Simplified LCD Explanation  
(from Exam 1, Fall 1998)

An X-Caliber5005 LCD (liquid crystal display) must be driven with a 68HC11. Memory-map the LCD to the two locations $C000$ and $C080$, where the first address is for commands and the second is for data. No other devices exist in the memory-mapped space from $C000$-$CFFF$. The LCD can display ASCII characters in 64 display positions (shown to the right).

There are four possible commands for this LCD: Write, Read, Clear and Complement. These commands are encoded in the most significant 2-bits of a one-byte command word. The lower 6 bits of the command word specifies the appropriate LCD display position, 0 through 63.

Below describes how to write a “!” to position 37 ($= \$25 = \%10 0101$).

• First send (write) the command $A5$ ($\%1010 0101$) since a write command has $\%10$ in bits 7 and 6). Write this byte to location $C000$ (the command register).

• Next send (write) the ASCII code for “!” ($21$) to location $C080$ (the data register).

To read from position 37=$\$25$, for example:

• First send (write) the command $65$ (since a read command has $\%01$ in bits 7 and 6) to location $C000$

• Next read the ASCII code at location $C080$.

The Clear and Complement commands require no data, and respectively blank or invert the colors of a particular LCD character position.

The CE, WR, and RD (sometimes called OE) operate identically to the same pins on the RAM used in lab. There is one additional control line C/~D (command/data) that tells the LCD whether the information on its data lines is a command (when high) or data (when low). On the next 2 pages, you will design a circuit (no PAL allowed) to connect the microcontroller with the X-Caliber5005 and create a subroutine to fill the LCD with characters.