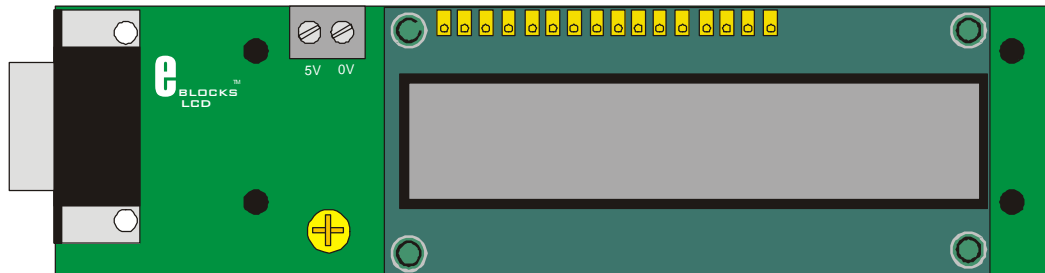
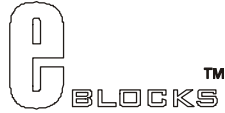


# LCD Display datasheet



## Contents

1. About this document
  2. General information
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  4. Getting Started
  5. Users Guide
- Appendix
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# 1 About this document

This document concerns the Matrix LCD Display code EB-005-00-1.

## Trademarks and Copyright

PIC, PICmicro are registered trademarks of Arizona Microchip Inc.

E-blocks is a trademark of Matrix Multimedia Limited.

EB-005-00-1 and associated software and documentation are Copyright ©2004 Matrix Multimedia Limited.

## Other sources of information

There are various other documents and sources that you may find useful:

### Getting started with E-Blocks.pdf

This describes the E-blocks system and how it can be used to develop complete systems for learning electronics and for PICmicro programming.

### PPP Help file

This describes the PPP software and its functionality. PPP software is used for transferring hex code to a PICmicro microcontroller.

## Disclaimer

The information in this document is correct at the time of going to press. Matrix Multimedia reserves the right to change specifications from time to time.

## Technical support

If you have any problems operating this product then please refer to the troubleshooting section of this document first. You will find the latest software updates, FAQs and other information on our web site:

[www.matrixmultimedia.co.uk](http://www.matrixmultimedia.co.uk). If you still have problems please email us at:

support@matrixmultimedia.co.uk. When emailing please state the operating system, the version of PPP you are using.

## 2 General information

### Description

This is an LCD Display designed for E-blocks. It is a 16 character, 2-line alphanumeric LCD display connected to a single 9-way D-type connector. This allows the device to be connected to most E-Block I/O ports.

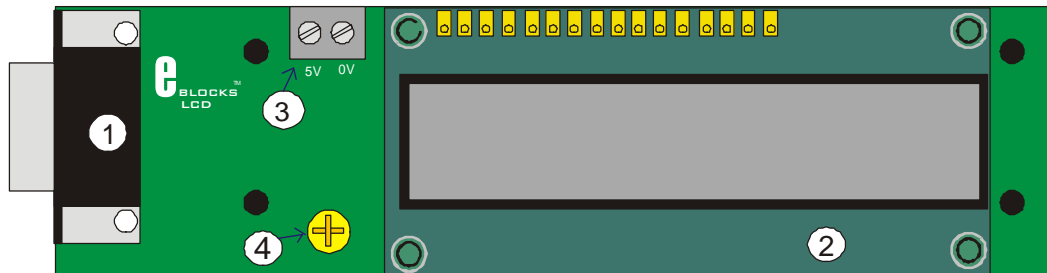
The LCD display requires data in a serial format, which is detailed in the user guide below. The display also requires a 5V power supply. Please take care not to exceed 5V, as this will cause damage to the device. The 5V is best generated from the E-blocks Multiprogrammer or a 5V fixed regulated power supply.

The potentiometer RV1 is a contrast control that should be used to adjust the contrast of the display for the environment it is being used in.

### Features

- E-blocks compatible
- Low cost
- Compatible with most I/O ports in the E-Block range (requires 5 I/O lines via 9 way D-type connector)
- Ease to develop programming code using Flowcode icons.

## 3 LCD Board Layout



- 1) 9 Way D-type Plug
- 2) 16 character, 2-line alphanumeric LCD display
- 3) 9 Screw terminal
- 4) Contrast Control

## 4 Getting Started

As can be seen the circuit diagram (Appendix 1) consists of a simple LCD circuit. To test this board you will need to apply 5V to the LCD Board via the screw terminal and then set the appropriate bits using the 9-Way D-type connector. The details off the LCD configuration are stated in the Chapter 4 Users' guide.

### Testing the LED Board - LCD.hex

The following instructions explain the steps to test and use your LCD Board. The instructions assume that PPP is installed and functional. It also assumes that you are confident in sending a program to the PIC via the multiprogrammer.

The LCD.hex program will place a counter on to the LCD Board

- 1) Ensure power is supplied to all the necessary boards.
- 2) Insert the LCD board into Port B of the Multiprogrammer
- 3) Ensure that the Multiprogrammer is in correct configuration
  - Fast mode (SW1 towards the centre of the board)
  - Ensure that a 19.6608MHz crystal is inserted in the Multiprogrammer board
  - SW2 is not used when in Xtal mode so it doesn't matter it's position
- 4) Program the a PIC16F88 with the test program LCD.hex
- 5) Press the reset button on the Multiprogrammer.
- 6) Adjust contrast accordingly.

This should satisfy that the LCD Board is fully functional!

## 4 Users' guide

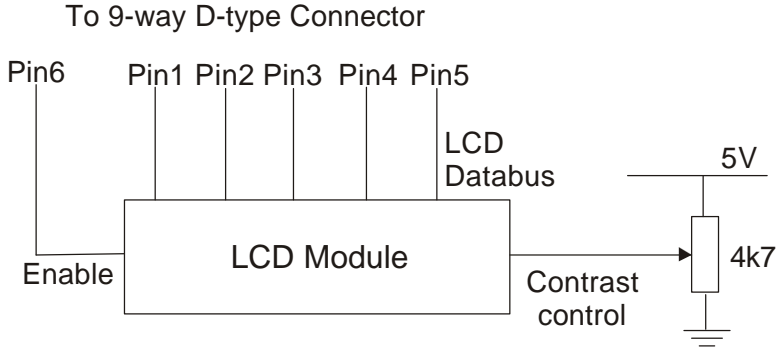
The LCD is a 16 character x 2 lines module. Internally it is 40 characters x 2 lines. Line 1 ranges from H'00' to H'27' and Line 2 ranges from H'40' to H'67'.

0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E	1F	20	21	22	23	24	25	26	27
40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F	50	51	52	53	54	55	56	57	58	59	5A	5B	5C	5D	5E	5F	60	61	62	63	64	65	66	67

Display Window [16x2]
 Internal [40x2]

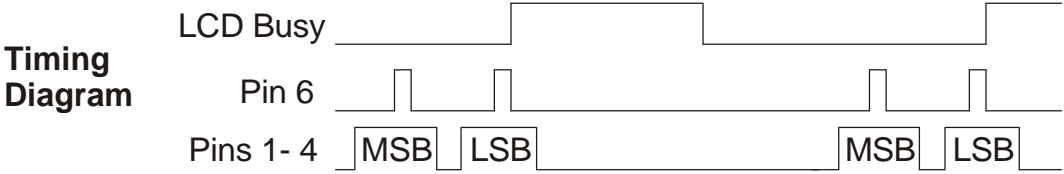
The LCD Module uses a Samsung KS0066U controller, which is similar to the Hitachi HD44780 controller.

The PICmicro board uses pins 1 - 6 on the 9-way D-type connector to program the LCD, as shown in the circuit diagram below. When the LCD board is turned on, data can only be sent to it after 30ms, this is the time taken for the LCD to initialize [as it clears all the RAM and sets up the Entry Mode].



**LCD Block Diagram**

To send a command to the LCD, data must be sent in two steps, the MSB followed by the LSB [byte is data on pins 1 - 4]. As each byte is sent to the LCD, B5 must go high then low, for the LCD to acknowledge the byte. After the second byte has been acknowledged the LCD executes the command. The PICmicro board must wait for at least the length of the execution time for that command, before the next command can be sent. A timing diagram of this process is shown below.



The first command to be sent to the LCD must be 'Function Set' [to setup the LCD], this is usually followed by 'Display Control' and then 'Clear Display'. According to 'Entry Mode Set' after each character is sent to the LCD, the position of the cursor changes [by default it is incremented].

## LCD Instruction Set

Instruction	Code					Description	Execution Time	
	MSB LSB	B4	B3	B2	B1			B0
Clear Display	0	0	0	0	0	0	Clear all display data. Set DDRAM address to 0. Move cursor to home position. Entry mode set to increment.	1.53 ms
		0	0	0	0	1		
Return Home	0	0	0	0	0	0	Set DDRAM address to 0. Move cursor to home position.	1.53 ms
		0	0	0	1	X		
Entry Mode Set	0	0	0	0	0	0	Sets cursor move direction (I/D), specifies to shift the display (S). These operations are performed during data read/write.	39 us
		0	0	1	I/D	SH		
Display Control	0	0	0	0	0	0	D is Display ON/OFF bit, C is Cursor ON/OFF bit, B is Blink Cursor ON/OFF bit.	39 us
		1	D	C	B			
Cursor/Display Shift	0	0	0	0	0	1	Sets cursor-move or display-shift (S/C), shift direction (R/L). DDRAM contents remains unchanged.	39 us
		S/C	R/L	X	X			
Function Set	0	0	0	0	1	0	Configuration data for setting up LCD. [Send First]	39 us
		1	0	X	X			
Set CGRAM Address	0	0	1	A5	A4		Sets the CGRAM address. CGRAM data is sent and received after this setting.	39 us
		A3	A2	A1	A0			
Set DDRAM Address	0	1	A6	A5	A4		Sets the DDRAM address. DDRAM data is sent and received after this setting.	39 us
		A3	A2	A1	A0			
Write Data to RAM	1	D7	D6	D5	D4		Writes data to CGRAM or DDRAM.	43 us
		D3	D2	D1	D0			

DDRAM is Display Data RAM  
 DDRAM address is location of cursor  
 CGRAM is Character Generator RAM  
 X is Don't Care

Bit Name	0	1
I/D	Decrement cursor position	Increment cursor position
SH	No display shift	Display shift
D	Display off	Display on
C	Cursor off	Cursor on
B	Cursor blink off	Cursor blink on
S/C	Move cursor	Shift display
R/L	Shift left	Shift right

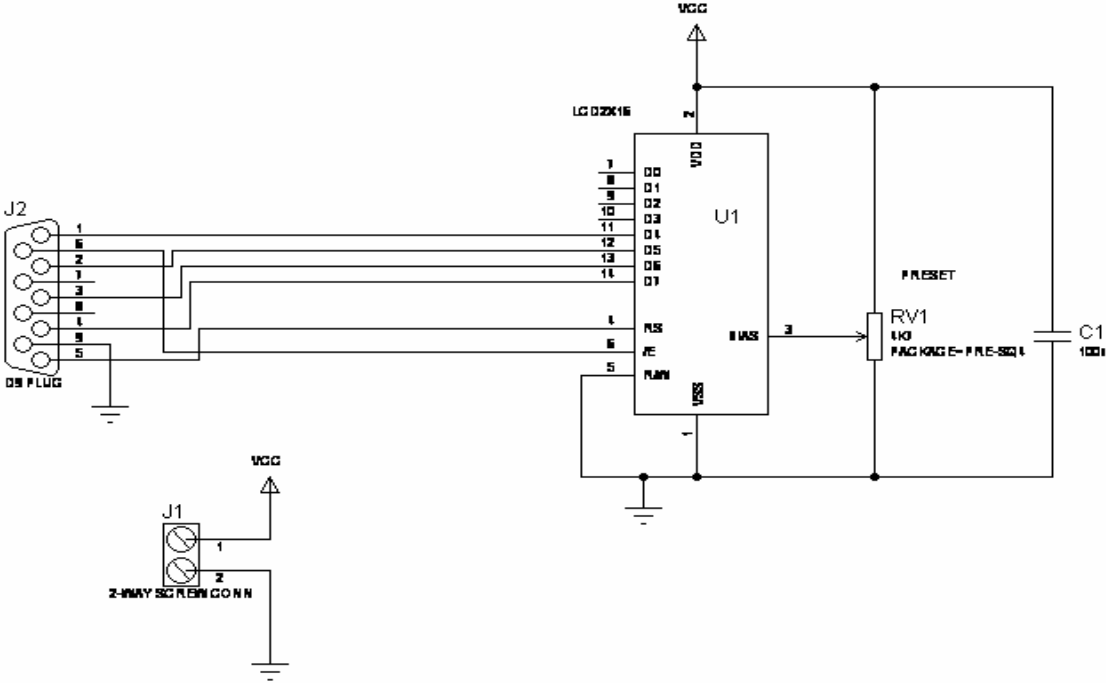
## LCD Character Set


Higher Lower 4bit	0000	0010	0011	0100	0101	0110	0111	1010	1011	1100	1101	1110	1111
xxxx0000	(0)	0	1	P	^	P		-	9	3	α	p	
xxxx0001	(2)	!	1	A	Q	a	q	.	7	4	ä	q	
xxxx0010	(3)	"	2	B	R	b	r	「	イ	ツ	×	ε	θ
xxxx0011	(4)	#	3	C	S	c	s	」	ウ	テ	ε	ω	
xxxx0100	(5)	\$	4	D	T	d	t	、	エ	ト	μ	Ω	
xxxx0101	(6)	%	5	E	U	e	u	・	オ	ナ	1	σ	Ü
xxxx0110	(7)	&	6	F	V	f	v	ヲ	カ	ニ	ヨ	ρ	Σ
xxxx0111	(8)	'	7	G	W	g	w	ヲ	キ	ヲ	ラ	q	π
xxxx1000	(1)	<	8	H	X	h	x	ィ	ウ	ネ	リ	」	Σ
xxxx1001	(2)	>	9	I	Y	i	y	ッ	ケ	ル	」	」	」
xxxx1010	(3)	*	:	J	Z	j	z	エ	コ	ン	レ	」	」
xxxx1011	(4)	+	;	K	[	k	[	オ	サ	ヒ	ロ	」	」
xxxx1100	(5)	,	<	L	¥	l	¥	ハ	シ	フ	ワ	」	」
xxxx1101	(6)	-	=	M	]	m	]	ユ	ズ	ハ	ン	」	」
xxxx1110	(7)	.	>	N	^	n	^	ヲ	セ	ホ	」	」	」
xxxx1111	(8)	/	?	O	_	o	_	ッ	ツ	マ	」	」	」

# Matrix Multimedia LCD Display

## Appendix 1 - Circuit Diagram

THIS SYSTEM INCLUDES:-  
 → FEET



		MATRIX MULTIMEDIA LTD. www.matrixmultimedia.co.uk © Copyright 2004 Matrix Multimedia	
TITLE: LCD BOARD EB-005-00-1		DATE: 25/03/04 PAGE: 1/1	
BY: Color Carr		REV: 1	