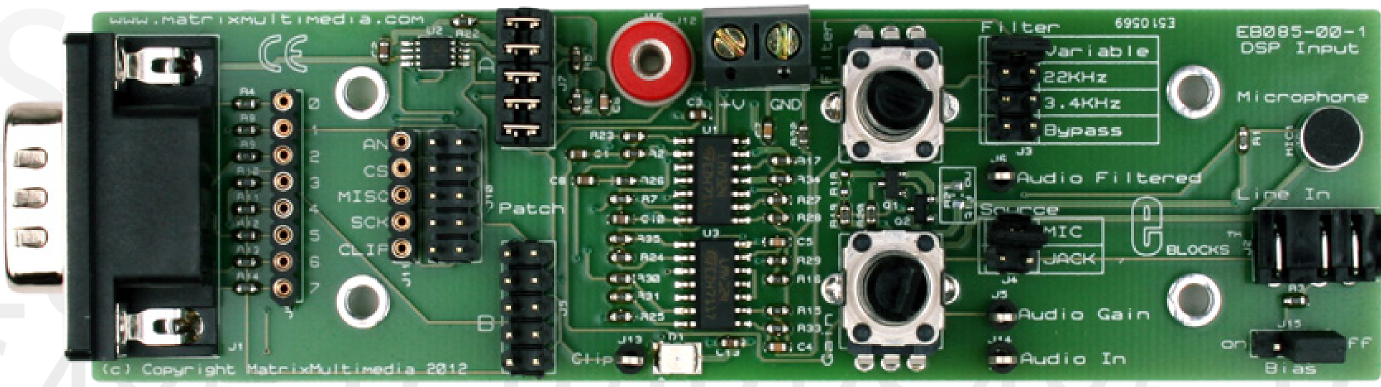
eBLOCKS®

DSP Input Board



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About This Document

This document concerns the E-blocks DSP Input board with code EB085 version 1.

The order code for the DSP Input board product is EB085.

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 Input 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 analogue to digital converter ADC, a configurable low pass filter circuit and multiple scope test points so you can monitor the signals at various points in the input chain. The board also has a LED output which detects if 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 analogue signal so that it can be read correctly by a microcontroller.

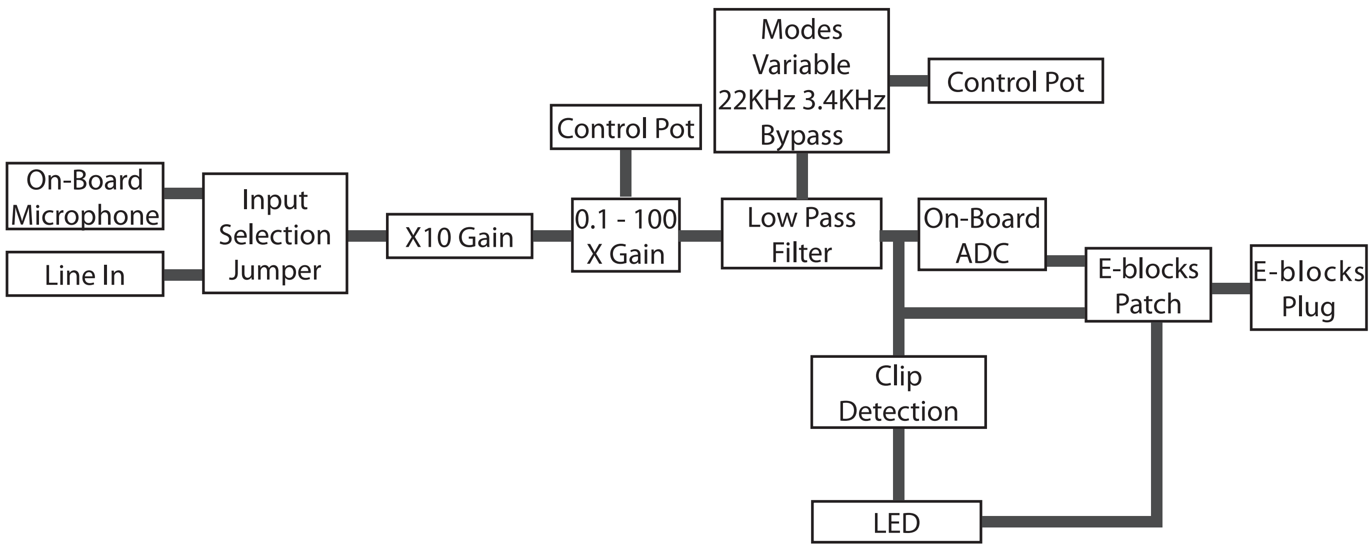
2. Features

- On-board 100Ksps 16-bit ADC
- Eight active amplifier circuits
- Configurable active low pass filter circuit
- Scope test points
- On-board microphone
- On-board mono line in jack

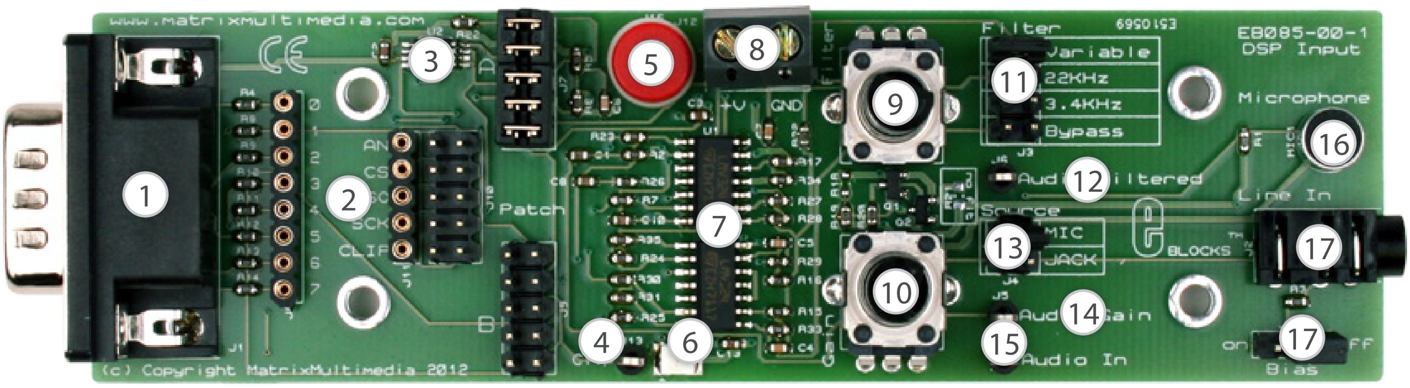
3. 3.3V System Compatibility

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 ADC
4. Clip Detection Scope Pin
5. +V 2mm Socket
6. Clip Detection LED
7. Quad Op-Amp IC x 2
8. Input supply voltage screw terminals
9. Variable Filter Control Potentiometer
10. Variable Gain Control Potentiometer
11. Low Pass Filter Selection Jumper
12. Filtered Signal Scope Pin
13. Microphone / Jack Input Selection Jumper
14. Gain Signal Scope Pin
15. Input Signal Scope Pin
16. On-Board Microphone
17. Line In Socket (mono)
18. Line In Voltage Bias – Passive / Active Signals

Testing This Product

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

1. System Setup

Oscilloscope

Signal generator – (smart phone with sig gen app will do)

Audio lead

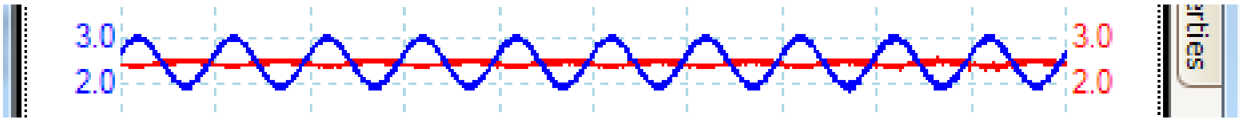
Multi-programmer board (EB006) with:

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 In board EB085
Port D	
Port E	
Test program	DSP_Input.hex

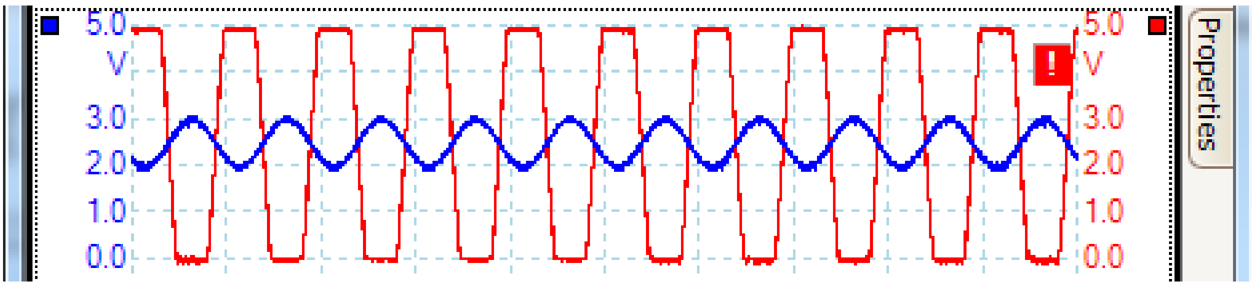
Testing This Product

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.

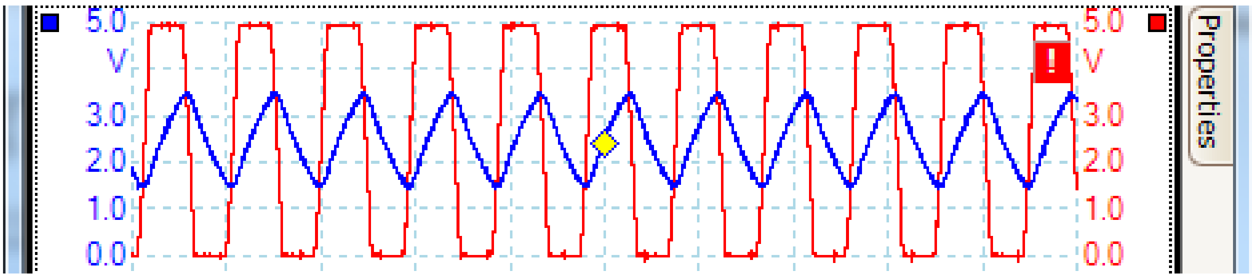
2. Insert the LED board (EB-004-00-1) into Port B of the Multiprogrammer.
3. Program the a PIC16F877A with the test program “DSP_Input.hex”.
4. Insert the DSP Input board into Port C of the Multiprogrammer jumper settings - B, Bypass, Jack, Off.
5. Connect wire from “+V” of DSP Input board to “+V” of Multiprogrammer.
6. Attach scope channel A to the test point Audio In.
7. Attach scope channel B to the test pint Audio Gain.
8. Connect the signal generator to the phono socket using the audio lead.
9. Set the signal generator to output a 10KHz Sine wave at roughly 1V peak to peak.
10. Move the Gain potentiometer fully anti clockwise, the output signal should be sat at 2.5V with a peak to peak voltage of around 0V. The Clip LED should be off.



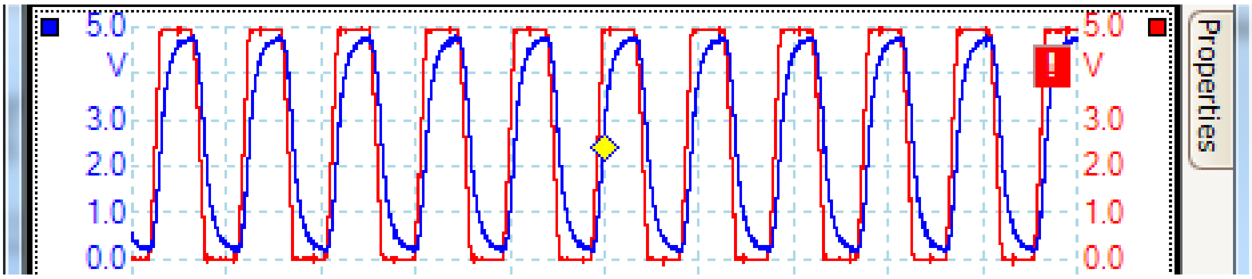
11. Move the Gain potentiometer fully clockwise, the output signal should now go from 0V to 5V in an almost square wave. The Clip LED should appear to be constantly on.



12. Move scope channel A to the test point Audio Filter.
13. Keeping the gain set fully clockwise, change the filter jumper setting to 3.4KHz.

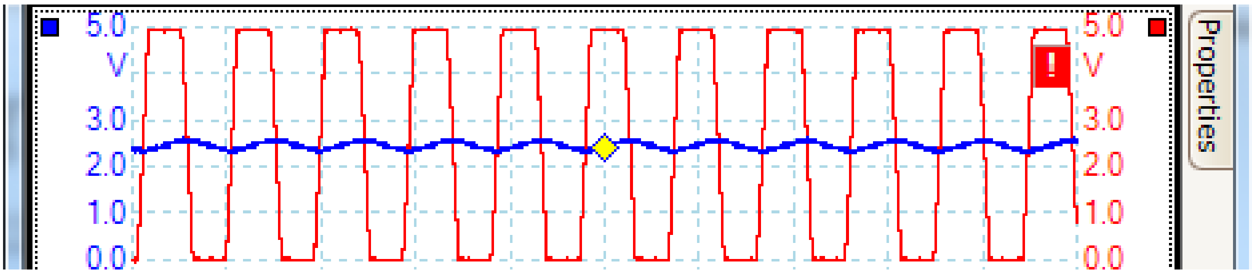


14. Keeping the gain set fully clockwise, change the filter jumper setting to 22.1KHz.

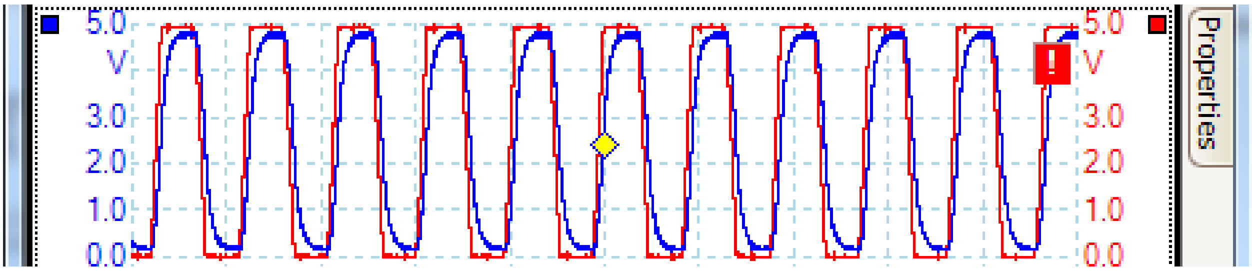


Testing This Product

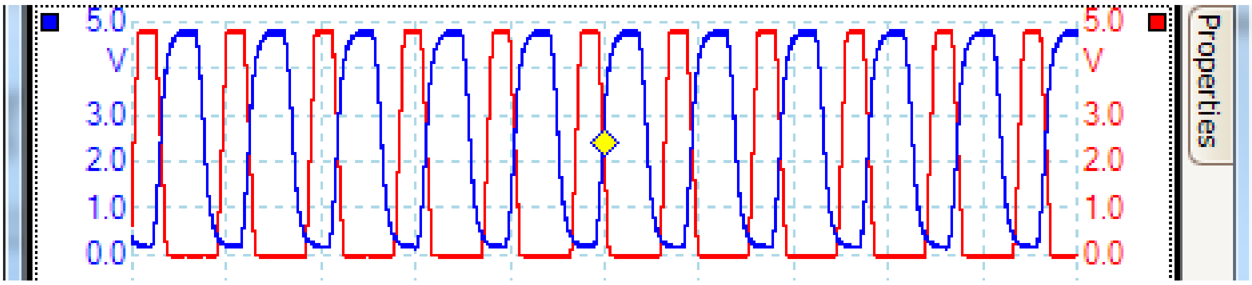
15. Keeping the gain set fully clockwise, change the filter jumper setting to variable, adjust the filter pot so that it is fully clockwise.



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



17. Move scope channel B to the test point Clip.
18. The Clip signal should be high whenever the filter signal is in the lower 5% of the voltage range. 0 – 0.5V.



19. Finally remove the scope probes and signal generator.
20. Change the input source from Jack to Mic using the jumper.
21. Tap the MIC and ensure the Clip LED lights.
22. Tap the MIC and ensure that the LEDs on PortB are changing to match your tapping.
23. Reset the potentiometers so they are both full anti clockwise.
24. If everything went as listed above then the board has fully passed the test routine.

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 input board to the microcontroller on the 'upstream' E-blocks programmer board. The AN signal is the raw analogue signal provided from the E-block. The CS, MISO and SCK pins are used to communicate with the on-board ADC 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
AN	Bit-0	Bit-1	Patch
CS	Bit-5	Bit-0	Patch
MISO	Bit-1	Bit-4	Patch
SCK	Bit-4	Bit-3	Patch
CLIP	Bit-3	Bit-2	Patch

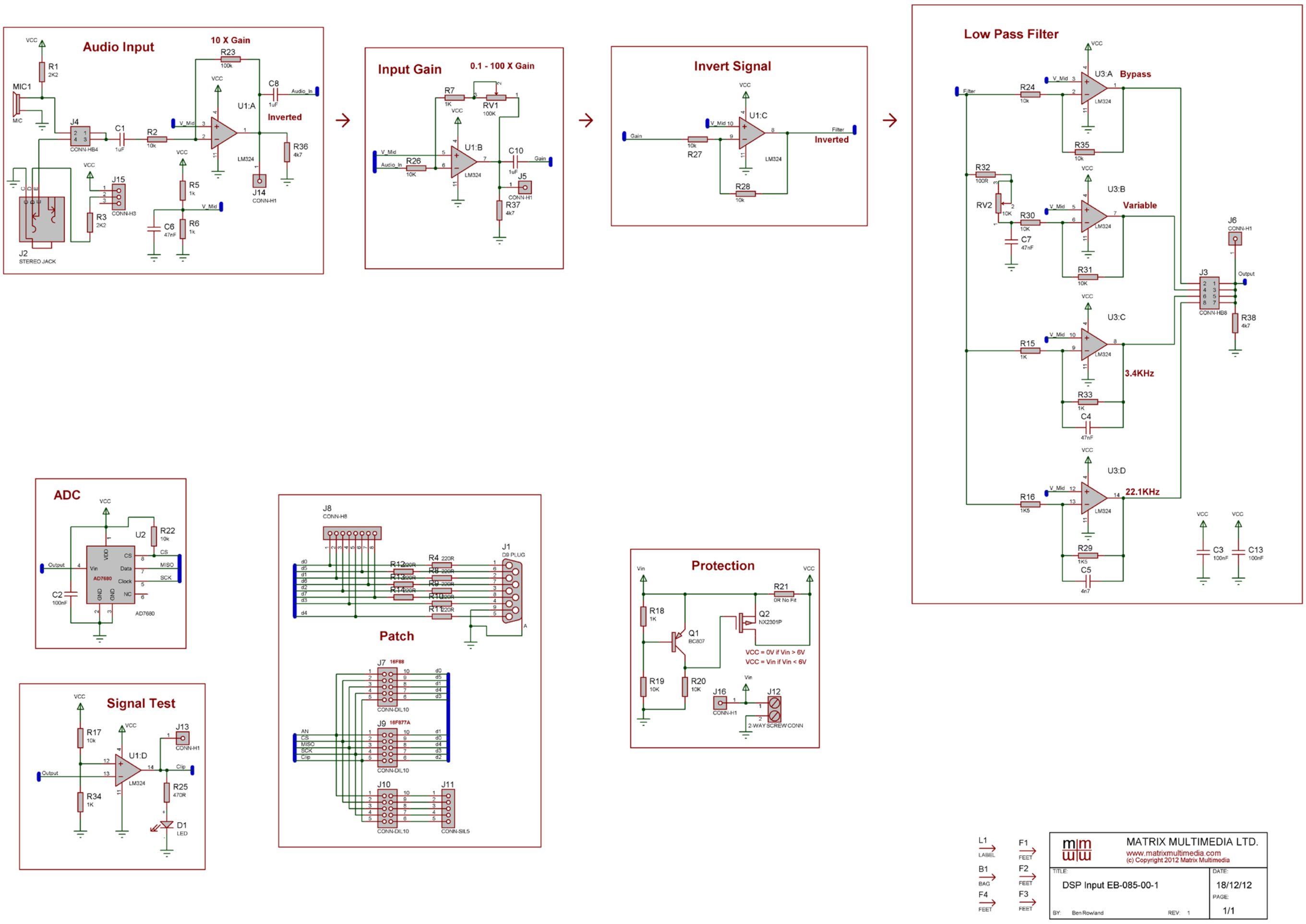
2. ADC Operation

The on-board ADC is a AD7680 IC and can be referenced by using the SPI Legacy component in Flowcode or you can read the analogue signal directly using the ADC module on-board your microcontroller device. There is an example of how to use the SPI component to read the data back from the on-board ADC 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 cut-off frequency the signal has been attenuated by 50%. Filtering is important because of an issue when converting analogue signals into digital signals, known as aliasing. If any of the input frequencies are greater than half the sample frequency, the frequency will be misread as a lower frequency. In other words all input frequencies must be less than ½ the sample frequency or aliasing will occur.

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


Audio Input
10 X Gain
Inverted
Input Gain
0.1 - 100 X Gain
Invert Signal
Inverted
Low Pass Filter
Bypass
Variable
3.4KHz
22.1KHz
ADC
Patch
Protection
VCC = 0V if Vin > 6V
VCC = Vin if Vin < 6V
Signal Test
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DSP Input EB-085-00-1
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