Your power testing solution.

How to use the IT2800 SMU to quickly test the I-V characteristics of MOSFET devices

Introduction

MOSFET, short for Metal Oxide Semiconductor Field Effect Tube, is a common power switching device used in circuit design. It is a voltage controlled device. It is characterized by gate voltage to control the drain current and has the advantages of simple driving circuit, low driving power, fast switching speed, high operating frequency and higher thermal stability than GTR. According to the conductive channel power, MOSFET can be divided into P-channel and N-channel. According to the gate voltage amplitude, it can be divided into depletion type (when the gate voltage is zero between the drain and source, there is a conductive channel) and enhancement type (gate voltage is not zero when there is a conductive channel). Power MOSFETs are mostly N-channel enhancement type.

Characteristic of MOSFET

Generally, Power MOSFET device parameters include static, dynamic, and switching characteristics. Among them, static characteristics are mainly characterized device intrinsic characteristics indicators. The static characteristics of MOSFETs mainly refer to output characteristics and transfer characteristics, and the main parameters corresponding to static

characteristics are drain breakdown voltage, drain rated voltage, drain rated current and gate turn-on voltage. This article will introduce how to test the static I-V characteristics and parameters of MOSFETs with ITECH's latest IT2800 Graphic SMU.

1) MOSFET Transfer Characteristics Test $I_D=f(V_{GS})$

The transfer characteristic verifies that the gate voltage V_{GS} controls the I_D, which characterizes the amplification capability of the device. For a constant V_{DS}, the higher the V_{GS}, the more electrons moving in the channel, the smaller the channel resistance, and the higher the corresponding I_D. Of course, when V_{GS} reaches a certain limit, the voltage will no longer rise, and the I_D will not change much by then. Taking a MOSFET parameter as an example, its transfer characteristic curve is shown in the following figure.
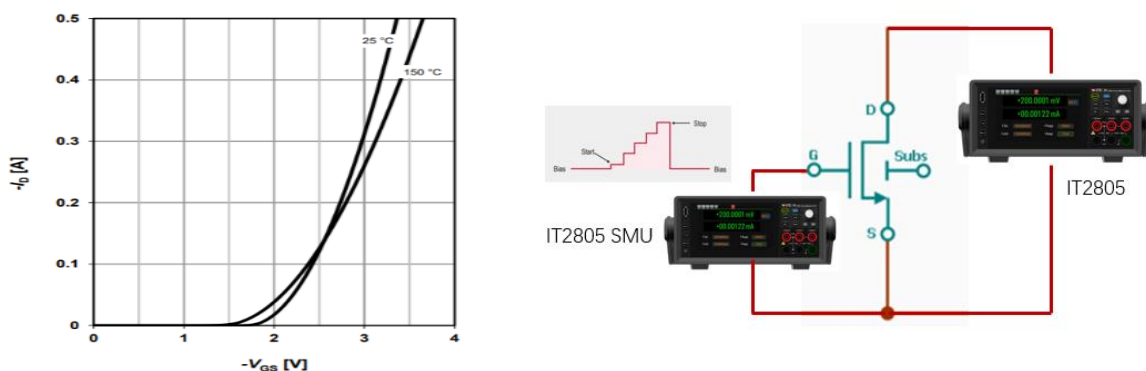
Test method

As shown above, SMU1-IT2805 (200V/1.5A/20W) is connected between drain D and source S, and a specific V_{DS} is applied. Then the V_{GS} is scanned by SMU2-IT2805 and the I_D is measured simultaneously. As the V_{GS} rises, the I_D also rises, and the curve is finally plotted.

Advantage

The IT2800 SMU offers multiple scan modes: DC or pulsed, linear or logarithmic, unidirectional or bidirectional. For sensitive power devices, testers can choose pulse scan

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mode to reduce the problems of device temperature increase and characteristic change through continuous DC. On the other hand, in order to ensure synchronous measurement of stable I_D parameters when V_{GS} changes, fiber optic communication is used between the two SMUs, which greatly reduces the synchronization error to less than 30ns.

2) MOSFE output characteristic test $I_D=f(V_{DS})$

The output characteristics of the MOSFET contain a cutoff region, a constant current region, and a variable resistance region. When the MOSFET works in the switching state, the MOSFET switches back and forth between the cutoff zone and the variable resistance zone as V_{GS} is turned on/off. When the MOSFET is working in the constant current zone, the I_D can be controlled by controlling the V_{GS}.
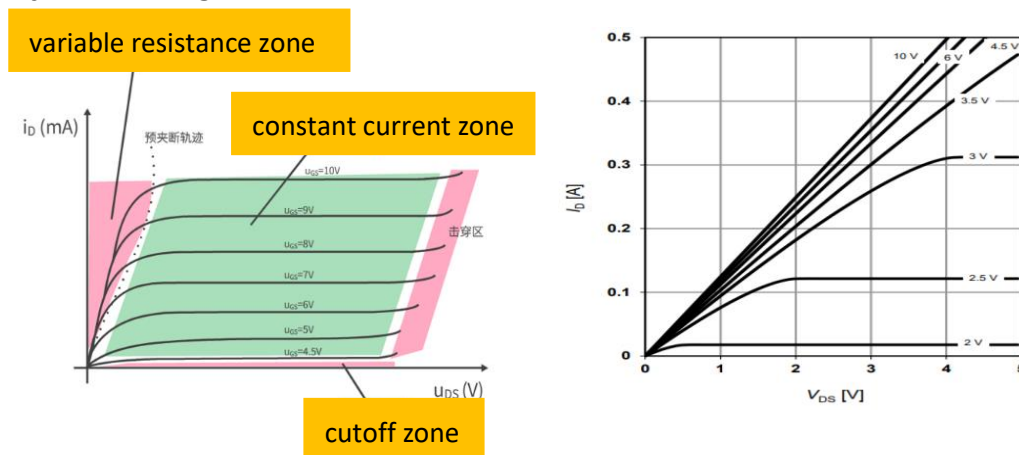
Test Method:

SMU1- IT2805 (200V/1.5A/20W) is connected between drain D and source S to provide the scan voltage V_{DS}. SMU2- IT2805 is connected between gate G and source S to provide the scan V_{GS}. During the test, the drain-source V_{DS} is set to scan from 0V to the termination voltage. When the V_{DS} scan is finished, the gate V_{GS} is stepped to the next value and the V_{DS} is scanned again.

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Advantage

With the optional software ITECH SPS5000, you can perform automated static semiconductor characterization tests. the SPS5000 software has a built-in CMOS semiconductor model and a rich set of static index test items, you only need to make simple parameter configuration to quickly complete the test. When the test is finished, the software can perform a comprehensive analysis of multiple tests and display table data or curves to help improve test efficiency.

Summary

ITECH IT2800 Series Graphic SMU combines 6 functions in one, including a four-quadrant voltage source, a current source, a 6.5-digit digital multimeter, pulse generator, electronic load and battery simulator. It is designed with a 5-inch touchscreen display, which greatly reduces engineers' operation configuration time and measurement resolution up to 100nV /10fA. Thanks to the large screen design, the IT2800 series provides three graphical display modes: Graph view/Scope view/Record view.

IT2800 Graphic Source Measure Unit

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