FOUR KEY TESTS: Validating MOSFET Performance in Power Supply Designs

TEST SPECIFICATIONS

Drain Family of Curves

Definition: Transistor output characteristics plotted as I_{DS} versus V_{DS} for several values of V_{GS}.
Measurement Parameter: I_{DS} vs. V_{DS}
Importance in Device Selection: By looking at these curves, the designer can determine the best operating point for the application. At low drain-source voltages, the MOSFET behaves like a variable resistance whose value is controlled by the applied gate-source voltage. At higher drain-source voltages, the MOSFET passes a current whose value depends on the applied gate-source voltage. In most circuits, it is used in this 'high voltage' region and acts as a voltage-controlled current source.

Test Technique:

1. Step the gate voltage (V_{GS}) across the desired range of values at specified increments.
2. At each V_{GS} value, V_{DS} is swept across the desired V_{DS} range.
3. Measure the drain-source current (I_{DS}) at each V_{DS} increment.

Threshold Voltage

Definition: The minimum gate-to-source voltage differential required to produce current flow from the source to drain.
Measurement Parameter: V_{TH}
Importance in Device Selection: Threshold voltage is important for determining the on-state and the off-state of the MOSFET. $V_{GS(th)}$ is defined where $V_{DS} = V_{GS}$, although it is sometimes quoted for a fixed V_{DS} (e.g. 10 V.)

Test Technique:

1. Sweep the gate voltage (V_{GS}) while the drain-source voltage (V_{DS}) is set to a particular value.
2. Measure the drain current (I_D) at each value incremental of V_{GS} in the sweep.
3. Determine the threshold voltage (V_{TH}) through a linear curve fit. A linear region on the curve is selected. The interception of the voltage axis gives the threshold voltage.

Gate Leakage

Definition: Transistor gate leakage current as a function of the gate voltage.
Measurement Parameter: I_G vs. V_G
Importance in Device Selection: The gate leakage current is important when calculating how much current is required to keep the device turned on. Because it is a leakage current through an insulator, this current is independent of temperature.

Test Technique:

1. Sweep the gate voltage (V_G) over the desired range while the drain and source are tied to common.
2. Measure the gate current (I_G).

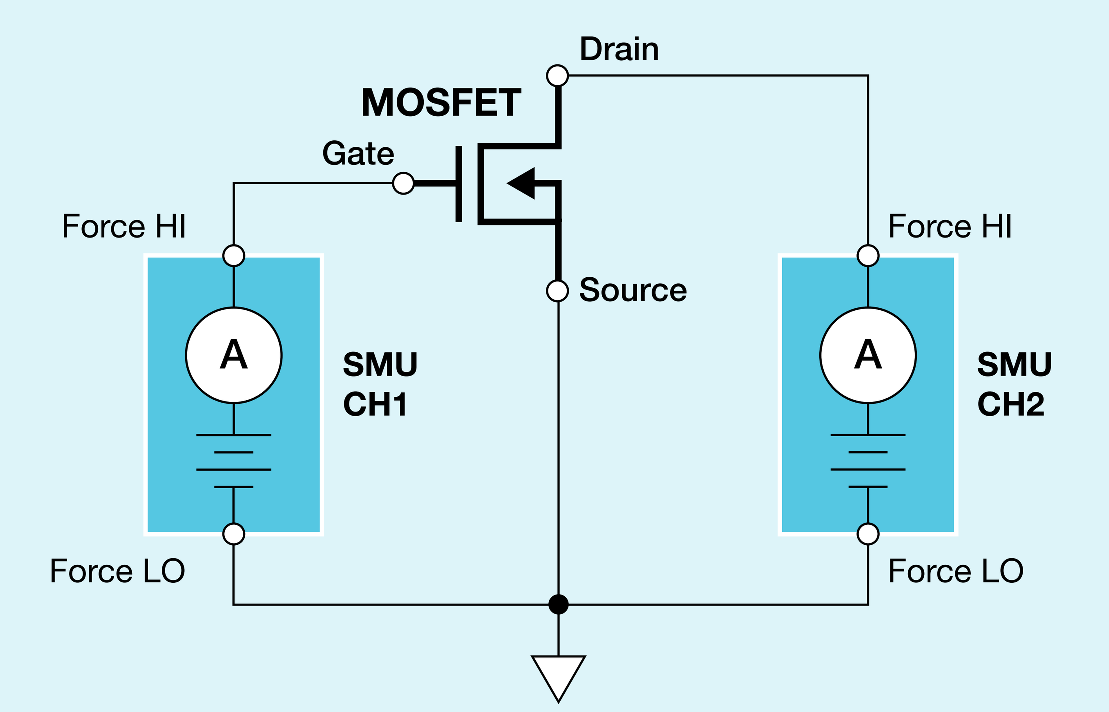
Transconductance

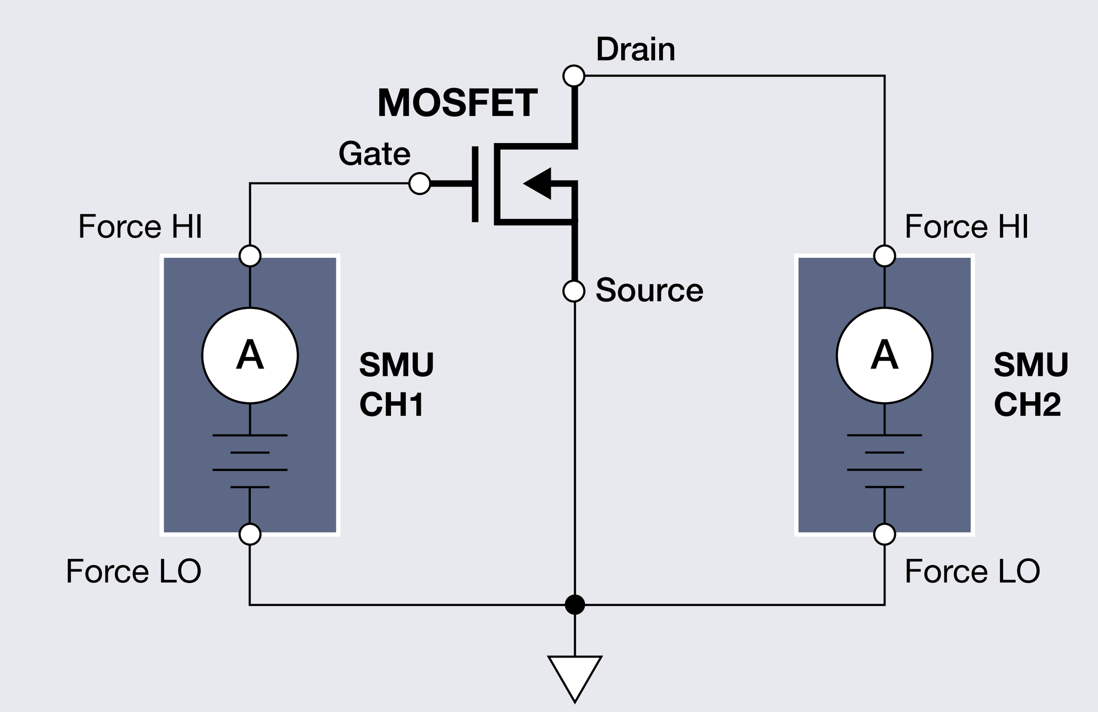
Definition: The change in the drain current divided by the small change in the gate/source voltage with a constant drain/source voltage.
Measurement Parameter: I_D vs. V_{GS}
Importance in Device Selection: Transconductance helps the engineer to choose the best MOSFET with the right amount of gain (amplification) for the designs.

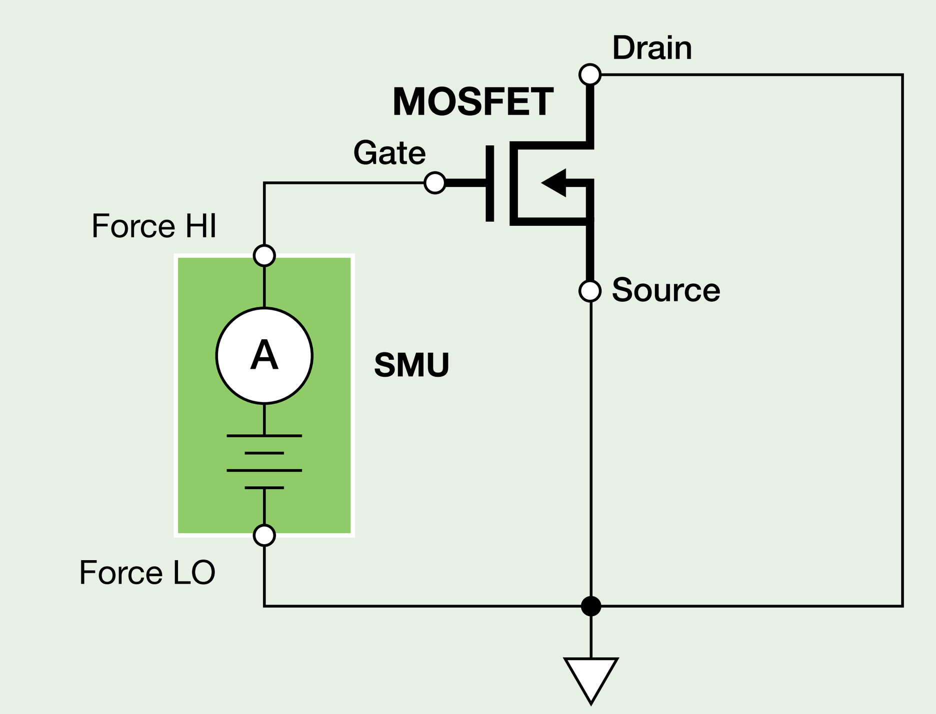
Test Technique:

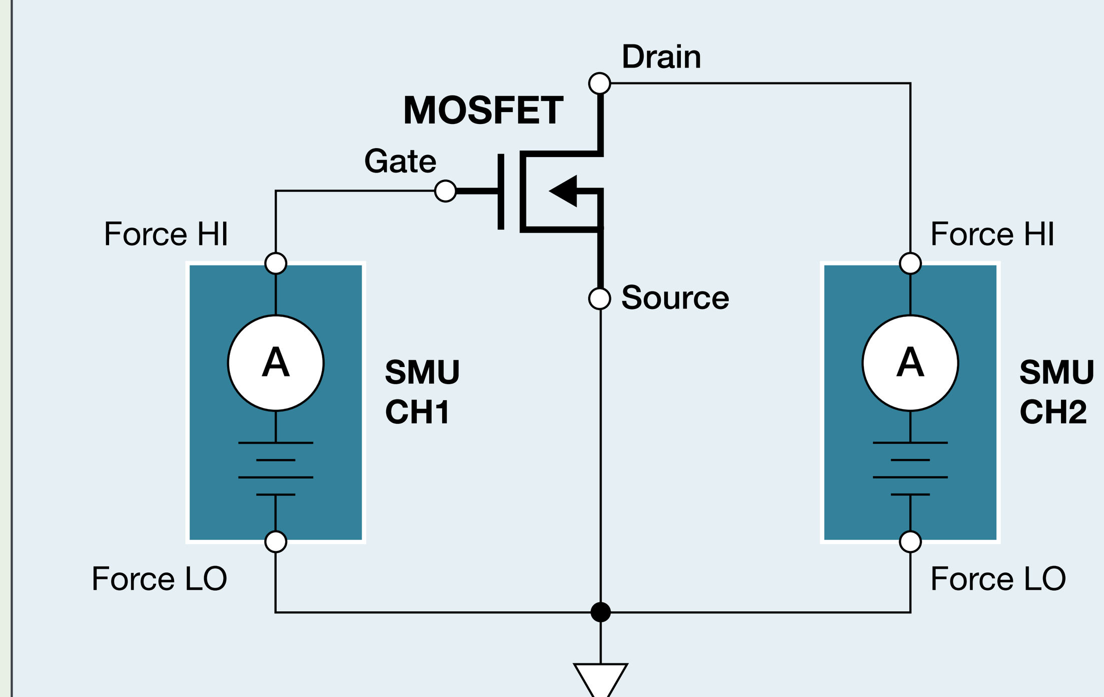
1. Sweep the gate voltage (V_{GS}) over the desired range, while maintaining a constant drain/source voltage (V_{DS}.)
2. Measure the drain current (I_D) at each increment step of V_{GS}.
3. Calculate transconductance (g_m) by dividing the small changes in I_D by the small changes in VGS. $g_m = \Delta I_D / \Delta V_{GS}$.

TEST CONFIGURATION

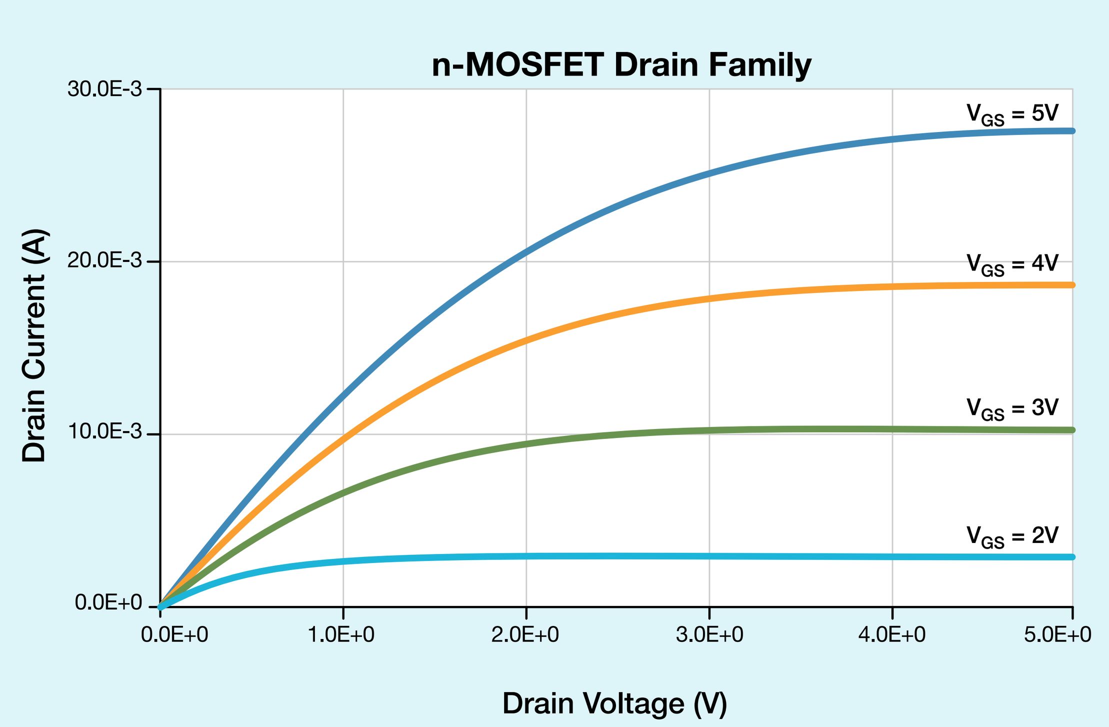


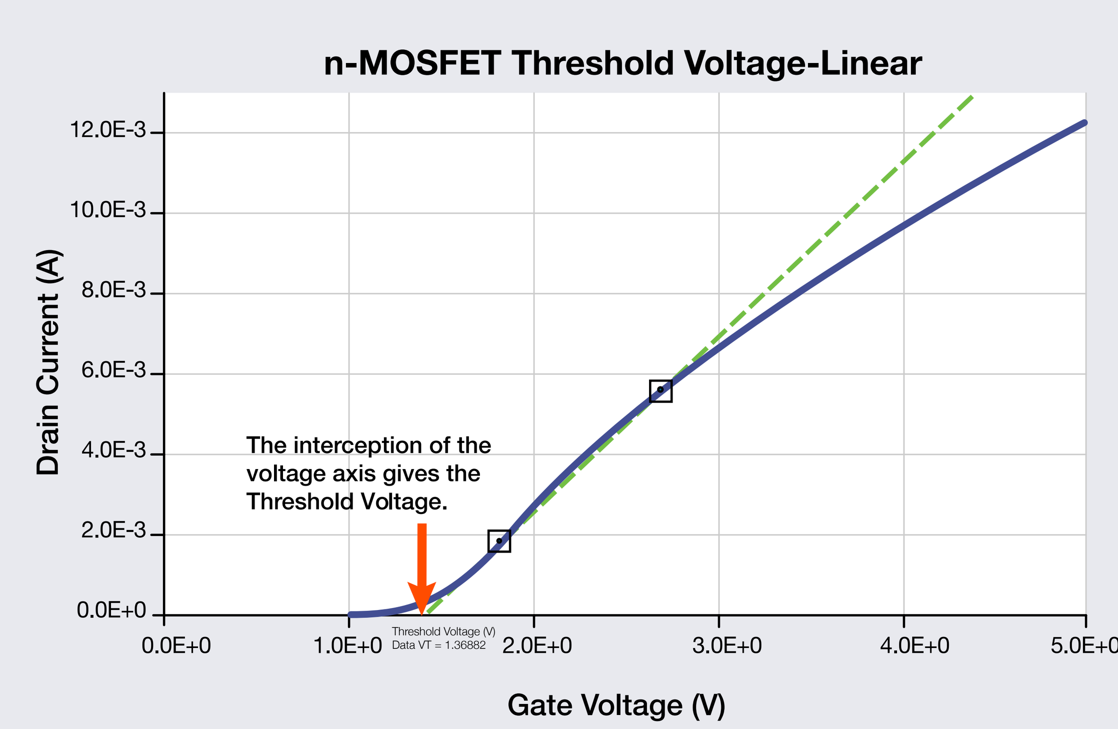


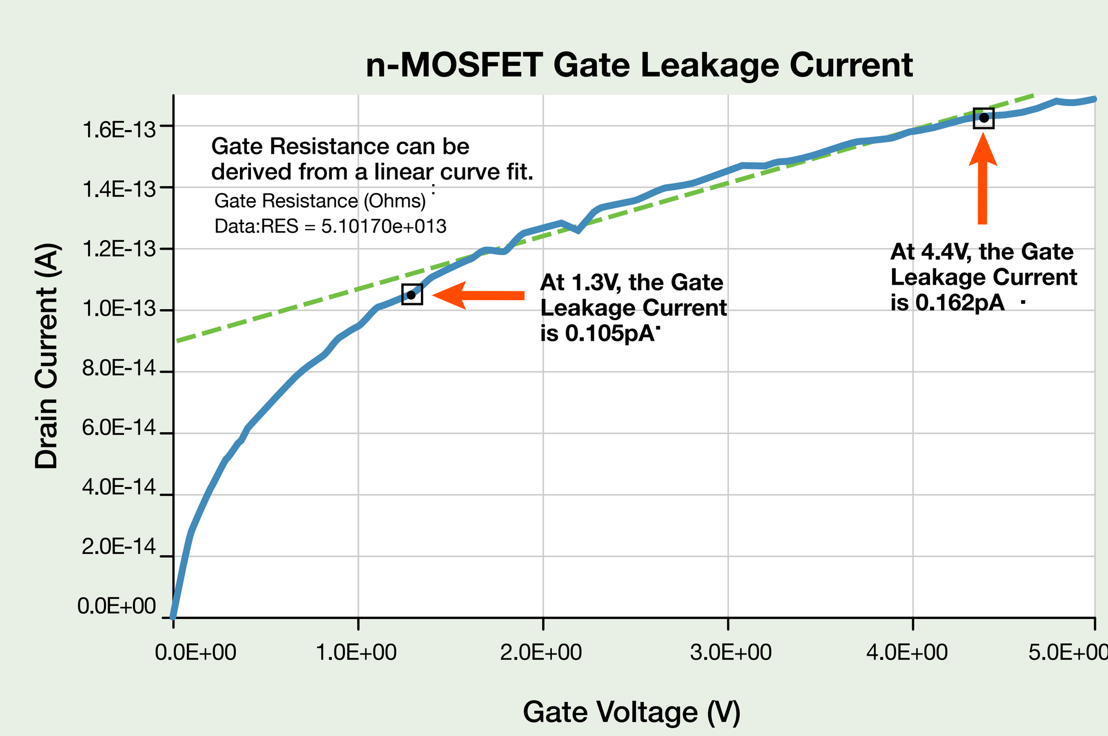


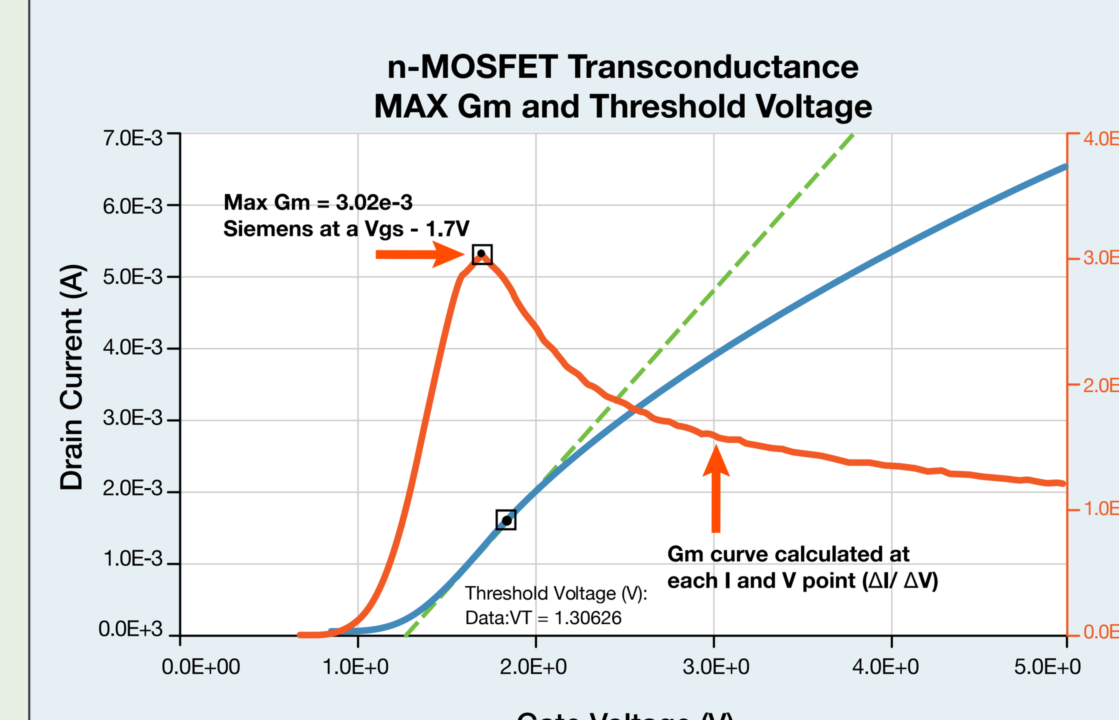


TYPICAL RESULTS









Contact Information:

Australia* 1 800 709 465
Austria 00800 2255 4835
Balkans, Israel, South Africa and other ISE Countries +41 52 675 3777
Belgium* 00800 2255 4835
Brazil +55 (11) 3759 7627
Canada 1 800 833 9200
Central East Europe / Baltics +41 52 675 3777
Central Europe / Greece +41 52 675 3777
Denmark +45 80 88 1401
Finland +41 52 675 3777
France* 00800 2255 4835
Germany* 00800 2255 4835
Hong Kong 400 820 5835
India 000 800 650 1835
Indonesia 007 803 601 5249
Italy 00800 2255 4835
Japan 81 (3) 6714 3010
Luxembourg +41 52 675 3777
Malaysia 1 800 22 55835
Mexico, Central/South America and Caribbean 52 (55) 56 04 50 90
Middle East, Asia, and North Africa +41 52 675 3777
The Netherlands* 00800 2255 4835
New Zealand 0800 800 238
Norway 800 16098
People's Republic of China 400 820 5835
Philippines 1 800 1601 0077
Poland +41 52 675 3777
Portugal 80 08 12370
Republic of Korea +82 2 6917 5000
Russia / CIS +7 (495) 6647564
Singapore 800 6011 473
South Africa +41 52 675 3777
Spain* 00800 2255 4835
Sweden* 00800 2255 4835
Switzerland* 00800 2255 4835
Taiwan 886 (2) 2656 6688
Thailand 1 800 011 931
United Kingdom / Ireland* 00800 2255 4835
USA 1 800 833 9200
Vietnam 12060128

*** European toll-free number. If not accessible, call:** +41 52 675 3777

Four Key Tests for Validating MOSFET Performance in Power Supply Designs

POSTER

Find more valuable resources at TEK.COM

03.30.16 KI 1KW-60515-0