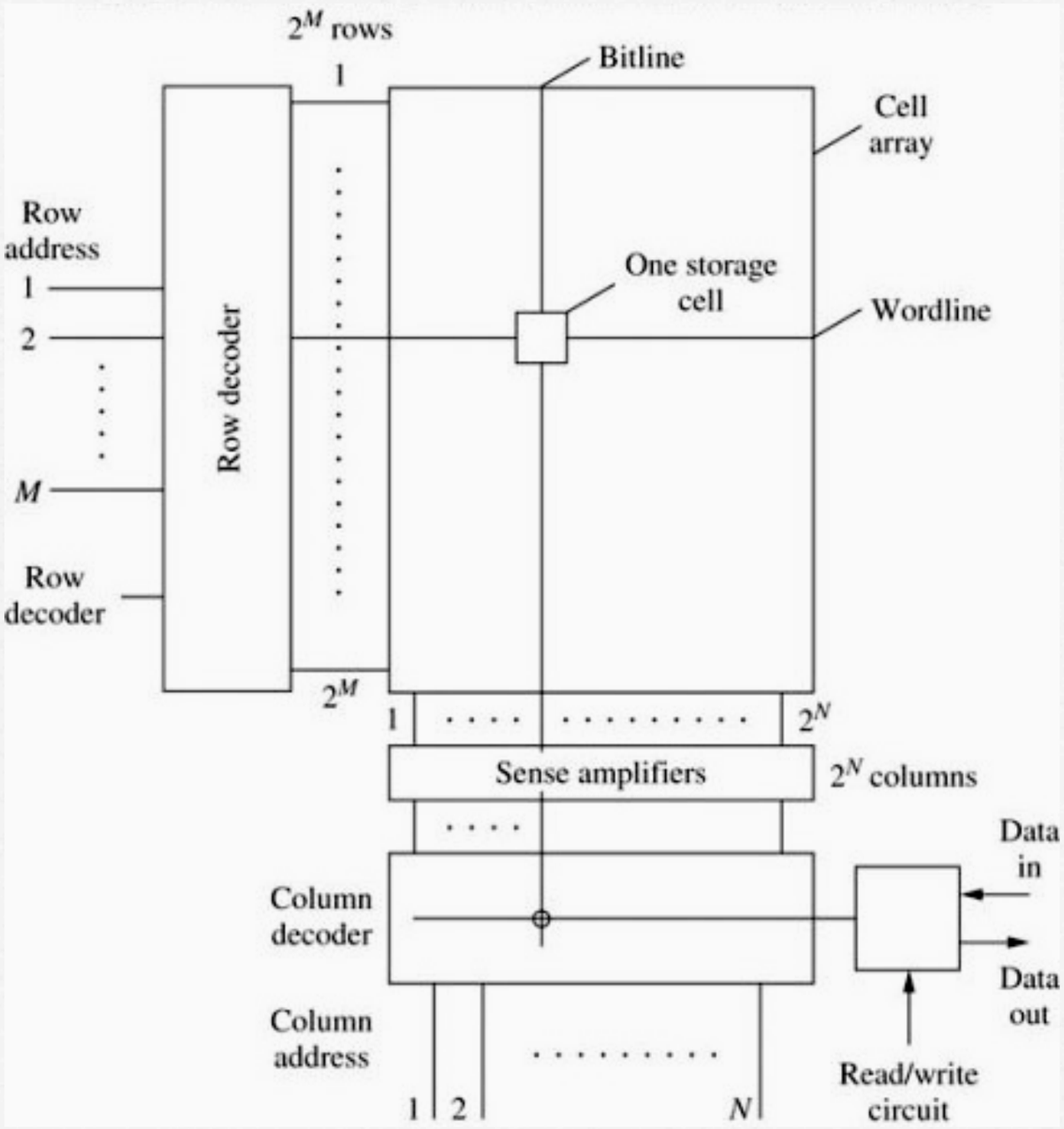
ROM Memory and Decoders

INEL4207 - April 27, 2011

Read-Only Memory (ROM)

- Non-volatile
- ROM is often needed in digital systems such as:
  - Holding the instruction set for a microprocessor
  - Firmware

A 256-MByte Memory Chip



- Memory block contains 2^{M+N} storage locations
- When a bit is selected,
  - sense amplifiers: used to read/ write to the RAM location

NMOS NOR Address

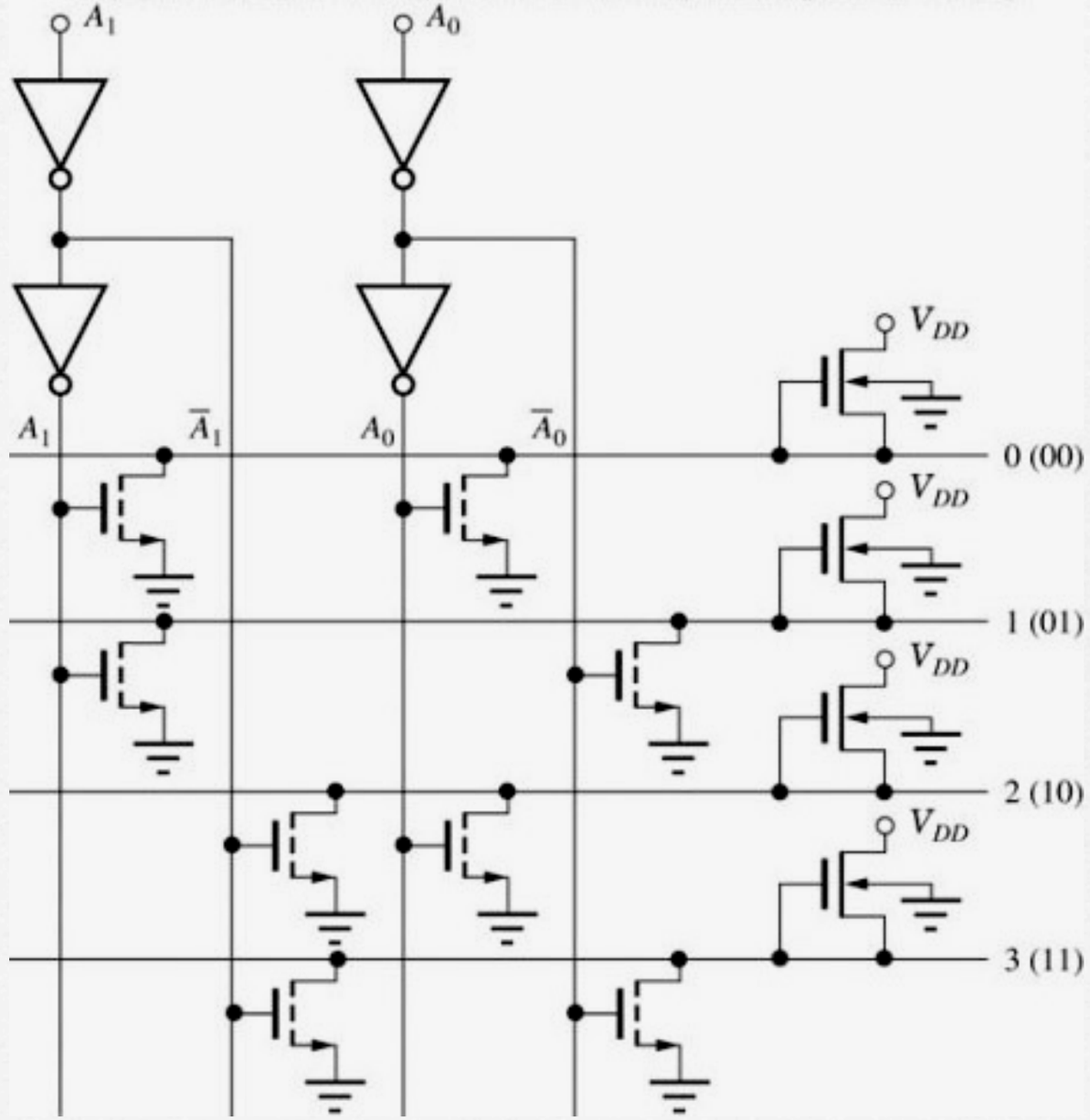
- Output 0 is high if both A0 and A1 are low

Row 0 = (A1+A0)'

Row 1 = (A1+A0')'

Row 2 = (A1'+A0)'

Row 3 = (A1'+A0')'



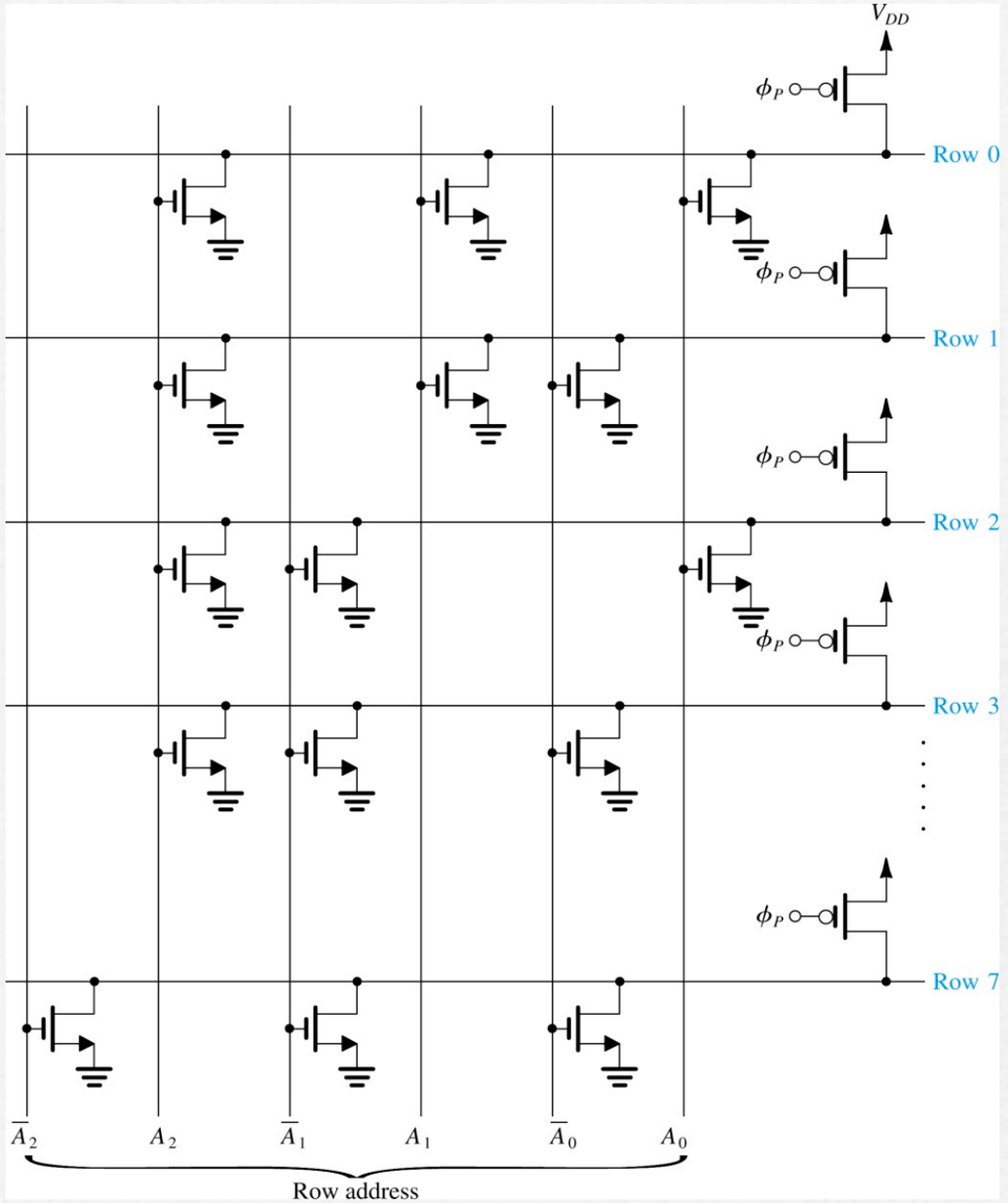


Figure 16.25 A NOR address decoder in array form. One out of eight lines (row lines) is selected using a 3-bit address.

NMOS NAND Address Decoders

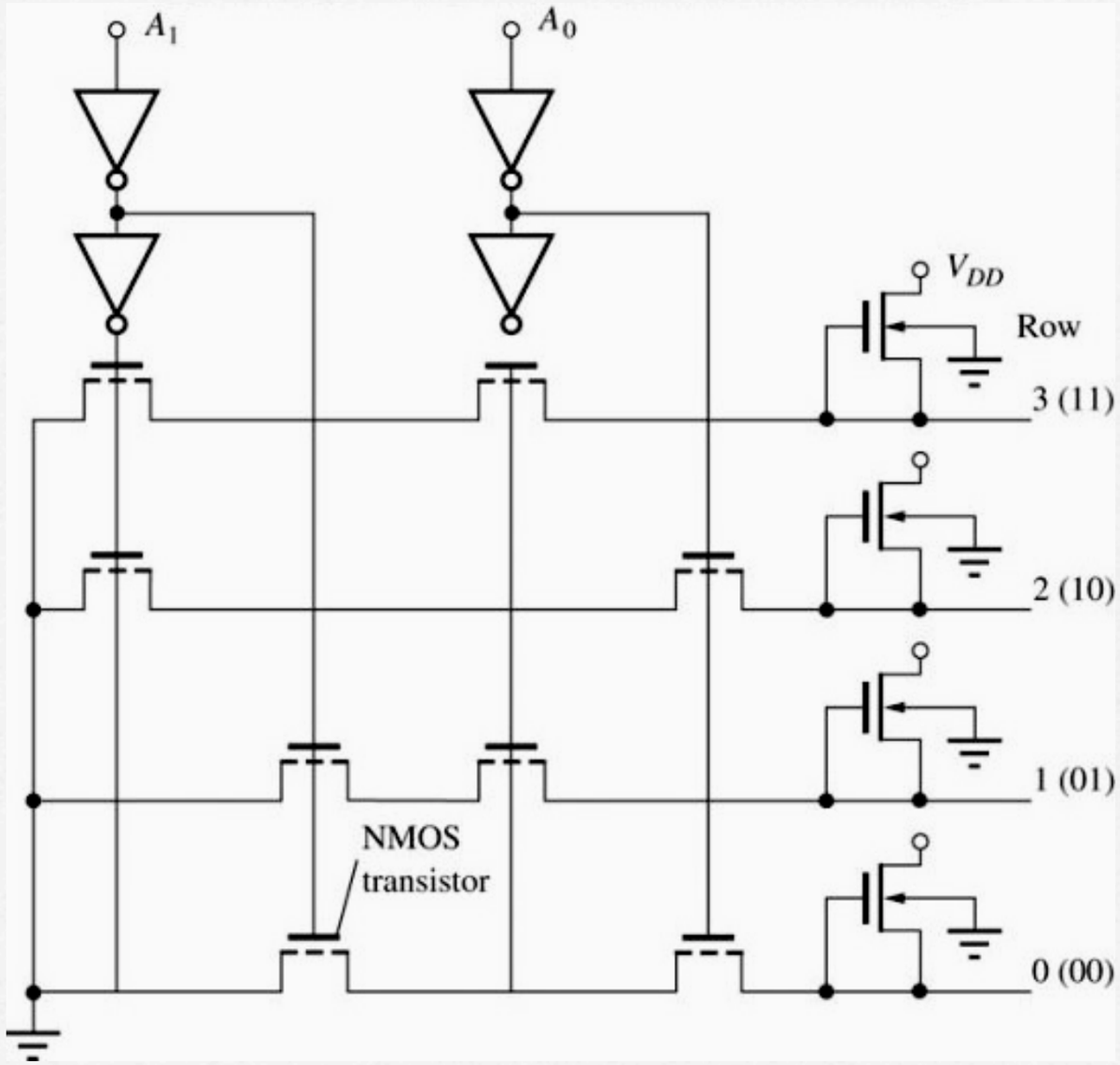
- Output 3 is low if both A0 and A1 are high

Row 0 = $(A_1'A_0')'$

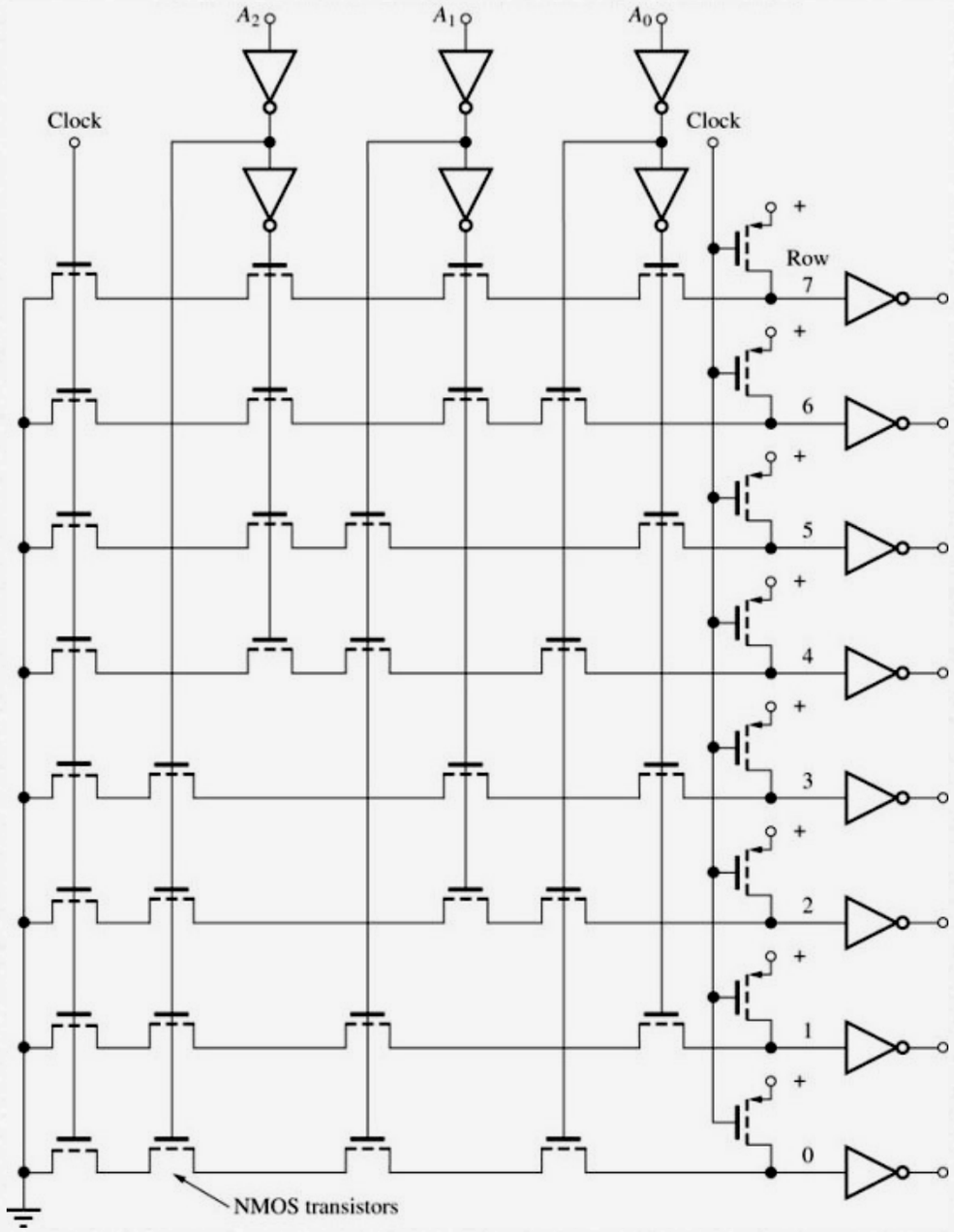
Row 1 = $(A_1'A_0)'$

Row 2 = $(A_1 \cdot A_0')'$

Row 3 = $(A_1 \cdot A_0)'$

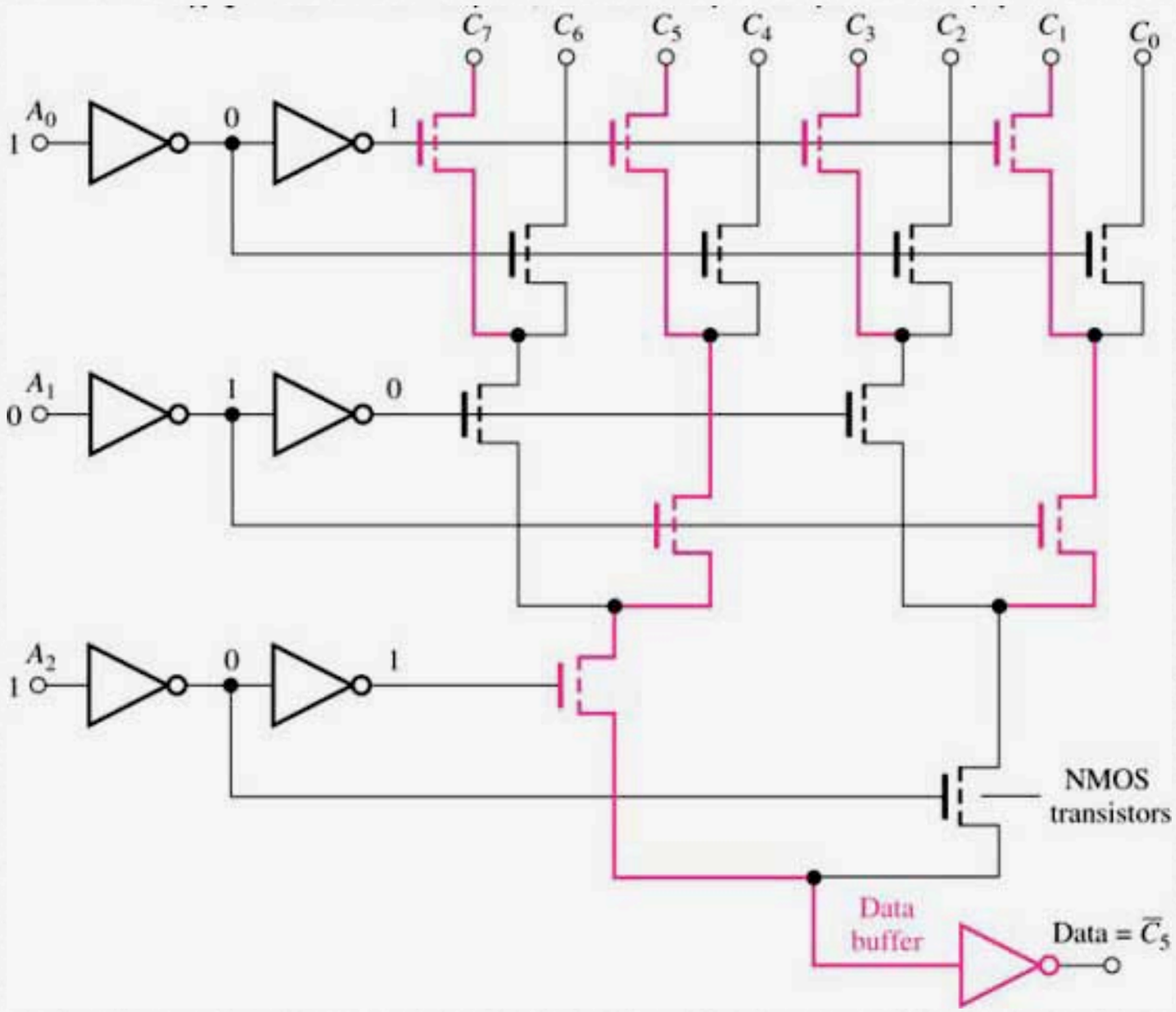


Domino CMOS Address Decoders



Pass-transistor Column Decoder

- 3-bit column data selector using pass-transistor logic



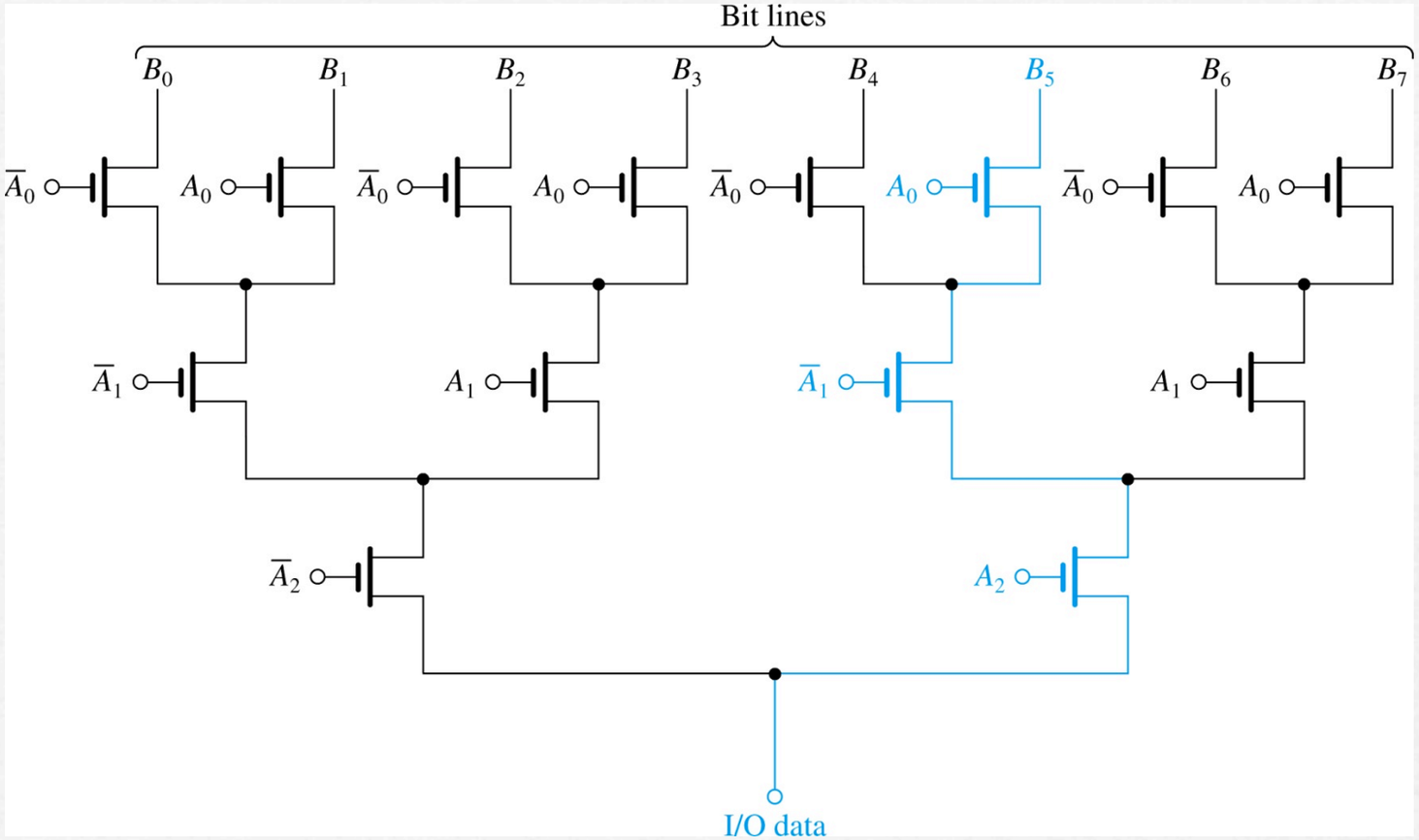


Figure 16.27 A tree column decoder. Note that the colored path shows the transistors that are conducting when $A_0 = 1$, $A_1 = 0$, and $A_2 = 1$, the address that results in connecting B_5 to the data line.

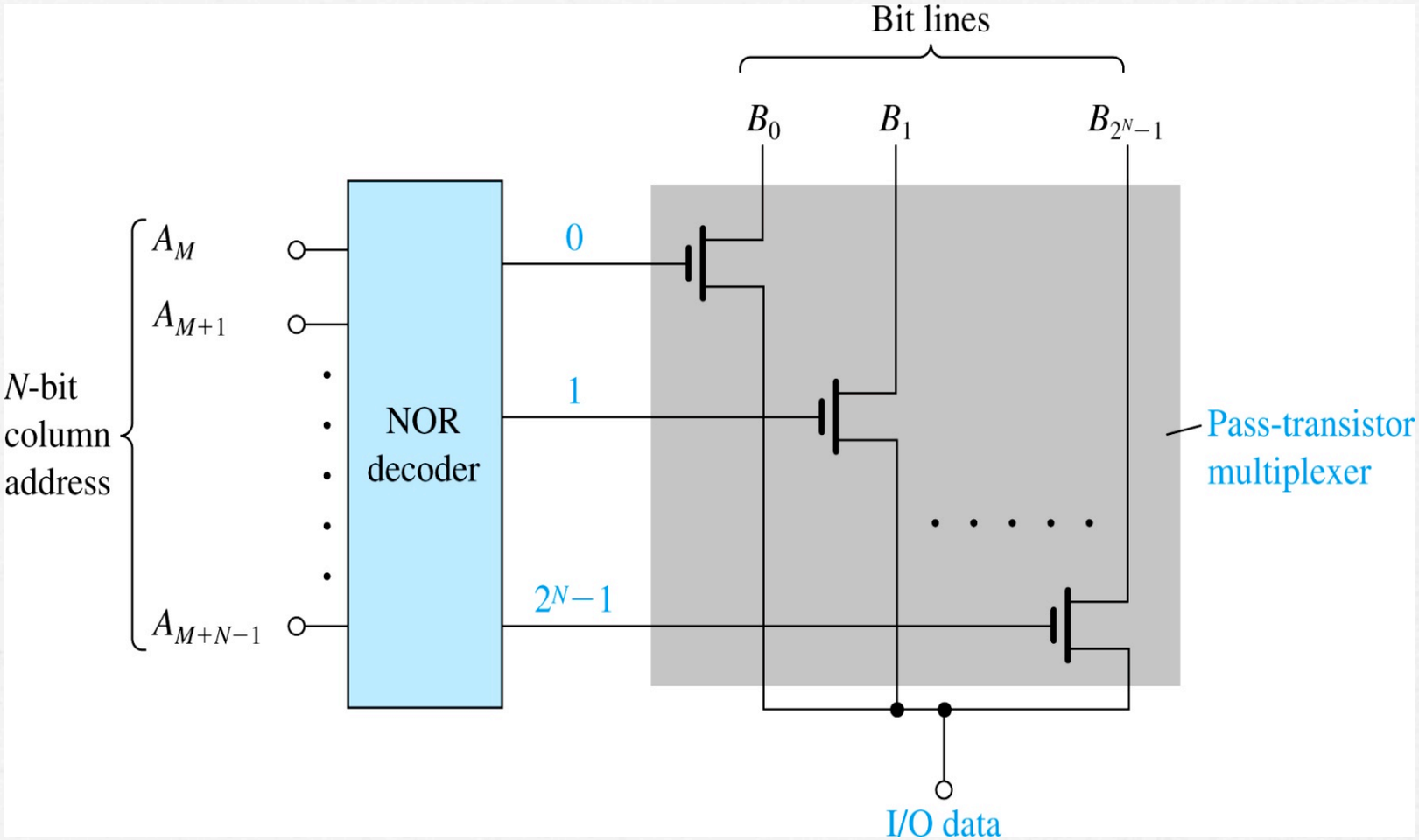
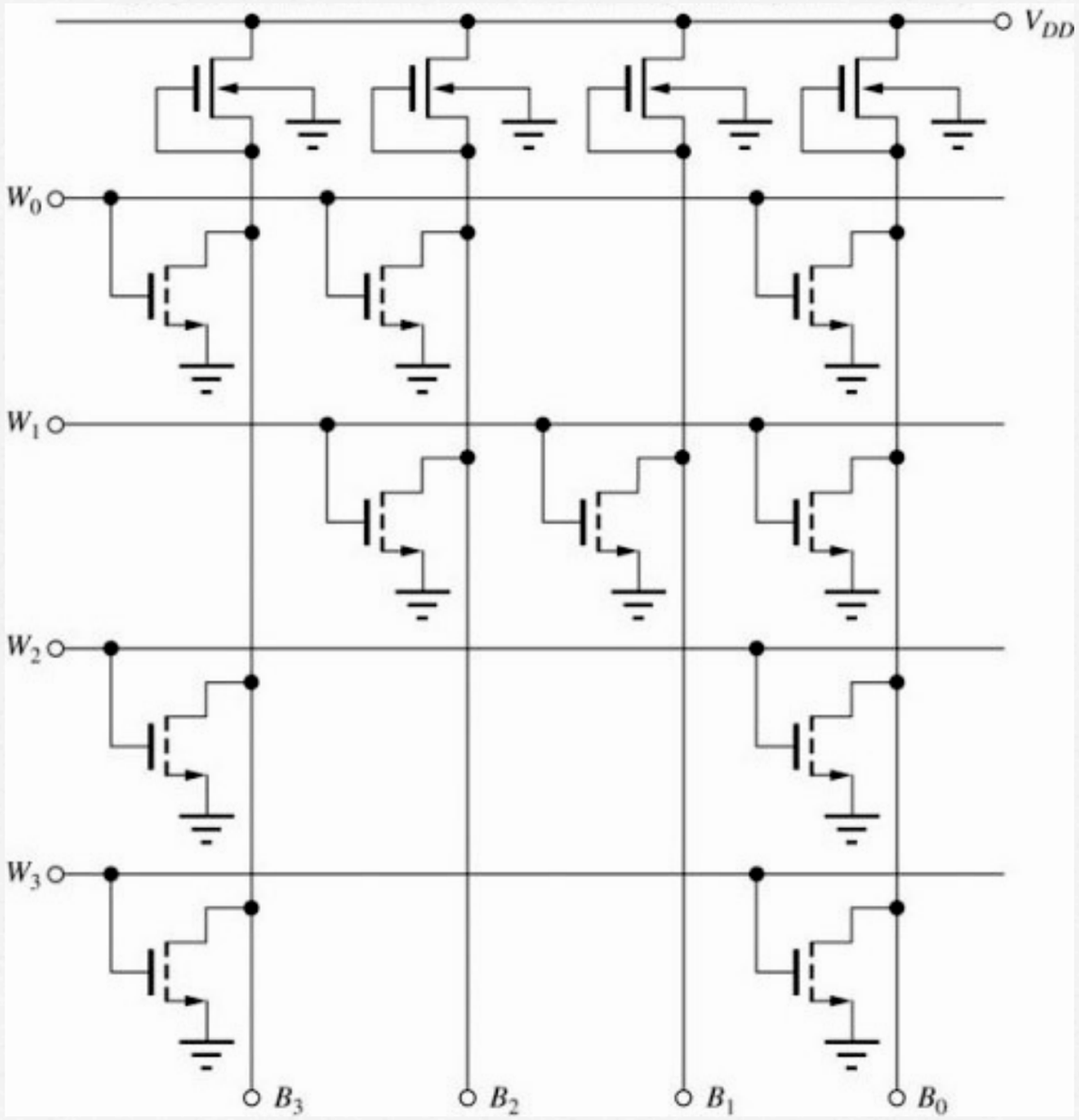


Figure 16.26 A column decoder realized by a combination of a NOR decoder and a pass-transistor multiplexer.

Read-Only Memory (ROM)



- The basic structure of the NMOS static ROM is shown in the figure
- The existence of a NMOS means a "0" is stored at that address otherwise a "1" is stored
- The major downfall to this particular circuit is that it dissipates a lot of power

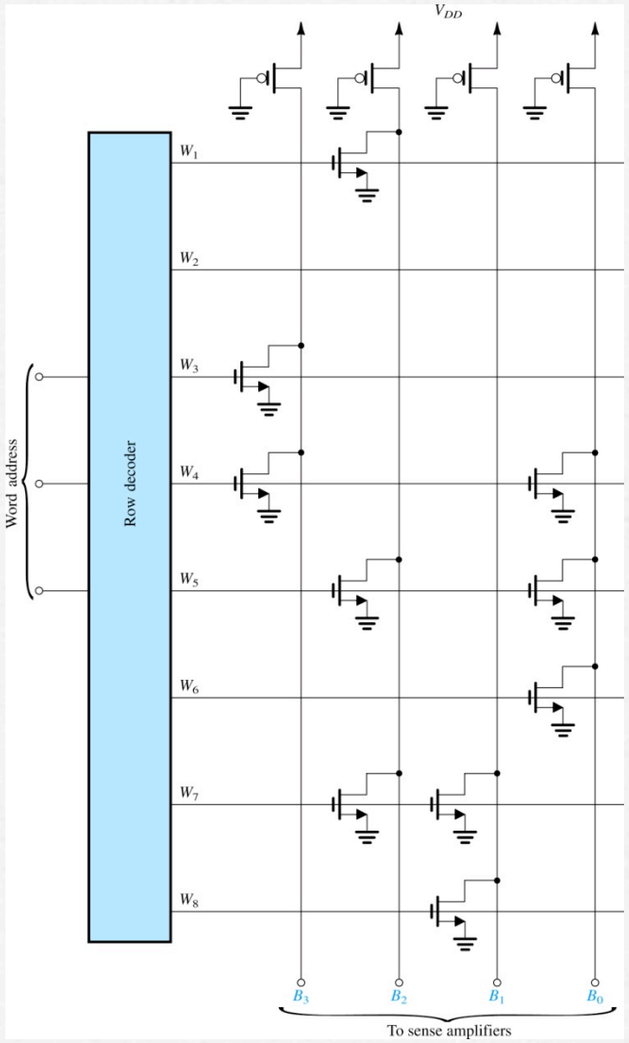
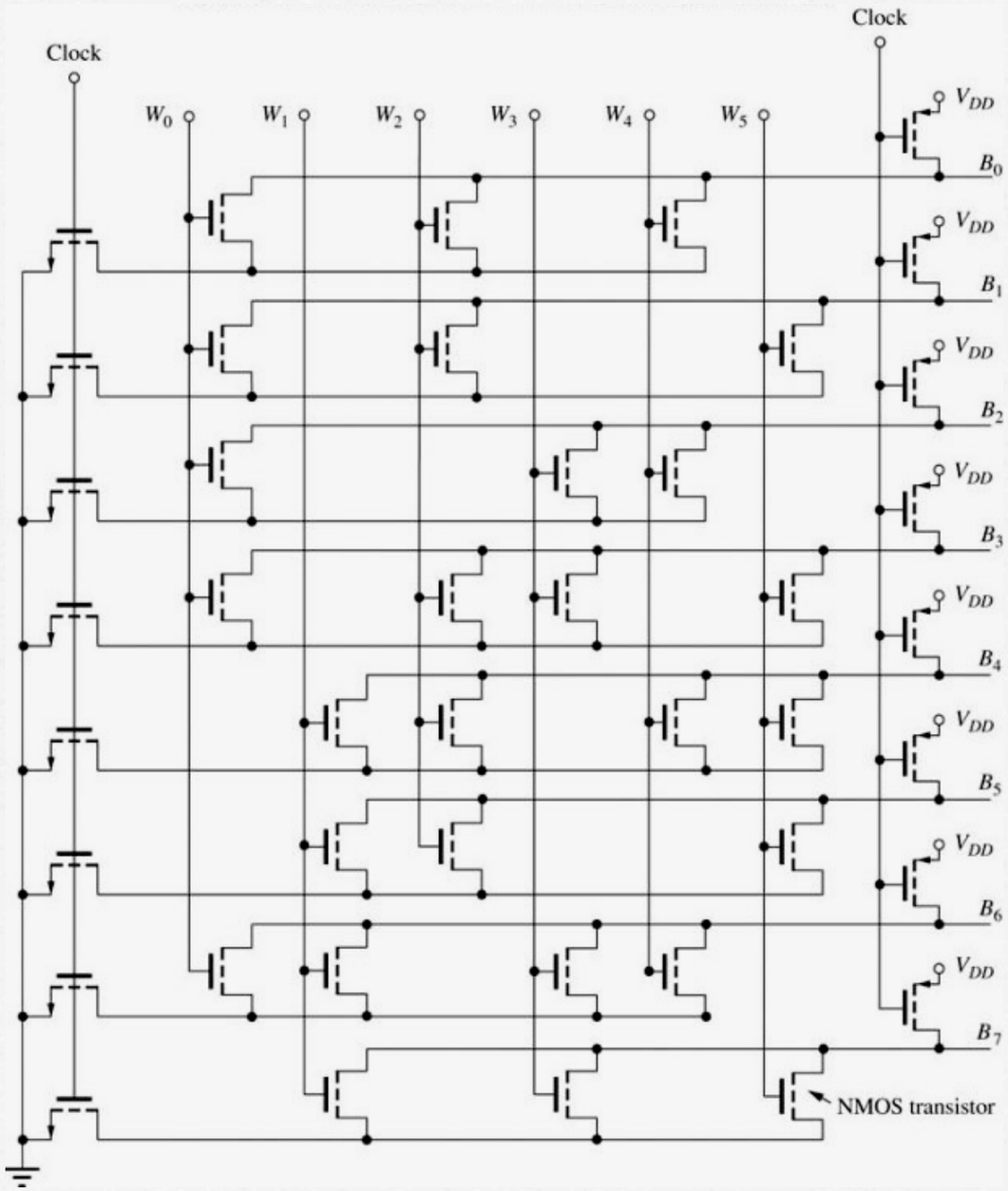


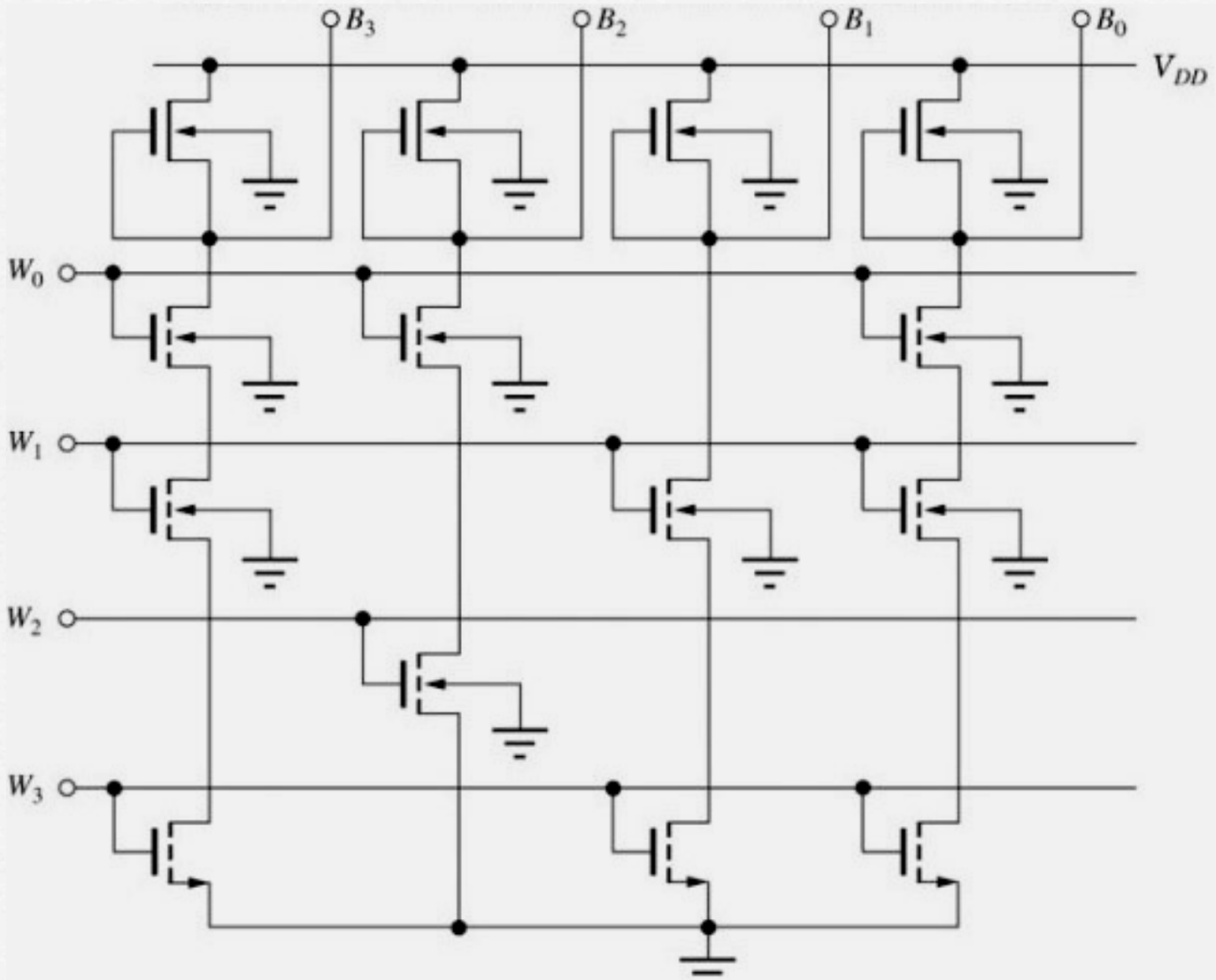
Figure 16.30 A simple MOS ROM organized as 8 words ×4 bits.

Read-Only Memory (ROM)

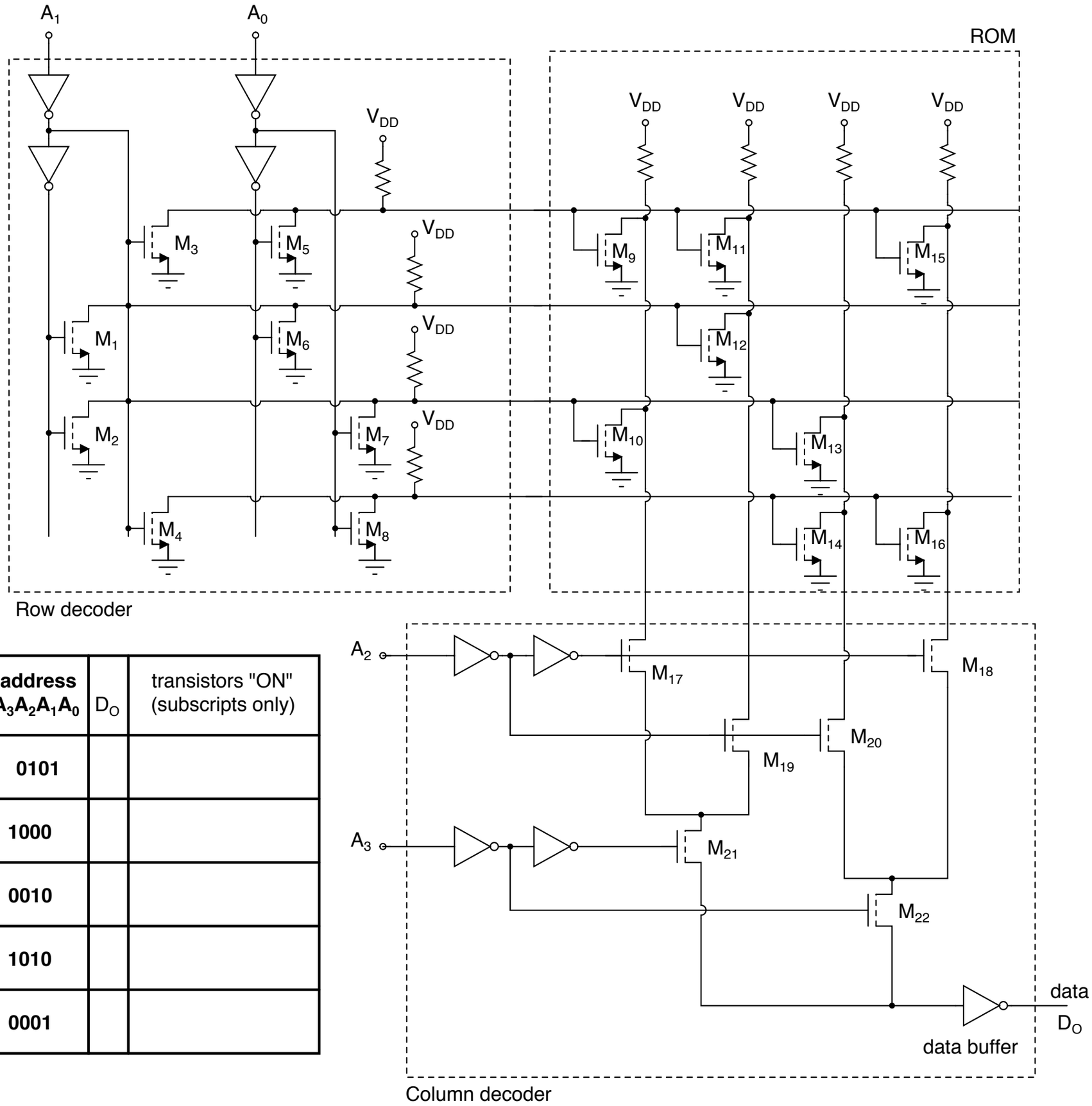


- The domino CMOS ROM is one technique used to lower the amount of power dissipation

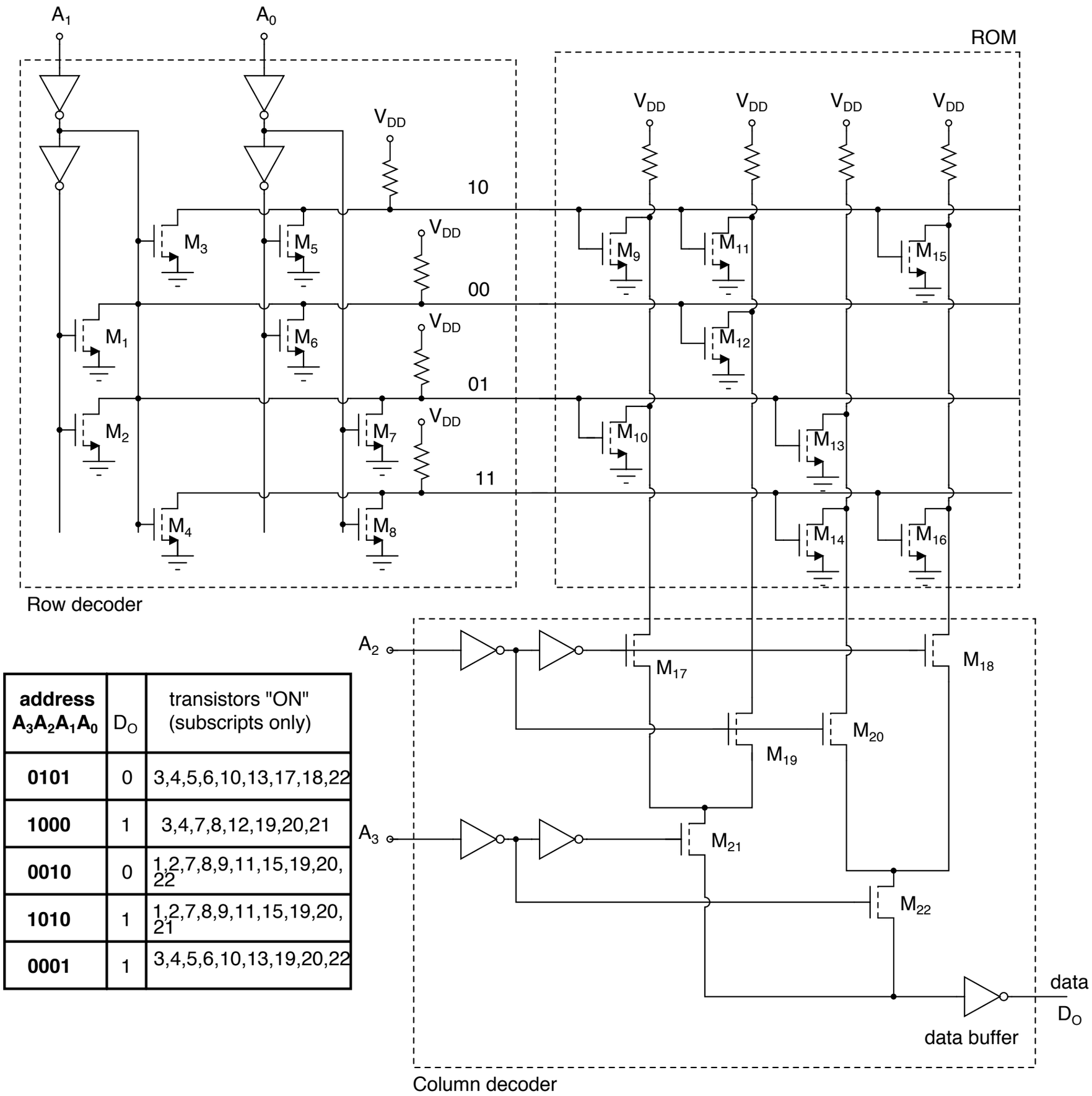
NAND-array structure ROM



- Can be directly used with NAND decoder
- Active-low word bits:
  - All W's are HIGH except selected row
  - absence of FET makes bit low;
  - presence makes bit high



address $A_3A_2A_1A_0$	D_O	transistors "ON" (subscripts only)
0101		
1000		
0010		
1010		
0001		



address $A_3A_2A_1A_0$	D_O	transistors "ON" (subscripts only)
0101	0	3,4,5,6,10,13,17,18,22
1000	1	3,4,7,8,12,19,20,21
0010	0	1,2,7,8,9,11,15,19,20, 22
1010	1	1,2,7,8,9,11,15,19,20, 21
0001	1	3,4,5,6,10,13,19,20,22