Experiment 8: Medium Scale Integration (MSI) Logic Circuits

In-Lab Procedure and Report (30 points)

Before starting the procedure, record the table number you are working at in your lab report. Also record the EE Inventory number of any equipment that you use.

(1) Equipment. You will use the following:

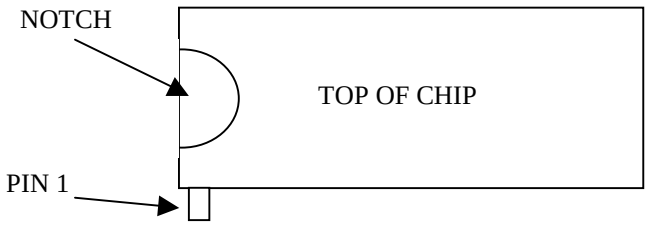
- Bit Bucket digital logic breadboard system
- Digital Multimeter
- The usual assortment of 16 banana-plug cables, and a tub of hookup wires.

If any of these are missing or non-functional, let your lab instructor know.

(2) Obtain the required components. You will use the following:

Table 1. Required parts for this experiment.

Qty	Part # or value	Description	Instructions
1	330 Ω resistor	orange-orange-brown	Measure and record the value
1	LED	red	Identify the anode and cathode. (The anode is the longer lead.)
1	74151, 16-pin DIP	8-input multiplexer (MUX), TTL	Identify pin 1 (see drawing)
1	74154, 24-pin wide DIP	4–16 decoder, TTL	Identify pin 1 (see drawing)



(3) Connect the 74154 decoder and verify correct operation. The pinout diagram is shown in Figure 1.

(a) Make the connections listed in Table 2.
(b) Verify the correct operation of the 74154 by setting the input bits *DCBA* to at least three different values of your choosing, and confirming that the correct output is active. To confirm an output is active, connect it to the logic probe or to any convenient LED in the bit bucket display area. Then you should see it respond when you press the pushbutton connected to *G2*. Record your input values and the observed outputs in a table in your report.

(4) Connecting an LED to a TTL output.

In this step, you will learn how to connect an LED to a TTL output. In order to limit the LED current and to protect the chip, it is necessary to put a resistor in series with an LED. For a standard TTL output, it is desirable to limit the current to approximately 8 mA. For a standard red LED, this can be accomplished by using a 330 Ω resistor as shown in Figure 2.

Figure 1. Pinout Diagram for the 74154 4–16 decoder.

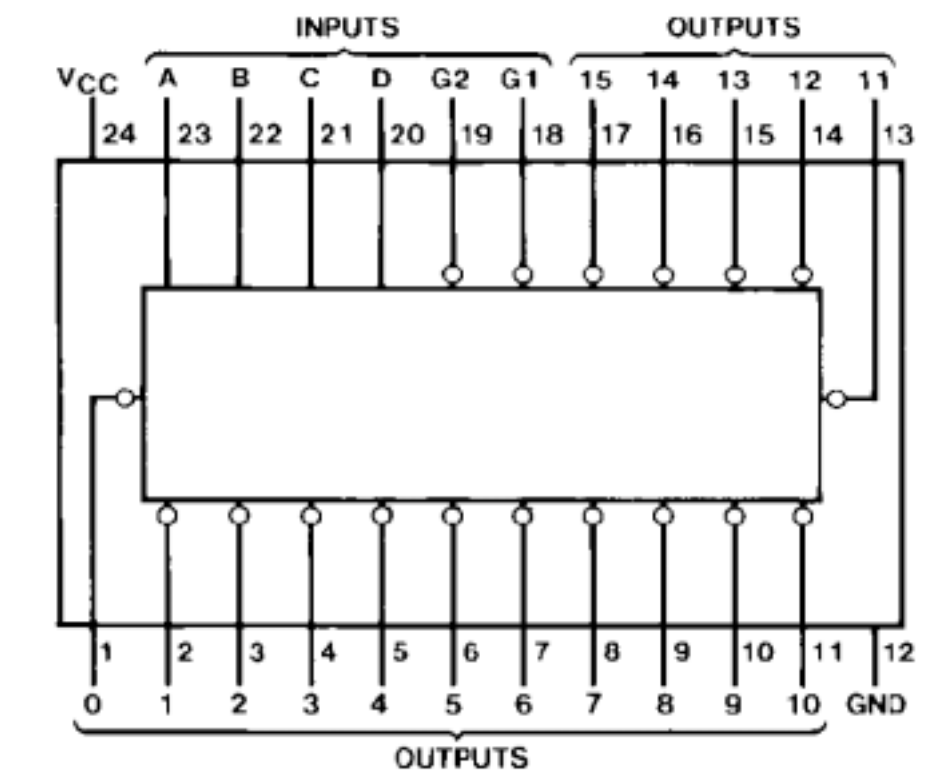
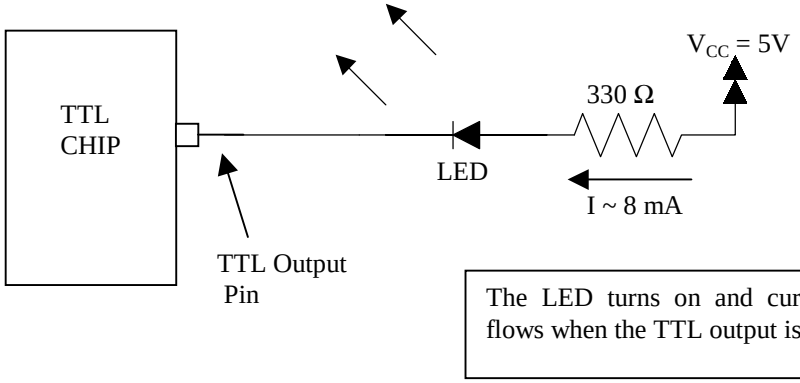


Table 2. Connection list for the 74154. Complemented I/O pins are shown with an asterisk (*)

Pin	Label	Function	Connect to	Notes
24	VCC	power	+5 V	
12	GND	ground	ground	
18	G1*	chip is enabled when G1 and G2 are low	ground	
19	G2*	chip is enabled when G1 and G2 are low	Pushbutton PB-1* (the Q-bar output of PB1)	This will be your "data" input.
20	D	MSB of 4-bit select input	Toggle switch SW-4	
21	C	select input	Toggle switch SW-3	
22	B	select input	Toggle switch SW-2	
23	A	LSB of 4-bit select input	Toggle switch SW-1	
Pins 1–11, 13–17	Outputs 0–10, 11–15	outputs	As instructed in the procedure	All outputs are active low.

Figure 2. Connecting an LED to a TTL output.



(Step 4 continued)

(a) Set the inputs *DCBA* to 0000 to activate output 0. Verify that this output is active as described in Step 3.
(b) Turn off the power, and connect an LED and resistor to output 0 as shown in Fig. 2. Also connect output 0 to the logic probe.
(c) Turn on the power, and verify that your LED comes on when output 0 is low, and turns off when output 0 is high.
(d) Using the DMM, measure and record the current through your LED when it is on. This will require breaking the circuit and inserting the DMM in series with the LED. Compare your reading with the desired value of approximately 8 mA stated earlier.

When you are done measuring current, set the DMM back to voltage by pressing the "V" selector switch. This will avoid potential short circuits and blown fuses.

(e) Using the DMM, measure the output high and output low voltages on at least three different outputs. Record the output voltages both with and without your LED/resistor connected. Compare your results to the manufacturer's specifications in the data sheet and comment.

(5) Connect the 74151 8-input Multiplexer.

The pin-out diagram and pin descriptions for the 74151 are shown in Fig. 3

(a) Carefully read the pin-out diagram and pin descriptions and connect the 74151 to verify its operation. First you should construct a table similar to Table 2 to guide your breadboarding.
(b) To verify correct operation, select at least 3 inputs using S2-S1-S0 and observe that they are transmitted to the output Z.

(6) Cleanup

DO NOT PUT RESISTORS, CAPACITORS, CHIPS, OR ANY OTHER COMPONENTS IN THE WIRE TUBS.

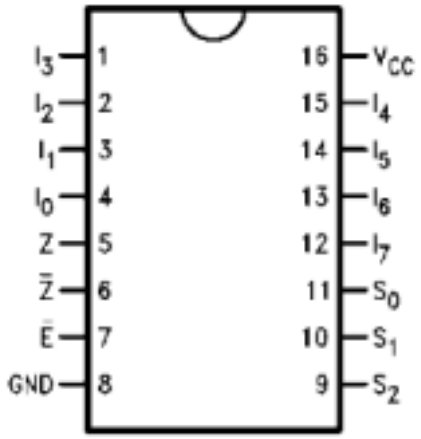
(a) Turn off the power to the Bit Bucket.
(b) Turn off the DMM.
(c) Disassemble your circuit and place all wires back in the wire tub.
(d) Put all chips and other components back in the proper bins.
(e) Clean up your workstation and discard any trash.

Review and Report Completion

Finish writing your lab report, following the outline given in the Course Information. Submit your lab report to your instructor before leaving the lab.

Figure 3. Pin-out and pin descriptions for the 74151 8-input multiplexer.

Connection Diagram



Pin Descriptions

Pin Names	Description
I_0–I_7	Data Inputs
S_0–S_2	Select Inputs
$\overline{E}$	Enable Input
Z	Data Output
$\overline{Z}$	Inverted Data Output