Parts Suppliers

Nemesis PIC — Kronos Robotics (**www.kronos robotics.com**)
LCDs — Crystalfontz (**www.crystalfontz.com**)

Other Components
Jameco Electronics — **www.jameco.com**
Mouser Electronics — **www.mouser.com**
Digi-Key Corp — **www.digikey.com**
Newark InOne — **www.newark.com**
All Electronics — **www.allelectronics.com**
Parallax Inc. — **www.parallax.com**
Microchip Technology, Inc. — **www.microchip.com**

on-board power supply can drive the chip and LCD without difficulty.

There are a number of different LCD backlight configurations. Crystalfontz has a broad selection of character-mode (and other) LCDs. The one illustrated in the schematic diagrams (Figures 3 and 4; the CFAH 1602A-YYB-JP), is a two-line, 16-characters-per-line, green/yellow display with an LED backlight that draws 130 mA, (240 mA max). The TIP-102 Darlington transistor is overkill for driving the backlight, since it can handle up to eight amps. It does not require a heatsink with the current levels used to drive the backlight. The value of the current limiting resistor, R6 (Figures 3 and 4), in series with the backlight depends upon the power supply voltage and the current drawn by the backlight.

Many of my microcontroller projects run from a 9V wall wart power supply. I draw the LCD's backlight power from the ~9-12 VDC, unregulated source. The 51 Ω, 1 W resistor then limits the backlight current to ~130 mA. This value can be decreased to draw more current and make the backlight even brighter, up to the display's maximum of 240 mA. The value of the resistor can also be decreased if the backlight is powered from the regulated 5 V supply. If this is done, however, the 5 V supply must provide the additional 130 mA. If a 7805, three-pin voltage regulator is used, it will require a heatsink.

A similar display is available with an edge-mounted LED backlight. It draws only 20 mA. Using this display would require a higher-valued resistor, to limit the backlight current. Clearly the "trivial task" of driving the LCD's backlight is non-trivial, and the designer has several decisions to make in this regard. Choose the backlight current-limiting resistor carefully, based upon the display's specifications, and the voltage of the power supply.

NEMESISPROGRAMMER PARTS LIST

ITEM	DESCRIPTION
❑ MAX232	TTL to RS232 serial communications chip
❑ LM7805	Three-pin voltage regulator, five volts
CAPACITORS	
❑ C1	100 µF, 35 V
❑ C2	10 µF, 10V
❑ C3, C4	0.1 µF, 35 V
❑ C5-9	1 µF, 20 V (with MAX232 chip)
❑ C5-9	0.1 µF, 20 V (with MAX232A chip)
RESISTORS	
❑ R1	10 KΩ, 1/4 W, 5%
❑ R2	470 Ω, 1/4 W, 5%
DIODES	
❑ D1	1N4002
LEDs	
❑ D2	Red LED (power indicator)
MISC.	
❑ SW1	SPSTtoggle switch (oower on/off)
❑ J1	Nine-pin, female RS-232 serial connector
❑ Batt	Nine-volt battery and connector

LCD Driver Software

As mentioned earlier, Athena Basic includes firmware to directly drive HD44780 parallel interfaced LCDs. The LCDinit command specifies the ports used for the data and control signals to the LCD module. LCDControl, LCDChar, and LCDWrite commands send control codes and ASCII data to the display. A simple data parser looks at the incoming data stream to determine if the next byte is a command instruction (Esc, 27 decimal) or simply more ASCII data to display. Commands such as clear screen, home, and position send control codes to the display. LED and piezoelectric-beeper commands are intercepted and the appropriate port set high, low, or pulsed for the beeper. In these instances, no data is sent on to the display itself.

The LCD Driver Features sidebar also illustrates the commands used by several common microcontrollers to display information on an LCD. Data is sent using the serial-output instructions, at either 2400 or 9600 baud, using the N81 format. The Nemesis doesn't require a crystal or ceramic resonator to control its internal clock frequency or communications baud rate. With an 80 byte buffer, the main project's processor can send data without regard to timing and processing delays. If the display is blank, be sure to adjust the contrast control!

Summary

By incorporating a serial-to-parallel LCD driver within one's project one can focus on the project's primary function, not on the nuances of LCD interfacing and control. Only a single I/O port is required for sending serial data to the controller, and programming memory is conserved for the main project at hand. Data display truly becomes trivial, and advanced user interfaces become readily achievable. Once again, microcontrollers make it easy! **NV**