MOSFET MODELING WITH SPICE

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ABSTRACT

This project report is about the study of MOS Field Effect Transistor (MOSFET) characteristic for various channel length. In this project, the characteristic of n-channel enhancement-type MOSFET will be examined. Simulation Program with Integrated Circuit Emphasis (SPICE) circuit simulator is used to analyze the current–voltage characteristics of MOSFET for various channel length. Other parameters in the SPICE MOSFET model use the default values. The switching speed of the devices can also be calculated. The focus of this project is on LEVEL 1 and LEVEL 2 MOSFET model.

CONTENTS

CHAPTER 1

MOS TRANSISTOR

1.1 Introduction

The MOS Field Effect Transistor (MOSFET) is the fundamental building block of Metal Oxide semiconductor (MOS) digital integrated circuits. The basic structure and the electrical behavior are examined for nMOS (n-Channel MOS) transistor that is used as the primary switching device in virtually all circuits' applications. The characteristics of n-channel enhancement-type MOSFET will be examined in detail. A brief description on small-signal behavior and the switching speed of the devices. Also the definitions of effective channel length end width.

1.2 MOSFET Structure

The basic structure of n-channel enhancement-type MOSFET is shown in Figure 1.1. A MOS transistor which has no conducting channel region at zero gate bias is called an enhancement-type or enhancement-mode MOSFET. This four-terminal device consist of a p-type substrate, in which two n+ diffusion regions, the drain and the source, are formed. The surface of the substrate region between the drain and the source is covered with a thin oxide layer, and the metal (or polysilicon) gate is deposited on top of this gate dielectric. The two n+ regions will be the current-conducting terminals of this device. Note that the device structure is completely symmetrical with respect to he drain and source regions; the different roles of these two regions will be defined only in conjunction with the applied terminal voltages and the direction of the current flow.

A conducting channel will eventually be formed through applied gate voltage in the section of the device between the drain and the source diffusion regions. The distance between the drain and the source regions is the *channel length* L, and the lateral extent of the channel (perpendicular to the length dimension) is