

Practical No.10: Build and test the functionality of 4:1/8:1 Multiplexer.

I Practical Significance

In most of the electronic systems, the digital data is available on more than one line. It is necessary to route this data over a single line. Under such circumstances we require a circuit which selects one of the many inputs at a time. This circuit is a multiplexer, which has many inputs, one output and some select line inputs. Practical significance lies in their ability to simplify complex digital designs, reduce hardware complexity, and improve system performance

II Industry/Employer Expected Outcome(s)

Students will be able to test the functionality of the digital circuits/system.

III Course Level Learning Outcome(s)

Develop combinational logic circuits for given applications.

IV Laboratory Learning Outcome(s):

1. Build/Test function of MUX Digital IC

V Relevant Affective Domain related outcome(s)

Significance of select lines to select one output from many inputs.
Handle the component and equipment carefully.
Follow all safety precaution

VI Relevant Theoretical Background

Multiplexer is a combinational circuit that is one of the most widely used in digital design. The multiplexer is a data selector which gets one out of several inputs to a single output. It has n data inputs and one output line and m select lines where $2^m = n$ shown in fig10.1. Depending upon the digital inputs applied at the select inputs one out of n data input is selected and transmitted to a single output channel. Normally strobe (E) input is incorporated which is generally active low which enables the multiplexer when it is LOW. Strobe input helps in cascading. IC 74151A is an 8: 1 multiplexer which provides two complementary outputs Y and \bar{Y} The output Y is same as the selected input and \bar{Y} is its complement. The n : 1 multiplexer can be used to realize m variable function. ($2^m = n$, m is no. of select inputs)

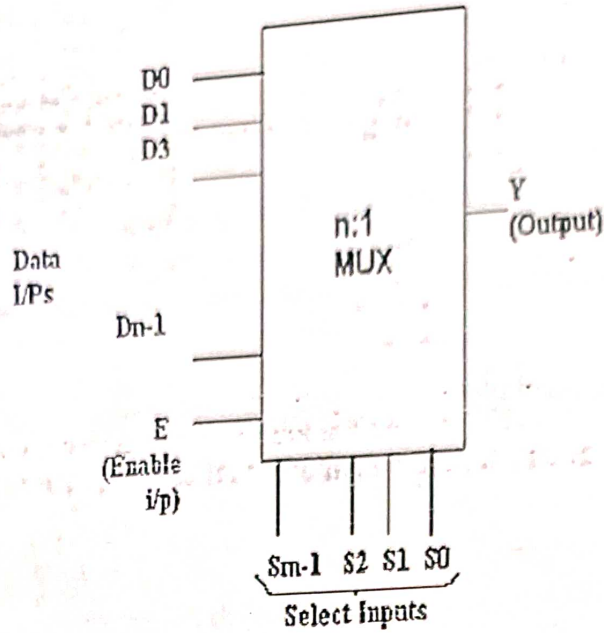


Fig 10.1: Block diagram of n: 1 Multiplexer

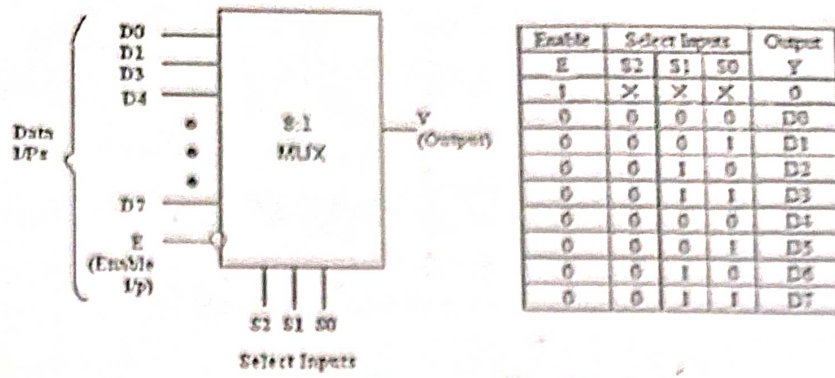
Courtesy: <https://www.google.co.in/search?client=firefox-b&biw=1366&bih=654&ctbm=isc>

Types of Multiplexer (MUX):

1. 2:1 MUX (2 lines to 1 line)
2. 4:1 MUX (4 lines to 1 line)
3. 8:1 MUX (8 lines to 1 line)
4. 16:1 MUX (16 lines to 1 line)

List of ICs which provides multiplexing

IC No.	Function	Output State
74157	Quad 2:1 MUX	Output same as input given
74158	Quad 2:1 MUX	Output is inverted input
74153	Dual 4:1 MUX	Output same as input
74352	Dual 4:1 MUX	Output is inverted input
74151A	8:1 MUX	Both outputs available (i.e. complementary outputs)
74151	8:1 MUX	Output is inverted input
74150	16:1 MUX	Output is inverted input



(E=1 for active high E=0 for active low)

Fig 10.2: Block diagram of 8: 1 MUX, Truth Table of 8:1 MUX

VII Circuit diagram

a) Sample circuit

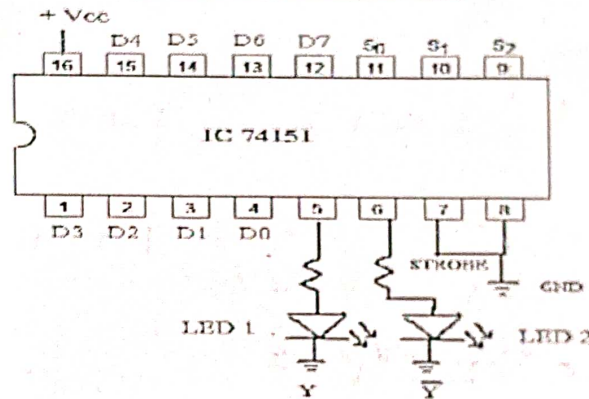
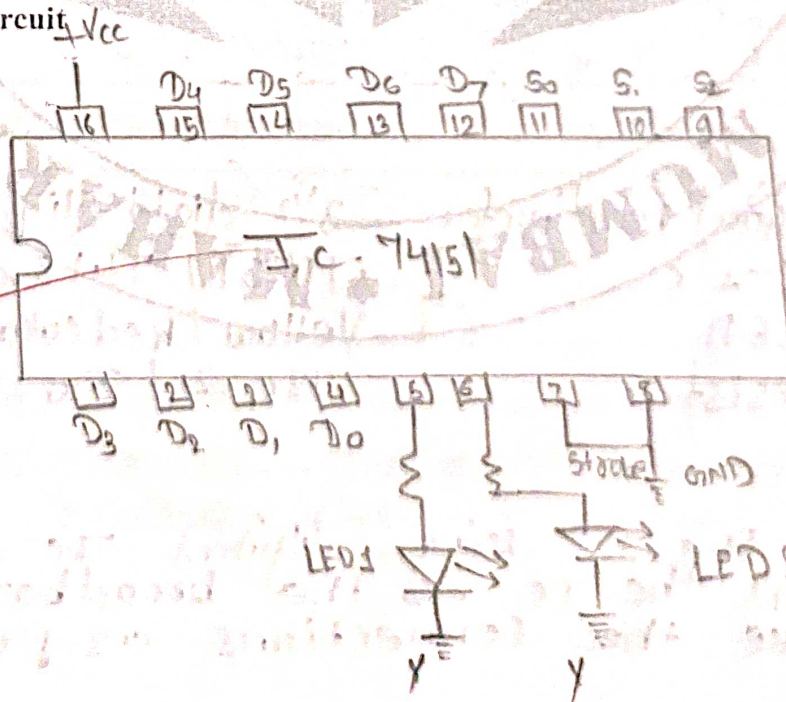


Fig 10.3: Circuit Diagram (8:1 Mux IC)

b) Actual circuit



VIII Resources Required

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Digital Multimeter	3 ½ digit display	1 or 2
2	Digital IC Tester	Tests a wide range of digital IC's such as 74 series, 40/45 series of CMOS IC's	1
3	DC Power supply	+5 V fixed power supply or Variable DC power supply (0-30V)	1
4	Breadboard	5.5cm X 17cm	1
5	Connecting Wires	Single strand wires of 0.6 mm	As per Requirement
6	IC	74151/74150	1
7	LED	Red/Yellow color 5 mm	4(3 for Select Lines and One for outputs)
8	Resistor	220Ω/330Ω	2

IX Precautions to be followed

- 1) Check IC before use.
- 2) Set power supply to 5V (Variable DC Power Supply) before connecting.
- 3) Check all the connections as per circuit diagram

X Procedure

1. Test the IC using Digital IC tester
2. Mount the IC on the breadboard
3. Make the connection as per fig 10.3
4. Connect the +5V to +Vcc pin of IC and GND pin to ground
5. Observe the LED (on or off) for each combination of input as per truth table
6. Verify the truth table

XI Resources Used

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Digital multimeter	3 ½ digit display	1 or 2
2	IC	74151 / 74150	1
3	LED	Yellow / Red color 5mm	4
4	Resistor	220-Ω / 330-Ω	2

XII Actual Procedure

- i) Test the IC using digital IC tester.
- ii) mount the IC on the breadboard.
- iii) make the connections as per fig 10.3

- 4] Connect the +5V to +Vcc pin of IC and GND pin to ground.
- 5] Verify the truth table.

XIII Observation:

Table 10.1: Observation Table

Strobe	Data Input	Inputs			Outputs		Outputs	
		Select Input			Y	\bar{Y}	Y (O/P volt)	\bar{Y} (O/P volt)
G	D_n	S_2	S_1	S_0				
0	$D_0=0$ $D_1=1$ $D_2=1$ $D_3=0$ $D_4=0$ $D_5=1$ $D_6=1$ $D_7=0$	0 (0V)	0 (0V)	0 (0V)	0	1	6V	4.5V
0		0 (0V)	0 (0V)	1 (5V)	1	0	4.5V	0V
0		0 (0V)	1 (5V)	0 (0V)	1	0	4.5V	0V
0		0 (0V)	1 (5V)	1 (5V)	0	1	0V	4.5V
0		1 (5V)	0 (0V)	0 (0V)	1	0	4.5V	0V
0		1 (5V)	0 (0V)	1 (5V)	0	1	0V	4.5V
0		1 (5V)	1 (5V)	0 (0V)	0	1	0V	4.5V
0		1 (5V)	1 (5V)	1 (5V)	1	0	4.5	0V
1		X	X	X				

(Write the observation with respect to Inputs)

(Note: 'X' indicates the don't care condition. It means the status of selected input may be any combination)

XIV Result(s)

In this practical we learnt how to build and test the functionality of 4:1 / 8:1 multiplexer.

XV Interpretation of results

In this practical we observe how to build & test the functionality of 4:1 / 8:1 multiplexer.

XVI Conclusion and recommendation

Hence we learnt how perform or build and test the functionality of 4:1 / 8:1 multiplexer.

XVII Practical related questions

Note: Below given are a few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. List the function of the Strobe (G) pin?
2. List the absolute maximum ratings of IC 74151.
3. List the name of manufacturers of ICS used for this practicals?
4. List the applications where MUX is used?

[Space for Answers]

1] →

Here is the list of functions of the strobe (G) pin

1. Enables or disables data transfer
2. Controls the flow of data
3. Select which data
4. Acts as a clock or control signal for data storage or transfer
5. Latches data in latch circuits
6. Selects input signals in multiplexers
7. Determines output channels in demultiplexers
8. Controls data transfer in memory chip

2] →

The absolute maximum ratings for the IC 74151 are -

1. Supply Voltage : $-9V$
2. Input Voltage : $-0.5V$ to $V_{CC} + 0.5V$
3. Output Voltage : $-0.5V$ to $0.5V$
4. Operating temperature range : $0^{\circ}C$ to $70^{\circ}C$
5. Storage temperature range : $-65^{\circ}C$ to $150^{\circ}C$
6. Input current : $\pm 10mA$
7. Output current : $\pm 10mA$
8. Power dissipation : $500mW$

3] →

1. 7400 series (NAND gates)
2. 7402 (NOR gates)
3. 7408 (AND gates)
4. 7432 (OR gates)
5. 74151 (8-Channel multiplexer)
6. 74154 (4 to 16 line decoder)
7. 74175 (quad 0 flip-flop)
8. 7493 (4-bit binary counter)

15) →

1. Data Selection & routing System
2. digital Communication System
3. Computer networks
4. Telephone networks
5. Automotive System
6. Digital logic & circuits & microprocessors
7. medical equipment
8. Image & Video processing

XVIII References/Suggestions for further reading

1. <https://datasheetpdf.com/datasheet/74151.html>
2. <https://dec-iiitkgp.vlabs.ac.in/exp/functions-using-multiplexers> (Virtual Lab Link)
3. https://www.youtube.com/watch?v=JR6_a3KPKHE (NPTEL Video Link on Multiplexer)

XIX Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		60 %
1	Handling of the components	10%
2	identification of components	20%
3	Measuring value using suitable instrument	20%
4	working in teams	10%
Product Related: 10 Marks		40%
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusion	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		100 %

Marks Obtained			Dated signature of Teacher
Process related (15)	Product related (10)	Total (25)	
13	10	23	