SJ1-04 Low Voltage Power MOSFET Device Characterization

Group Members: Kwok Ka On
Wan Yuk Shing
Wong Tik Lai

Supervisor: Prof. Johnny Sin
Overview

This project was focused on the area of power MOSFET device’s characterization. In order to carry out the characterization work efficiently, automation must be needed. Three automation tools were successfully designed and implemented in the three areas: Unclamped Inductance Switching (UIS) measurement, wafer level recognition and thermal analysis.

An automatic UIS measurement program was written to fully characterize the UIS performance of power devices. A fancy graphical user interface was implemented which help users to do the characterization work in the simplest way.

A wafer level recognition program has been written which is used to automatically identify on wafer devices for screening out the failed die during the wafer level testing.

A program was written to automatically control the probe machine, which can be used for wafer probing and testing. Thermal measurement was demonstrated as an example. An additional mini program was also written for organizing the data and plotting the graph for thermal analysis.

Methodology

1. UIS measurement:
   - Three instruments were used and controlled by the computer to carry out the measurement automatically.
   - Waveform will be collected by the program.
   - Energy delivered to the transistor will be calculated by the program.
2. Wafer Level Recognition:

- Two instruments (probe station and CCD) were used to collect wafer image.
- The program will do automation on recognizing the original wafer pattern and support different wafer profile and sizing.

3. Thermal Analysis

- The probing machine was automatically controlled by the control program with three different modes.
- Data will be collected by the program.
- The contour graph will be generated by the data program.

Results and Conclusions

This project has successfully built three characterization tools. They can help to characterize the electrical performance of power transistors in a simply and automatic way with user friendly graphic user interface (GUI).

1. UIS measurement

- A testing fixture for the transistor devices was etched and built.
- A program is written by Microsoft Visual C++ 6.0.
- The program can calculate the energy delivered.
- Waveform data is saved in spread sheet format.
- Waveform graph is plotted on the panel of the program using National Instruments Measurement Studio 6.0.
2. Wafer Level Recognition
   - The program can screen out partial die with GUI interface in Matlab 7.0
   - Histogram Equalization, Edge Detection, Cross-Correlation was used
   - Three types of transistors was tested on wafer-level

3. Thermal Analysis
   - The program controls the movement of prober machine and performs thermal measurement.
   - Data is saved in text format.
   - Result is plotted in contour graph in Matlab 7.0