We have a growing number of application notes that show how to use the PIC, as shown in the first page of Note #6:

PIC Application Notes

PARALLAX
PIC Application Notes

Driving a Liquid Crystal Display

Introduction. This application note shows how to interface PIC microcontrollers to common Hitachi liquid-crystal display (LCD) modules. The program, in Parallax assembly language, writes text to the display, reads display status, and creates custom character patterns.

Background. LCD modules based on the Hitachi 44780 controller are plentiful and inexpensive, and range in size from 8 to 80 characters. While a complete description of these LCDs' features and operation is beyond the scope of this application note, here are the highlights:

Hitachi LCD modules display the standard ASCII character set, plus selected Japanese, Greek, and math symbols. They operate from a single-ended 5-volt supply, and communicate with a bus or controller through 11 input/output (I/O) lines. The data lines are tri-state; they go into a high-impedance state when the LCD is not enabled.

The three control lines 'control' the LCD. The enable (E) line determines whether the LCD listens to the other control and data lines. When disabled, the LCD ignores all data and control signals. When enabled, the LCD checks the state of the other two control lines and responds accordingly.

The read/write (R/W) line determines whether the LCD reads bits from the data lines, or writes bits to them.

Register-select (RS) determines whether the LCD treats data as instructions or characters. Here is the truth table for the control lines:

E	0	LCD disabled.
	1	LCD enabled.
R/W	0	Write to LCD.
	1	Read from LCD.
RS	0	Instructions.
	1	Characters/bytes.

Writing to the LCD requires the basic steps listed below. (Reading from the LCD follows the same sequence, but the R/W bit must be set.)

- Clear the R/W bit.
- Set or clear the RS bit as appropriate.
- Set the E bit (E=1).
- Clear the E bit (E=0).

When power is applied to the LCD, it resets itself and waits for instructions. Typically these instructions turn on the display, turn on the cursor, and set the display to print from left to right.

Once the LCD is initialized, it can receive data or instructions. If it receives a character, it prints it on the screen and moves the cursor one character to the right. The cursor marks the next location at which a character will be printed. The LCD's internal processing is similar. A memory pointer determines where the next byte will be stored. When a new byte arrives, the pointer advances. To write to sequential locations, establish the starting address and then write one byte after another.

Characters are stored in data display (DD) RAM. Regardless of the number of characters visible on the

Figure 1. Schematic to accompany program LCD_DRVR.SRC.