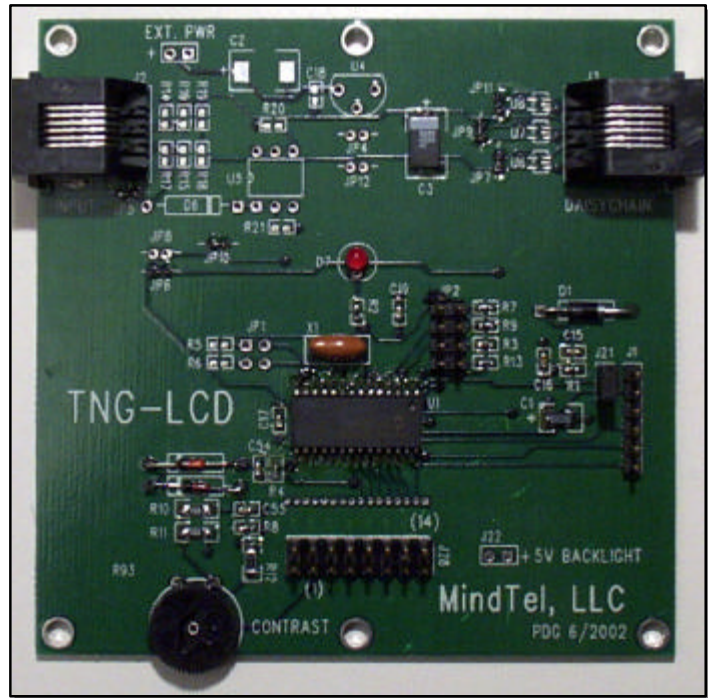


TNG-LCD Driver Board

The TNG-LCD driver board will control a single LCD text module. The board performs a similar function to the Scott Edwards Electronics serial backpack. TNG-LCD uses a PIC16F73 microcontroller with a 4 MHz ceramic resonator.

The display being controlled must use the standard pin assignments for displays = 80 characters (14 pins) or >80 characters (16 pins), using a Hitachi HD44780-based format. The J28 16-pin header is utilized for 14-pin interfaces as the number legends "(1)" and "(14)" on the board indicate. The "(14)" pin becomes pin 1 for 16-pin interfaces. Displays greater than 80 characters must have the jumper to the left of R13 installed.

TNG-LCD may be daisy-chained with other addressable SPI TNG boards such as TNG-key or TNG-servo. The board address is determined by the presence or absence of shunts on the three jumpers adjacent to resistors R7, R9, and R3. The jumper adjacent to R7 is the least significant bit of the address. Presence of a shunt constitutes a "1" in the address. The address range is 0-7. Receipt of



The shunt at J21 must be present for proper operation; it must be removed for in-circuit serial programming via J1.

TNG-LCD uses the SPI communications protocol available via the SPI/expansion port on TNG-4. No modifications from the default protocol parameters are required.

Board options include termination of SPI lines, SPI line buffering, operation from an external power source with on-board regulation (+5V power normally comes through the modular connector from TNG4), RS-232 communication with optional propagation as inverted TTL, and a connection for 5V backlighting.

LCD contrast may be adjusted via the contrast adjustment dial potentiometer. The negative voltage for the contrast adjustment is generated by the PIC processor via a charge pump technique.

For command references see: <http://home.iae.nl/users/pouweha/lcd/lcd.shtml>

The **communications protocol** is as follows:

1. Sync Byte: (FFh [255])
2. Address Byte.
 form: x****bbb where
 - x = 1 switches chips in displays > 80 char. The switch bit switches chips in displays > 80 char. That is the first bit = 1 in a sequence switches chips-- 1 to 2; 2 to 1.
 - **** = undefined bits.
 - and bbb = board base address (0-7). This byte must equal the base address selector lines.

3. # bytes in LCD message 1-255. 0 terminate sequence.

4. 4-(#bytes+3) bytes: Message.

Source must send FE followed by one command byte to send a command. The switch bit switches chips in displays > 80 char. That is the first bit = 1 in a sequence switches chips-- 1 to 2; 2 to 1. If a command requires two bytes, then send FE XX FE YY.

Examples:

All number pairs represent hexadecimal bytes.

99 07 0B FF 01 08 FE 38 FE 0E FE 06 FE 01: Send an 11-byte SPI message using Port C bit 2 as the chip select line. The message starts with FF and is sent to board address 1. 8 bytes are in the LCD message. The LCD message consists of 4 command pairs. The first command is a function set command (8-bits, 2-lines, 5x7 font). The second command is a display command (display on, cursor on). The third command is an entry mode set (increment, no shift). The fourth command is clear display command.

99 05 FF 00 02 FE 87: Send a 5-byte SPI message using Port C bit 2 as the chip select line. The message begins with the FF sync byte and is sent to board address 0 on using this chip select. The LCD message is 2 bytes. The LCD command moves the data pointer to address 7.

99 07 0F FF 00 0C 48 65 6C 6C 6F 20 57 6F 72 6C 64 21: Send an 15-byte SPI message using Port C bit 2 as the chip select line. The message starts with FF and is sent to board address 0. 12 bytes are in the LCD message. The LCD message is "Hello World!".