APPLICATION NOTE

IN CIRCUIT DEVICE CURVE TRACING

OVERVIEW

This application note describes a range of scripts that we have developed that can plot various characteristics of BJTs and MOSFETs. The scripts operate on a single selected device in the current schematic and do not require a test schematic to be opened.

We developed these scripts partly because we felt they may be of direct benefit to users, but also as a demonstration of what is possible with the scripting language. All the curve tracing scripts have been developed entirely using the script language with no support from other programs.

The scripts can be used as the basis for developing other device plotting routines.

SUPPORTED VERSIONS

Ideally you should use version 4.5a or later. If you have version 4.5, you can update using a patch. The scripts *will* work with versions 4.2 to 4.5 but will fail under some special circumstances.

IMPORTANT: You cannot use these scripts with SIMetrix Intro. You must have a full production version of SIMetrix to run user scripts.

AVAILABLE TRACING FUNCTIONS

The following table shows the available curve tracing functions

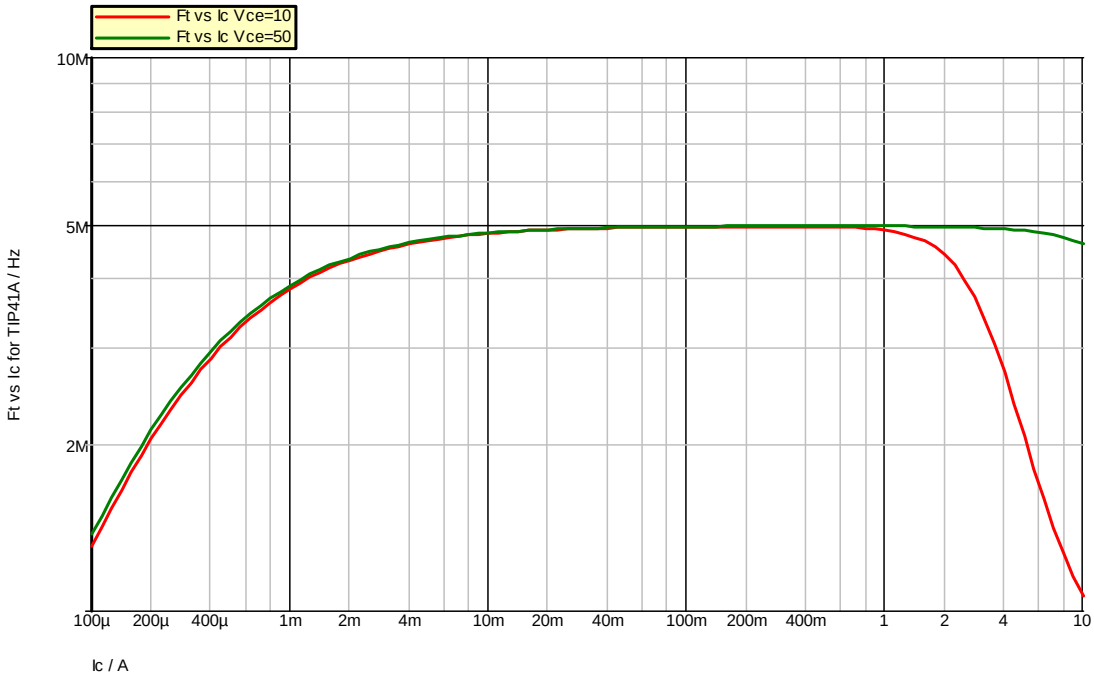
DEVICE	OPERATION	SCRIPT NAME	DESCRIPTION
BJT	Ft	BJT\run_ft	Transition frequency (Ft) versus collector current and collector-emitter voltage. Test frequency, current range and voltage range are user selectable
BJT	Hfe	BJT\run_hfe	Gain vs collector current and collector emitter voltage. Current range and voltage range are user selectable
BJT	Output	BJT\run_fo	Collector current versus collector emitter voltage and base current. Base current range and voltage range are user selectable
MOSFET	Gate charge	MOS\ run_gate_charge	Plots turn on gate charge vs time. Gate current, drain current and operating drain source voltage are user selectable.
MOSFET	Output	MOS\run_fo	Drain current vs drain source voltage and gate voltage. Gate current range and drain source voltage range are user selectable

The MOSFET scripts will work with both lateral (such as BSIM3) and vertical devices. However, the gate charge script has been designed for use with high current vertical DMOS devices.

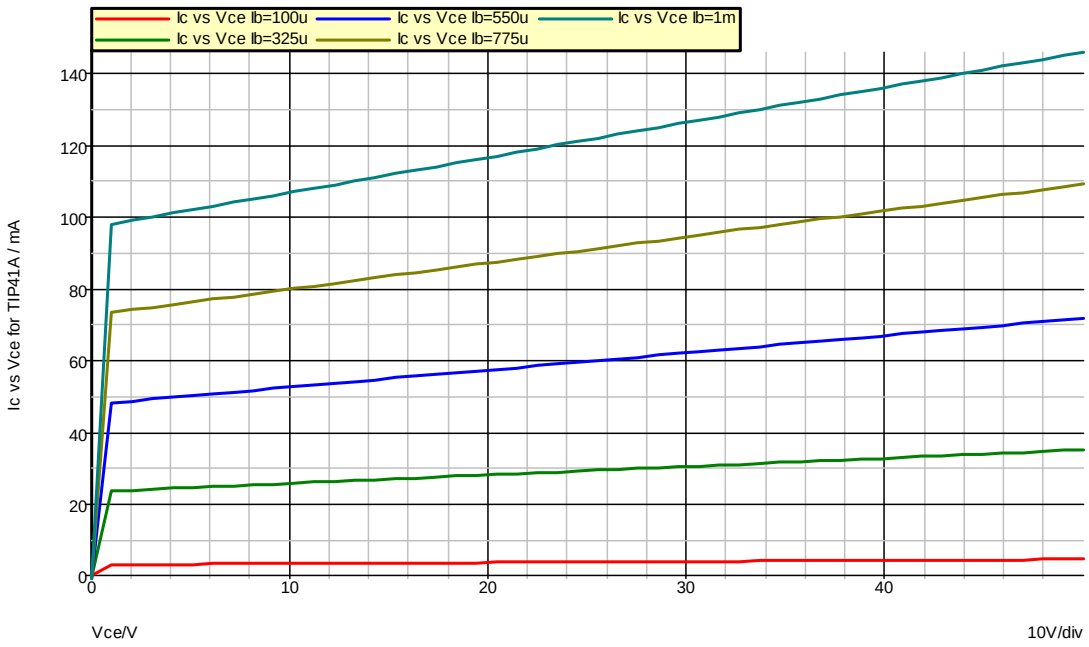
The scripts automatically determine the polarity of the device under test.

EXAMPLES

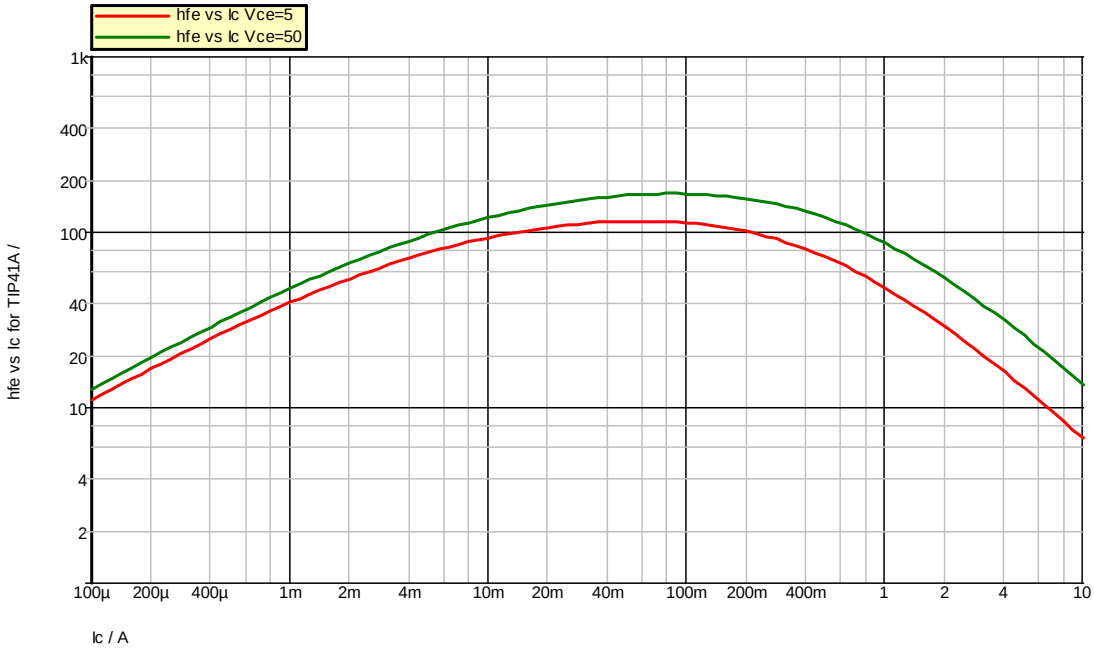
The following graphs show examples of the results from each of the scripts



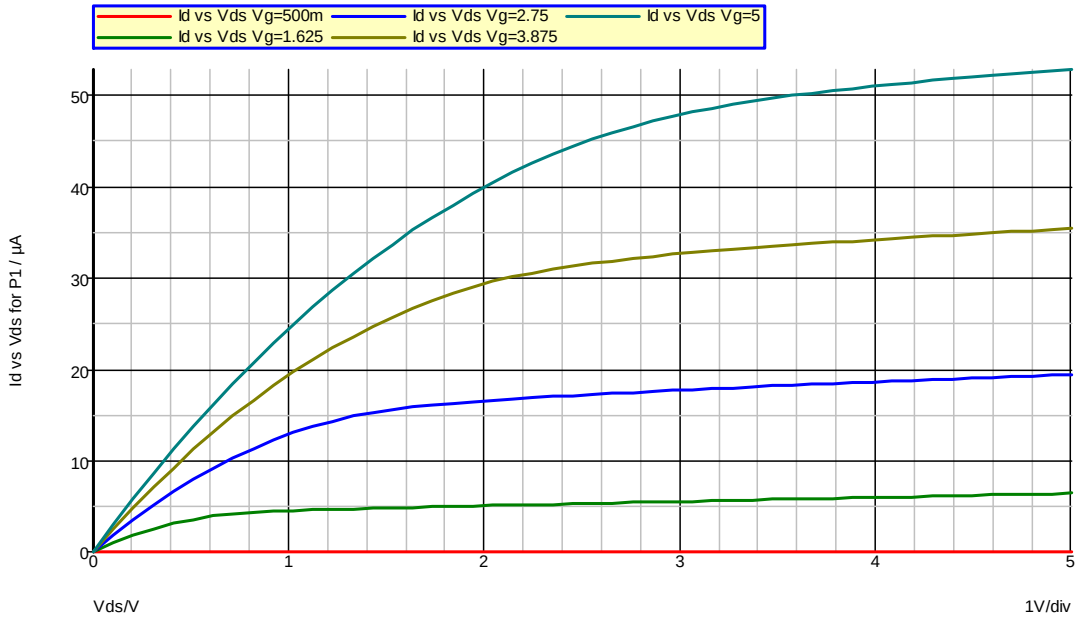
BJT Plot of Ft vs Ic for Vce=10 and Vce=50



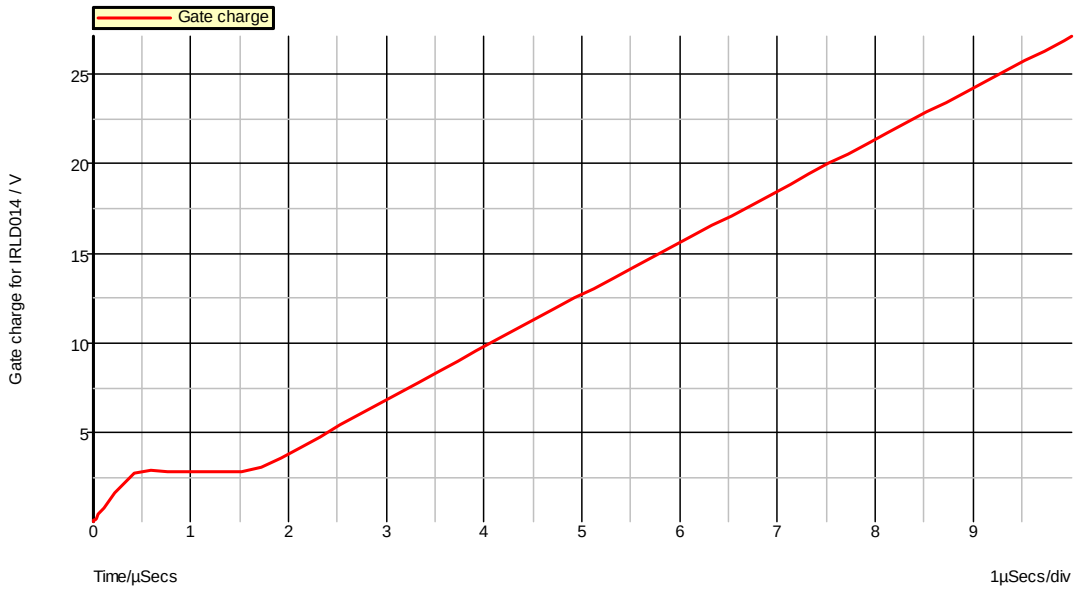
BJT Plot of Ic vs Vce for Various Base Currents



Hfe vs Ic for Vce=5 and Vce=50



Plot of Id vs Vds for P-channel BSIM3 MOSFET



Gate Charge of IRLD014 Vertical DMOS Fet

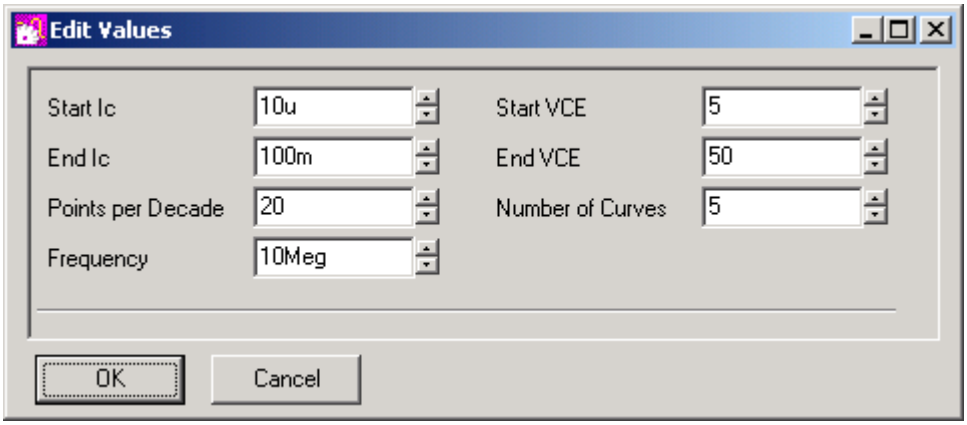
How to Install and Use the Scripts

If you don't already have them the scripts can be downloaded from our web site. Please visit http://www.catena.uk.com/Pages/AppNotes.html and click on the 'Curve Tracing Scripts' link.

The scripts are located in three subdirectories in the ZIP file. The scripts that you call are located in Scripts\BJT and Scripts\MOS while Scripts\Support contains some additional helper scripts called by the main ones. You should copy these scripts to your script directory under the SIMetrix root. Be sure to preserve the directory structure as they are in the ZIP file.

To run the scripts, proceed as follows:

1. On your schematic, select the BJT or MOSFET you wish to test. If you don't have a device on a schematic, simply open an empty one and place a single device on it. You do not need to connect anything to it. The scripts build their own test circuits.
2. Select menu File|Scripts|Run... and locate the relevant script appropriate to the type of device.
3. You will now be presented with a dialog box. The exact design will depend on the script. The following is what you will see for the BJT Ft test:



   Enter values appropriate to the type of device that you are measuring.
4. Press OK and you should see a graph appear immediately.

How do the Scripts Work?

All of the scripts follow the same procedure. A key feature is that they generate a simulation netlist to perform the test and don't rely on existing netlists or schematics. This is the basic sequence:

1. Retrieve device to be tested. This is done using the helper script 'get_bjt' or 'get_mos' which themselves run a simple simulation to determine the device's validity and also its polarity
2. Dialog box opened to ask the user the parameters for the test. This uses the NewValueDialog function which opens a general purpose user input dialog box
3. The simulation netlist is now constructed. This will include some of the contents of the F11 window of the current schematic. This allows the test to work when the device model is not in the libarary but defined locally
4. Simulation run in 'quiet' mode using the '/nofocus /nostatus' switches of the RUN command. This inhibits the update of the simulation status dialog box
5. Graph plotted