Lab Experiment 3

Introduction to Digital Electronics Lab Equipment and Components

COMPONENTS

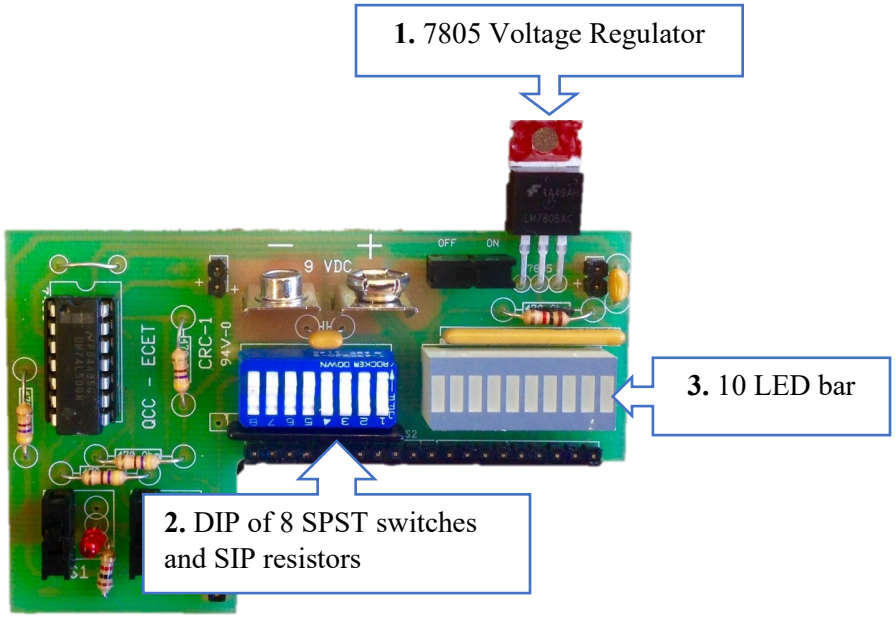
- Digital and voltage regulator board
- Stainless Steel IC Puller
- Breadboard/protoboard
- Jumper wires kit
- IC chips set
- 9 V battery

INSTRUMENT

- Power Supply

INTRODUCTION

Main parts of the digital and voltage regulator board



1. Voltage regulator: Transistor-Transistor-Logic (TTL) circuit operates between 0 V to 5 V. Hence, input voltage greater than 5 V needs a voltage regulator to reduce the voltage to the required 5 V before operation.

2. Since digital circuits are represented in binary form, a voltage level of 0 V is identified as an "OFF" or a logic "0", and a voltage level of 5 V is identified as an "ON" or a logic "1". For instant, to simulate logic inputs, Single-Port-Single-Throw (SPST) switches can be used. For the lab digital circuit, it has a DIP of 8 SPST switches rocker. Also, each switch requires a resistor to limit the current through it when it is on. The DIP of 8 SPST switches operates at the level of 60 mA and 5 VDC, then a Single-Inline Packing (SIP) of 100 Ω resistors in connected to each of the switches.

3. Light-Emitter-Diode (LED) can be used to identify if the output of a logic circuit in ON or OFF. The lab digital circuit uses an assembly of 10 segment LED bar. Also as switches, each LED requires a series resistor to limit the current through it for safety operation.

Other parts of the digital and voltage regulator boar

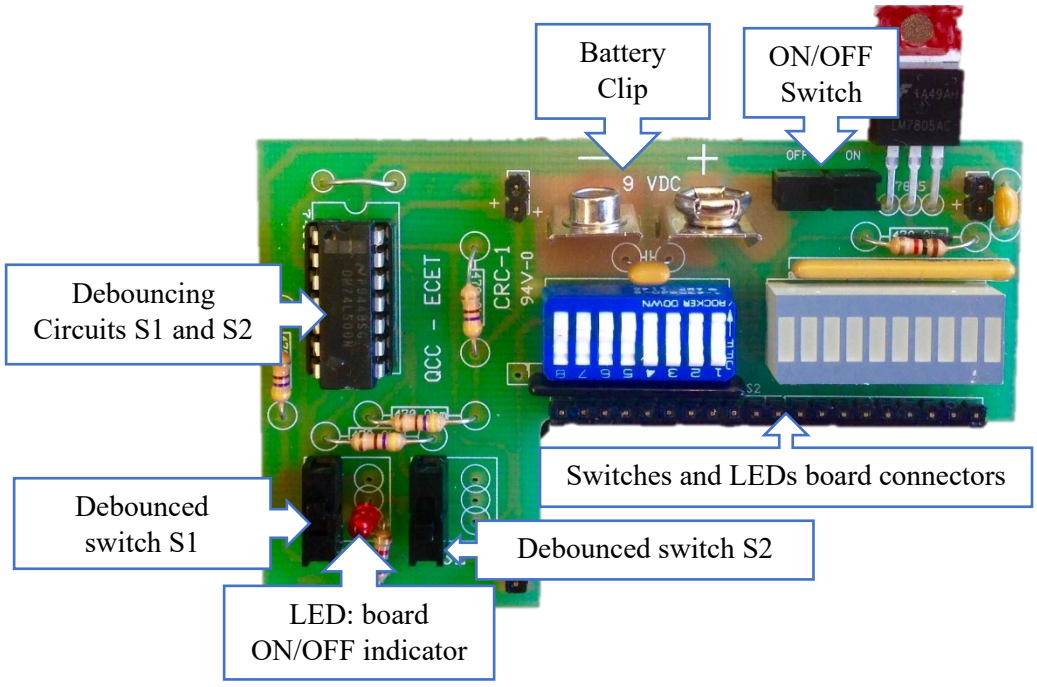
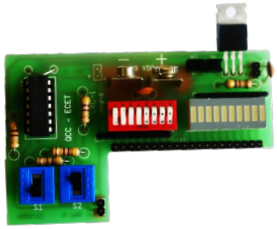


Figure 3.1 – Part of the digital board

LAB EXPERIMENT PROCEDURE

Lab Components kit

The main components for the digital electronics laboratory are listed below. Once you have your lab component kit, your lab instructor will introduce each component and the use of it. Take note of it and answer the question for each component in table 3.1

<table>
<tr><th>#</th><th>Component</th><th>Description and Use</th></tr>
<tr><td>1</td><td>Digital and voltage regulator board
What does LED stand for?
How does a/n LED work?
  </td><td>_____
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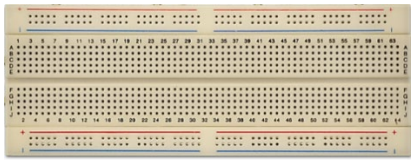
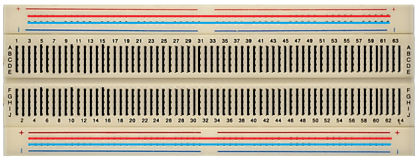
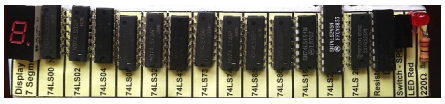
_____</td></tr>
<tr><td>2</td><td>Breadboard/protoboard
How to connect components in a breadboard?
 
  </td><td>_____
_____
_____
<table><tr><th>Description</th><th>Number nodes</th><th>Number of connection in a node</th></tr><tr><td>Power supply nodes: Each long red or blue line</td><td></td><td></td></tr><tr><td>Basic nodes: Each short line (on each side of the indentation)</td><td></td><td></td></tr></table></td></tr>
<tr><td>3</td><td>IC chips set
What does TTL stand for?
How many TTL chips does the IC chip set have?
What are the non-TTL chips in the IC chip set?
What does "LS" code stand for? What does it mean?
  </td><td>_____
_____
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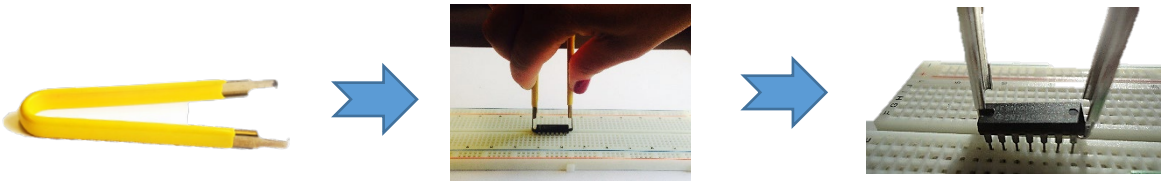
</table>

4	**Stainless Steel IC Puller** Why is it important to use an IC puller to take off IC chips from the breadboard? 	
5	**Jumper Wires** Why do jumper wires come in different color and length? 	
6	**9-V battery** 	
7	**Digital single variable power supply** 	

8	Banana plug to Alligator clip Test Lead 	_____ _____ _____ _____ _____

Table 3.1 – Component Description and use

Extra notes: _____

_____

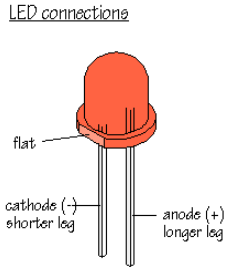
_____

_____

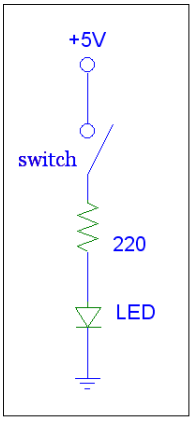
_____

Testing a single discrete LED

1. Insert the discrete LED with the long lead (anode) in b30 and the short lead (cathode) in b31.



2. Connect a 220 Ω resistor (red, red, brown) from a31 to ground.
3. Connect a jumper from switch 8 (a13) to a30.
4. Connect the battery. You have just wired the following circuit.



5. Operate the switch and observe the LED turn on and off.
6. With your DMM measure the voltage across the LED. It should be approximately 2V.
7. Remove the wire, the LED, and the resistor. Disconnect the battery.

Digital circuit assembling

To assemble the digital board into the breadboard, make sure that the positive ± connector of the digital board is connected to the edge positive node of the protoboard. Always check that the digital board is OFF before assembles into the protoboard.

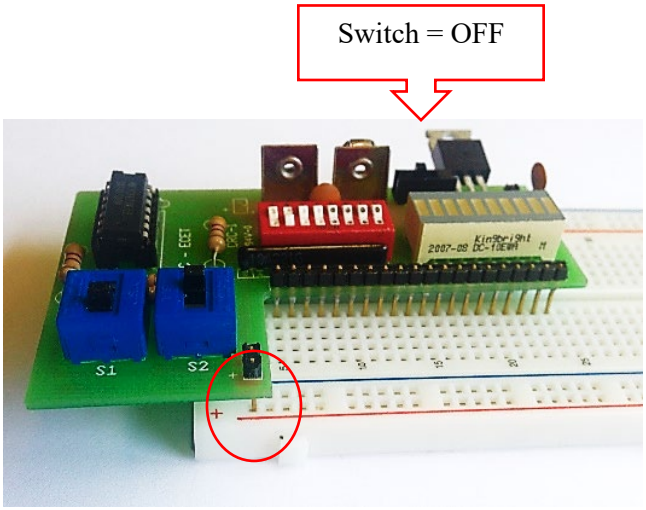
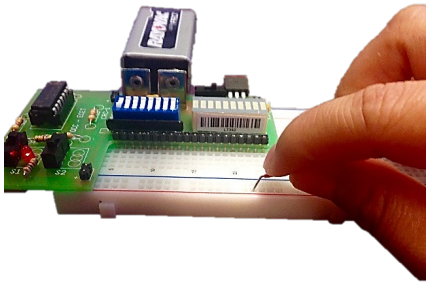


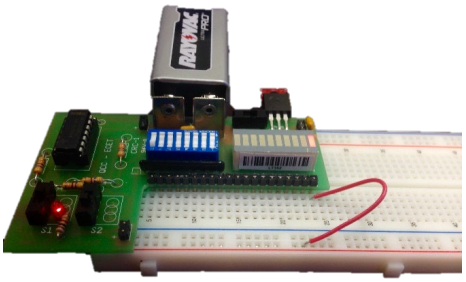
Figure 3.2 – Assembling digital board into the breadboard

Testing the switches and the LEDs

1. Connect a 9 V battery to the clip. You can also set the power supply to 9 V and clip the leads to the board's clips
2. Turn the power switch OFF
3. Take a long jumper wire and connect one of its terminal to any positive node in the protoboard



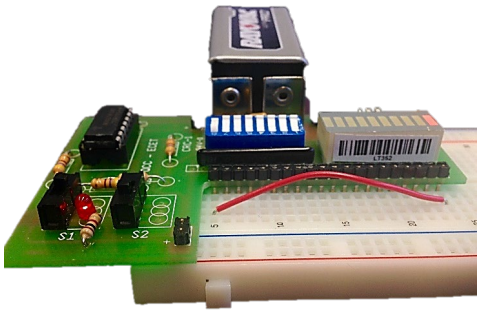
4. Connect the other terminal of the jumper wire to the rightmost LED



	Switch							
	8	**7**	**6**	**5**	**4**	**3**	**2**	**1 (Rightmost)**
ON								
OFF								

Table 3.3 – Switches test

5. Turn of the power switch to ON
6. Observe if the LED turn ON
7. Repeat the same step for each LED from right to left and record your observation in table 3.2
8. Turn OFF the digital board
9. Check that all switches are in the OFF position.
10. Take off the jumper wire, connect one terminal of the jumper wire to the rightmost LED and the other to the switch 8.



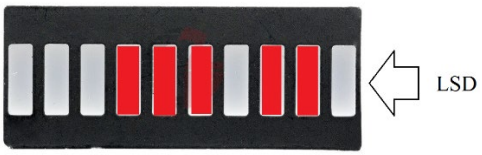
11. Turn switch 8 ON and observe if the rightmost LED turn ON
12. Test each switch and complete Table 3.3

	LED							
	8	**7**	**6**	**5**	**4**	**3**	**2**	**1 (Rightmost)**
ON								
OFF								

Table 3.2 – LED test

QUESTIONS

1. A student measured an output voltage of a ICs chip as 0.12 V. In digital, this output can be represented as _____, _____
2. If a student measured an input voltage and recorded it as logic ***1*** in his lab manual, this means that the student measured a voltage close to _____ volts. Explain your answer
3. Can a logic circuit be connected directly to a 9 V battery? Explain your answer
4. A 10-segment LED DIP displays the following (the LED on the right side is the LSD):



   If a student recorded the 10-segment LED display as binary code, the recorded binary code is _____. Explain your answer?
5. During the assembling of the digital board to the protoboard as shown in Figure 3.2, a student accidentally invert the positive + pin of the digital board with the negative – pin of the protoboard. Explain the consequences that this error can cause?

Student's name: _____ Lab instructor's signature: _____

---------- LAB EXPERIMENT 3 ENDS HERE ----------