Millimeter Wave Front-end Integration Technology Study of 60GHz Communication

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Abstract

Millimeter wave front-end communication system occupies a pivotal position in the wireless network today. With the extensive use of high-definition television, such as HD set top boxes, Blu-ray DVD players, massive data exchange between personal hand-held devices to PC and wireless display applications，these all challenge the wireless high-speed transmission，which exceed the current capability of transmission provided by wireless communication systems. This paper is to study the research and application of the millimeter wave front-end integration technology of 60GHz communications.

Keywords

Millimeter wave，Frequency-Multiplier-by-eight，transceiver，zigzag filter.

1. Introduction

At present, the development trend of monolithic microwave integrated circuits in the world is:

1) new device and new technology:the continuous improvement process is based on the main active components of the heterojunction bipolar transistor (HBT) and high electron mobility transistor (HEMT).This reduces the size of the device and improves the product integration.And these devices have good performance in 100GHz;2) with the computer aided design (CAD) technology, the continuous improvement of all kinds of simulation tools and software.This is expected to achieve the goal of a successful design;3) with the continuous progress of MMIC technology, manufacturing costs have been greatly reduced, and constantly to the commercial and civilian conversion;4) after many years of research, MMIC has been integrated into the system, and the combination of millimeter wave and mixed signal is used to design the system chip (SOC).[1]

2. Integrated scheme design of communication front end system

The millimeter wave signal source is an important component in wireless communication, which provides the receiver with the vibration signal or radio frequency signal.The transmitter and receiver have completed the transmission and communication of the signal, not only to ensure the quality of the signal in the signal transmission process, but also to filter out the clutter so that it will not produce a signal to the adjacent channel interference and interference. Therefore, how to choose the front end of the millimeter wave front-end transceiver system is the key to determine the overall performance.In this chapter, the structure and scheme of eight frequency multiplication signal source are introduced.And on this basis, the architecture and scheme of receiver and transmitter are introduced.

The eight frequency multiplier source input terminal is used for the coaxial connector and the output end adopts the waveguide interface. All the modules are integrated in a sealed metal shield box.This metal shield includes many modules, such as frequency multiplication circuit, filter circuit, microstrip waveguide transition and so on.Transmitter scheme is relatively simple, roughly divided into two kinds of schemes.One is the design of the modulation of the baseband signal and the frequency conversion of the mixer in the same circuit, that is similar to the direct frequency conversion structure of the receiver.The second one is to make the modulation circuit of the base band signal separately, and the modulation frequency of the modulated medium frequency is mixed with the mixer, which is the two step frequency conversion mode.[2]

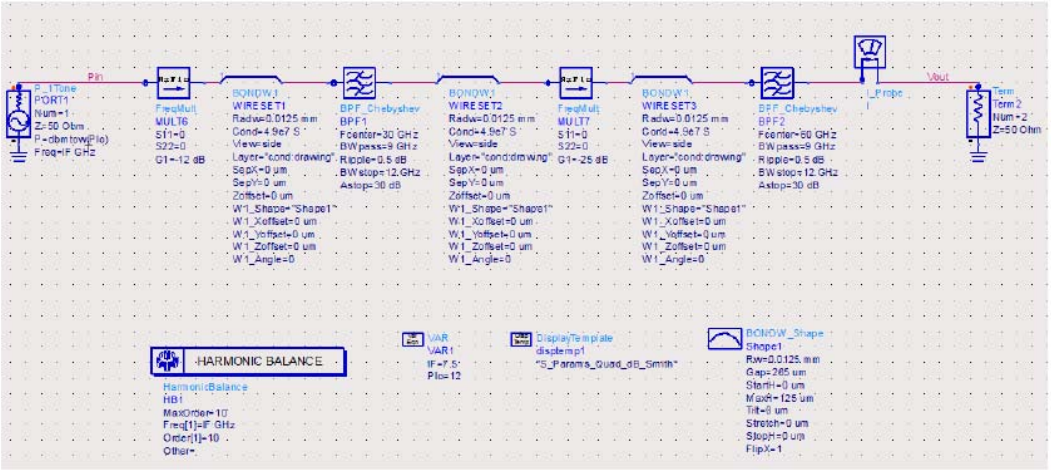

Figure 2.1 Eight frequency multiplication source system model is shown here.

The sub-harmonic mixer can effectively reduce the main vibration frequency of the vibration signal, and the frequency of the vibration signal link after four frequency and the frequency of the radio frequency signal.Therefore, the vibration signal and the frequency of the signal frequency is not big.So the receiver structure is more conducive to [20] frequency super-heterodyne structure.Considering the influence of chip interconnection, system level simulation and performance estimation is needed.

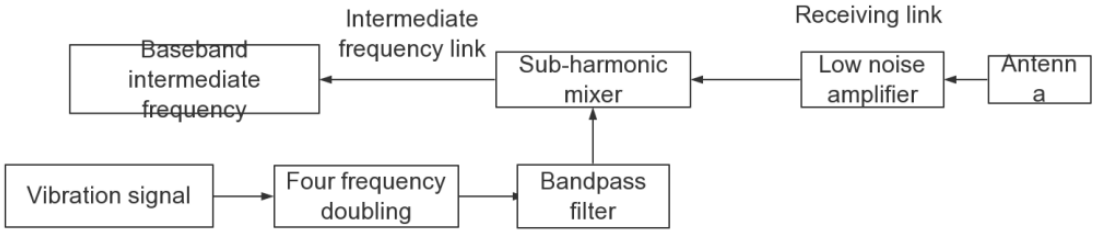

Figure 2.2,Its system frame diagram is shown here.

The frame diagram of bandpass filter for the lo link four octave frequency selection and suppression of other nonlinear products and improve the frequency spectrum quality.

Four frequency multiplier chip for the 7.5GHz of the vibration signal four to 30GHz.

Sub harmonic mixer will be four times the frequency of the vibration signal and the radio frequency signal to the desired frequency signal.The low noise amplifier power amplifier to amplify the radio frequency signal received by the antenna.So that it can provide enough power for the RF signal to be mixed.

3. Design of key technology in front of millimeter wave communication

In this chapter, the key techniques of the system design of the millimeter wave communication front end system include microstrip filter design, microstrip waveguide transition structure design, microstrip antenna design and active frequency multiplier, mixer, low noise amplifier.The theory of transmission line and the parameters of microstrip transition structure, filter, frequency multiplier, mixer, low noise amplifier are introduced in this paper.[3]The basis of the filter is the resonant circuit, which is a two port network.In the filter, the signal is transmitted to the signal, and the signal is attenuated in the stop band, so as to realize the function of signal filtering.Common filter frequency response is low pass, band pass, high pass and band stop characteristic.Microstrip transmission and waveguide transmission are the most common and the most basic two ways in signal transmission.

The transition structure of microstrip waveguide probe is the bridge of two kinds of transmission modes, which can realize the interconnection and energy conversion of microstrip and waveguide.

4. Fabrication and testing of front end transceiver

This chapter describes the actual circuit design of the millimeter wave transceiver front end, including the actual processing of the module circuit assembly, verification, transmitter assembly and testing, the assembly and testing of the receiver.

According to the design principle of the eight frequency multiplication, the choice of the frequency multiplication chip and the design of the filter is the eight frequency multiplication source.In order to make the eight frequency multiplication source of the signal radiation as small as possible, in the actual processing of the eight frequency multiplication source is installed in the closed metal cavity, the cavity is the overall external surface gold to reduce the loss

The cavity makes the structure of the eight frequency multiplication source is very compact, at the same time, the anti interference ability of the frequency multiplier is enhanced.[4]

Four frequency doubling chip and two chip need DC power supply, therefore, in the process of metal shield, the upper and lower layer of the shield box is required to set up a suitable way to introduce the DC wire power supply.When the frequency and power of the input signal source are adjusted, the frequency spectrum of the output signal can be obtained from the spectrum analyzer, and the single frequency point power of the output spectrum can be observed by adding Marker.

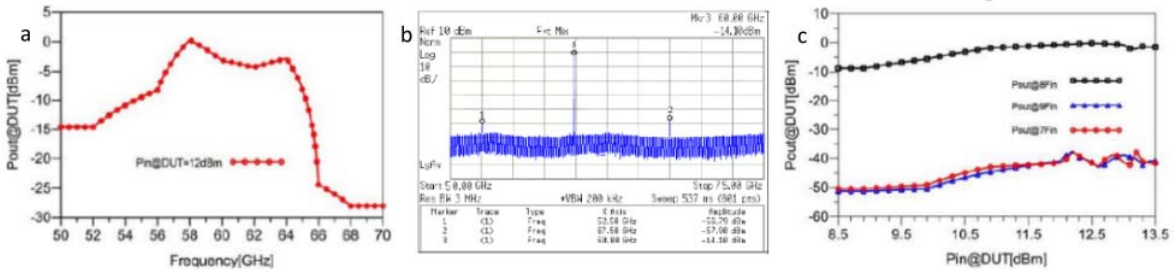

Figure4.1a,Eight frequency doubled output power;4.1b,The eight frequency multiplication source input 7.5GHz signal, the output is connected with the axis of the same axis by the mm mixer.The spectrum of the observed spectrum when the frequency spectrum analyzer is connected with a pre-selected millimeter mixer.4.1c,For the frequency multiplication source input 7.25GHz, the eight frequency multiplication signal, the seven harmonic and the nine harmonic power test curve under different input power.

5. Conclusion

The millimeter wave front end communication system is a very important position in the wireless network. With the wide application of high definition TV, such as high definition set-top box, blue light DVD player, personal handheld devices and personal computer, the application of mass data exchange and wireless display has proposed the challenge of high speed transmission.

These are far more than the transmission capabilities provided by the current wireless communication system. Therefore, it is necessary to meet the needs of these applications by new type of wireless communication technology.These applications mainly provide transmission rate up to several gigabits per second or even tens of gigabits per second and the wireless transmission in 2-20 m range.60GHz millimeter wave technology provides an effective method for this kind of high speed transmission.

In this paper, the research and application of the integrated technology of 60GHz millimeter wave communication front-end system is studied in this paper.

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