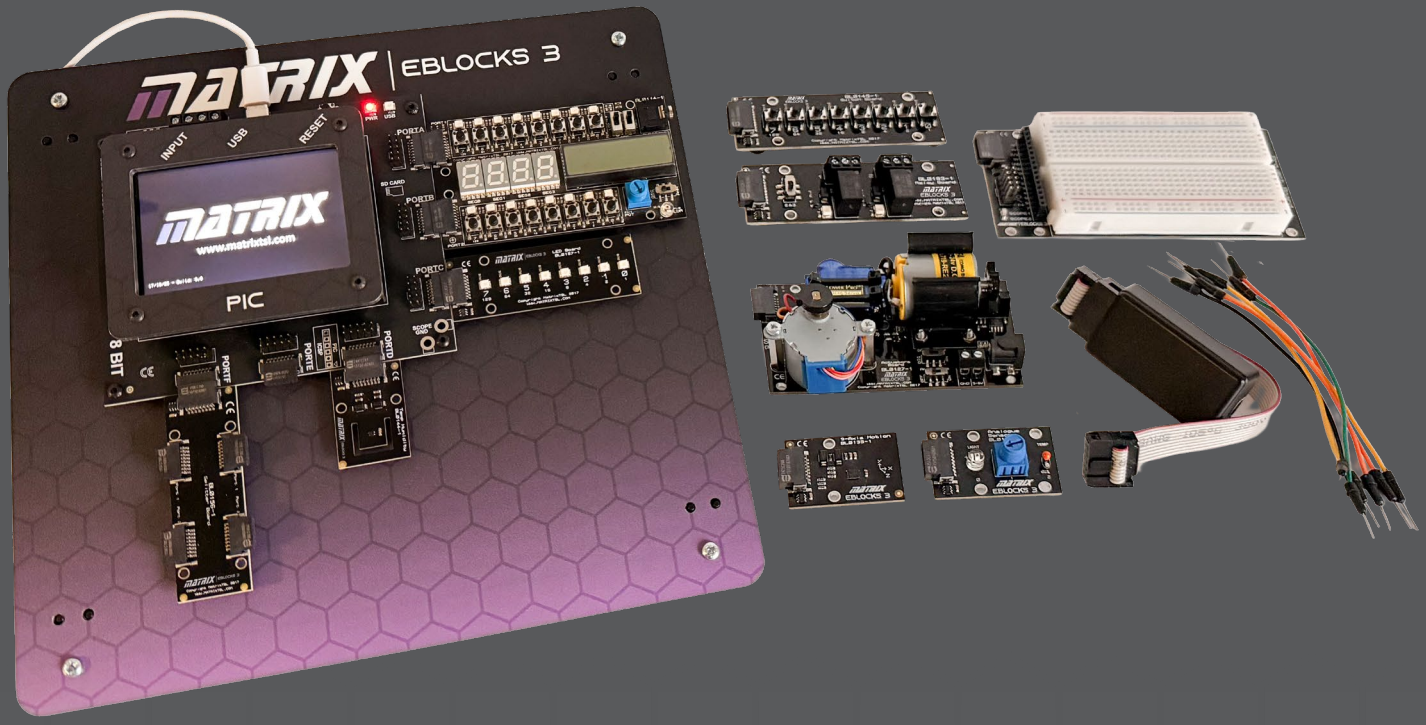
MATRIX | EBLOCKS 3



EBlocks 3

CP9645
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Inspiring The Next Generation Of Engineers

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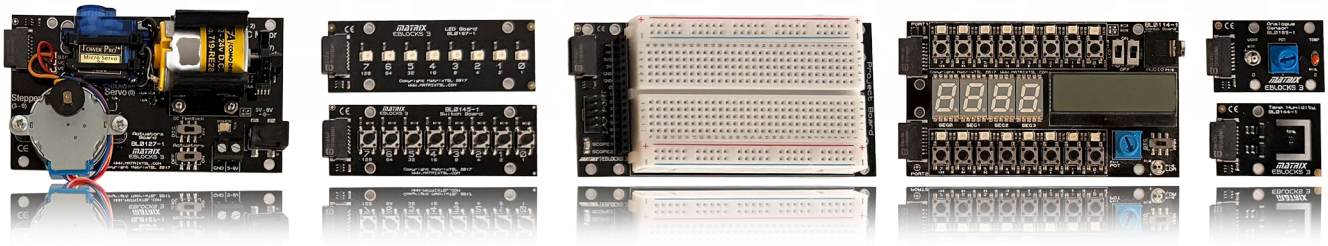
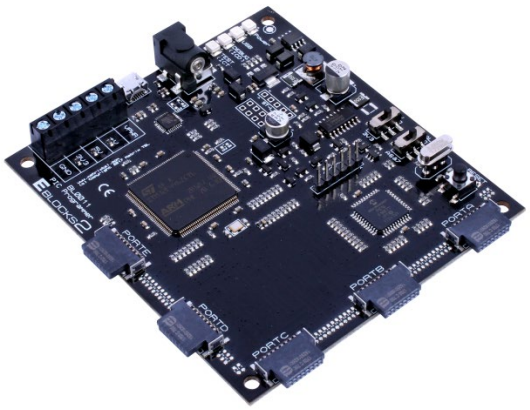


EBlocks 3 is the latest generation of microcontroller boards from Matrix. EBlocks 3 boards give you a choice of upstream programmer board. The system then allows users to connect their choice from a range of downstream boards, and build a complete system in a matter of minutes. The EBlocks 3 system is ideal for everyone, from those learning in an educational environment to engineers in the industrial world. Use of EBlocks is well supported with support for Grove® and Mikrobus® sensors and complementary ranges of software including Flowcode, MPLAB X and Arduino IDE. Technical support is available from our dedicated team through our forums. EBlocks 3 is fully backwards compatible with EBlocks 2 boards.

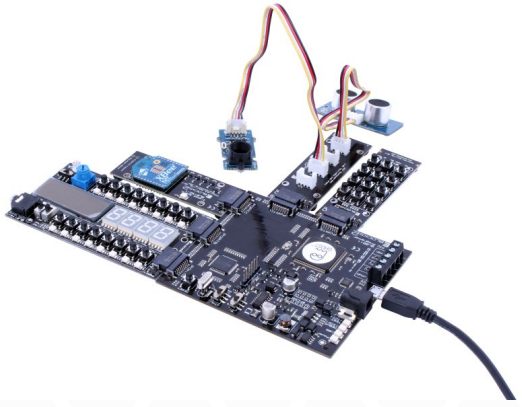
Upstream EBlocks

These contain the microcontroller / microprocessor brain that is used to drive the entire system. Usually this is loaded with user firmware to drive the required embedded functionality. These boards allow the host processor to be connected to multiple downstream boards via the microcontroller / microprocessor I/O pins. Upstream boards have facilities to re-program the host processor as well as providing debugging options such as USB to Serial communications and In Circuit Debug (ICD) when used with Flowcode.



Downstream EBlocks

These contain either a modularised specific feature which you want to connect to your host processor or a collection of features. For example LEDs, Switches, Displays, Communications, Sensors through to the Combo and Actuators boards. Each EBlocks 3 downstream board features an Auto ID device allowing the complete system to be analysed for potential issues and to aid in pre-configuring the software for the upstream firmware.



ABOUT EBLOCKS

What Are EBlocks 3?

Designed for Education

EBlocks 3 are ideal for learning about electronic systems, digital electronics and for rapid prototyping.
The boards fit together in a flat 2D layout manner allowing the entire system to be easily seen and understood.
The boards are designed for use in lab style environments and are designed to be both electrically and physically rugged whilst also being easy to use and understand. Our range consists of a number of bundles presented as individual boards or on panels (see right). These are multiple EBlocks 3 boards presented in a rugged design, suitable to withstand the rigours of educational environments. We also supply a microcontroller system development kit, alongside free curriculum for those studying about microcontroller programming in school, college or university. This kit (below) is available with the upstream programmer board of the users choice.

Language Independent

EBlocks 3 can be used with various programming languages allowing for flexible learning and understanding of multiple software toolchains without requiring multiple hardware sets including Flowcode, MPLAB X and the Arduino IDE.

Schematics and Examples Available

EBlocks schematics are available to allow you to re-create the boards on your own PCB once you have a working system up and running. Examples written in Flowcode and C are also available from our website to speed up your getting started times.

EBlocks boards are designed and manufactured in the UK

EBlocks 3 Key Points

If you're already familiar with the EBlocks systems then here are some of the new features included in EBlocks 3.

Power

Automatic powering via 5V USB or DC Power Supply Power routed via the connectors, no more flying leads and no more jumpers to set.

- 3.3V @ 1A
- 5V @ 500mA
- +V Microcontroller VCC Voltage
- Ground

Auto ID

- Basic Auto ID functionality (Flowcode 7.3 Onwards)
- Auto Project Setup and document (Flowcode 11 Onwards)
- Selects the correct microcontroller upstream target device
- Selects the correct component libraries and automatically configures them

Modernised, Miniaturised and Ruggedized

- Smaller Footprint using up to date surface mount technology
- Standard boards are now 24mm wide
- Mounting holes are on a 10mm spaced pitch
- Over current resettable fuse protection
- EMC and EMF protection

Upstream Boards

Upstream Boards
Microcontroller Programming
USB Reprogramming
USB Serial Communications from MCU to PC
Onboard Colour Graphical LCD

- Capacitive touch enabled display
- Onboard micro SD card for images and file I/O
- Onboard Bluetooth and WIFI capability
- Web mirroring technology allowing easy Mobile Phone integration

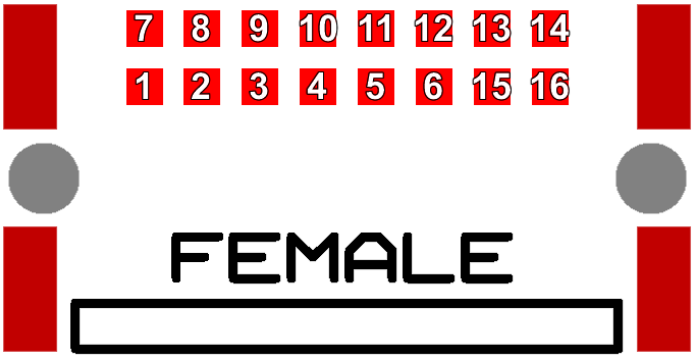
In Circuit Debug (ICD) - In conjunction with Flowcode

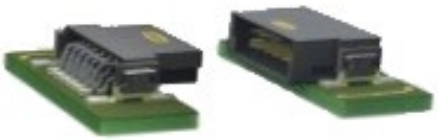
- Program Control Start / Pause / Step Into / Step Over / Stop / Restart
- Up to 8 user defined breakpoints
- Enhanced data collection routines

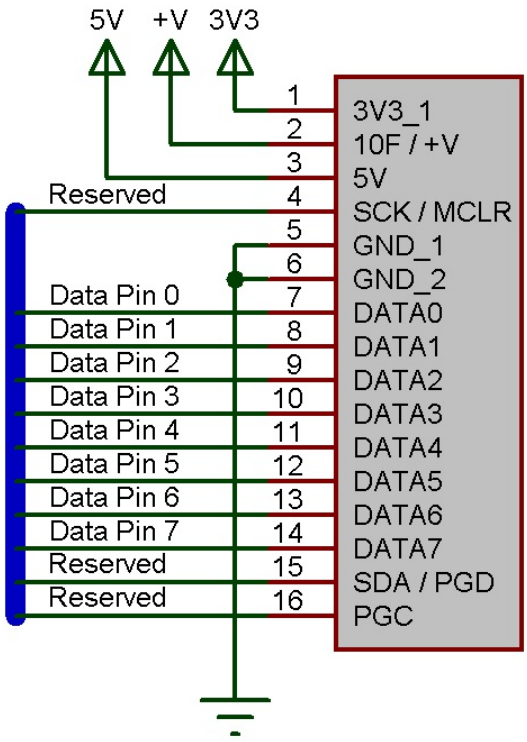
ABOUT EBLOCKS
Connector Pinout

EBlocks 3 Connector Layout

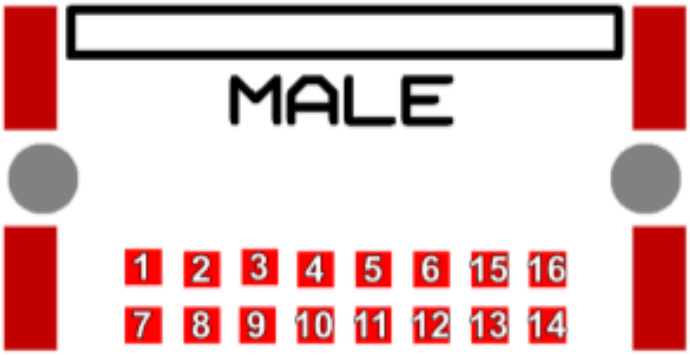
Upstream Connector PCB Footprint
Female





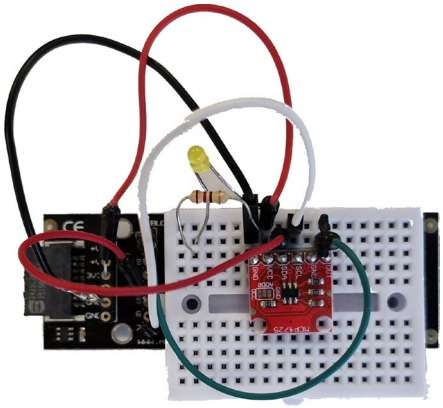


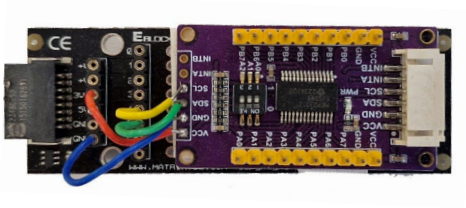
Downstream Connector PCB Footprint
Male



+V represents the I/O voltage of the microcontroller or processor on the upstream board. Depending on the upstream board this is either fixed at 5V or 3V3 or can be set by the user via a switch on the upstream board.
The connector used by EBlocks 3 hardware is a 16-way HarFlex connector by Harting.

Using Patch And Prototype Boards





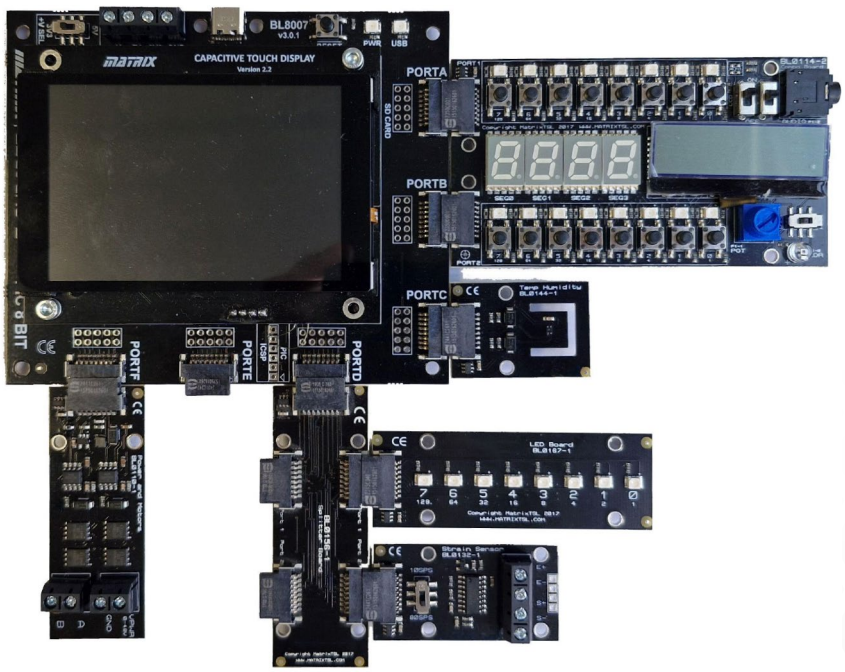
The Proto board (BL0117) and Project board (BL0118) can be used for adding extra circuitry: individual components or third party modules. The Proto board is small but you can fit a surprising amount of components on it. The Project board is larger allowing for more expansive external circuitry to be connected. The Proto board with the breadboard removed is useful for prototyping circuits semi-permanently.

Auto ID

Each board has a small PIC device fitted into it with the unique identity of the board inside it. The Upstream boards interrogate the downstream boards each time they are plugged in and on power up. In this way the Upstream boards know what Downstream boards are plugged in. This information is used to allow Flowcode to automatically add the relevant parts to the panel with all the right settings. This makes circuit construction easier.

Splitter Board

If you need to get two boards on one port then you can use a Splitter board (BL0156) to share the ports.

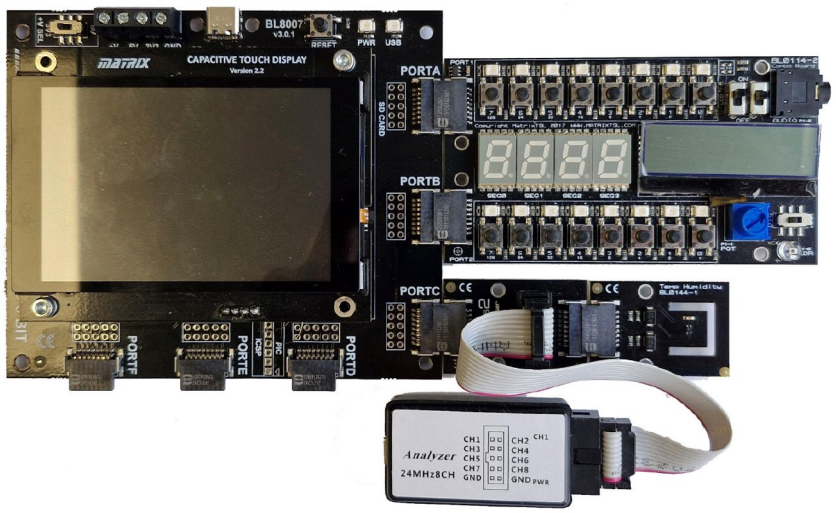


ABOUT EBLOCKS

New in EBlocks 3

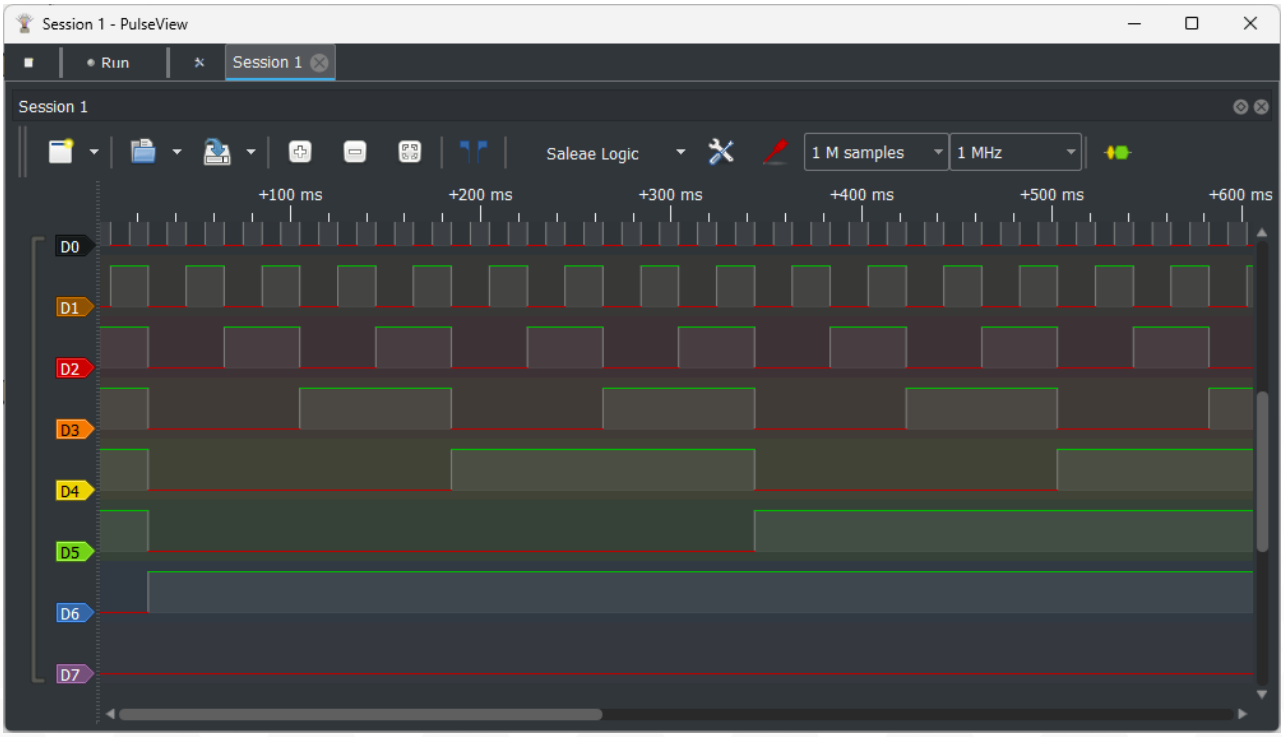
Logic Analyser Board

The upstream boards are fitted with headers by each of the port connectors to allow the easy integration of the logic analyser (BL0172). This allows the analyser to monitor the signals as they are fed through to a Downstream board. The logic analyser inputs are high impedance so that it should not affect the performance of the circuit.



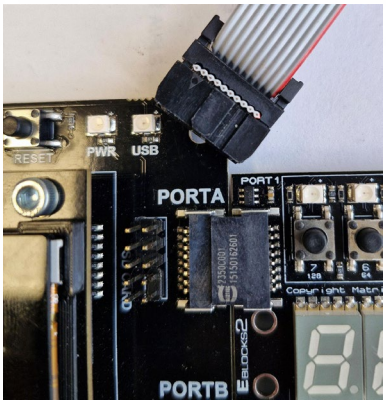
Logic Analyser Software

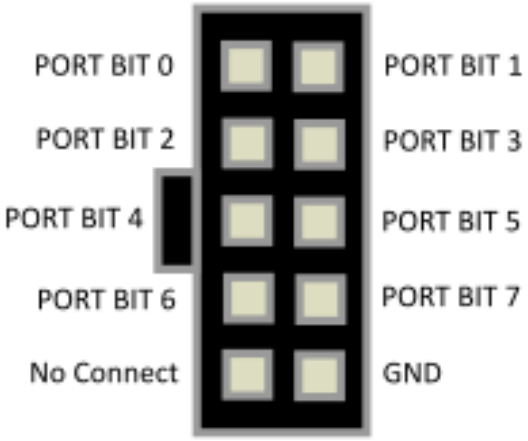
Pulse view software for the logic analyser (BL0172) can be downloaded from https://sigrok.org . The software includes packet decoders for I2C, SPI, UART and more.



Using IDC Connectors

Each port on the Upstream boards has space for an IDC style connector or individual dupont style wires. This allows you to create expansion boards that connect to the upstream board IO ports. The connectors include the 8 bits of the port as well as ground. The other voltage power rails are available via the screw terminals on the upstream boards. Additional connectors are located on the underside of the upstream PCB allowing for the various power rails and additional port pins to be accessed.





Colour Graphical Display

The EBlocks 3 upstream boards are supplied with a colour graphical display module with pixel dimensions 480 x 320. The display module includes a capacitive touch interface as well as an SD card socket to allow for bitmaps and fonts to be used with the display without consuming space on the host microcontroller memory. A dedicated serial UART is used to allow the upstream microcontroller to communicate with the display. The display module also features integrated Bluetooth and Wi-fi.

Serial Communications

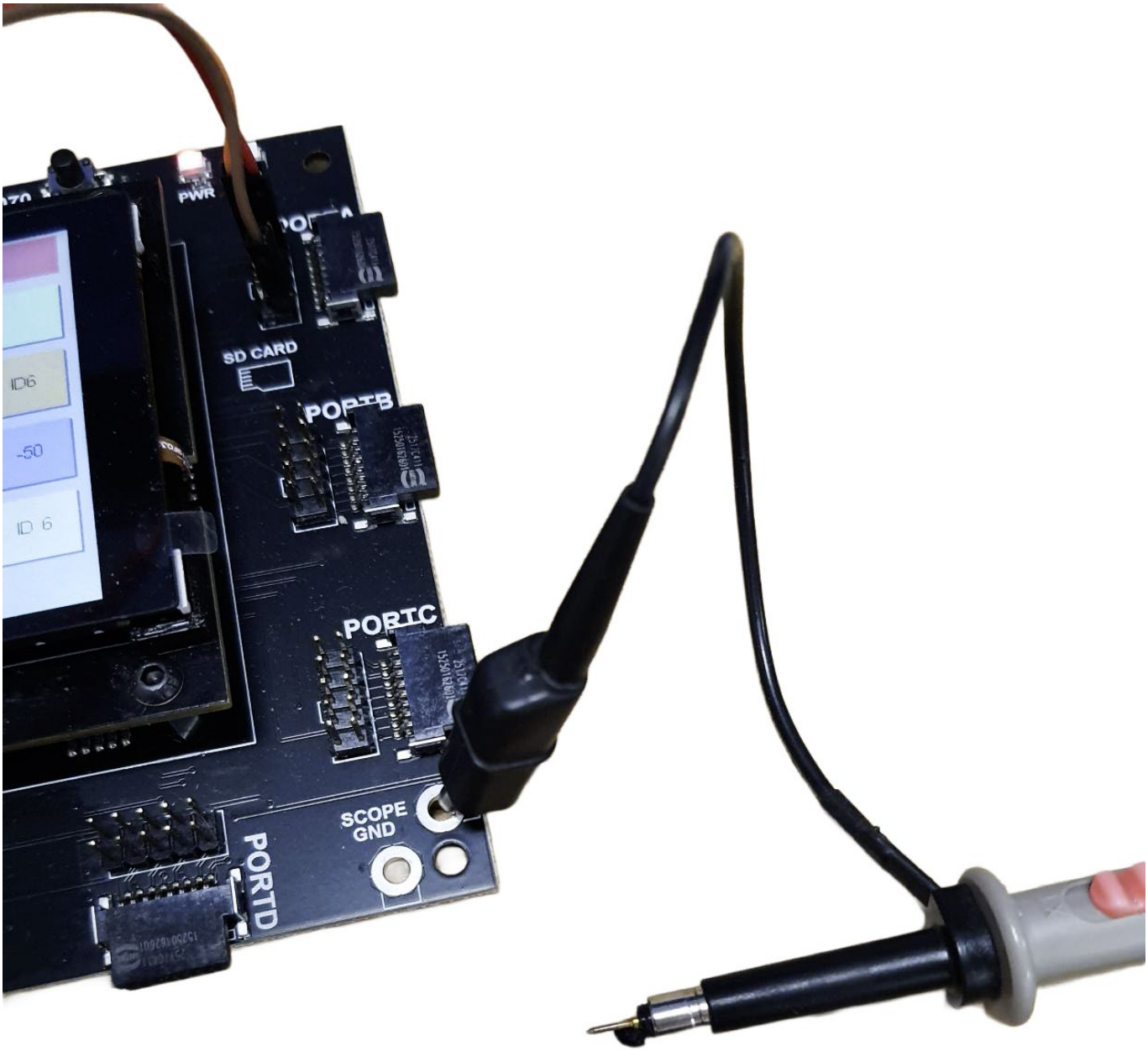
The EBlocks 3 upstream boards also feature a USB to serial module which converts the USB communications to a serial data connected to a second dedicated serial UART. This is used for reprogramming, user communications as well as for in circuit debug (ICD) in Flowcode. Note we do not recommend using user communications with ICD active.

ABOUT EBLOCKS

New in EBlocks 3

Scope Ground Points

The EBlocks 3 upstream boards have a couple of grounded holes designed in to allow for the ground clips from scope probes to easily be connected to the local PCB ground for easy use with third party hardware such as oscilloscopes.

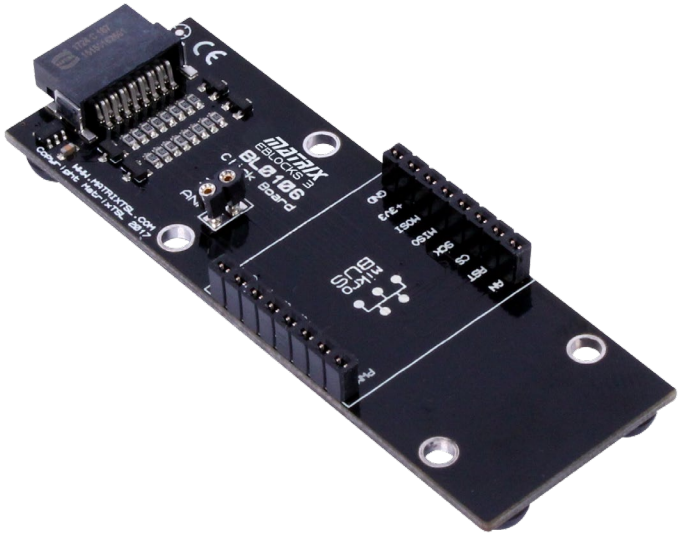


DOWNSTREAM BOARDS

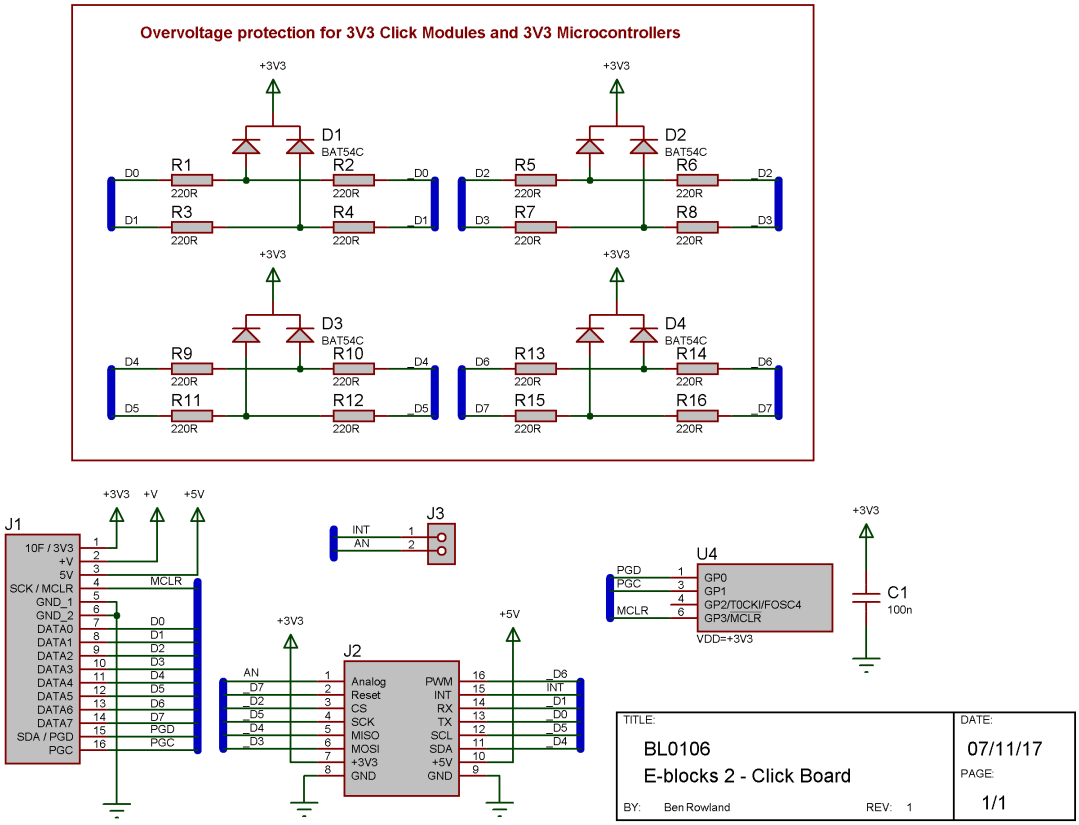
BL0106 - MikroBUS Adapter

This board provides a simple way of connecting a Click module from MikroElektronika using the Mikrobus connection and layout standard. The Click board therefore allows a wide range of different modules to be compatible with the EBlocks 3 system. Most of the Mikrobus pins are wired to allow for direct peripheral support from the EBlocks upstream controller IC. The exceptions to this are the Interrupt and Analogue pins which are exposed via turned pin sockets allowing you to wire these signals to any of the free pins of your EBlocks controller. Protection is provided on the board to ensure that 5V and 3V3 devices can work together seamlessly without causing any damage.

Port Bit	Function
0	uC RX / Click TX
1	uC TX / Click RX
2	SPI CS
3	SPI MOSI
4	SPI MISO / I2C SDA
5	SPI SCK / I2C SCL
6	PWM
7	Reset



BL0106 - Board Schematic



DOWNSTREAM BOARDS

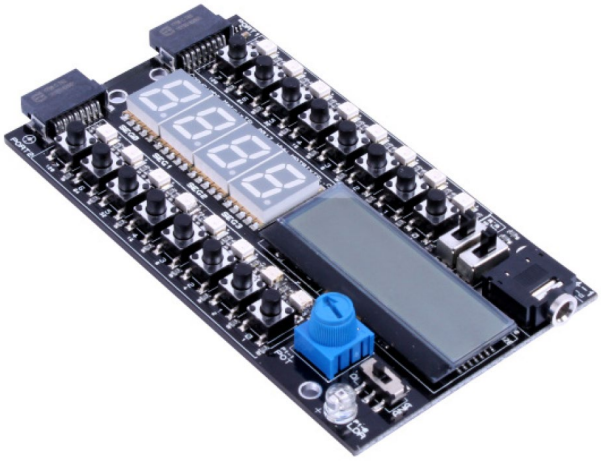
BL0114 - Combo Board

This flexible combination board is an ideal platform for learning and project development. The board will work with any upstream EBlocks system allowing multiple technologies to be explored using a single downstream EBlocks 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. The graphical LCD is driven via an intelligent conversion module to allow it to be treated as a standard Alphanumeric HD44780 compatible device.

Features

- 16 Individual LEDs
- 16 Individual Switches
- Quad 7-Segment Display
- 20 x 4 Character Alphanumeric LCD
- On-board sensors (Light / Potentiometer)
- Audio Output Socket

Refer to the LCD Key Differences section for more info on the LCD including the in-built LCD character set.



The ANA/DIG switch specifies the connections for pins 0 and 1 on Port 1. In the DIG position the pins will be connected to the digital circuitry including the Switch, LED and 7-Seg Common Pin. In the ANA position the pins will be connected to the light sensor and potentiometer inputs respectively. Connecting an Audio jack to the audio socket disconnects pin 2 and 3 on Port 1 from the digital circuitry (Switch, LED and 7-Seg Common Pin).

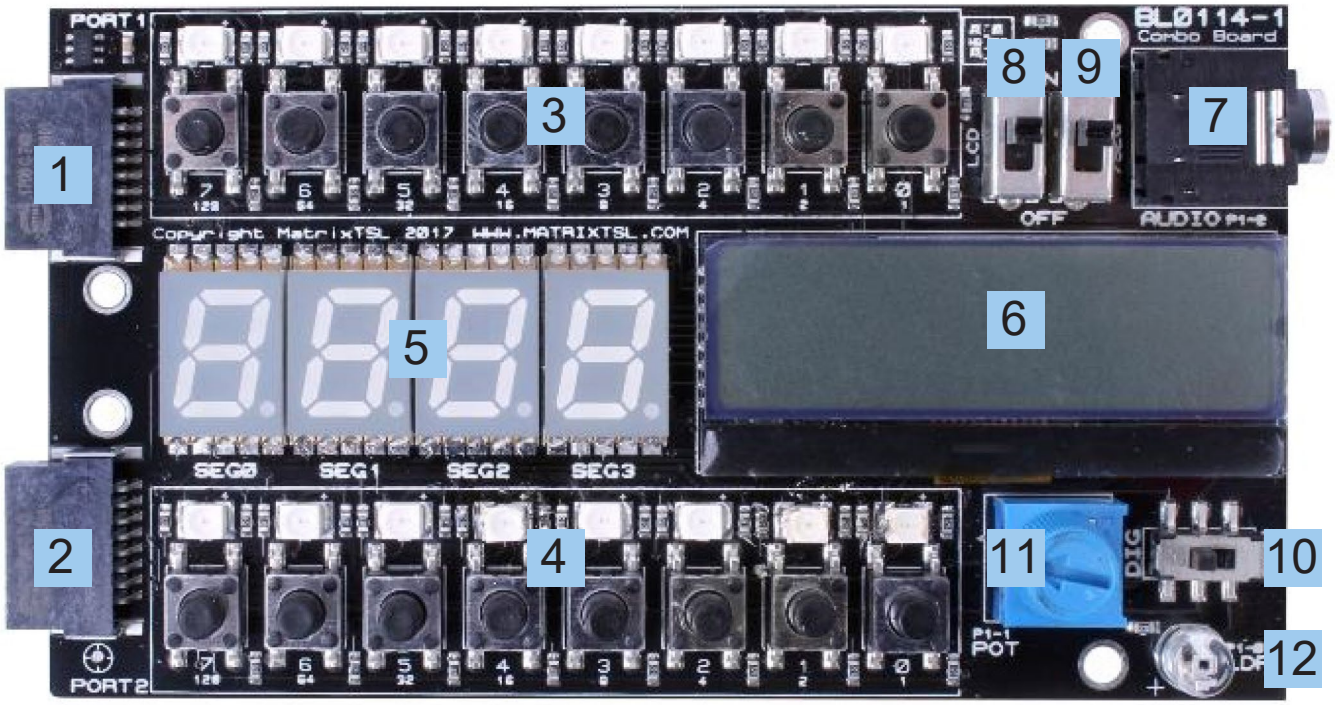
Connections

	PORT 1								PORT 2							
	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
7 Seg					Com3	Com2	Com1	Com0	DP	G	F	E	D	C	B	A
LCD											Enable	RS	Data3	Data2	Data1	Data0
							Pot	Light								
Sound					Out R	Out L										

DOWNSTREAM BOARDS

BL0114 - Combo Board

Board Layout

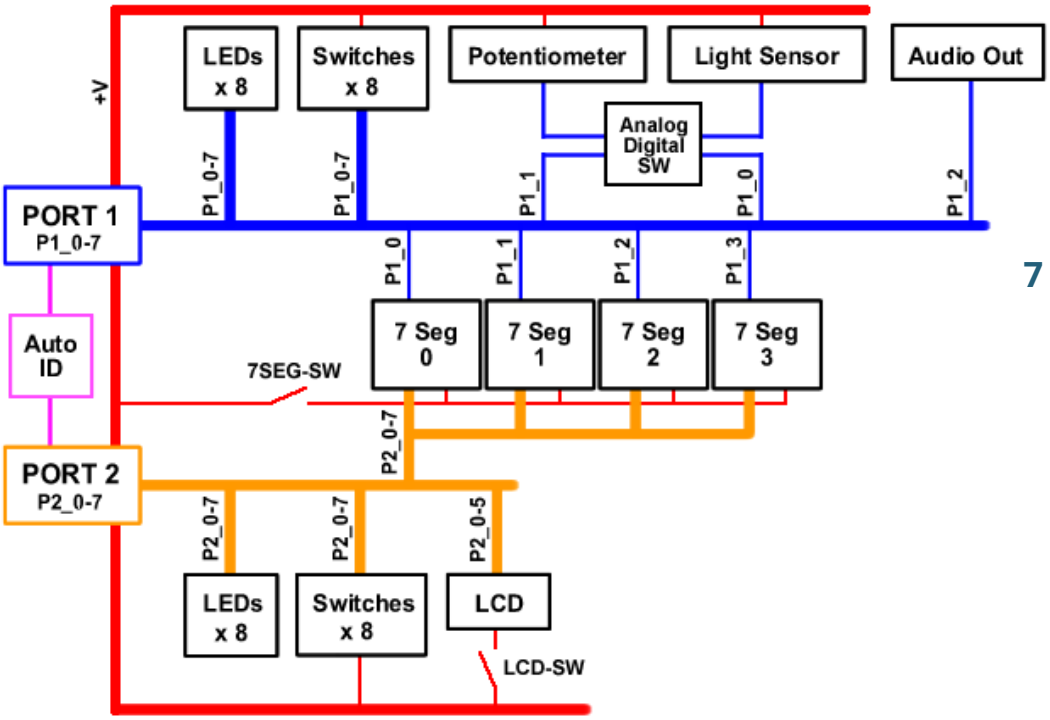


1. Port 1 EB3 Connector
2. Port 2 EB3 Connector
3. Port 1 Switches and LEDs
4. Port 2 Switches and LEDs
5. 7-Segment Display Bank
6. Alphanumeric LCD Audio Output Socket
7. LCD On/Off Switch
8. 7-Segment On/Off Switch
9. Analogue/Digital Switch
10. Analogue Potentiometer
11. Analogue Light Sensor

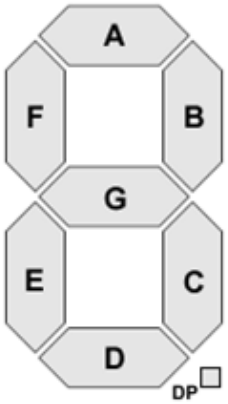
DOWNSTREAM BOARDS

BL0114 - Combo Board

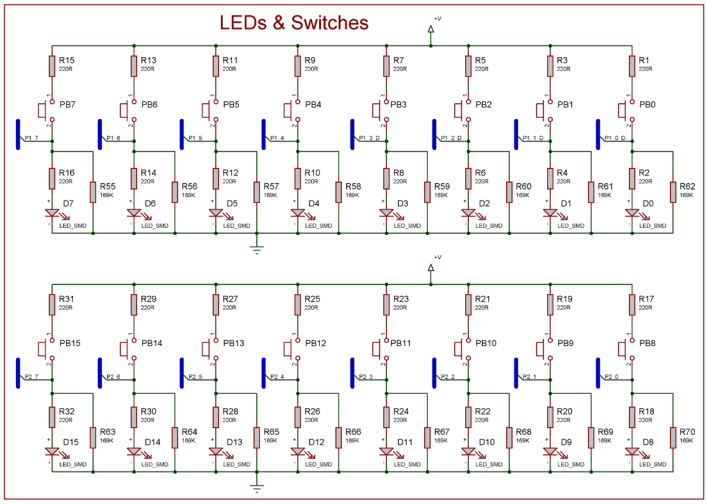
Block Diagram

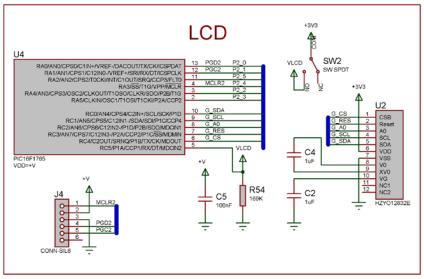


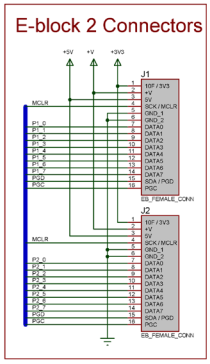
7 Segment Display -Segment Map

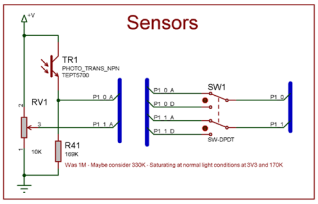


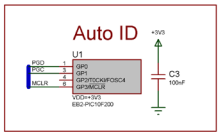
Board Schematic

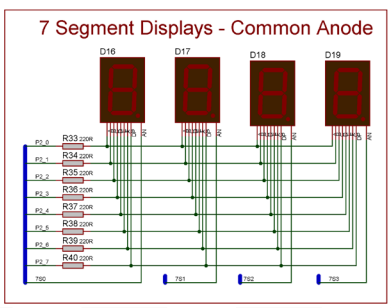


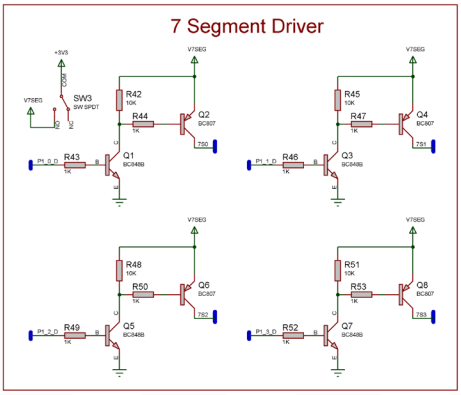


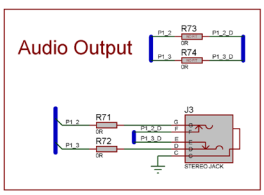




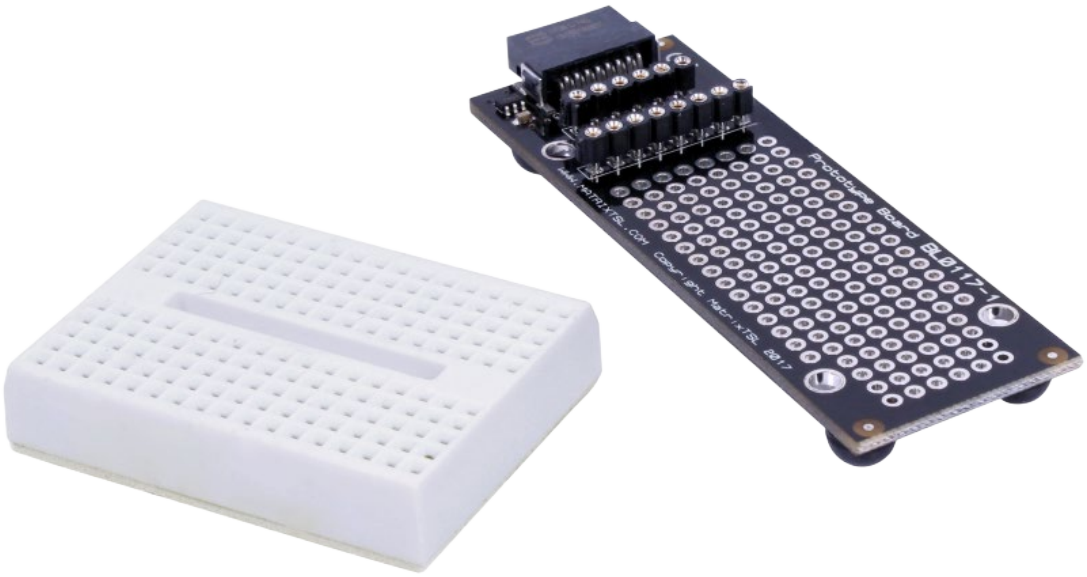






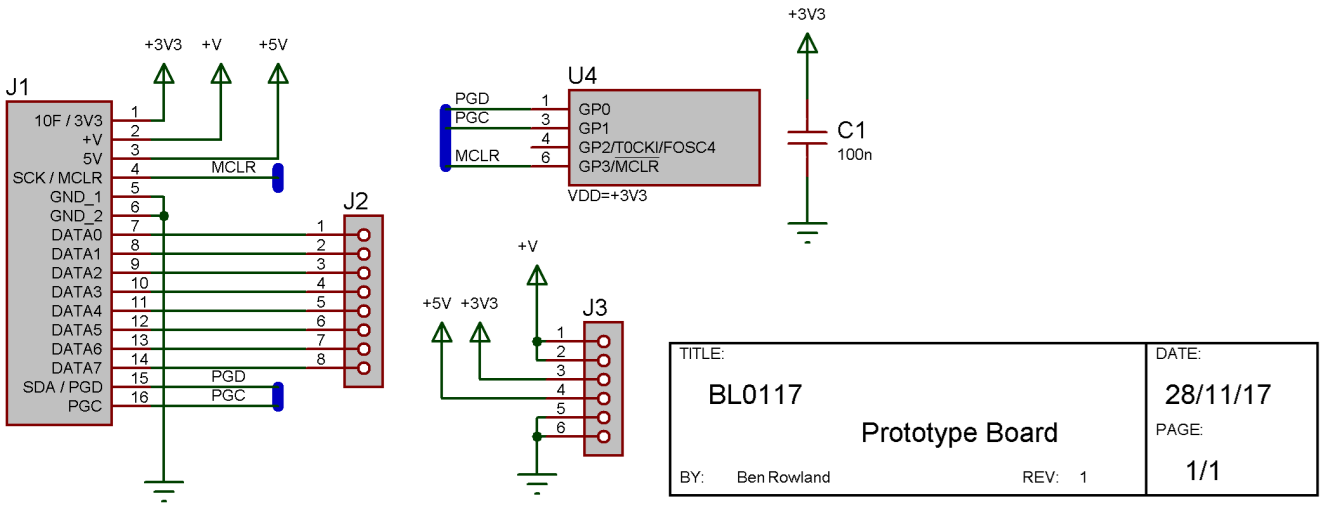


The Proto board allows for easy addition of custom circuitry into the EBlocks 3 system. The board provides an array of standard 2.54mm pitch holes which can be used to permanently solder electronics onto the EBlocks board. The board is also supplied with a small breadboard allowing for temporary electronics to be created and tested with the EBlocks 3 system. The small breadboard features a sticky back so it can be attached to the top of the Proto EBlocks circuit board if required. The board exposes the eight data lines from the microcontroller port as well as the various power connections +V, 3V3, 5V and GND via turned pin sockets suitable for linking to your circuitry using single core wire.



The prototype board comes complete with six single core style male to male cables allowing you to easily connect the signals from your upstream board to your custom circuitry.

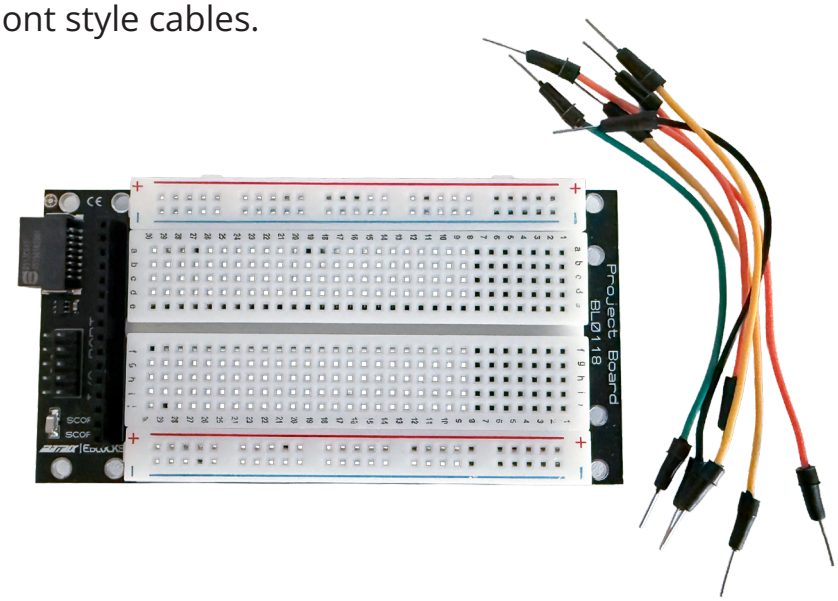
BL0117 - Board Schematic



DOWNSTREAM BOARDS

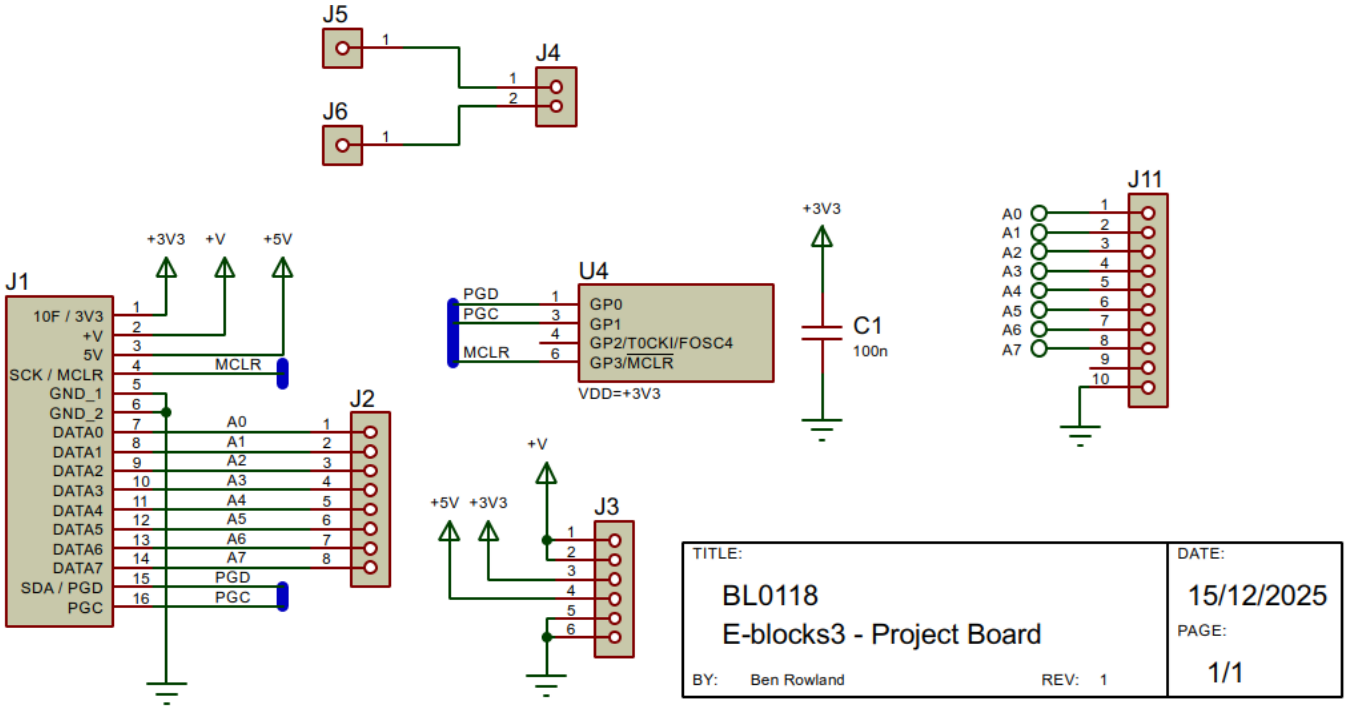
BL0118 - Project Board

The Project board allows for easy addition of custom circuitry into the EBlocks 3 system. The board is supplied with a larger breadboard allowing for temporary electronics to be created and tested with the EBlocks 3 system. The board exposes the eight data lines from the microcontroller port as well as the various power connections +V, 3V3, 5V and GND via 2.54mm pitch sockets suitable for linking to your circuitry using single core wire or dupont style cables.



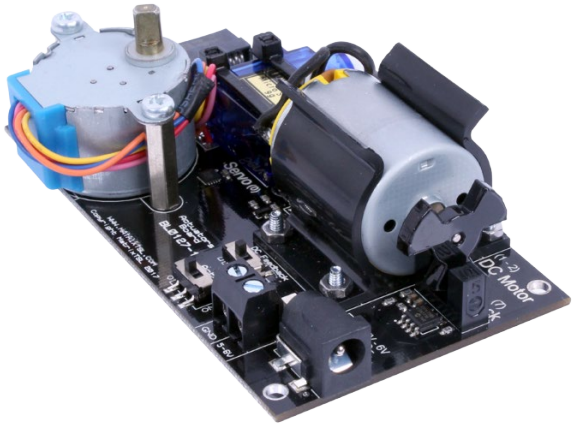
The project board comes complete with six Dupont style male to male cables allowing you to easily connect the signals from your upstream board to your custom circuitry. The board also features a couple of mounted scope connections allowing for easy connection to oscilloscopes.

BL0118 - Board Schematic

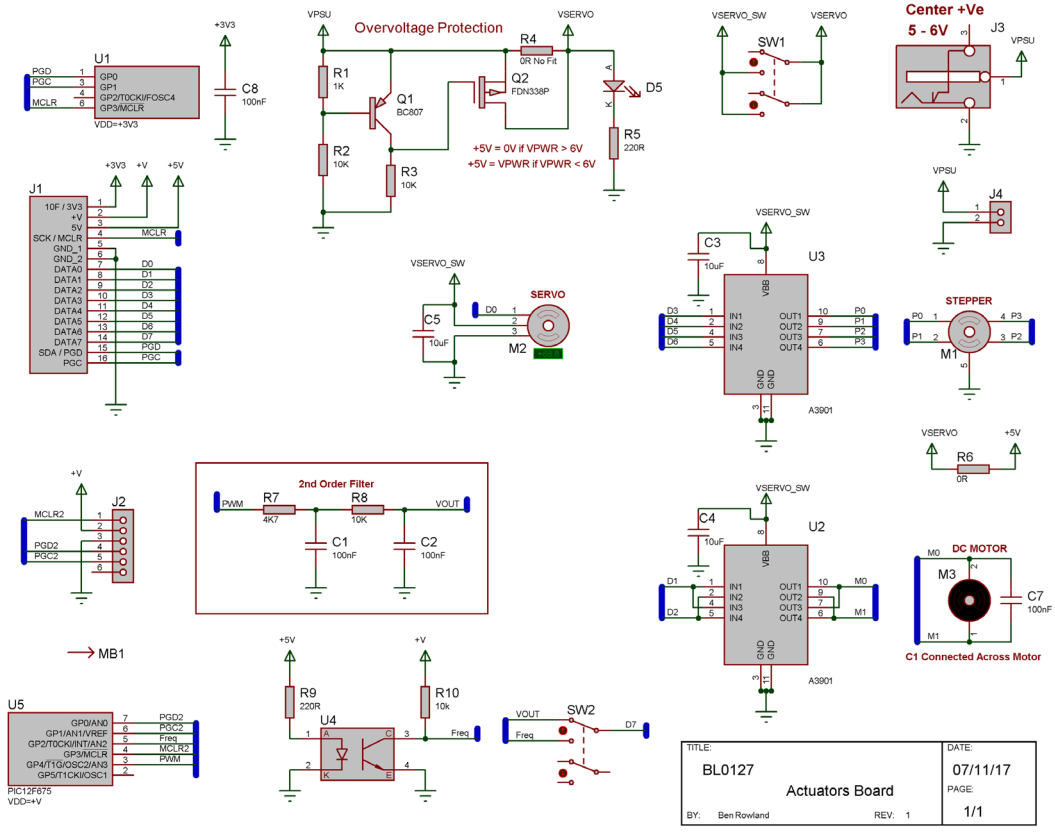


The Actuators board allows for investigation into several different motor types. Included on the board is a DC motor with both analogue and digital feedback, a servo motor and a stepper motor plus the circuitry to drive the motors. The DC motor is driven using a standard H-Bridge driver IC and can be driven using simple digital on/off right through to analogue pulse width modulation (PWM) techniques. By monitoring the feedback signal, a closed loop control system can be made to control the speed of the DC motor. A second H-Bridge driver IC is used to drive the four coils of the stepper motor allowing for full step and half step operation. The Stepper motor features an internal gearbox to provide a high level of torque and precise angle control. The servo motor is a standard R/C servo motor with a supplied actuator arm. The board features a DC socket to allow the various motors to be powered from a secondary 5 - 6V power supply.

Port Bit	Function
0	Servo Motor
1	DC Motor A
2	DC Motor B
3	Stepper A
4	Stepper B
5	Stepper C
6	Stepper D
7	DC Feedback



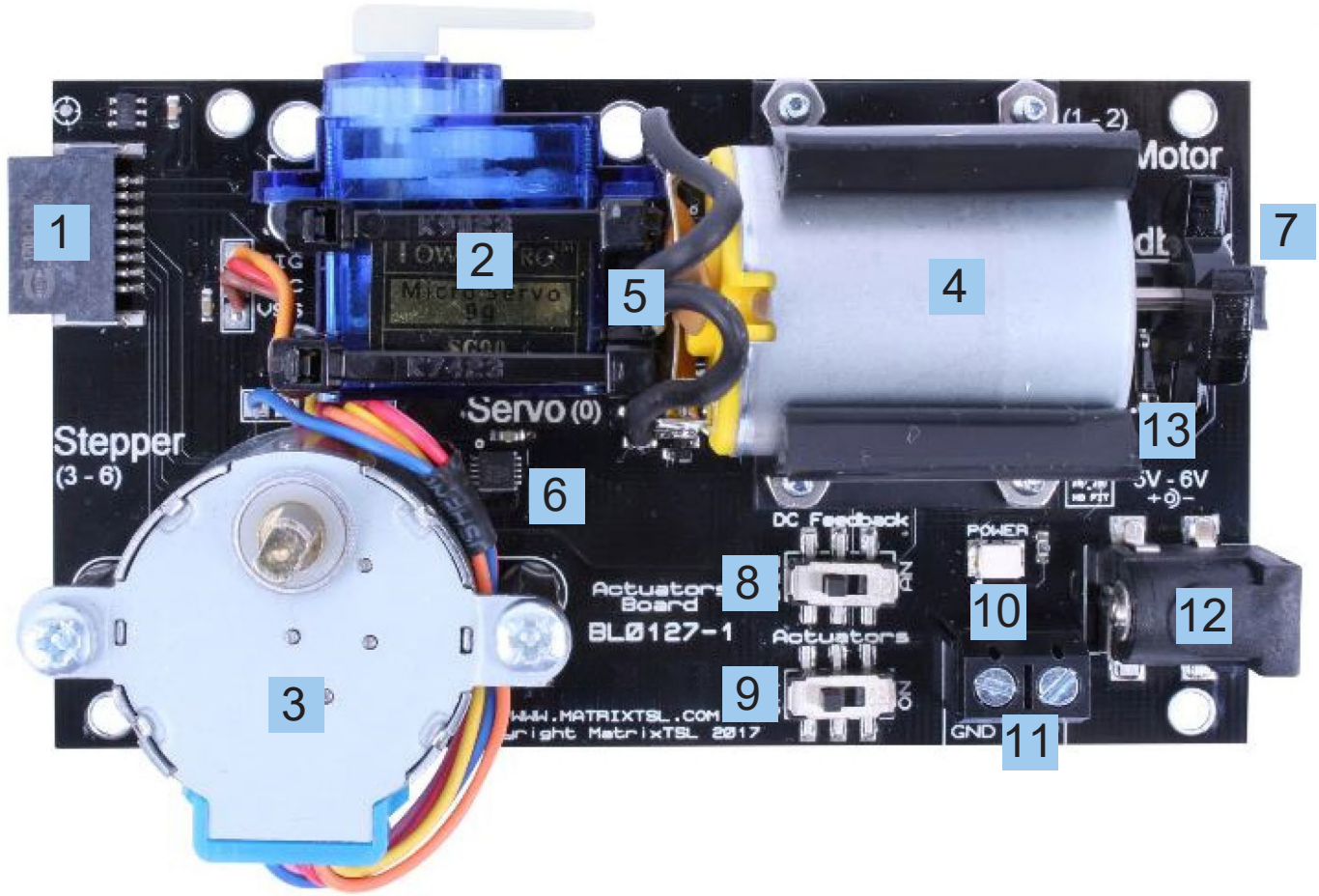
BL0127 - Board Schematic



DOWNSTREAM BOARDS

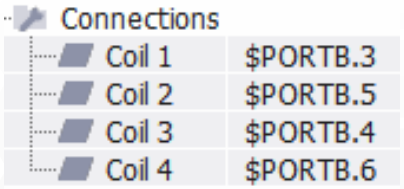
BL0127 - Actuators Board

Board Layout



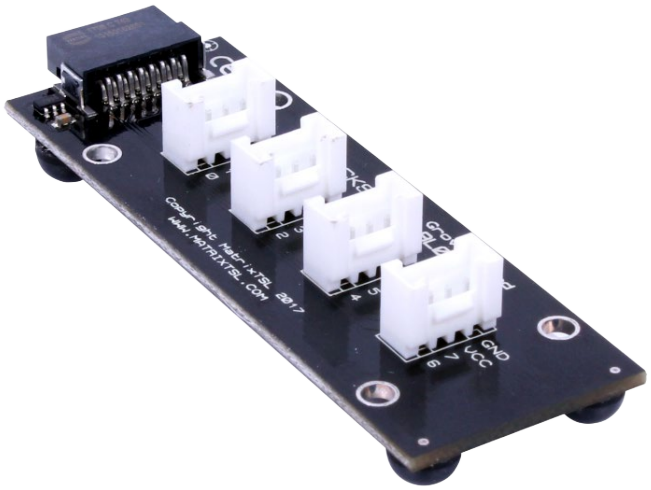
1. Port EB3 Connector
2. Servo Motor
3. Stepper Motor
4. DC Motor
5. DC Motor Driver IC
6. Stepper Motor Driver IC
7. DC Motor Feedback Photo Interrupter
8. DC Motor Feedback Analogue/Digital Switch
9. Actuators On/Off Switch
10. Power LED
11. Power screw terminals
12. Power DC Socket Inner Positive 5V-6V
13. DC Motor Analogue Speed Measurement IC

The stepper motor has a 64 step revolution count and features an internal 64:1 gearbox which equates to 4096 steps per revolution. For the stepper to work with the Flowcode Stepper motor component the pin connection properties must be setup as follows, replacing PORTB with the correct EB3 port.

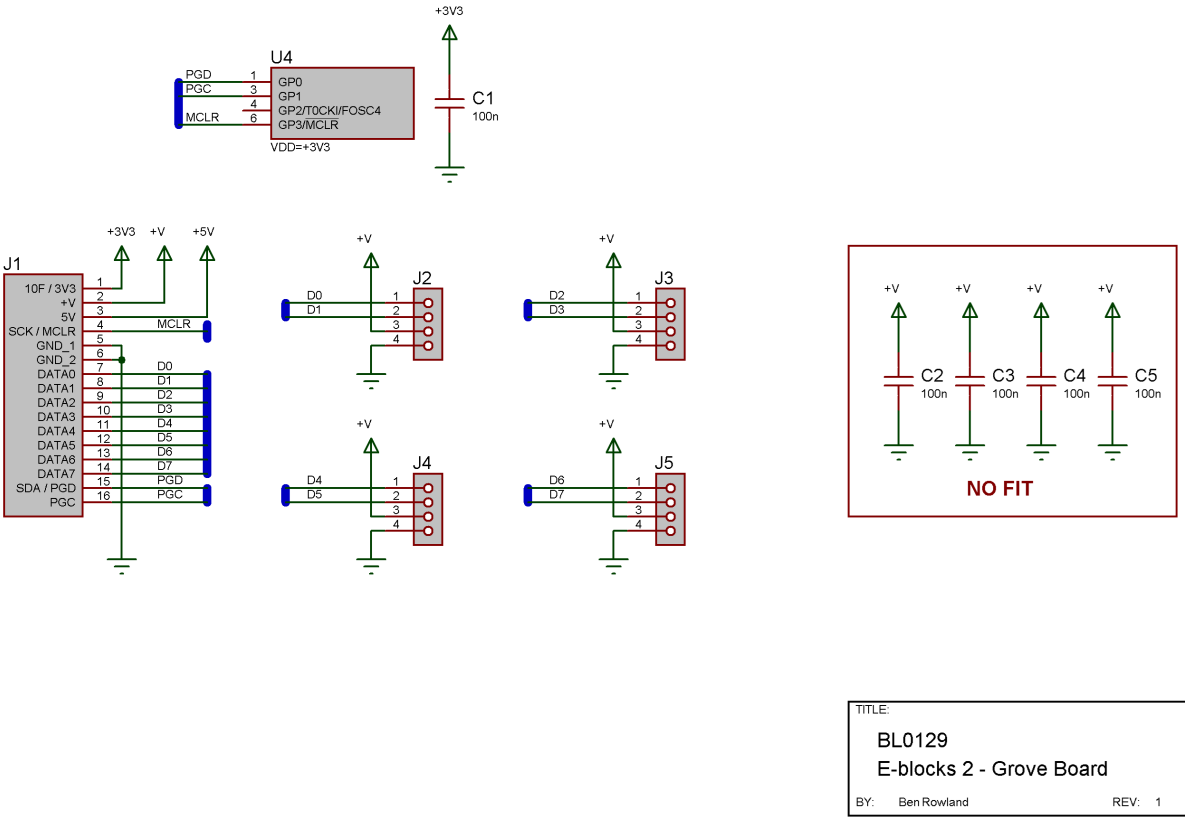


The Grove board allows for the easy addition of a large number of peripherals and sensors from the Seeed Studio range of Grove modules. The board can be used with up to four Grove modules at a time. Care should be taken to ensure that the system voltage is compatible with all the connected Grove modules to avoid damaging the Grove module.

Port Bit	Function
0	Socket 1 Even
1	Socket 1 Odd
2	Socket 2 Even
3	Socket 2 Odd
4	Socket 3 Even
5	Socket 3 Odd
6	Socket 4 Even
7	Socket 4 Odd



BL0129 - Board Schematic



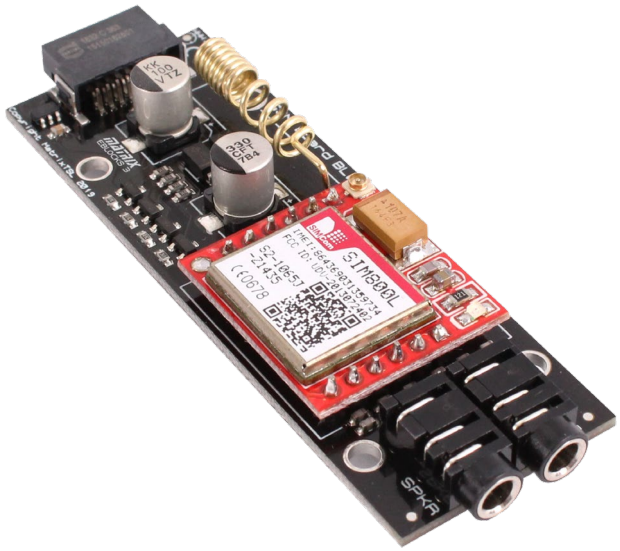
TITLE: BL0129 E-blocks 2 - Grove Board	DATE: 13/09/17
BY: Ben Rowland REV: 1	PAGE: 1/1

DOWNSTREAM BOARDS

BL0131 - GSM Board

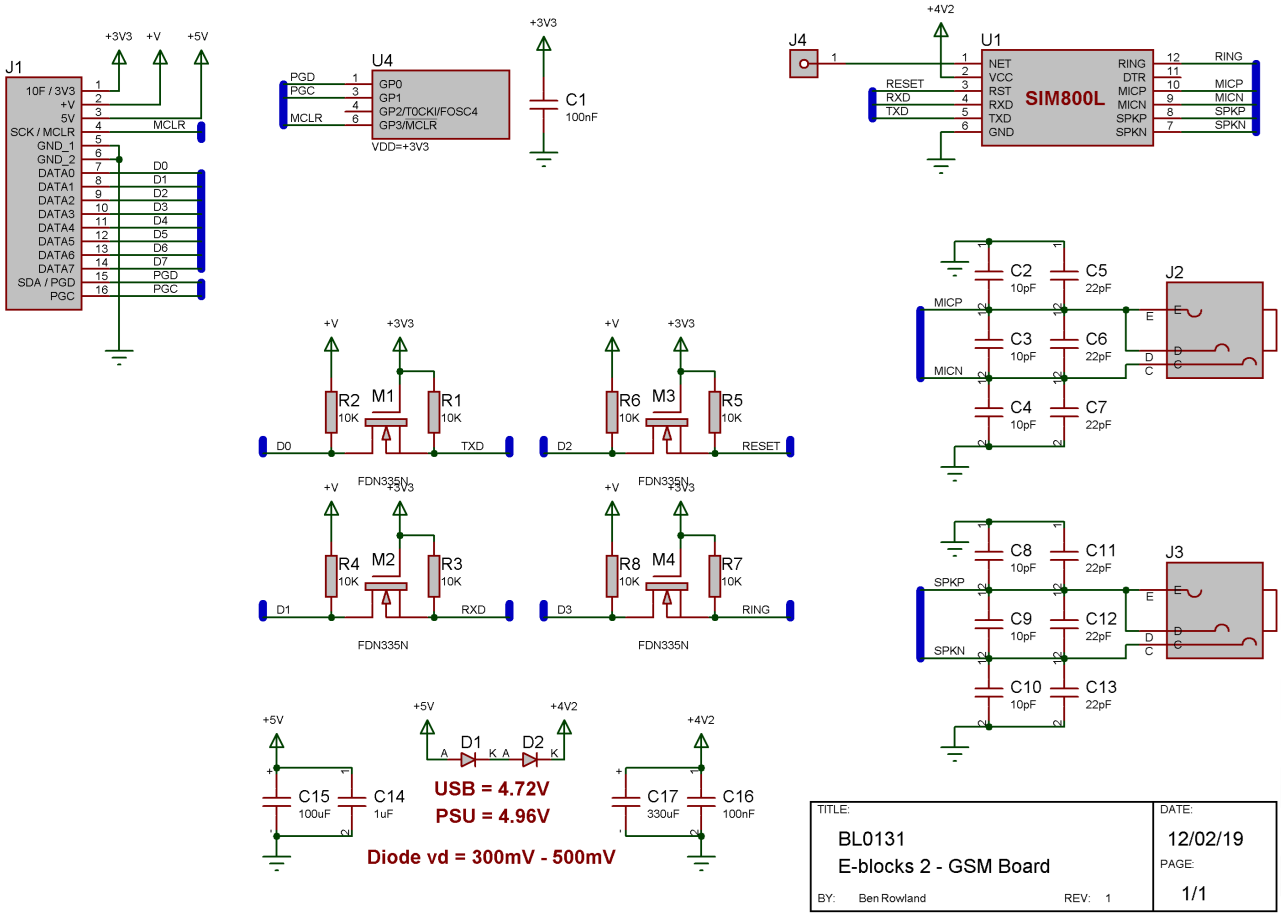
The GSM board allows the EBlocks system to connect and communicate with a mobile phone (GSM) network. It can be used to make and receive phone calls, send and receive text messages as well as go onto the internet using GPRS for IoT style applications. The board features audio sockets to allow the board to be connected to a standard headset and microphone. A micro SIM socket is hidden away under the GSM module and a quad band antenna is included.

Port Bit	Function
0	uC RX / GSM TX
1	uC TX / GSM RX
2	Reset
3	Ring
4	
5	
6	
7	



GSM Chip : SIMCOM SIM800
Transmitting Frequency: 824 ‘’’ 849 MHz
Receiving Frequency : 869 ‘’’ 894 MHz
Transmitting power: 2W

BL0131 - Board Schematic

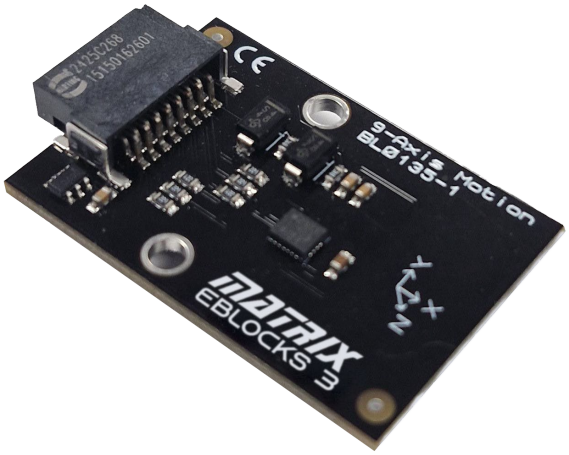


DOWNSTREAM BOARDS

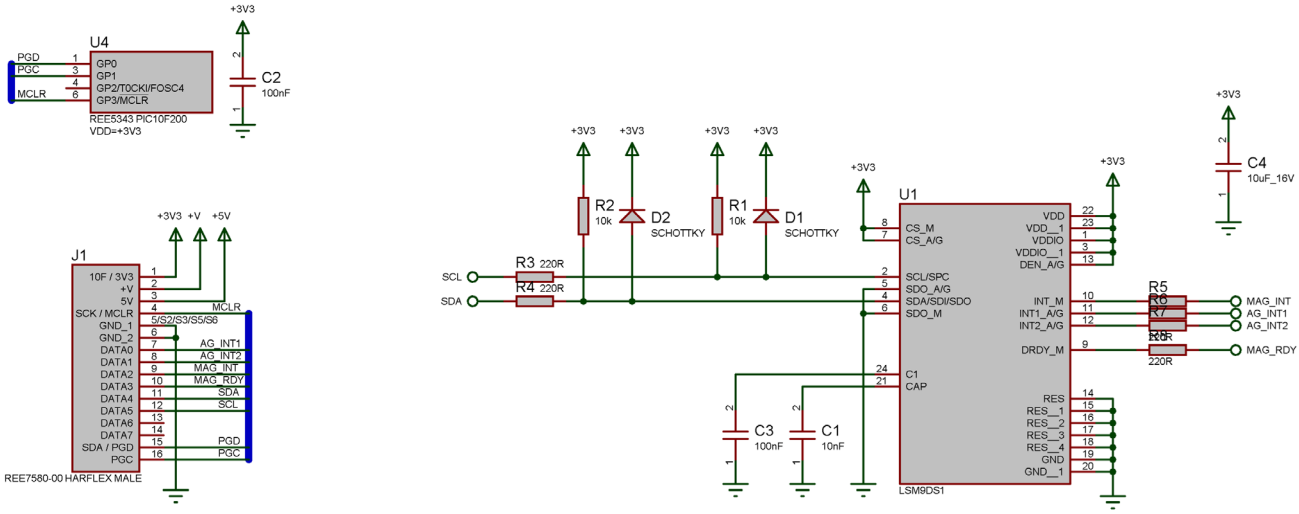
BL0135 - 9-Axis Motion Sensor

The 9-axis motion detector board houses a LSM9DS1 inertial chip which includes a 3D accelerometer, 3D gyroscope, and 3D magnetometer and a temperature sensor. This has a lot of applications in navigation, smart user interfaces, gesture recognition, gaming, virtual reality and mapping. The device is connected via I2C which works at 100KHz and 400KHz.

Port Bit	Function
0	A/G INT1
1	A/G INT2
2	MAG INT
3	MAG RDY
4	SDA
5	SCL
6	
7	



BL0135 - Board Schematic

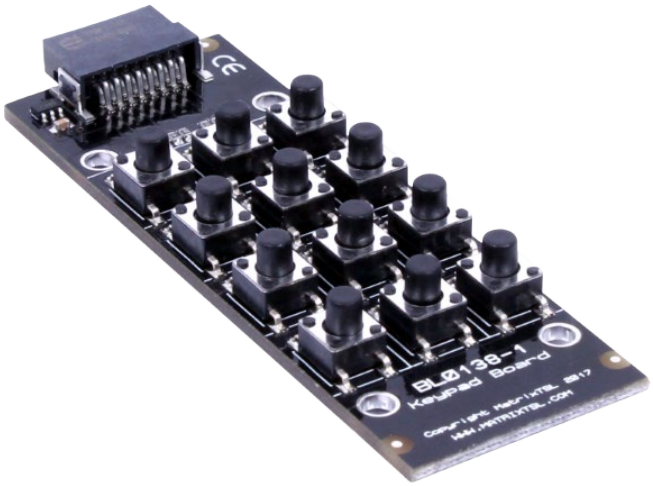


DOWNSTREAM BOARDS

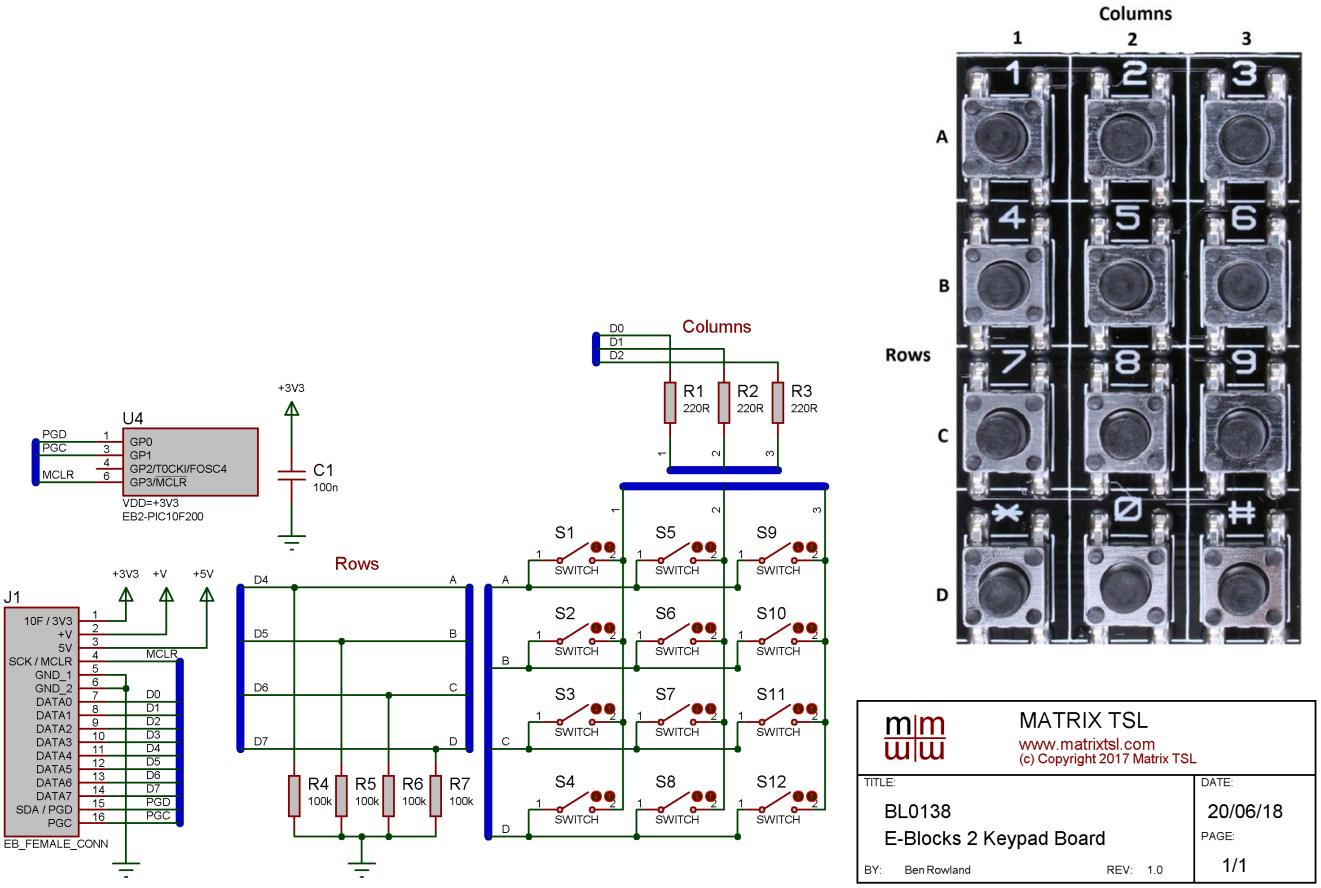
BL0138 - Keypad

The Keypad board allows for simple data entry using an array of switch inputs which can be added to the EBlocks 3 system. Keypads are useful tools as they allow you to enter numeric and textual data into the embedded system. The switches are all push to make type and read by controlling the logic level of the columns and reading back the state of the rows. Only a single active switch on the keypad can be read at once.

Port Bit	Function
0	Column 1
1	Column 2
2	Column 3
3	
4	Row A
5	Row B
6	Row C
7	Row D



BL0138 - Board Schematic

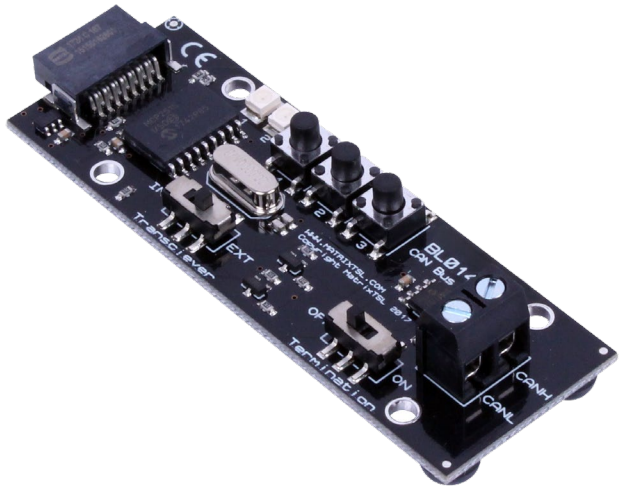


DOWNSTREAM BOARDS

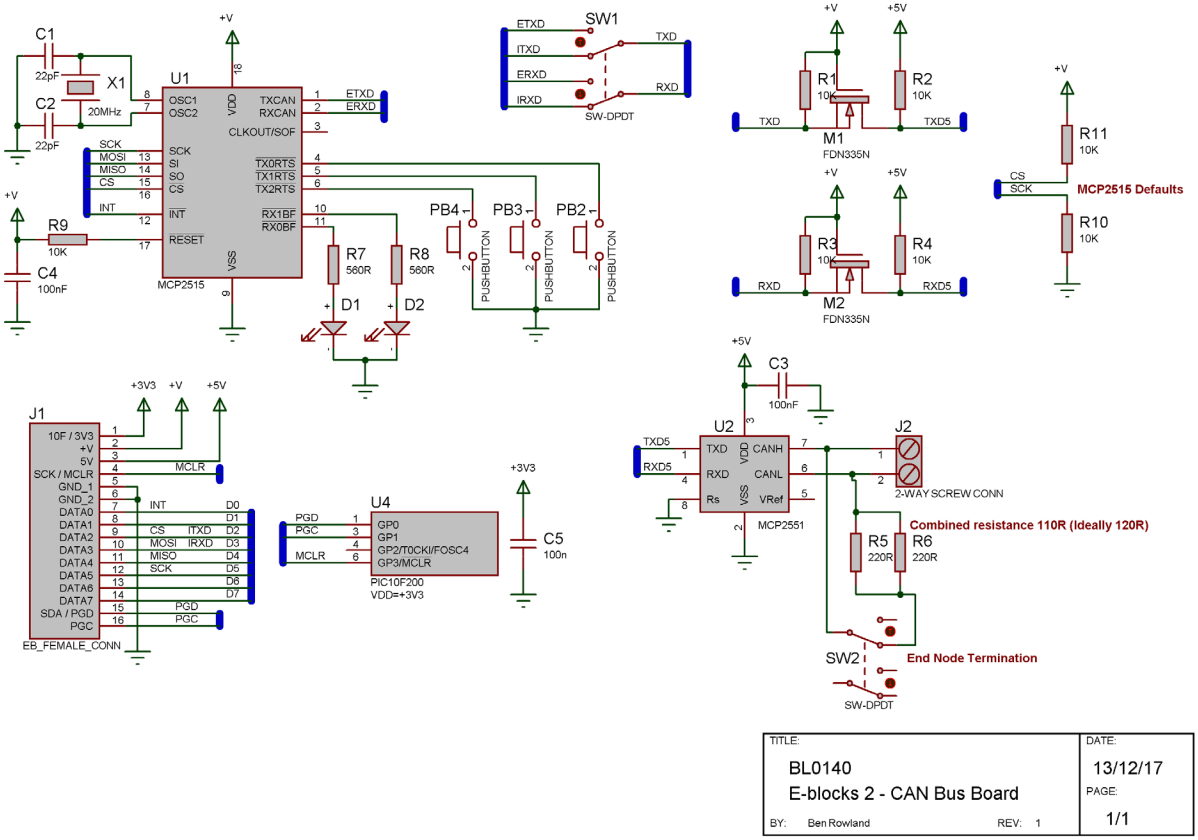
BL0140 - CAN bus Board

The CAN bus board allows the E-block system controller to connect with other controllers. CAN is widely used in automotive applications due to its low cost, high data throughput and noise immunity. The board can be used with upstream EBlocks boards both with or without CAN bus peripherals allowing the maximum flexibility. The board includes both a CAN transceiver and a CAN controller which can be accessed via a simple SPI bus. For development and training purposes the board is fitted with three switches and two LEDs which can be controlled using the CAN transceiver chip. Flowcode macros for this E-block are available.

Port Bit	Internal (INT)	External (EXT)
0		INT
1		
2	TXD	CS
3	RXD	MOSI
4		MISO
5		SCK
6		
7		



BL0140 - Board Schematic

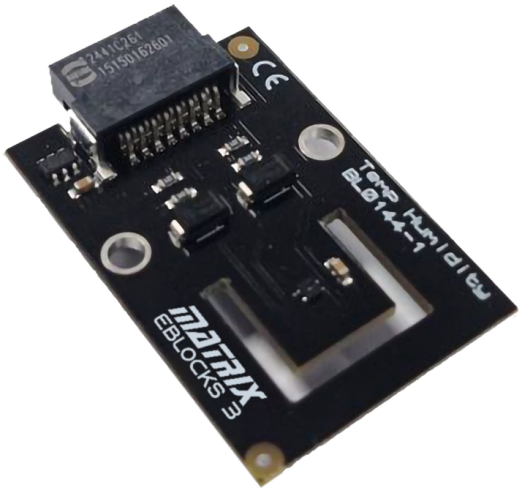


DOWNSTREAM BOARDS

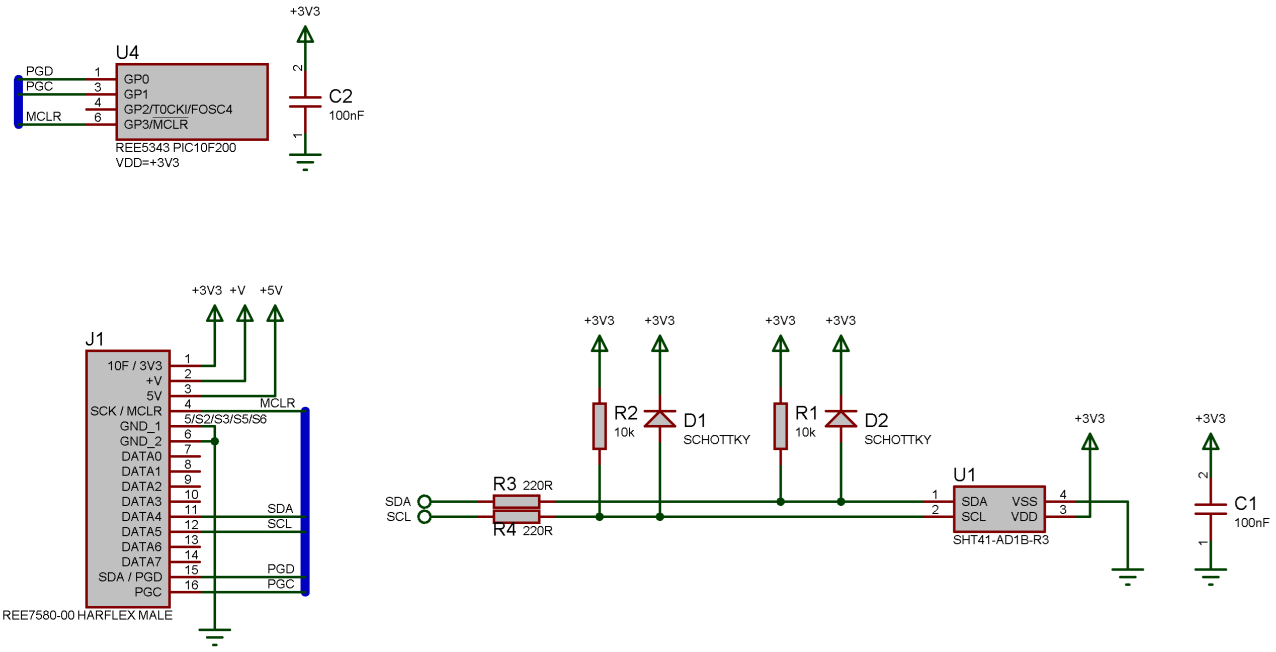
BL0144 - Temperature Humidity Sensor

The temperature humidity board houses a SHT41 temperature and humidity sensor chip which has a side range of applications in microcontroller systems. The device is connected via I2C which works at 100KHz and 400KHz.

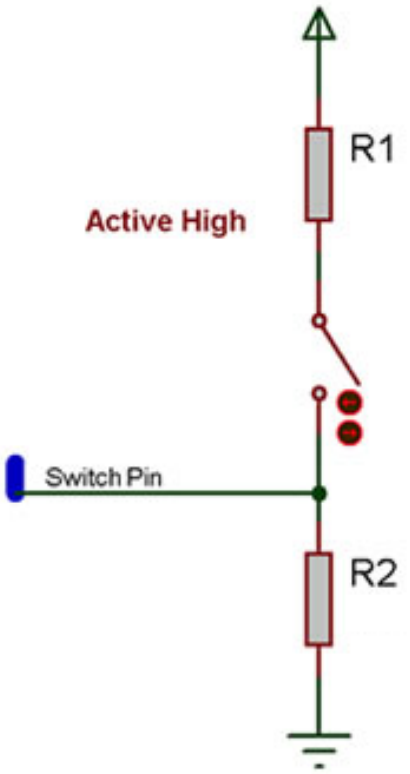
Port Bit	Function
0	
1	
2	
3	
4	SDA
5	SCL
6	
7	



BL0144 - Board Schematic

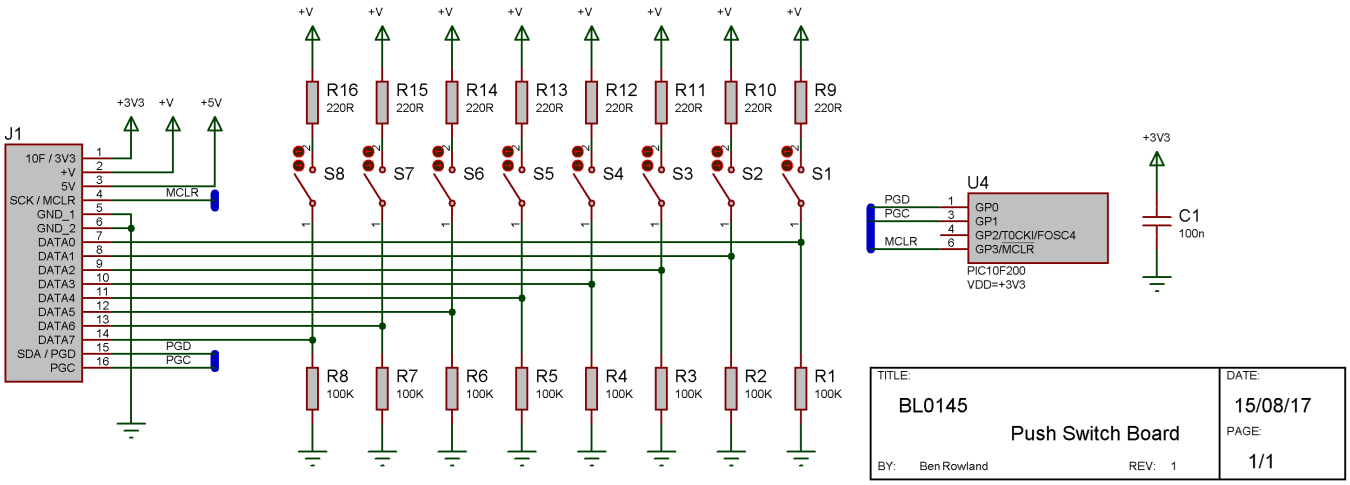


The Switch board allows a bank of eight switch inputs to be added to the EBlocks 3 system. Switches are useful tools as they allow you to control what is happening in the system. The switches are all push to make type and active high meaning the voltage to the microcontroller port pins is low when the switch is not pressed and high when the switch is pressed.



Each switch is in the active high configuration. When the switch is pressed R1 pulls the signal to the EBlocks port pin high. When the switch is not pressed R2 pulls the signal to the EBlocks port pin low to avoid picking up electrical noise from the environment (floating).

BL0145 - Board Schematic

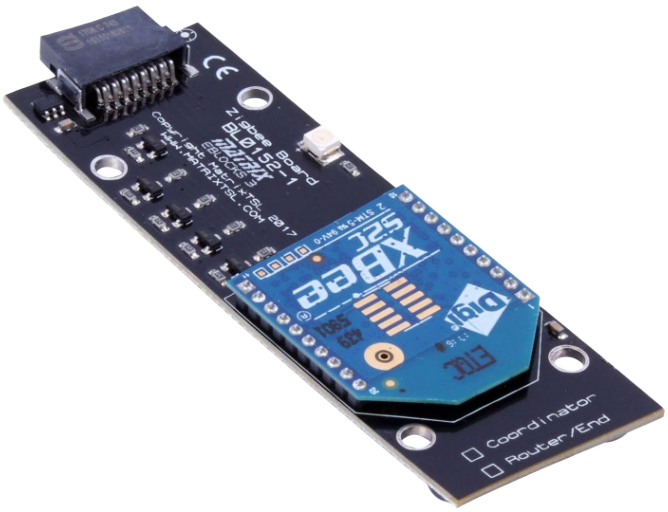


DOWNSTREAM BOARDS

BL0152C & BL0152R - Zigbee Board

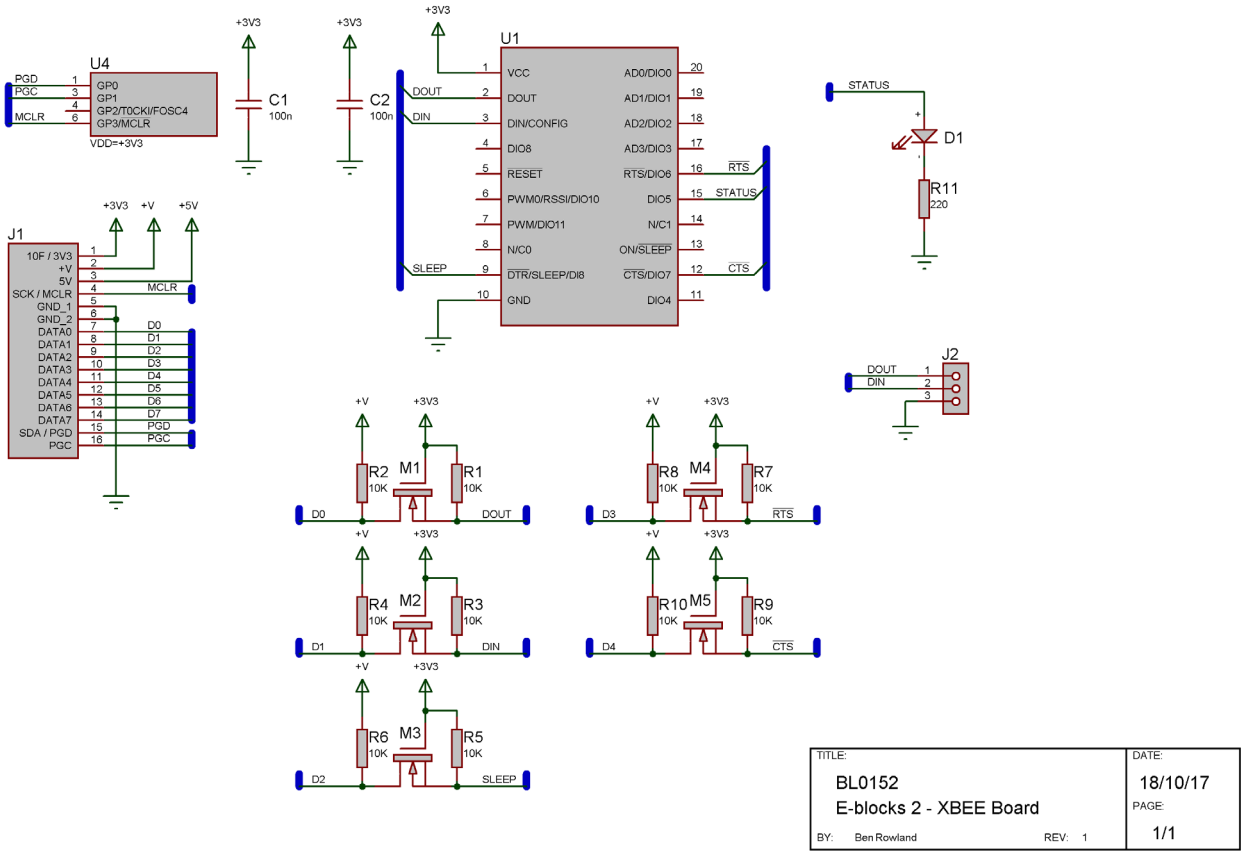
The Zigbee board uses a Series 2 XBEE module to allow you to connect one of more EBlocks systems together using the Zigbee (wireless area network) standard or to connect your system to a third party Zigbee system. The modules used are compliant with the 2007 Zigbee Pro standard. Because of the nature of the Zigbee standard there are two different boards the BL0152R is pre-programmed to behave as a router node in a Zigbee system. The BL0152C is pre-programmed to behave as a co-ordinator node in a Zigbee system.

Port Bit	Function
0	uC RX / XBEE TX
1	uC TX / XBEE RX
2	Sleep
3	RTS
4	CTS
5	
6	
7	



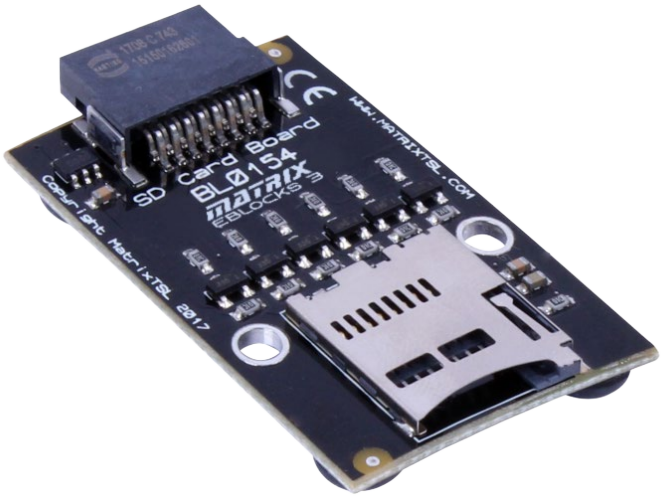
Zigbee Chip : DiGi DiGi XBee S2C
Frequency Band : 'ISM 2.4 GHz
Power: 3.lmW (+ SdBm) "'63mW (+ 18dBm)

BL0152 - Board Schematic

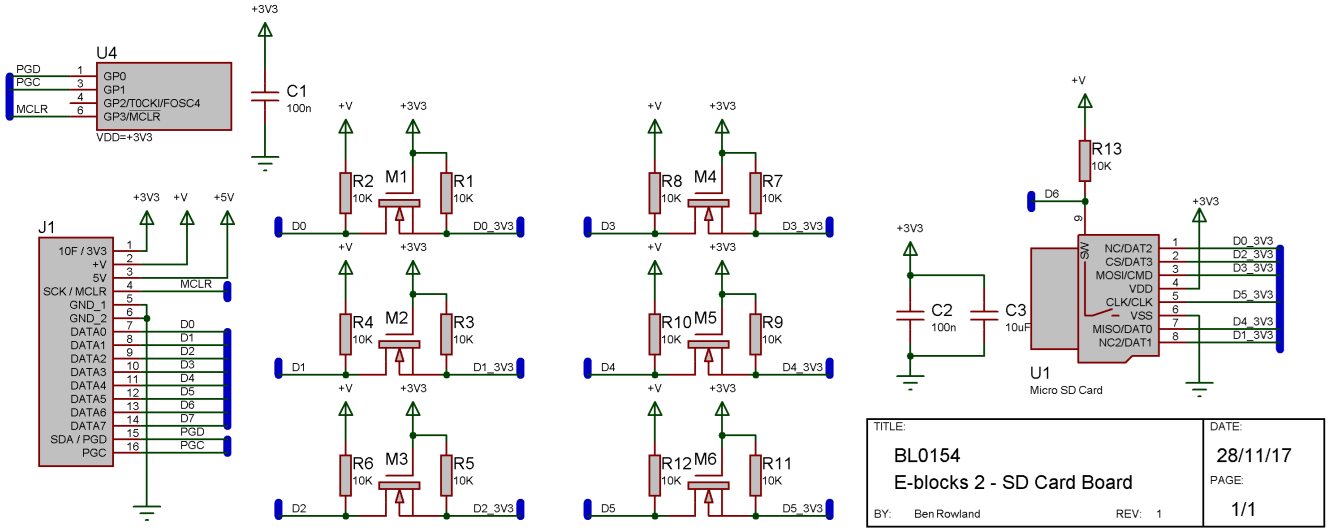


The micro SD card board allows a large amount of data storage to be added to the EBlocks system. The board provides a means of reading and writing data to the SD card as well as providing level shifting to allow 5V and 3V3 systems to be compatible. The board also provides a means of detecting if the card is present via a switch built into the card socket. The micro SD card is inserted by pushing it into the socket with the SD contacts pointing down. The SD card is removed from the socket by first pushing it inwards to unlock it from the socket before pulling it back out.

Port Bit	SPI Mode
0	
1	
2	CS
3	MOSI
4	MISO
5	CLK
6	SW
7	



BL0154 - Board Schematic

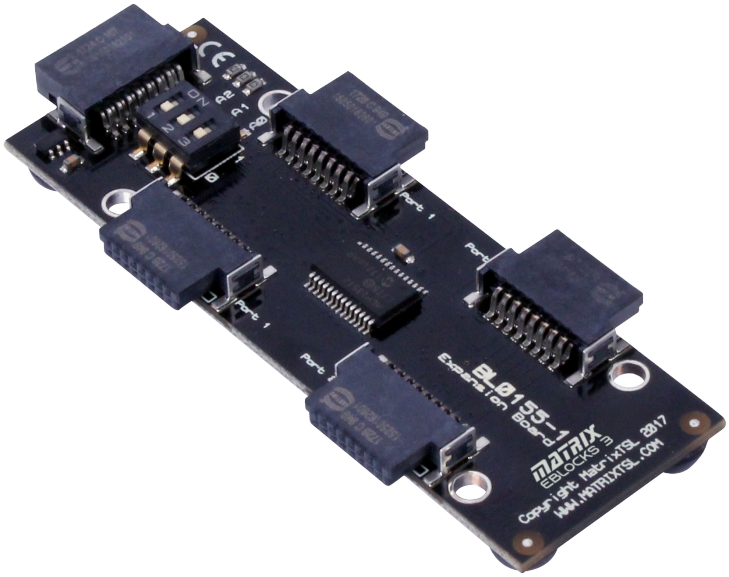


DOWNSTREAM BOARDS

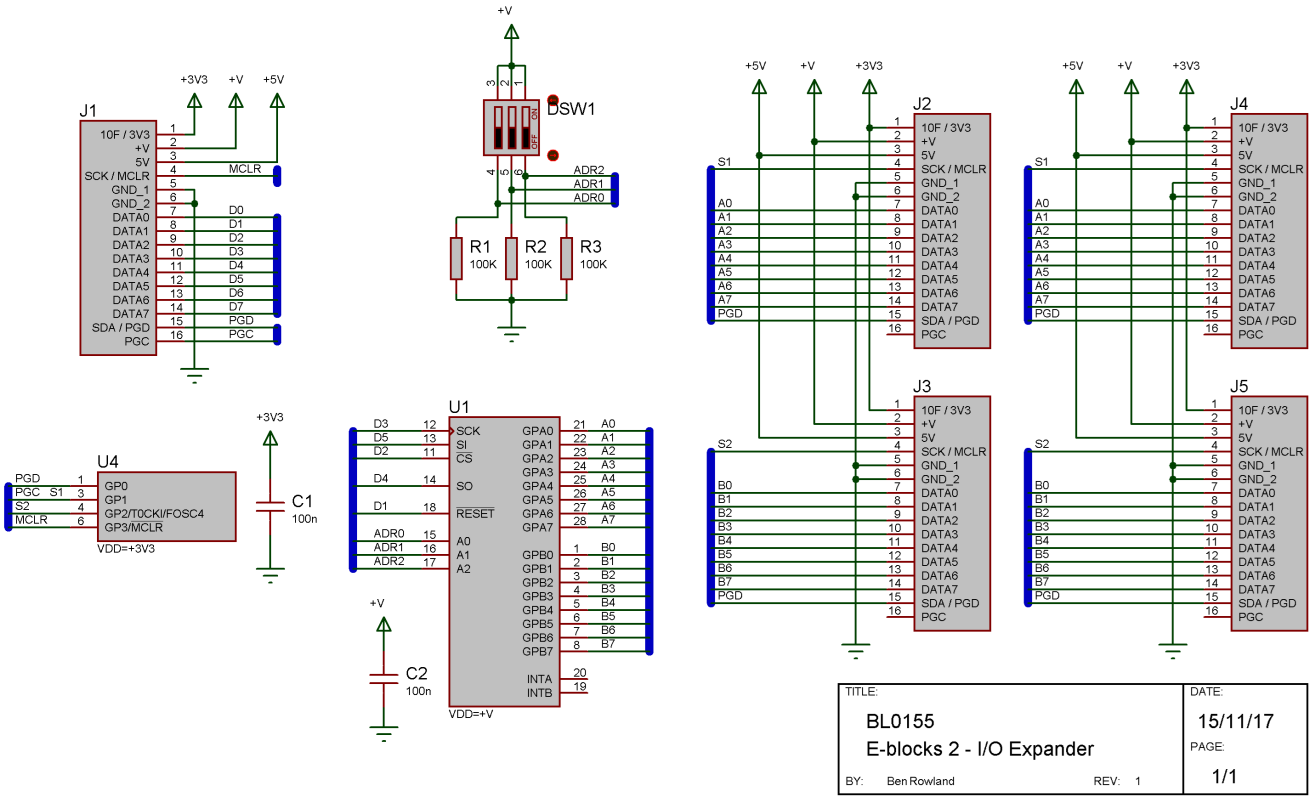
BL0155 - I/O Expander Board

The expander board allows multiple EBlocks 3 boards to be connected to a single upstream EBlocks 3 port. The data pins are controlled using an MCP23S17 I/O expander IC via an SPI connection to the host controller. The I/O expander provides digital input and output functionality as well as more advanced features such as interrupt on change. The board also features three DIP switches which are used to set the address of the I/O expander allowing for up to 8 expander boards to exist on the same SPI connections. The auto ID functionality is forwarded onto the connected boards. Please note that only one board should be connected to ports labelled 1 and ports labelled 2 to allow the expansion pins to be unique and auto ID to function correctly.

Port Bit	Function
0	
1	Reset
2	CS
3	SCK
4	MISO
5	MOSI
6	
7	



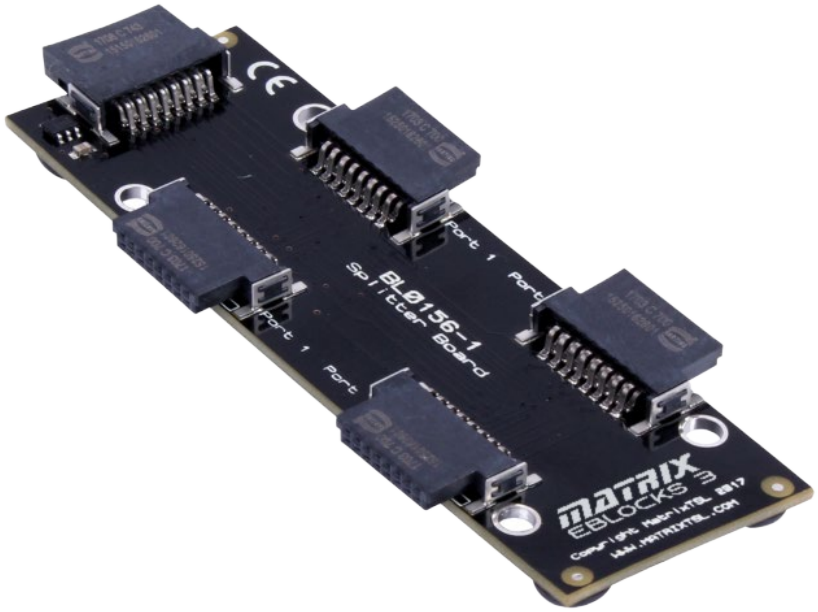
BL0155 - Board Schematic



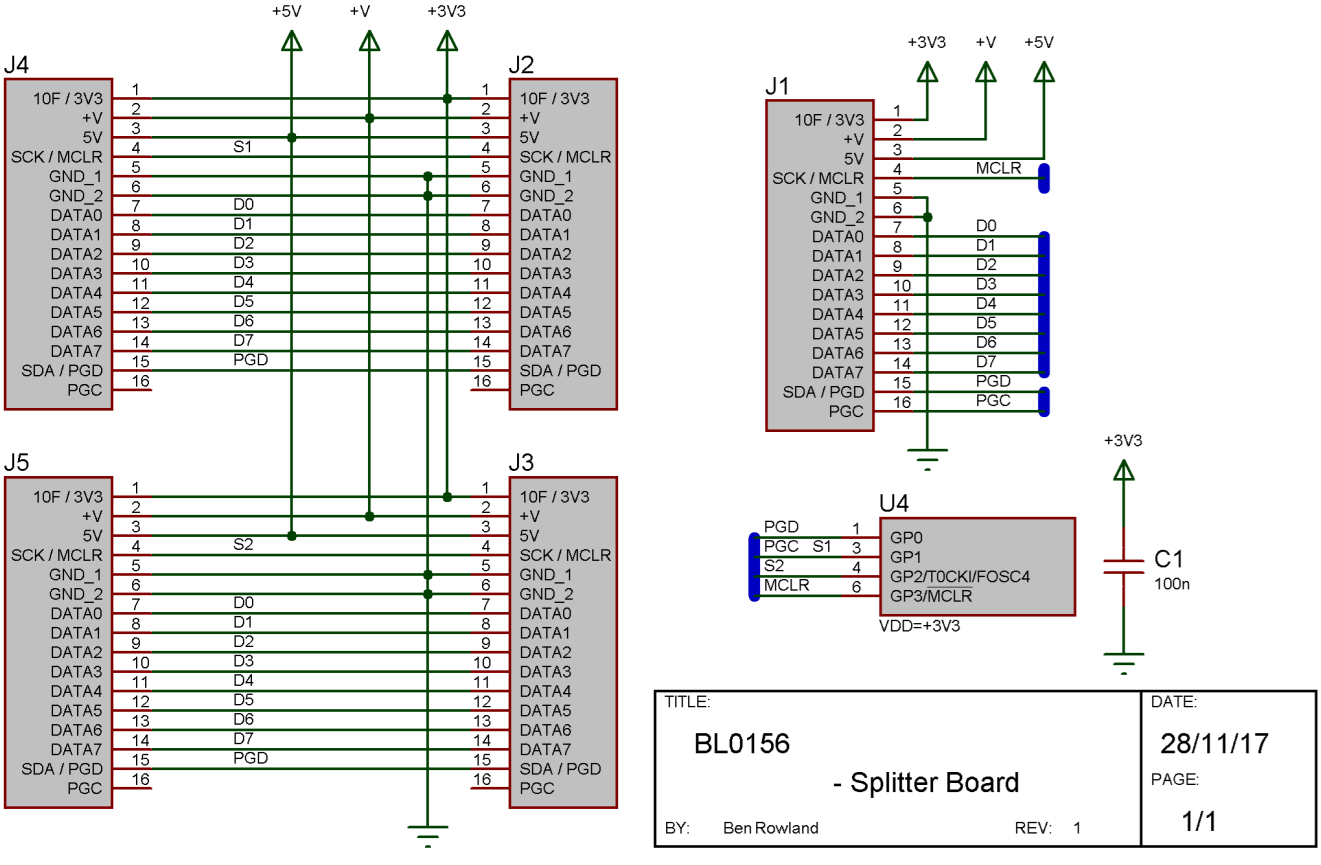
DOWNSTREAM BOARDS

BL0156 - Splitter Board

The splitter board allows multiple EBlocks 3 boards to be connected to a single upstream EBlocks 3 port. The data pins are shared between the connected boards and the auto ID functionality is forwarded onto the connected boards. Please note that only one board should be connected to ports 1 and 2 to allow the auto ID to function correctly.



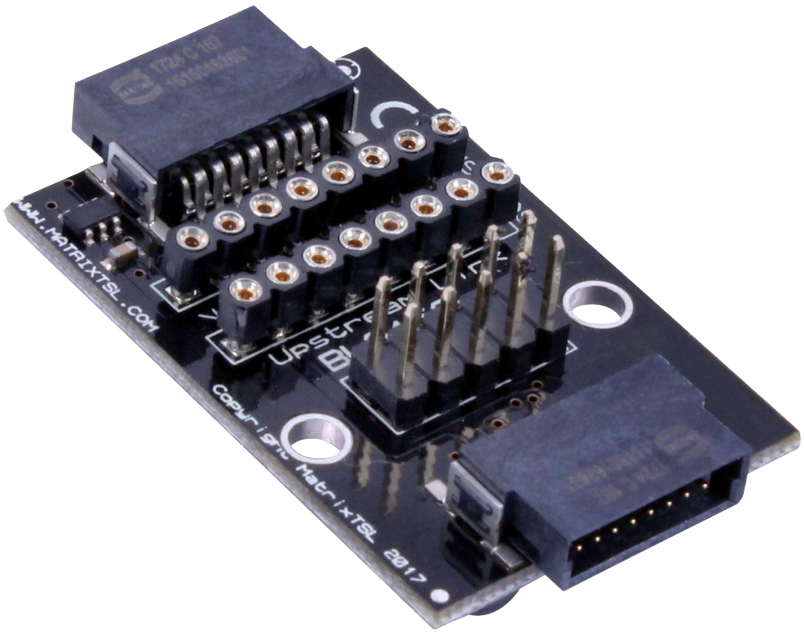
BL0156 - Board Schematic



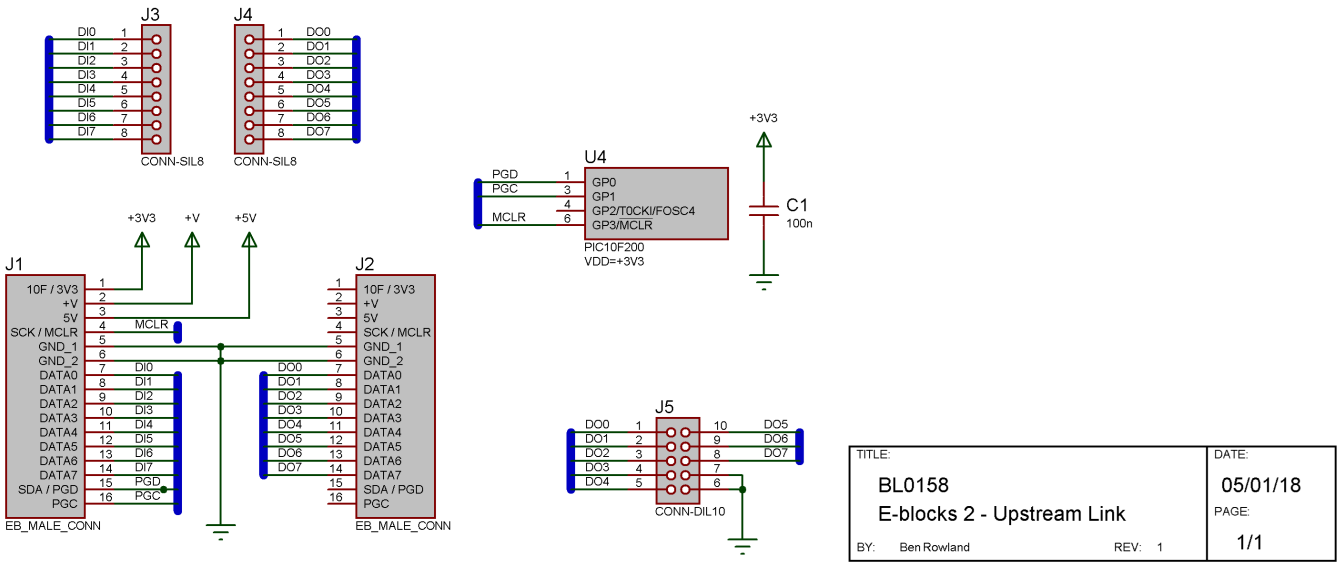
DOWNSTREAM BOARDS

BL0158 - Upstream Connector Board

The upstream connector board allows one upstream E-block board to be connected directly to another to allow for things like chip to chip communications to be explored and implemented. Chip to chip communications might include busses such as I2C, SPI or UART peripherals. The Upstream connector board features an IDC compatible header allowing for ribbon cables to be used to connect the boards together using simple push fit connections. The board also features a patch section allowing data pins to be re-wired through to other data pins. For example when connecting a UART to a UART the TX pin from one upstream board connects to the RX pin of the other upstream board and visa versa.



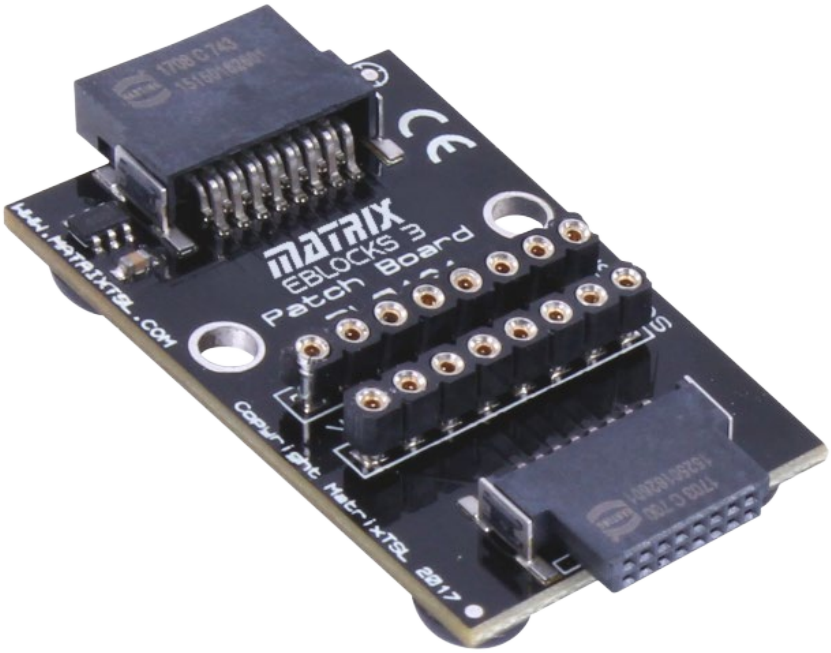
BL0158 - Board Schematic



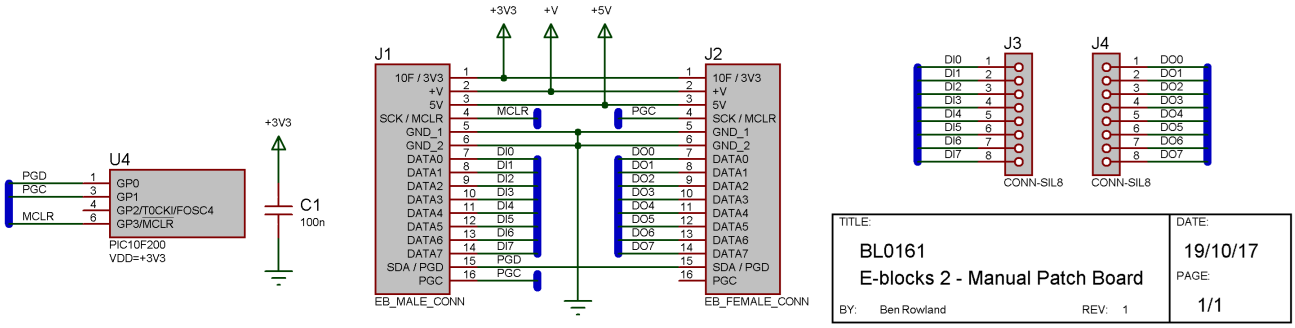
DOWNSTREAM BOARDS

BL0161 - Manual Patch Board

The patch board allows the various data signals to be re-ordered between upstream and downstream boards. This is useful for upstream processors with peripherals using none standard connections or for combining signals together from multiple ports. The patch board comes complete with six Dupont style male to male cables allowing you to easily assign the signals to your downstream board.



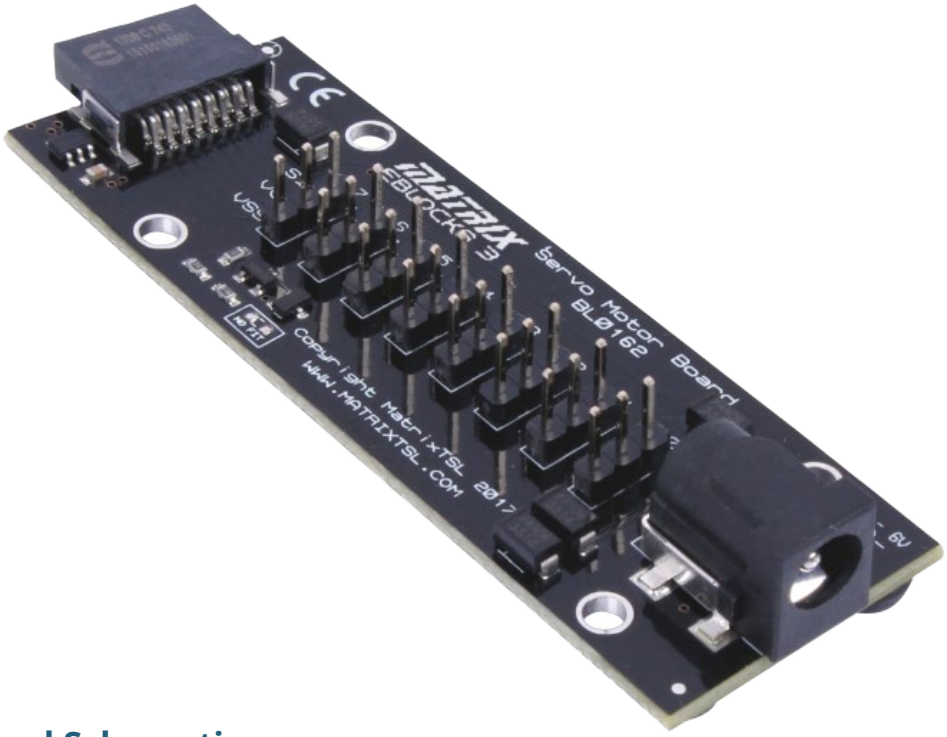
BL0161 - Board Schematic



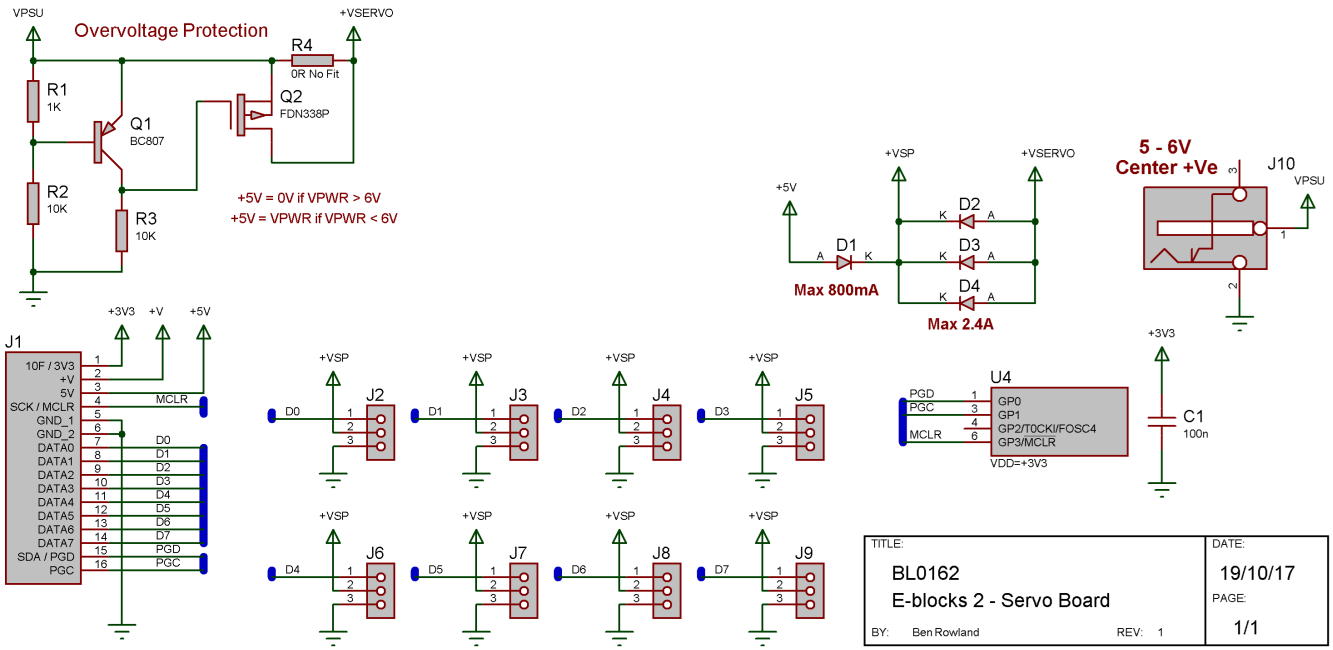
DOWNSTREAM BOARDS

BL0162 - Servo Motor Board

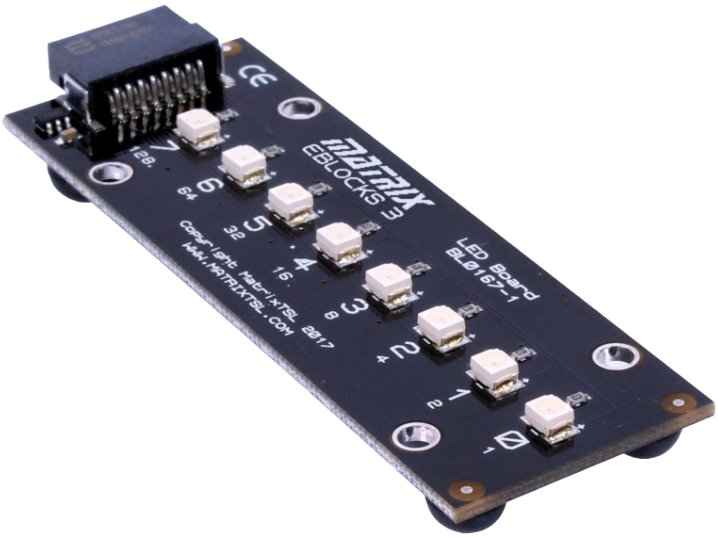
The servo motor board allows up to eight servo motors to be connected to an EBlocks 3 system. Up to eight channels can be individually controlled for connection to device such as servo motors or brushless electronic speed controllers. The board also provides a DC socket allowing the motors to be powered from an external DC power supply separate from the EBlocks 3 supply rails. Overvoltage protection is built onto the board stopping any voltages greater than 6V from being allowed to damage the connected motors.

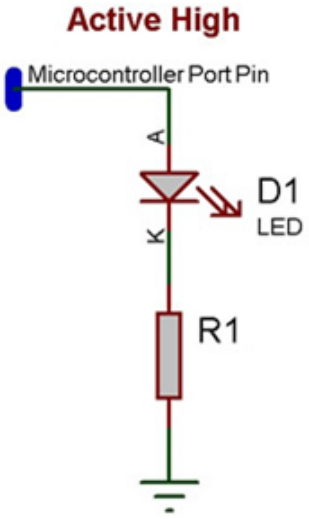


BL0162 - Board Schematic



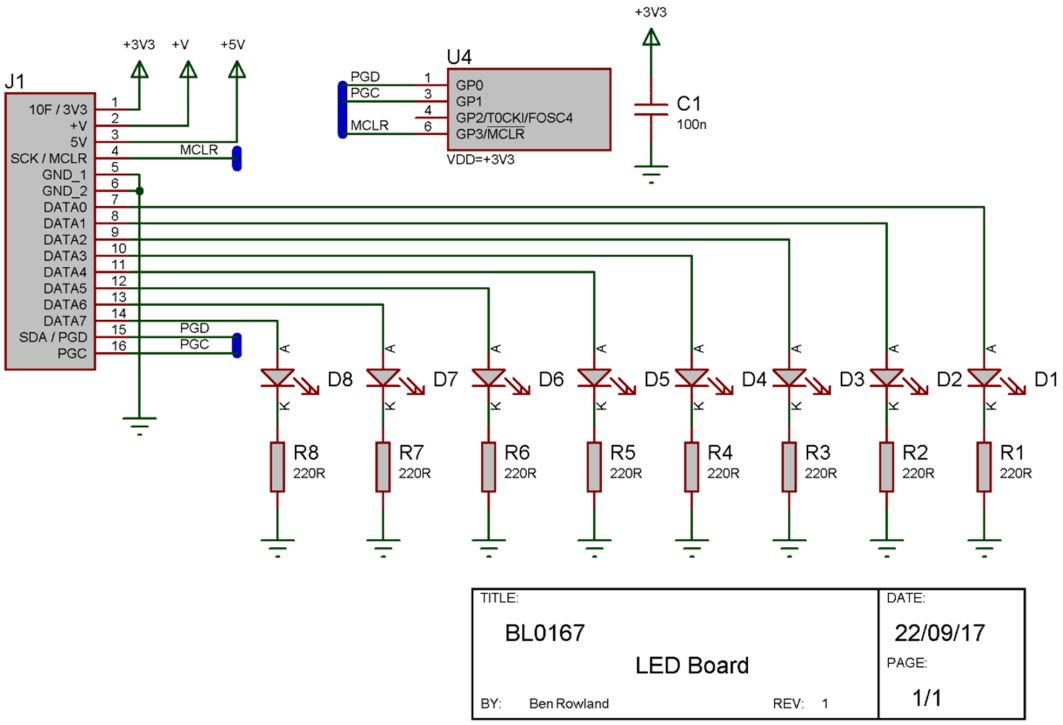
The LED board allows a bank of eight LED indicators to be added to the EBlocks 3 system. LEDs are useful tools as they allow you to indicate what is happening or the ongoing real time status of the system. LEDs can be driven in a digital way using on or off output states or an analogue way using pulse width modulation (PWM) techniques.





Each LED is in the active high configuration. When the EBlocks 3 port pin outputs a logic high the LED will light. When the port pin outputs a logic low or is in input mode the LED will be off. Each LEDs brightness level can be altered by switching the LED on and off at high speed (PWM).

BL0167 - Board Schematic

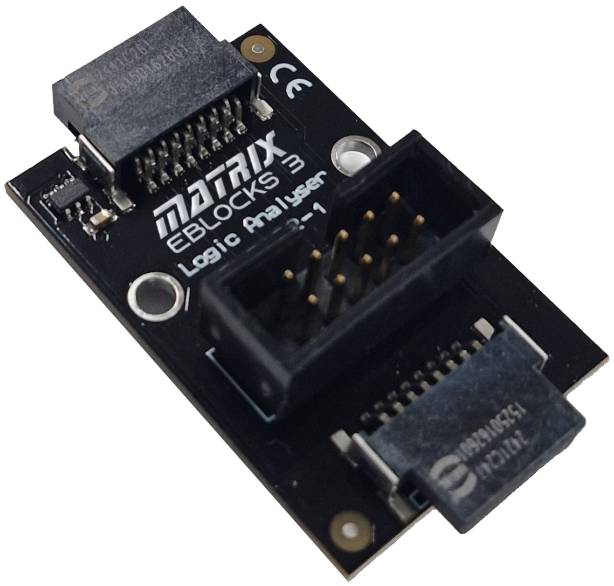


DOWNSTREAM BOARDS

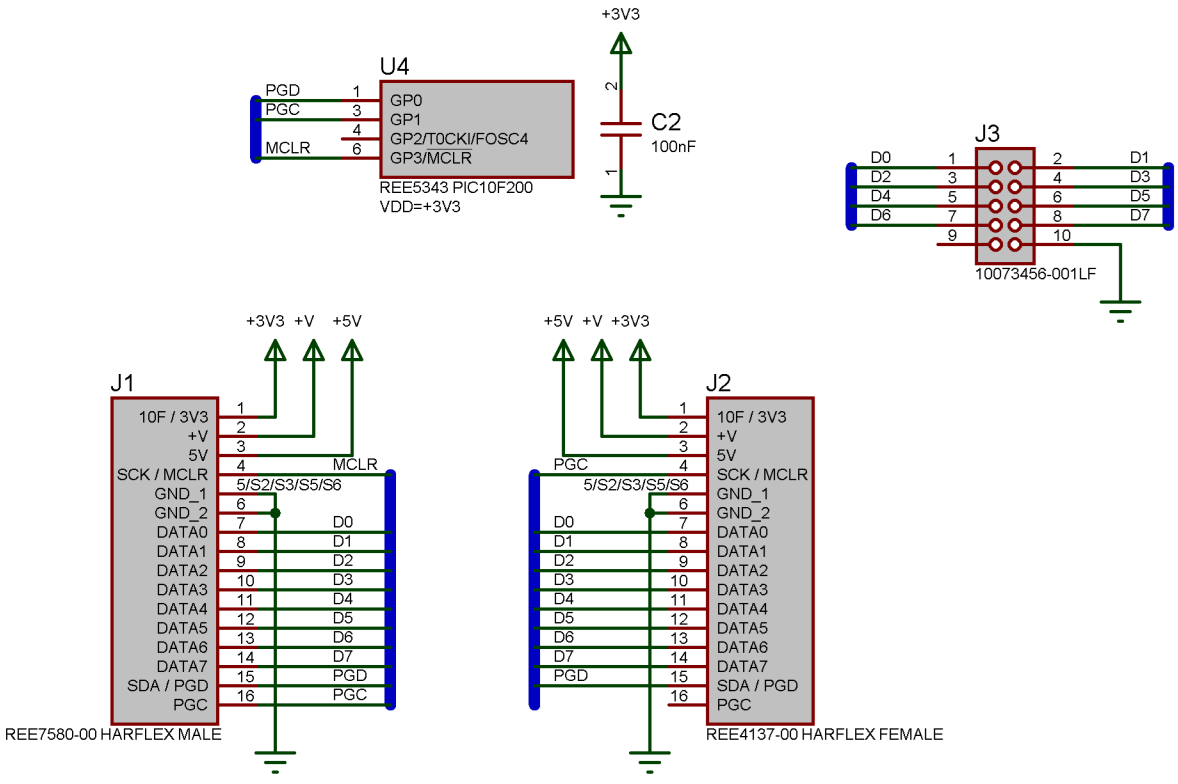
BL0172 - Logic Analyser Board

The logic analyser board houses a 24MHz 8 channel logic analyser which is wired in parallel with the pins on an EBlocks port. The board is fitted with male and female EBlocks connectors so that a further downstream EBlocks can be connected to it. The device connects to your computer using USB. Lead and analyser are included. The hardware is compatible with the Sigrok / Pulseview software. https://sigrok.org

Port Bit	Function
0	
1	
2	
3	
4	
5	
6	
7	



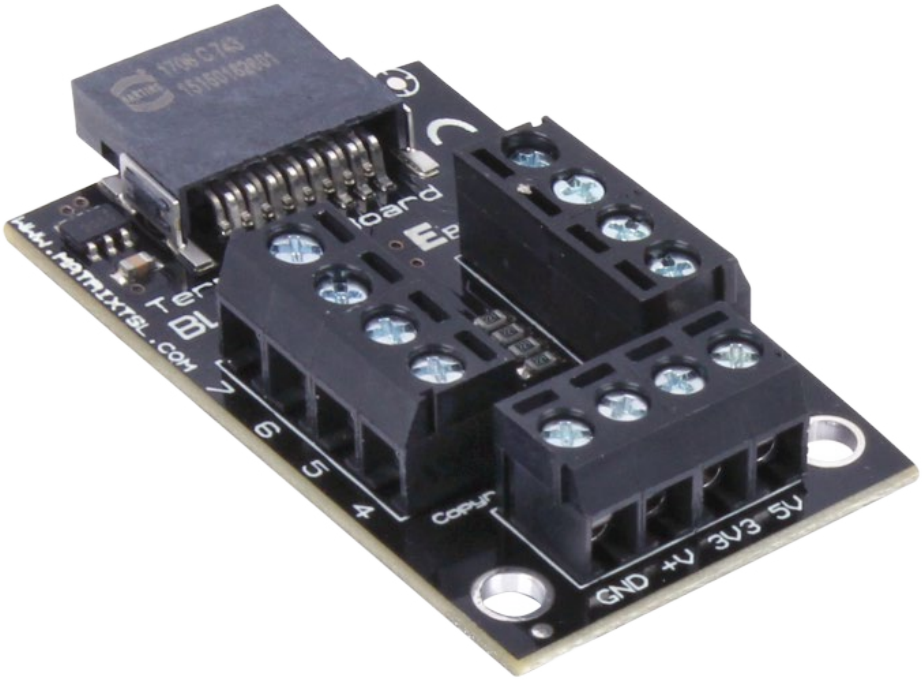
BL0172 - Board Schematic



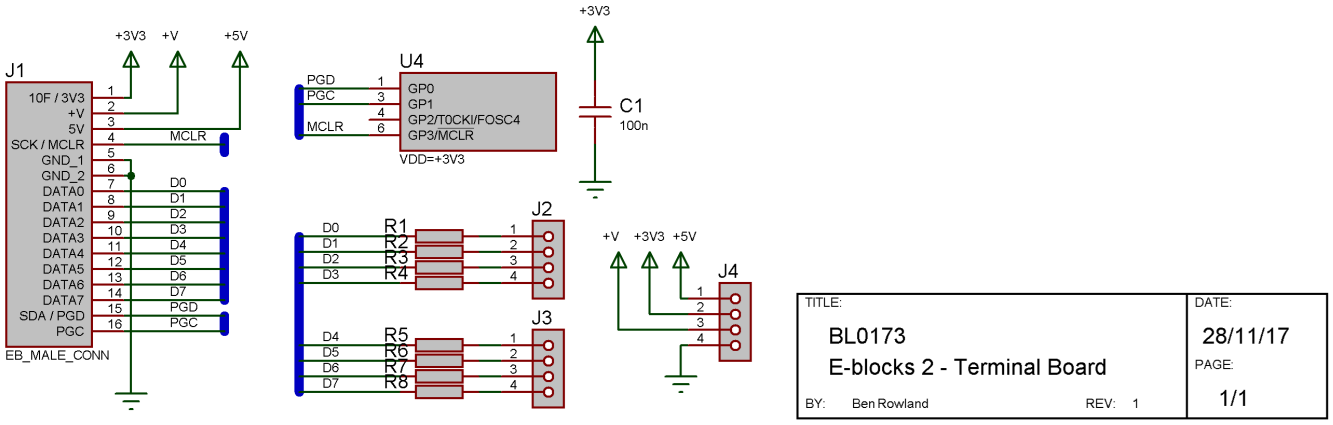
DOWNSTREAM BOARDS

BL0173 - Terminals Board

The terminals board provides screw terminals which can be used to directly connect wires to an EBlocks 3 system. Terminals are buffered by 220ohm resistors to provide protection for upstream boards. The various EBlocks 3 supply voltage rails are also available as screw terminals allowing you to power your external electronic devices.



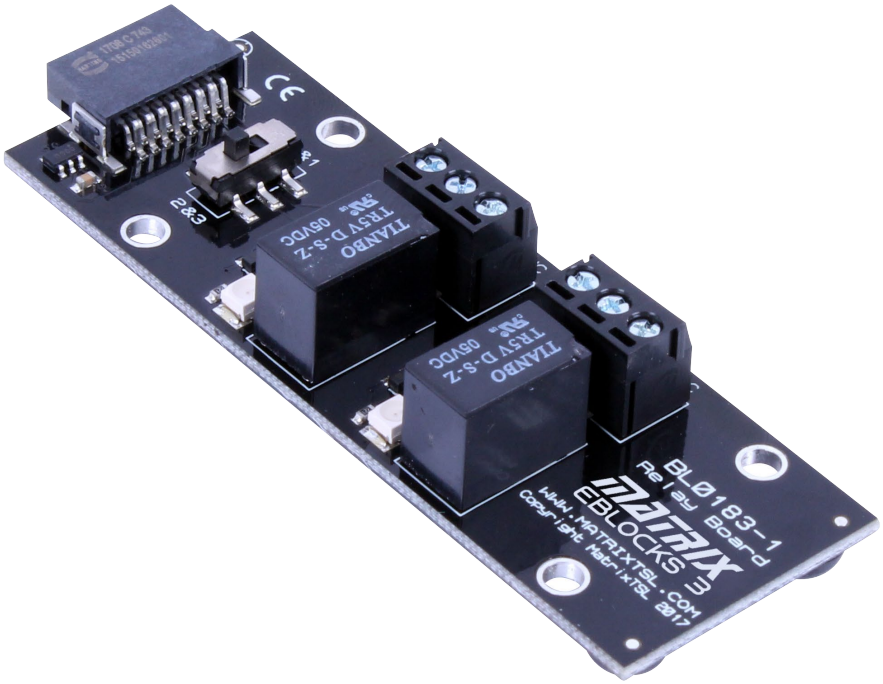
BL0173 - Board Schematic



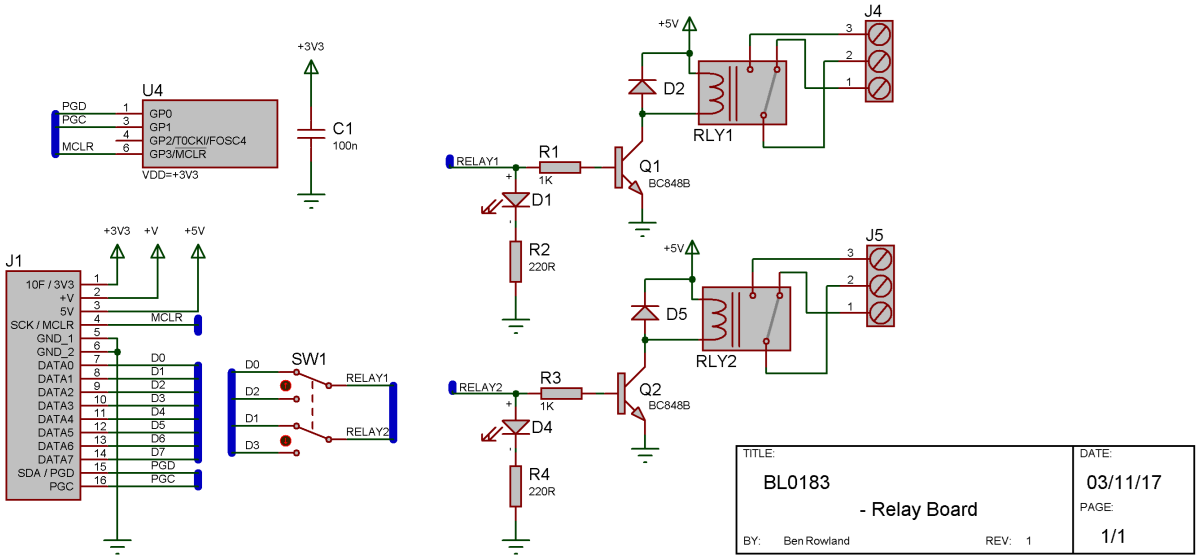
DOWNSTREAM BOARDS

BL0183 - Relay Board

The relay board provides two electrically controllable relays which act as isolated switches. The external connections to the relays are provided using screw terminals and both the normally open (NO) and normally closed (NC) connections are available allowing for the maximum flexibility. Each relay features an LED to indicate when the relay is active. Two relay boards can be used on the same EBlocks port by using a BL0156 Splitter board and setting the slide switch on each board to opposing positions. The relays are rated for use with Mains voltage but great care should be taken to avoid electrical shocks when using high voltage such as mains. We recommend to always use an inline RCD and to place the EBlocks boards into a rugged, insulated enclosure with clear danger warnings.



BL0183 - Board Schematic

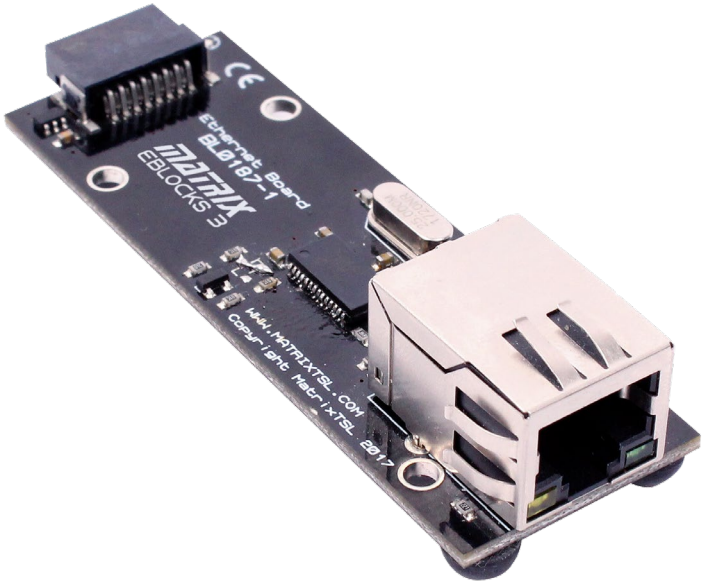


DOWNSTREAM BOARDS

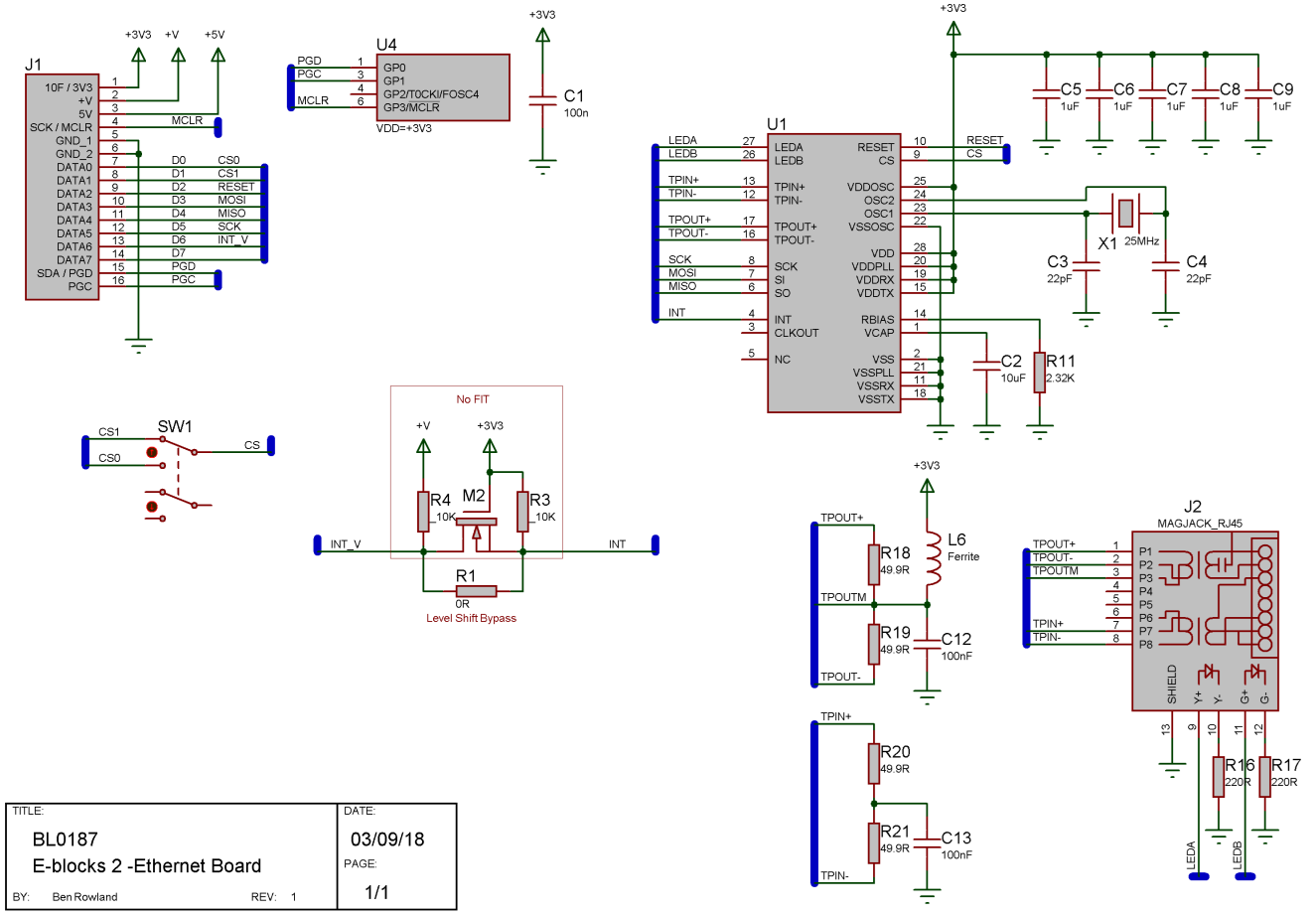
BL0187 - Ethernet Board

The Ethernet board provides a means of communicating via a standard RJ45 network cable with a router or network. It can be used for local network communications as well as internet based communications and IoT style applications. The board features a switch to allow two boards to be used together on the same EBlocks port using a splitter board for firewall type applications.

Port Bit	SPI Mode
0	CS0
1	CS1
2	Reset
3	MOSI
4	MISO
5	SCK
6	INT
7	



BL0187- Board Schematic

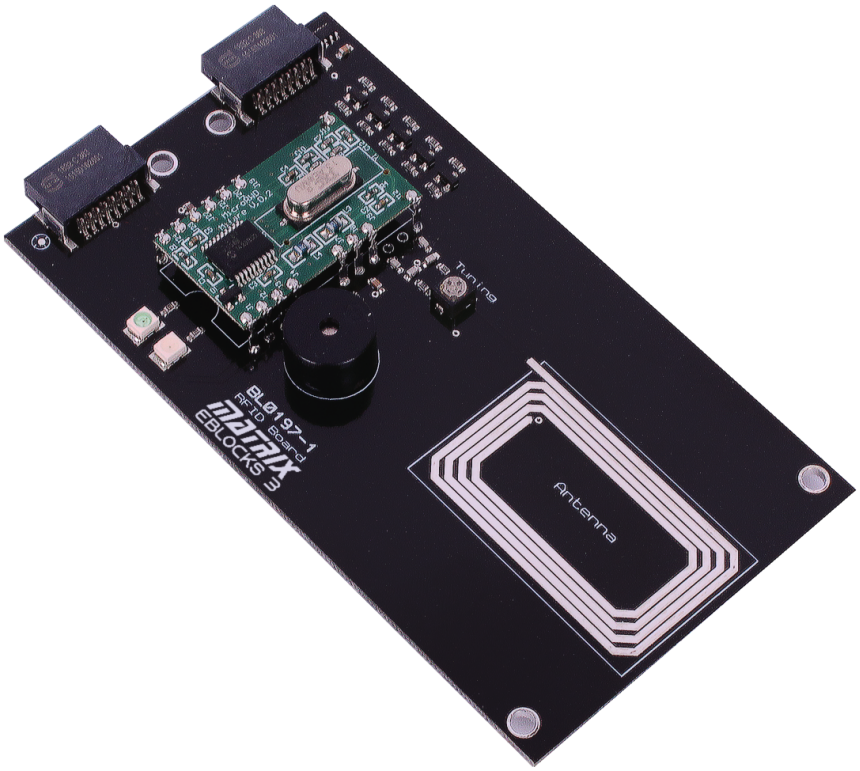


DOWNSTREAM BOARDS

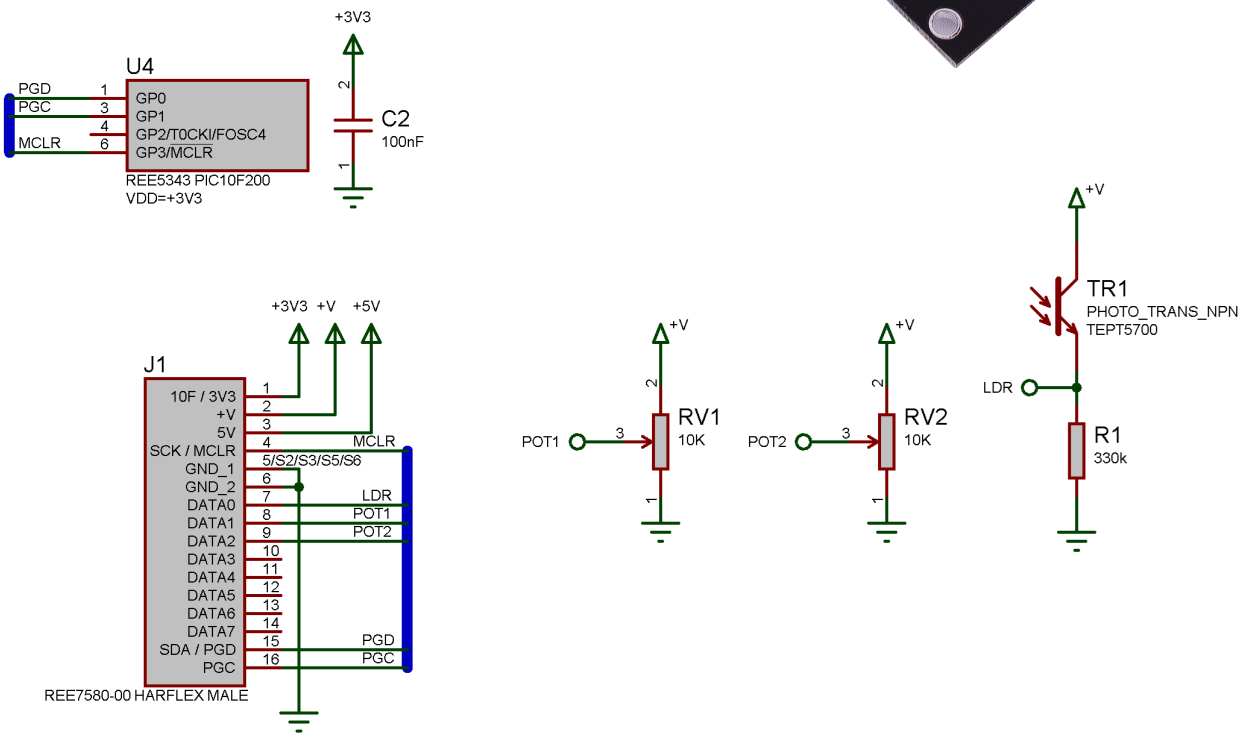
BL0197 - RFID Board

The RFID board provides a means of communicating with standard RFID type tags. The board supports MIFARE and ICODE type tags and features an on-board antenna complete with tuning capacitor. The board features a buzzer which can be programmed to beep on the presence of a RFID tag as well as signals back to the microcontroller to detect when a valid tag is present.

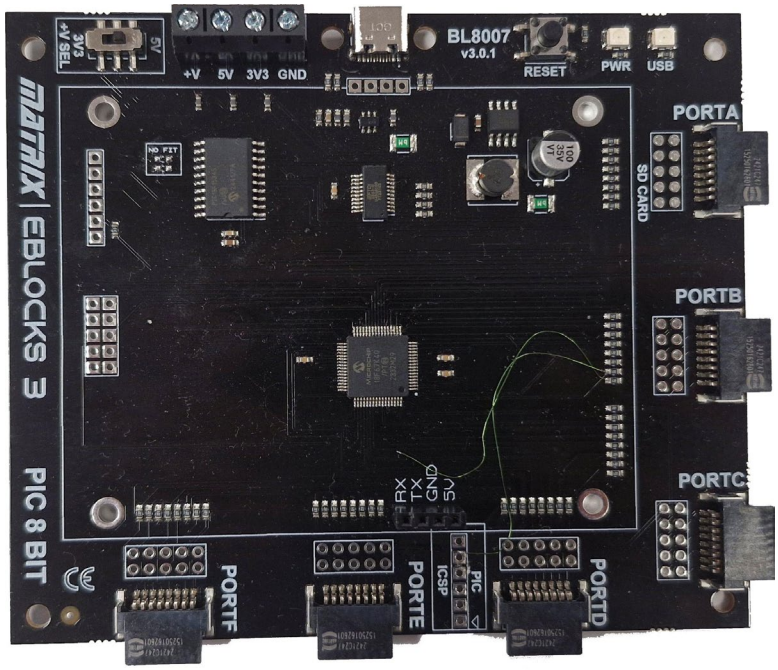
Port Bit	Function
0	uC RX / RFID TX
1	uC TX / RFID RX
2	Beep
3	LED
4	CTS
5	
6	
7	



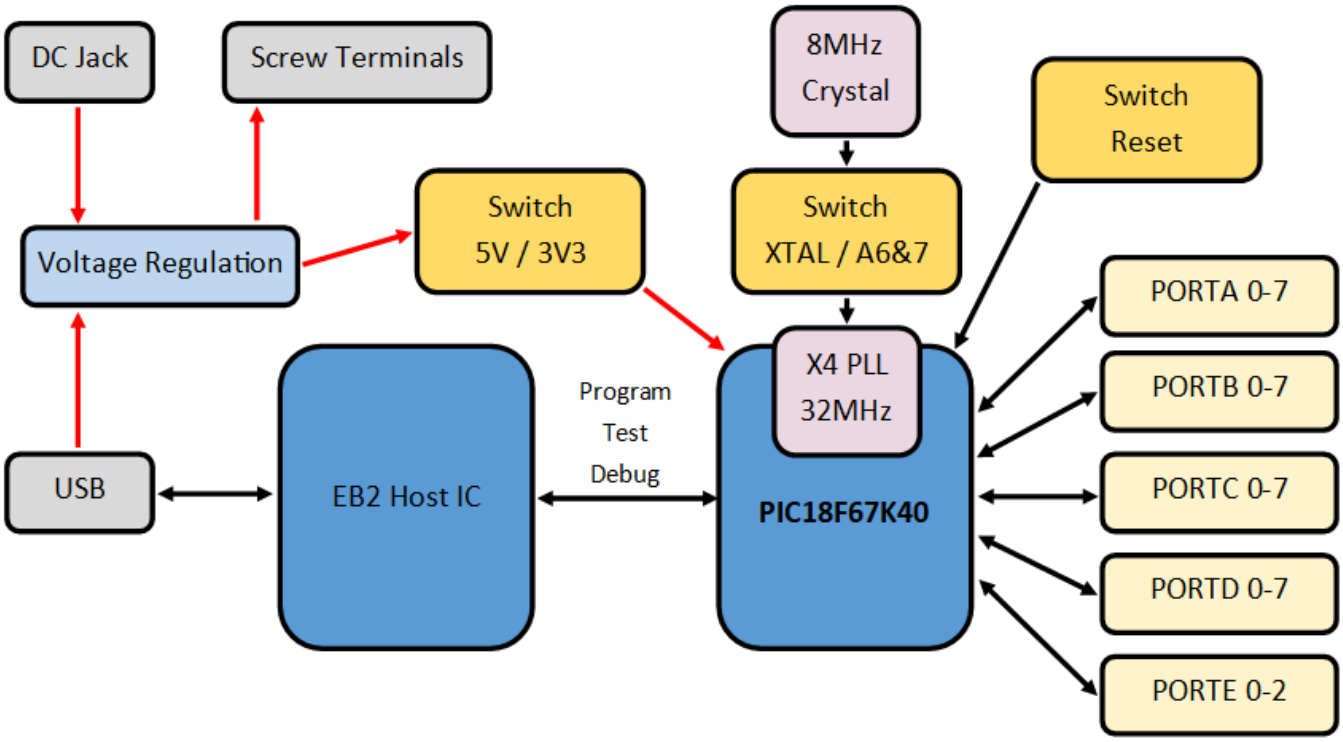
BL0197 - Board Schematic



The 8-bit PIC microcontroller programmer connects to your PC via USB to provide you with a powerful microcontroller programming and debugging platform. The board can be used with various programming languages including: Assembly, C and Flowcode.



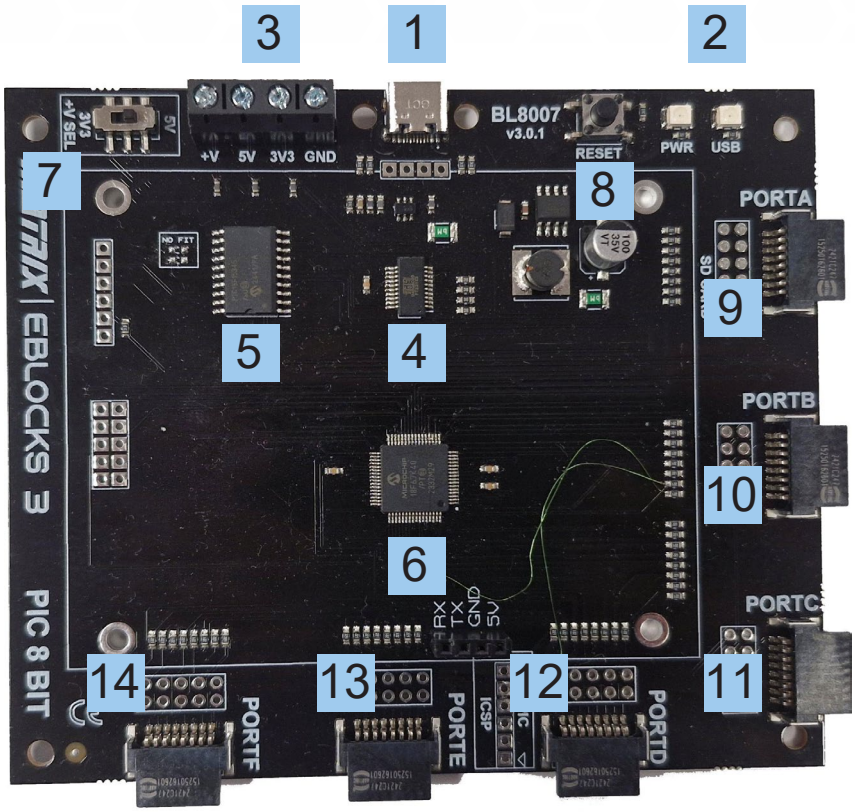
BL0082 - Block Diagram



UPSTREAM BOARDS

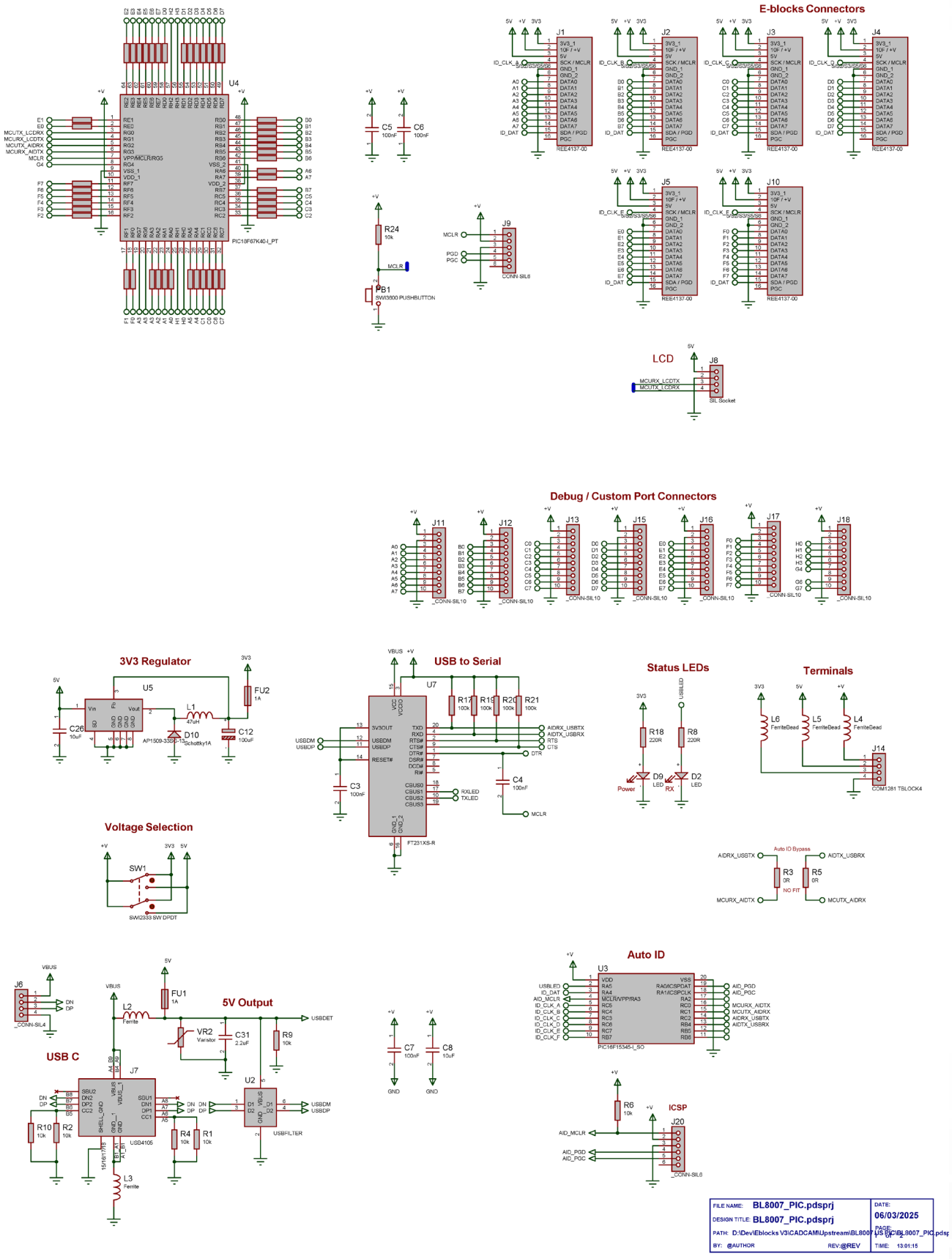
BL0082 - 8-Bit PIC Programmer

Board Layout



1. USB-C Socket
2. Status LEDs
3. Power Terminals
4. USB to Serial IC
5. Auto ID IC
6. Target Microcontroller 18F67K40
7. Voltage Selection Switch
8. Reset Switch
9. EB3 Port A Connector
10. EB3 Port B Connector
11. EB3 Port C Connector
12. EB3 Port D Connector
13. EB3 Port E Connector
14. EB3 Port F Connector

BL0082 - Block Diagram



UPSTREAM BOARDS

BL0082 - 8-Bit PIC Programmer

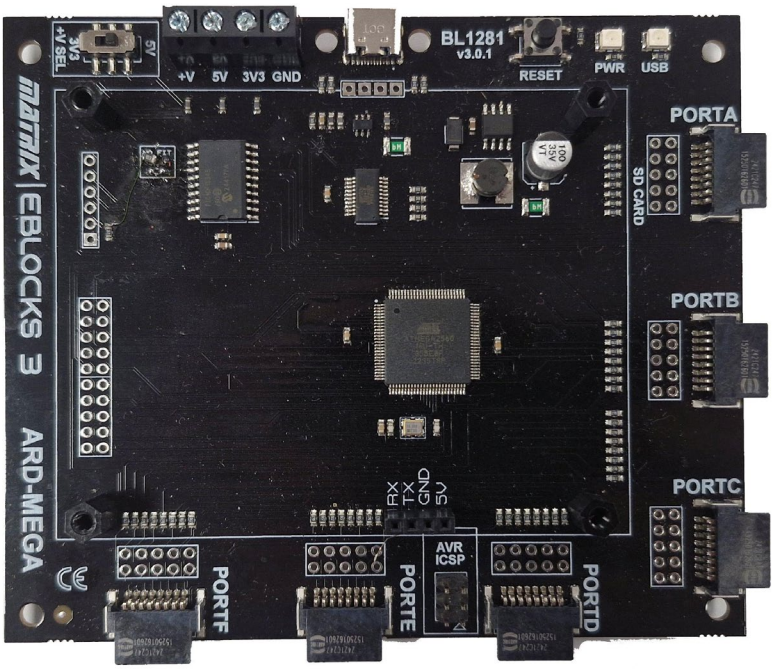
Pin Connections

PIC16F18877

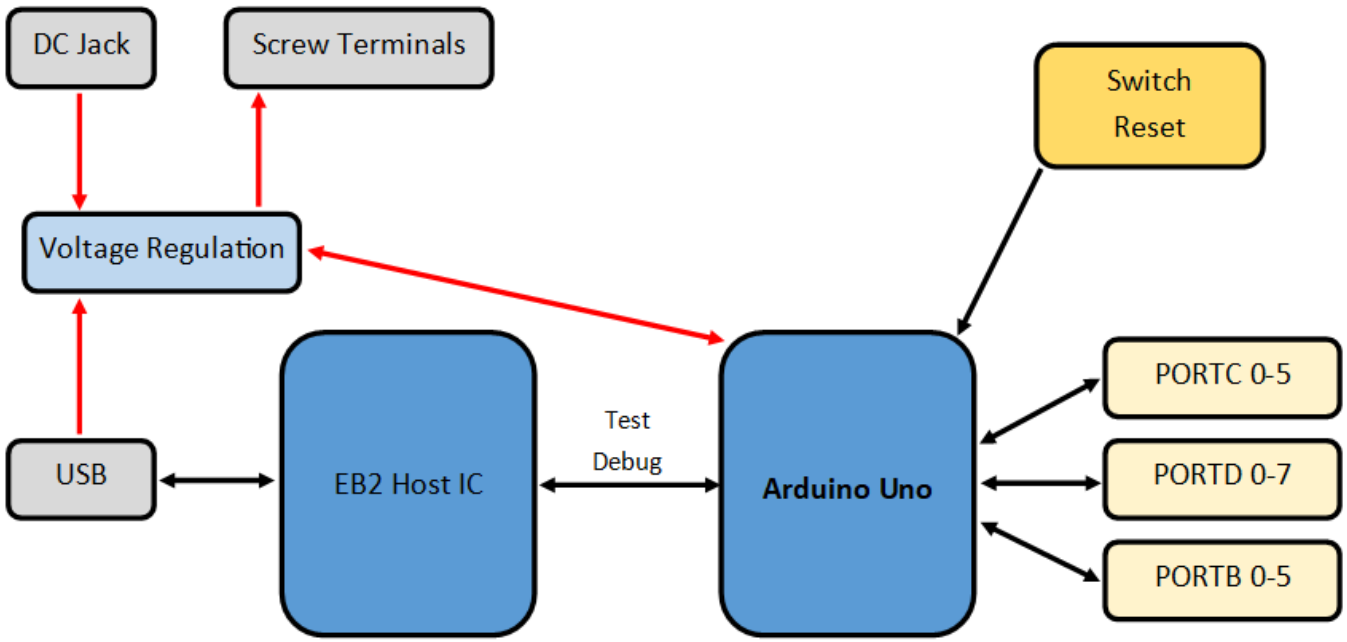
Pin no	Port	Bit	Power	GND	ADC	Osc	RESET	USART	SPI	I2C	INT	PCINT	PWM
1	E	3	VPP				!MCLR					IOCE3	
2	A	0			ANA0							IOCA0	
3	A	1			ANA1							IOCA1	
4	A	2			ANA2							IOCA2	
5	A	3			ANA3							IOCA3	
6	A	4			ANA4							IOCA4	CCP5
7	A	5			ANA5				SS1			IOCA5	
8	E	0			ANE0								
9	E	1			ANE1								
10	E	2			ANE2								
11			VDD										
12				VSS									
13	A	7			ANA7	OSC1/CLKIN						IOCA7	
14	A	6			ANA6	OSC2/CLKOUT						IOCA6	
15	C	0			ANC0	SOSCO							
16	C	1			ANC1	SOSCI						IOCC1	CCP2
17	C	2			ANC2							IOCC2	CCP1
18	C	3			ANC3				SCL1/SCK1			IOCC3	
19	D	0			AND0					SDA1/SDI1		IOCC4	
20	D	1			AND1							IOCC5	
21	D	2			AND2							IOCC6	
22	D	3			AND3							IOCC7	
23	C	4			ANC4								
24	C	5			ANC5								
25	C	6			ANC6			CK					
26	C	7			ANC7			RX/DT					
27	D	4			AND4								
28	D	5			AND5								
29	D	6			AND6								
30	D	7			AND7								
31				VSS									
32			VDD										
33	B	0			ANB0				SS2			IOCB0	CCP4
34	B	1			ANB1				SCLK2			IOCB1	
35	B	2			ANB2					SDA2		IOCB2	
36	B	3			ANB3							IOCB3	
37	B	4			ANB4							IOCB4	
38	B	5			ANB5							IOCB5	CCP3
39	B	6			ANB6	ICSPCLK						IOCB6	
40	B	7			ANB7	ICSPDAT						IOCB7	

The PIC16F18877 is an 8 bit device from Microchip.
The table above shows you a summary of the devices capability.
Pin no: the pin of the device
Port: This is an 8 bit device. I/O is split into 8 bit ports. This is also the EBlocks connection.
Bit: shows the bit number on the port.
Power / GND: shows the programming (VPP), power and ground connections.
ADC: shows the internal ADC on each pin.
Xtal: shows the crystal connections. We are using a 64MHz internal oscillator and there is no crystal on the board.
OSC: shows optional Oscillator pins - not used.
RESET!: shows the reset pin .
USART /SPI / I2C: Shows the default communications pins. On this device the comms peripherals are internally remappable to any of the shaded pins.
INT: shows interrupt pins
PCINT: shows the Pin Change INTerrupt pins.
PWM: shows the default Capture/Compare/PWM pins. On this device the comms peripherals are internally remappable to any of the shaded pins.

The Arduino Uno Shield connects to your PC via USB to provide you with a powerful microcontroller programming and debugging platform. The board can be used with various programming languages including: Assembly, C, Arduino IDE and Flowcode. To program the Arduino on the board a free tool called mLoader is available to download from the Matrix TSL website. The board presents all port pins collected together as EBlocks 3 sockets. The board takes power from an external power supply or from the micro USB port. Using the board with Flowcode allows the use of the advanced Ghost debugging features including in circuit debugging, real time pin monitoring and bus decoding. Microchip AVR-ISP compatible sockets are fitted to provide an alternative reprogramming and debugging techniques.



BL0040 - Block Diagram

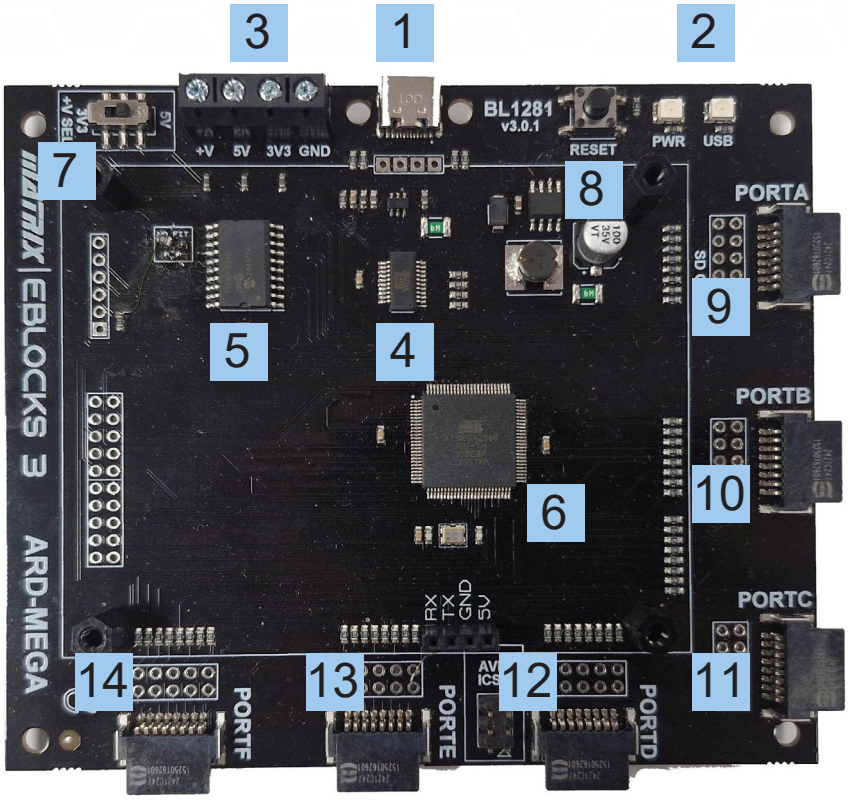


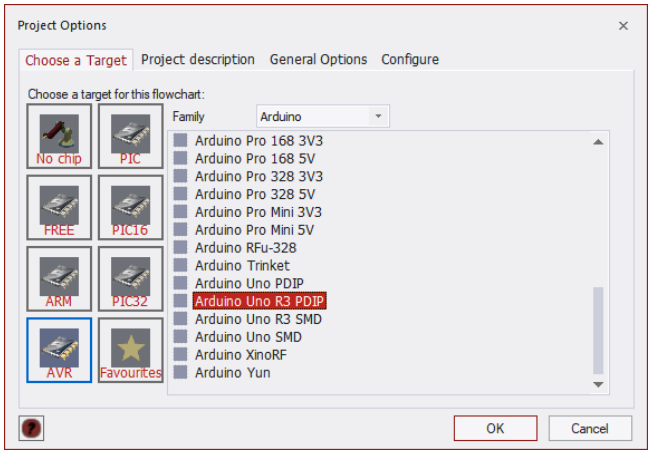
UPSTREAM BOARDS

BL0040 - ArdMega AVR Programmer

Board Layout

1. USB-C Socket
2. Status LEDs
3. Power Terminals
4. USB to Serial IC
5. Auto ID IC
6. Target Microcontroller ATMEGA2560
7. Voltage Selection Switch
8. Reset Switch
9. EB3 Port A Connector
10. EB3 Port B Connector
11. EB3 Port C Connector
12. EB3 Port D Connector
13. EB3 Port E Connector
14. EB3 Port F Connector



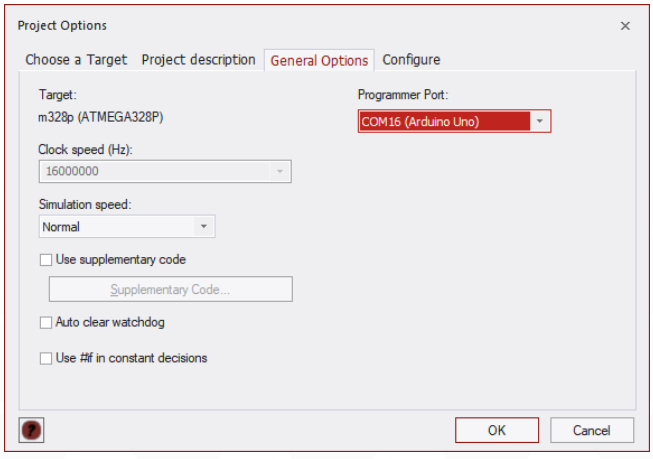


Flowcode Compatibility

When selecting a target device in Flowcode choose the device that matches your Arduino board.

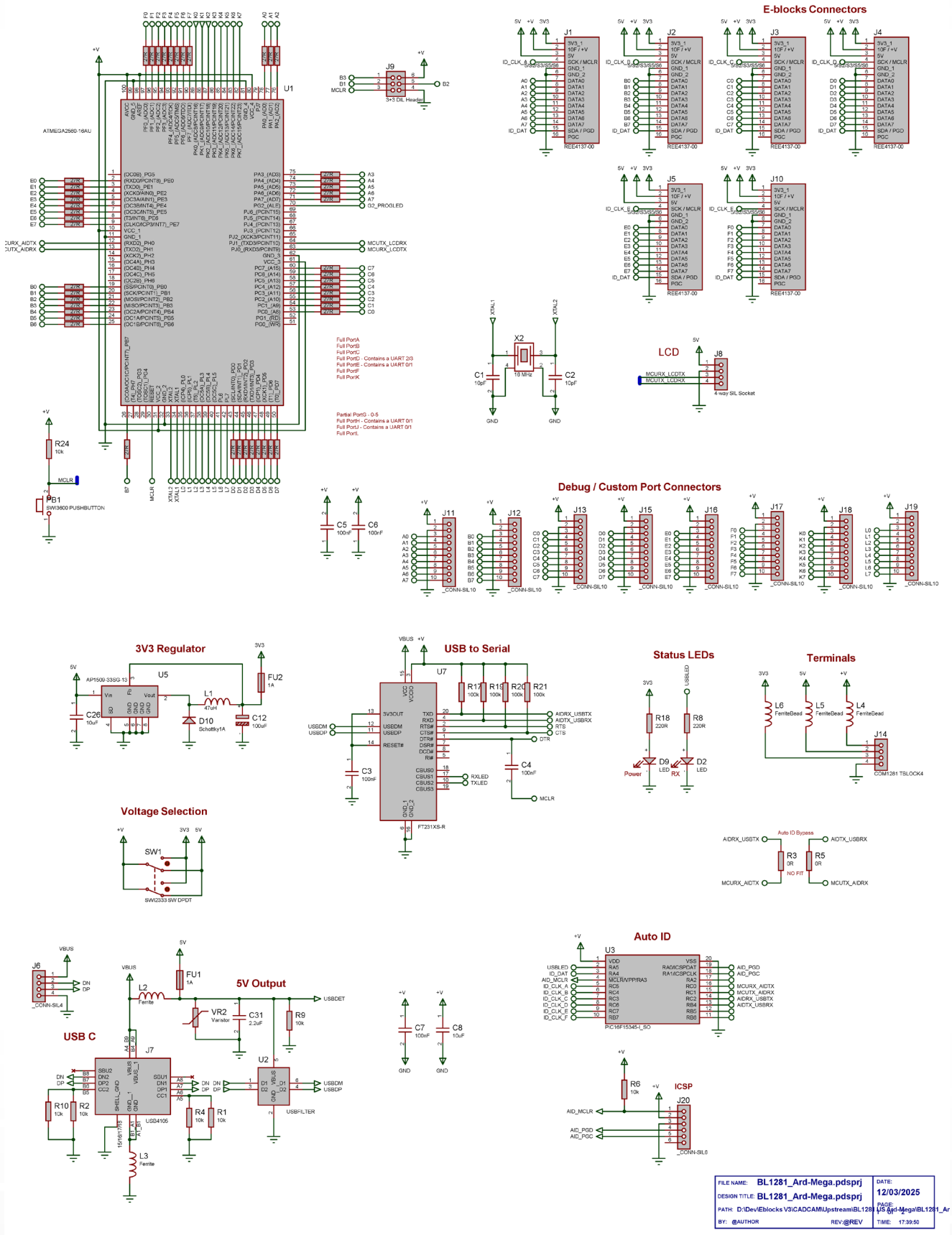
For example:
AVR -> Arduino -> Arduino Uno R3 PDIP

In the General Options tab select the correct COM port for the Arduino device. If no COM port is available then check your Arduino device is connected to the USB and that the USB driver is correctly installed.



Please note the Arduino needs to be connected to the USB to allow it to be re-programmed. The EBlocks need to be connected to the USB to allow Ghost (ICD/ICT) features. Both USB connections will provide power to the ports. Alternatively, an external power supply from 6V to 9V DC can be used.

BL0040 - Block Diagram



UPSTREAM BOARDS

BL0040 - ArdMega AVR Programmer

Pin Connections

Arduino Mega														
Pin no	Port	Bit	Power	GND	Analog	Xtal	RESET	USART	SPI	I2C	INT	PCINT	PWM	Arduino Ref.
1	G	5											PWM	D4
2	E	0						RXD0				PCINT8	PWM	D0
3	E	1						TXD0					PWM	D1
4	E	2												
5	E	3												D5
6	E	4									INT4		PWM	D2
7	E	5									INT5		PWM	D3
8	E	6									INT6			
9	E	7									INT7			
10			VCC											VCC
11				GND										GND
12	H	0						RXD2						D17
13	H	1						TXD2						D16
14	H	2												
15	H	3											PWM	D6
16	H	4											PWM	D7
17	H	5											PWM	D8
18	H	6											PWM	D9
19	B	0							SS			PCINT0		D53
20	B	1							SCK			PCINT1		D52
21	B	2							MOSI			PCINT2		D51
22	B	3							MISO			PCINT3		D50
23	B	4										PCINT4	PWM	D10
24	B	5										PCINT5	PWM	D11
25	B	6										PCINT6	PWM	D12
26	B	7										PCINT7	PWM	D13
27	H	7												
28	G	3												
29	G	4												
30							!RESET							!RESET
31			VCC											VCC
32				GND										GND
33						XTAL1								XTAL1
34						XTAL2								XTAL2
35	L	0												D49
36	L	1												D48
37	L	2												D47
38	L	3												D46
39	L	4												D45
40	L	5												D44
41	L	6												D43
42	L	7												D42
43	D	0								SCL	INT0			D21
44	D	1								SDA	INT1			D20
45	D	2						RXD1			INT2			D19
46	D	3						TXD1			INT3			D18
47	D	4												
48	D	5												
49	D	6												
50	D	7												D38
51	G	0												
52	G	1												D40
53	C	7												D30
54	C	6												D31
55	C	5												D32
56	C	4												D33
57	C	3												D34
58	C	2												
59	C	1												D36
60	C	0												
61			VCC											VCC
62				GND										GND

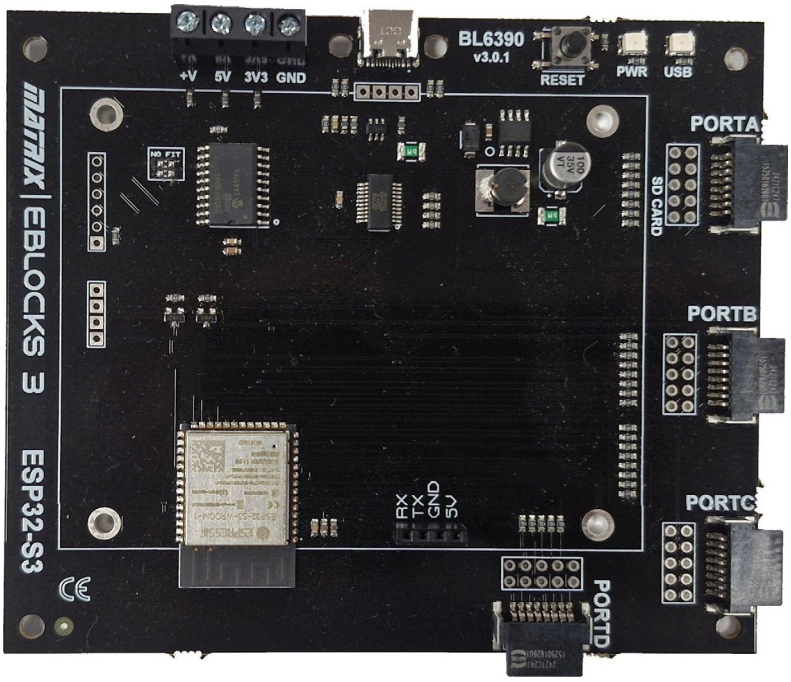
63	J	0						RXD3				PCINT9		D15
64	J	1						TXD3				PCINT10		D14
65	J	2										PCINT11		
66	J	3										PCINT12		
67	J	4										PCINT13		
68	J	5										PCINT14		
69	J	6										PCINT15		
70	G	2												
71	A	7												D29
72	A	6												D28
73	A	5												D27
74	A	4												D26
75	A	3												D25
76	A	2												D24
77	A	1												D23
78	A	0												D22
79	J	7												
80			VCC											VCC
81				GND										GND
82	K	7			ADC15							PCINT23		A15
83	K	6			ADC14							PCINT22		A14
84	K	5			ADC13							PCINT21		A13
85	K	4			ADC12							PCINT20		A12
86	K	3			ADC11							PCINT19		A11
87	K	2			ADC10							PCINT18		A10
88	K	1			ADC9							PCINT17		A9
89	K	0			ADC8							PCINT16		A8
90	F	7			ADC7				TDI					A7
91	F	6			ADC6				TDO					A6
92	F	5			ADC5				TMS					A5
93	F	4			ADC4				TCK					A4
94	F	3			ADC3									A3
95	F	2			ADC2									A2
96	F	1			ADC1									A1
97	F	0			ADC0									A0
98					AREF									
99				GND										GND
100			AVCC											AVCC

The ArdMega is an 8 bit device from Microchip.
The table above shows you a summary of the devices capability.
Pin no: the pin of the device
Port: This is an 8 bit device. I/O is split into 8 bit ports. This is also the EBlocks connection.
Bit: shows the bit number on the port.
Power / GND: shows the programming (VPP), power and ground connections.
ADC: shows the internal ADC on each pin.
Xtal: shows the crystal connections. We are using a 16MHz internal oscillator and there is no crystal on the board.
RESET!: shows the reset pin .
USART: Shows the RX TX pins. 4 USARTS on this device.
SPI: shows the SPI pins. 2 ports on this device.
I2C: shows the I2C pins. 1 port on this device.
INT: shows INTerrupt pins.
PCINT: shows the Pin Change INTerrupt pins.
PWM: shows the PWM pins.

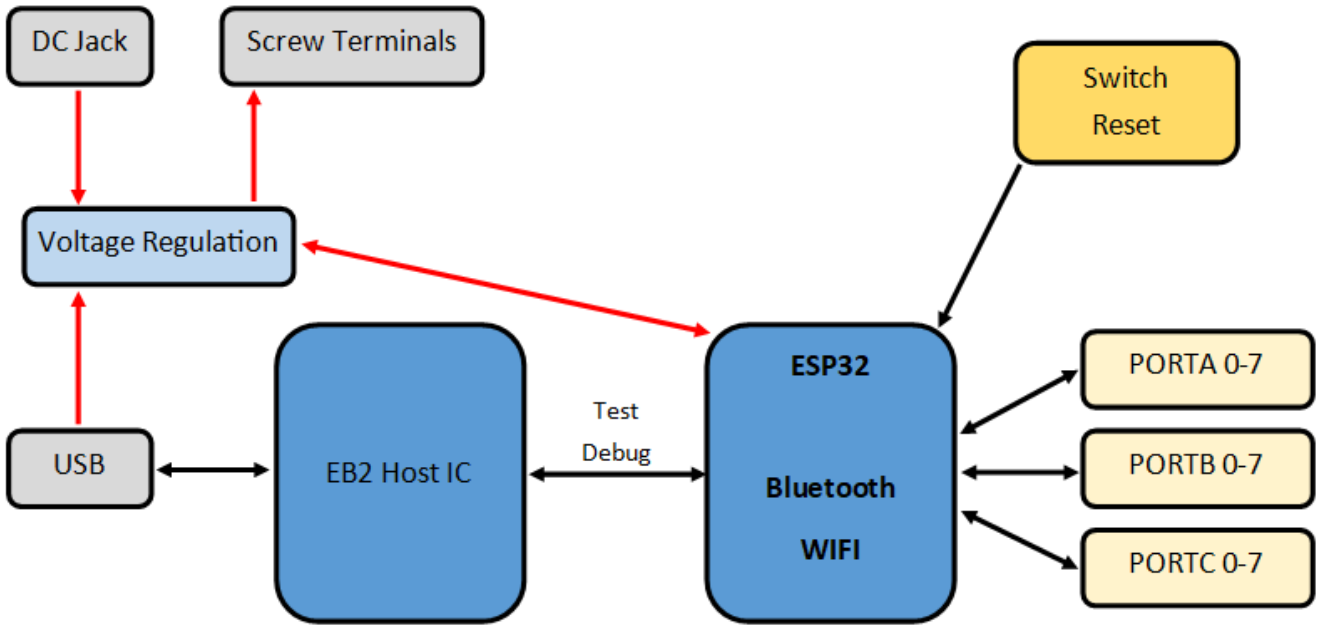
UPSTREAM BOARDS

BL0070 - ESP32S3 Programmer

The ESP32 Programmer board connects to your PC via USB to provide you with a powerful microcontroller programming and debugging platform. The board features a powerful dual core 32-bit microcontroller running at 240MHz and features built in Bluetooth and WIFI communications. The board can be used with various programming languages including: Assembly, C, Arduino IDE and Flowcode. To program the ESP32 on the board a free serial tool is available to download as part of the Arduino or Flowcode toolchains. The board presents all port pins collected together as EBlocks 3 sockets. The board takes power from an external power supply or from the micro USB port. Using the board with Flowcode allows the use of the advanced Ghost debugging features including in circuit debugging, real time pin monitoring and bus decoding.



BL0070 - Block Diagram

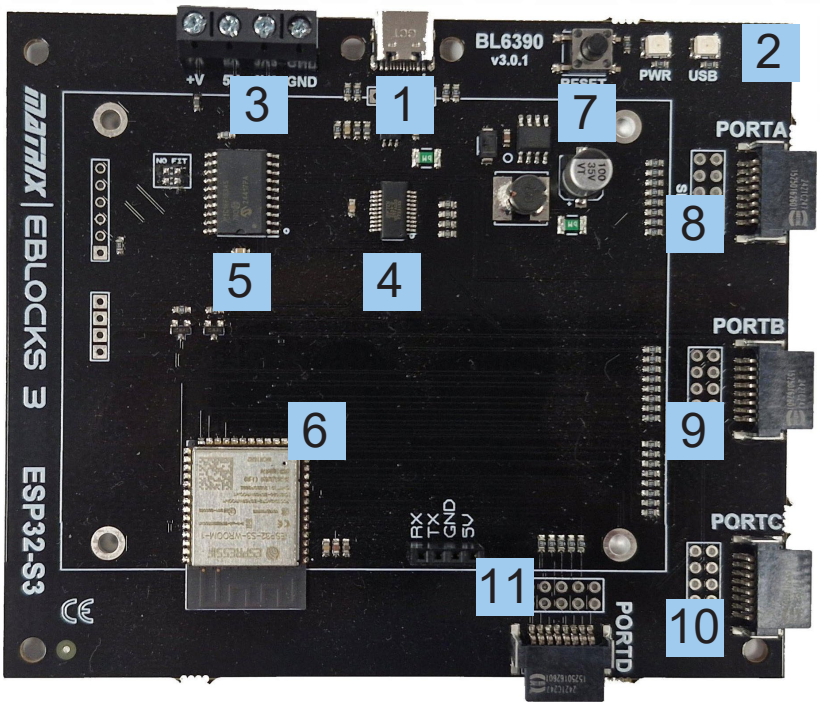


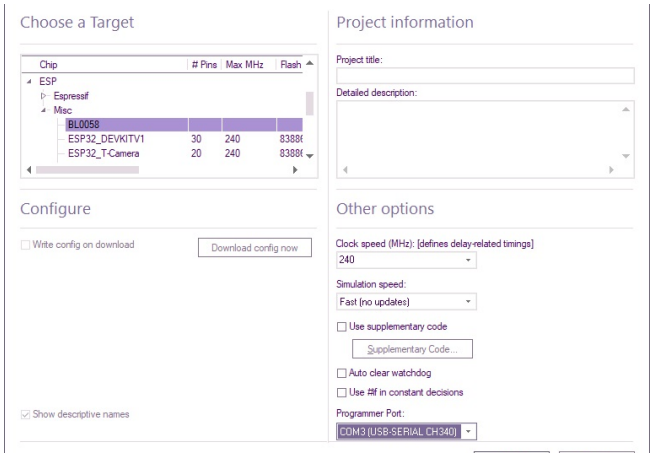
UPSTREAM BOARDS

BL0070 - ESP32S3 Programmer

Board Layout

1. USB-C Socket
2. Status LEDs
3. Power Terminals
4. USB to Serial IC
5. Auto ID IC
6. Target Microcontroller ESP32S3
7. Reset Switch
8. EB3 Port A Connector
9. EB3 Port B Connector
10. EB3 Port C Connector
11. EB3 Port D Connector





Flowcode Compatibility

When selecting a target device in Flowcode choose:
ESP32 -> Misc -> BL0058.

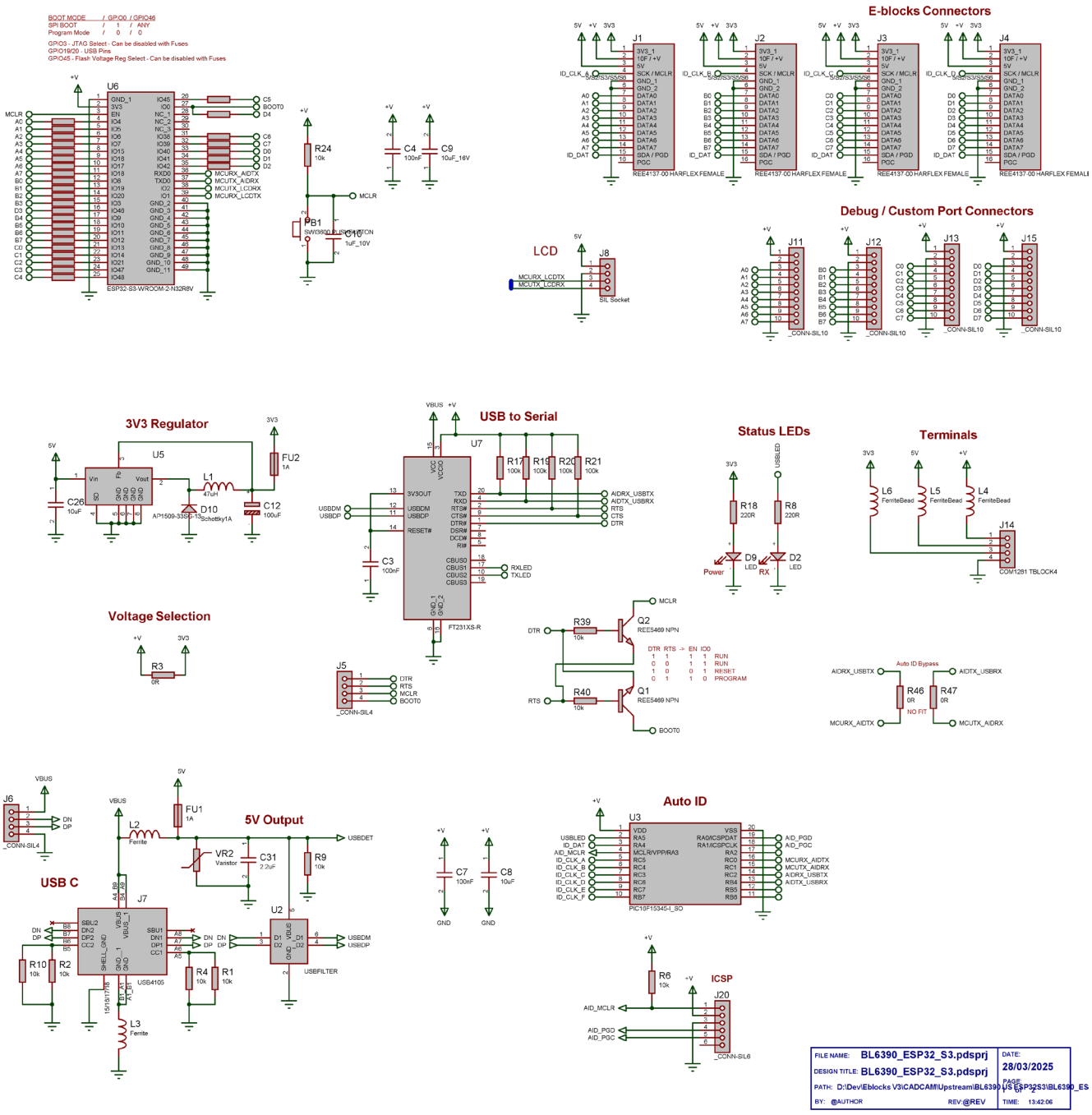
In the General Options tab select the correct COM port for the ESP32 device. If no COM port is available then check your ESP32 device is connected to the USB and that the USB driver is correctly installed.

Please note the ESP needs to be connected to the USB to allow it to be re-programmed. The EBlocks need to be connected to the USB to allow Ghost (ICD/ICT) features. Both USB connections will provide power to the ports. Alternatively, an external power supply from 6V to 9V DC can be used.

UPSTREAM BOARDS

BL0070 - ESP32S3 Programmer

BL6390 - Block Diagram



Pin Connections

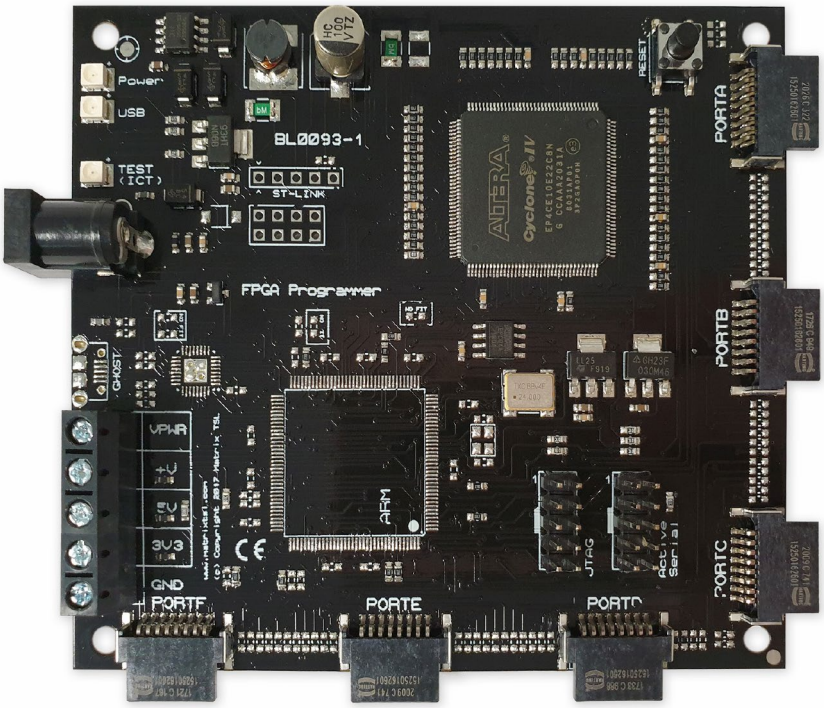
ESP32 S3 Wroom												
Pin no	Port	Bit	Power	GND	ADC	RESET	USART	SPI	I2C	INT	PWM	Mfr. Ref.
1				GND								
2			3V3									
3						EN						
4	A	0			ADC1-3		✓	✓	✓	✓	✓	GPIO4
5	A	1			ADC1-4		✓	✓	✓	✓	✓	GPIO5
6	A	2			ADC1-5		✓	✓	✓	✓	✓	GPIO6
7	A	3			ADC1-6		✓	✓	✓	✓	✓	GPIO7
8	A	4			ADC2-4		✓	✓	✓	✓	✓	GPIO15
9	A	5			ADC2-5		✓	✓	✓	✓	✓	GPIO16
10	A	6			ADC2-6		✓	✓	✓	✓	✓	GPIO17
11	A	7			ADC2-7		✓	✓	✓	✓	✓	GPIO18
12	B	0			ADC1-7		✓	✓	✓	✓	✓	GPIO8
13	B	1			ADC1-8		✓	✓	✓	✓	✓	GPIO19
14	B	2			ADC1-9		✓	✓	✓	✓	✓	GPIO20
15	B	3			ADC1-2		✓	✓	✓	✓	✓	GPIO3
16	D	3					✓	✓	✓	✓	✓	GPIO46
17	B	4			ADC1-8		✓	✓	✓	✓	✓	GPIO9
18	B	5			ADC1-9		✓	✓	✓	✓	✓	GPIO10
19	B	6			ADC2-0		✓	✓	✓	✓	✓	GPIO11
20	B	7			ADC2-1		✓	✓	✓	✓	✓	GPIO12
21	C	0			ADC2-2		✓	✓	✓	✓	✓	GPIO13
22	C	1			ADC2-3		✓	✓	✓	✓	✓	GPIO14
23	C	2					✓	✓	✓	✓	✓	GPIO21
24	C	3					✓	✓	✓	✓	✓	GPIO48
25	C	4					✓	✓	✓	✓	✓	GPIO48
26	C	5					✓	✓	✓	✓	✓	GPIO45
27	D	4					✓	✓	✓	✓	✓	GPIO0
28												NC_1
29												NC_2
30												NC_3
31	C	6					✓	✓	✓	✓	✓	GPIO38
32	C	7					✓	✓	✓	✓	✓	GPIO39
33	D	0					✓	✓	✓	✓	✓	GPIO40
34	D	1					✓	✓	✓	✓	✓	GPIO41
35	D	2					✓	✓	✓	✓	✓	GPIO42
36							RXD USB					GPIO44
37							TXD USB					GPIO43
38							TXD gLCD					GPIO2
39							RXD gLCD					GPIO1
40				GND								

The ESP32 S3 Wroom is a 32 bit device from Espressif. It includes Wi-fi and Bluetooth. The table above shows you a summary of the device's capability.
Pin no: the pin of the device
Port: This is an 32 bit device. I/O is split into 8 bit ports. This is also the EBlocks connection.
Bit: shows the bit number on the port.
Power / GND: shows the programming (VPP), power and ground connections.
ADC: shows the internal ADC on each pin.
Xtal: shows the crystal connections. We are using a 64MHz internal oscillator and there is no crystal on the board.
OSC: shows optional Oscillator pins - not used.
EN: shows the reset pin.
USART /SPI / I2C: Shows the default communications pins. On this device the comms peripherals are internally remappable to any of the shaded pins.
INT: shows interrupt pins
PCINT: shows the Pin Change INTerrupt pins.
PWM: shows the default Capture/Compare/PWM pins. On this device the comms peripherals are internally remappable to any of the shaded pins.

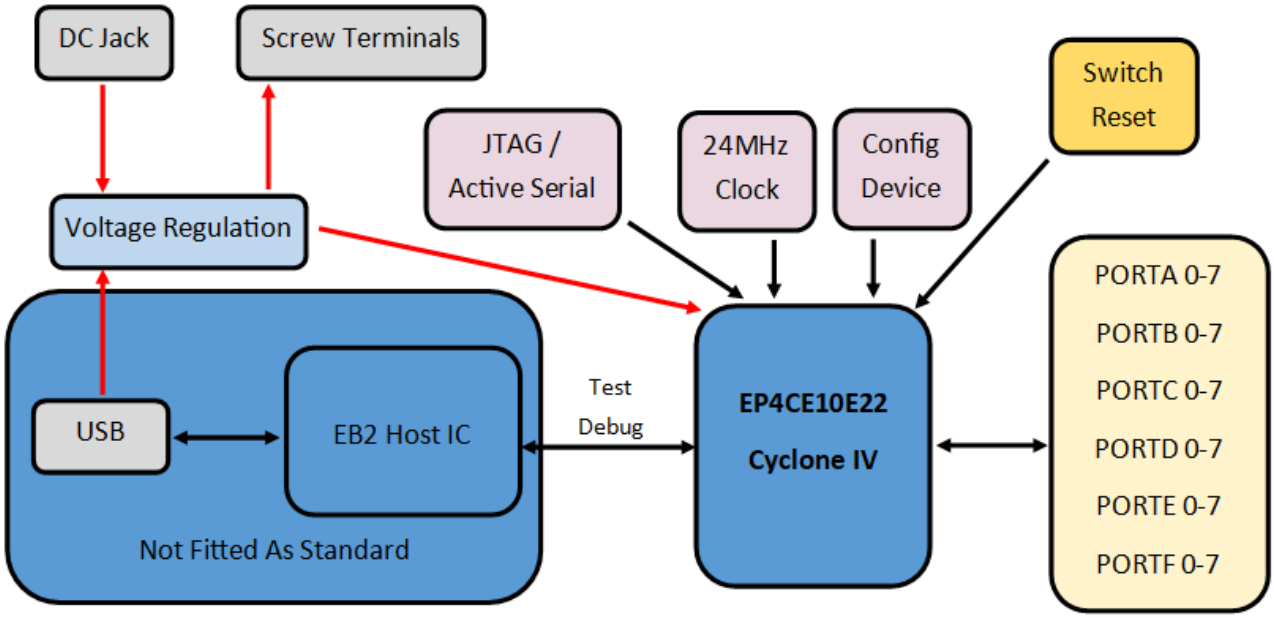
UPSTREAM BOARDS

BL0093 - FPGA Programmer

The FPGA EBlocks 3 board combines the speed and power of the Altera Cyclone IV series FPGA devices with the simplicity of EBlocks to provide six full 8-bit EBlocks compatible I/O ports. The FPGA is programmed using Intel's Quartus software via a USB blaster cable from Terasic. The FPGA device used is a EP4CE10E22 which has 10320 macrocells and 414Kb of RAM. The board also features a 4MB configuration device allowing the FPGA to auto start with the users last program on power up or reset. Full course notes are available.



BL0093 Block Diagram

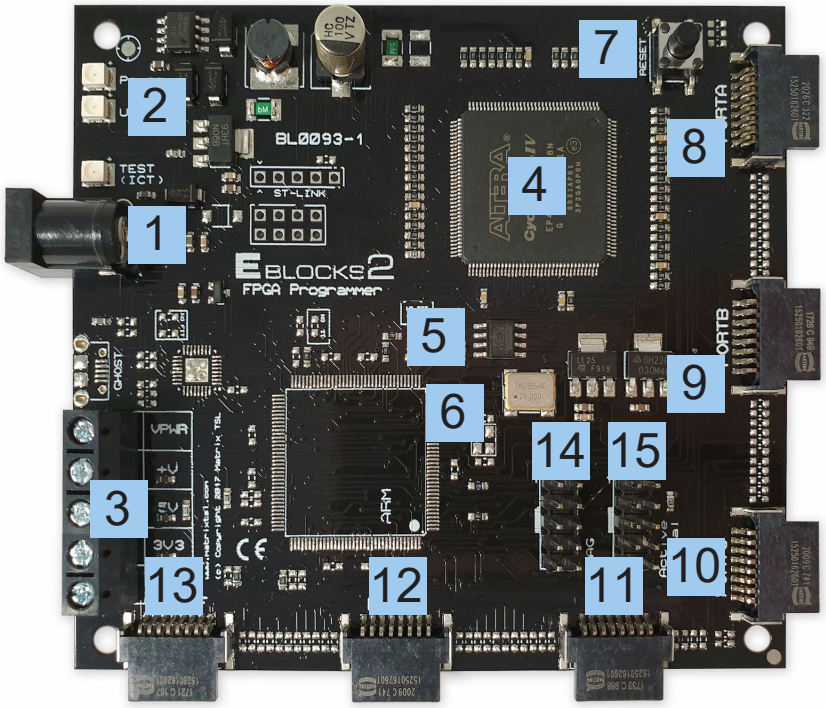


UPSTREAM BOARDS

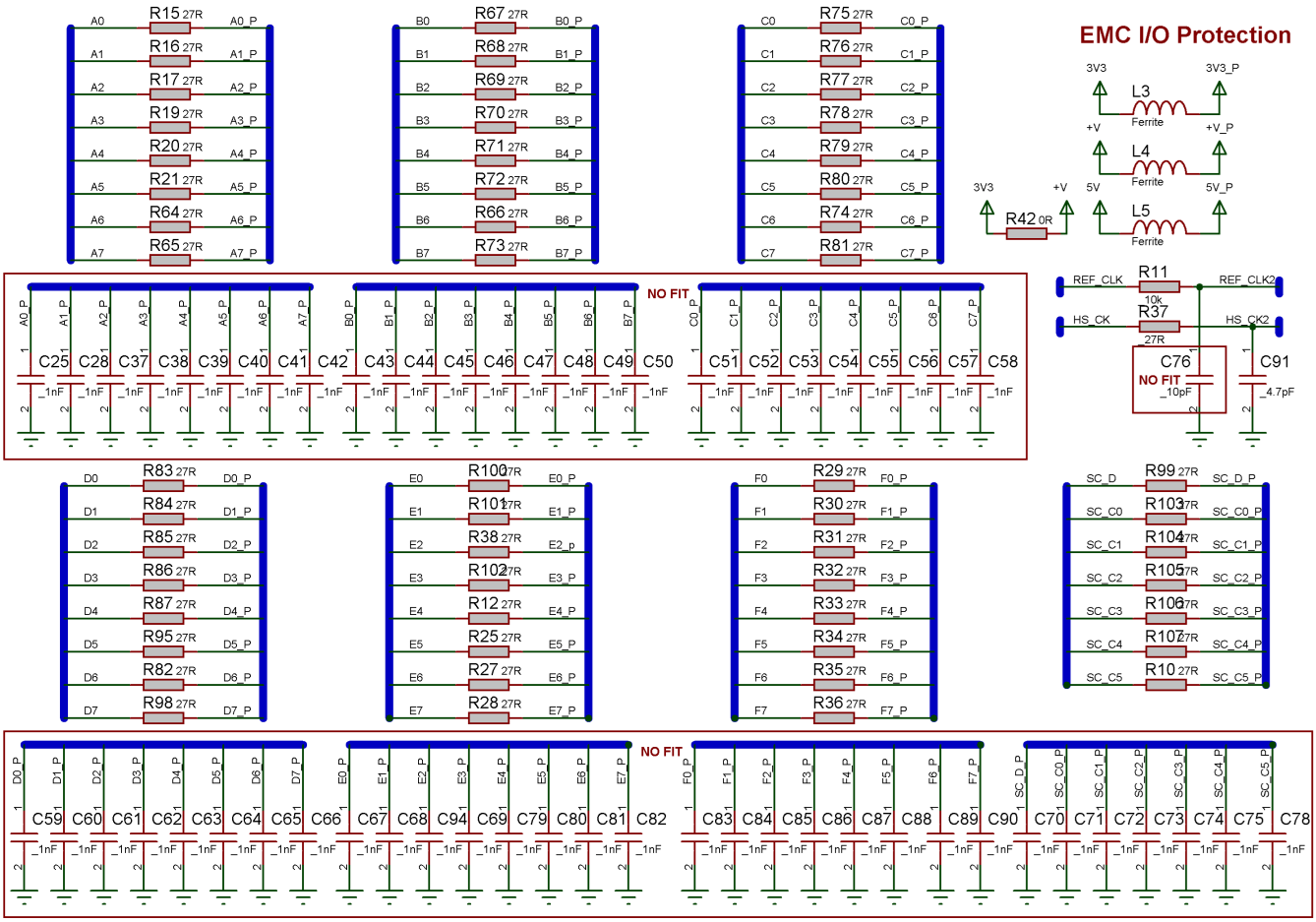
BL0093 - FPGA Programmer

Board Layout

1. DC Power Jack 7.5 - 12V
2. Status LEDs
3. Power Output Terminals
4. FPGA EP4CE10E22
5. Config Device
6. 24MHz Digital Clock
7. Reset Switch
8. EB3 Port A Connector
9. EB3 Port B Connector
10. EB3 Port C Connector
11. EB3 Port D Connector
12. EB3 Port E Connector
13. EB3 Port F Connector
14. JTAG Programming Header
15. Active Serial Programming Header



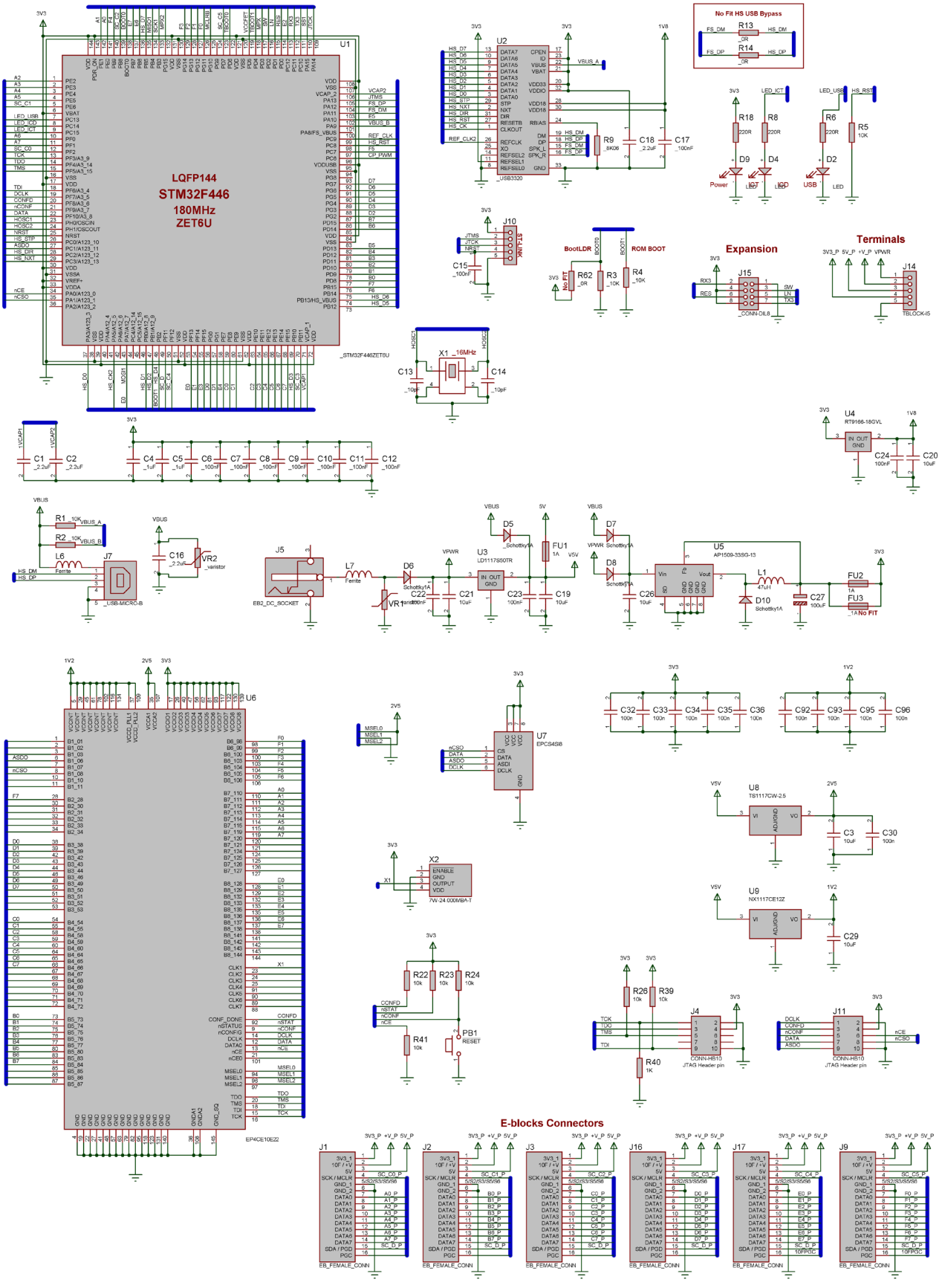
BL0093 - Board Schematic



UPSTREAM BOARDS

BL0093 - FPGA Programmer

BL0093 - Block Diagram



FPGA Pin Specification

IO Voltage: 3V3
Core Voltage: 1V2 / 2V5
Clock Input: CLK1_23
Digital Pins: 48

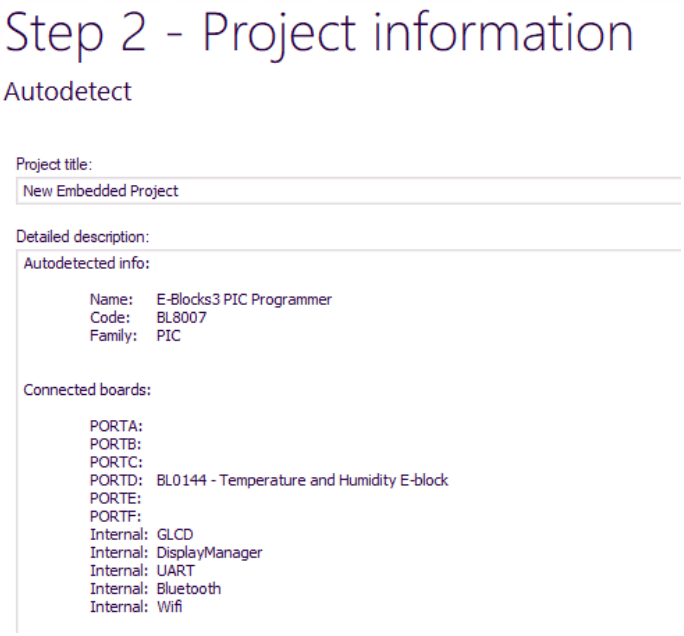
	7	6	5	4	3	2	1	0
Port A	B7_120	B7_119	B7_115	B7_114	B7_113	B7_112	B7_111	B7_110
Port B	B5_84	B5_83	B5_80	B5_77	B5_76	B5_75	B5_74	B5_73
Port C	B4_66	B4_65	B4_64	B4_60	B4_59	B4_58	B4_55	B4_54
Port D	B3_50	B3_49	B3_46	B3_44	B3_43	B3_42	B3_39	B3_38
Port E	B8_138	B8_137	B8_136	B8_135	B8_133	B8_132	B8_129	B8_128
Port F	B2_28	B6_106	B6_105	B6_104	B6_103	B6_100	B6_99	B6_98

ADDITIONAL INFORMATION

Using EBlocks 3 with Flowcode

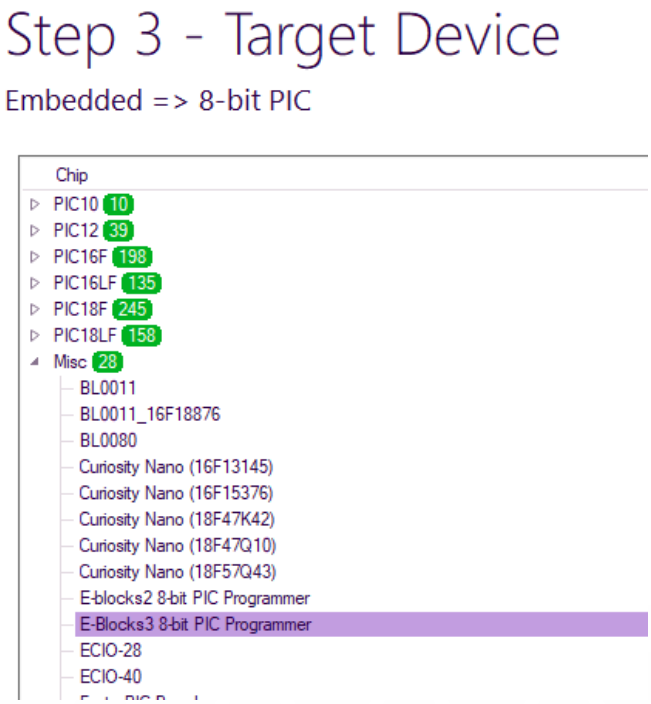
Autodetect

The easiest way to setup an EBlocks 3 compatible Flowcode project is to connect the EBlocks 3 upstream board to the computer and connect in any downstream boards you want to use. Ensure you have the USB drivers for the EBlocks 3 hardware installed. Then start Flowcode, select New Project and click on the Autodetect option. This detects the upstream board, configures the COM port for reprogramming and creates a dialogue asking which components you would like to add to the project based on the detected downstream boards. Any components auto added will be automatically configured so they are on the correct port etc.



Manual Configuration

You can also manually setup the Flowcode project by selecting the EBlocks 3 target board from the Embedded -> Family -> Misc section. At the next step check you have the Programmer Port set correctly for the EBlocks 3 COM port. You can change the target device and COM port setting via the Build -> Project Options menu.



Programming

Once the project is setup use the Build -> Compile to chip button to send the Flowcode program to the microcontroller on the board.

Using EBlocks 3 without Flowcode

To reprogram the EBlocks 3 hardware outside of Flowcode you can use the following series of tools.
BL0040 ArdMega—Arduino IDE use the Mega 2560 R3 target, AvrDude, AvrDudess
BL0070 ESP32S3— Arduino IDE use the ESP32S3 target, ESP32 IDF, Chrome ESP Tool
BL0082 PIC—EB3_PIC_PROG see the readme for the graphical touchscreen library below for more information

Libraries and examples on how to use the graphical touchscreen are available here.
https://github.com/BenMatrixTSL/EBlocks3

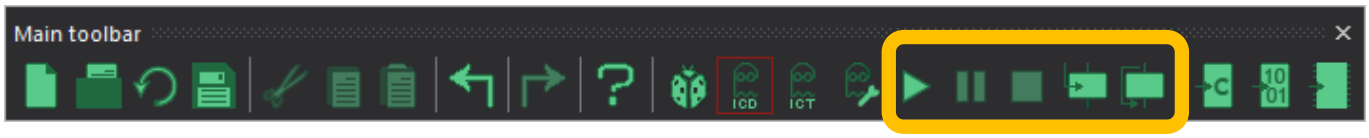
ADDITIONAL INFORMATION

In Circuit Debug (ICD) using Flowcode

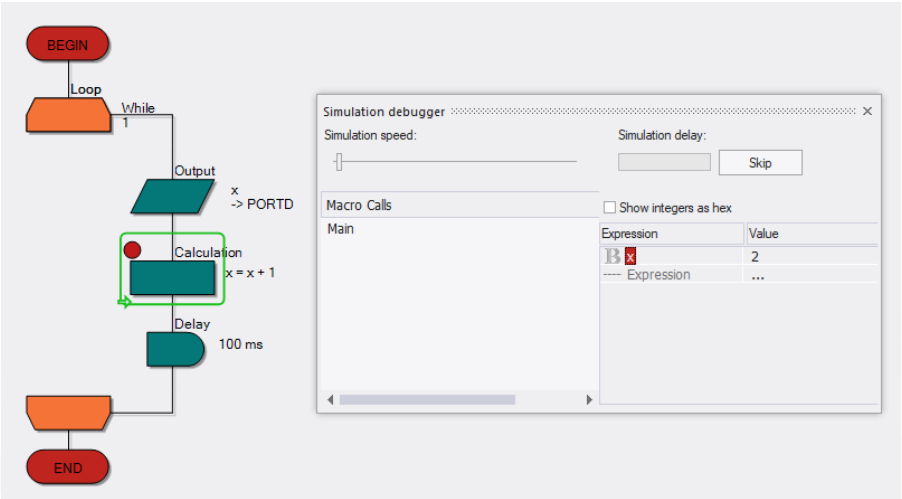
In Circuit Debug (ICD) allows you to follow and control the execution of your Flowcode program on real world hardware using Flowcode to control the program execution. ICD support for the EBlocks 3 range is available in Flowcode 11 onwards.
To enable ICD first connect the EBlocks 3 board via USB and ensure the USB drivers are installed correctly. Once the board is detected the three Ghost icons will become available.

Click the ICD icon to toggle ICD mode on and off, When ICD mode is enabled the icons will turn green and the ICD LED will light on the EBlocks board.

Compile the program to the device as normal using the Compile To Chip button. Please note that a program in ICD mode will wait for the trigger from Flowcode before being allowed to run.
The simulation controls (Run, Pause, Stop, Step) will now control the execution of the hardware.



You can set or clear breakpoints while the program is stopped or paused by right clicking an icon and choosing Toggle Breakpoint. Active breakpoints will be shown with a red circle highlighting the Flowchart icon. When paused or stepping the current icon will be highlighted in green.
When the program is paused or running slowly variable values can be monitored or changed using the simulation debugger window. Variables can be added to the window by double clicking the "Expression" field and typing the name of the variable you want to display or control. The value of the variable can be altered by selecting the corresponding value text field and manually changing the value. Please note that only Global variables can be used with the simulation debugger.

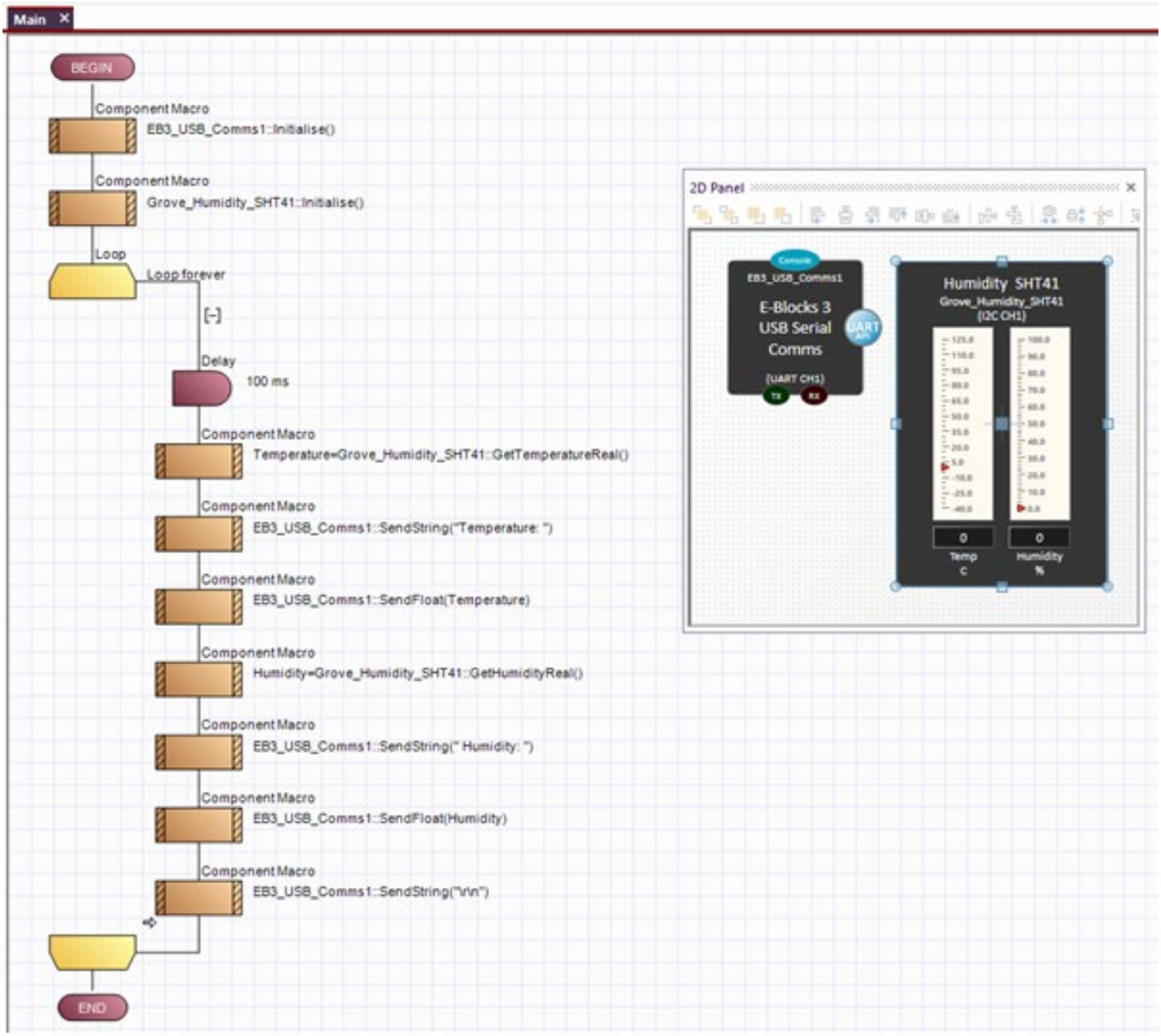


ADDITIONAL INFORMATION

Serial Communications using Flowcode

There is a dedicated Serial UART component in Flowcode which is used for communications to a connected computer using the USB C data connection. This can be found when creating a new project using auto detect, the component will be automatically added for you or from the Hardware -> EBlocks 3 component category. A standard UART component can also be used with the correct channel chosen and a baud rate of 115200. Note that we do not recommend serial communications in a project which is using ICD.

Here is an example that takes a temperature and humidity reading and forwards the data to the connected computer.



The data can be seen using a serial monitor or via the Flowcode console.

ADDITIONAL INFORMATION

LCD - Embedded Font Set

Here is the inbuilt alphanumeric font set. As with standard alphanumeric displays, locations 0-7 are user programmable allowing you to create your own characters or glyphs. The columns shown in green are common with standard HD44780 displays, other columns are specific to the BL0169 and the BL0114 displays only.

LCD Key differences

There are a number of key differences between this LCD and the standard HD44780 type displays which are listed below.

- Scrolling and blinking cursor display commands are not supported.
- Printing characters to the display automatically moves through lines 0,1,2,3 rather than the usual 0,2,1,3.
- Enhanced character set support.

ADDITIONAL INFORMATION

Release History

29 05 25	first beta

EBlocks 3

CP9645
DATASHEET

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