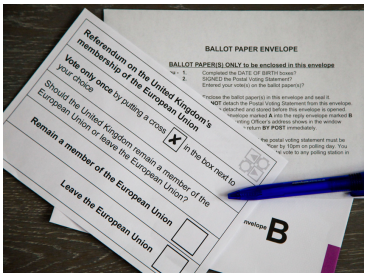
A prototype electronic voting machine

Prerequisites

This lab assignment contains elements of design and is intended to reinforce your understanding of how multiplexers can be used. You should be familiar with the function of these devices that takes advantage of complex circuitry in the chips. You should also have studied Module 8.1 for the method of using an 8 to 1 MUX with 2^3 combinations of the inputs.

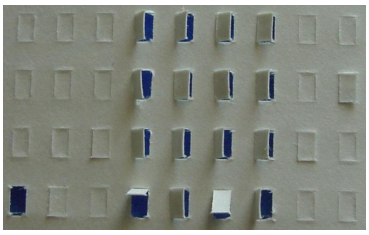


Objectives

This lab is intended to follow the basic understanding of multiplexers. As this is an early LogicWorks assignment, considerable skills need to be built and, though the circuitry in this lab is not complex, the intricacy of connecting paths lends itself to the need for great care and attention to detail.

Introduction

A Vending company has been asked to design and test a prototype electronic voting machine. Paper voting is slow and subject to errors in reading. Punched cards can also be a problem as we found out in Florida in the 2000 presidential election – remember hanging chad?



So, we will look at a way to input voter choices by switches and produce a binary output to indicate the result. In doing the design, we will exploit the logical functionality of multiplexers specifically the SN74153 4-1 device.

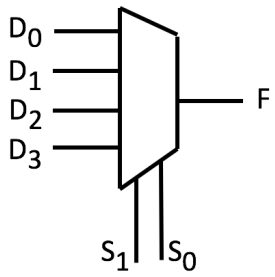
Part one

To simplify things and, again, in a prototyping situation, we will assume that initially each group of three voters will approach the electronic machine whose first operation is to decide on a majority output of the three voters.

Our three voters will be W, X, & Y. Initially we are to find the majority vote of these three voters as follows: F is the majority decision.

You have a 4 to 1 MUX to implement this.
Use W and X as the select inputs.

W	X	Y	f
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1



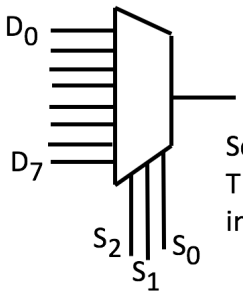
This is the diagram for a 4-1 MUX.
$S_1$and S_0 are the select inputs. D_0 appears at F if S_1S_0 is 00, D_1 appears at F if S_1S_0 is 01, etc.

Procedure

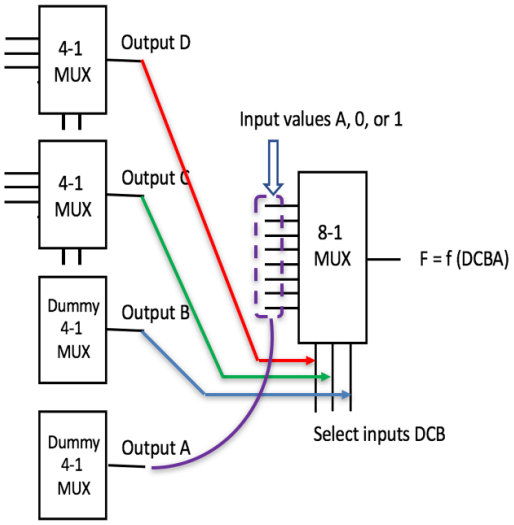
Design and build the circuit above in LogicWorks to satisfy yourself that it produces the required function as defined by the truth table. Then build the circuit on your protoboard and test.

Part two

We plan to extend the voter participation to 12 persons. To make this a “proof of concept” we will utilize a further 8-1 MUX as below. Our new voter decisions will be derived from four 4-1 MUXs, hence allowing input from 12 (4 x 3) voters. However, the 74153 chips we are to use are linked devices and so we can only use one MUX in each chip independently. So, we will use four 74153 chips. The complete schematic is shown below. The function F will be a majority decision of D, C, B, & A when it equals a 1. In other words, F will be a 1 when either 3 or 4 of the DCBA inputs are 1s.



Schematic for an 8 to 1 MUX. The S values are the select inputs

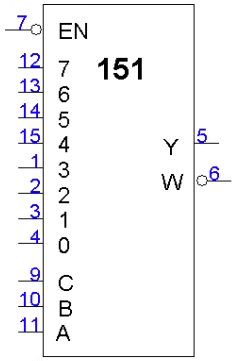


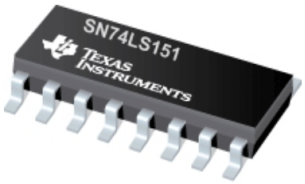
Procedure

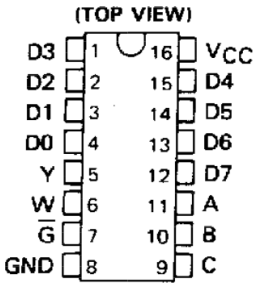
For the second part, you do not need to build the circuit in LogicWorks (though knowing the members of the class, it is likely you will do this anyway). You should create the voting system circuitry on your protoboard. Where you need more inputs than are available from your pre-built input circuit, just use a wire that you can touch to the high (1) and ground (0) lines.

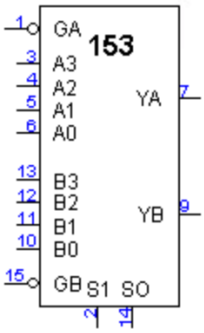
Theory

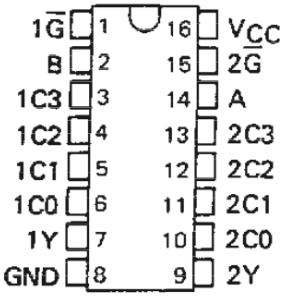
The theory behind this exercise is to be found in Module 8.1











Testing

You can test your output 8-1 circuit exhaustively. (you have already tested the 4-1 MUX outputs)
All of your results should agree with the specifications.

Deliverables

Once you've tested and thoroughly debugged your circuit, demonstrate your results to your TA. Then write a report which follows the required format. You should also include a picture of your circuit within your report.