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Design and Analysis of RF Power Amplifier Based on WCDMA

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Abstract

The paper designed a RF power amplifier (RFPA) used in WCDMA based on the ADS software. And the circuit design and optimization is based on the method of S parameter, eventually making the PAE, the Gain , and so on meet the design requirements.

Keyword：WCDMA；Gain ； MRF6S27015N

1. Introduction

The RF power amplifier is in the front of the antenna in wireless communication system, and its effect is magnified input signal before launched, in order to overcome overcome channel loss between transmitter and receiver[1]. The frequency range of the power amplifier refers to the range of the amplifier working band. For WCDMA, the working frequency is from 2100 MHz to 2170 MHz[2].

In practical work, the frequency of power amplifiers greater than of the definition of the signal frequency range. Therefore, the design frequency of the rf power amplifier includes the working frequency(2110 MHz 2170 MHz) of WCDMA signal[3].

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2. Design scheme

2.1. Power gain

Power gain is refers to power magnification of the power amplifier, and it is described by the ratio of output power with the input power, usually use logarithm form to said, and its unit is decibels (dB). The definition of power gain is[4]:

$$Powergain(G)=10log(Pt/Pr)=Pt(dB)-Pr(dB) \quad (1)$$

2.2. PAE

The efficiency of the rf power amplifier reflects the power amplifier ability of dc power to rf power, usually defined by three form, they are leakage way very efficiency ,Power-add Efficiency (PAE), and the comprehensive efficiency efficiency. Define for rf power output, for rf power input, and for dc power. So Power-add Efficiency (PAE) defined as[5]:

$$PAE=(Pout-Pin)/PDC \quad (2)$$

3. Rf power amplifier circuit design

3.1. Design goal

Design a suitable rf power amplifier for WCDMA, its parameters just as the efficiency, the power gain[5], and the output power must as follows:

- Working voltage: DC28V
- Output power: 7.5 W (60 dBm)
- Gain: > 3 dB
- Bobby: <30
- PAE: > 10%

3.2. Design process to realize

Design and implementation procedure is as follows：

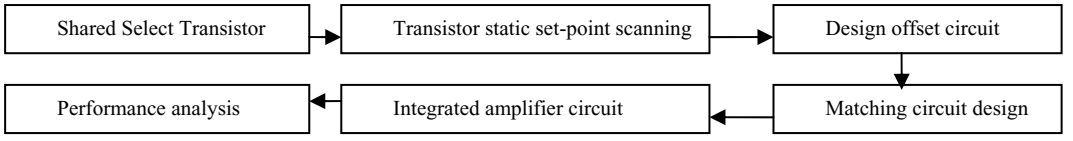

Fig.1 Programming flowchart

3.3. Design circuit

In this design we use the MOSFET named MRF6S27015N, it is designed for 3G-WCDMA.After a series of design, The final circle as shown in the Fig.2(At the end of the article).

4. The simulation index analysis of Power amplifier

4.1. Stability analysis

Design stability curve in the scope of 2110 MHz-2170 MHz being shown below:

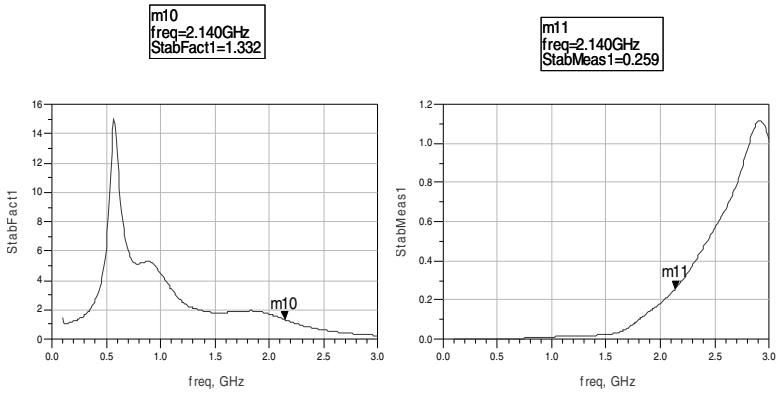

Fig.3 Stability simulation diagram

In the Fig.3, the first chart describes stabilizing factor K. From the simulation we can seen the factor K are greater than 1 in the range of 2110 MHz-2170 MHz;The second chart describs , in the same range, it is greater than zero. Two steady factor will meet the stability condition of the power amplifier, the designed power amplifier is stability in the range of 2110 MHz-2170 MHz, and the design is successful.

4.2. Gain

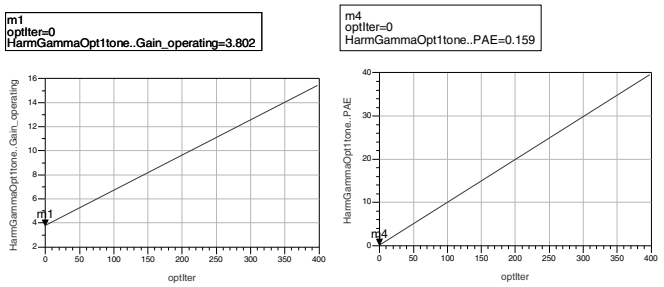

Fig.4 (a) The amplifier's gain curve;(b) The amplifier's PAE

From the Fig.4(a) we can see the minimum gain value is 3.802 dB, accord with a good power amplifier requirements, what is that its gain must greater than the 3 dB. it indicating that this design is successful.

4.3. Power additional efficiency (PAE)

From the Fig.4 (b) we can see the minimum power additional efficiency is 15.9%, far more than 10% of the standard.This shows the rf power amplifier has high efficiency additional power.

5. Summary

From the simulation image of the various features, we can see the WCDMA power amplifie that designed by MRF6S27015 module is successful.

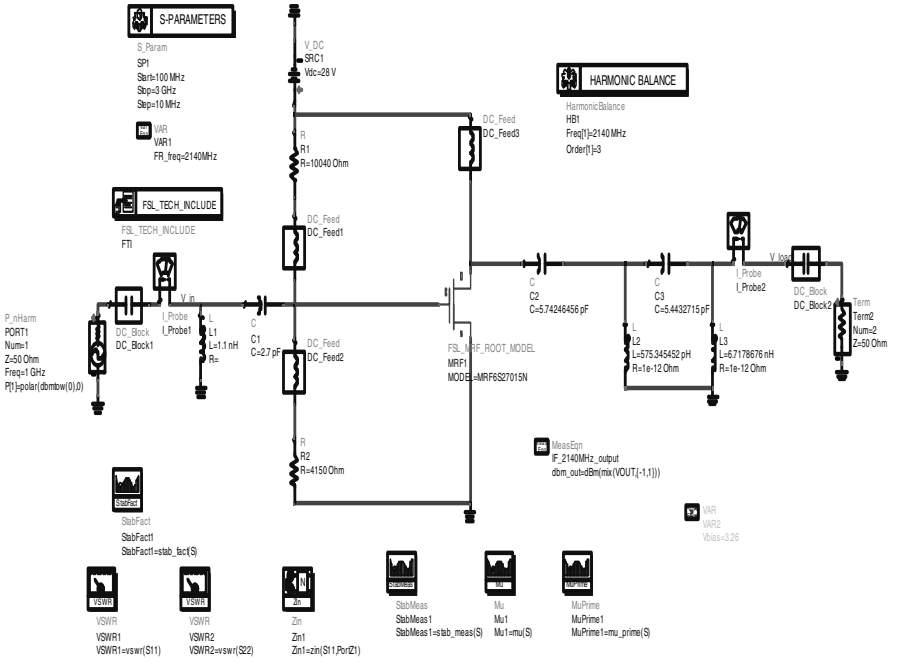

Fig.2 Full of power amplifier circuit diagram

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