

ECCS-1721 Digital Logic
Homework 2

1. Find the product of the following numbers represented in 5 bit two's complement.
 - $10 * 11$ **0001101110**
 - $-12 * 13$ **1101100100**
 - $15 * -15$ **1100011111**
 - $-14 * -15$ **0011010010**
2. Find the product of the following numbers represented in 5 bit two's complement. Make sure to pay attention to the fixed point.
 - $5 * 0.75$ **00000011.11**
 - $10 * (-0.75)$ **11111000.10**
 - $-12 * (-0.25)$ **00000011.00**
3. Convert the following unsigned numbers to CSD:
 - **101111011** **10 $\bar{1}$ 00000 $\bar{1}$ 0 $\bar{1}$**
 - **1001111101000111** **101000000 $\bar{1}$ 0100100 $\bar{1}$**
 - **111001011111011011100** **100 $\bar{1}$ 010 $\bar{1}$ 0000000 $\bar{1}$ 00 $\bar{1}$ 00 $\bar{1}$ 00**

HW 2

1) $10 \cdot 11$

$$\begin{array}{r} 01010 \\ 01010 \cdot 01011 \\ \times 01011 \end{array}$$

$$\begin{array}{r}
 & & & 1 & \\
 & & & | & \text{Carry} \\
 & & & 00000001010 & \text{PP0} \\
 & & & 00000010100 & \text{PP1} \\
 & & & \cancel{00000000000} & \text{PP2} \\
 & & & 00010100000 & \text{PP3} \\
 & + & \cancel{00000000000} & \text{PP4} \\
 \hline
 & \textcircled{0001101110} & & &
 \end{array}$$

2) $-12 \cdot 13$

$$\begin{array}{r} 10100 \\ 10100 \cdot 01101 \\ \times 01101 \end{array}$$

$$\begin{array}{r}
 & & & 1 & \\
 & & & | & \text{Carry} \\
 & & & 11111 & \text{Carry} \\
 & & & 111110100 & \text{PP0} \\
 & + & \cancel{0000000000} & \text{PP1} \\
 & & 1111010000 & \text{PP2} \\
 & & 1110100000 & \text{PP3} \\
 & + & \cancel{0000000000} & \text{PP4} \\
 \hline
 & \textcircled{101100100} & & &
 \end{array}$$

3) $15 \cdot -15$

$$\begin{array}{r} 01111 \\ 01111 \cdot 10001 \\ \times 10001 \end{array}$$

$$\begin{array}{r}
 & & & 1 & \\
 & & & | & \text{Carry} \\
 & & & 00000001111 & \text{PP0} \\
 & + & \cancel{0011110000} & \text{PP4} \rightarrow 2^5 \text{ complement}
 \end{array}$$

$$\begin{array}{r}
 & & & 1 & \\
 & & & | & \text{Carry} \\
 & & & 00000001111 & \text{PP0} \\
 & + & 1100010000 & \text{PP4} \\
 \hline
 & \textcircled{1100011111} & & &
 \end{array}$$

$$1) -14.15 \quad 10010$$

$$10010 + 10001 \quad \underline{+ 10001}$$

C

C

$$\begin{array}{r} 1111110010 \text{ PPO} \\ + 1100100000 \text{ PP4} \end{array} \rightarrow 2^8 \text{ complement}$$

$$\begin{array}{r} 1111110010 \text{ PPO} \\ + 0011100000 \text{ PP4} \\ \hline 10011010010 \end{array}$$

$$2a) 5 \cdot 0.75$$

$$00101 \cdot 000.11 \quad \begin{array}{l} 0010 \\ \times 000.11 \end{array}$$

C

C

$$\begin{array}{r} 0000000101 \text{ PPO} \\ + 0000000101 \text{ PP1} \\ \hline 0000000101 \end{array}$$

$$2b) 10 \cdot -0.75$$

$$01010 \cdot 111.01 \quad \begin{array}{l} 01010 \\ \times 111.01 \end{array}$$

C

$$\begin{array}{r} 0000000101 \text{ PPO} \\ 0000101000 \text{ PP2} \\ 0001010000 \text{ PP3} \\ + 001010000 \text{ PP4} \end{array} \rightarrow 2^8 \text{ comp.}$$

$$\begin{array}{r} 1111110010 \text{ PPO} \\ 0000101000 \text{ PP2} \\ 0001010000 \text{ PP3} \\ + 1101100000 \text{ PP4} \\ \hline 1111100010 \end{array}$$

$$2c) -12 \cdot -0.25 \quad |0100$$

$$10100 \cdot \underline{111.11} \times \underline{111.11}$$

$$\begin{array}{r}
 & \begin{array}{c} | \\ | \\ | \\ | \\ | \\ | \end{array} & C \\
 1101000000 & 1111110100 & PPO \\
 0011000000 & 1111110100 & PPI \\
 & 1111010000 & PP2 \\
 & 1110100000 & PP3 \\
 & + 0011000000 & PP4 \\
 \hline
 & \textcircled{\begin{array}{c} 00000 \\ 011.00 \end{array}} &
 \end{array}$$

$$3a) 0101111011$$

$$\begin{array}{r}
 \textcircled{0} \textcircled{1} \textcircled{0} \textcircled{0} \textcircled{0} \textcircled{1} \textcircled{1} \textcircled{0} \textcircled{1} \\
 \hline
 \textcircled{1} \textcircled{0} \textcircled{1} \textcircled{0} \textcircled{0} \textcircled{0} \textcircled{0} \textcircled{1} \textcircled{0} \textcircled{1}
 \end{array}$$

$$3b) 10011111101000111$$

$$\begin{array}{r}
 101000000\overline{1}0100100\overline{1}
 \end{array}$$

$$3c) 01110010111111011011100$$

$$\begin{array}{r}
 100\overline{1}001100000\overline{0}1101100\overline{1}00 \\
 100\overline{1}010\overline{1}0000000\overline{1}00100\overline{1}00
 \end{array}$$