

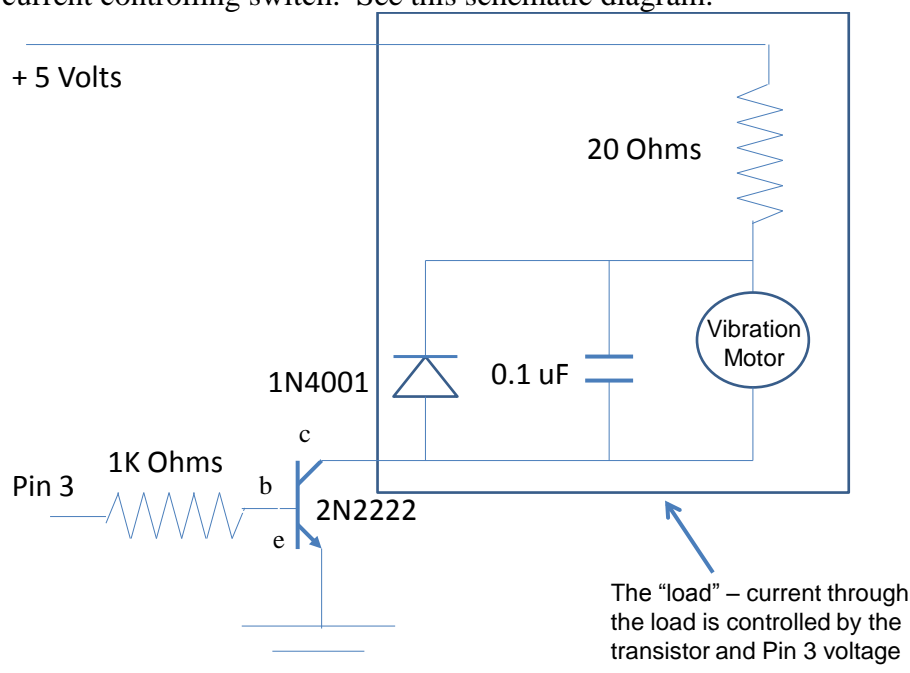
NAME(S) _____

CS 341 – Lab 8
Computer Architecture and Organization
Getting a Buzz On (Without Alcoholic Beverages)

Equipment: Arduino UNO microcomputer, PC with Arduino IDE installed, and a USB cable.
3VDC Vibration Motor, Transistor, Diode, Capacitor, and Resistors

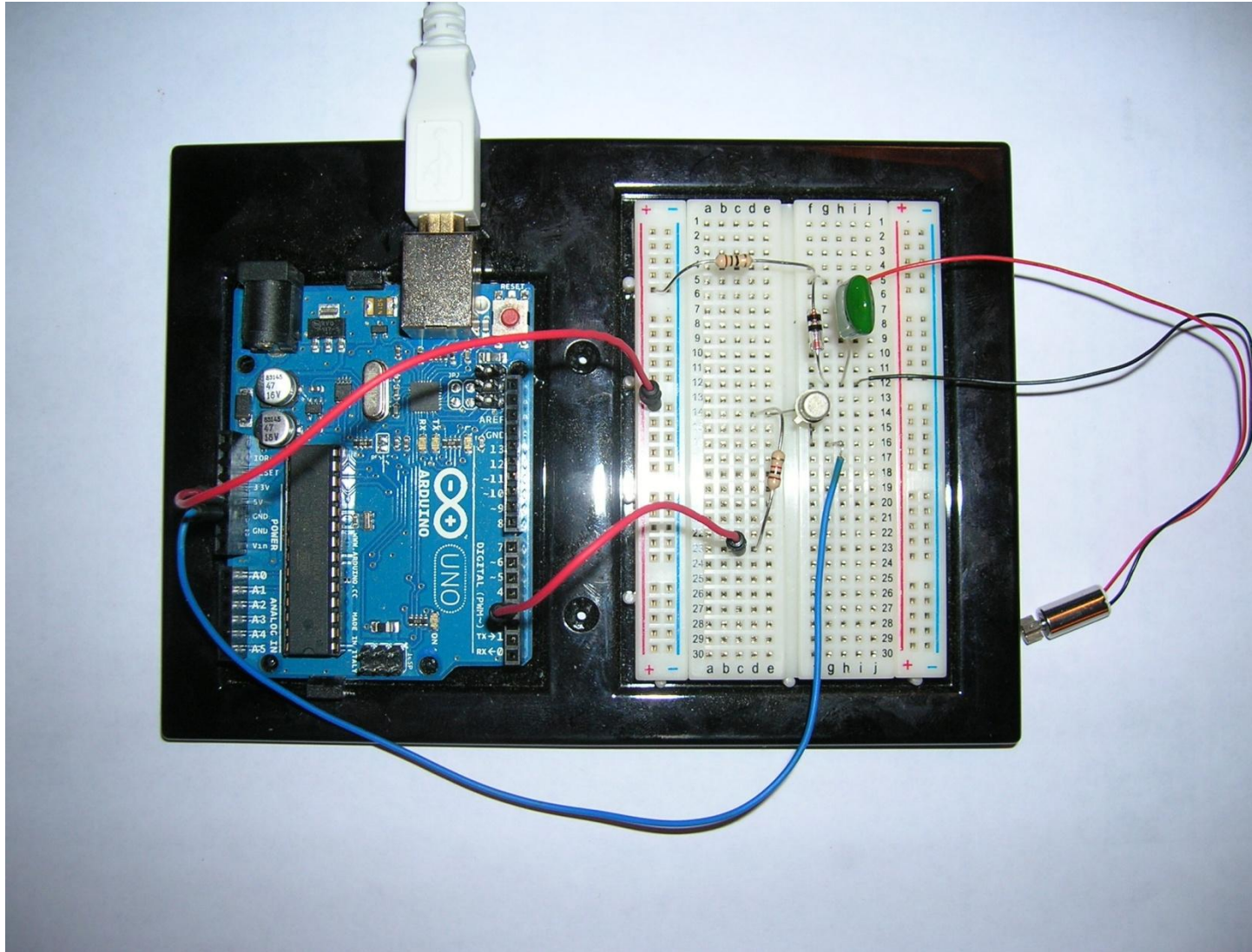
Your assignment is to connect a vibration motor to the Arduino board. Disconnect the Arduino board from the USB port. Connect the appropriate wires to the Arduino UNO via the breadboard. *NOTE: When you are adding, changing, or removing wiring on a prototype connected to the Arduino UNO board, always disconnect the power from the USB port and check your wiring carefully before reconnecting it to the USB port. Otherwise, you may damage the Arduino board. If you have any doubts, show your wiring to the TA before reconnecting it to the USB port.*

There is a limit to the current that an Arduino output pin can supply. In order to provide the larger current needed to run the vibration motor, we use an external [2N2222](#) transistor as a current controlling switch. See this schematic diagram.



A transistor has three leads. The emitter lead is connected to ground. The base lead is connected to a control source (the Arduino output pin). The collector lead is connected through a load (the motor and the 20 Ohm resistor) to the supply voltage. When no current flows from the Arduino pin through the 1K resistor and base lead to ground through the transistor, the transistor is turned off and no current will flow through the 20 Ohm resistor and the load (the motor). When current

does flow from the Arduino pin through the 1K resistor and base lead to ground through the transistor, the transistor turns on and current will also flow through the 20 Ohm resistor and the rest of the load (the motor). Hence the transistor is an electronically controlled switch.



Notice that there are two other components as part of the load connected in parallel with the motor. Here's why they are used.

When a motor is running, the commutator carrying current to the spinning armature creates sparks which can cause voltage spikes. The capacitor absorbs any voltage spikes that occur while the motor is running and protects the rest of the circuitry. Find and use a 0.1 microFarad capacitor with help from this [Capacitor Code Chart](#).

When a motor is shut off, there is a collapsing magnetic field around the coils of wire in the motor. That creates a backward voltage in the opposite direction to the normal voltage that makes the motor turn. The diode ([1N4001](#)) absorbs (short circuits) this

current and prevents it from flowing back through and damaging the transistor or other parts of the circuit. Normally, the voltage is applied to the load in the opposite direction to the direction that the diode carries current so the diode does not carry any current when the motor is running.

Study the following picture for implementing the circuit shown in the above schematic. Connect the transistor emitter to ground and the collector to the load. Connect the transistor's base lead through a 1K Ohm resistor to the Arduino digital output pin 3. Connect the components of the load together and to the transistor collector and +5 volt power.

Connect the PC to the Arduino UNO board using the USB cable. Open the Arduino.exe program. Write the code for the sketch to turn on and off the digital signal on pin 3.

In the setup function for this sketch, you need to configure the pin 3 as an output.

In the loop function for this sketch, you need to use calls to delay and digitalWrite to turn on and off the signal to pin 3 according to a timed pattern. I chose 1 second on and 5 seconds off, but you can choose your own timing.

If you have additional time, try connecting a sensor from one of the earlier labs and use the input from the sensor to turn the vibrator on and off.

As a team, write your lab report to explain what you did, how you did it, and what you learned about interfacing hardware to a microprocessor and its software (the "sketch"). Turn in your report including a copy of your team's final "sketch" at your next lab session.

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