Power MOSFET Device Characterization
SJK1-07

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Overview

This project was focused on the area of power MOSFET device's characterization. Two characterization methods were successfully designed and implemented in two areas: Unclamped Inductance Switching (UIS) measurement and Reverse Recovery time (TRR) measurement. Moreover, in order to carry out the characterization work more efficiently, automation process was also implemented.

Aim and objectives:

UIS measurement is a high stress used to determine the maximum amount of avalanche energy a device can sustain. However, it is a time consuming process. A program was designed and written to do the UIS measurements automatically.

A simple circuit is designed and modified such that users can measure the Reverse Recovery Time and also the Maximum Reverse Current of a Power Electronics Device under different conditions. This is an ideal measurement method for small-scaled company since its testing circuit only consists of common and cheap components and equipments.

Methodology

1. UIS measurement:

Three instruments were used and controlled by the computer to carry out the UIS measurement automatically. Waveform data will be saved by the program. Energy and Power delivered to the transistor will be calculated by the program.
2. TRR measurement:
Several circuit boards are built based on the designed circuit. A pulse with suitable period and duty is input to the switch such that the desirable forward current is produced. Afterwards, different testing condition, the forward diode current, can be simply changed by tuning the inductance, duty cycle and the period of the input signal. Once the Reverse Recovery behavior is obtained, the corresponding Reverse Recovery Time and Maximum Reverse Current can be found.

Results and Conclusions
This project has successfully built two 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
~ Four testing circuits with different sockets were built (TSOP-8, SOIC-8, SOT-23 and TO-252)
~ 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.
Merit of this program:
By using the automatic UIS measurement program, users can perform the measurements on a large amount of transistors easily and efficiently. The time taken for this program is less than a quarter of the time of carrying out the measurement manually!

2. TRR measurement
~ PCB circuit boards with simple component were built
~ Both the Reverse recovery Time and the Maximum Reverse Current can be measured directly by using the CRO.
~ Testing condition, forward diode current, can be simply modified by changing the inductance, duty cycle and the period of the input signal.

~ In addition, the relationship between the Duty Cycle, Diode Forward Current and Maximum Reverse Recovery Current has also been discovered.