CPE 2211 COMPUTER ENGINEERING LAB

EXPERIMENT 9 LAB MANUAL

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RANDOM ACCESS MEMORY FOR COMBINATIONAL LOGIC

OBJECTIVES

In this experiment you will
- Examine the use of Random Access Memory (RAM) and Read Only Memory (ROM), as a means of realizing combinational logic circuits.
- Gain experience with a MCM 6810 RAM IC.

LAB REPORTS

The format of lab reports should be such that the information can be used to reproduce the lab, including what values were used in a circuit, why the values were used, how the values were determined, and any results and observations made. This lab manual will be used as a guide for what calculations need to be made, what values need to be recorded, and various other questions. The lab report does not need to repeat everything from the manual verbatim, but it does need to include enough information for a 3rd party to be able to use the report to obtain the same observations and answers. Throughout the lab manual, in the Preliminary (if there is one), and in the Procedure, there are areas designated by **Qxx followed by a question or statement**. These areas will be **bold**, and the lab TA will be looking for an answer or image for each. These answers or images are to be included in the lab report. The lab TA will let you know if the lab report will be paper form, or if you will be able to submit electronically.

REFERENCES

Givone: Section 5.8

MATERIALS REQUIRED

MCM 6810 RAM (see Appendix C), Digital Logic Development Station

DISCUSSION

Random Access Memory (RAM) is a memory device that can be used as another means of implementing combinational logic. A memory device is a circuit that contains an array of semiconductor devices, which are interconnected to store an array of binary data. Data words are stored in unique locations in the memory. These locations are accessed by addresses. The word length and number of addresses depend on the size of a particular memory. Data words can be read from or written into a memory location by accessing it with the desired address. RAM is a volatile memory device, meaning that it must be powered whenever data is to be written to, read

from, or stored in it; and it loses all stored information whenever the power is turned off. One of the advantageous features of this device is that it allows for changing of the stored data during operation. The MCM 6810 is a 12x8 bit static RAM, which consists of 128 unique addresses, accessed by seven address lines, which each store an 8-bit word. The chip is fabricated with n-MOS technology and is TTL compatible. Memory expansion is provided through multiple chip select inputs.

Read Only Memory (ROM) is a memory circuit that consists of coupling devices, often diodes. ROM is similar to RAM in operation, except that stored data cannot be changed under normal operating conditions and ROM is non-volatile, meaning that stored data is not lost when the power is turned off.

PRELIMINARY

1. Write the truth table for function **F(x, y, z) = xy + xz + yz**. Also complete the truth-table for a 2-bit adder (adding **a1a0** to **b1b0**, outputs are output carry, **cout**, and **s1s0**).

x	y	z	F		a1	a0	b1	b0	Cout	s1	s0
0	0	0			0	0	0	0			
0	0	1			0	0	0	1			
0	1	0			0	0	1	0			
0	1	1			0	0	1	1			
1	0	0			0	1	0	0			
1	0	1			0	1	0	1			
1	1	0			0	1	1	0			
1	1	1			0	1	1	1			
					1	0	0	0			
					1	0	0	1			
					1	0	1	0			
					1	0	1	1			
					1	1	0	0			
					1	1	0	1			
					1	1	1	0			
					1	1	1	1			

2. Write the procedure to read from memory location 2Ch, write A5h to address 2Ch, then read from address 2Ch.

PROCEDURE

1. With the power off, set up the MCM 6810 so that it is in "write mode," as depicted in Figure 1. Have your instructor check your circuit before turning the power on.
2. Set switches SW2 – SW5 to correspond to your truth table's first line inputs.

3. Set switches SW7 – SW10 to correspond to your truth table's first line outputs.
4. Pulse switch SW1 low, in order to write the first line of data into the RAM.
5. Repeat steps 2 through 4 for each line of your truth table.
6. Remove the switches from the data lines and connect the data lines to the LEDs.
7. Remove /CS$_1$ from SW1 and connect /CS$_1$ to ground. Do not remove R/W from SW1. At this point your setup should look like Figure 2.
8. Verify that both functions are correct for all inputs by reading from the memory.
9. After the instructor verifies that circuit is operating correctly, turn the power off and then back on. Read and record the truth table data from the memory.
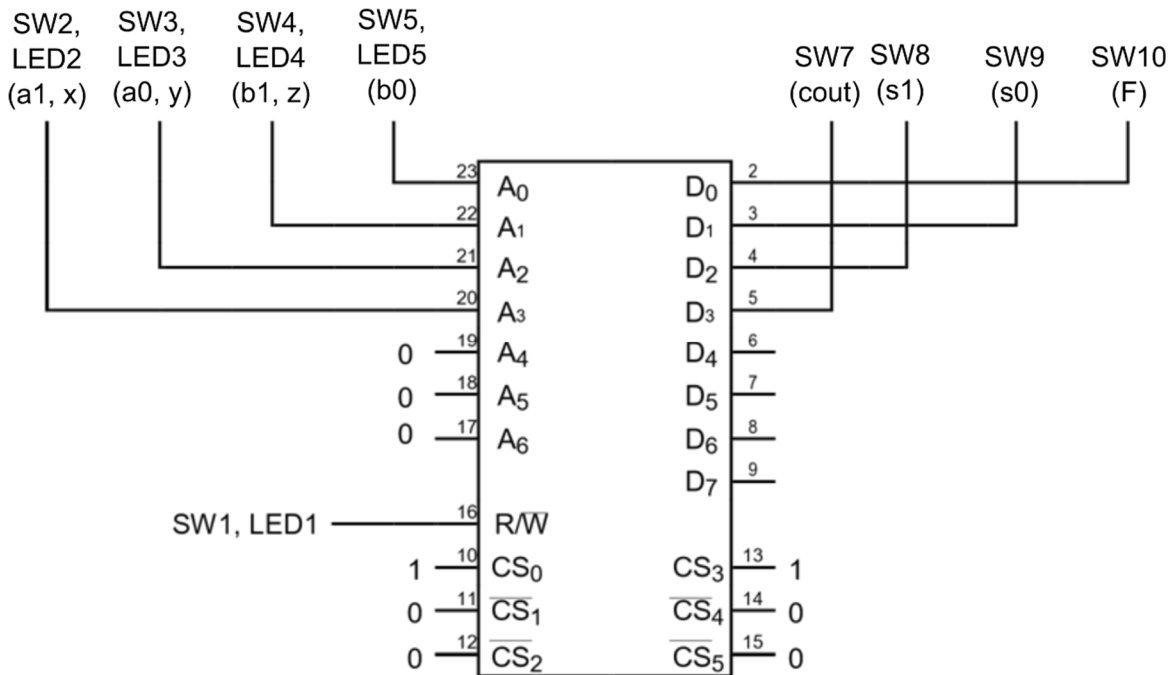

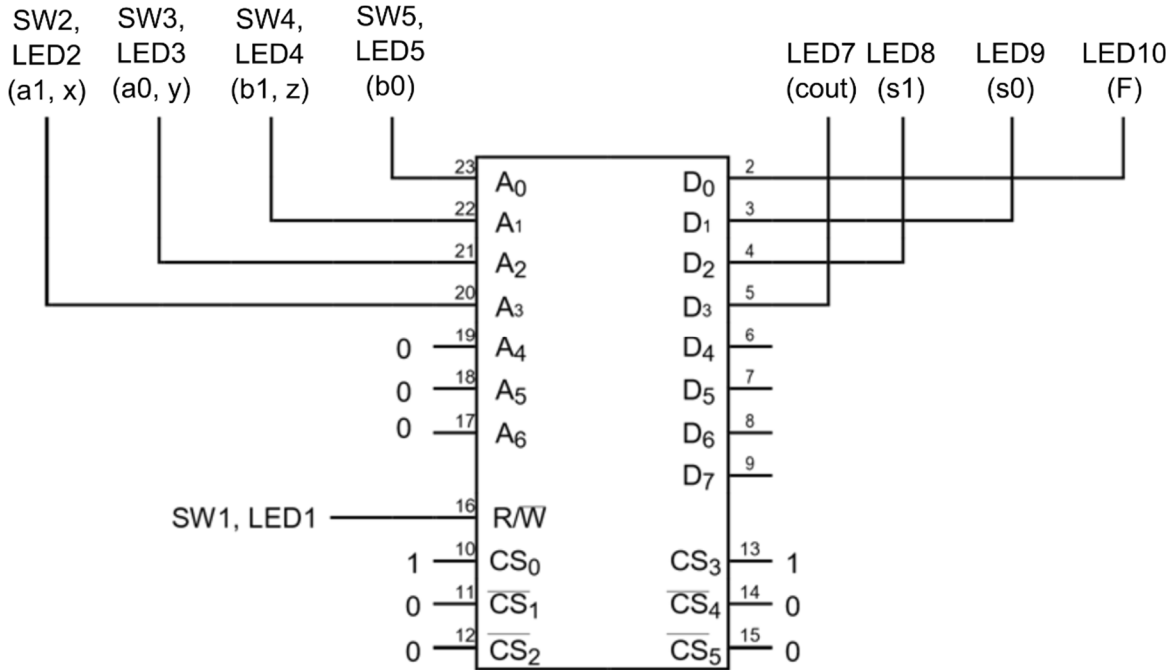*Figure 1: 'Write Mode' Schematic Diagram.*

SW2, LED2 (a1, x) SW3, LED3 (a0, y) SW4, LED4 (b1, z) SW5, LED5 (b0)

LED7 (cout) LED8 (s1) LED9 (s0) LED10 (F)

23 A_0 2 D_0
22 A_1 3 D_1
21 A_2 4 D_2
20 A_3 5 D_3
0 — 19 A_4 6 D_4
0 — 18 A_5 7 D_5
0 — 17 A_6 8 D_6
9 D_7

SW1, LED1 — 16 R/$\overline{W}$
1 — 10 CS_0 CS_3 13 — 1
0 — 11 $\overline{CS_1}$ $\overline{CS_4}$ 14 — 0
0 — 12 $\overline{CS_2}$ $\overline{CS_5}$ 15 — 0

Figure 2: 'Read Mode' Schematic Diagram.

Q1. **Discuss the advantages for using Ram for implementing combinational circuits.**

Q2. **Why are there so many chip select lines?**

Q3. **Would the MCM 6810 be a feasible alternative for any combinational logic circuits designed in previous laboratory experiments? Explain.**

Q4. **A memory circuit is going to be used to implement a combinational function in a commercial CD player. Which is more practical, RAM or ROM? Explain.**