Basic PLC Electronics Lab 1

Program: Electrician Technician

Course: EL- 180 – Programmable Logic Controls –

Objectives: Under the supervision of your instructor, you should be able to do the following:

- Determine the forward-bias and reverse-bias conditions of a diode.
- Understand how Zener diode operates.
- Identify NPN and PNP transistors.
- Identify the base, emitter, and collector leads of each transistor to be tested.
- Identify both regular and Zener diodes.

Lab Equipment:

- 1 – DMM (digital multi-meter)
- 1 – DC power supply, 0-15 VDC, Or 9v Battery or USB Power Supply (+5vdc)
- 1 – Breadboard
- 1 – Set of test leads

Required Tools:

- 1 – Pair of strippers

Materials:

- 4 – 1N4004 Diodes
- 1 – Kit of Various size Resistors, (1K, 10K, 2.2K 22K 4.7K 47K)
- 4 – Zener diodes (BZX55C5v1 or any low voltage Zenner)
- 2 – NPN transistors (2n2222, 2n3904, BC547)
- 2 – PNP transistors (2n3906, 2n5401, BC327)

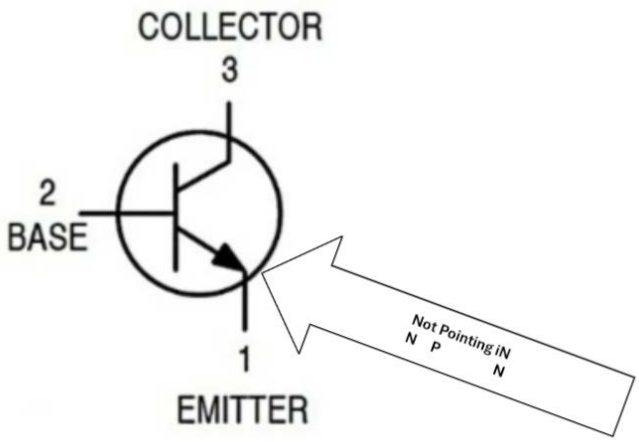
Safety (PPE):

- Safety glasses/goggles

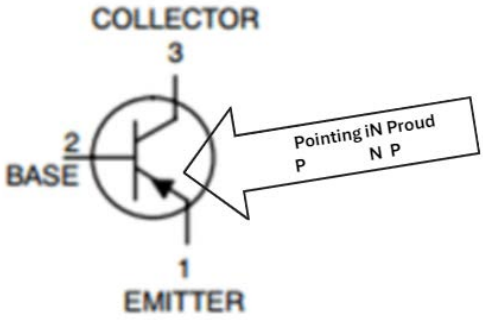
Resources: N/A

Instructor Notes: How to tell the difference between NPN and PNP on a schematic.

NPN: The arrow is Not Pointing iN



PNP: The arrow is Pointing iN Proudly



Required Time: 240 Minutes

Shop Maintenance:

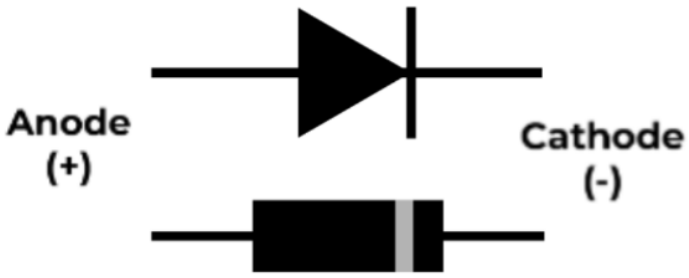
- All work will cease 20 minutes prior to the end of class.
- All work areas must be cleaned.
- Tools and equipment must be cleaned and returned to the designated areas (cage, tool room, cabinets etc.)
- Any broken or missing tools must be reported immediately.
- Tools and equipment are students' responsibility.

Basic Electronic Lab 1

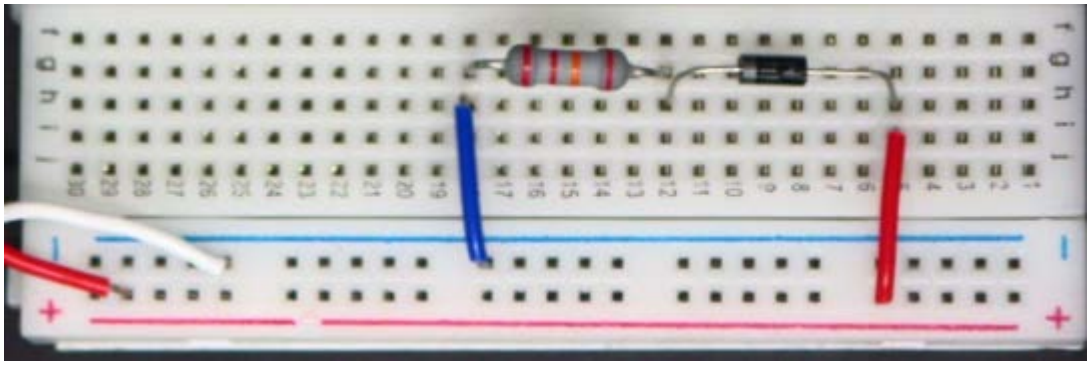
Exercise 1 Testing Diodes

1. With the Digital Multi-meter (DMM) on the ***ohmmeter function***, connect the positive lead (Red) to the anode side and negative lead (Black) to the cathode side measure and record the forward and reverse resistances of both regular and Zener diodes.

Forward Bias: _____ Reverse Bias: _____



2. Insert a diode into the breadboard with a resistor of any value in series the cathode side of the diode. (See below)



3. Connect the positive terminal (Red +volts) of the power supply (5 – 9 vdc) to the anode side of the diode and negative terminal (Blue - volts) to the bottom side of the load resistor.

4. Connect the voltage supply (either 5vdc or 9vdc battery) to the board as shown and connect the Digital Multi-meter (DMM) across each component measure and record the voltages.

   DIODE Voltage: _____ RESISTOR Voltage: _____

5. Disconnect power supply, reverse the diode, and repeat step 4 above.

   DIODE Voltage: _____ RESISTOR Voltage: _____

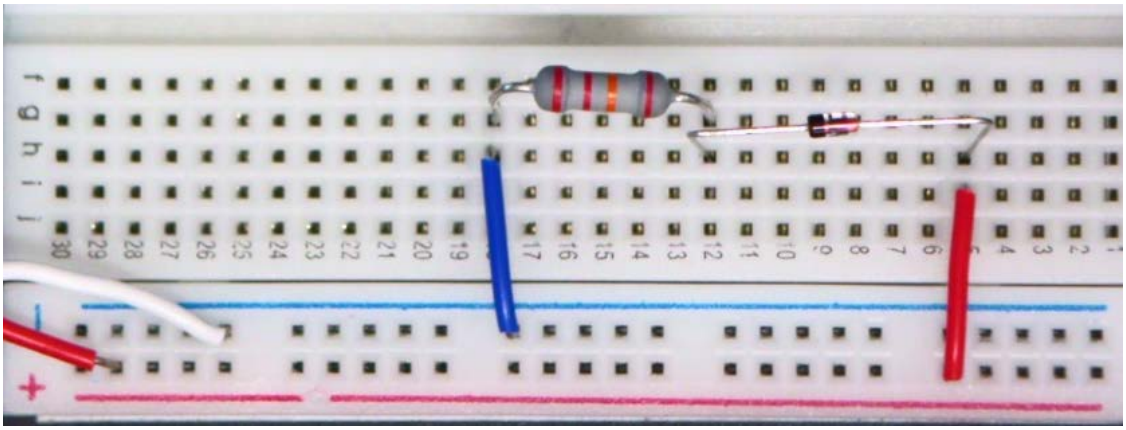
   Turn off the power supply and explain any discrepancies in your own words below:

Exercise 1.2: Testing Zener Diodes.

1. Insert a Zener diode into the breadboard in series with a resistor of any value to the cathode side of the Zener diode. (See picture below)
2. Connect the positive terminal (Red +volts) of the voltage supply (5 – 9 vdc) to the anode side of the diode and negative terminal (Blue - volts) to the bottom side of the load resistor. (See picture below)
3. Set the DMM (Digital Multi-meter) for VDC and connect the DMM across each component, measure and record the voltages.

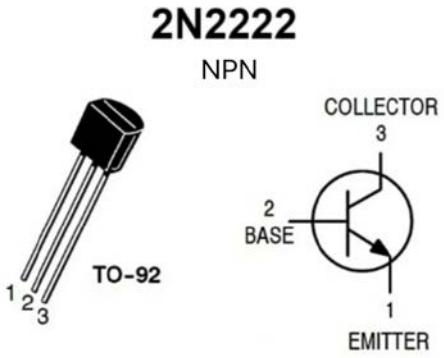
   a. DIODE Voltage: _____ RESISTOR Voltage: _____
4. Disconnect the voltage supply, reverse the Zener diode, and repeat step 3 above.

   a. DIODE Voltage: _____ RESISTOR Voltage: _____
5. Compare your results of step 4 above with the results of step 5 in exercise 1 and briefly explain your findings here:
6. Disconnect the voltage supply and remove your components from the breadboard and put them in a safe place.



Exercise 1.3: Transistors - NPN

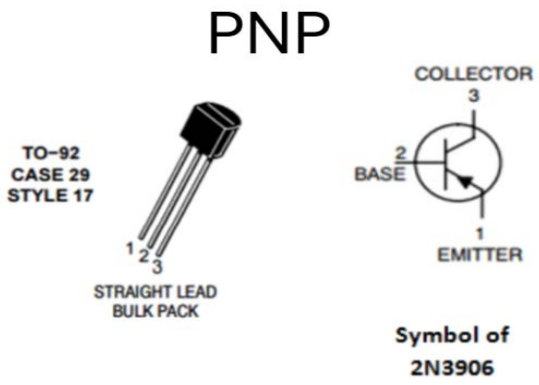
1. Checking the transistors: Connect the positive lead (Red) of the DMM (Digital Multi-Meter) to the BASE and negative lead (black) to the EMITTER of the NPN transistor (2n2222, 2n3904, BC547) to test the functionality of the component.



2.

3. Now repeat the step described in step 1 above for PNP (2n3906, 2n5401, BC327) transistors.

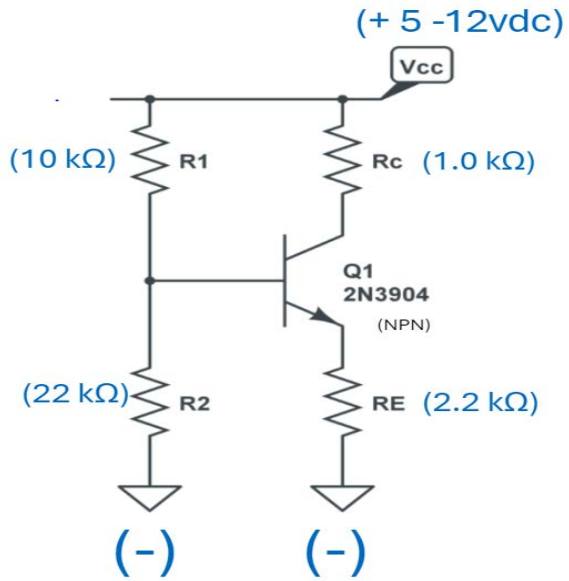
2N3906



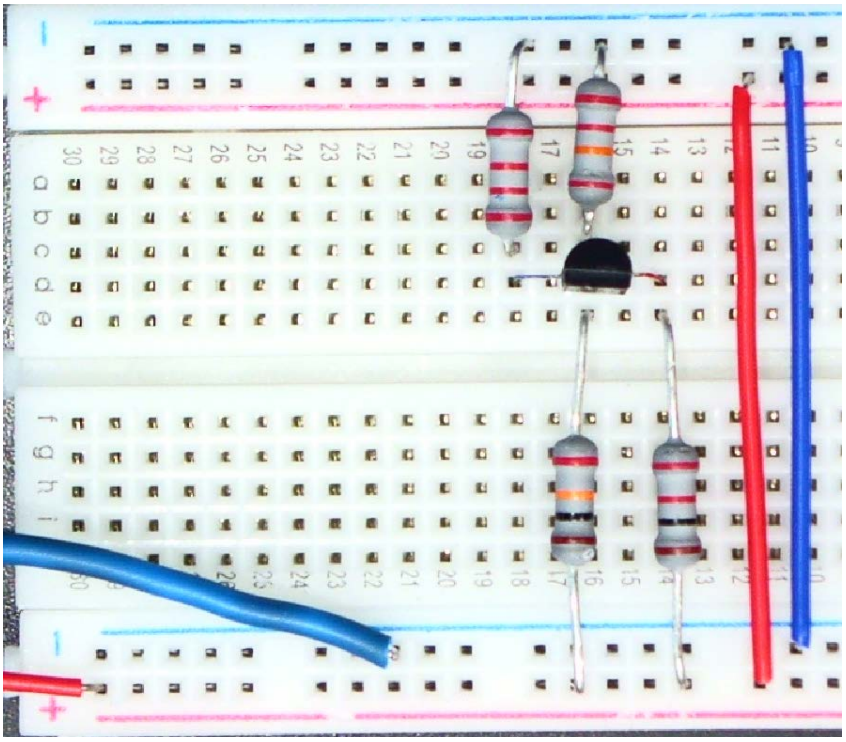
4. Note the differences here:
5. Use breadboard to construct a voltage divider circuit using different values resistors for R1, R2, Rc and Re. Below are recommended values, but any resistors can be used if they are different values.
6. Apply a positive voltage (Red lead) to the top of RC and negative voltage (Black lead) to the bottom of RE.
7. Use Digital Multi-meter (DMM) to measure and record voltages across R1, R2, RC and RE.

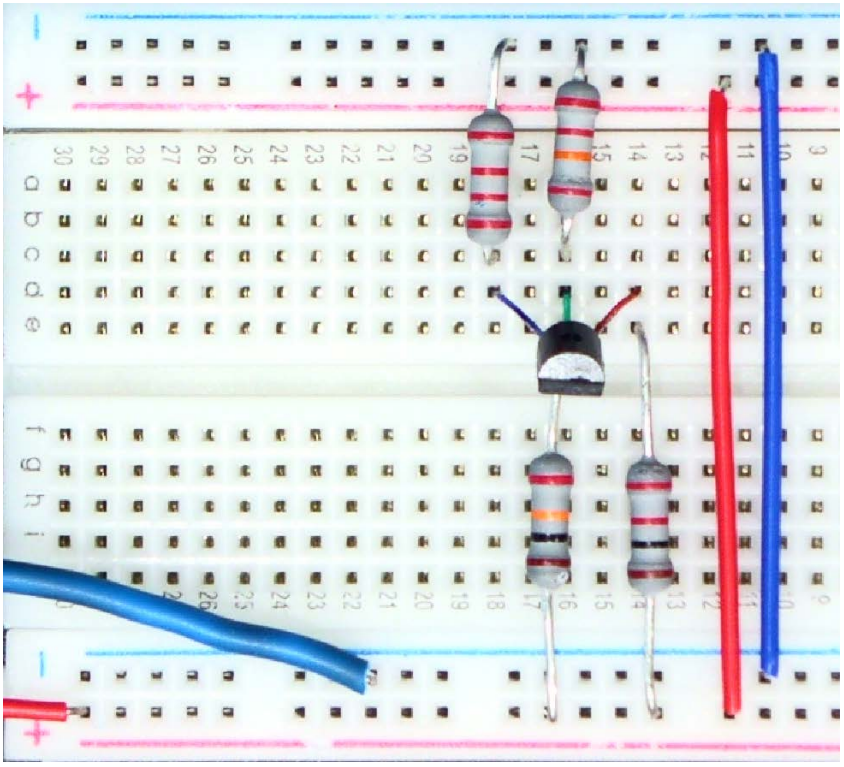
    a. R1 Volts: _____ R2 Volts: _____ RC Volts: _____ RE Volts: _____

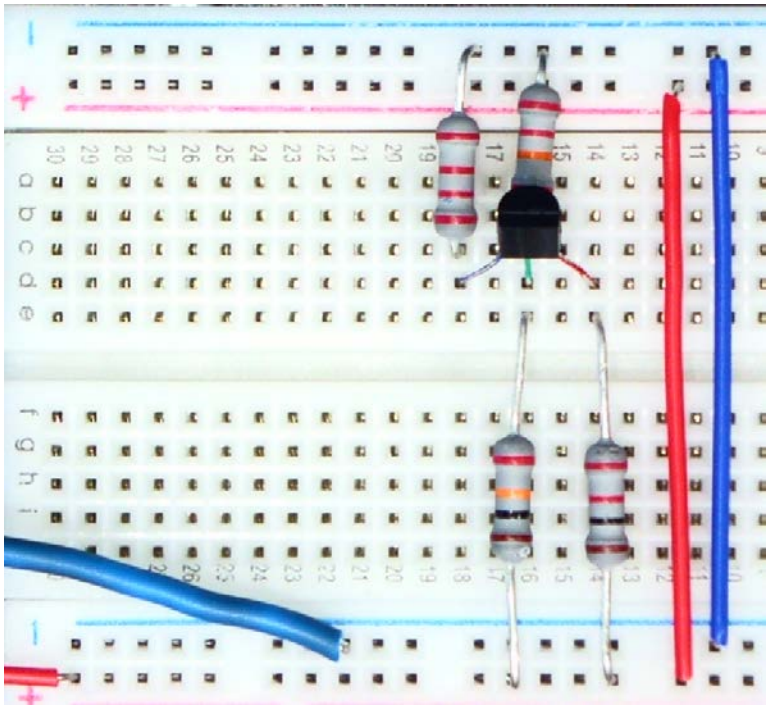
8. Turn off power supply and save the components for future use.
9. Describe the voltage relationship of the voltage drops across each resistor:

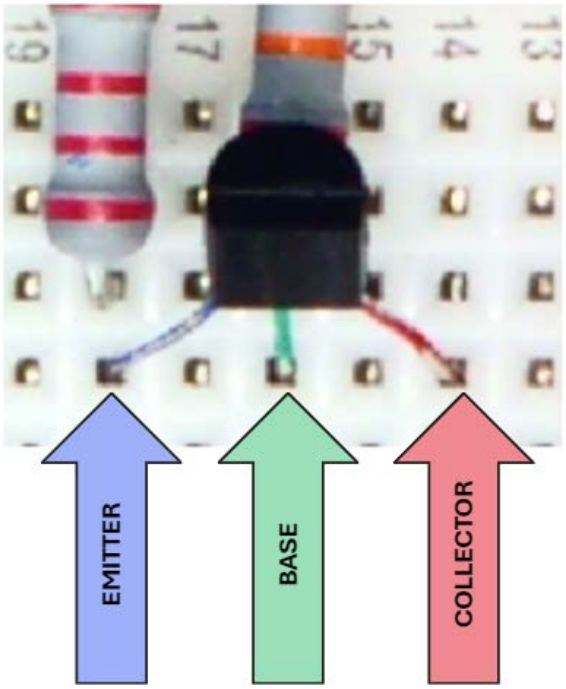


(Actual pictures of breadboard Voltage Divider, three different views)









Exercise 1-4: Transistors – PNP

1. Use breadboard to construct a PNP voltage divider (Same as the NPN Voltage divider - see schematic in exercise 3A above) circuit using 2n3906 NPN Transistor, and different values resistors for R1, R2, RC and RE.
2. Apply a positive voltage (Red lead) to the top of RC and negative voltage (Black lead) to the bottom of RE.
3. Use Digital Multi-meter (DMM) to measure and record voltages across R1, R2, RC and RE.

   R1 Volts: _____ R2 Volts: _____ RC Volts: _____ RE Volts: _____
4. Turn off power supply and save the components for future use.
5. Describe the voltage relationship of the voltage drops across each resistor: