1 it is seen that crossover distortion occurs in the output signal in the absence of base capacitors. For $R_3=1\,\text{K}\Omega$ some distortion occurs in the output. The circuit gives best response only for the chosen values and for 10 kHz frequency of input signal. At higher frequencies some flatness at the peak of output wave occurs and the distortion in output signal starts. A little distortion occurring in the output signal of first circuit is removed by using two diodes at the bases of the transistors as shown in fig 2. A special feature of circuit in fig 2 is that it gives best output only when variable capacitor is used at load.

From fig 5.

Third harmonic distortion $\%D_3 = \frac{|A_3|}{|A_1|} \times 100\%$

$= \frac{0.1}{5} \times 100\%$

$= 2\%$

Fifth harmonic distortion $\%D_5 = \frac{|A_5|}{|A_1|} \times 100\%$

$= \frac{0.05}{5} \times 100\%$

$= 1\%$

Seventh harmonic distortion $\%D_7 = \frac{|A_7|}{|A_1|} \times 100\%$

$= \frac{0}{5} \times 100\%$

$= 0\%$

Thus, % total harmonic distortion (%THD) of circuit 1 is,

$$\%\text{THD} = \sqrt{\left(D_3^2 + D_5^2 + D_7^2 + \ldots \right)} \times 100\%$$

$$= \sqrt{\left(2 + 1 + 0 + \ldots \right)} \times 100\%$$

$= 2.2\%$

From fig. 7 and fig. 9, we get estimated distortion given below.

Third harmonic distortion $\%D_3 = \frac{|A_3|}{|A_1|} \times 100\%$

$= \frac{0}{5} \times 100\%$

$= 0\%$

Further harmonic components are also zero.

Hence %THD for these circuits 2 and 3 is zero percent.

From the above analysis it is clear that the modified push-pull circuit has better performance than the conventional one. And the diodes can remove the distortion in the output signal giving the more improved signal. Further study leads to one another conclusion that if a Darlington pair is used instead of simple transistor to design push-pull amplifier the better signal performance of the circuit is achieved as it is clear from fig 9 and as proved by calculations also. This leads to conclusion that distortion is completely removed in these circuits. Thus
such circuits may be frequently used to design distortion less push-pull amplifier. For modified circuits temperature variations are shown from fig 10, 11, 12 and 13 respectively. It is found in present simulation that the circuits shown in fig 1, 2 and 3 are performing well for the temperature ranges -150 Deg. Celsius to +410 Deg. Celsius, -100 Deg. Celsius to +410 Deg. Celsius and -150 Deg. Celsius to 300 Deg. Celsius respectively. But one strange feature of third circuit is that there is gradual decrease in the output voltage with increase in temperature.

CONCLUSIONS

Theses results lead to conclusion that these power amplifiers are useful for the temperature range mentioned above. Although even harmonic components are minimised in the conventional push-pull amplifier our attempt leads to more useful circuits which reduce odd harmonic distortion also. This gives a pure undistorted sine wave. Our further attempt is to study noise and other parameters for such modified circuits which will be given in further publications.

REFERENCES


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