

# CMOS Combi-2 (H.2)

20151111

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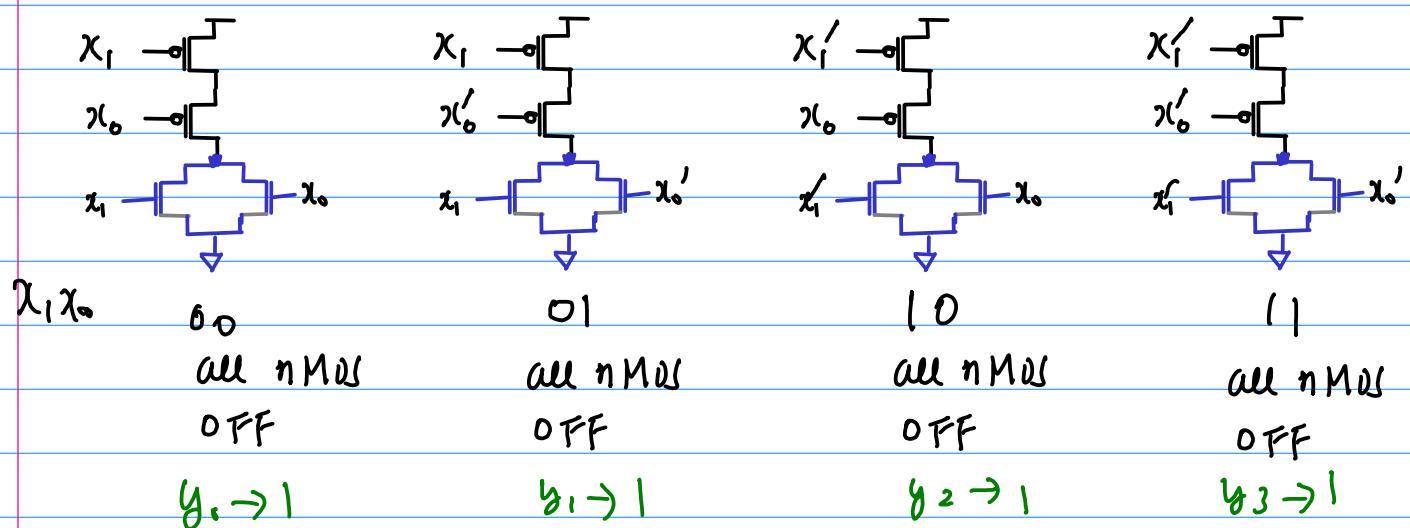
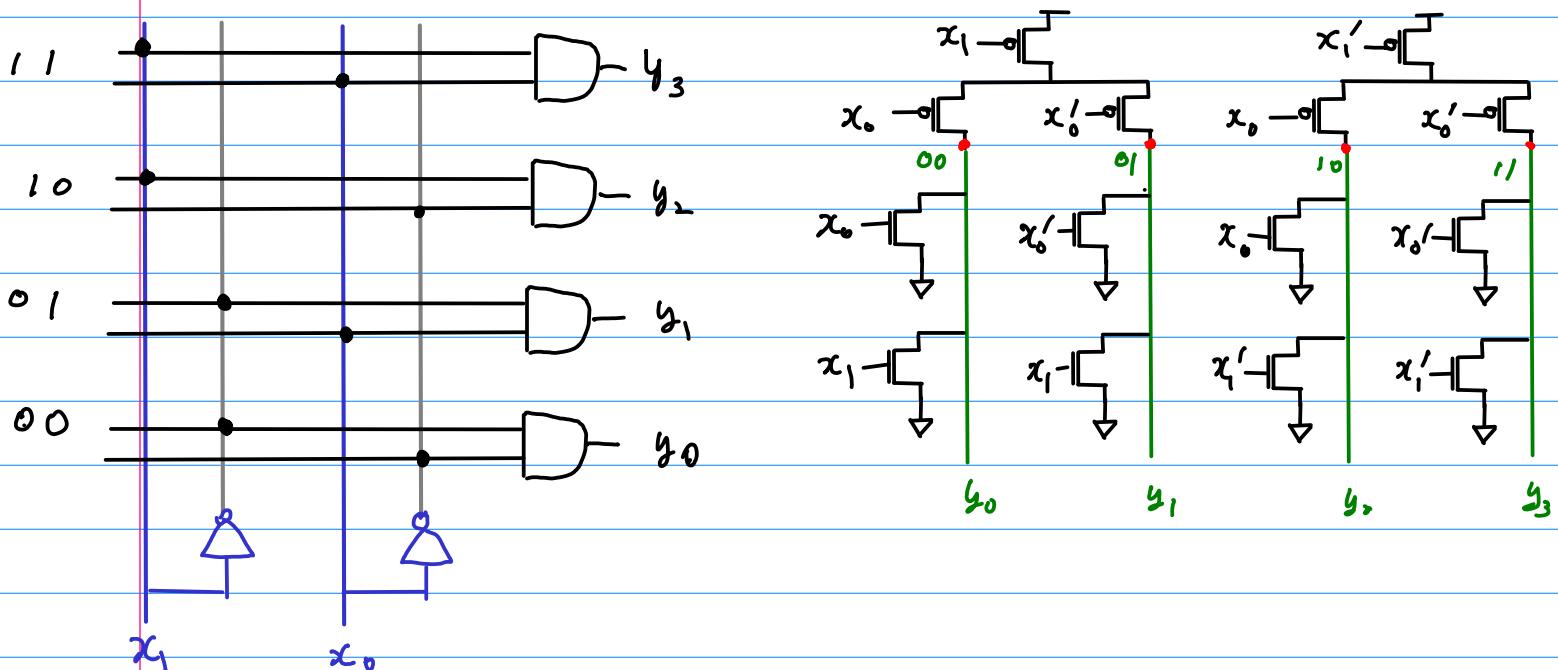
# References

Some Figures from the following sites

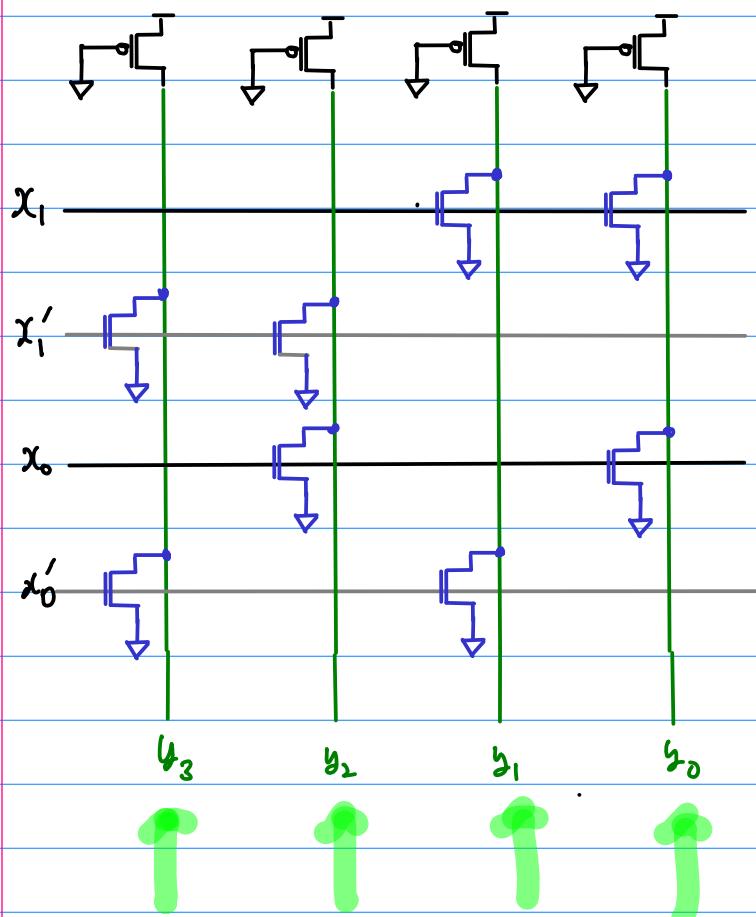
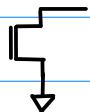
- [1] <http://pages.hmc.edu/harris/cmosvlsi/4e/index.html>  
Weste & Harris Book Site
- [2] [en.wikipedia.org](http://en.wikipedia.org)
- [3] Digital Integrated Circuits : A Design Perspective,  
Jan M. Rabaey,  
(<http://bwrcs.eecs.berkeley.edu/Classes/IcBook/>)
- [4] Digital Electronics and Design with VHDL  
Pedroni

# Decoder

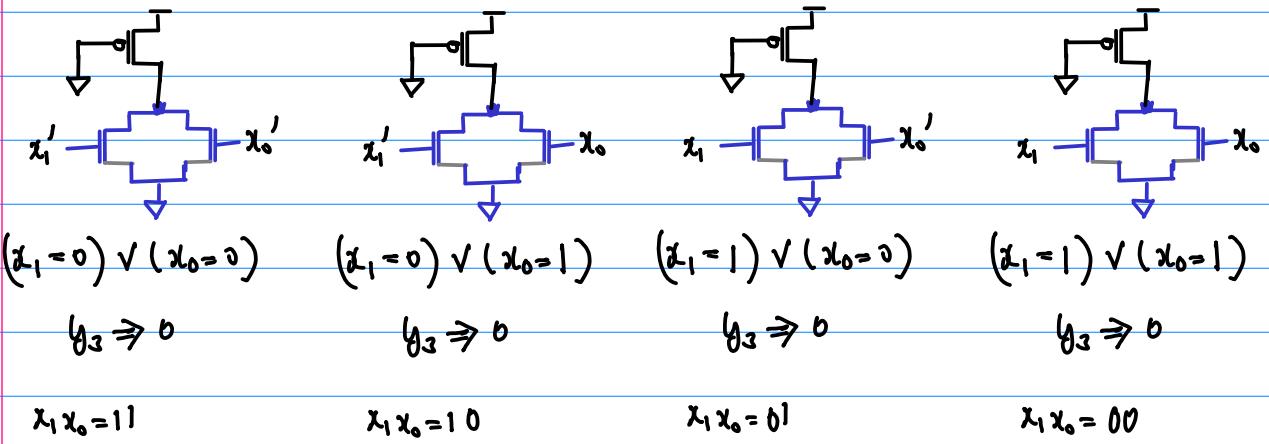
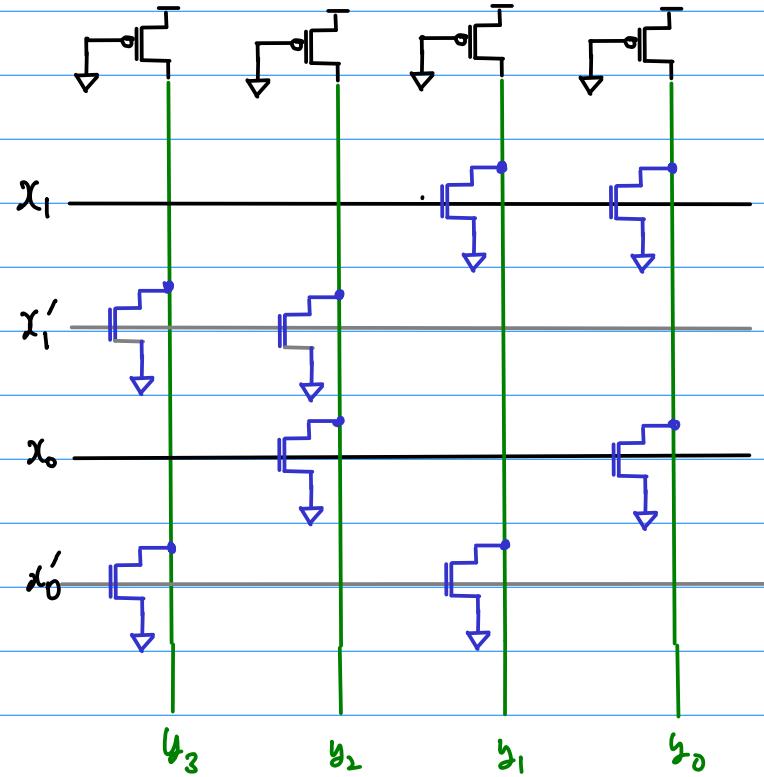
$x_1$	$x_0$	$y_3$	$y_2$	$y_1$	$y_0$
0	0	0	0	0	1
0	1	0	0	1	0
1	0	0	1	0	0
1	1	1	0	0	0



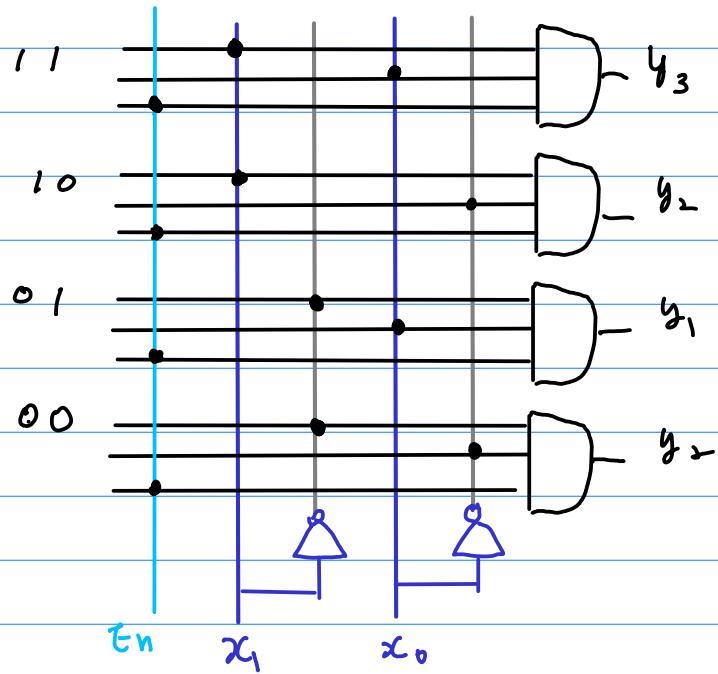
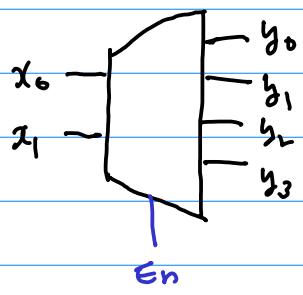
$x_1$	$x_0$	$y_3$	$y_2$	$y_1$	$y_0$
0	0	0	0	0	1
0	1	0	0	1	0
1	0	0	1	0	0
1	1	1	0	0	0



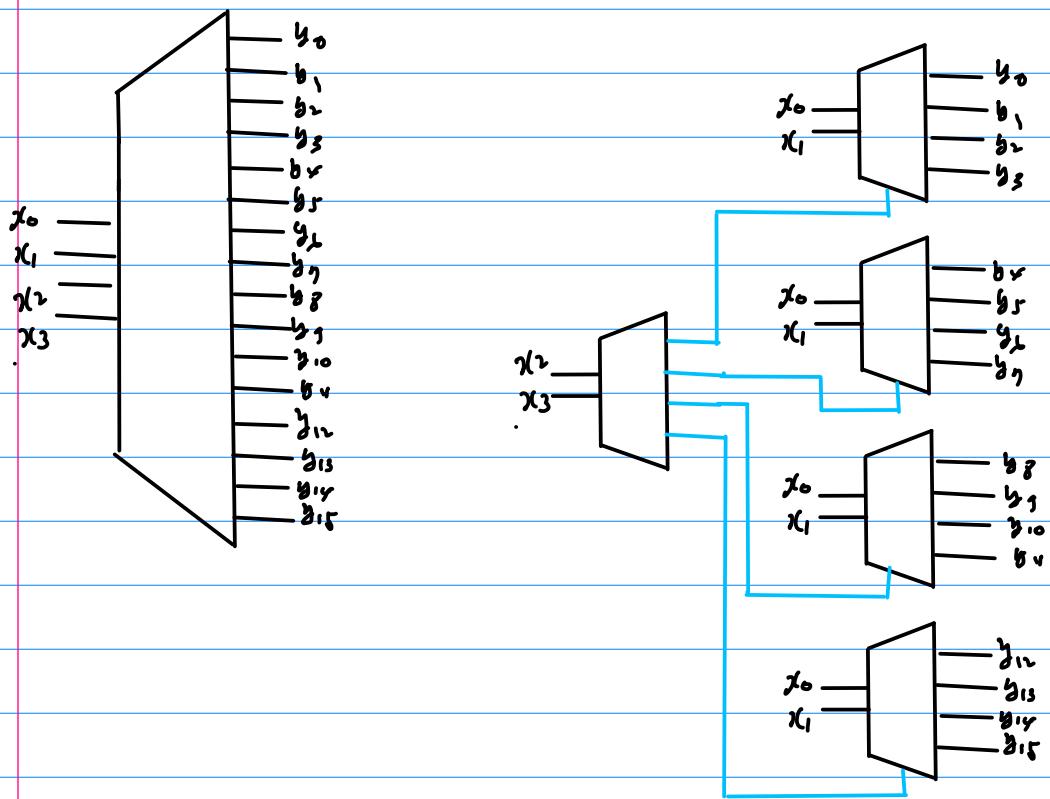
$x_1 x_0$	11	10	01	00
all nMOS	all nMOS	all nMOS	all nMOS	
OFF	OFF	OFF	OFF	



# Decoder with Enable

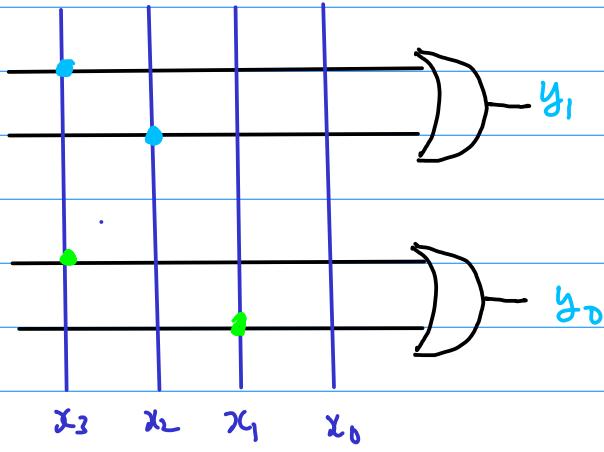


# Large Address Decoder

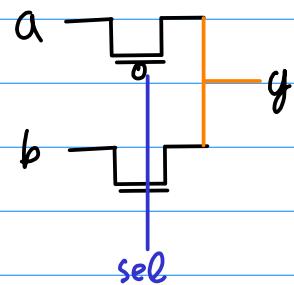
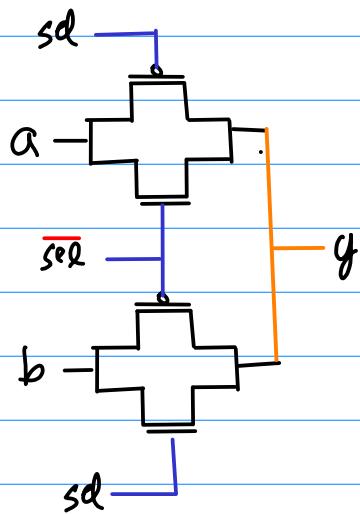
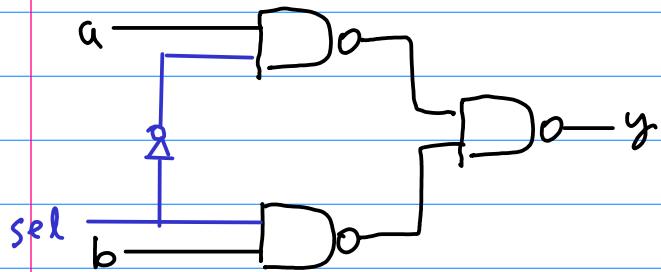


# Address Encoder

$x_3$	$x_2$	$x_1$	$x_0$		$y_1$	$y_0$
0	0	0	1		0	0
0	0	1	0		0	1
0	1	0	0		1	0
1	0	0	0		1	1

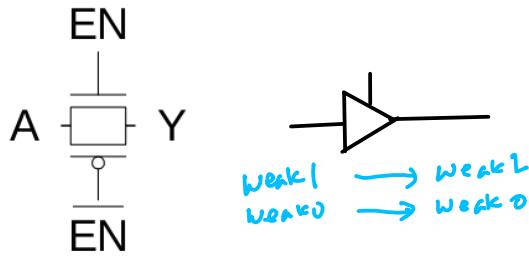


# Multiplexer



# Nonrestoring Tristate

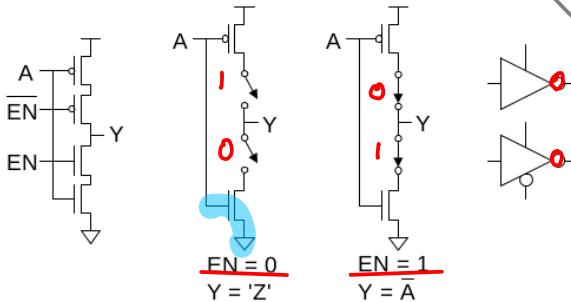
- Transmission gate acts as tristate buffer
  - Only two transistors
  - But nonrestoring
    - Noise on A is passed on to Y



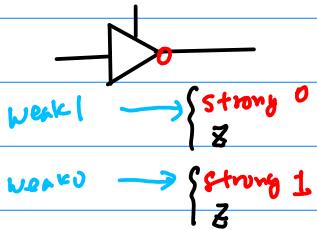
if A is weak 1 or weak 0,  
then it is propagated to the output Y

# Tristate Inverter

- Tristate inverter produces restored output
  - Violates conduction complement rule
  - Because we want a Z output



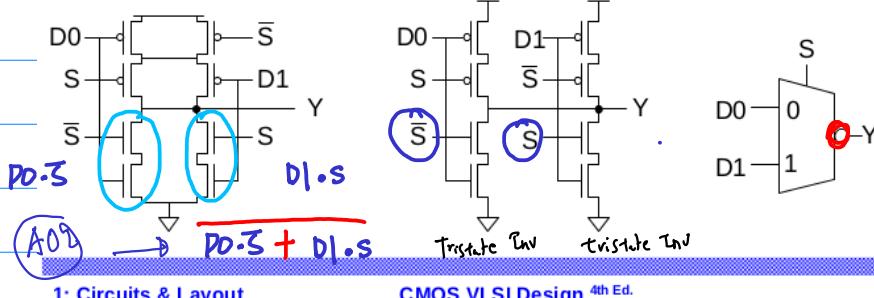
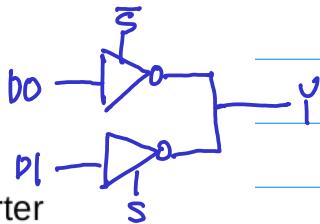
can make a signal strong.  
weak1 → { strong 0  
weak0 → { strong 1



$$\begin{aligned} 1 &\rightarrow Z \\ 0 &\rightarrow Z \end{aligned}$$

# Inverting Mux

- Inverting multiplexer
  - Use compound AOI22
  - Or pair of tristate inverters
  - Essentially the same thing
- Noninverting multiplexer adds an inverter



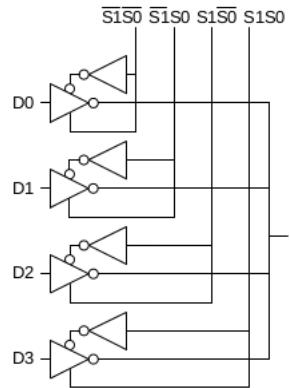
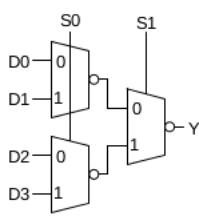
1: Circuits & Layout

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# 4:1 Multiplexer

- 4:1 mux chooses one of 4 inputs using two selects
  - Two levels of 2:1 muxes
  - Or four tristates



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