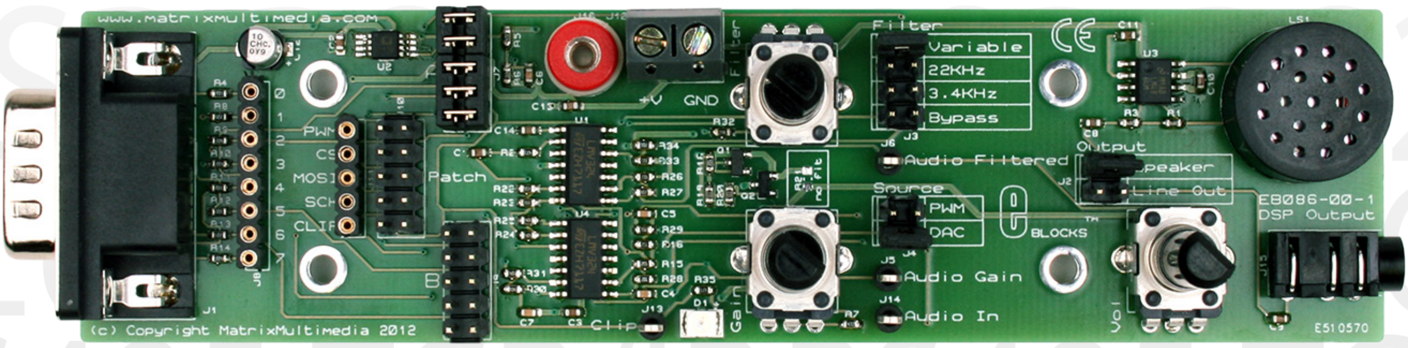
eBLOCKS®

DSP Output Board



Contents

About This Document

This document concerns the E-blocks DSP Output board with code EB086 version 1.

The order code for the DSP Output board product is EB086.

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 DSP Output board allows the exploration of DSP (Digital Signal Processing) style digitally sampled analogue waveforms such as audio or feedback control signals. The board features multiple adjustable amplifier stages, a high speed 16-bit digital to analogue converter DAC, a configurable low pass filter circuit and multiple scope test points so you can monitor the signal at various stages in the output chain. The board also has a LED output which detects is the signal is being over amplified and therefore if data is potentially being lost. Using this board it should be possible to configure almost any output analogue representation of the digital signal so that it can be used in any external circuitry.

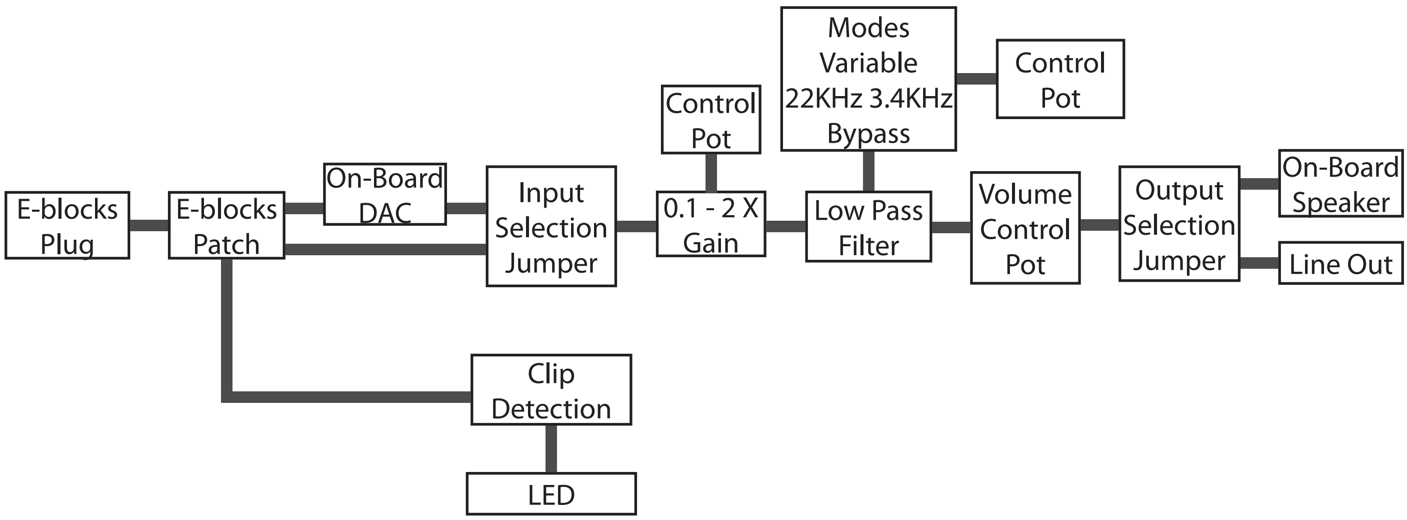
2. Features

- On-board 100Ksps 16-bit DAC
- Eight active amplifier circuits
- Configurable active low pass filter circuit
- Scope test points
- On-board speaker
- On-board mono line out jack

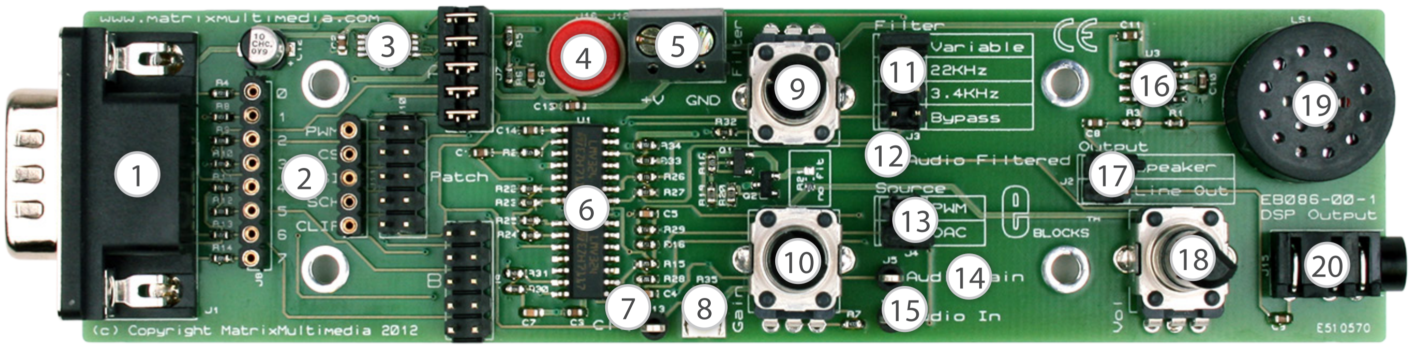
3. 3.3V system compatibility

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

4. Block diagram



Board Layout



1) 9 Way D-type Plug
2) Patch system
3) On-Board High Speed 16-bit DAC
4) +V 2mm Socket
5) Input supply voltage screw terminals
6) Quad Op-Amp IC x 2
7) Clip Detection Scope Pin
8) Clip Detection LED
9) Variable Filter Control Potentiometer
10) Variable Gain Control Potentiometer
11) Low Pass Filter Selection Jumper
12) Filtered Signal Scope Pin
13) PWM / DAC Input Selection Jumper
14) Gain Signal Scope Pin
15) Input Signal Scope Pin
16) Loudspeaker driver IC
17) Speaker / Lineout Output Selection Jumper
18) Volume Control Potentiometer
19) Onboard Speaker
20) Line Out Jack Socket (mono)

Testing This Product

The following program will test the operation of the DSP Output E-block.
The test file can be downloaded from www.matrixtsl.com.

1. System Setup

Oscilloscope

Headphones / Earphones

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	
Port B	LED board EB004
Port C	DSP Out board EB086
Port D	
Port E	
Test program	DSP_Output.hex

Testing This Product

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 LED board (EB-004-00-1) into Port B of the Multiprogrammer.

3 Program the a PIC16F877A with the test program "DSP_Output.hex".

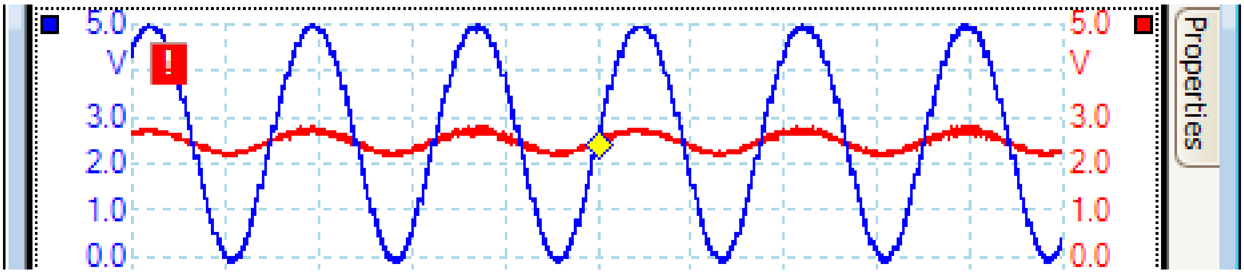
4 Insert the DSP Output board into Port C of the Multiprogrammer jumper settings - B, Bypass, DAC, Line out.

5 Connect wire from "+V" of DSP Output board to "+V" of Multiprogrammer.

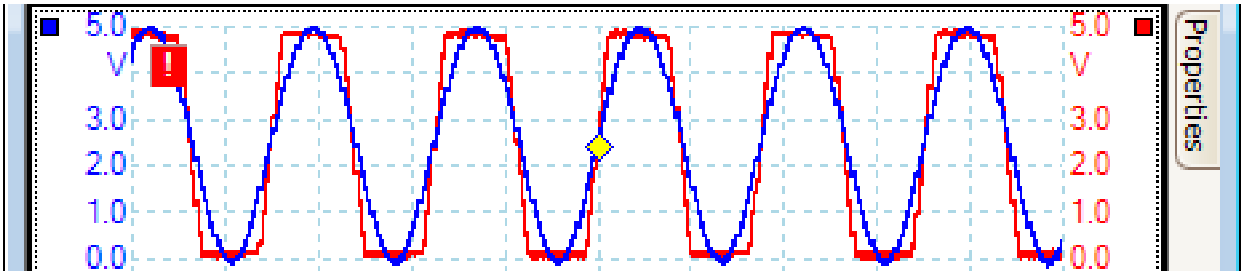
6 Attach scope channel A to the test point Audio In.

7 Attach scope channel B to the test pint Audio Gain.

8 Move the Gain potentiometer fully anti clockwise, the output signal should be sat at 2.5V with a peak to peak voltage of less than 1V. The Clip LED should be off.

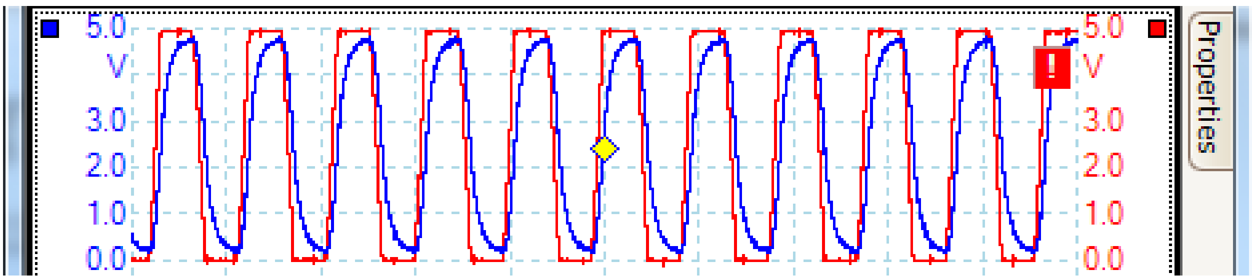


9 Move the Gain potentiometer fully clockwise, the output signal should now go from 0V to 5V in an almost square wave. The Clip LED should appear to be constantly on.

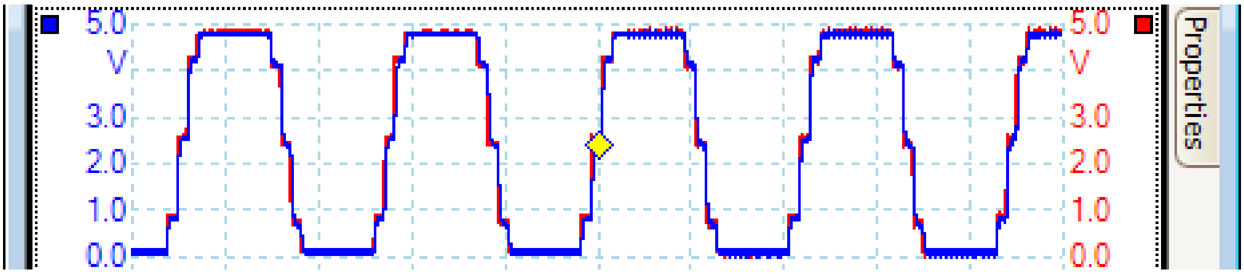


10 Move scope channel A to the test point Audio Filter.

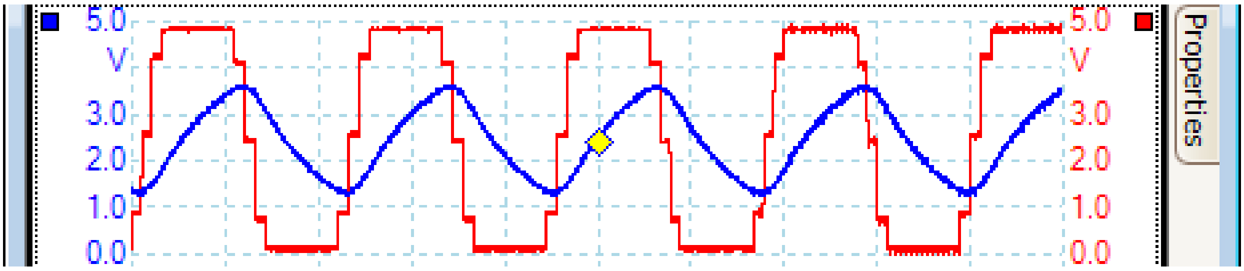
11 Keeping the gain set fully clockwise, change the filter jumper setting to 3.4KHz.



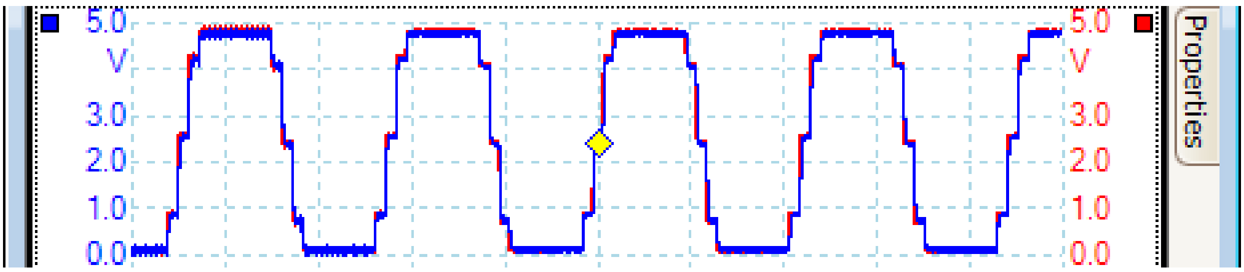
12 Keeping the gain set fully clockwise, change the filter jumper setting to 22.1KHz.



13 Keeping the gain set fully clockwise, change the filter jumper setting to variable, adjust the filter pot so that it is fully clockwise.

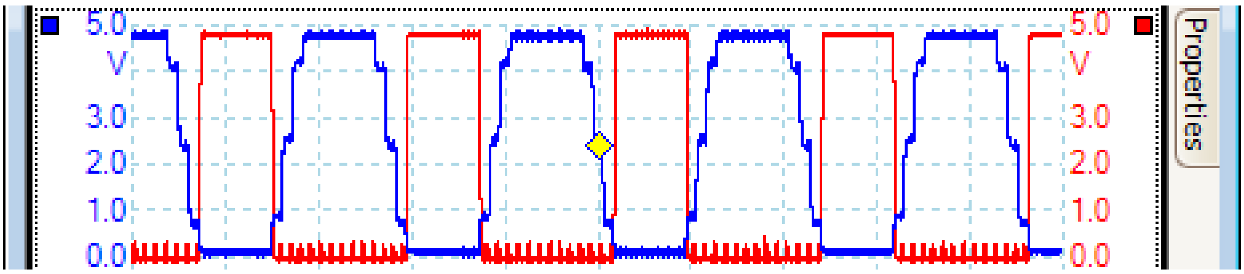


14 Keeping the gain set fully clockwise, adjust the filter pot so that it is fully anti-clockwise.



15 Move scope channel B to the test point Clip.

16 The Clip signal should be high whenever the filter signal is in the lower 5% of the voltage range. 0 – 0.5V.



17 Finally remove the scope probes and connect the headphones to the audio out socket. (Warning - do not place headphones over your ears as the output may be loud).

18 Change the volume control pot and ensure the volume changes with the pot position.

19 Change the output source from line out to Speaker using the jumper.

20 Again adjust the volume control and ensure that the volume changes with the pot position.

Circuit Description

1. Description

The circuit board consists of 5 digital I/O lines on a 'downstream' 9-way D-type plug. This routes the various signals from the output board to the microcontroller on the 'upstream' E-blocks programmer board. The PWM signal is the raw pulse width modulates digital version of the analogue output signal provided by the Microcontroller. The CS, MOSI and SCK pins are used to communicate with the on-board DAC IC. The CLIP signal is the same output signal which drives the Clip LED so the microcontroller can warn if portions of the signal are potentially being lost.

SPI based jumper settings.

Jumper Setting A	Jumper Setting B	Patch
PIC16F88	PIC16F877A	Any Device
	PIC16F1939	Any Device

Individual pin jumper settings.

Pin Function	Jumper Setting A	Jumper Setting B	Patch
PWM	Bit-3	Bit-2	Patch
CS	Bit-7	Bit-7	Patch
MOSI	Bit-2	Bit-5	Patch
SCK	Bit-4	Bit-3	Patch
CLIP	Bit-6	Bit-6	Patch

2. DAC Operation

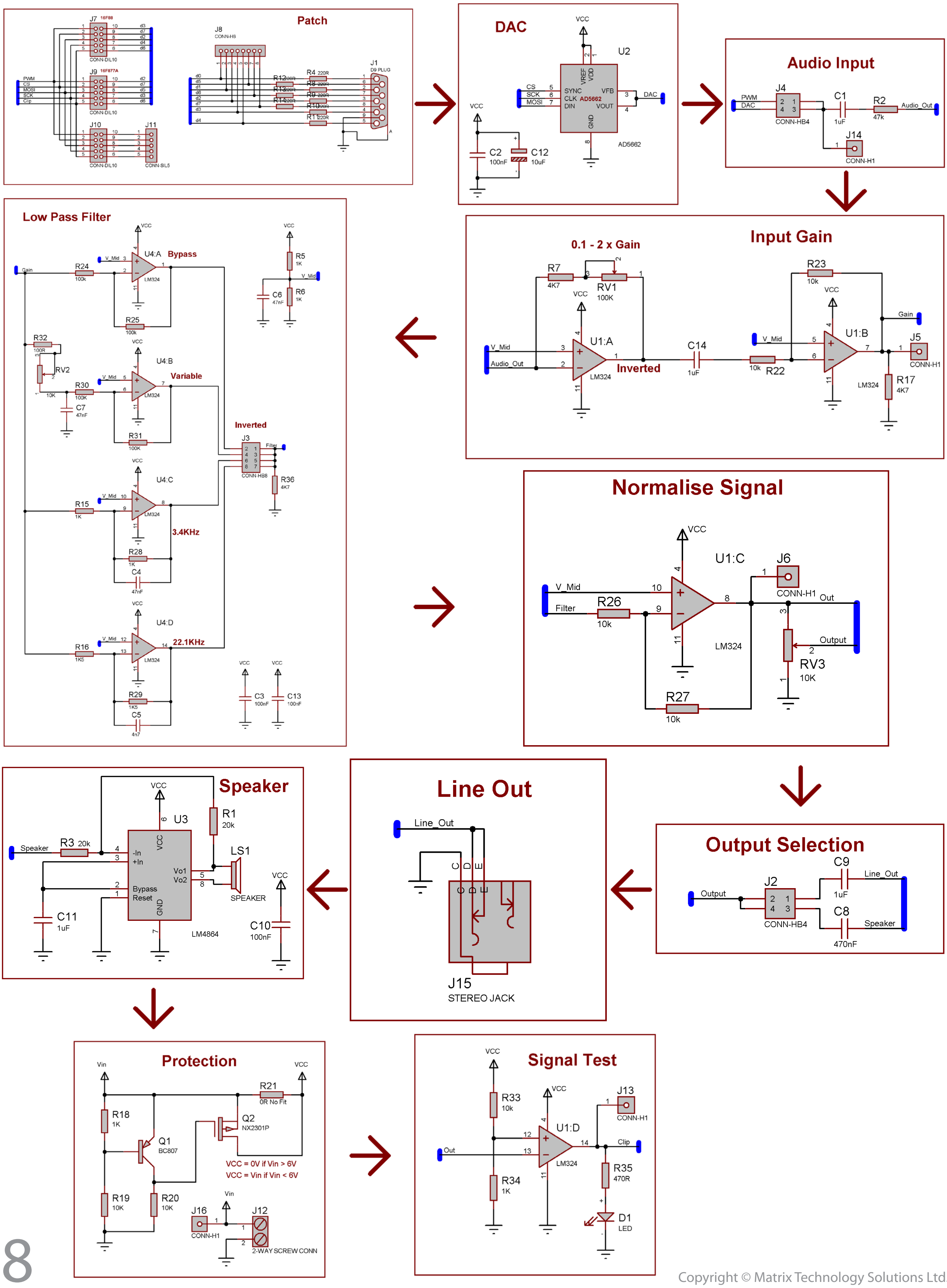
The on-board DAC is a AD5662 IC and can be referenced by using the SPI Legacy component in Flowcode or you can output the analogue signal directly using the PWM module on-board your microcontroller device. There is an example of how to use the SPI component to send the waveform data to the on-board DAC available as part of the main set of Flowcode examples.

3. Filter Operation

The on-board low pass filter has several operational modes which are selected by moving the jumper on J3. The filter's response is that so that by the cutoff frequency the signal has been attenuated by 50%. Filtering is important because of issues when converting digital signals into analogue signals such as quantization errors and high frequency digital noise. By providing a low pass filter on the output it is possible to overcome some of these restraints.

- Bypass – Full bypass, no filtering is performed on the signals.
- 3.4KHz – Active filter with cutoff frequency at 3.4KHz allowing for low quality phone style audio quality.
- 22.1KHz - Active filter with cutoff frequency at 22.1KHz allowing for high quality CD style audio quality.
- Variable – Passive filter with adjustable cutoff frequency ranging from approx. 100KHz to several Hz.

Circuit Diagram



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

EB086-30-1

BLUETOOTH RS485 TCP/IP SD/FAT ZIGBEE SPI CAN GSM USB RS232