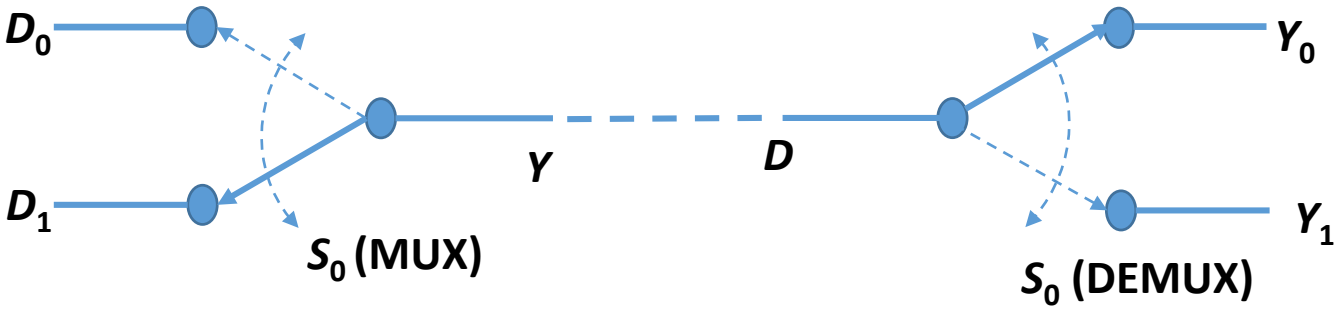
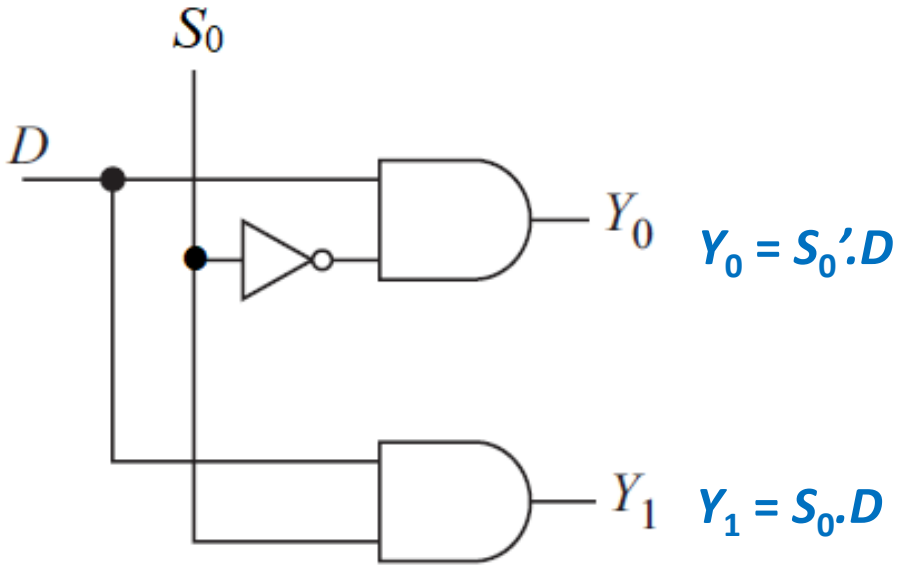
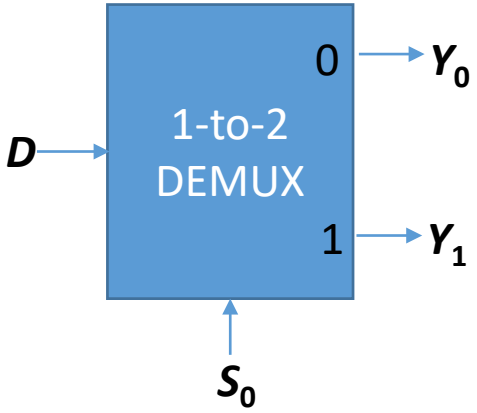
Digital Electronic Circuits
Section 1 (EE, IE)

Lecture 12

Demultiplexer



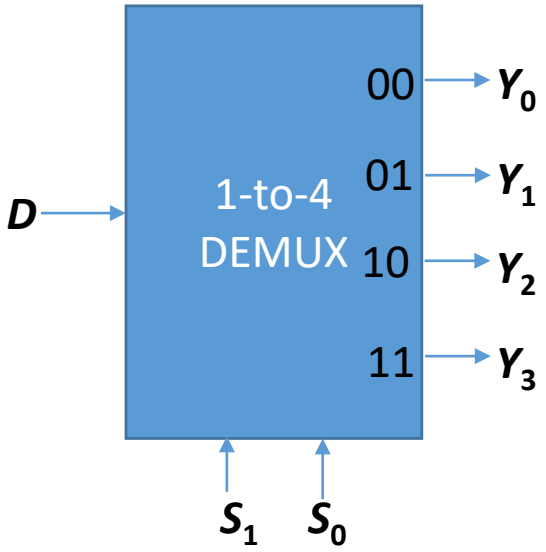




S_0	Y_0	Y_1
0	***D***	0
1	0	***D***

A demultiplexer steers the input to one of the many outputs based on control input(s).

1-t0-4 Demultiplexer



$Y_0 = S_1'S_0'.D$

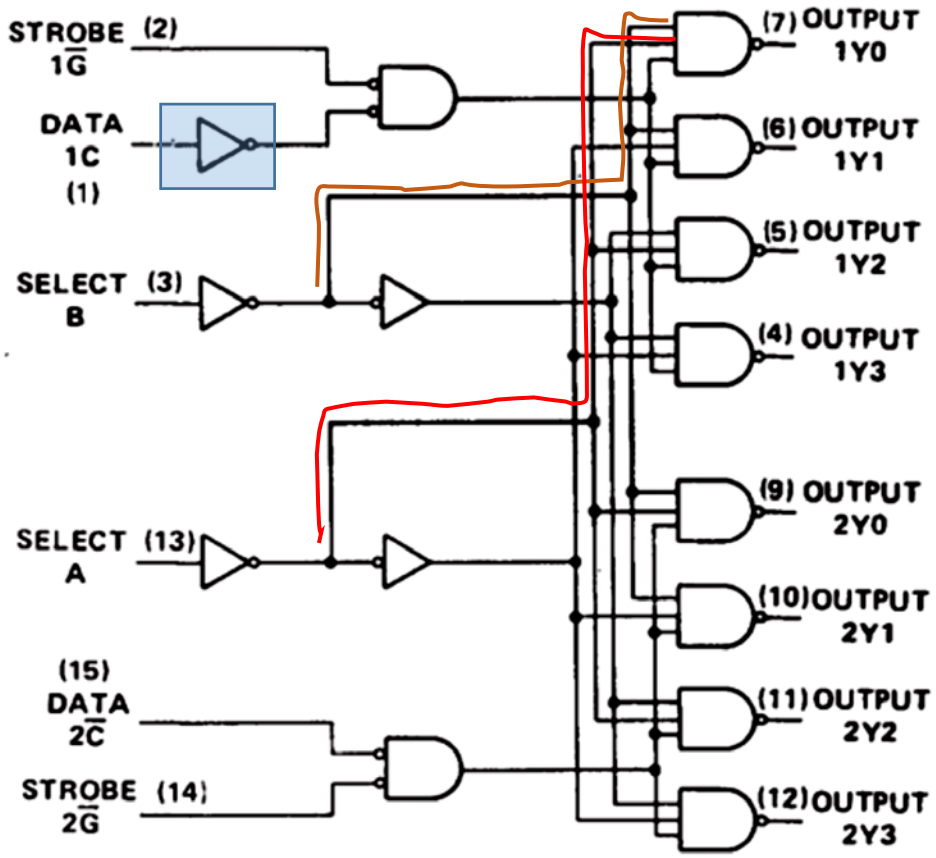
$Y_1 = S_1'S_0.D$

$Y_2 = S_1S_0'.D$

$Y_3 = S_1S_0.D$

S_1	S_0	Y_0	Y_1	Y_2	Y_3
0	0	***D***	0	0	0
0	1	0	***D***	0	0
1	0	0	0	***D***	0
1	1	0	0	0	***D***

IC 74155



B	A	G_1	C_1	$1Y_0$	$1Y_1$	$1Y_2$	$1Y_3$
X	X	H	X	H	H	H	H
X	X	X	L	H	H	H	H
L	L	L	H	L	H	H	H
L	H	L	H	H	L	H	H
H	L	L	H	H	H	L	H
H	H	L	H	H	H	H	L

B	A	G_2	C_2	$2Y_0$	$2Y_1$	$2Y_2$	$2Y_3$
L	L	L	L	L	H	H	H

.....

$1Y_0 = (B'A'.G_1'.1C)'$

$1Y_1 = (B'A.G_1'.1C)'$

.....

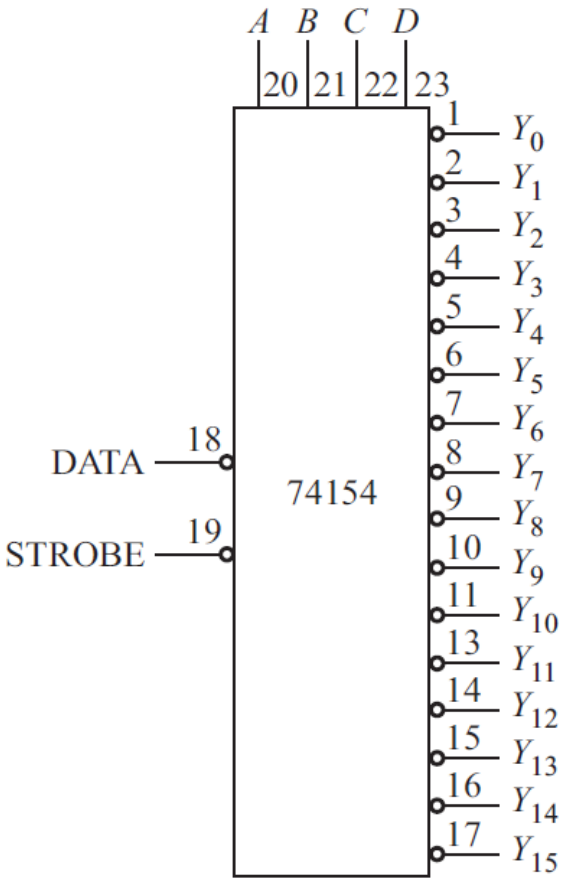
$2Y_0 = (B'A'.G_2'.2C')'$

$2Y_1 = (B'A.G_2'.2C')'$

.....

IC 74155: Dual 1-to-4 DEMUX

1-to-16 Demultiplexer



Strobe	*Data*	*A*	*B*	*C*	*D*	Y_0	Y_1	Y_2	.	Y_{14}	Y_{15}
L	*L*	*L*	*L*	*L*	*L*	*L*	*H*	*H*	.	*H*	*H*
L	*L*	*L*	*L*	*L*	*H*	*H*	*L*	*H*	.	*H*	*H*
L	*L*	*L*	*L*	*H*	*L*	*H*	*H*	*L*	.	*H*	*H*
L	*L*	*L*	*L*	*H*	*H*	*H*	*H*	*H*	.	*H*	*H*
L	*L*	*L*	*H*	*L*	*L*	*H*	*H*	*H*	.	*H*	*H*
L	*L*	*L*	*H*	*L*	*H*	*H*	*H*	*H*	.	*H*	*H*
L	*L*	*L*	*H*	*H*	*L*	*H*	*H*	*H*	.	*H*	*H*
L	*L*	*L*	*H*	*H*	*H*	*H*	*H*	*H*	.	*H*	*H*
L	*L*	*H*	*L*	*L*	*L*	*H*	*H*	*H*	.	*H*	*H*
L	*L*	*H*	*L*	*L*	*H*	*H*	*H*	*H*	.	*H*	*H*
L	*L*	*H*	*L*	*H*	*L*	*H*	*H*	*H*	.	*H*	*H*
L	*L*	*H*	*L*	*H*	*H*	*H*	*H*	*H*	.	*H*	*H*
L	*L*	*H*	*H*	*L*	*L*	*H*	*H*	*H*	.	*H*	*H*
L	*L*	*H*	*H*	*L*	*H*	*H*	*H*	*H*	.	*H*	*H*
L	*L*	*H*	*H*	*H*	*L*	*H*	*H*	*H*	.	*L*	*H*
L	*L*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	.	*H*	*L*
L	*H*	*X*	*X*	*X*	*X*	*H*	*H*	*H*	.	*H*	*H*
H	*L*	*X*	*X*	*X*	*X*	*H*	*H*	*H*	.	*H*	*H*
H	*H*	*X*	*X*	*X*	*X*	*H*	*H*	*H*	.	*H*	*H*

IC 74154: 1-to-16 DEMUX

$Y_0 = (A'B'C'D'.DATA'.STROBE')'$

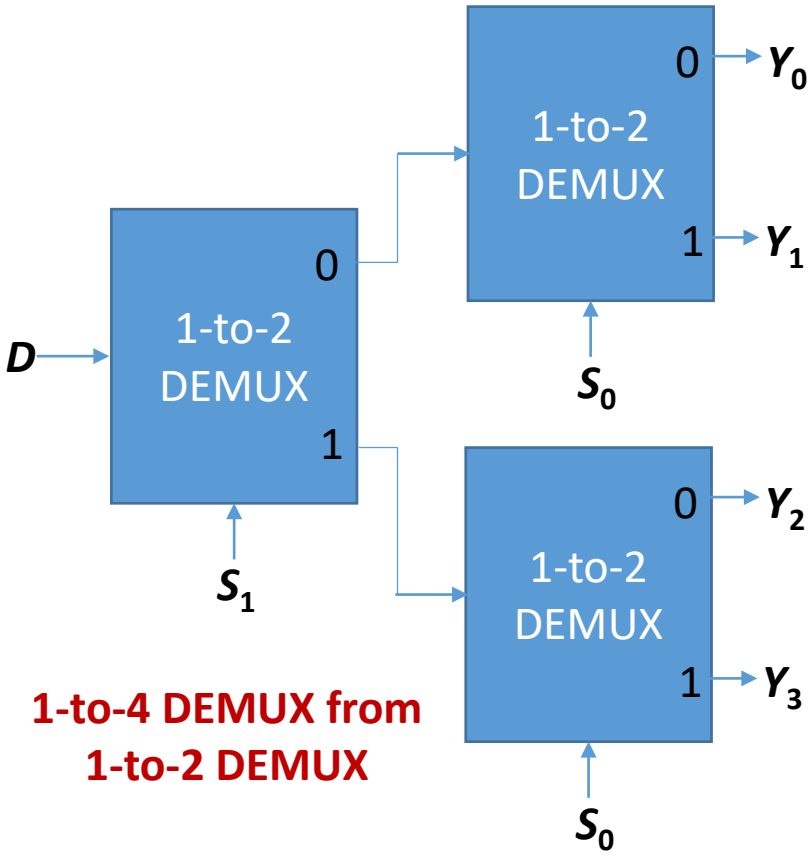
$Y_1 = (A'B'C'D.DATA'.STROBE')'$

.....

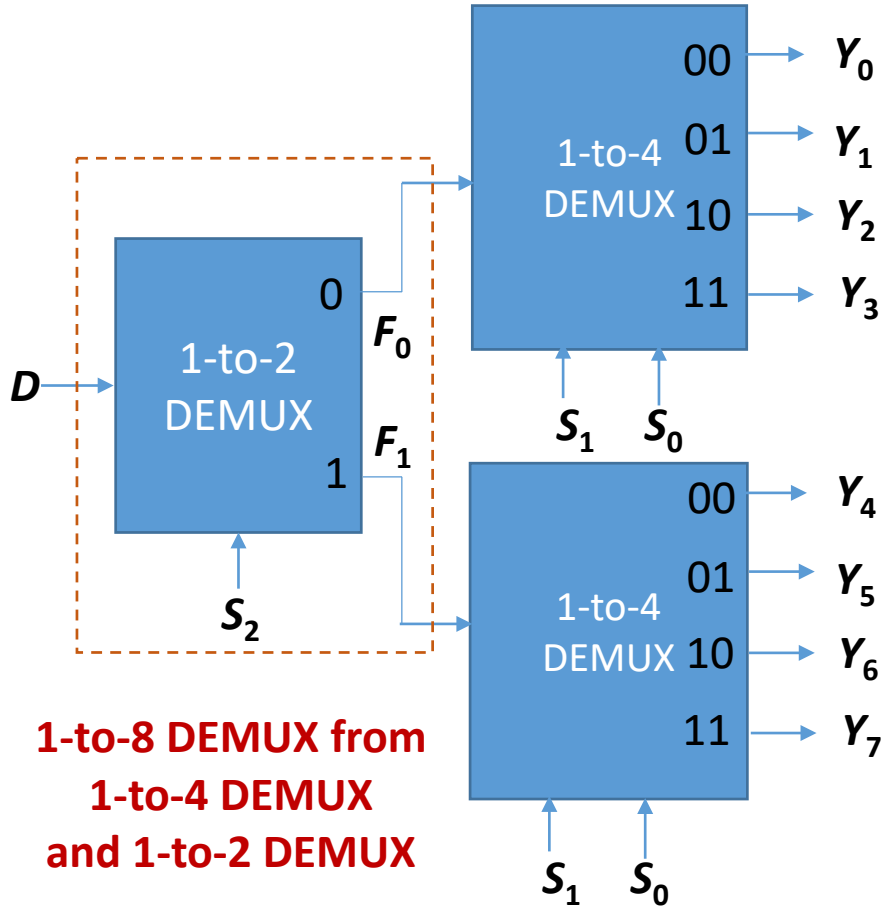
$Y_{15} = (ABCD.DATA'.STROBE')'$

If STROBE = 0 and *A* = 0, select inputs *BCD* steers *DATA* to one of Y_0 … Y_7 outputs: **1-to-8 DEMUX.**

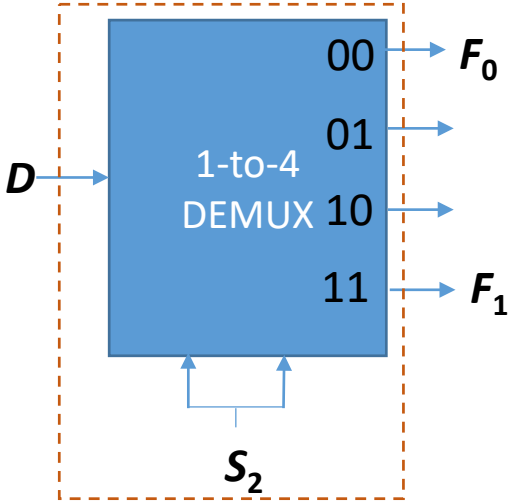
Higher order DEMUX from lower order



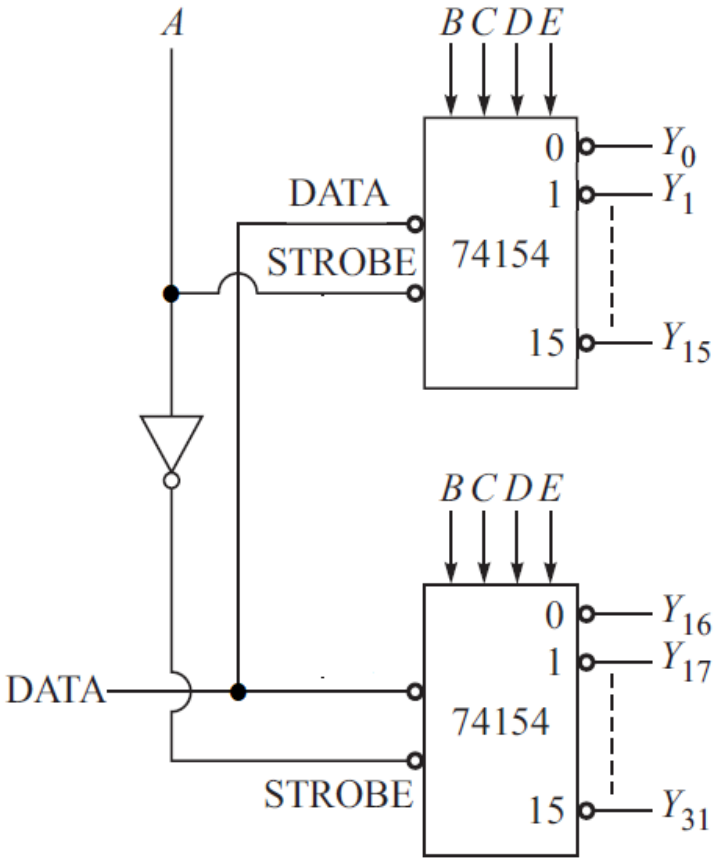
1-to-4 DEMUX from 1-to-2 DEMUX



1-to-8 DEMUX from 1-to-4 DEMUX and 1-to-2 DEMUX



Higher order DEMUX using Strobe



$Y_0 = (B'C'D'E'.DATA'.A')'$

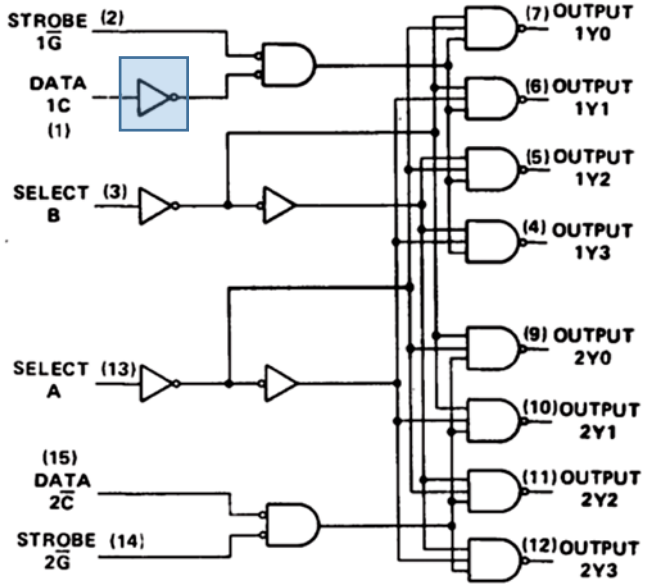
$Y_1 = (B'C'D'E.DATA'.A')'$

.....

$Y_{16} = (B'C'D'E'.DATA'.A)'$

.....

$Y_{31} = (BCDE.DATA'.A)'$

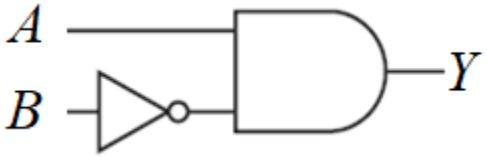


IC 74155: 1-to-8 from dual 1-to-4
Select = 1C = 2C'
Data = 1G = 2G

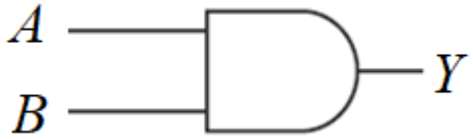
Decoder

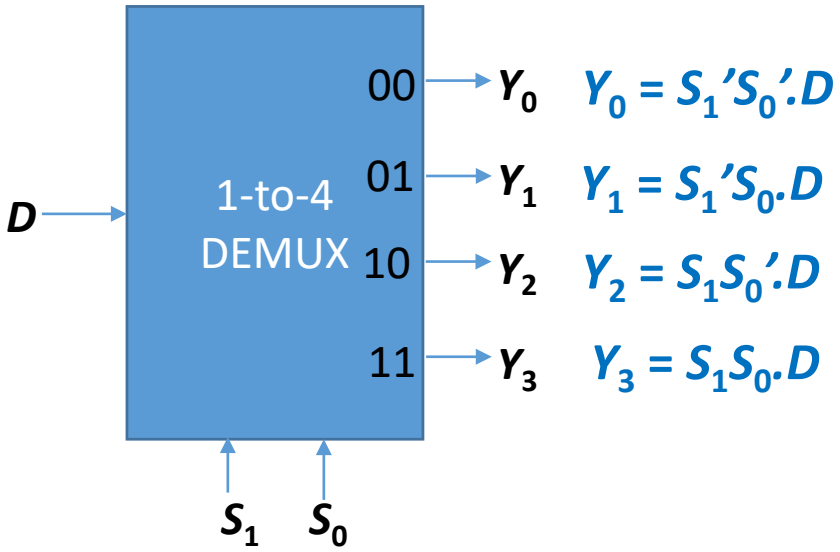
A decoder decodes input bit pattern by appropriate logic and activates the output when specific combination is present.

To decode *AB* = 01
(active HIGH)



To decode *AB* = 11



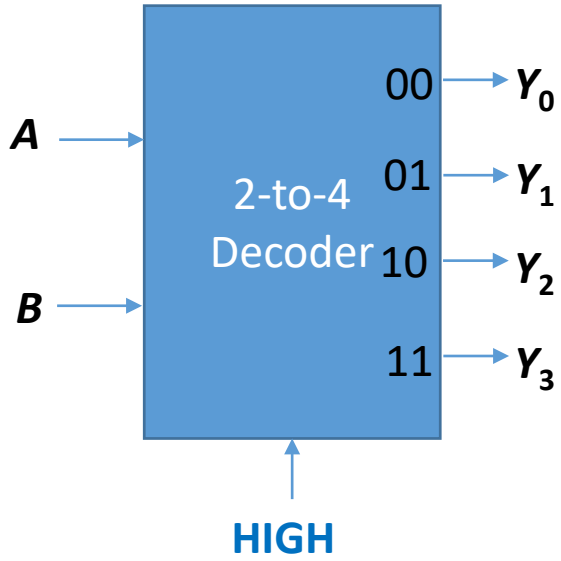


$Y_0 = S_1'S_0'.D$

$Y_1 = S_1'S_0.D$

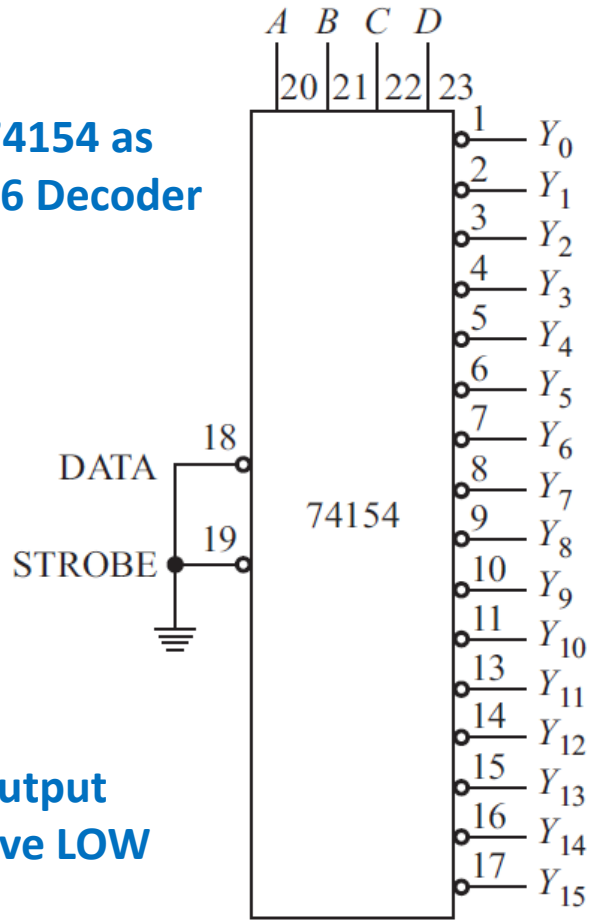
$Y_2 = S_1S_0'.D$

$Y_3 = S_1S_0.D$

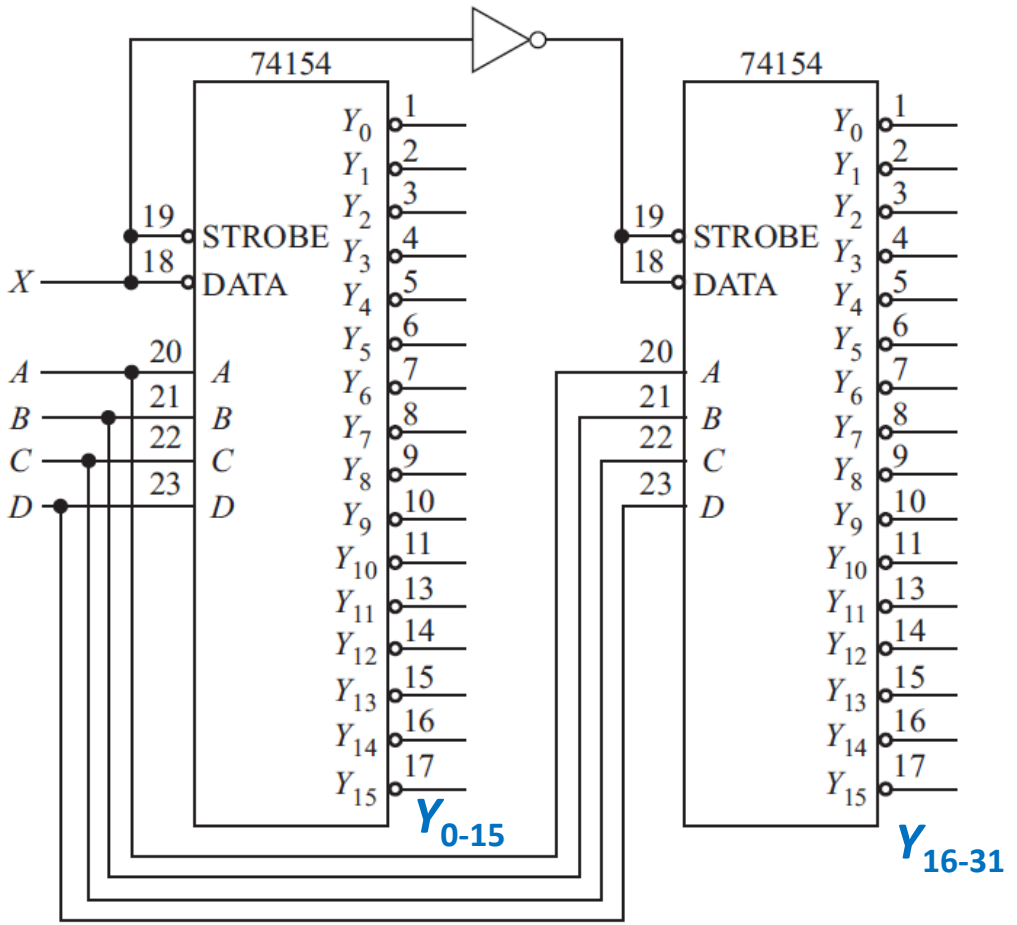


IC 74154 as Decoder

IC 74154 as
4-to-16 Decoder

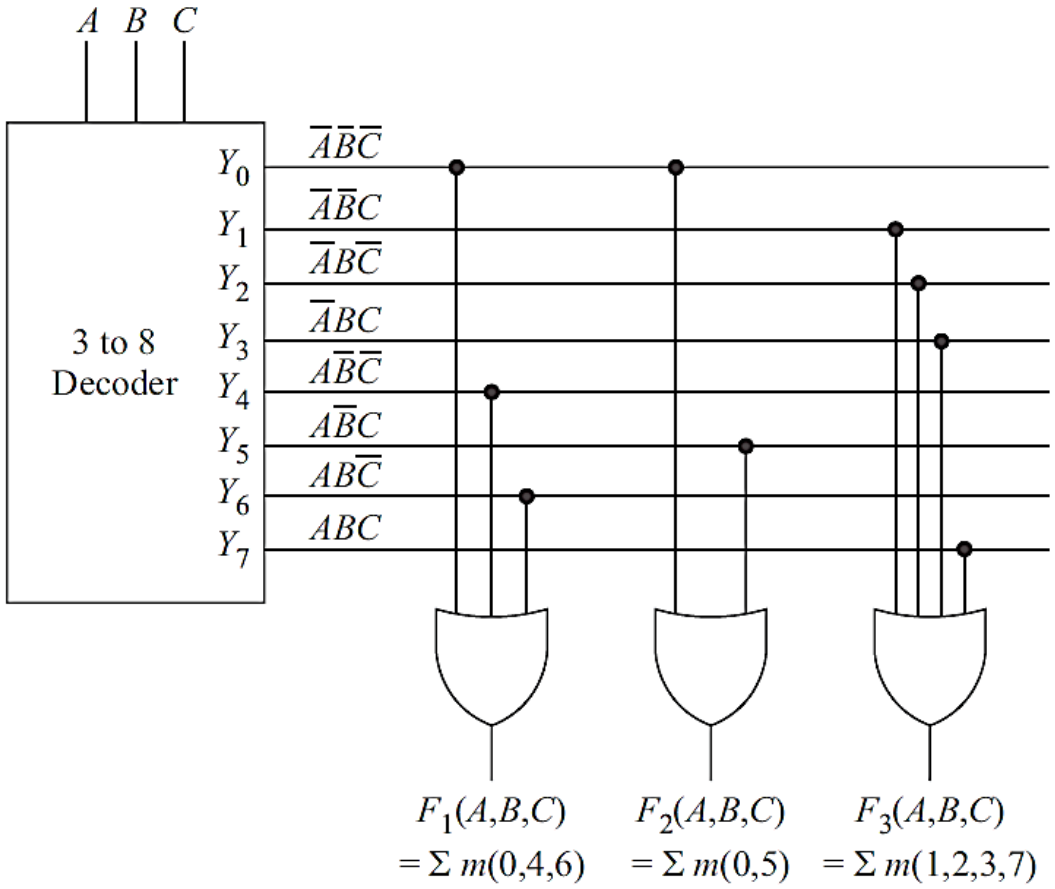


Output
Active LOW



Chip expansion /
Higher order from
lower order:
Similar to DEMUX

Decoder for Multiple Output



- Decoder generates all the minterms.
- OR gate sums up minterms defining a function.

References:

- Donald P. Leach, Albert P. Malvino, and Goutam Saha, Digital Principles & Applications 8e, McGraw Hill
- Technical documents from http://www.ti.com accessed on Oct. 08, 2018