Name: Soleil Demick

Collaborators: ____________________

THAYER SCHOOL OF ENGINEERING • DARTMOUTH

ENGS 28, W26

LAB 1 — ALL KINDS OF VARIATIONS ON BLINKY

Due: Tuesday January 13, 2026 2:15 PM

Contents

Deliverables

Deliverable 2: LED Properties *(3 points)*

Using values from the datasheet, answer the following questions.

Green LED

- What is the typical forward voltage V_f for your diode?

  Answer: 2.2V

- What is the maximum forward current I_f for your diode?

  Answer: 25mA

- What material is your LED composed of?

  Answer: Gallium Phosphide

- Is the color of your LED light emitted determined solely by the color of the plastic housing? Explain your reasoning in the space below.

No, the light depends on the composition of the semiconductor within the LED. On the datasheet, $\lambda_{peak} = 565nm$.

- Assume V_{OH} (the output high voltage) for the Nucleo is V_{CC} (3.3V). Using I_F and V_F from above, what is the smallest resistor that will keep the current safe for your LED? Show your work. (Note: refer to Figure 1a if you are unsure what the circuit should look like).

$$R = \frac{V_{cc} - V_F}{I_F} = \frac{3.3V - 2.2V}{25mA} = 44\Omega.$$

3.2 LED Measurements

With your Nucleo unplugged, select an LED and a 220Ω resistor from your kit. Construct the circuit shown in Figure 1a.

- The anode of the LED will be connected to the red 3.3V power rail on the breadboard, also called V_{CC}. Always use **RED** for wiring connections to this power rail.
- Connect the cathode of the LED to one leg of the 220Ω resistor.
- Connect the other leg of the 220Ω resistor to the circuit ground reference (0V), also called GND. Always use **BLACK** for wiring connections to ground.
- Connect the **RED** (V_{CC}) rail to the 3.3V pin in the *Power* section of the Nucleo board.
- Connect the **Black** (*Gnd*) reail to the *GND* pin in the *Power* section of the Nucleo board.

Deliverable 3: LED Measurements *(3 points)*

> Using your voltmeter, make the measurements described below. You measurements should agree quite well with Kirchoff's voltage law ($V_{CC} = V_F + V_R$) If they don't, think about what you might have done wrong (reversing the positive and negative probes is a common error - in this circuit, all your measured voltages should be positive). Keep at it until you have a good result, then write down your three voltages.

- V_{CC} - the voltage across the power rails.

  Answer: 3.30 V
- V_F - the voltage across the diode.

  Answer: 2.57 V
- V_R - the voltage across the resistor.

  Answer: 0.72 V

Ohm's law states that the voltage across a resistor is proportional to the current flowing through the resistor multiplied by its resistance, or $V = IR$.

Deliverable 4: Current Limiting Resistor *(2 points)*

> Using the voltage across the resistor you measured in Deliverable 3 answer the following questions

- Calculate the current flowing through the resistor (I_R). $\frac{0.72V}{220\Omega}$

  Answer: 3.27 mA
- How much current flows through the LED?

  Answer: 3.27 mA
- In the space below, compare this current to the maximum indicated by your LED's datasheet. Is the current limiting resistor doing its job? Why or why not?

> Yes, $I < I_{F,max} = 25mA$.

Replace the 220Ω resistor with a 1kΩ resistor and repeat the measurements from before.

- V_{CC} - the voltage across the power rails.

  Answer: 3.31 V
- V_F - the voltage across the diode.

  Answer: 2.36 V
- V_R - the voltage across the resistor.

  Answer: 0.94 V

Deliverable 5: Light Intensity *(2 points)*

In the space below, answer these questions.

1. Did the forward voltage drop across your LED change?
2. Did the voltage drop across the resistor change? If so, what does this tell us about the circuit?
3. How did the intensity of the light created by the LED change? Why?

1. Yes. 2.57V → 2.36V
2. NO. 0.72V → 0.94V.
3. Light intensity decreased because the current decreased.
(3.27mA → $\frac{0.94V}{1k\Omega}$ = 940µA).

3. blinkyCNT: Design and implement a three-bit counter (0 to 7), displaying the three bits with the three LEDs. This is harder. You can use a `uint8_t` variable to represent the count, but you have to figure out how to isolate bits 0, 1, and 2 so they can be displayed on the LEDs (consider a bit mask). Make sure the counter counts slowly enough that you can easily see the lights flash in binary sequence: $000, 001, 010, ..., 111, 000, etc$

Use your best C programming style. Be sure to clearly document your code with inline comments and a descriptive header. Make a copy of the template project from class to get started.

As you work through these problems, think about the build and test philosophy described in class and how it applies to this system. Also think about how you are organizing your file system so you can refer to these three programs at a later date with ease.

Demonstrate each of your designs to a TA or instructor. If you are unable to demonstrate the design to a TA or instructor, upload a video of each challenge working to Canvas.

See attached videos + code.

Deliverable 6: BlinkSIM *(2 points)*

> Obtain a signature or submit a video of blinkySim. Upload your code to Canvas.

TA or Instructor Signature ____________________

Deliverable 7: BlinkSEQ *(3 points)*

> Obtain a signature or submit a video of blinkySeq. Upload your code to Canvas.

TA or Instructor Signature ____________________

Deliverable 8: BlinkCNT *(5 points)*

> Obtain a signature or submit a video of blinkyCnt. Upload your code to Canvas.

TA or Instructor Signature ____________________