

Design of Communication FM Receiver

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Abstract: This paper designs a set of wireless FM receiver system, which can receive the transmitted signal with frequency of 45mhz and convert it into the target signal with frequency of 3kHz. After scheme comparison, the wireless FM receiving system with single coordinated amplifier amplification amplitude and MC3362p mixing circuit and frequency discriminator is finally determined. The designed circuit is verified by simulation software.

1. Introduction

The FM signal transmits the audio and video signal to be transmitted according to the set frequency, and the FM receiver restores the electromagnetic signal into audio and video signal through a series of processes such as demodulation. In our daily life, signal reception is widely used in industrial, medical, commercial and military fields. Generally, the receiver converts the electromagnetic signal into superheterodyne form, initially suppresses the useless signal through the high-frequency power amplifier, then mixes it, and demodulates it to obtain the final result. Therefore, designing a reasonable FM receiver has certain research significance and value.

2. Scheme Design of Wireless FM Transmitter

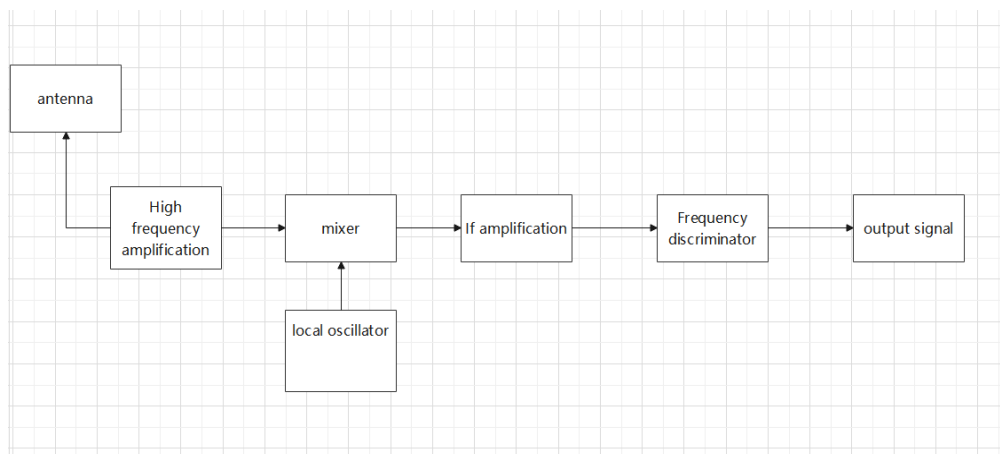


Fig.1 Overall Design of Receiver

In the FM receiver, the frequency of 46MHz is selected as the received signal. After twice mixing ($f_{o1} = 700\text{kHz}$, $BW_1 = 0.2\text{MHz}$, $f_2 = 100\text{kHz}$, $BW_2 = 20\text{kHz}$), a 10kHz IF signal is obtained. After intermediate frequency amplification and frequency discriminator, the target signal with the value of 300mv and 3kHz is obtained.

3. Scheme Design of Wireless FM Transmitter

3.1 Comparison and Selection of High Frequency Amplifier Circuit Schemes

Scheme 1: single tuned amplifier: the advantage of single tuned amplifier is that the circuit of single tuned amplifier is simple, which is easier to be made into frequency conversion resonant amplifier than double tuned amplifier. The disadvantage is the poor selectivity of the amplifier; The contradiction between gain and passband is prominent, and the rectangular coefficient is large; Under the same gain and bandwidth, the number of stages of single tuned amplifier is greater than that of double tuned amplifier. [1]

Scheme 2: dual tuned amplifier: the advantages of dual tuned amplifier are wide frequency band, good selectivity, small rectangular coefficient, and the capacitance of dual tuned loop is smaller than that of single tuned loop, reducing instability factors. The disadvantage is that the circuit structure is slightly complex and it is difficult to adjust; When used in frequency conversion amplifier, the circuit structure is complex and difficult to adjust; Compared with single tuned amplifier, its structure is complex and it is not easy to realize inter stage matching. [1]

3.2 Design and Simulation with Multisim

According to the basic principle of dual tuning circuit, using the schematic diagram 2 designed by Multisim:

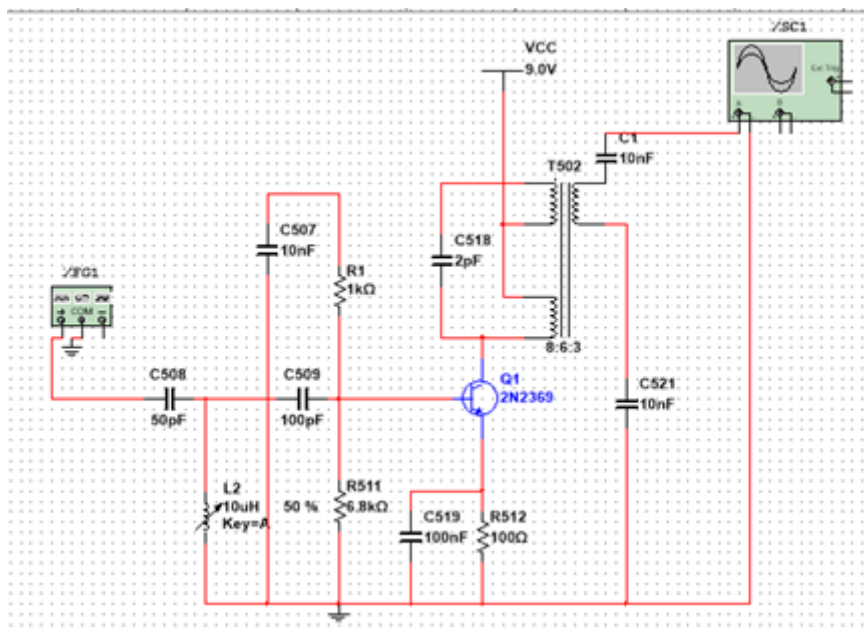


Fig.2 Circuit Design of High Frequency Amplifier

Through the analog input of 46mhz input signal and the designed circuit simulation, the results shown in Figure 3 can be obtained. Through analysis, it is found that the results are consistent with the expected results and meet the design requirements

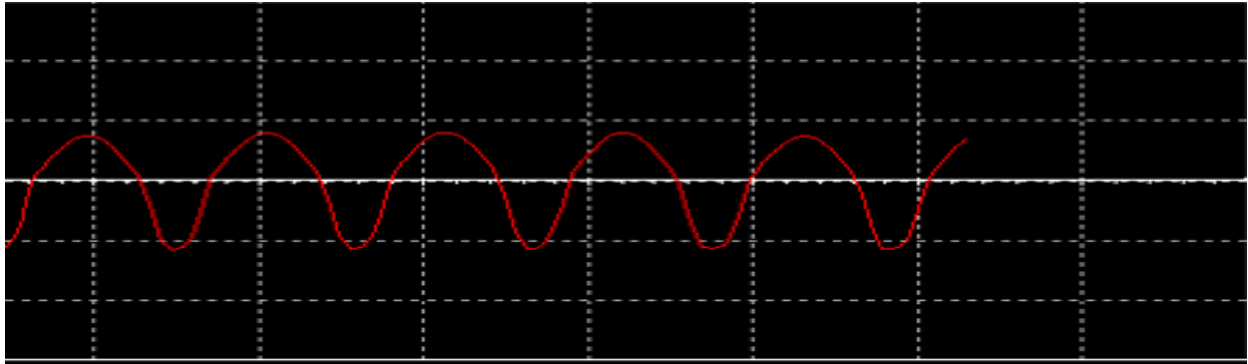


Fig.3 Simulation Results of High Frequency Amplifier

The results of output amplitude after frequency change are recorded in Table 1:

Table 1 Simulation Result

$f_0(\text{MHz})$	46.36	46.44	46.53	46.61	46.74	46.87	46.90
$V_{pp}(\text{mV})$	415	498	635	512	492	411	321
A_v	4.01	5.23	6.38	5.11	4.67	4.26	3.49

4. Description of Mixer Circuit Scheme

4.1 Comparison and Selection of Mixer Circuit Schemes

For the signal amplified by high-frequency amplifier, it is usually necessary to change the signal from one frequency to another, that is, the signal moves to a new frequency domain while the amplitude remains unchanged. During frequency conversion, the new frequency is equal to the sum or difference between the original frequency and the reference frequency of the signal. This reference frequency is commonly referred to as the local oscillation frequency. When the local oscillation is provided by a separate signal source, the frequency conversion process is called mixer.[4]

For the selection of mixing circuit, there are three schemes: transistor mixing circuit, crystal triode mixing circuit and mc3362 chip Multiplier mixing circuit. Compared with the other two schemes, mc3362 chip Multiplier mixer circuit has a complete dual frequency conversion system, wide input bandwidth, low working voltage and low power consumption current. Therefore, MC3362 chip Multiplier mixing circuit is selected to realize the function of mixing.[5]

4.2 Using Matlab to Simulate Mixer

The mixer module is made by using Simulink in MATLAB, as shown in Figure 4

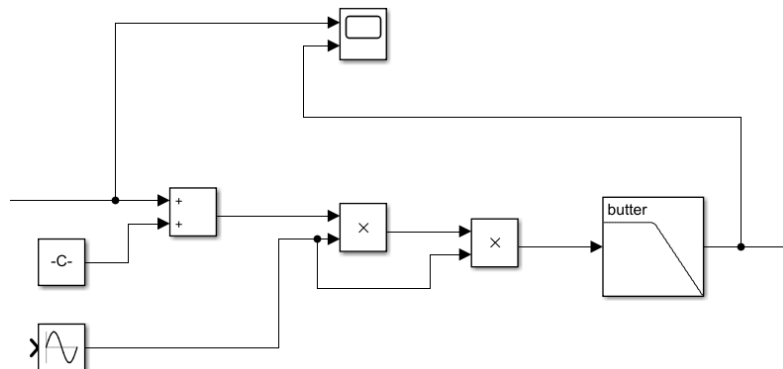


Fig.4 Realization of Mixer Function with Matlab

Add high-frequency small signal with frequency of 46.610mhz and V_{pp} of about 10mV. Through theoretical calculation, the frequency should be around 35.915mhz. MATLAB simulation is used. The results are shown in Figure 5.

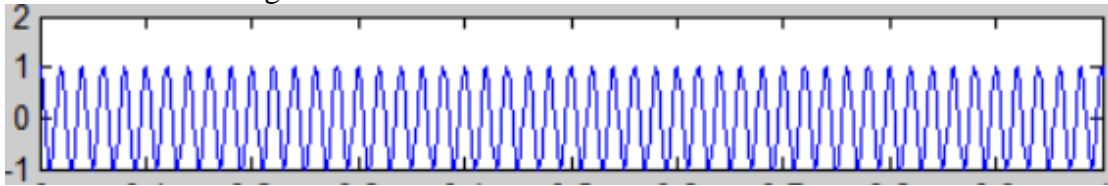


Fig.5 Spectrum after mixing

5. Results

This paper designs a FM signal receiving system. The wireless FM receiver consists of two modules: high frequency small signal amplifier and multiplication and mixing circuit based on mc3362, which are used to demodulate the modulated signal and obtain the required sound or video signal. The wireless FM receiver can receive a signal with a frequency of 46 MHz and obtain a target signal with a value of 300mv and 3Mhz. It can realize signal reception and meet the design index.

6. Conclusions

This design designs the FM receiver system, mainly designs the frame structure diagram and principle understanding and inspection of mixer, power amplifier, frequency discriminator and frequency multiplier. At the same time, it further consolidates and deepens the working principle of FM receiver. However, the current research is only in an ideal state and needs further development.

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