NEC NG-87243-001 LCD initialisation sequence

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These were recovered from an NEC DTR-16D-1A phone manufactured around 2003 to 2006.
LCD controller compatible with Hitachi HD44780.

LCD 16 pin interface: led, led, led, RS, E, D0, D1, D2, D3, Vcc, Gnd, Contrast?, Vcc, -, Gnd, -

LED K	Green LED cathode
Common	LED anodes
LED K	Red LED cathode
RS	Register select, low for commands, high for data
E	Enable, clocks in each 4 byte nibble on the trailing edge.
D0 - D3	Data lines. These are actually lines D4 through D7 as far as the HD44780 is concerned – the other 4 data-lines aren't brought out to the interface, and so communication is via 4 bit mode.
Vcc	3.3V, logic power supply.
GND	0V
Contrast?	Varies from 1.7V to 1.9V, maybe contrast control
Vcc?	Seems to be tied high
-	no connection
GND	Seems to be tied low, R/W maybe?
-	no connection

Once the controller is in 4 bit mode, bytes are sent to the controller as two successive nibbles, with two E clock pulses 39uS apart, most significant nibble first. Generally there is a 39uS delay between nibbles forming one byte and a 72uS delay between successive command bytes.

LCD initialisation:

(each byte is a command, unless designated with a "d" as data, ie RS was high)
Typical initialisation sequence for Hitachi HD44780, starts off assuming it is unknown whether the chip is in 8 bit or 4 bit mode. The first 3 bytes are written with a single E clock pulse each (the MPU is only asserting 4 bits of data each time. It assumes the other 4 data-lines (which aren't brought out to the interface) are all tied low.

3   3   3   2 28 08 01 06 0C

30   Function set interface to be 8 bits long

8mS delay

30   Function set interface to be 8 bits long
If the chip happened to have been in 4 bit mode already, it has now received the command 33 which would also set it to 8 bit mode

194uS delay

30   Function set interface to be 8 bits long
Now chip is definitely in 8 bit mode, set it to 4 bit mode!
20   Function set interface to be 4 bits long
28   Function set 4bits, 2 rows of character, 5x7 font
08   Set display OFF, cursor OFF, blink OFF
01   Clear display
06   Set increment

`0c`   Set display ON, cursor OFF, blink OFF

2S delay

<u>Phone test sequence:</u>
`0c`   Set display ON, cursor OFF, blink OFF
`80`   Set display RAM address 0
"TEST   PUSH=   "
`54d`
`45d`
`53d`
`54d`
`20d`
`20d`
`20d`
`20d`
`20d`
`50d`
`55d`
`53d`
`48d`
`3dd`
`20d`
`20d`
`20d`
`20d`
`20d`
`20d`
`20d`
`20d`
`20d`
`20d`

`a0`   Set display RAM address 32
"   **NEXT=F12**   "
`20d`
`20d`
`20d`
`20d`
`20d`
`20d`
`20d`
`20d`
`20d`
`4ed`
`45d`
`58d`
`54d`
`3dd`
`46d`
`31d`
`32d`
`20d`

20d
20d
20d
20d
20d
20d

c0   Set display RAM address 64
"   **L16+B 0**"
20d
20d
20d
20d
20d
20d
20d
20d
20d
20d
20d
20d
20d
20d
20d
20d
20d
4cd
31d
36d
2bd
42d
20d
30d

Store 8 programmable character patterns

40   Set character generator address 0
04d   . . . . . . ■ . .
0ed   . . . . ■ ■ ■ .
15d   . . . ■ . ■ . ■
04d   . . . . . . ■ . .
04d   . . . . . . ■ . .
04d   . . . . . . ■ . .
04d   . . . . . ■ . .
00d   . . . .

04d   . . . . . ■ . .
04d   . . . . . . ■ . .
04d   . . . . . . ■ . .
04d   . . . . . ■ . .
15d   . . . ■ . ■ . ■
0ed   . . . . ■ ■ ■ .
04d   . . . . . ■ . .
00d   . . . .

```
08d   . . . . ▄ . . .
04d   . . . . . ▄ . .
00d   . . . . . . . .
0ed   . . . . █ . . .
11d   . . . █ . . . .
1fd   . . . █ . . . .
11d   . . . █ . . . .
00d   . . . . . . . .

02d   . . . . . . ▄ .
04d   . . . . . ▄ . .
00d   . . . . . . . .
0ed   . . . . █ . . .
11d   . . . █ . . . .
1fd   . . . █ . . . .
11d   . . . █ . . . .
00d   . . . . . . . .

04d   . . . . . ▄ . .
0ad   . . . . █ . █ .
00d   . . . . . . . .
0ed   . . . . █ . . .
11d   . . . █ . . . .
1fd   . . . █ . . . .
11d   . . . █ . . . .
00d   . . . . . . . .

05d   . . . . . █ . █
0ad   . . . . █ . █ .
00d   . . . . . . . .
0ed   . . . . █ . . .
11d   . . . █ . . . .
1fd   . . . █ . . . .
11d   . . . █ . . . .
00d   . . . . . . . .

04d   . . . . . ▄ . .
0ad   . . . . █ . █ .
1fd   . . . █ . . . .
10d   . . . █ . . . .
1ed   . . . █ █ █ . .
10d   . . . █ . . . .
1fd   . . . █ █ █ . .
00d   . . . . . . . .

05d   . . . . . █ . █
0ad   . . . . █ . █ .
00d   . . . . . . . .
0ed   . . . . █ . . .
11d   . . . █ . . . .
11d   . . . █ . . . .
1ed   . . . █ █ █ . .
00d   . . . . . . . .
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After this point the display and programmable characters appear to be refreshed over and over while it waits for input (key-presses to test the phone):

0c Set display ON, cursor OFF, blink OFF
80 Set display RAM address 0
"TEST"
54d
45d
53d
54d

...