AROR UNIVERSITY
OF ART, ARCHITECTURE,
DESIGN & HERITAGE,
SUKKUR, SINDH

Faculty of Artificial Intelligence & Multimedia Gamming

BS – Multimedia Gamming

Digital Logic Design Lab

Lab # 09: Multiplexer & Demultiplexer

Engr. Muhammad Younis

Submission Profile

Name: Submission date (dd/mm/yy):

Marks obtained:

Comments:

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Instructor

Lab Learning Objectives:

Upon successful completion of this experiment, the student will be able:

- Reflect on the similarities and differences between encoders and multiplexers
- Examine the function of different Multiplexer and Demultiplexer using logic gates

Lab Hardware and Software Required:

Platform: NI ELVIS III	✔ View User Manual: http://www.ni.com/en-us/support/model.ni-elvis-iii.html ✔ View Tutorials: https://www.youtube.com/playlist?list=PLvcPIuVaUMIWm8ziaSxv0gwtshBA2dh_M
Software: NI Multisim 14.0.1 Education Version or newer	✔ Install Multisim: http://www.ni.com/gate/gb/GB_ACADEMICEVALMULTISIM/US ✔ View Help: http://www.ni.com/multisim/technical-resources/

Background Theory:

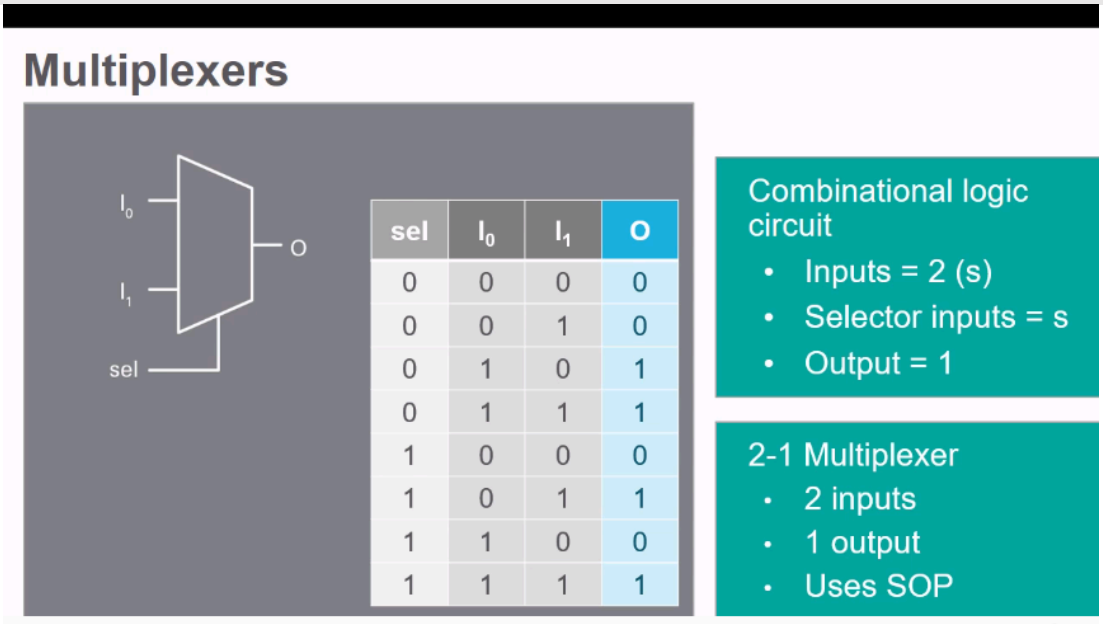


Figure 1-1 Video. View the video here: https://youtu.be/khmQ-LT_Cxg

Video Summary

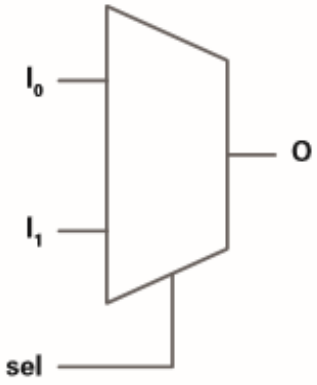
- Multiplexers are combinational logic circuits
- Clock multiplexing is used for operating the same logic function at different clock rates from different sources
- Demultiplexers are combinational logic circuits that have the opposite function of a multiplexer

Multiplexers

The *multiplexer*, abbreviated *MUX*, is a combinational logic circuit which has multiple data inputs, one or more select inputs and one output.

- It passes the data on one of the inputs, depending on the selection signals, to the output
- With the help of this logic circuit, multiple signals can share the same data output
- Multiplexers have 2s inputs and s selector lines, which determine which of the inputs to output.
- Multiplexers are one of the most widely used combinational circuits, their application areas include:
    - Data routing
    - Operation sequencing
    - Parallel-to-serial conversion
    - Waveform generation

The simplest circuit is the 2-to-1 multiplexer, with the graphical symbol presented in the leftmost figure. Its functionality is described by the joining truth table. The multiplexer below is only 1-bit wide since bit line is connected to a single output bit line.



sel	I_0	I_1	O
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	1

Figure 1-2 Image of 2-to-1 multiplexer (left) and truth table (right)

The truth table can be simplified to the following truth table for a bitter understanding of the circuit's operation:

sel	O
0	I_0
1	I_1

Figure 1-3 Simplified truth table

Using the sum-of-products Boolean function gives the following combinational logic circuit:

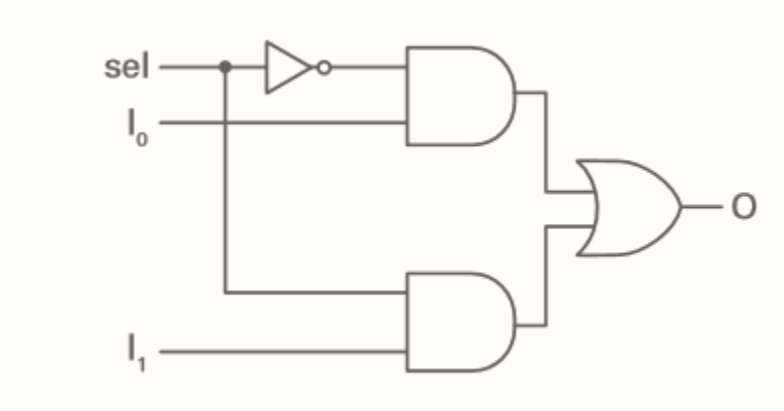


Figure 1-4 Combinational logic circuit

Clock multiplexing is a technique used for operating the same logic function at different clock rates, from different sources (inputs).

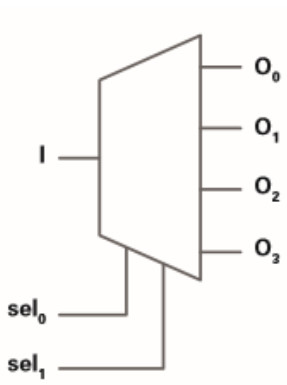
- The logic circuits are switched by the select signal often while the circuit is running
- This process of switching isn't very safe and can result in a glitch that occurs when one signal is going down as the other is going up.
- Clock safe switches can be implemented to eliminate glitches.

Demultiplexers

Demultiplexers (DEMUX) have the opposite function of a multiplexer

- It places the value of a single data input on several data outputs depending on a selection signal
- Usually demultiplexers have s select inputs and 2s outputs
- Since demultiplexers take one input and connect it to many outputs, some of their uses are for communication (two-way communication usually includes both multiplexers and demultiplexers) and for serial to parallel converters

- The graphical symbol for a 1-to-4 demultiplexer is shown below (left) as well as the corresponding 1-to-4 DEMUX truth table (centre) and the CLC (right)



sel_1	sel_0	O_3	O_2	O_1	O_0
0	0	0	0	0	I
0	1	0	0	I	0
1	0	0	I	0	0
1	1	I	0	0	0

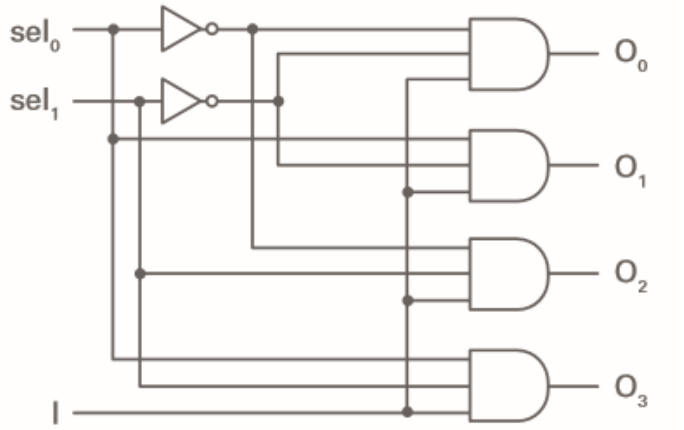
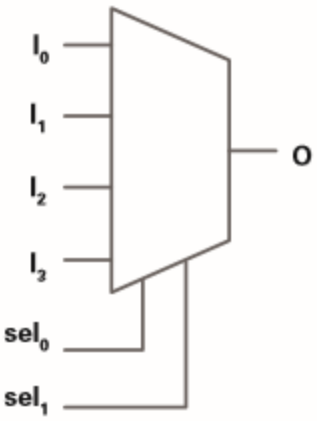


Figure 1-5 Demultiplexer (top left), truth table (top center) and CLC (bottom)

Lab Activities:

4-to-1 MUX

Using the following truth table (right) to describe the behavior of a 4-to-1 MUX (left), design and implement the corresponding circuit in multisim.



sel_1	sel_0	O
0	0	I_0
0	1	I_1
1	0	I_2
1	1	I_3

Figure 1-8 Image of 4-to-1 MUX (left) and truth table (right)

1-to-4 Demultiplexer

In simulation build and run the following 1-to-4 demultiplexer

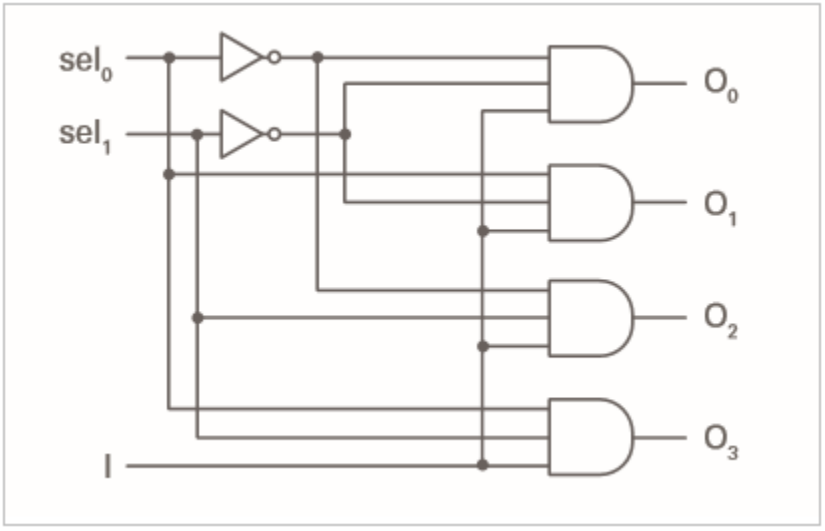


Figure 1-9 Image of 1-to-4 demultiplexer

Lab Exercise:

- Implement 4 to 1 multiplexer circuit on **NI-ELVIS II** using 74HC153/74LS153
- Implement 1 to 4 de-multiplexer circuit on **NI-ELVIS II** using 74HC155/74LS155

1-1 Write the sum-of-products Boolean functions for the 4-to-1 Multiplexer:

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_____

1-2 Write the sum-of-products Boolean functions for the 1-to-4 Demultiplexer:

_____

_____

1-3 What is the function of the Selector (Sel) in Multiplexers and Demultiplexers?

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1.2 74LS153 MULTIPLEXER IC:

The TTL 74LS153 Multiplexer IC has two 4-input multiplexers. It has two selection inputs which act on both selectors, two enabling inputs which must be usually low, four inputs for each channel, and two outputs.

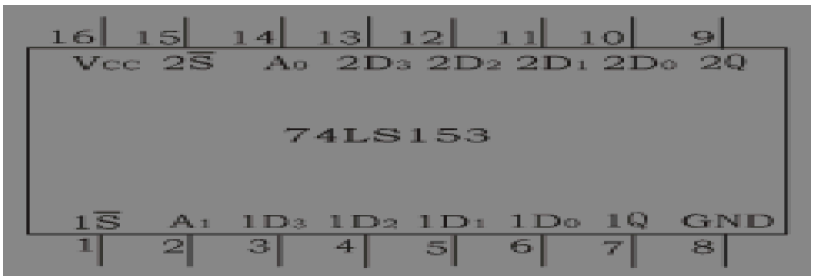

Figure 1-6 Pin diagram

1.3 74LS155 DE-MULTIPLEXER IC:

The TTL 74LS155 is a-output De-multiplexer. Inside it has two identical decoding circuits, from 1 to 4 lines, with individual strobe commands (inhabitation) and common inputs of the binary addresses. The individual strobes enable the activation or inhabitation of each of the two 4-bit sections. The data across the input IC appear inverted across the output, while the data across 2C is not inverted.

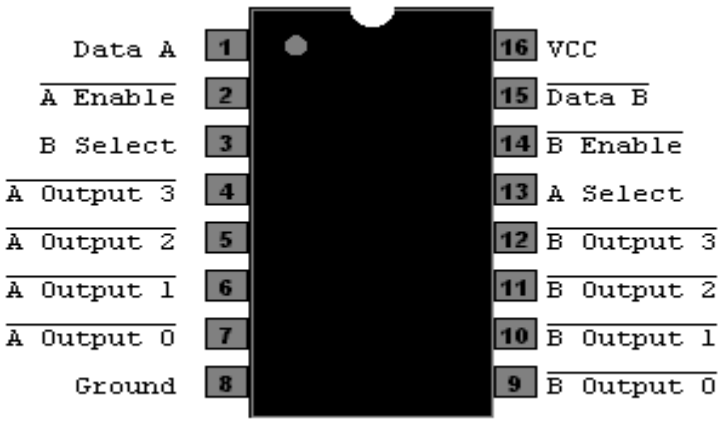

Figure 1-7 Pin Diagram