EXPERIMENT NUMBER 10
RANDOM ACCESS MEMORY FOR COMBINATIONAL LOGIC

Purpose
The purpose of this exercise is to examine the use of RAM (and ROM) as a means of realizing combinational logic circuits.

References
Givone: Section 5.8

Materials Required
MCM 6810 RAM (see Appendix H), Digital Logic Development Station

Discussion
Read/Write Memory: RAM is a memory device that can be used as another means of implementing combinational logic. A memory device is a MSI, LSI, or VLSI (depending on the memory size) 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 a RAM. These locations are accessed by addresses. The word length and number of addresses depend on the size of a particular RAM. Data words can be read from or written into a RAM 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 128 × 8 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 LSI or VLSI 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 $\mathbf{a_1a_0}$ to $\mathbf{b_1b_0}$, outputs are output carry, $\mathbf{c_{out}}$, and $\mathbf{s_1s_0}$).

x	y	z	F

a_1	a_0	b_1	b_0	c_{out}	s_1	s_0

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 10-1. 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 $\overline{CS_1}$ from SW1 and connect $\overline{CS_1}$ to ground. Do not remove $R/\overline{W}$ from SW1. At this point your setup should look like Figure 10-2.

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.

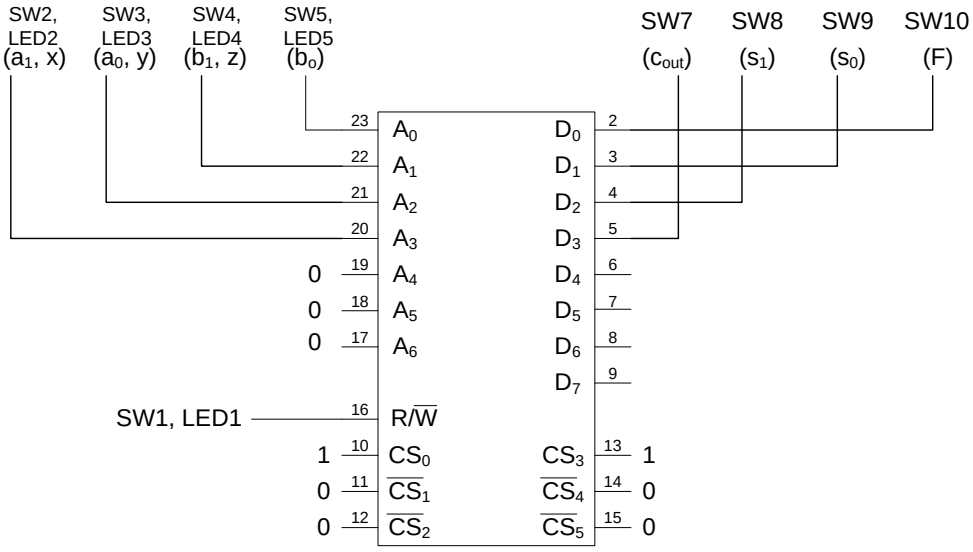

Figure 10-1: "Write Mode" Schematic Diagram

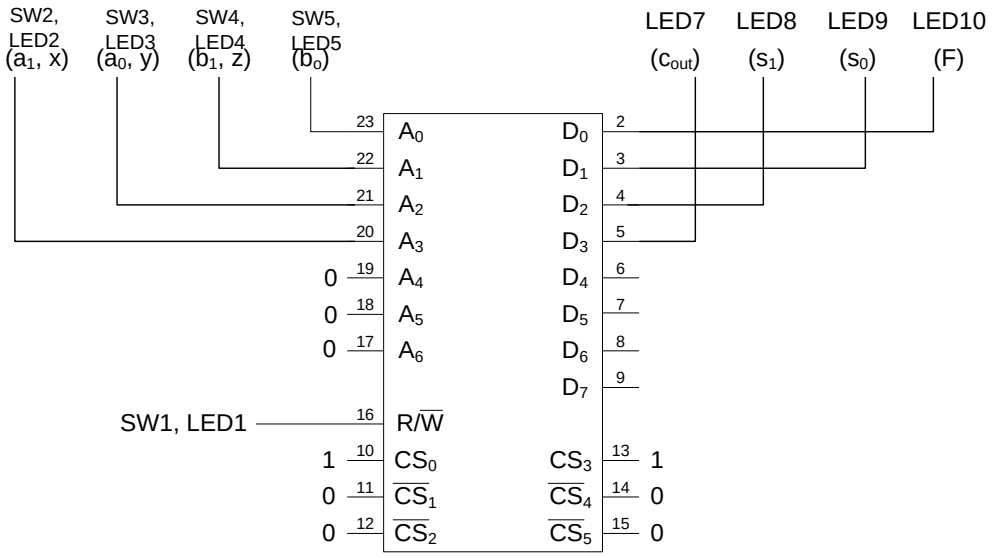

Figure 10-2: "Read Mode" Schematic Diagram

Questions

1) Discuss the advantages for using Ram for implementing combinational circuits.

2) Why are there so many chip select lines?

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

4) 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.