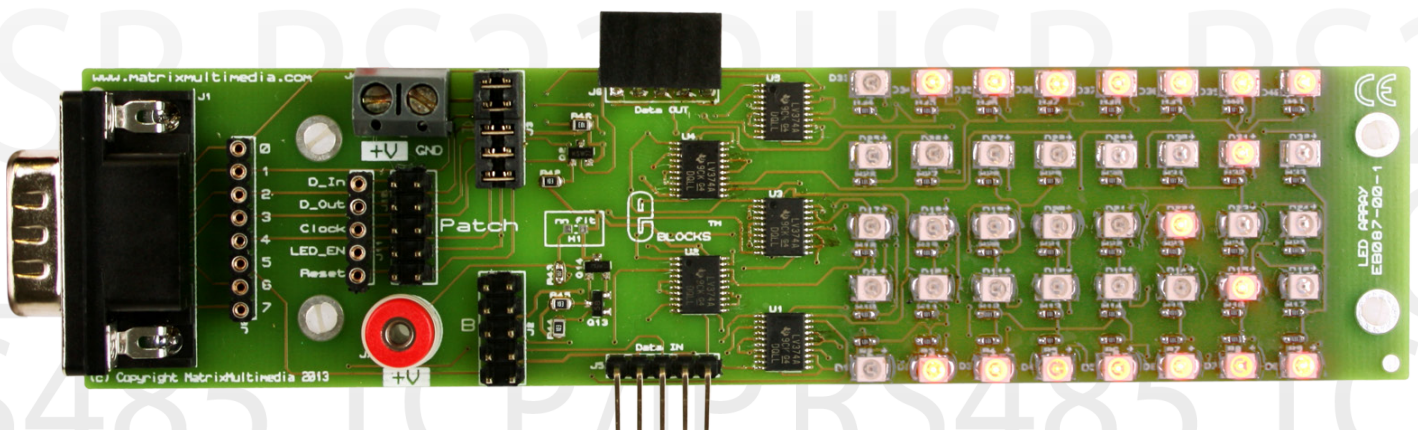


# EBLOCKS<sup>®</sup>

## LED Array Board



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## About This Document

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This document concerns the E-blocks LED Array board with code EB087 version 1.

The order code for the LED Array board product is EB087.

### 1. Trademarks and copyright

PIC and PICmicro are registered trademarks of Arizona Microchip Inc. E-blocks is a trademark of Matrix Technology Solutions Ltd.

### 2. Disclaimer

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

### 3. Testing this product

It is advisable to test the product upon receiving it to ensure it works correctly. Matrix provides test procedures for all E-blocks, which can be found in the Support section of the website.

### 4. Product support

If you require support for this product then please visit the Matrix website, which contains many learning resources for the E-blocks series. On our website you will find:

- How to get started with E-blocks - if you are new to E-blocks and wish to learn how to use them from the beginning there are resources available to help.
- Relevant software and hardware that allow you to use your E-blocks product better.
- Example files and programs.
- Ways to get technical support for your product, either via the forums or by contacting us directly.

# General Information

## 1. Description

The LED Array board allows the exploration of basic display control mechanisms. The board features an 8 by 5 LED matrix where each LED has its own buffer to maintain the state. Each LED buffer output is connected to the input of the next meaning that data cascades from one LED to the next starting from LED D0 and running through to LED D40. Multiple LED Array boards can be connected together to form a longer LED chain. Fitting the boards to a 20mm pitch E-blocks backplane allows a constant spaced message board type display to be created. The current for all of the LEDs is passed through a MOSFET which allows the LED's brightness to be controlled or switched off when idle to save power. The display interface is capable of handling very high speed data allowing large display boards with high frame rate animations or scrolling text to be created.

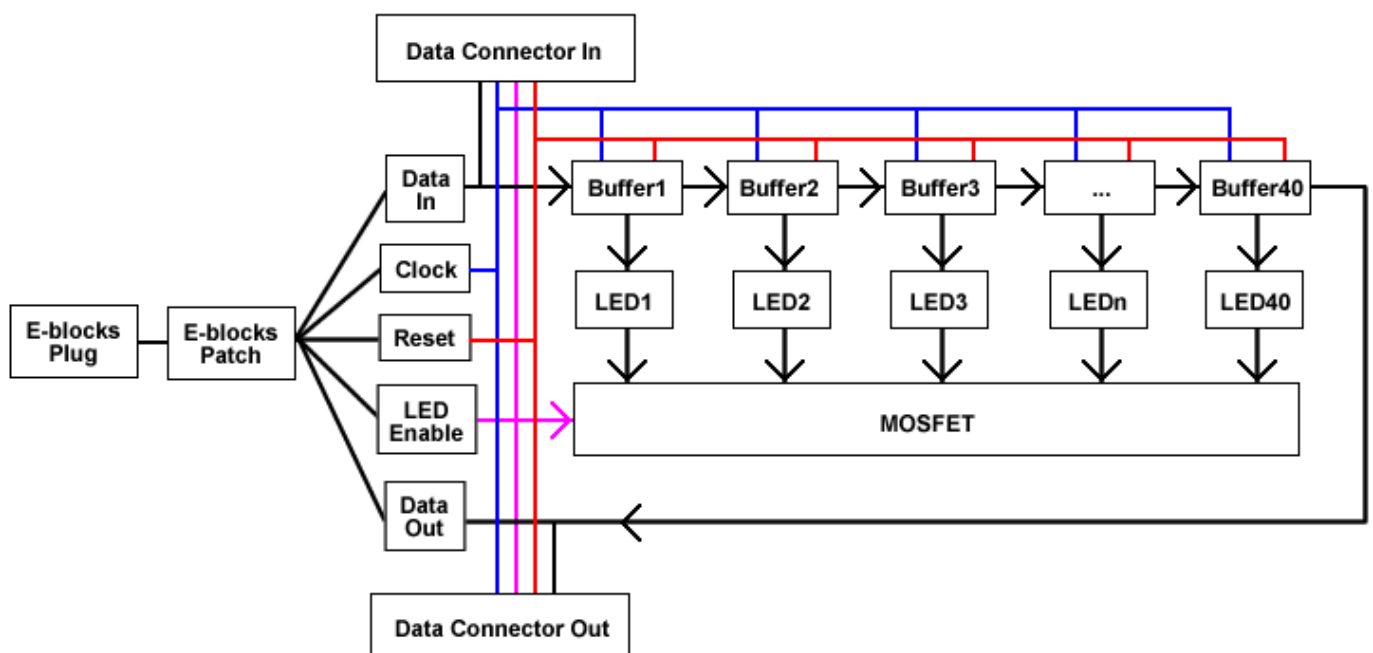
## 2. Features

- 40 Bright Red LEDs – 8 rows x 5 columns
- 40 Digital Logic Buffers
- Master Brightness Control
- No Complicated Software Multiplexing Required
- Overvoltage Protection Circuit
- Inter-connectable to allow much larger displays to be created

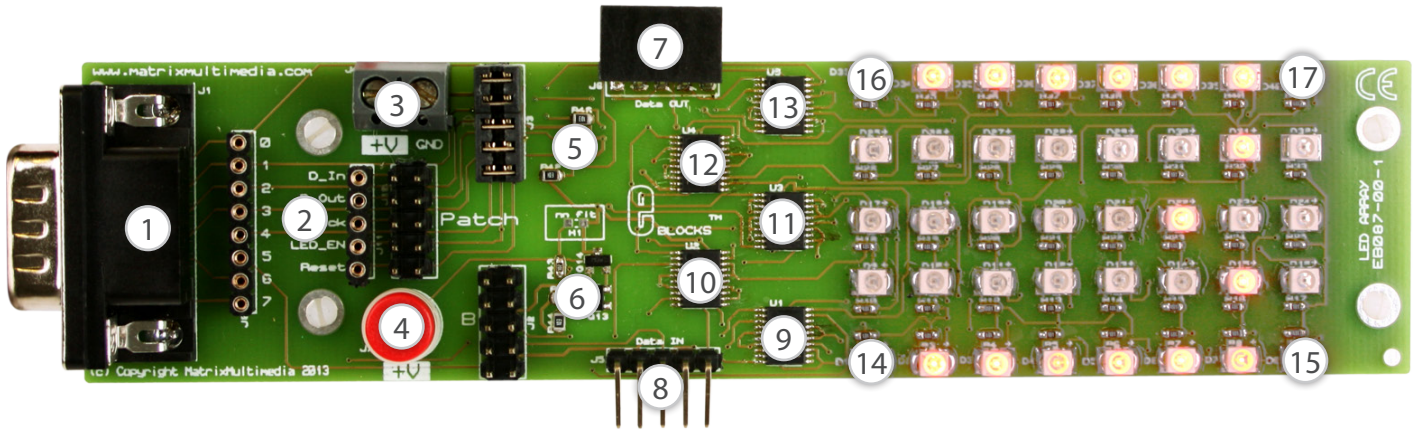
## 3. 3.3V system compatibility

The board is compatible with 3.3V and 5V systems.

## 4. Block Diagram



# Board Layout



- |  |  |
|--|--|
| 1) 9 Way D-type Plug                           | D9 – D16                                       |
| 2) Patch system                                | 11) Octal Buffer IC Controlling Colum 3 - LEDs |
| 3) Input supply voltage screw terminals        | D17 – D24                                      |
| 4) +V 2mm Socket                               | 12) Octal Buffer IC Controlling Colum 4 - LEDs |
| 5) LED Control MOSFET Circuit                  | D25 – D32                                      |
| 6) Overvoltage Protection Circuit              | 13) Octal Buffer IC Controlling Colum 5 - LEDs |
| 7) Data Out Expansion Socket                   | D33 – D40                                      |
| 8) Data In Expansion Socket                    | 14) LED D1                                     |
| 9) Octal Buffer IC Controlling Colum 1 - LEDs  | 15) LED D8                                     |
| D1 – D8  | 16) LED D33                                    |
| 10) Octal Buffer IC Controlling Colum 2 - LEDs | 17) LED D40                                    |

# Testing This Product

The following program will test the operation of the LED Array E-block.

The test file can be downloaded from [www.matrixtsl.com](http://www.matrixtsl.com).

## 1. System Setup

(Optional) Sensors board EB003

(Optional) Additional working EB087 LED Array Block

Multi-programmer board (EB006) with:

| EB006 Options   | Setting               |
|-----------------|-----------------------|
| Power supply    | External, 14V         |
| PICmicro device | 16F877A               |
| SW1 (Fast/Slow) | Fast                  |
| SW2 (RC/Xtal)   | Xtal                  |
| Xtal frequency  | 19.6608MHz            |
| Port A          | Sensors board EB003   |
| Port B          |                       |
| Port C          |                       |
| Port D          | LED Array board EB087 |
| Port E          |                       |
| Test program    | LED_Array_2.hex       |

1 Ensure that the Multiprogrammer is in correct configuration.

- Fast mode (SW1 towards the center of the board).
- XTAL mode (SW2 towards the center of the board).

- Ensure that a 19.6608MHz crystal is inserted in the Multiprogrammer board.

2 Insert the Sensors board (EB003) into Port A of the Multiprogrammer.

3 Connect wire from "+V" of Sensors board to "+V" of Multiprogrammer.

4 Connect a 12V PSU to the EB006 and power up.

5 Program the a PIC16F877A with the test program "LED\_Array\_2.hex".

6 Disconnect PSU.

7 Plug the known working EB087 Data IN connector (J5) onto the unit under test EB087 Data OUT connector (J6).

8 Wire a connection from +V on the EB087 unit under test to +V on the EB006.

9 Wire a connection from the +V on the known working EB087 to +V on the EB006.

10 Using a ribbon cable connect the EB087 unit under test to Port D of the Multiprogrammer.

11 Connect a 12V PSU to the EB006 and power up.

12 Turn the potentiometer on the Sensors board EB003 all the way anti-clockwise.

13 Each LED should light in turn on the unit under test.

14 Next each LED should light in turn on the second known working board.

15 If any LED fails to light then the board has failed the test routine.

16 A diagonal check board pattern is then shown.

17 If any LED is lighting when it should be off then the board has failed the test routine.

18 The inverse diagonal check board patter is then shown.

19 If any LED is lighting when it should be off then the board has failed the test routine.

20 At this point the display portion of the board can be considered passed if all of the above is working correctly.

21 A test pattern with the letters "MATRIX" should then scroll across the display.

22 The test routine then repeats from step 13.

23 At any point in the test adjust the LED brightness by turning the potentiometer on the Sensor board EB003.

24 The LEDs should all be the same brightness and should vary according to the position of the pot.

25 If all the LEDs are working correctly and the brightness is varying correctly then the board has passed the test routine.

# Circuit Description

## 1. Description

The circuit board consists of 5 digital buffer ICs each with 8 logic level buffers which are in turn connected to each column of 8 LEDs. The D\_In signal is the output from the microcontroller and the input to the first data buffer. The D\_Out signal is the output from the last buffer and an input to the microcontroller should you choose to use it in your application. The data moves from the buffer's input to the buffer's output each time the clock output is toggled through high and low by the microcontroller. By setting the state of the D-In signal and then toggling the clock you can set and clear every LED on the board. By providing more clock signals you can set and clear every LED on subsequent boards connected via the Data OUT port (J6).

Individual pin jumper settings.

| Pin Name | Function           | Jumper Setting A | Jumper Setting B | Patch |
|----------|--------------------|------------------|------------------|-------|
| D_In     | Buffer 1 Input     | Bit-0            | Bit-0            | Patch |
| D_Out    | Buffer 40 Output   | Bit-1            | Bit-1            | Patch |
| Clock    | Buffer Clock Input | Bit-2            | Bit-2            | Patch |
| LED_EN   | LED Enable Input   | Bit-3            | Bit-3            | Patch |
| Reset    | Buffer Reset Input | Bit-4            | Bit-5            | Patch |

## 2. MOSFET LED Control

The LED\_EN signal is responsible for switching off power to all LEDs at once. By default the LEDs will be on when the buffer's output is set. By outputting a logic 0 to the LED\_EN pin all LEDs on all connected boards will be forced off. By outputting a high frequency PWM type signal to the LED\_EN pin it is possible to control the brightness of all LEDs on all the connected boards.

When refreshing the display using a slow clock speed some of the LEDs which should be off will appear to flicker slightly as the data for the other set LEDs is cycled through the chain. To eliminate this flicker you can switch off all LED activity by outputting a 0 to the LED\_EN signal while performing the refresh and only re-enable the LEDs once the refresh is complete.

## 3. Reset Control

The Reset signal is responsible for clearing all the current buffer output states back to a logic 0. The Reset signal defaults to not active allowing the buffers to operate as expected. Outputting a logic 1 to the Reset pin will force all of the buffer outputs to be cleared allowing all connected display boards to be cleared with a single operation.

## 4. Data Out

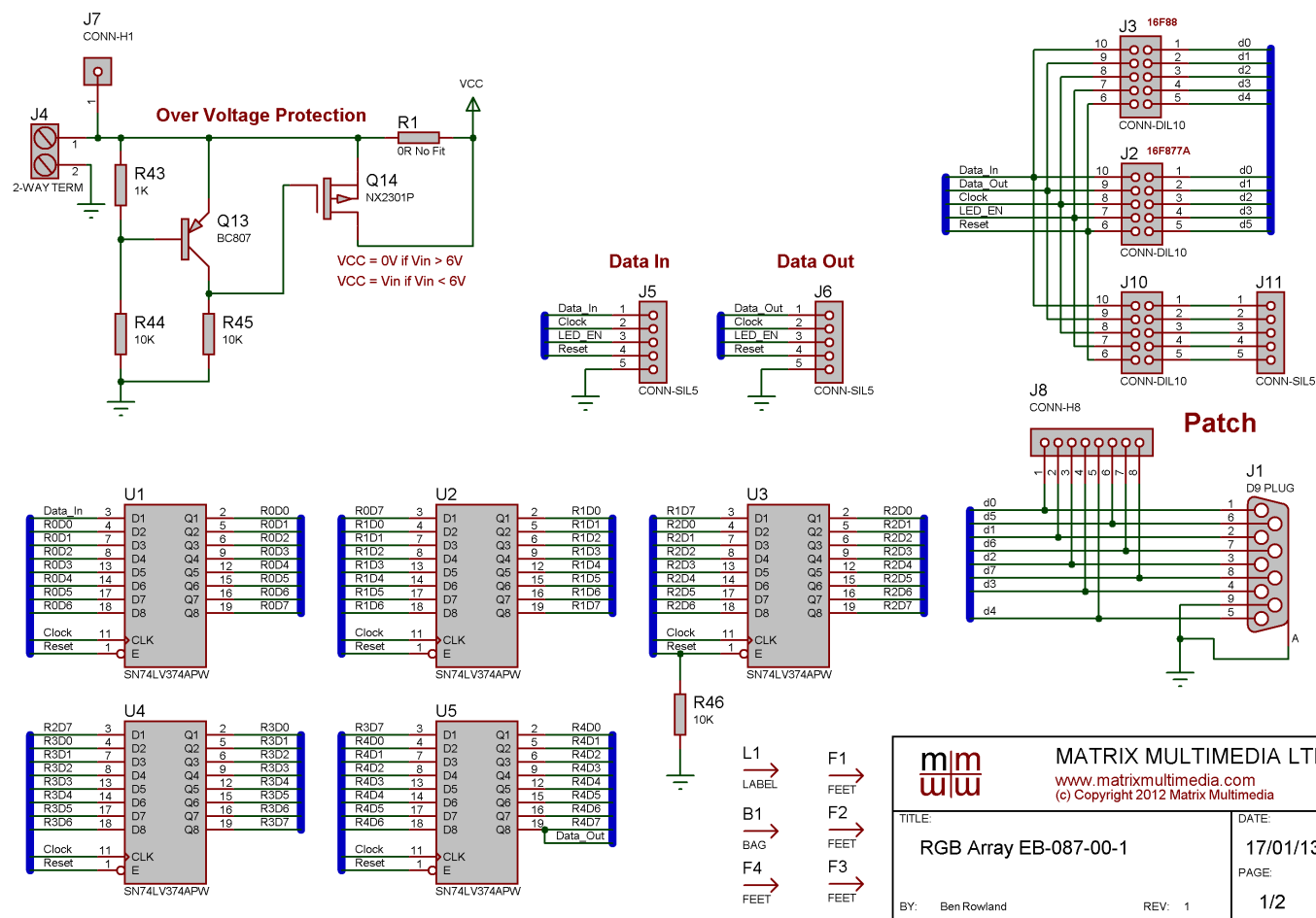
The D\_Out signal provides the output from buffer 40 on the connected board allowing you to scroll data on the display in either direction and wrap around if need be. If multiple boards are connected together then the D\_Out signal from the last board in the chain can be brought back to the D-type connector on the first board by using single core wire and the E-blocks patch system. Ensure that if you are doing this that the pin you connect the signal to is not being used by anything else or you will get a conflict and could potentially damage the buffer circuitry.

## 5. Current Usage

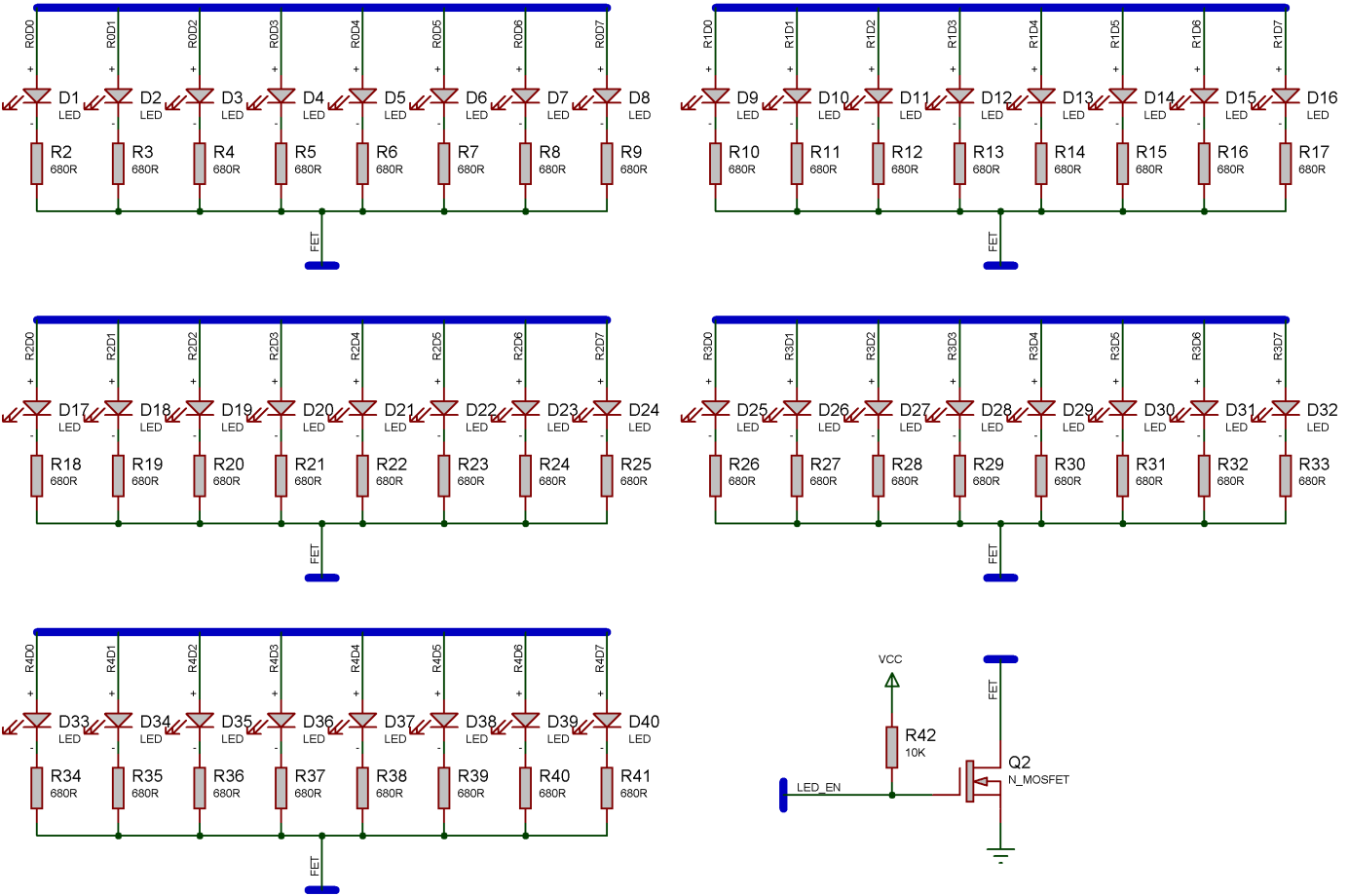
Each LED will consume around 5mA when switched on at full brightness. A board full of permanently on LEDs will consume a maximum of around 200mA. When adding more boards to the system it is important to remember current usage and not try to draw too much power via the EB006. The maximum power drawn from the EB006 should not really exceed 500mA or the regulator will start to get hot. A second power supply can be used to power the LED boards or the MOSFET and PWM type control signal can be used to dim the brightness of the LEDs.



# Circuit Diagram



# Circuit Diagram







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