Power MOSFET Characterization
for Portable Electronics

Project Code: SJK16-05
Supervisor: Professor Johnny Sin

Group members:
Tang Ying Lok  (03362631)
Chan Chun Yeung  (03339749)
Project Overview

Nowadays, the use of electronic devices in portable appliances, such as PDA, digital video camera and notebook with high power and frequency are common. In the past, we used the bipolar transistor to scale up the power, however, for those high power and frequency appliances, the efficiency will be decreased. Therefore, increasing speed of microprocessor is accompanied by the increased power dissipation. As we can see that the trend of the development in power MOSFET is demanding, the characterization of it is step for the further improvement.

In order to increase the performance of MOSFET, different areas of research in this stream have to be taken. In this project, the objective mainly divided into two parts.

Part 1:
Theoretically understand and characterize the Electro-Static Discharge (ESD) protection structure in Power MOSFET

Part 2:
Characterization automation of low voltage power MOSFET devices

Objective
Part 1

The goal of this part is to understand and analyze the performance of the ESD protection structure with different parameters. The following is the system block diagram:

**Structure Parameter**
- The number of ring, \( R \)
- The width of ring, \( W \)
- The separation of ring, \( S \)
- The Doping concentration

**Structure Performance**
It is measured by how many voltage the structure can withstand before reach its breakdown.

**Step To Achieve**

**Specification**
Obtain the specified ESD protection structure for analysis

**Process Simulation**
Using software TSUPREM-4 generates the structure for next step

**Device Simulation**
Using software MEDICI gets the electrical data of the structure from TSUPREM-4 and plots out different graph to analyze

**Wafer Measurement**
Measure the data from the run wafers to verify the simulation results and further analysis.

**Result**
From the data, the ESD protection structure has following performance with parameters:

- Number of ring \( \propto \) Breakdown voltage
- Width of ring \( \propto \) Degree of shooting
- Doping concentration \( \propto \) Breakdown voltage
Part 2

Designed a system which can automatically remote control the devices testing machine to find the characterizations of the high power MOSFET devices.

Software and hardware choosing
1. Tektronix 371B High Power Curve Tracer as the curve tracer machine
2. GPIB cable as the Linkage
3. LabView as the Remote Control Software
4. Curve Tracer Utility as the Graph Plotting Software

1st Stage: Hardware Linkage
- Interactive Control
- Operation of the curve tracer 371B

2nd Stage: Approach Decision
- Features of LabWindow
- Features of LabView
- Compare them and make decision

3rd Stage: Interface Building
- Remote 371B to find out characteristics of the DUTs

4th Stage: Data Collection and Analysis
- Selection on Graph Plotting Software
- Extract data back to PC by using Curve Tracer Utility

Result
Automatically find the characteristics of high power MOSFET devices including:

- $I_d$ versus $V_d$
- $I_d$ versus $V_g$ with offstage breakdown
- $I_d$ versus $V_g$