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ECE 473

Lab 2 Calculations and Measurements

LED Current Limiting Resistor

The maximum current that we can move through Port A is 100mA, so the maximum that can move though a LED segment is 12.5mA (assuming they are all on at once, 100mA / 8 is 12.5mA).

That leads to the following calculations for resistor sizing:

$$5v - .2 * 2\ (assumption\ for\ BJT\ V_{CE}) - 2v\ (LED, from\ datasheet) = 2.6$$

$$V = IR$$

$$\frac{2.6v}{.0125mA} = 208\Omega$$

From this, we can assume a real world value of 220Ω as a starting value.

Current was measured at 11mA, which is very close to our desired value. It is lower (which is definitely desired)

PWM Biasing Resistor

To bias the BJTs, we need to select a value that can ensure the transistor is saturated during the entire operating range (from all the LEDs being turned off to them all being on). A 2mA current through the base will ensure this, according to the Datasheet. The following math considers the drops by the BJTs.

$$5v - .7v = 4.3v$$

$$\frac{4.3v}{2mA} = 2150\Omega$$

For the other biasing transistors (for the digit select), the math is very similar:

$$5v - .1v - .7v = 4.2v$$

$$\frac{4.2v}{2mA} = 2100\Omega$$

These values were rounded up to 3.3K due to resistor availability, but this value was checked to work as well.

Measured Duty Cycle

Total period: $3.03mS$

Total Duty Cycle: $\frac{750uS}{3.03mS} = 24.75\%$