

Due Date: **Monday, October 5, 11:00 AM**

Laboratory Exercises

The point of this lab is to:

- construct a graph of DC power dissipation as a function of load current for a power MOSFET when the transistor is fully turned on, and
- investigate how well a MOSFET can be modelled as a resistance $R_{DS(ON)}$ when fully turned on

The specific procedure is left for you to design (emphasis on the word DESIGN). Show your design to your instructor before you turn anything on. NOTE: An experiment design comprises both a circuit and a procedure for how that circuit will be used.

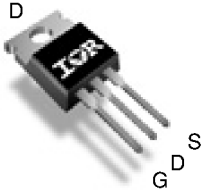
It is expected that you will submit:

- A single graph (supported by a table of values, with proper headings) that plots MOSFET power dissipation as a function of current conducted. All points must be connected to show a clear curve.
- A graph of MOSFET drain-to-source resistance as a function of current and a comment on how well the MOSFET can be modeled as a single resistance $R_{DS(ON)}$.
- A comment on how the MOSFET's resistance $R_{DS(ON)}$ compares to the worst-case value published on the datasheet.
- Current must extend from 0A to either the maximum supported by the device (as described on the datasheet) or until the case temperature of the device reaches 100^oC (measured with a thermocouple).
- Use enough current values, and at appropriate spacings, to provide a clear graph without large “jumps” from one point to the next.

Notes

1. Use the electronic load. Remember: the electronic load will tell you how much power it is dissipating, not how much power the transistor is dissipating! Still, perhaps you can design a circuit that lets you use the electronic load's readings to allow you to easily compute the transistor's power dissipation.
2. Use a thermocouple. Take readings only up to a case temperature of 100^oC. Measure the case temperature on the metal tab, close to the center of the package. Do not measure on the plastic part of the package.
3. For a TO-220 package, a case temperature of 100^oC corresponds to a power dissipation of *approximately* 1.2W. Design accordingly.
4. Remember that the MOSFET gate terminal is very sensitive and it is easy to destroy the MOSFET by allowing charge to accumulate at the gate. Keep a 12V zener diode (reverse biased) between the gate and source terminals at all times.
5. A MOSFET is fully on when its gate-to-source voltage is at least 10V. Ensure that this is the case.
6. This lab is not hard. It is meant to be done and written up in 3 hours. Don't make it harder than it needs to be by being careless or failing to think about what you're doing.
7. Make sure you hook up the transistor correctly! There is a right way and a wrong way, and the wrong way will destroy the device and/or set the breadboard on fire.
8. EXTRA CREDIT: A MOSFET's $R_{DS(ON)}$ actually changes with temperature. Modify your lab procedure to use short-duration pulses and long-duration recovery times to gather your data such that the MOSFET does not have time to self-heat, thus distorting your readings.

9. Here are the devices you are to choose from (all available in the lab, in varying quantities so you may not find a particular device):

Device	Type	Max. Current	Max. Voltage	Pinout
IRF540	MOSFET N-channel	23A	100V	
IRF520	MOSFET N-channel	9.2A	100V	as above
IRL2703	MOSFET N-channel	24A	30V	as above
NDP4060L	MOSFET N-channel	15A	60V	as above
STP16NK60Z	MOSFET N-channel	14A	600V	as above
FQP17P06	MOSFET P-channel	17A	60V	as above
IRF9Z10	MOSFET P-channel	6.7A	60V	as above