

9

Lab Experiment

Data Selector: Multiplexer

COMPONENTS

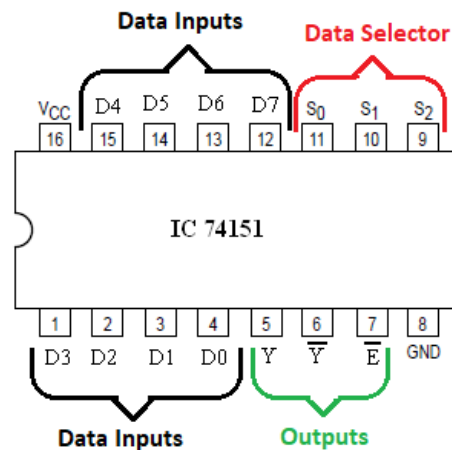
- 74151 MUX
- Jumper wires
- Protoboard
- Digital board

INTRODUCTION

A multiplexer performs the function of selecting the input on any one of several input lines and feeding this input to one output line. Usually there are 4, 8, or 16 inputs. These are referred to as 4 to 1, 8 to 1, or 16 to 1 multiplexers. A multiplexer is also referred to as a 'Data Selector' and sometimes as a MUX. A MUX can be used in two ways. One way is to use it to implement a hardware version of a truth table. The other way is to use it to convert parallel data bits into a stream of serial data bits.

Anytime you tune in a radio station you are using the radio as a multiplexer. There are many radio stations available on the radio dial and by 'tuning in' one station, you are 'selecting' that station and connecting it to the rest of the radio circuitry, and eventually to an amplifier and speaker. In other words, you are **selecting one of many** stations and connecting it to the speaker.

The 74151 is an 8 to 1 MUX. On some pinout diagrams the inputs are labeled I0 through I7 (where I stands for 'input'), on some other pinout diagrams the inputs are labeled D0 through D7 (where D stands for 'data'.) The MUX has one output usually labeled Y. The inverse of the output is also available and is labeled as W or \bar{Y} . On some pinout diagrams the output is labeled Z and the inverse \bar{Z} . The 'tuning dial' for the 74151 is made up of three lines called the Select lines. These are usually identified as S0, S1, and S2. On some pinout diagrams these select lines are labeled A, B, and C. S0 (or A) has a binary weight of 1, S1 (or B) has a binary weight of 2, and S2 (or C) has a binary weight of 4. It should be obvious that these three lines can address the data inputs I0 through I7, and connect them, one at a time, to the output. The 74151 also has an Enable line which is labeled \bar{E} (or S = strobe) which is active low. This is a lock. If the enable line is high, the MUX is locked out and non operative. To make the MUX operative, the enable line must be low (grounded.) The 74151 is packaged as a 16 pin DIP. The power supply pins are +5V (or VCC) to pin 16 and ground (or GND) to pin 8. Here is one version of the pinout diagram for the 74151.

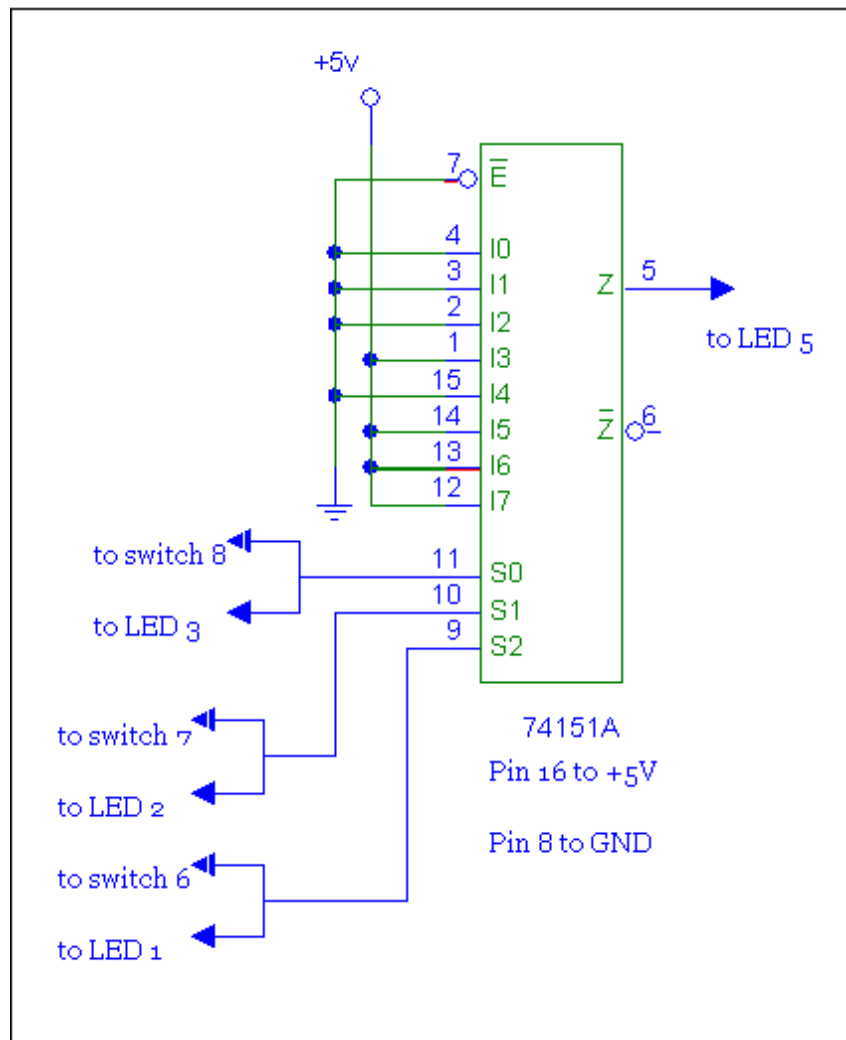


In this experiment you will use the 74151 multiplexer to implement the fluid level detector circuit from experiment 5.

First, examine the truth table. Notice that there are 8 possible outputs, therefore the 8 to 1 74151 MUX is the chip of choice. Note that for minterms 0, 1, 2, and 4 the output is LOW. Therefore the pins D0, D1, D2, and D4 (pin numbers 4, 3, 2, 15) get connected to ground. For minterms 3, 5, 6, and 7 the outputs are HIGH. Therefore the pins D3, D5, D6, and D7 (pin numbers 1, 14, 13, and 12) get connect to +5V. To enable the chip the Enable or Strobe line (pin number 7) has to be connected to ground. The data selector lines are connected to switches. The output Y on pin 5, can be monitored with an LED.

LAB EXPERIMENT PROCEDURE

1. For this exercise we will build circuit 9.1 to simulate that it is a vending machine. The vending machine will have eight data inputs from 0 to 7. To make the selection, we will use switch 8, 7, and 6 where switch 8 represents the LSB and switch 6 represents the MSB. The output will be displayed in LED 5.
2. Power the 74151A, 8-1 MUX, by connecting pin 16 to +5V and pin 8 to GND



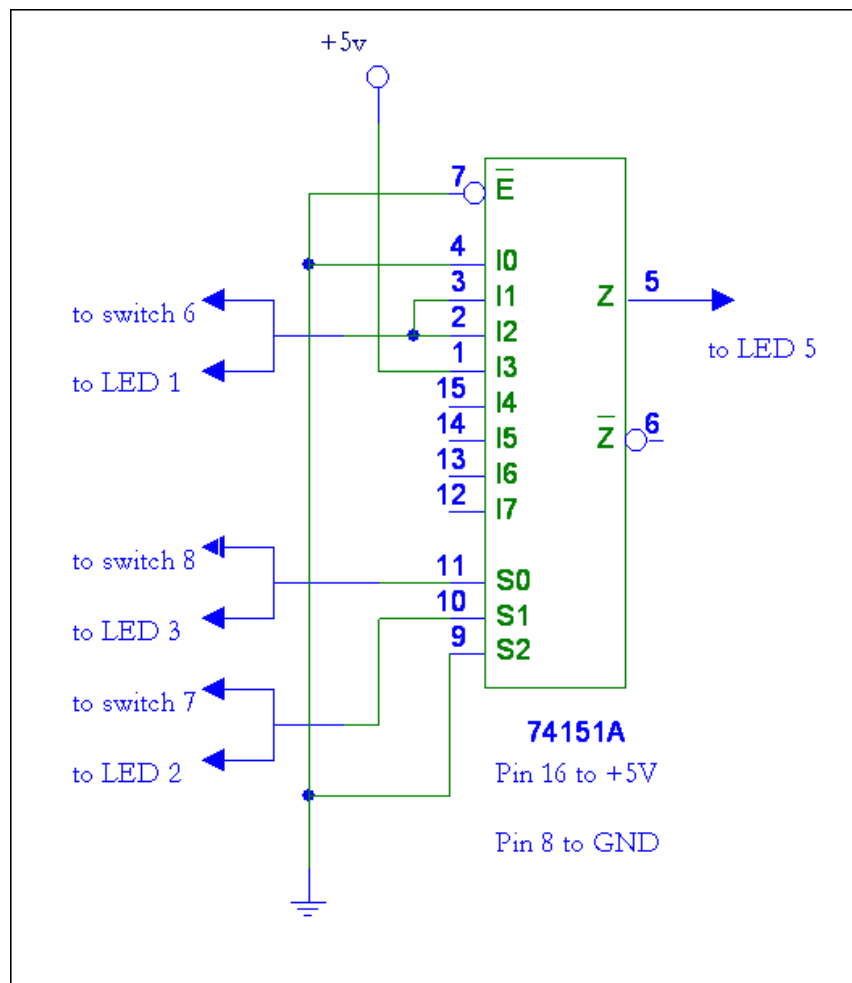
Circuit 9.1 – 8-1 Multiplexer Circuit

3. After building circuit 9.1, operate switch 8, 7, and 6 according to Table 9.1 and record if LED 5 is ON or OFF for each minterm.

Minterms	Switch 8 (LED 3)	Switch 7 (LED 2)	Switch 6 (LED 1)	Output (LED5)
0	0	0	0	
1	0	0	1	
2	0	1	0	
3	0	1	1	
4	1	0	0	
5	1	0	1	
6	1	1	0	
7	1	1	1	

Table 9.1 – Truth Table 8-1 MUX: Circuit 9.1

4. Disassemble circuit 9.1 and build circuit 9.2. Circuit 9.2 works as a 4-1 MUX, therefore, Circuit 9.1 is using only two data selectors, switch 8 and 7, and four data inputs, from I_0 to I_3 .



Minterms	Switch 8 (LED 3)	Switch 7 (LED 2)	Switch 6 (LED 1)	Output (LED5)
0	0	0	0	
1	0	0	1	
2	0	1	0	
3	0	1	1	
4	1	0	0	
5	1	0	1	
6	1	1	0	
7	1	1	1	
<i>Table 9.2 – Truth Table 4-1 MUX: Circuit 9.2</i>				

QUESTIONS

1. How many data line does a 4-1, 8-1, and 16-1 MUX have?
2. Draw a circuit block of a 4-1, 8-1, and 16-1 MUX. For each MUX, identify and label the data selector, data inputs, and output. Also explain the number of input and selector data of each MUX.
3. What is the purpose of the Enable line in a multiplexer?

Student's Name: _____ Lab Instructor's Signature _____

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