

1. Do the following non-textbook problems:

1a.

| Number (unsigned) | 1's complement | 2's complement |
|----------------------|-------------------|-------------------|
| 1000 1000 | 0111 0111 | 0111 1000 |
| 1001 1001 | 0110 0110 | 0110 0111 |
| 1010 1100 | 0101 0011 | 0101 0100 |
| 0000 0000 | 1111 1111 | 0000 0000 |
| 1000 0000 | 0111 1111 | 1000 0000 |

1b.

a) $1\ 1011 - 1\ 0000 = 01\ 1011 + -(01\ 0000)$
 2's complement of $-01\ 0000 \rightarrow 10\ 1111 + 1 = 11\ 0000$

| | |
|----------|-----|
| 01 1011 | 27 |
| +11 0000 | -16 |
| <hr/> | |
| ±00 1011 | 11 |

b) $1\ 0110 - 1\ 0111 = 01\ 0110 + -(00\ 1011)$
 2's complement of $00\ 1011 \rightarrow 11\ 0100 + 1 = 11\ 0101$

| | |
|-----------|-----|
| 01 0110 | 22 |
| + 11 0101 | -11 |
| <hr/> | |
| ±00 1011 | 11 |

c) $100 - 10\ 1000 = 000\ 0100 + -(010\ 1000)$
 2's complement of $010\ 1000 \rightarrow 101\ 0111 + 1 = 101\ 1000$

| | |
|-----------|-----|
| 000 0100 | 4 |
| +101 1000 | -40 |
| <hr/> | |
| 101 1100 | -36 |

d) $101\ 1100 - 101\ 1100 = 0101\ 1100 + -(0101\ 1100)$
 2's complement of $0101\ 1100 \rightarrow 1010\ 0011 + 1 = 1010\ 0100$

| | |
|-------------|-----|
| 0101 1100 | 92 |
| + 1010 0100 | -92 |
| <hr/> | |
| ± 0000 0000 | 0 |

1c.

a)

$$\begin{array}{r} 10\ 1111 \\ +\ 11\ 1011 \\ \hline 10\ 1010 \end{array} \qquad \begin{array}{r} -17 \\ +\ -5 \\ \hline -22 \end{array}$$

b)

$$\begin{array}{r} 00\ 1011 \\ +\ 10\ 0010 \\ \hline 10\ 1101 \end{array} \qquad \begin{array}{r} 11 \\ +\ -30 \\ \hline -19 \end{array}$$

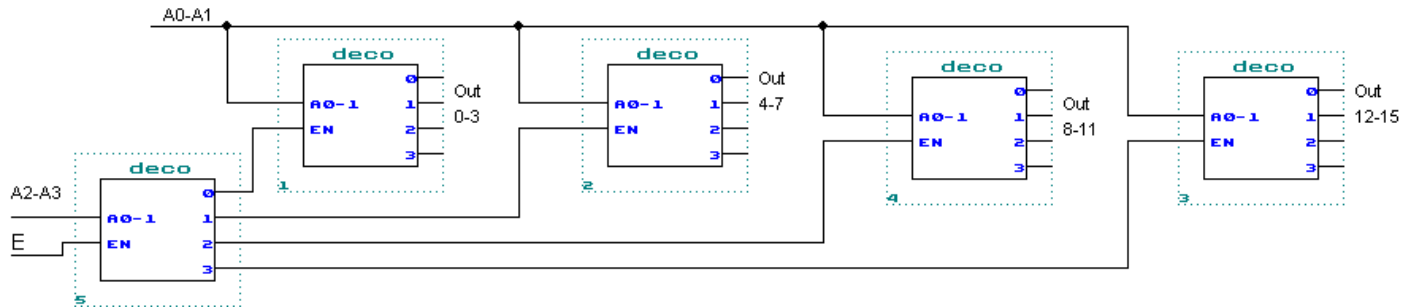
c)

$$\begin{array}{r} 11\ 0001 \\ -\ 00\ 1110 \\ \hline 10\ 0011 \end{array} \rightarrow \begin{array}{r} 11\ 0001 \\ +\ 11\ 0010 \\ \hline \pm 10\ 0011 \end{array} \qquad \begin{array}{r} -15 \\ +\ -14 \\ \hline -29 \end{array}$$

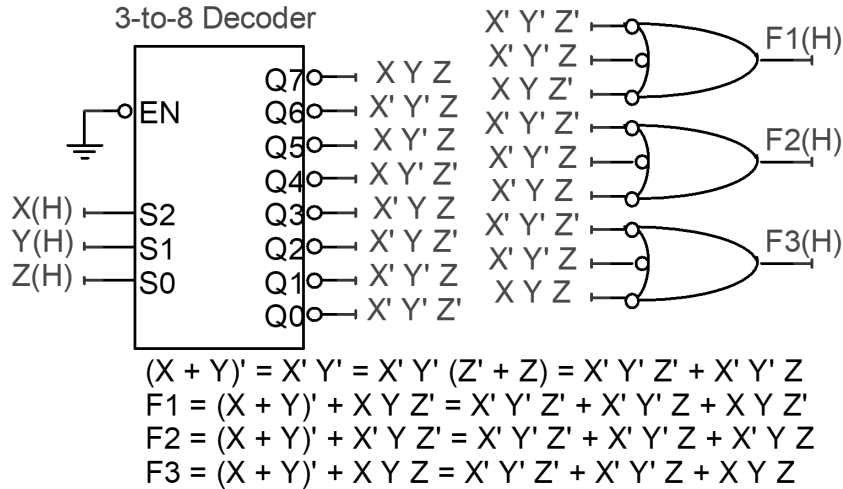
d)

$$\begin{array}{r} 10\ 1010 \\ -\ 11\ 0111 \\ \hline 11\ 0011 \end{array} \rightarrow \begin{array}{r} 10\ 1010 \\ +\ 00\ 1001 \\ \hline 11\ 0011 \end{array} \qquad \begin{array}{r} -22 \\ +\ 9 \\ \hline -13 \end{array}$$

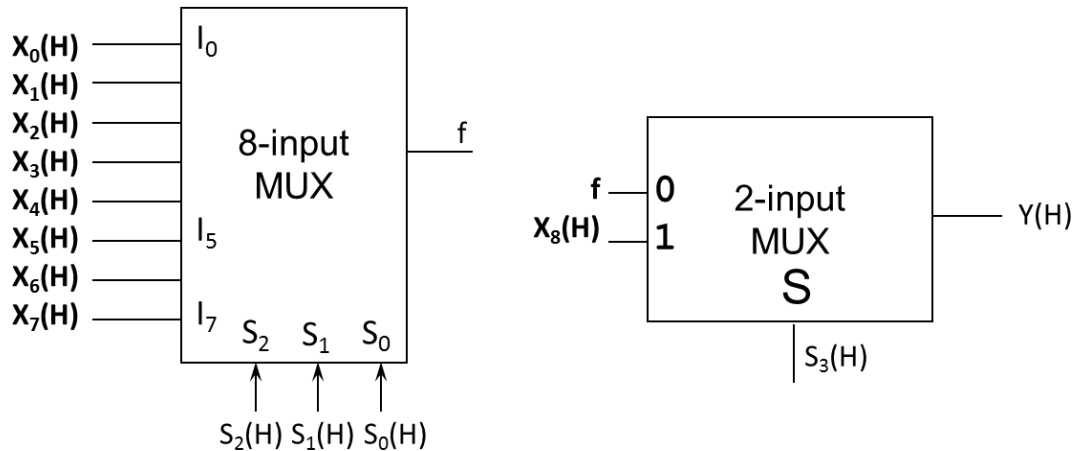
1d.



1e.



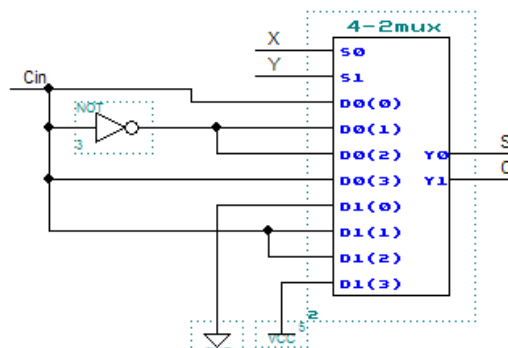
1f.



1g.

Binary Full Adder

| X | Y | Cin | S | C |
|---|---|-----|---|---|
| 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 | 0 |
| 0 | 1 | 0 | 1 | 0 |
| 0 | 1 | 1 | 0 | 1 |
| 1 | 0 | 0 | 1 | 0 |
| 1 | 0 | 1 | 0 | 1 |
| 1 | 1 | 0 | 0 | 1 |
| 1 | 1 | 1 | 1 | 1 |



2. Find a) SOP (using minterms), b) POS (using maxterms), c) MSOP, and d) MPOS for the following function. Use K-maps for c) and d). Note: The SOP using minterms is called a Canonical SOP; the POS using maxterms is a Canonical POS.

Homework 6 Solutions

$$F = A C + B D' + A' C' D + A B' C D + A' B' C D'$$

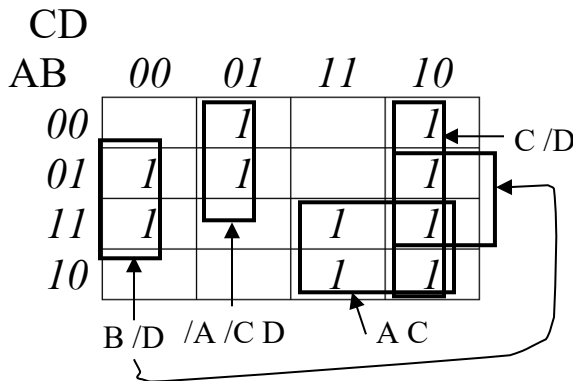
| | | | | |
|----|----|----|----|----|
| | CD | | | |
| AB | 00 | 01 | 11 | 10 |
| 00 | | 1 | | 1 |
| 01 | 1 | 1 | | 1 |
| 11 | 1 | | 1 | 1 |
| 10 | | | 1 | 1 |

| A | B | C | D | F |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 1 |
| 0 | 0 | 1 | 0 | 1 |
| 0 | 0 | 1 | 1 | 0 |
| 0 | 1 | 0 | 0 | 1 |
| 0 | 1 | 0 | 1 | 1 |
| 0 | 1 | 1 | 0 | 1 |
| 0 | 1 | 1 | 1 | 0 |
| 1 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 1 | 0 |
| 1 | 0 | 1 | 0 | 1 |
| 1 | 0 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 1 |
| 1 | 1 | 0 | 1 | 0 |
| 1 | 1 | 1 | 0 | 1 |
| 1 | 1 | 1 | 1 | 1 |

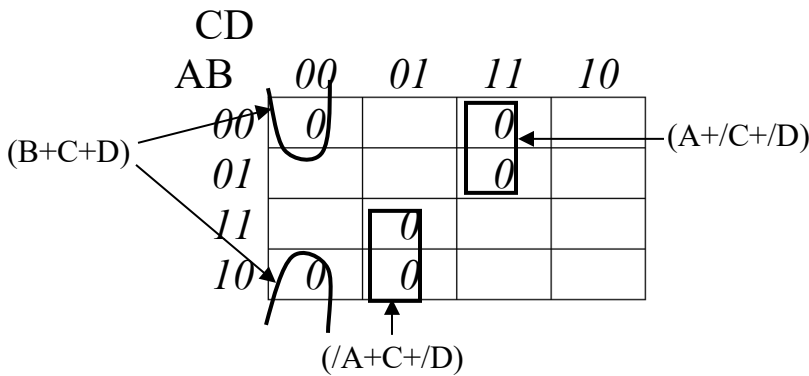
a) $F = \sum m(1, 2, 4, 5, 6, 10, 11, 12, 14, 15)$
 $F_{SOP} = A'B'C'D + A'B'CD' + A'BC'D' + A'BCD + A'BCD' + AB'CD' + AB'CD + ABC'D' + ABCD' + ABCD$

b) $F = \prod M(0,3,7,8,9,13)$
 $F_{POS} = (A'+B'+C+D')(A'+B+C+D')(A'+B+C+D)(A+B'+C'+D')(A+B+C'+D')(A+B+C+D)$

c) $F_{MSOP} = /A /C /D + A C + B /D + C /D$



d) $F_{MPOS} = (/A + C + /D)(A + /C + /D)(B + C + D)$



Homework 6 Solutions

Revision 0

3. Do the following Roth textbook problems:

5.4

5.4(a)

| | | | | | |
|-----|----|-----|----|----|----|
| | | A B | | | |
| | | 00 | 01 | 11 | 10 |
| C D | 00 | 1 | 1 | 1 | 1 |
| | 01 | | | 0 | |
| | 11 | 1 | | 1 | 1 |
| | 10 | 1 | 1 | 1 | 1 |

$F = BD' + B'CD + ABC + ABCD + BD'$

5.4(b)

| | | | | | |
|-----|----|-----|----|----|----|
| | | A B | | | |
| | | 00 | 01 | 11 | 10 |
| C D | 00 | 1 | 1 | 1 | 1 |
| | 01 | | | 1 | |
| | 11 | 1 | | 1 | 1 |
| | 10 | 1 | 1 | 1 | 1 |

$F = D' + B'C + AB$

5.4(c)

| | | | | | |
|-----|----|-----|----|----|----|
| | | A B | | | |
| | | 00 | 01 | 11 | 10 |
| C D | 00 | 1 | 1 | 1 | 1 |
| | 01 | 0 | 0 | 1 | 0 |
| | 11 | 1 | 0 | 1 | 1 |
| | 10 | 1 | 1 | 1 | 1 |

$F = (A+B+D')(B+C+D')$

Note: These answers are NOT in our required lexical order.

5.9a Note: I do NOT do 5-variable K-maps like this. These answers are NOT in our required lexical order.

| | | | | | |
|-----|----|-----|----|----|----|
| | | B C | | | |
| | | 00 | 01 | 11 | 10 |
| D E | 00 | 1 | 1 | 1 | 1 |
| | 01 | 0 | 1 | 0 | 0 |
| | 11 | X | 0 | 1 | 1 |
| | 10 | 1 | 1 | 1 | 1 |

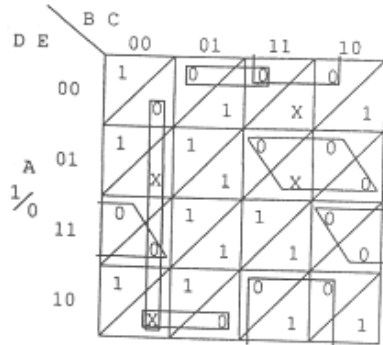
$F = (A'+B'+C+E)(A'+B+C+D')(A+B'+C+E)(B'+D+E)(A+C+D)(A'+C+D+E)(A'+B'+C+E)$

| | | | | | |
|-----|----|-----|----|----|----|
| | | B C | | | |
| | | 00 | 01 | 11 | 10 |
| D E | 00 | 1 | 0 | 0 | 0 |
| | 01 | 0 | 1 | 0 | 0 |
| | 11 | X | 0 | 0 | 1 |
| | 10 | 1 | 0 | 0 | 1 |

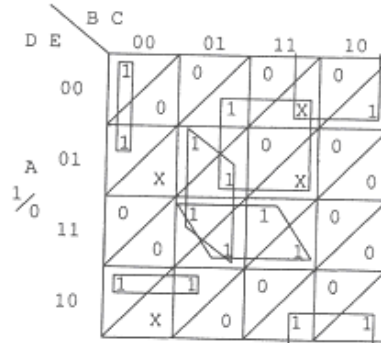
$F = A'CE + A'CD + A'DE + ABC'D' + CDE + ABCDE + B'CE' + A'B'D$

Alt: $F = A'CE + A'CD + A'DE + ABC'D' + CDE + ABCDE + B'CE' + A'B'E$

5.9b Note: These answers are NOT in our required lexical order.



$$F = (A' + B' + E)(A' + C' + D + E)(C + D' + E)(A + B + D' + E)(A + B + C)(B' + D + E)$$

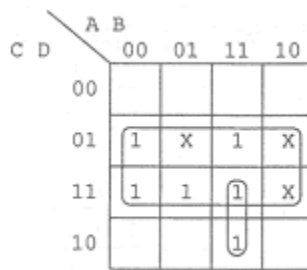


$$F = A'CD' + ABE' + CDE + AB'CD' + AB'DE' + B'CE$$

Alt:
$$\begin{cases} F = A'CD' + ABE' + CDE + AB'CE' + AB'CD + B'DE \\ F = A'CD' + ABE' + CDE + AB'CD' + AB'DE' + B'DE \\ F = A'CD' + ABE' + CDE + AB'CE' + AB'DE' + B'DE \end{cases}$$

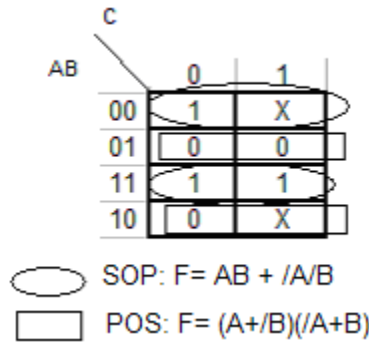
5.25 Note: These answers are NOT in our required lexical order.

Roth 6th: 5.30

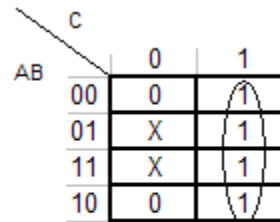


$$F = D + ABC$$

4.6a Note: These answers are NOT in our required lexical order.



4.6b.



$$G = C$$

Homework 6 Solutions

Revision 0

4.25a Note: These answers are NOT in our required lexical order.

Roth 6th: 4.32a

| | | | |
|----|----|---|---|
| | | c | |
| | | 0 | 1 |
| AB | 00 | 1 | X |
| | 01 | 0 | 0 |
| | 11 | 0 | 1 |
| | 10 | 0 | X |

○ SOP: $F = \bar{A}/B + AC$
 □ POS: $F = (A + \bar{B})(\bar{A} + C)$

4.25c Note: These answers are NOT in our required lexical order.

Roth 6th: 4.32c

| | | | |
|----|----|---|---|
| | | c | |
| | | 0 | 1 |
| AB | 00 | 0 | 0 |
| | 01 | X | 1 |
| | 11 | X | 1 |
| | 10 | 1 | 1 |

○ SOP: $F_3 = A + B$
 □ POS: $F_3 = A + B$

9.1 Answer located in back of book

9.5

| y3 | y2 | y1 | y0 | X1 | X0 | W |
|----|----|----|----|----|----|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| 0 | 0 | 1 | X | 0 | 1 | 1 |
| 0 | 1 | X | X | 1 | 0 | 1 |
| 1 | X | X | X | 1 | 1 | 1 |

| | | | | | |
|------|----|------|----|----|----|
| | | y0y1 | | | |
| | | 00 | 01 | 11 | 10 |
| y2y3 | 00 | 0 | 0 | 0 | 0 |
| | 01 | 1 | 1 | 1 | 1 |
| | 11 | 1 | 1 | 1 | 1 |
| | 10 | 1 | 1 | 1 | 1 |

$X_1 = y_3 + y_2$

| | | | | | |
|------|----|------|----|----|----|
| | | y0y1 | | | |
| | | 00 | 01 | 11 | 10 |
| y2y3 | 00 | 0 | 1 | 1 | 0 |
| | 01 | 1 | 1 | 1 | 1 |
| | 11 | 1 | 1 | 1 | 1 |
| | 10 | 0 | 0 | 0 | 0 |

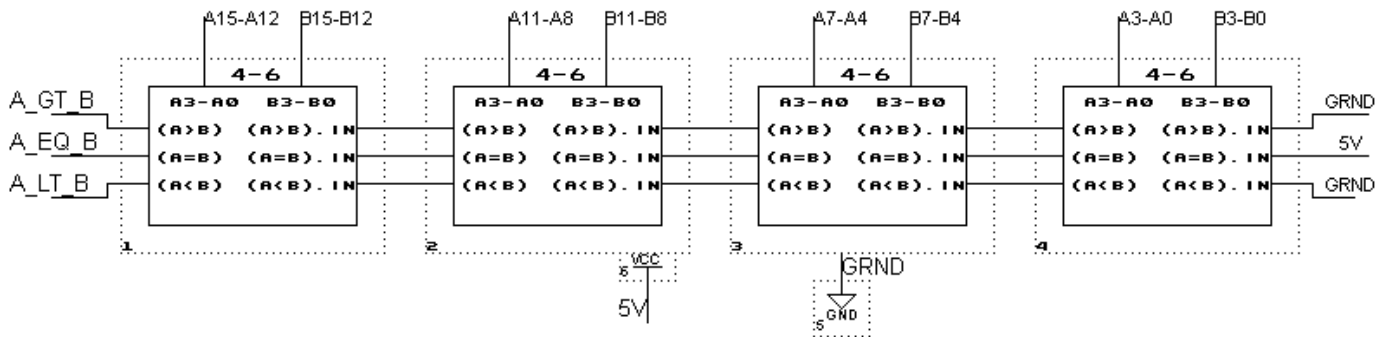
$X_0 = y_3 + /y_2 y_1$

| | | | | | |
|------|----|------|----|----|----|
| | | y0y1 | | | |
| | | 00 | 01 | 11 | 10 |
| y2y3 | 00 | 0 | 1 | 1 | 1 |
| | 01 | 1 | 1 | 1 | 1 |
| | 11 | 1 | 1 | 1 | 1 |
| | 10 | 1 | 1 | 1 | 1 |

$W = y_3 + y_2 + y_1 + y_0$

4. Do the following Lam textbook problems:

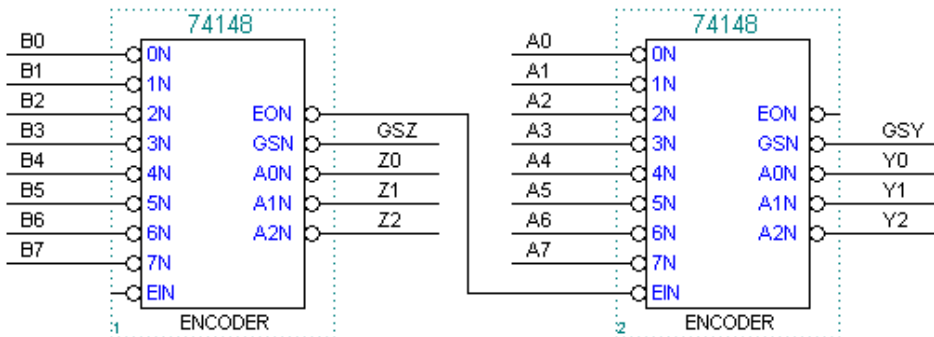
4.6

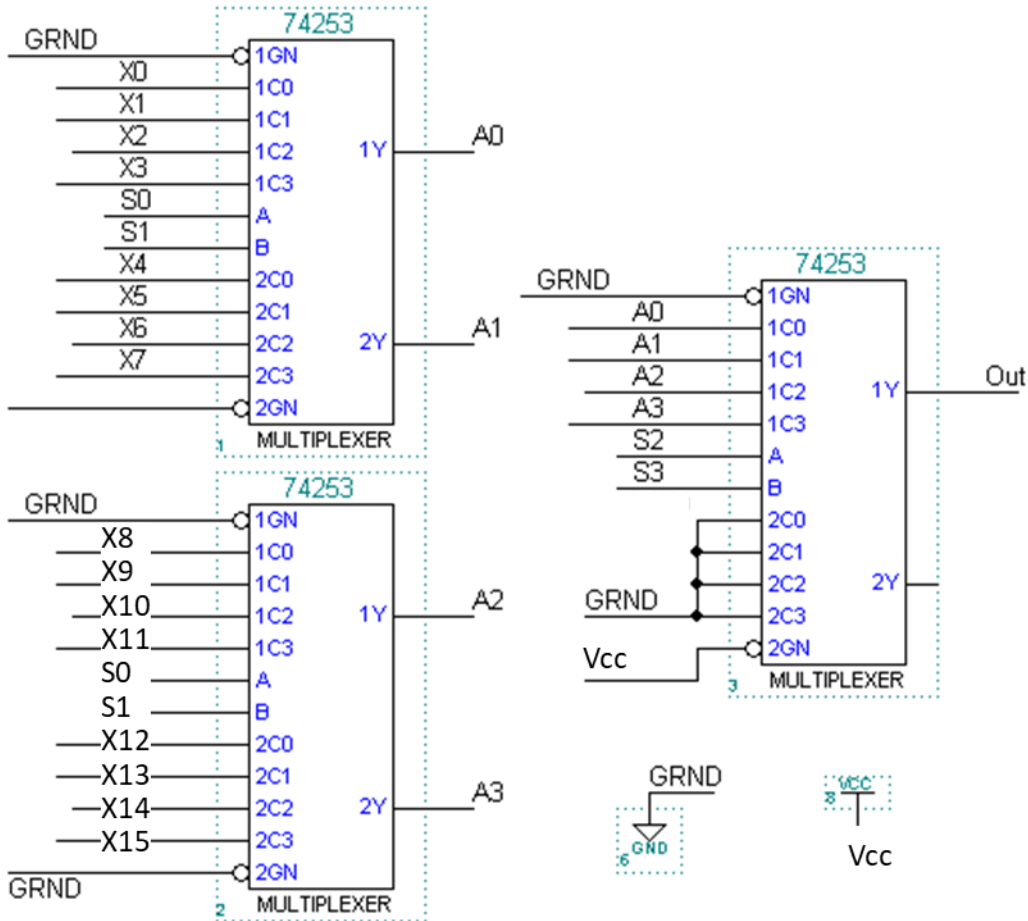


4.9

Addresses for M0: 000XXXXX
 Addresses for M1: 001XXXXX
 Addresses for M2: 010XXXXX
 Addresses for M3: 011XXXXX

4.13





4.16

| REQD.L | REQC.L | REQB.L | REQA.L | S1.H | S0.H |
|--------|--------|--------|--------|------|------|
| L | X | X | X | H | H |
| H | L | X | X | H | L |
| H | H | L | X | L | H |
| H | H | H | X | H | H |

