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Design of Communication AM Receiver

Zirui Zhao*, Yazhong Chen, Qian Wang

Department of Electrical and Information, Jinan Campus, Shandong University of Science and Technology, Jinan, Shandong, 250031, China
**Corresponding author: 519277522@qq.com*

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Abstract: In this paper, the AM receiver system is designed, the input and output voltage amplitude and frequency are calculated, the component parameters are adjusted according to the target, and the design simulation is carried out through Multisim. After the digital signal received by the antenna is processed by each module, the required audio or video signal is obtained.

1. Introduction

The field of modern communication has developed rapidly. Communication has been the most important thing in people's life since ancient times. From the previous beacon to the current digital communication, it is the communication method that human beings are looking for. People have been working hard for more convenient communication, and amplitude modulation receiver, as the most typical way to receive signals, has been studied by people. [1]The wireless AM receiver receives the audio or video signal by changing the amplitude of the signal without changing the signal frequency. The AM receiver recovers the electromagnetic signal into audio and video signals through a series of processes such as demodulation. A good wireless AM receiver system can more truly reflect the information conveyed by the signal, so it is very important to study the infinite AM receiver

2. Scheme Design of Wireless AM Transmitter

This design is mainly divided into four parts: oscillator, mixer, if amplifier and audio amplifier. The whole system framework is shown in Figure 1. The system mainly processes and restores the electromagnetic signal received by the antenna into audio or video signal. The specific principle is as follows: the electromagnetic signal received by the antenna is first amplified and suppressed by the high-frequency amplifier, and the shielded signal is transmitted to the mixer. The mixer mixes the local oscillator signal generated by the local oscillator with the obtained RF input signal, obtains the low-frequency signal through the sum frequency or difference frequency of the RF signal and the local oscillator signal of the IF amplifier behind the mixer, obtains the low-frequency signal through the demodulator, and amplifies it through the audio amplifier to obtain the required audio signal. The process adopts superheterodyne form. For this receiver, because the IF signal is fixed, the system has good selectivity and anti-interference ability[2].

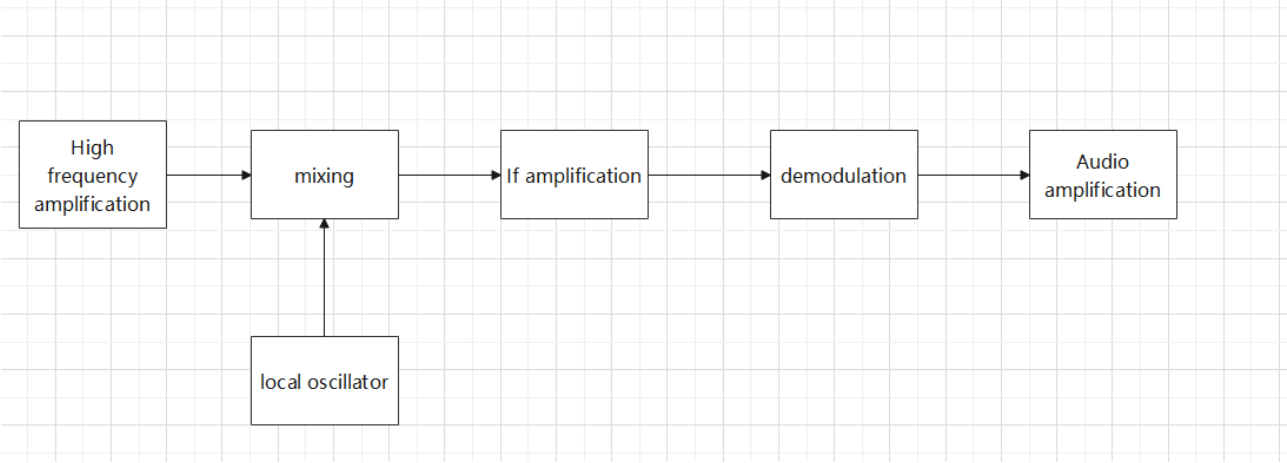

Fig.1 Overall Design of Receiver.

3. Design of Each Module

3.1 High Frequency Small Signal Amplifier

When the signal is received from the antenna, the received signal is a high-frequency electromagnetic signal. At this time, the received signal power is very small. Therefore, the received electromagnetic signal is amplified and preliminarily screened through the high-frequency small signal to obtain the input signal. The designed high frequency small signal amplifier is shown in Figure 2[3-4]:

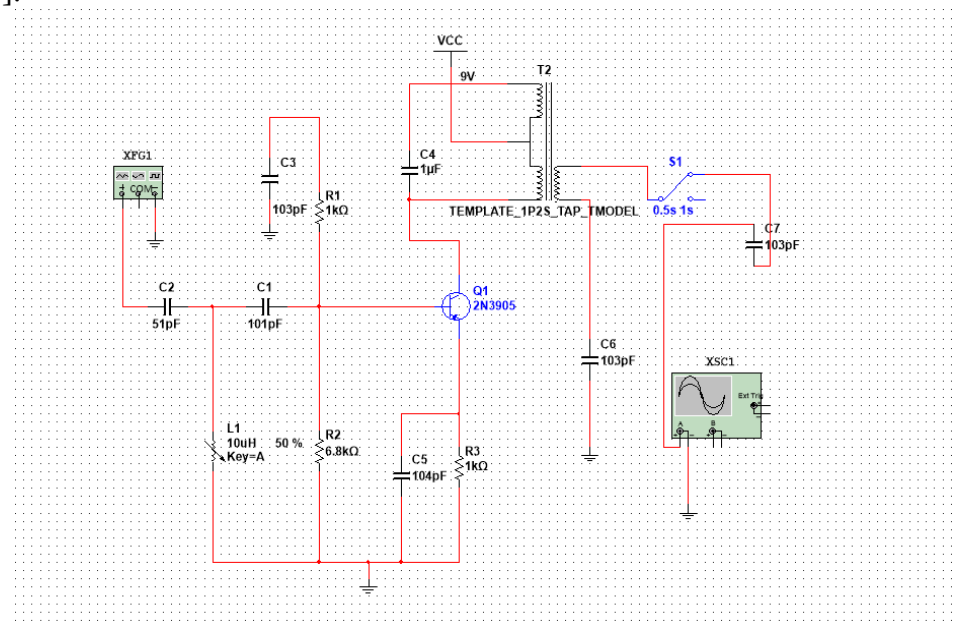

Fig.2 High Frequency Small Signal Amplifier

3.2 Design of Local Oscillation Circuit and Mixer

The local oscillator is a sine wave oscillator. It will generate an IF signal and transmit the signal to the mixer. Here, set the local oscillator to generate a signal with a frequency of 10. 5Mhz. According to the capacitive three-point oscillator, the circuit diagram designed by Multisim is shown in Figure 3. [3-4]The local oscillation signal $f_1$satisfies the following relationship:

$$f_1 = \frac{1}{2\pi\sqrt{lc}}$$

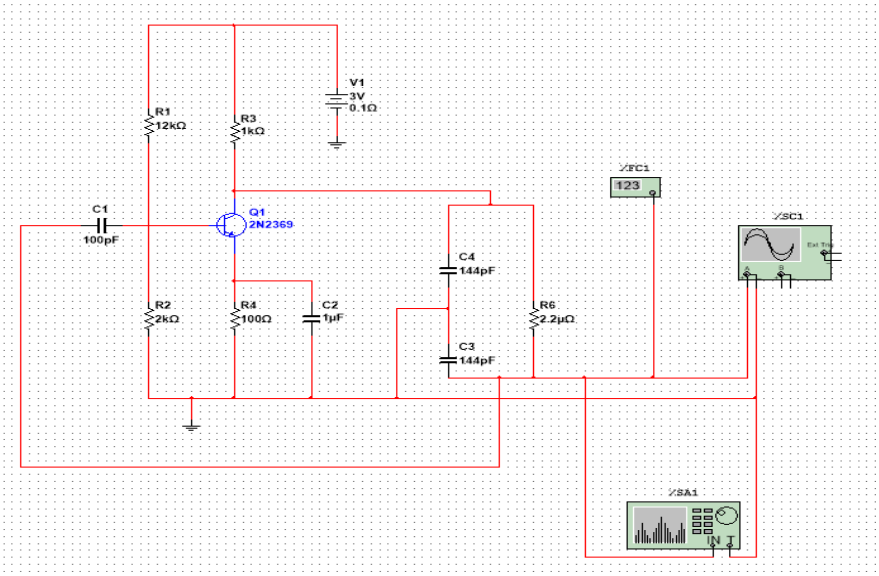

Fig.3 Capacitive Three-Point Oscillator

3.3 Mixer Design

Mixing is to add the local oscillator signal f_1 generated by the local oscillator and the modulated signal F2 amplified by the high-frequency small signal to the input of the nonlinear element at the same time, and use the nonlinearity of the element for mixing. The result of mixing includes high-order harmonic signals with output frequencies of f_1, f_2, $f_1 + f_2$ or $f_2 - f_1$. The output signal includes two input signal frequencies, sum frequency and difference frequency. The mixer contains demodulation part, which will select the difference frequency signal, filter the sum frequency signal, and move the spectrum of AM signal to the middle frequency.

The mixer is a linear moving process of spectrum, and the key to completing this process is the opportunity of two input signals. Therefore, the mixer can be disassembled into multiplier, a frequency selection network and band-pass filter. Combining the local oscillator with the input signal loop, the resulting signal is shown in Figure 4[3-4]

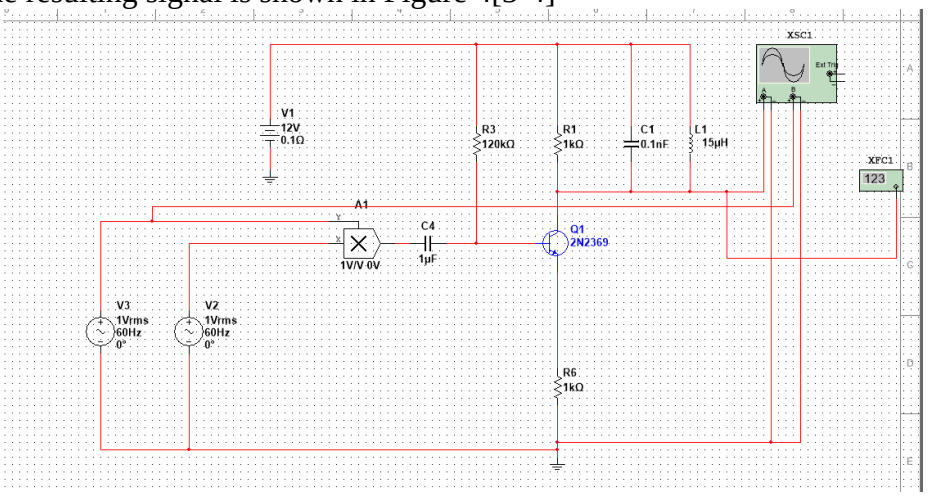

Fig.4 Mixer Circuit Design

The input frequency of the local oscillator is 10. 5Mhz. Assuming that the input frequency of the high-frequency small signal amplifier is 10MHz, the intermediate frequency signal with the frequency of 450kHZ can be measured by the oscilloscope in the designed mixing circuit loop

3.4 Design of Intermediate Frequency Amplifier

The intermediate frequency amplifier is an amplifier for intermediate frequency amplification. And the amplification object of the intermediate frequency amplifier only acts on the intermediate frequency signal, and plays a screening role for the signals of other frequencies. For the differential frequency signal transmitted from the mixer, the intermediate frequency amplifier is screened first. The screened intermediate frequency signal is amplified by line amplitude and the frequency remains unchanged.

3.5 Audio Amplifier Design

The signal power obtained after demodulation is too low to meet the actual power of the required audio signal. Therefore, an audio power amplifier is added here. The amplifier is different from the high-frequency power amplifier. It is a low-frequency component. Here, tda2030 chip is selected to build the integrated circuit of audio amplifier. The built circuit is shown in Figure 5[3-4].

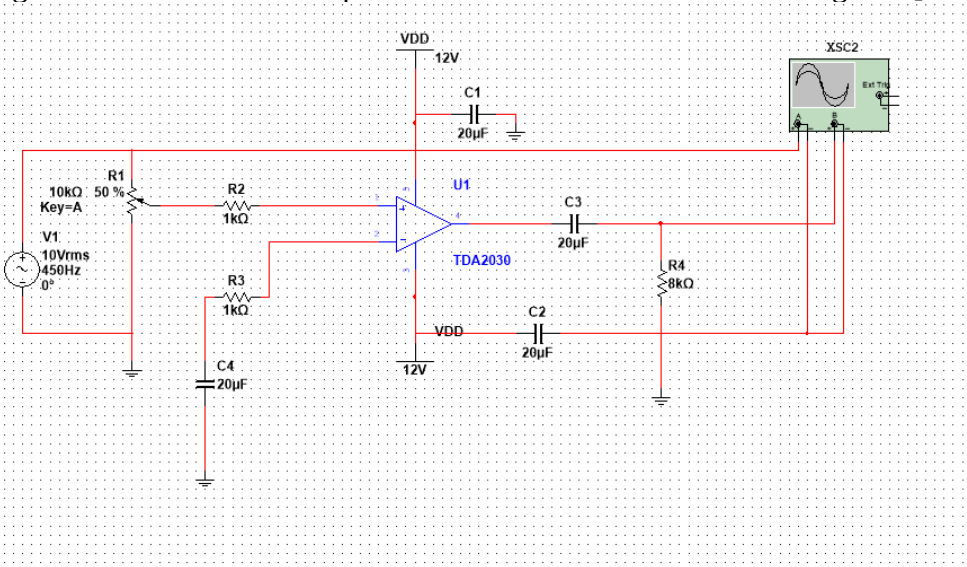

Fig.5 Circuit Design of Audio Amplifier

4. Conclusions

In this paper, the overall scheme of wireless AM receiver and the preliminary design scheme of each module are given, the relevant design ideas of each module under the proposed data and the changes of data are obtained, and the parameter indexes set for the circuit are tested by Multisim Simulation software. However, the design only gives a preliminary idea in theory, and there are still many deficiencies, which need to be improved in the follow-up.

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