Today's Mission: Multiple Outputs

The U.S. Atlas Rocket Network is a set of defensive intercontinental missiles that are to be launched whenever it is certain that enemy missiles have been launched at the United States. To ensure that defensive missiles are not mistakenly or prematurely launched, the presence of enemy missiles must be verified by four separate Missile Surveillance Systems (MSS):

(S) Space Satellite Surveillance
(L) Long Range Radar Surveillance
(R) Radar Surveillance by Ship
(V) Visual observation by USAF pilots

The DEFCON (Defensive Condition) level is based on the number of MSS that have detected incoming missiles. If none of the MSS have detected missiles, then the DEFCON is set to zero. If two MSS have detected missiles, then the DEFCON is set to two, and so forth.

The DEFCON status is indicated by a "barchart" of four LEDs.

DEFCON ZERO	All of the SLRV are inactive (no LEDs are lit).
DEFCON ONE	Only one of the SLRV is active (LED 1 is lit).
DEFCON TWO	Two of the SLRV are active (LED 1 and 2 are lit).
DEFCON THREE	Three of the SLRV are active (LED 1, 2, and 3 are lit).
DEFCON FOUR	Four of the SLRV are active (LED 1, 2, 3, and 4 are lit).

You must build a circuit that evaluates the overall status of the four early warning systems, and uses this information to indicate the appropriate DEFCON Level.

Input Summary:	Four inputs (switches 0, 1, 2, and 3)
Output Summary:	Four DEFCON indicators (LEDs #0, 1, 2, and 3)
Chip Summary:	Two 74151 multiplexers, two 74153 multiplexers, one 7404 hex inverter, and one 7432 quad OR

Instructions for Part A

- Complete the truth table on the worksheet for each of the Four LED's Q1, Q2, Q3, and Q4.
- Draw your final circuit *neatly* on the worksheet using only two 74151 Multiplexer chips, two 74153 Multiplexer chips, one 7404 chip, and one 7432 chip. It might be worth your time to decide which Q to solve with each type of MUX before getting too deep into your solution.

  Next to each pin of each chip, name the appropriate connection (for example, **V**, or $\overline{S}$, or +5v, or Q2, or GROUND). Also draw your OR gates as necessary.
- Build the circuit on a proto-board, and have the instructor verify that it works.
- Turn in the worksheet.

Part B

A soldier in the bunker must manually press a button to open or close the door to the missile silo. The soldier is instructed to *open* the silo door (motor spins clockwise) by pushing the switch after the DEFCON rises from 2 to 3. Also, he is instructed to *close* the door (motor spins counter-clockwise) by pushing the switch again after the DEFCON falls from 2 to 1. In case you missed it, the motor ONLY runs during DEFCON 3 or DEFCON 1.

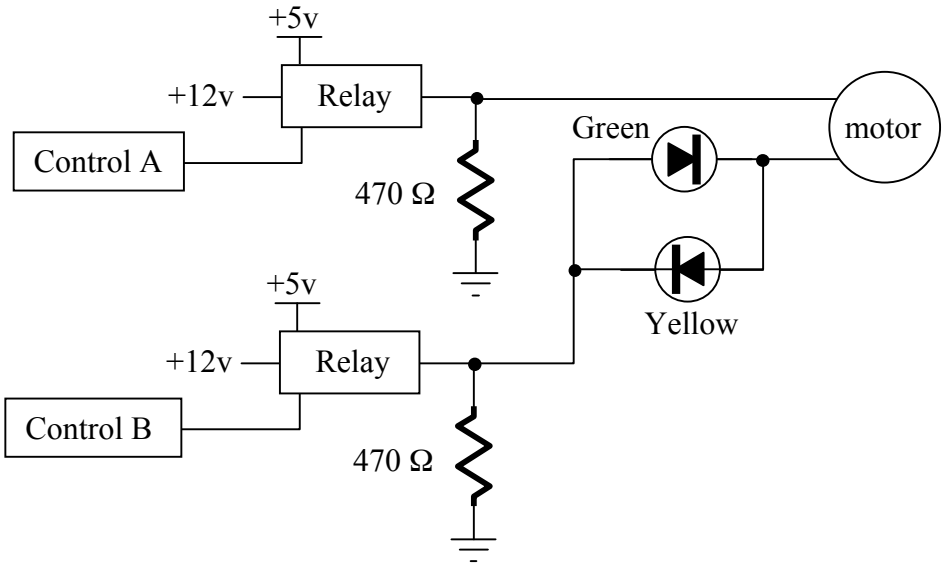
You must build the circuit to control the motor based on the status of the switch and on the DEFCON level.

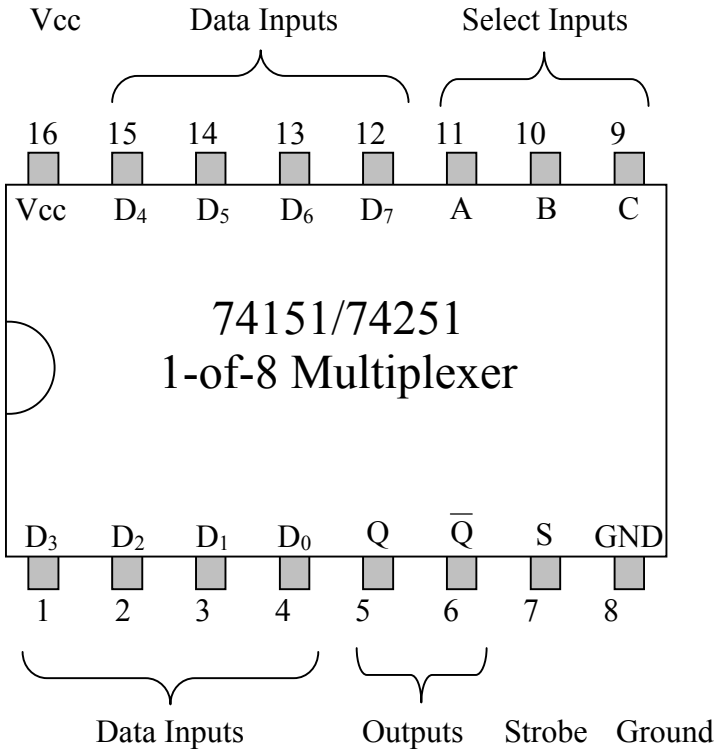
Input Summary: One "activate" switch (momentary switch 0)
Output Summary: One motor, with two directional LED indicators:
Green LED (clockwise motor, door is opening)
Yellow LED (counter-clockwise motor, door is closing)
Chip Summary: One 7408 quad AND, 2 gates of existing 7404 chip

The schematic below shows the circuit needed to operate the DC motor in two directions. The key is that the particular motor that we are using will change direction depending on which of its wires is at a higher voltage. You are invited to puzzle out how this works, but the result is given in the "truth table" to the right. Which direction is "clockwise" depends on which way the motor is connected.

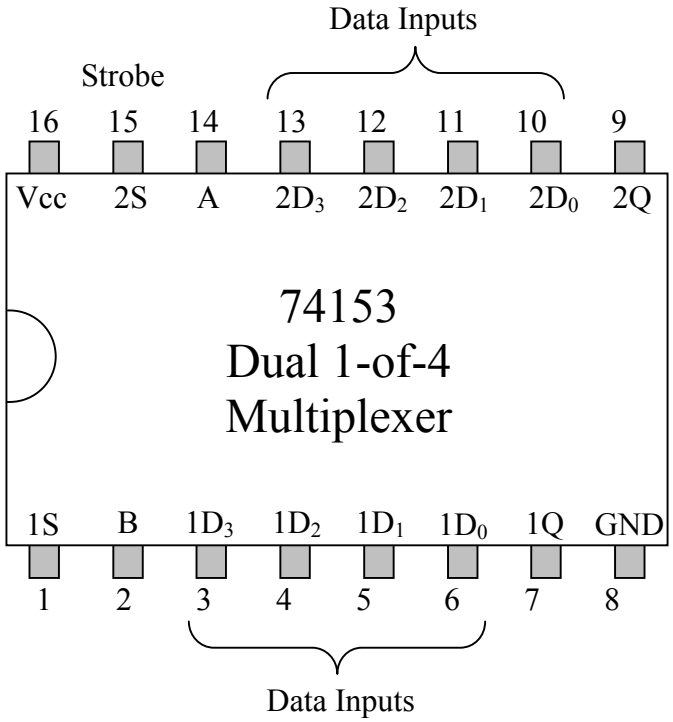
A	B	Motor Status
0	0	off
0	1	one direction (yellow LED)
1	0	other direction (green LED)
1	1	off

You will need to design the logic to appropriately activate "A" and "B" to achieve the desired outcomes. Hint: The logic depends only the activate switch and the four LED signals; the surveillance switches are not involved.





Inputs				Outputs	
Select			Strobe		
C	B	A	S	Q	$\overline{Q}$
any	any	any	1	0	1
0	0	0	0	D_0	$\overline{D_0}$
0	0	1	0	D_1	$\overline{D_1}$
0	1	0	0	D_2	$\overline{D_2}$
0	1	1	0	D_3	$\overline{D_3}$
1	0	0	0	D_4	$\overline{D_4}$
1	0	1	0	D_5	$\overline{D_5}$
1	1	0	0	D_6	$\overline{D_6}$
1	1	1	0	D_7	$\overline{D_7}$



Inputs			Output
Select		Strobe	
B	A	S	Q
any	any	1	0
0	0	0	D_0
0	1	0	D_1
1	0	0	D_2
1	1	0	D_3

Name: _____

You MAY NOT write on this sheet in pen!

Truth Table:

S	L	R	V	Q1	Q2	Q3	Q4
0	0	0	0				
0	0	0	1				
0	0	1	0				
0	0	1	1				
0	1	0	0				
0	1	0	1				
0	1	1	0				
0	1	1	1				
1	0	0	0				
1	0	0	1				
1	0	1	0				
1	0	1	1				
1	1	0	0				
1	1	0	1				
1	1	1	0				
1	1	1	1				

Your final diagrams: