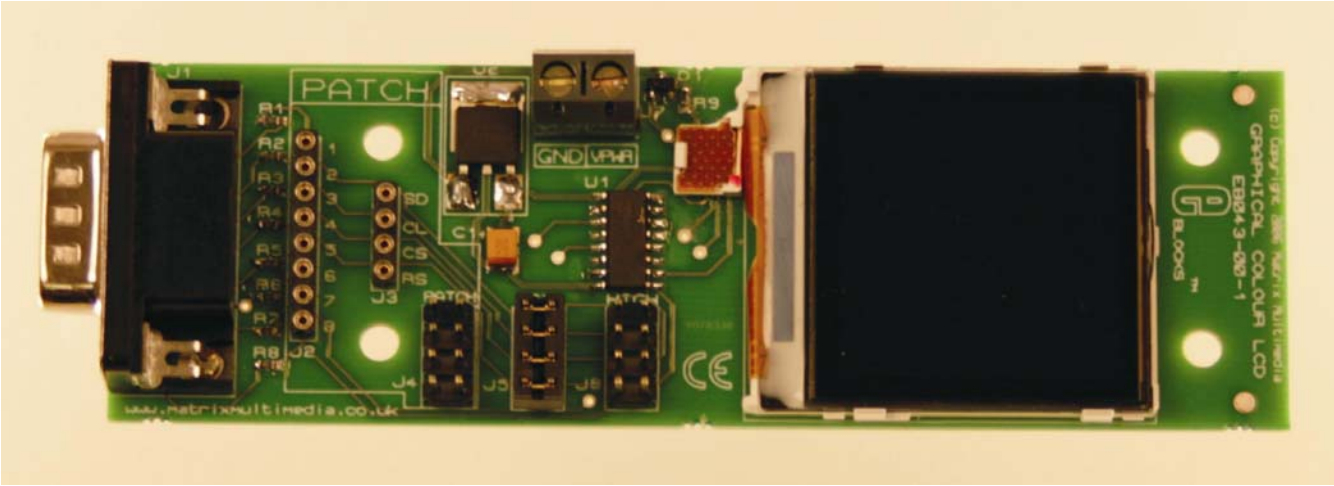
Graphical LCD Display Datasheet
EB043-00-1



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Appendix 1 Circuit diagram

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1. About this document

This document concerns the E-blocks Graphical LCD Display board code EB043 version 1.

The order code for this product is EB021.

1. Trademarks and copyright

PIC and PICmicro are registered trademarks of Arizona Microchip Inc.
E-blocks is a trademark of Matrix Multimedia Limited.

2. 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.

C and assembly strategies

This is available as a free download from our web site.

3. 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. This product is for development purposes only and should not be used for any life-critical application.

4. 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.com . If you still have problems please email us at: support@matrixmultimedia.co.uk.

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2. General information

1. Description

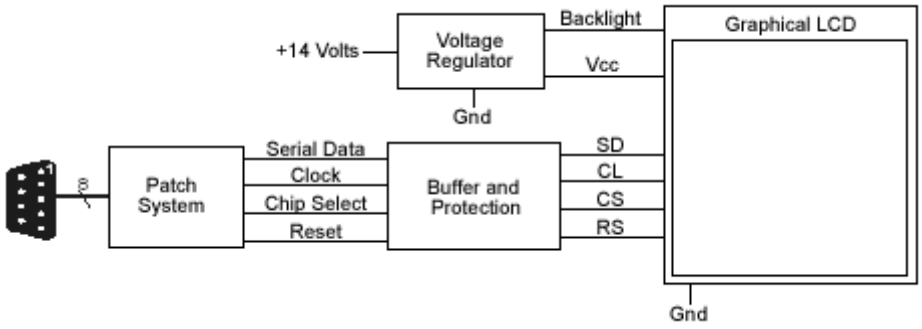
This is a Graphical LCD display designed for E-blocks, which allows a large amount of data to be displayed to help reduce development time or to increase productivity in projects. The display features 130 by 130 pixels totaling at 16900 individually addressable pixels. There is also a maximum of 65,536 individual colours available for each pixel and a white backlight to provide maximum display visibility even in the dark.

A set of jumper links are included which allow the Graphical LCD Display E-block to easily be set for all PICmicro® microcontroller compatible devices. Combining this with the on board patch system makes this board compatible with numerous other devices.

2. Features

- Backlit LCD Display
- 130 x 130 Pixels at a 1:1 Ratio
- Up to 65,535 colours
- 3 or more programmable font sizes
- Up to 16 lines of text
- With up to 21 characters per line
- E-Blocks compatible
- Compatible with most I/O ports in the E-Block range (requires 4 I/O lines via 9 way D-type connector)

3. Block schematic



4. Programming Guide

The Graphical LCD is a 130 by 130 pixel module. Internally it has enough memory to automatically refresh the screen and provide a constant display. Only the pixels that need changing have to be written to the display, therefore decreasing write times and vastly improving refresh and animation performance.

Sending Data to the Display

To send a data packet to the display the data has to be clocked in serial form. The diagram below shows how this is achieved. The first bit of data to be sent is marked ‘A’ and tells the display whether a command or a parameter is being sent. Commands are sent as a logical 0 and parameters as a logical 1. Following the instruction bit is the data byte. This is transmitted one bit at a time starting with the most significant bit and ending in the least significant bit. Each bit is read into the graphical LCD at the change from low to high on the clock input.

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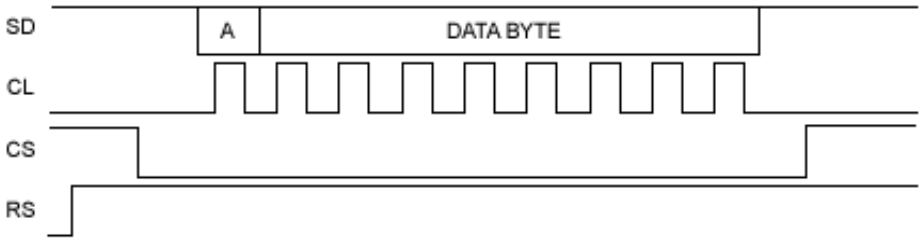
Timing Diagram



Resetting and initializing the Display – 256-colour mode

To initialize the display the display the display must first be reset. This is done by simply setting RS low, waiting 10 milliseconds and the setting RS high again. After the display has been reset a few other commands are necessary to initialize the hardware and configure the display.

1. Send command 0x01 to reset graphics hardware.
2. Wait 10 milliseconds.
3. Send command 0x11 to bring display out of sleep mode.
4. Wait 40 milliseconds.
5. Send command 0x29 to switch on the display.
6. Wait 40 milliseconds
7. Send command 0x3A to set interface mode into pixel format.
8. Send parameter 0x02 to set 8 bits per pixel.
9. Send command 0x20 to set no colour inversion.
10. Send command 0x2D to build an eight-bit colour look up table.
11. Send the following twenty colour constants as parameters to build look up table.

Colour constants – 256 colour mode.

0x00, 0x02, 0x04, 0x06, 0x09, 0x0B, 0x0D, 0x0F, 0x00, 0x02, 0x04, 0x06, 0x09, 0x0B, 0x0D, 0x0F, 0x00, 0x04, 0x0B, 0x0F

Colour Data – 256 Colour mode

Colour	Hex Value	Decimal Value
Blue	0x03	3
Yellow	0xFC	252
Red	0xE0	224
Green	0x1C	28
Black	0x00	0
White	0xFF	255
Bright Green	0x3D	61
Dark Green	0x14	20
Dark Red	0xA0	160
Dark Blue	0x02	2
Bright Blue	0x1F	31
Orange	0xF8	248

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Outputting a to a window

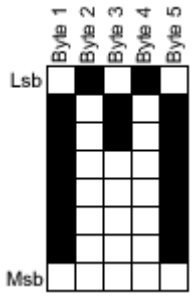
The display is updated by writing to chunks of the screen. This can be a section as small as a single pixel anywhere up to the entire screen area. The area that gets set for overwriting is referred to as a window. A few steps must be taken when writing information to windowed areas.

1. Send command 0x2A to assign a column address
2. Send parameter upper left x coordinate of window (0 - 129)
3. Send parameter upper left y coordinate of window (0 - 129)
4. Send command 0x2B to assign page address
5. Send parameter bottom right x coordinate of window (X1 - 129)
6. Send parameter bottom right y coordinate of window (Y1 - 129)
7. Send command 0x2C to set the window as editable area.
8. Send parameter colour value to be assigned to top left pixel.
9. Continue sending parameter colour values until every pixel in that row has been assigned a colour.
10. Repeat steps 8 and 9 for all of the rows in the specified window.

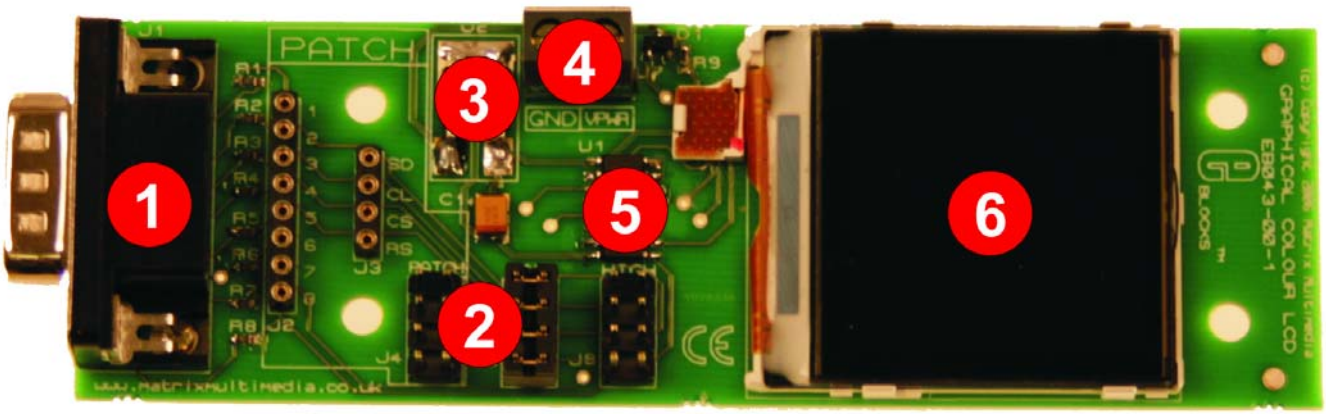
Outputting Text

To output text to the display the first step is to create a window size of 5 x 8 to house the pixel information. Each character will take up 5 bytes of memory to fill the 5 x 8 window. It is then simply a case of going through the bytes 1 to 5 and checking the least significant bits. If the bit is a 0 then send a background colour else if the bit is a 1 then send a foreground colour. After completing this for all 5 bytes you then move onto the next least significant bits and so on until the windowed area is full of pixel data.

Example Letter M



3. Board layout



EB043-74-2.jpg

1) 9-way downstream D-type connector
2) Patch system
3) 3.3V Regulator
4) Input power screw terminals
5) Voltage shifter
6) 130 x 130 pixels LCD display

General Guide for Patch settings:

	Jumper at low	Jumper at high	Jumper at D
SD	Bit 0	Bit 4	Patch
CL	Bit 1	Bit 5	Patch
CS	Bit 2	Bit 6	Patch
RS	Bit 3	Bit 7	Patch

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4. Testing this product

The following program will test the circuit. The test file can be downloaded from www.matrixmultimedia.com.

1. System Setup

Multi-programmer board (EB006) with:

EB006 Options	Setting
Power supply	External, 14V
PICmicro device	16F877A
SW1 (Fast/Slow)	Don't care
SW2 (RC/Xtal)	Xtal
Xtal frequency	19.6608MHz
Port A	
Port B	
Port C	Graphical LCD board EB043
Port D	
Port E	
Test program	EB043TP.hex

EB021 Options	Setting
Patch system	low

2. Test Procedure for Graphical LCD E-Block

1) Wire power from +14V on the Multiprogrammer to VPWR on the EB043.
2) Configure system and board options as above.
3) Power up the Multiprogrammer from the power source. (this should cause the LCD backlight to switch on)
4) Download EB043TP.hex to the 16F877A PICmicro®.
5) Press reset on the Multiprogrammer.
6) If the program is running correctly the Graphical LCD should display the following.

    1. Set the background to plain white.
    2. Draw a star made out of a black cross and a red and blue cross.
    3. Draw a block containing the 256 colour table
    4. Draw the word Matrix with black writing and yellow background.

This test procedure tests the complete functionality of the board

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5. Circuit description

The circuit as can be seen in the circuit diagram below (See Appendix 1 – Circuit diagram), made up of three sections: Connectors, Voltage regulation and Backlight driver.

1. Connectors

The design of this product is to enable you to use it with many standard PICmicro® microcontroller devices. This is achieved by identifying the PICmicro® that you are using and which input output pins are available. Depending on which I/O pins are free you can configure the jumpers on the Graphical LCD E-Block to route access to the four control lines. (See section 3 for jumper guide)

The Patch System allows the user to route the four control lines to any 8 of the bits that they require. This allows great flexibility.

2. Voltage Regulation

The Voltage Regulator that is used is a LP2950 and is simply used to convert the 14V input supply to a 3.3V source for the repeater logic. The repeater logic consists of a 74HC4050D which is essentially made up of four voltage shifting buffers. The buffers take a 5V input from the PICmicro® and converts that input into a 3.3V output to be sent the graphical LCD.

3. Backlight Driver

The backlight driver is fairly simple and just consists of the 14V input and a single resistor to limit the current drawn by the light.

4. 3.3V operation

The Graphical LCD E-Block is compatible with 3.3V and 5V systems. However the VPWR line must be between 12V and 14V to power the display's backlight.

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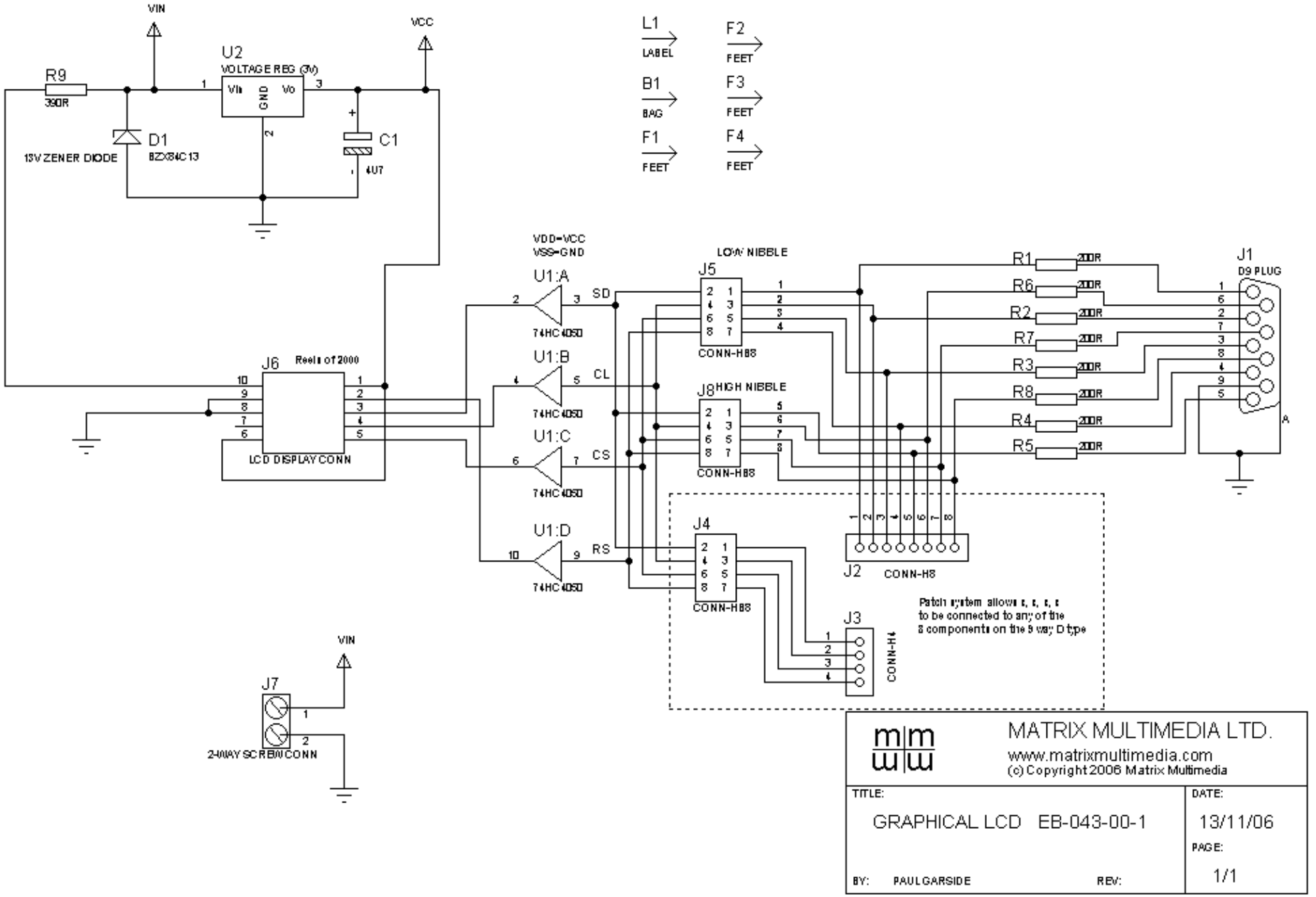
Appendix 1 – Circuit diagram