

**EE 2274**  
**Pre-Lab for Experiment #8**  
**MOSFET Night Light and Voltmeter**

**1. Night Light**

The purpose of this part of Experiment 8 is to use the switching characteristics of the MOSFET to design a Night Light using a LED, MOSFET, photocell, resistors, and power source. For our PSpice design we will use a variable resistor and diode in place of the photocell and LED. PSpice does not have these two devices available. In the lab we will use a photocell and LED.

For the night light circuit below use the following specifications:

Calculate R1 such that the MOSFET is “on” when R2(photo cell) is equal to 1k  
Limit the diode (LED) current to approximately 20ma by R3.

Show all work. Then simulate your design with PSpice plotting the switching voltages.

Plot: **Vds vs. RVAR**

**Ids vs. RVAR**

**Vgs vs. RVAR**

**Turn in your plots and circuit diagram.**

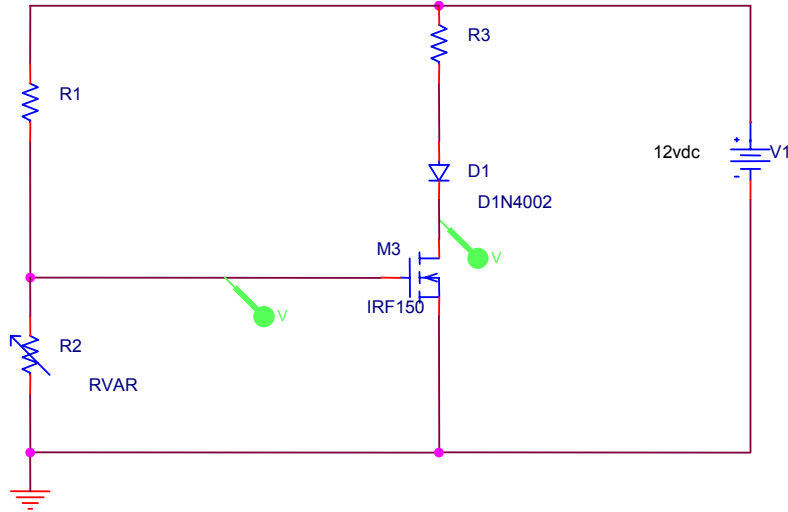
**PSpice tips:**

Edit PSpice Model: change  $V_{to}$  of the **IRF150** to 2.0v to match the **2N7000 MOSFET** that we will use in the lab.

1. Variable Resistor for Photocell
2. Instead of RVAR (photocell) having a numeric value for its resistance, it has the name of a global parameter, RVAR. We define the global parameter by adding the Param part from the Special Library.
3. Param → New Column → Name, RVAR, Value (500Ω)
4. Highlight resistance value of R2 → Edit Properties – Change value to RVAR
5. Edit simulation → DC Sweep → V1 → start 12v → End 12v → Increment → 1v.
6. Parametric Sweep → Global parameter → start value → 500Ω → end value → 2K → Increment → 100Ω
7. Place voltage probe on drain of MOSFET.
8. Make a plot RVAR against drain voltage to be turned in with pre-lab.

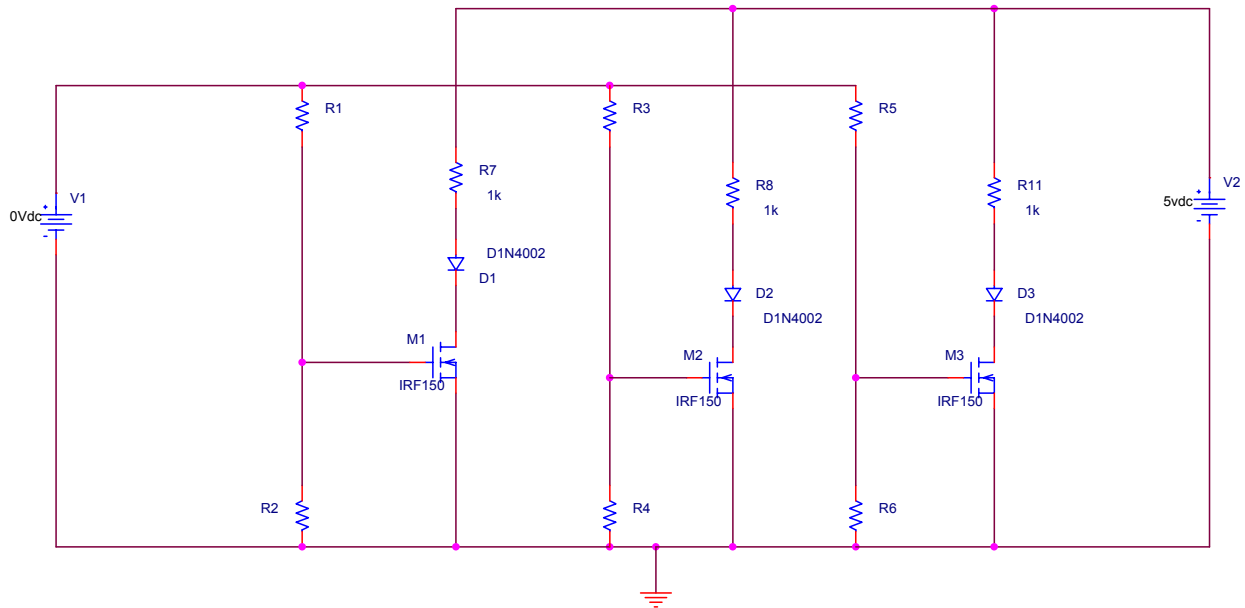
**LED spec:** Typical,  $V_f=2.8V$  @  $I_f = 20ma$

Go to the web and find the spec. for the 2N7000. Turn in with pre-lab.



### Voltmeter 2

1. Build a MOSFET-controlled voltmeter in PSpice. The MOSFETs in the voltmeter act as switches to turn on the LEDs. Design the resistor values such that D1 turns on at approximately 10V, D2 turns on at approximately 15V, and D3 turns on at approximately 20V. **Choose resistor values that are in the 10kΩ range. (Don't forget to change  $V_{to}$  to 2v) (Important!!!!!!!!!!)**



2. Run a DC Sweep simulation on V1 from 0V to 25V in increments of 1V. Plot  $V_{ds}$  vs.  $V_{gs}$  for each MOSFET (M1, M2, & M3). Print out your plot. Remember that a MOSFET is considered to be “on” after  $V_{ds}$  voltage approximately 0.5 volts. Does M1, M2, and M3 have a 0.5  $V_{ds}$  voltage?

**Lab Exercise  
Experiment 8  
Night Light and Voltmeter**

***Part 1***

1. Build the Night Light you designed in the pre-lab. Use the 2N7000 MOSFET, LED, Photocell, resistors, and power supply.
2. Measure  $V_{ds}$ ,  $I_{ds}$ , and  $V_{gs}$  in the “on” and “off” mode. Compare with your design. (To make “on” hold hand over photocell)
3. Verify to your instructor that your night light works.

**Lab Instructor must sign off.**

***Part II***

1. Build the voltmeter you designed in pre-lab. Replace the diodes with LEDs for a visual effect. Simulate the circuit using a DC sweep from 0 to 25V. Do the LEDs turn on at the appropriate voltages of 10, 15, and 20? If so, then turn in the following plots for each “on” voltage range with your lab report:  $V_{ds}$  vs.  $V_{gs}$ ,  $I_{ds}$  vs.  $V_{gs}$ . You will have a total of six plots to be turn in with your lab report. Remember to label each plot. Also, remember  $I_{ds}$  is the LED current. How does it compare with your design?

**MAKE SURE ALL PLOTS ARE LABELED CORRECTLY.**

**DATA SHEET**  
**Experiment # 8**  
**MOSFET Night Light and Voltmeter**

Part I.

	Measured Values	Design Values
$V_{ds}$	_____ (on) _____ (off)	_____ (off) _____ (on)
$I_{ds}$	_____ (on) _____ (off)	_____ (off) _____ (on)
$V_{gs}$	_____ (on) _____ (off)	_____ (off) _____ (on)

Part II.

1.	LED	10v	15v	20v
	Measured	_____	_____	_____
2.		Measured Values	Design Values	
	$V_{gs10v}$	_____	_____	
	$V_{gs15v}$	_____	_____	
	$V_{gs20}$	_____	_____	
	$V_{ds10v}$	_____	_____	
	$V_{ds15v}$	_____	_____	
	$V_{ds20v}$	_____	_____	
	$I_{ds10v}$	_____	_____	
	$I_{ds15v}$	_____	_____	
	$I_{ds20v}$	_____	_____	