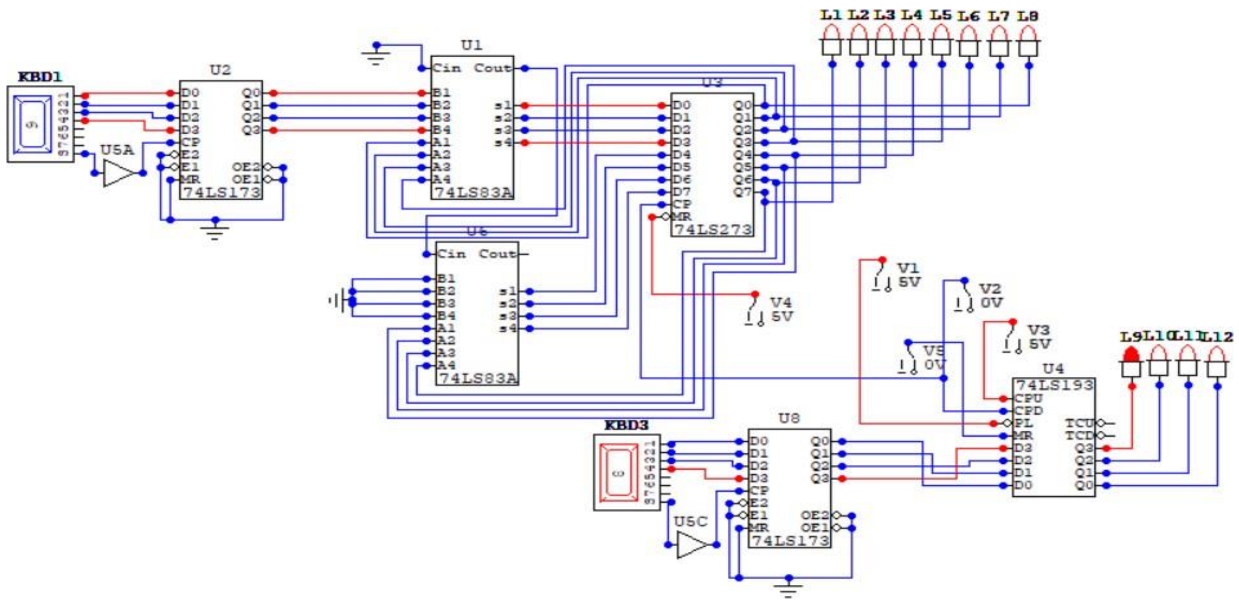
DESIGNING 4X4 BIT MULTIPLEXER

Aim of experiment:

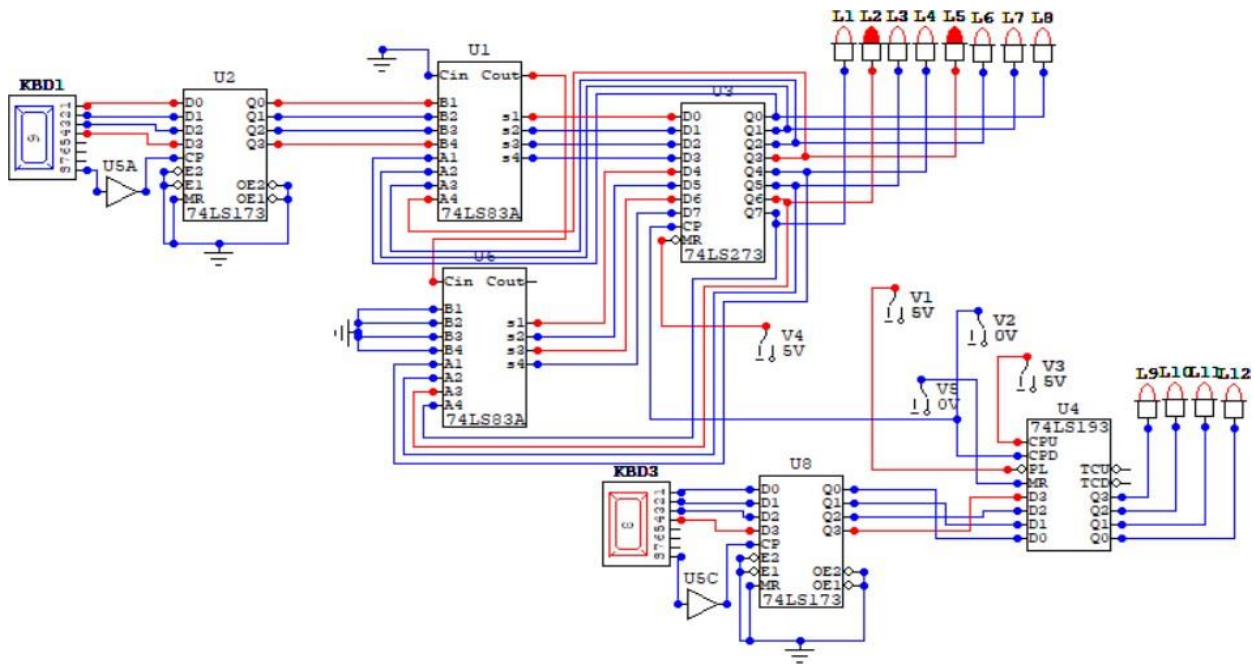
- To realize 4x4 bit multiplexer using product-accumulator register, down-counter

Circuit diagrams:

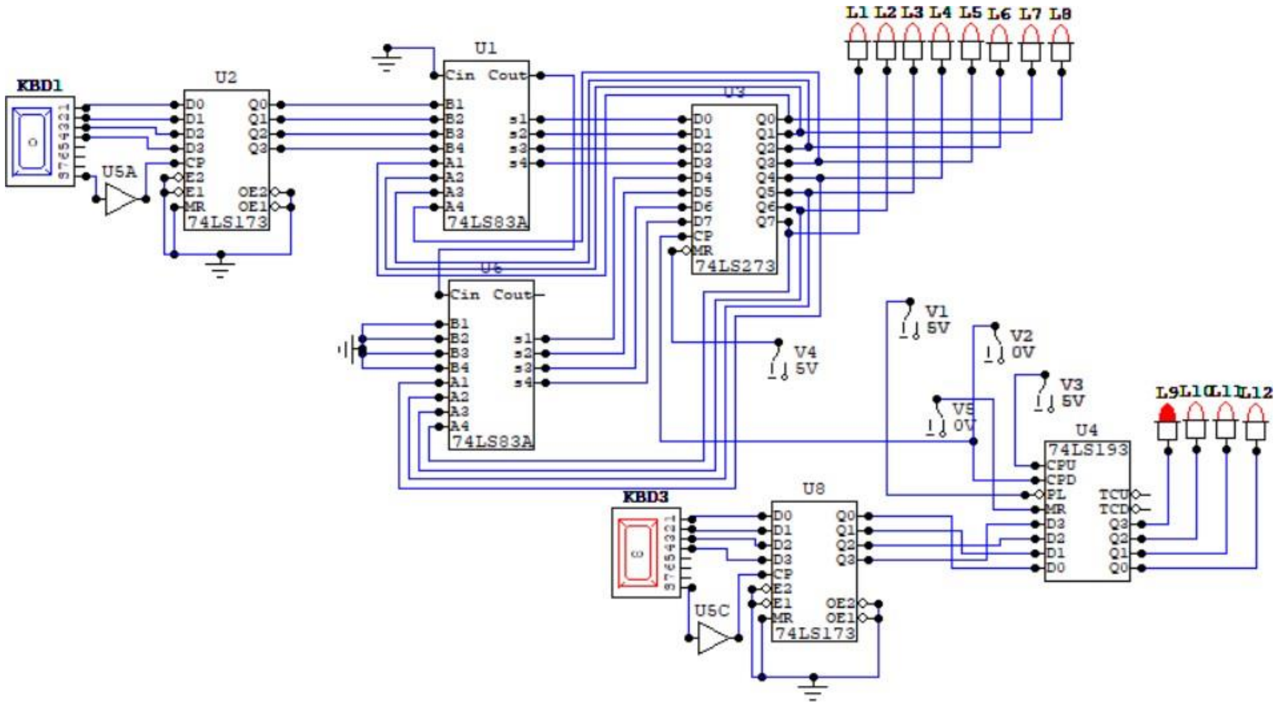
For manual multiplexer: multiplicand = 9; multiplier = 8



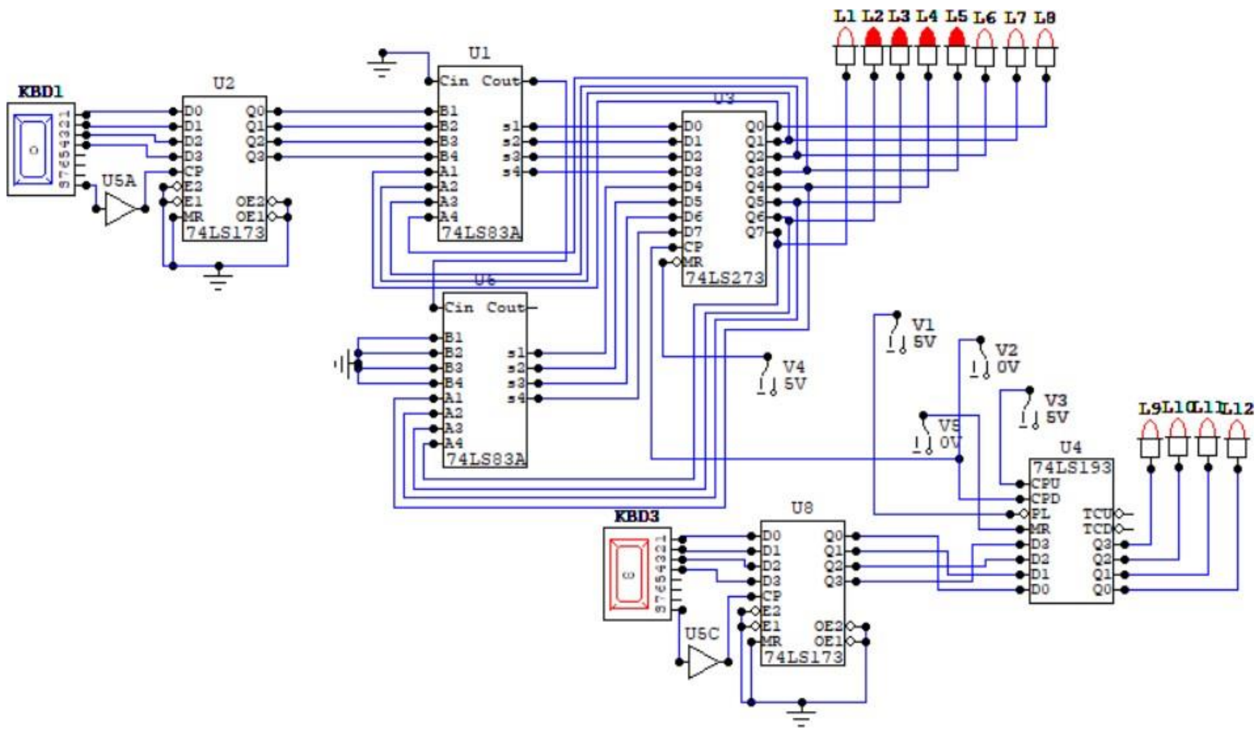
Output of multiplexer with input 9, 8



multiplicand = 15; multiplier = 8

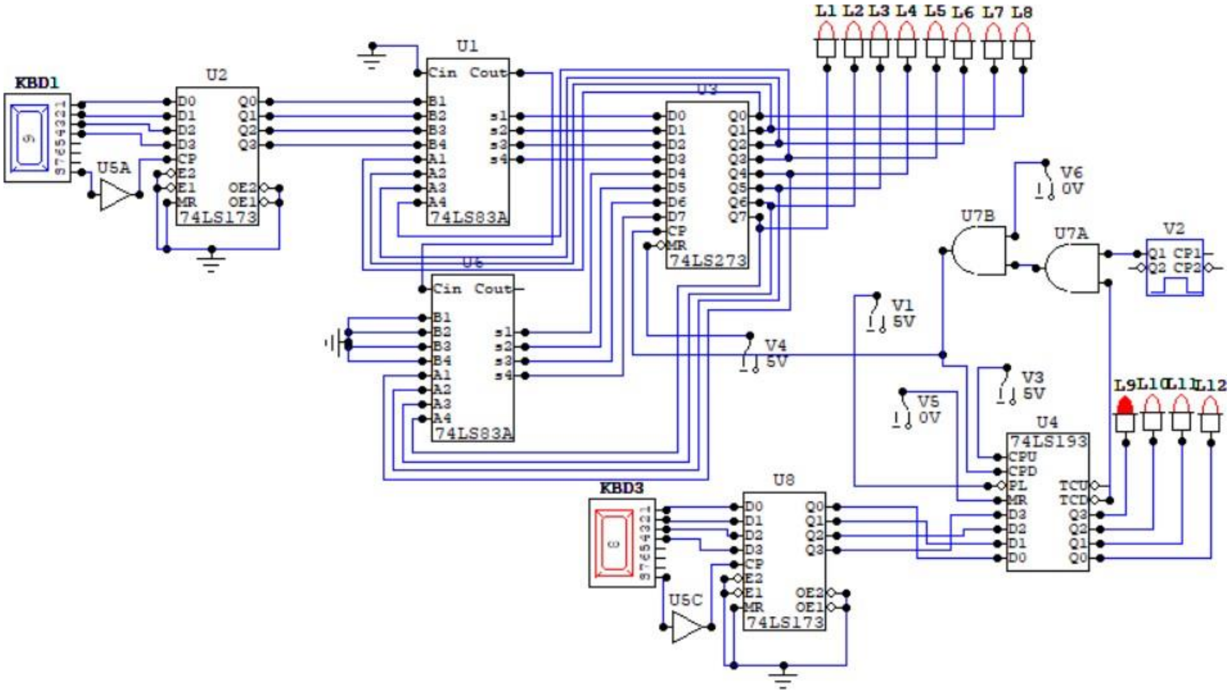


Output of multiplexer with input 15, 8

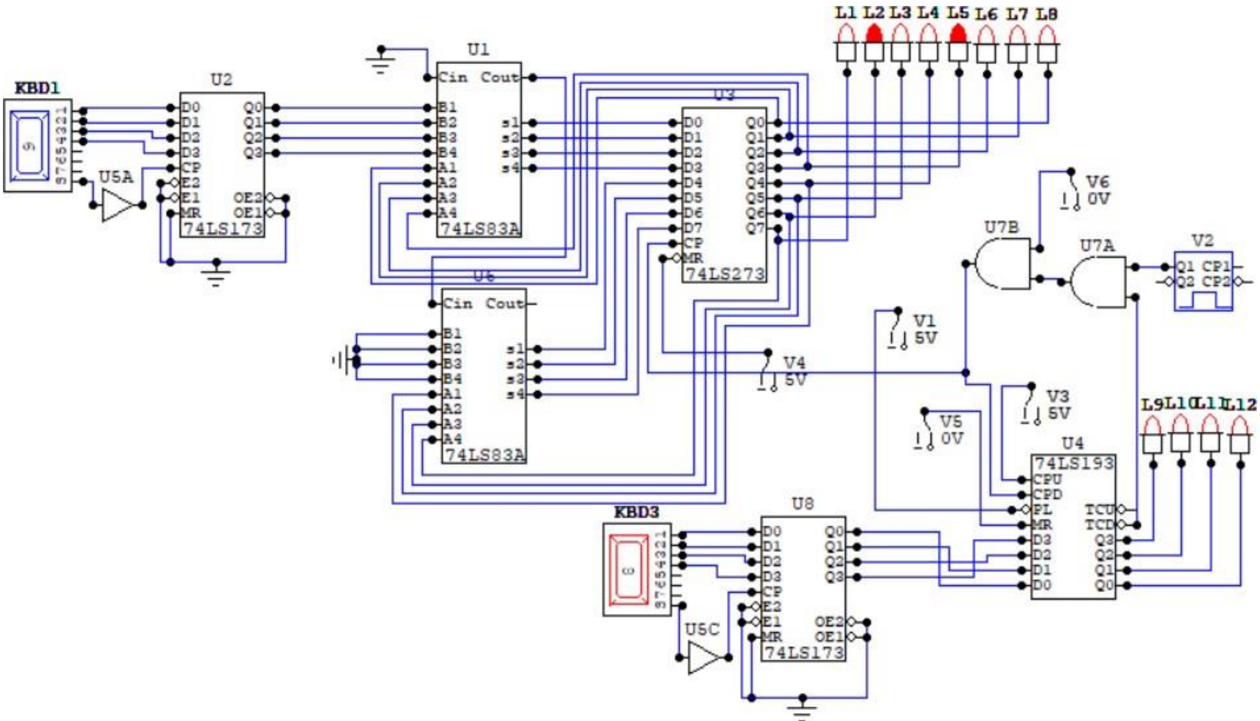


For manual multiplexer:

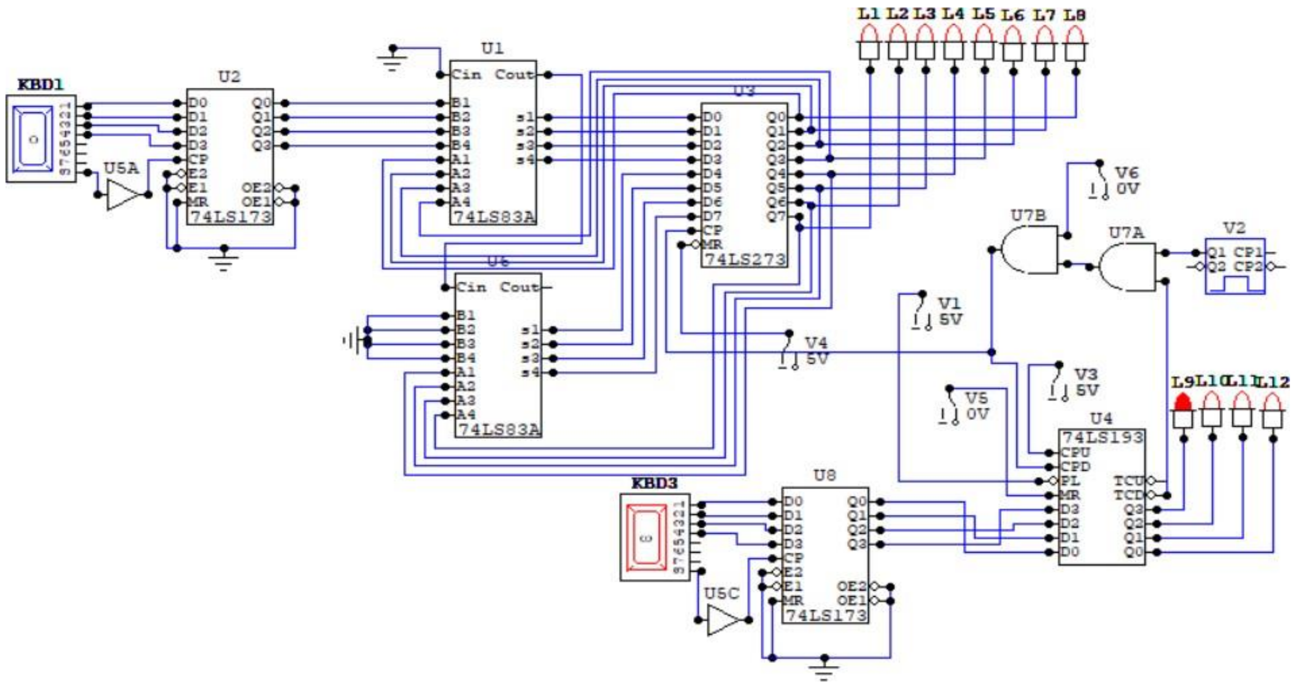
multiplicand = 9; multiplier = 8



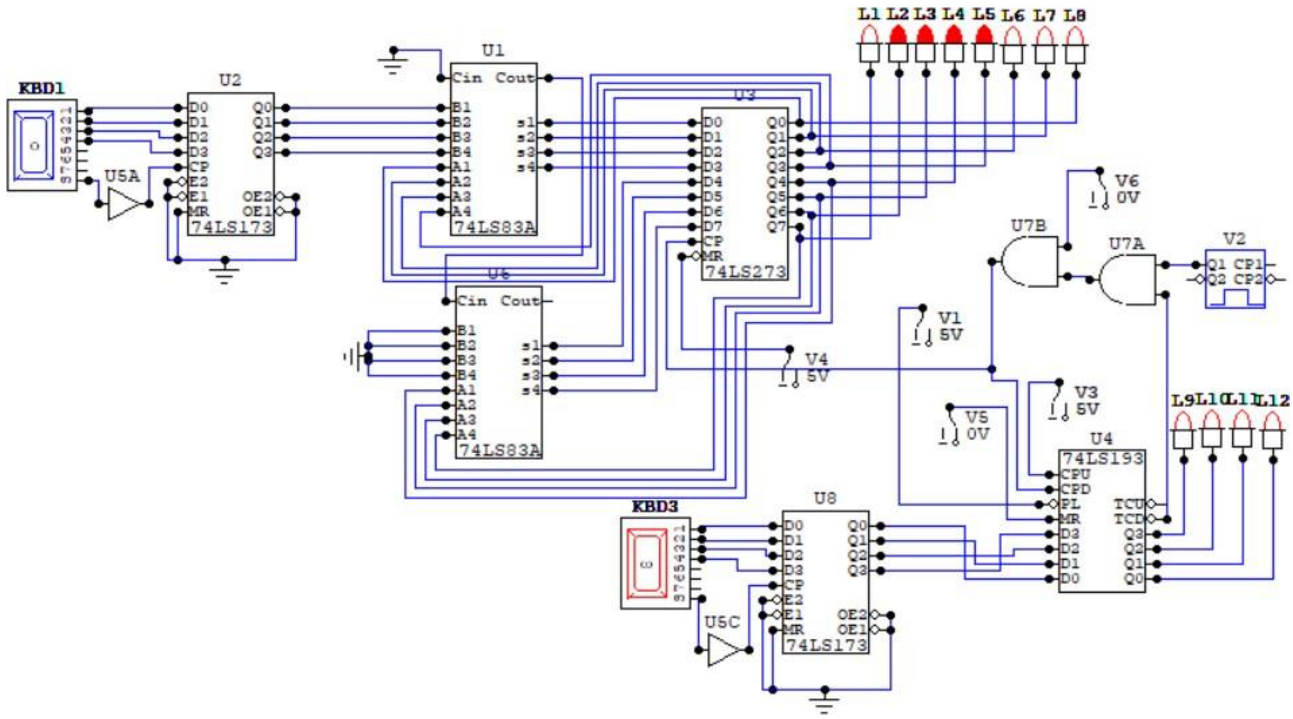
Output of multiplexer with input 9, 8



multiplicand = 15; multiplier = 8



Output of multiplexer with input 15, 8



Components:

- **IC-74273:** octal positive edge triggered DFF with MR (active low) pin.

- **IC-74173:** quad positive edge triggered DFF with IE, OE, MR (active low) pins.
- **IC-7483:** 4-bit parallel adder with C_in, C_out.
- **IC-74193:** synchronous 4-bit counter with dual clocks. (CPU for up counting, CPD for down counting).
- Basic gates
- ASCII keyboard.
- pulser
- Power supply, LED's, logic displays.

Theory of connections:

- ✓ Inputs we use for multiplications are 4-bit each (maximum it can represent is 15) so, result of multiplication maximum is 225 in which we require output as 8-bit.
- ✓ We perform multiplication as repetitive addition of multiplicand of multiplier times. Firstly, we need one 4-bit register (IC-74173) to store multiplicand.
- ✓ Since output is 8-bit long we need 8-bit register (IC-74273), 8-bit adder (we connect two IC-7483 in series). We also need 4-bit down counter (IC-74193) to observe number of time repetitive addition has done.
- ✓ To perform 8-bit adder we connected two IC-7483 in series mean C_out of least significant 4-bit adder is connected to C_in of more significant 4-bit adder.

Loading 4-bit multiplicand:

- We input our multiplicand through ASCII keyboard, in which we will enter value needed manually. Since we work on 4-bit only. The output of 4 pins of ASCII keyboard is stored in IC-74173.
- Strobe S pin is connected to IC so that it will get clock input through it. Master reset, input and output enable pins are grounded because 4-bit value is stored in register only when input enable pins are low and to reach this stored data to output pins, output enable pins are grounded.

Loading 4-bit multiplier:

- This one is also input manually and storing is similar to multiplicand.

Circuit for manual multiplexer:

- Output pins of stored multiplicand register is connected to B1-B4 pins of lower significant adder which those pins are grounded for higher significant adder.
- Now the outputs of both IC's are connected to IC74273 such that less significant 4-bit output of IC-74273 are connected to A1-A4 pins of low significant adder.
- Similarly for high significant adder also. Now the entered inputs are turned into 8-bit significant digits.
- We use IC-74193 which contains CPU, CPD, TCU, TCD, PL, MR pins. Here we want to know how many know times repetitive addition occurs.

- So, we want to decrease multiplier such that when it goes to 0, our addition completes. So, we need down counting functionality therefore we prefer to put CPU pin inactive while addition is done.
- We get clock pulse from pulser. The MR pins of IC-74193 has to be set low. The process we follow to see output is
- Initially CPU, CPD, PL pins are low. But before entering second input (multiplier) we have to keep CPU, PL to high. Then to perform repetitive addition we have to switch CPD pin from low→high→low such that one time addition has occurs.

Circuit for auto multiplexer:

- In this we will not do repetitive addition manually. To perform it automatically we connect two 2-input AND gates in which one input is from pulser and other is TCD pin of IC-74193. we connect output of this AND gate as input of other AND gate in which its second input is logic switch. output of this second AND gate is connected to CPD input pin of IC74193.
- For this circuit to get output we perform same as before but rather than switching CPD pin, we just switch logic switch at output of AND gate.

Observations:

From attached simulation results

- 9 multiplied by 8 (1000) = 72 (01001000)
- 15 (o) multiplied by 8 (1000) = 120 (01111000)

We cannot enter 15 through ASCII keyboard but we can enter variables in which their values are defined.

Summary:

We concluded that output from both manual and auto multiplexers are same from simulations results which are shown under circuit diagrams.

From this experiment I have learned

- Designing of circuit which performs repetitive addition.
- How to approach with 8-bit adders which was not done earlier.

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