RSA Lab #0: Light-Emitting Diodes & Photo-Transistors

# Part 1: Light-emitting diodes

In this section I was able to get the basic parameters of the LED and a resistance that is appropriate to run with the LED.

1. Read the MT2118-G-A data sheet to find the manufacturer’s specification for the nominal forward current (IF) through the LED; record this.

I found this answer in the datasheet next to the label for forward current.

1. Read the MT2118-G-A data sheet and estimate the manufacturer’s specification for the typical forward voltage drop (VF) of the LED at 25C and forward diode current of 20 mA.

I found this answer in the datasheet next to the label for forward voltage.

1. Given a 5 Volt power supply, and the forward voltage of the diode (from Question 2), what value for resistor R1 will result in the desired diode current of 20 mA? Show your work.

Since the voltage drop across the LED is typically 2.1V, we must take the difference of this value and the input voltage to find the voltage on the other side of the LED.

This can be used with Ohm’s law to find the resistance.

# Part 2: Infrared LEDs and Photo resistors

In this section I constructed the circuit to visualize the behavior of this phototransistor through both the multimeter and the oscilloscope. I was able to depict the low and high voltages as a result of the state of the phototransistor.

1. Make top view sketch of the device for your lab report. Your sketch should clearly identify the package orientation and label the location of each of the four pins.

I made this sketch by simply flipping the top view pins from their diagram.

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1. Read the Omron EE-SX1042 data sheet to find the manufacturer’s specification for the maximum forward current (IF) through the LED; record this.

I found this answer in the datasheet next to the label for the maximum forward current.

1. Read the Omron EE-SX1042 data sheet to estimate the manufacturer’s specification for the typical forward voltage drop of the LED at 25 C for the following different forward diode currents. a) 5 mA, b) 20 mA, c) 50 mA

I was able to find these answers by matching the current with the graph for a voltage drop at a temperature of 25 degrees Celsius.

1. Use your digital multimeter (DMM) in “Diode Test” mode to measure the forward voltage drop of the IR LED. Note your result. How does this compare to the values that you obtained from the data sheet? Why?

I measured this forward voltage drop by connecting my DMM to both sides of the diode on “Diode mode”, then recording the output voltage.

This value is slightly less than the typical value, which makes sense because the datasheet assumes a room temp of 25 C.

1. We wish to drive the infrared LED with a current of about 20 mA. Given a 5 Volt power supply, and the forward voltage of the diode (from Question 5), what value for resistor RLED will result in the desired diode current of 20 mA?

I used the formula for calculating the voltage on the other side of the LED in order to use Ohm’s law to find the required resistance of the diode resistor.

1. Use your DMM to measure and note the actual LED current.

I measured this current by first putting the DMM in current-reading mode (400mA since our currents are small here) and putting it in series next to the LED in the phototransistor.

1. Connect an oscilloscope probe cable to CH1 on your oscilloscope. Test the function of the oscilloscope by performing the “Probe Compensation” process (search for this in the scope User Manual on the course Blackboard site).

I was able to test that by noticing a square wave in the screen of the oscilloscope.

1. Using the oscilloscope, estimate the frequency of the probe compensation signal

I found the frequency through getting the reading of the square wave from the oscilloscope.

1. Using CH1 on your oscilloscope, measure the value of the emitter/detector output voltage Vout.

I was able to get the output voltage by measuring the voltage from the high and low channels (or peak-to-peak in this case since the low voltage was 0V), which was shown on the oscilloscope.

1. Using your oscilloscope, measure and record the output voltage in the blocked and unblocked conditions. Set the scope horizontal (time) axis to a slow rate, say, 0.2 or 0.5 second/division so that you can see the slot blocked and unblocked. Print and annotate a scope plot showing the output of the system as you block and unblock the infrared light. Describe in words what is happening here. What are the two states of this sensing system? How do they work?

I first turned on the oscilloscope and connected the probes to the output voltage and ground. This allows me to depict the voltage generated by the LED and how it changes when something obstructs the path of the light to the transistor. I visualized this through a square wave where the high voltage channel corresponds to the non-obstructed LED and the low voltage channel is for when a card is inserted between the gap in the photoresistor to block the light (shown in annotated plot).