LINEAR 3 -TERMINAL VOLTAGE CONTROL CURRENT SOURCE

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Abstract

The circuit is designed for improving the relationship between input voltage and output current of the MOS transistor, which is square function. This circuit can be used instead of n-channel MOSFET at once. The circuit consists of MOSFET, which acts as a voltage receiver. The source of MOSFET is connected to current control part which consist of bipolar transistors. The exponential characteristic of bipolar transistor is used to solve the square function of MOSFET that base on concept of log and anti-log circuit. The experimental results of simulation are agreed with the implemented circuit.

I. Introduction

A device, which is able to amplify the power gain, has been used to be the component of general circuits presently. In case of a bipolar transistor, we find that the relationship between output current and input current is linear, but the output current, I_C, is an exponential function of input voltage, V_{BE}. This characteristic cause the input voltage has to vary in narrow range to avoid the exponential curve. In other words, if we want to use a bipolar transistor to be a linear amplifier circuit, the input voltage will be biased in the narrow interval only. Like a bipolar transistor, if we use a field-effect transistor to be an amplifier, the relationship between input voltage, V_{GS}, and output current, I_{DS}, will be square function when it is biased greater than threshold voltage. In the other hand, the relationship will be exponential likes a bipolar transistor, [1] [2] if it is biased below threshold voltage. From the reason that has been described, when we want to design the transconductance amplifier circuit, input voltage and output current, from both devices (BJT and FET), we must detect the nonlinearity error of equipment.

This paper present an idea for developing circuit to improve the problem by combining I-V characteristic of MOSFET and bipolar transistor to solve the nonlinearity error. This circuit can be used instead of MOSFET and keep on the transconductance characteristic, input impedance (Z_{in}) is high, to work efficiently.

II. Circuit Description

From the I-V characteristic of MOSFET, [3] [4] we want to design the circuit that can be used for improving square function and replacing the MOSFET. The block diagram of this circuit has to represent MOSFET which is three terminals device, one for voltage control, and the others for current flowing, as depicted in Fig 1.

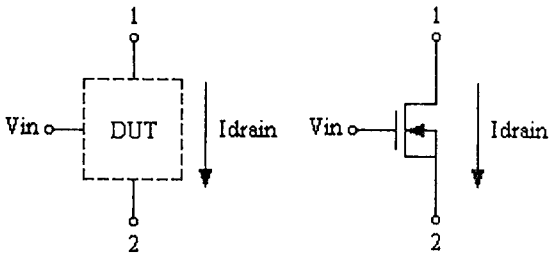

Fig. 1 The concept idea of the circuit.

Because we want to design the equivalent circuit that synthesized voltage and current interval identify with MOSFET; we use it to be input device. To use MOSFET to be input device not only identify with MOSFET, but also used to keep on high impedance characteristic of transconductance circuit. The current control part is the circuit which used to control amount of the current that flow out this MOSFET after V_{in} is biased. This circuit will control the characteristic of drain current to be linear. The synthesized circuit is given in Fig 2.

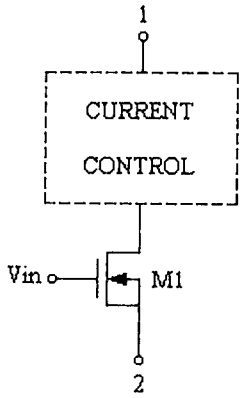

Fig 2. The synthesized circuit of Linear MOSFET Cell.

Fig. 3 shows the structure of control circuit consisting of three bipolar transistors. We use exponential characteristic of bipolar transistor to change input current square function to be output voltage exponential function, after that, use some technique to decrease voltage level and bias it into bipolar transistor again.