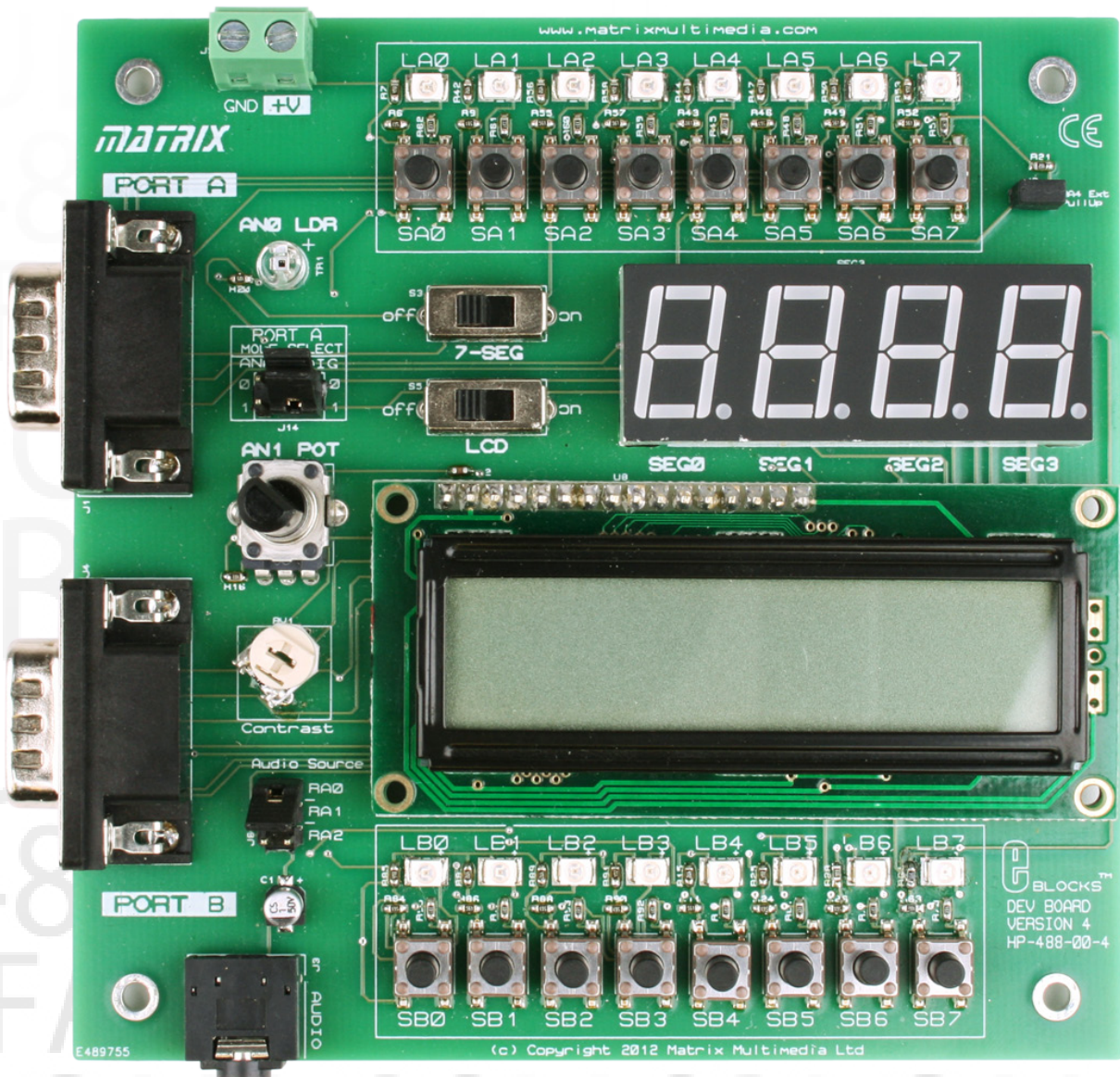


EBLOCKS[®]

Combo Board



Contents

About This Document	2
General Information	3
Board Layout	4
Testing This Product	5
Circuit Diagram	6
Liquid Crystal Display	7
Sensors	9
Circuit Diagram	10

About This Document

This document concerns the E-blocks combo board code EB083 version 1.

The order code for this product is EB083

1. Trademarks and copyright

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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

This flexible combo board is an ideal platform for learning and project development. The board will work with any upstream E-blocks system allowing multiple technologies to be explored using a single downstream E-blocks board. The board is ideal for using in conjunction with our CD ROM resources to help learn programming using flow charts, C or assembly code.

Makes it easier to develop embedded projects

- o 16 individual LEDs
- o 16 individual switches
- o Quad 7-segment display
- o 16 x 2 character alphanumeric LCD
- o On-board sensors (Light / Potentiometer)
- o Audio output socket
- o Overvoltage protected

2. Features

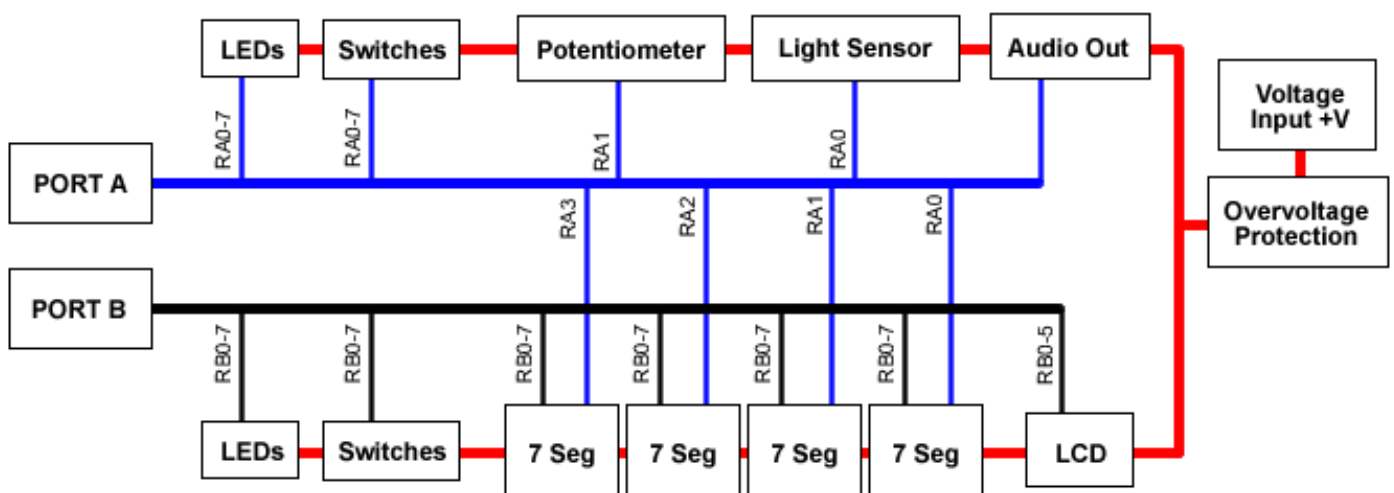
Makes it easier to teach and learn microcontrollers and embedded systems

- o Designed for educational use
- o Online / CD-ROM based resources in assembly, C, and flow chart programming are available
- o Compatible with upstream E-blocks boards - PIC, ECIO, AVR, ARM, FPGA, etc.

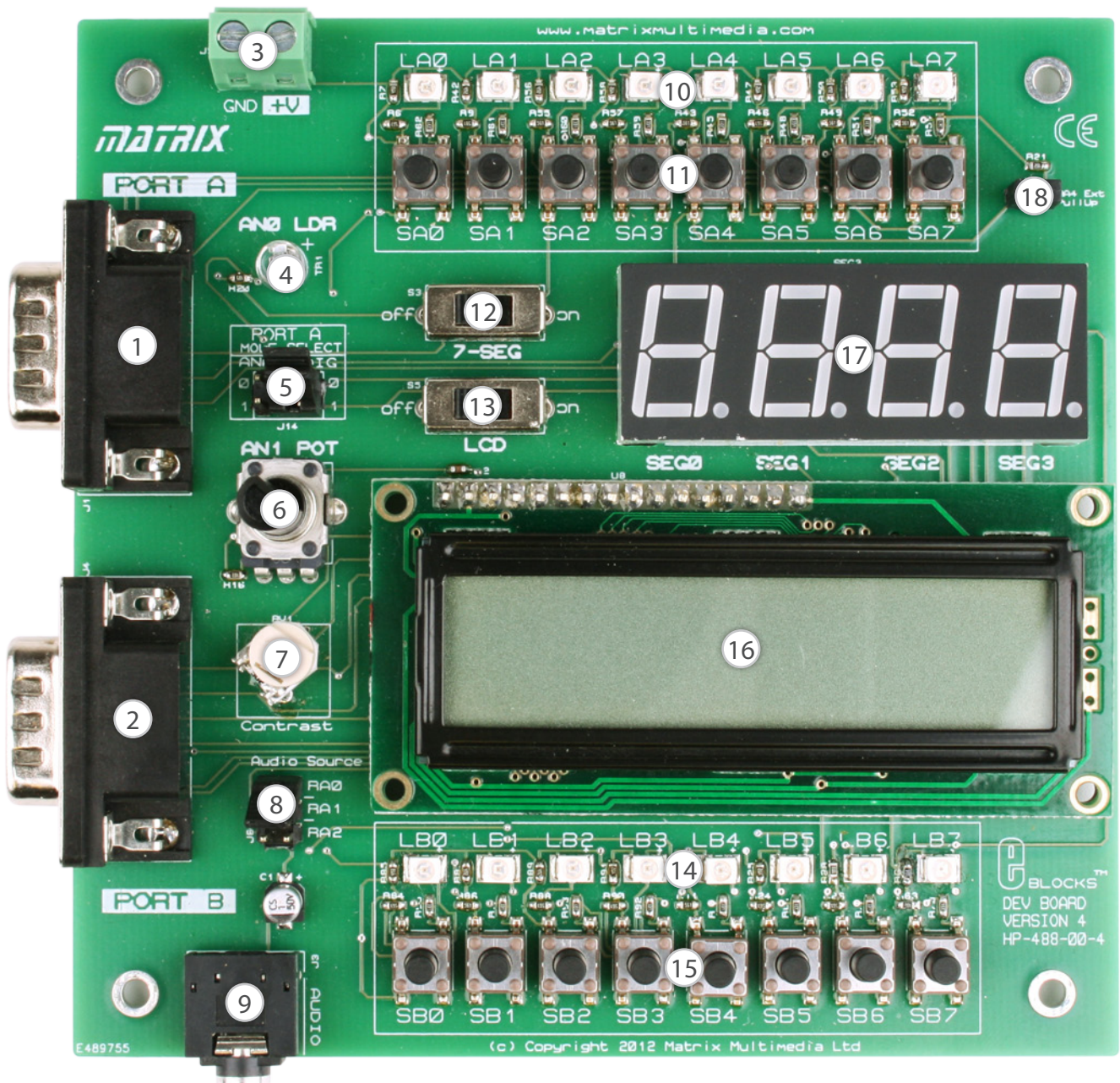
Low cost

Full suite of programming software available

3. Block Diagram:



Board Layout



- | | | | |
|----|--|-----|---|
| 1. | PORTA E-blocks Connector | 10. | PORTA 8-Bit LED Bank |
| 2. | PORTB E-blocks Connector | 11. | PORTA 8-Bit Switch Bank |
| 3. | Power Supply Screw Terminals | 12. | 7-Seg Power Control Switch |
| 4. | Light Sensitive Resistor | 13. | LCD Power Control Switch |
| 5. | PORTA Digital / Analogue Selection Jumpers | 14. | PORTB 8-Bit LED Bank |
| 6. | Potentiometer | 15. | PORTB 8-Bit Switch Bank |
| 7. | LCD Contrast Pre-set | 16. | 2 x 16 Character Alphanumeric LCD |
| 8. | Audio Source Selection Jumper | 17. | Quad 7-Seg Display |
| 9. | Audio Output Socket | 18. | RA4 Open Drain Pull Up Selection Jumper |

Testing This Product

The following program will test the circuit. The test file PPP software and USB drivers can be downloaded from www.matrixtsl.com.

1. Installation - Windows 2000 / XP / Vista / 7 / 8

To install, run PPPv3.exe, which can be downloaded from the Matrix Technology Solutions website.

Next download and run the USB drivers for the EB006 which are also available to download from the website.

Perform both these steps before plugging a new EB006 into your PC.

When you connect the Multiprogrammer to your computer, via the USB cable, the first time there will be installation routine for this 'new hardware'. This for most users will be a 'plug and play' routine where your computer will automatically recognize the hardware.

2. System Setup – testing with an external power supply

Set up EB006 board with:

EB006 Options	Setting
Power Supply	External, 14V
PICmicro Device	16F88
S4 (Fast/Slow)	Don't care
S2 (RC/Xtal)	Xtal
Xtal Frequency	19.6608MHz
Port A	EB083 PORTA
Port B	EB083 PORTB
Test Program	f_test_1.hex

3. Testing the board – with an external power supply

- 1) Ensure power is supplied to the board
 - USB cable required
 - PSU cable required
- 2) Set Jumper J29 to 'PSU'
- 3) Ensure Jumper J20 set to USB
- 4) Send the test program to the board using PPP
- 5) Check the illumination of all Port A and B LEDs

Circuit Description

The combo board is designed for learning how to program embedded applications in educational and industrial context.

The board has been designed to allow those with little or no experience of embedded microcontroller programming to be able to produce highly functional designs in as short a time as possible. With this in mind we have included switches on port A and B input/output pins, a quad 7-segment display, a 2 line 16 character alphanumeric display, simple on-board analogue sensor (light) and sensor simulator (potentiometer).

Full tutorials in programming the board using Assembly code, C, and flowcharts are available. These sets of tutorials are available online and via CD-ROM and require no other software - all compilers and development environments are included as part of the download or on the CDs themselves.

1. Board Description

The board is based on a flexible topology that allows the inputs and outputs to be used in a number of ways depending on switch settings on the board. This flexibility means that students will, as they use additional features, need to be aware of how a single input-output (I/O) pin can be used for a number of functions dictated by the circuitry attached to it. This is explained in the Circuits section of this document.

The architecture of the board is split into two main buses - the port A bus and the port B bus. Each line on each bus can be used as either an input or as an output. The connectors and displays on the board are all wired in parallel on the controller pins for convenience but clearly connecting more than one device to one pin will result in conflict: students will need to be made aware of this.

2. Port A bus

Under normal operation all of the jumper links in the J14 link block are in the Digital position. This means that the Port A I/O pins are routed to the push switches and LEDs. The actual circuit is described in the Circuits section.

With J14 links in the Digital position port A is routed to its push switches (SA0 to SA7), LEDs and the quad 7-segment display.

Bits RA0, RA1, RA2 and RA3 are used for the common anodes of each of the four 7-segment displays. RA0-RA2 is used for tone generation via the jack plug.

With J14 links in the Analogue position port A is switched to the analogue sensor section of the board. This means that RA0 is connected to the on-board light sensor, RA1 is connected to the potentiometer resistor to form an adjustable voltage divider for sensor simulation.

With J14 links in the Analogue position you should be aware that on-board switches and LEDs RA0-1 will not operate.

3. Port B Bus

Port B I/O pins are routed to its push switches (SB0 to SB7), the LEDs (LB0 to LB7), the quad 7-segment displays and the LCD display.

4. Overvoltage Protection Circuit

The board is normally operated from a DC supply of 3.3V to 5V as supplied from the E-blocks upstream board. Care should be taken not to connect voltages greater than 5V to the screw terminals or I/O pins. If the supply voltage exceeds 5V then the protection circuit will kick in and prevent the board from powering up.

5. Displays

The LCD display is connected to Port B I/O. The LCD display is turned on by switch S5.

The quad 7-segment display is connected to both Port A and Port B. Port B is used to control each of the 8 segments (7 for the main character and 1 for the full stop). Port A bits 0 to 3 are used to select each of the 4 characters. The quad 7-segment display is turned on by switch S3.

Note that turning on the display will affect the operation of Port B I/O and when using the quad 7-segment displays it is recommended that you do not use Port B for any other purposes. Under certain circumstances you will notice that segments of the quad 7-segment display may be lit up very dimly by Port A/B operation even when S3 is in the off position. This is a feature of the low cost driver circuitry and is unavoidable.

Liquid Crystal Display

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'.

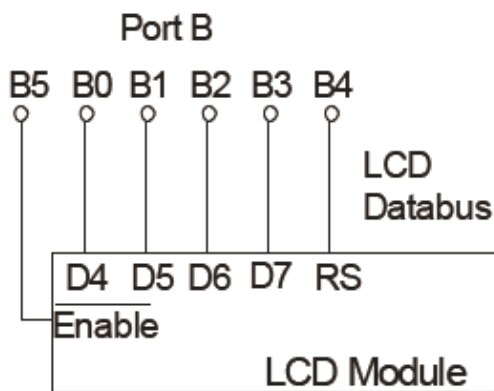
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E	1F	20	21	22	23	24	25	26	27
40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F	50	51	52	53	54	55	56	57	58	59	5A	5B	5C	5D	5E	5F	60	61	62	63	64	65	66	67

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 port B [B0 to B5] to program the LCD, as shown in the circuit diagram below. When the combo 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]. Flowcode will automatically add this startup delay for you. The default connections are:



To send a command to the LCD, data must be sent in two steps, the MSB followed by the LSB [byte is data on B0 to B3]. 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.

Timing Diagram



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].

Liquid Crystal Display

Instruction	MSR	Code					Description	Execution time
	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	1		
Return home	0	0	0	0	0	0	Set DDRAM address to 0. Move cursor to home position.	1.53 ms
			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	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	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	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	D4	Writes data to CGRAM or DDRAM.	43 us
			D3	D2	D1	D0		

DDRAM is Displayed Data RAM

DDRAM address is the location of the cursor

CGRAM is the 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 4bit	0000	0010	0011	0100	0101	0110	0111	1010	1011	1100	1101	1110	1111
xxxx0000	(1)	0	1	P	^	P		-	3	E	a	p	
xxxx0001	(2)	!	1	A	Q	a	q	.	7	4	ä	q	
xxxx0010	(3)	"	2	B	R	b	r	"	イ	ツ	×	β	θ
xxxx0011	(4)	#	3	C	S	c	s	」	ウ	〒	ε	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	ア	キ	ヲ	ラ	q	π
xxxx1000	(1)	<	8	H	X	h	x	イ	ク	ネ	リ	フ	Σ
xxxx1001	(2)	>	9	I	Y	i	y	ッ	ケ	ル	ニ	ウ	
xxxx1010	(3)	*	:	J	Z	j	z	エ	コ	ハ	レ	i	チ
xxxx1011	(4)	+	:	K	L	k	l	オ	サ	ヒ	ロ	×	π
xxxx1100	(5)	,	<	L	¥	1	1	ハ	シ	フ	ワ	φ	π
xxxx1101	(6)	-	=	M	J	m	j	ユ	ズ	ヘ	ン	も	÷
xxxx1110	(7)	.	>	N	^	n	^	ヨ	セ	ホ	°	ñ	
xxxx1111	(8)	/	?	0	_	o	+	ッ	ツ	マ	°	ö	■

Please look at our web site for examples of code that shows how to program the 7-segment display (factory test routine.)

Sensors

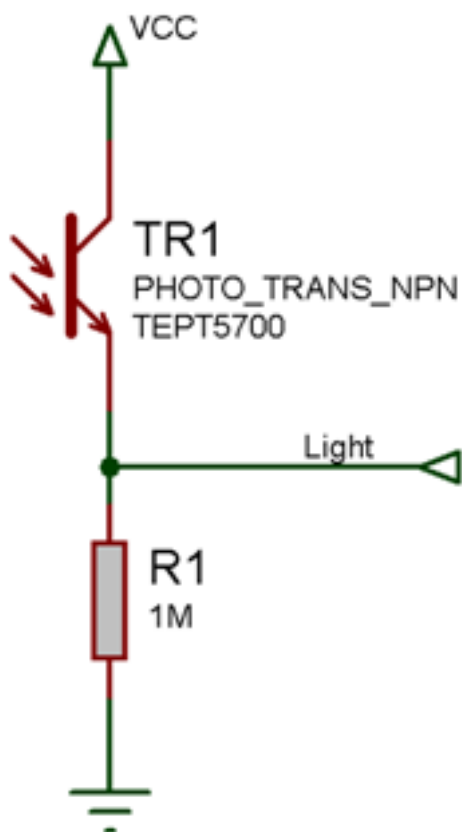
To use an analogue sensor, the combo board must manually be set to analogue mode and an analogue-capable controller must be used on the upstream programmer. Whilst in analogue mode certain port A pins [A0/RA0, A1/RA1] are able to convert an analogue signal to an 8 or 10 bit digital signal, using the on-board A to D converter inside the controller device.

Please refer to your controller data sheets for more details.

1. LDR

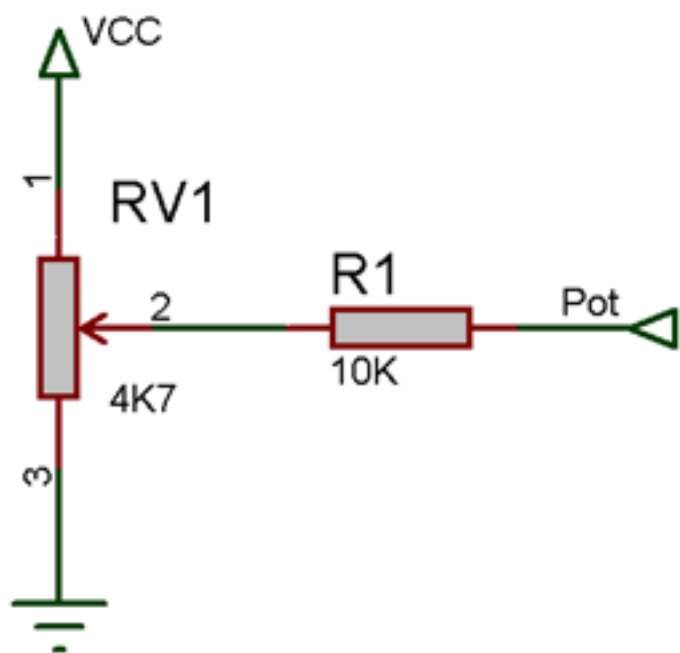
A compact photo transistor is soldered onto the combo board. When J14 link RA0 is in the 'analogue' position it is connected to PORTA pin 0 on the controller. The resistance of this device reduces as light falling on to it increases.

Technical Specification	
Dark Current	3nA
Sensitivity	75uA
Peak Spectral Response	570 nm
Power Consumption	100mW
Transistor Type	NPN

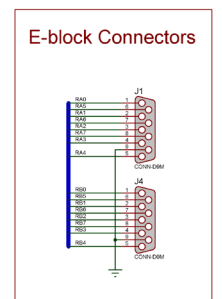
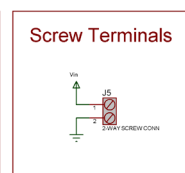
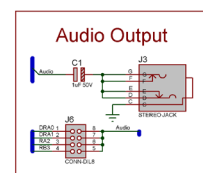
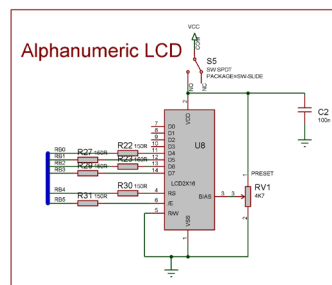
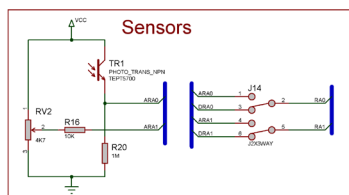
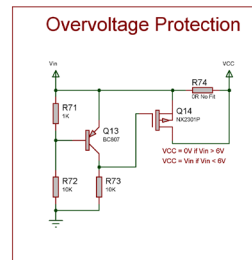
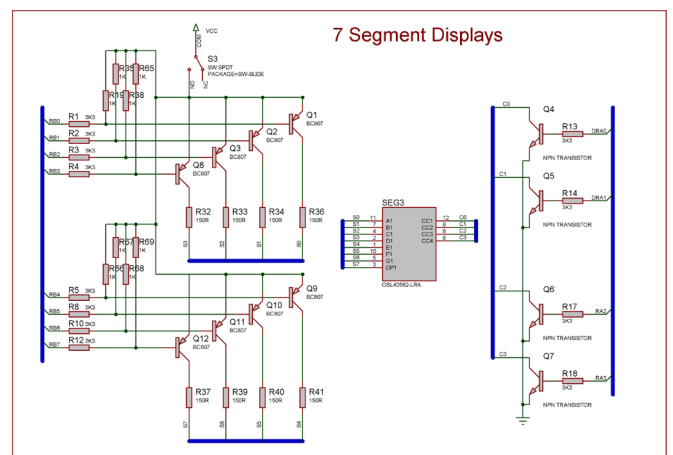
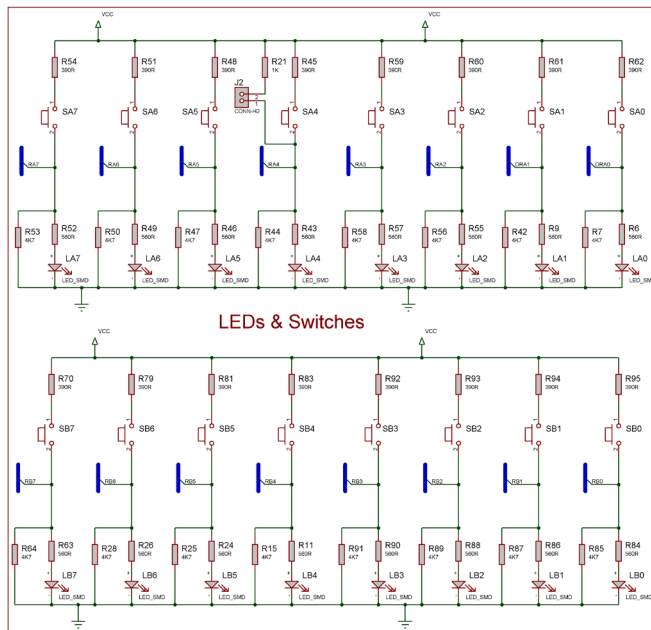


2. Potentiometer

Most passive sensors are based on a simple potential divider circuit. In order to get your code up and running as simply as possible it is therefore useful to have a simulation of the full operation range (0V to 5V) that a sensor might provide. This function is emulated by a simple 4k7 potentiometer (RV3). The potentiometer produces a voltage in the range of 0V to VCC on PORTA pin1 depending on the position of the control knob. Note that J14 / 1 will need to be in the analogue position to use this circuit.



Circuit Diagram



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TITLE	EB083-00-1	DATE	23/11/12
BY	Development board V4	PAGE	1/1



Matrix Technology Solutions Ltd.
The Factory
33 Gibbet Street
Halifax, HX1 5BA, UK

t: +44 (0)1422 252380
e: sales@matrixtsl.com

www.matrixtsl.com

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