BPK LCD Driver Board Part # 6-201

This note accompanies the following products:
BPK LCD Driver Board- Part Number 6-201,
Serial LCD 2x16, Part number 6-111
Serial LCD 2x20, Part number 6-121
Serial LCD 2x40, Part number 6-131
Serial LCD 4x20, Part number 6-141.

Suitability

The BPK Serial Driver Board is a daughterboard that attaches to LCD modules and converts the standard 4 or 8-bit parallel interface to a more easily managed serial interface at either 2,400 or 9,600 baud. It is compatible with all Hitachi 44780 controllers (or equivalents by OKI, Samsung etc) with up to 80 on-screen characters. It is not suitable for 4x40 displays.

Connecting the BPK Board

LCD Connection- Non Backlit LCDs

The BPK board is supplied with SIL and DIL connectors- select the most appropriate connector for your LCD. Non-backlit LCDs will have either a 14x1 pin or 7x2 pin arrangement- the supplied connectors are 16x1 and 8x2- trim these down to suit the LCD.
Solder the selected connector to the BACK (component, non-display side) of the LCD using the shorter length pins. Place the two double-sided foam pads on the back of the LCD to prevent the LCD and driver boards from touching. Position the driver board over the header- **ensure that pin 1 is connected to pin 1 and that BPK pins 15 and 16 remain un-connected.**
Solder in place

LCD Connection- LCDs with Backlighting

The BPK board is supplied with SIL and DIL connectors- select the most appropriate connector for your LCD. Backlit LCDs will have either a 16x1 pin or 8x2 pin arrangement- the BPK board assumes the back-lighting will be connected to pins 15 (Anode) and 16 (Kathode) – **check this configuration is correct before proceeding further**.
Solder the selected connector to the BACK (component, non-display side) of the LCD using the shorter length pins. Place the two double-sided foam pads on the back of the LCD to prevent the LCD and driver boards from touching. Position the driver board over the header- **ensure that pin 1 is connected to pin 1.** Solder in place

Connecting up the Driver Board/LCD

The Driver Board requires just 3 connections, incoming signal, ground and +5v at approximately 2mA (excluding back-lighting) making it suitable for driving from either of the BASIC Stamps.

DB-9 Socket

Connect the signal line to pin 3 and ground to pin 5. Some PC software requires handshaking so you may need to make the following connections:
1 to 4 to 6
7 to 8

DB-25 Socket

Connect the signal line to pin 2 and ground to pin 7. Additional connections that may be needed are:
Pin 4 to 5 Pin 6 to 8 to 20.

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Configuration

Back-Lighting (if fitted)
Power for the back-lighting is supplied via the 3-pin header. The back-lighting is selected On or OFF by the B/L jumper. The back-lighting current is set by resistor RBL to approximately 200mA (0.8V/3R9) or 170mA (0.8V/4R7) for the 6-111 and 6-201 products. RBL may be adjusted to suit particular LCDs but always ensure the maximum back-lighting current is not exceeded.

The Driver Board includes two jumpers to configure the LCD. Note the configuration is read on power-up and is retained until powered up again.

One or Two Lines?
The LCD can be configured to operate with either 1 or 2 lines of display. With the line jumper installed the display uses 2 lines.

Baud Rate?
The Driver Board will accept RS-232 signals at either 2400 Baud (jumper missing) or 9600 Baud (jumper installed).

Display
The potentiometer on the BPK board adjusts the display contrast- it has been adjusted at the factory but may be further adjusted to suit local lighting conditions.

Self-Test
Connect the serial input pin to the +5V pin and switch on to display the firmware version.

Programming

Text for display on the LCD must be sent serially at either 2400 or 9600 baud, no parity, 8 bits, 1 stop bit and inverted format.
Instructions to the LCD must be prefixed by the single byte <254> which will put the LCD into Instruction mode. The LCD automatically reverts to Display mode once an instruction is received.

Note that LCDs require approximately 500ms to settle down after powering up and data/control codes should not be sent to it during this period. Similarly a pause of 10ms should be inserted after a Clear Screen or Home command before other data is sent.

Programming examples are listed below:

Parallax BASIC Stamps
With the LCD serial line connected to pin 0 the following programme line should display the word "Hello"

```
SEROUT 0, N2400, ("Hello")      -Make sure the LCD is set for 2400Baud transfer
```

and for the Stamp2:

```
SEROUT 0,84+$4000,["Hello"]     -Make sure the LCD is set for 9600 Baud transfer
```

The LCD will accept all the common control codes. To differentiate between control codes and normal characters the LCD must first be sent the code 254. To clear the LCD screen therefore (control code 1):

```
SEROUT 0,N2400,(254,1)
```

Once the control code has been received the LCD will revert back to normal operation (ie expect to receive a normal character). The other control codes you may need are as follows:

Instruction/Action	Code
Clear Screen	1

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Scroll display one character left	24
Scroll display one character right	28
Home (and undo scrolling)	0
Move cursor one character left	16
Move cursor one character right	20
Turn on underline cursor	14
Turn on blinking cursor	13
Turn off cursor	12
Blank the display (retaining data)	8
Restore the display (without cursor)	12
Set display (DD) RAM address	128 + address
Set character (CG) RAM address	64+address

The last two instructions allow you to write to specific locations in the LCD's memory. By setting the display data (DD) RAM address, you can control the location on the display at which subsequent characters will appear. This lets you update part of the display without having to reprint the entire screen.

By entering values into character- generator (CG) RAM, you can define character patterns to create simple graphics. The following figure shows how to calculate the data for these patterns.

	Bit Map	Data (Binary	Data (Decimal)
0	□□□□□	00000	0
1	□□■□□	00100	4
2	□■■■□	01110	14
3	■■■■■	11111	31
4	□■■■□	01110	14
5	□□■□□	00100	4
6	□□□□□	00000	0
7	□□□□□	00000	0

To define one of the 8 characters in CG RAM, put the LCD into Instruction mode, then send the following value to the LCD: 64+ (8 x character_no.) where character_no. is in the range 0 to 7. Then send the bit-map data calculated as shown above. For example to define CG RAM 3 with the above character send the following byte string:
[254, 88,0,4,14,31,14,4,0,0] where 88 is calculated from 64+3 x 8 = 88.
To print this character at the 4th position on line 1 send the following:
[254,132] - 254 to put into instruction mode and move the cursor to 128 (start of line 1) +4= 132
[3] - Display the character in location 3. CG RAM occupies location 0 to 7.

See below for further information on print locations.

PC Operation

The following programme lines illustrate the equivalent lines to drive the LCD from QBASIC running on a PC.

```
OPEN "COM1:2400,N,8,1,CD0,CS0,DS0,OP0" FOR OUTPUT AS #1      'Sets up Com port 1 for 2400 baud
SLEEP 1                                  ' Pause for 1 second
PRINT #1, "Hello"                        ' Prints the word "Hello" to the screen
SLEEP 10                                 ' Pause for 1 0 seconds
PRINT #1, CHR$(254); CHR$(1);                    ' Clears the screen
```

Print Addresses

All LCDs are fitted with a 40 characters per line Character RAM. This means for example that sending 40 characters to a 20-character display would display only the first 20 characters sent. The missing characters are stored in the LCD's RAM but not displayed. It would be necessary to scroll-left the display to be able to see these characters. There is no automatic wrap-round to the second (or subsequent) lines. Once the end of a (physical) line is reached, the DD RAM address must be reset to the beginning of the next (physical) line. DD RAM address examples for our standard LCDs are shown below:

2x16 LCD

Line 1	address:	0	1	2	3	4	.....	15
	DD address:	128	129	130	131	132	.....	143
Line 2	address:	64	65	66	67	68	.....	79
	DD address	192	193	194	195	196	.....	207

2x20 LCD

Line 1	address:	0	1	2	3	4	.....	19
	DD address:	128	129	130	131	132	.....	147
Line 2	address:	64	65	66	67	68	.....	83
	DD address	192	193	194	195	196	.....	211

2x40 LCD

Line 1	address:	0	1	2	3	4	.....	39
	DD address:	128	129	130	131	132	.....	167
Line 2	address:	64	65	66	67	68	.....	103
	DD address	192	193	194	195	196	.....	231

4x20 LCD

Line 1	address:	0	1	2	3	4	.....	19
	DD address:	128	129	130	131	132	.....	147
Line 2	address:	64	65	66	67	68	.....	83
	DD address	192	193	194	195	196	.....	211
Line 3	address:	20	21	22	23	24	.....	39
	DD address:	148	149	150	151	152	.....	167
Line 4	address:	84	85	86	87	88	.....	103
	DD address	212	213	214	215	216	.....	231

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