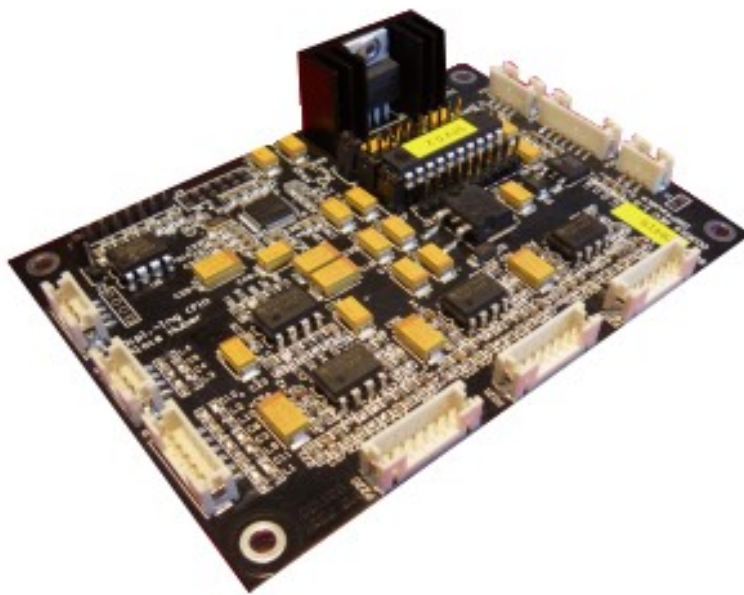


DSP4audio

Inexpensive Consumer Audio DSP system with a comprehensive software library.



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Description

DSP4audio is an audio DSP board. Main focus is simplicity and low price as a result of using Analog Devices' SigmaDSP™ and a small amount of peripheral components.

Besides being cheap, DSP4audio delivers a high audio performance. The DSP core can handle 56 bit double-precision algorithms and the analog input and output circuits are designed for balanced and unbalanced mode using low-noise amplifier stages.

DSP4audio is supposed to be a prototyping system. It provides a standard Mikrocontroller firmware including DSP software update functionality and standard analog hardware. With this configuration the customer is able to test his application already in product definition phase. We provide all custom changes in DSP code, send it via Email.

The board is designed to fulfil EMC criteria and a strict separation of analog and digital circuits provides the board layout to be a reference design for the end application.

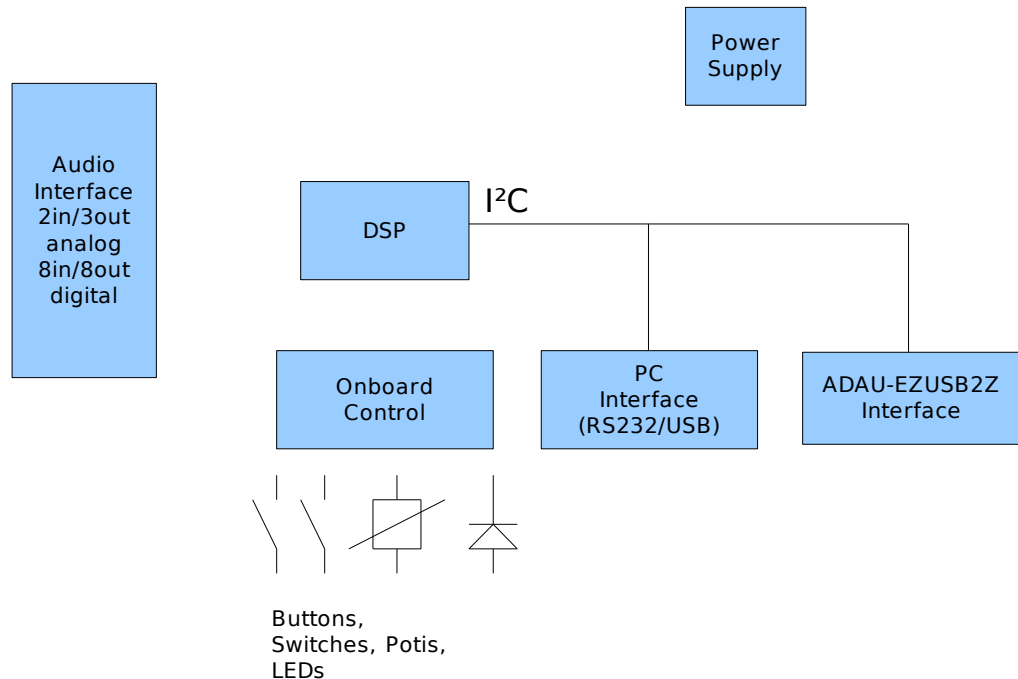
Typical applications are

- Subwoofer Crossover with speaker frequency response compensation and Limiter
- Multi-Effects Units
- DSP based Power Amplifiers

Specification

- Stand-alone DSP system, based on Analog Devices' SigmaDSP(TM)
- Analog 2-in, 3-out (opt. 4-out), balanced + unbalanced, +4 dBu
- Digital 8-in, 8-out
- DNR: >95 dB
- We provide a fast configuration of digital signal processing. There is an extensive library of DSP algorithms (crossover, compressor/limiter/expander, EQ, delay, loudspeaker frequency compensation, etc.) available.
- 28 bit core, 56 bit double precision
- Control via 12 I/O configurable pins, buttons, switches, rotary encoders, pots
- Furthermore, control via PC interface of all parameters and firmware update

The usage of SigmaStudio and the USB adapter EVAL-ADUSB2Z from Analog Devices enables the user any possible configuration of a custom signal processing.

Block Diagram

The Audio Interface consists of 2 analog, electronically balanced inputs and 3 (opt. 4) outputs, also electronically balanced. Additionally, there are 8 digital inputs and 8 digital outputs available (I²S, TDM, left-/right-justified).

The DSP is realized with Analog Devices' SigmaDSP™, supplied with clock and reset generation.

Onboard control has 12 free configurable I/O pins that can be connected with buttons, switches, rotary encoders, analog potentiometers, or LEDs, respectively. They are configured in the DSP. Changes in signal processing parameters are done clickless.

The PC interface is realized by a Mikrocontroller, that evaluates the commands and data from the host and that transmits and receives it over the I²C Bus to the DSP. All implemented READ and WRITE commands of the ADAU170x can be handled, for example:

- Read/write single data words or blocks
- Safeload, eg. Filter parameters
- Download of program code, data or parameters

Finally, the power supply provides power to all digital and analog circuits on the board.

External Connectors

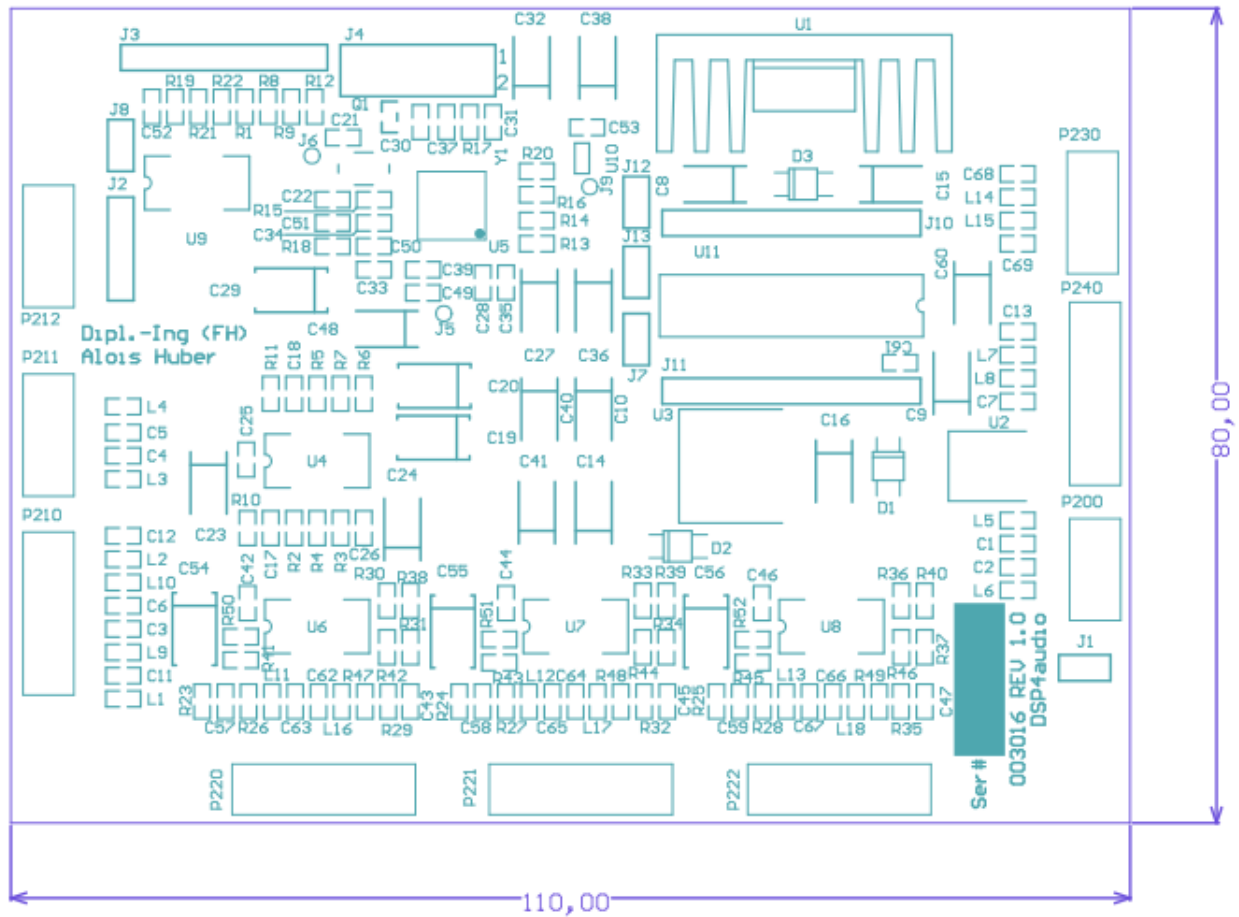


Illustration 1: Connectors

The external connectors are JST type.

Power Supply P200

Pin	Function	Description
1	VIN+	Positive Power Supply
2	GND	Common Ground Connection (Ground contact)
3	VIN-	Negative Power Supply

Analog Input Balanced P210

Pin	Function	Description
1	AIN_S_1_P	Positive Input to ADC 1
2	AIN_S_1_N	Negative Input to ADC 1
3	AIN_S_1_GND	Ground Input ADC 1 (analog)
4	AIN_S_0_GND	Ground input ADC 0 (analog)
5	AIN_S_0_N	Negative Input to ADC 0
6	AIN_S_0_P	Positive Input to ADC 0

Analog Input unbalanced P211

Pin	Function	Description
1	AIN_A_1_VIN	Input to ADC 1
2	AIN_A_1_GND	Ground Input ADC 1 (analog)
3	AIN_A_0_GND	Ground Input ADC 0 (analog)
4	AIN_A_0_VIN	Input to ADC 0

Connector for Extensions P212

Pin	Function	Description
1		Reserved for extensions
2		
3		
4		

Analog Output 2 P220

Pin	Function	Description
1	nc.	
2	nc.	
3	nc.	
4	AOUT_S_2_N	Negative Output of DAC 2
5	AOUT_S_2_N_GND	Ground Output DAC 2 (analog)
6	AOUT_S_2_P_GND	Ground Output DAC 2 (analog)
7	AOUT_S_2_P	Positive Output of DAC 2

Analog Output 1 P221

Pin	Function	Description
1	nc.	
2	nc.	
3	nc.	

4	AOUT_S_1_N	Negative Output of DAC 1
5	AOUT_S_1_N_GND	Ground Output DAC 1 (analog)
6	AOUT_S_1_P_GND	Ground Output DAC 1 (analog)
7	AOUT_S_1_P	Positive Output of DAC 1

Analog Output 0 P222

Pin	Function	Description
1	nc.	
2	nc.	
3	nc.	
4	AOUT_S_0_N	Negative Output of DAC 0
5	AOUT_S_0_N_GND	Ground Output DAC 0 (analog)
6	AOUT_S_0_P_GND	Ground Output DAC 0 (analog)
7	AOUT_S_0_P	Positive Output of DAC 0

Connector for External Control P230

The RS232 connection at 3,3V level. For connecting a RS232 device, a level shifter of RS232/USB converter has to be put in here.

Pin	Function	Description
1	DVDD	Internal Power Supply Digital
2	RS232_RXD	RS232 Interface Data Input, 3,3V Level
3	RS232_TXD	RS232 Interface Data Output, 3,3V Level
4	GND	Ground Connection (Digital)

DSP I/O Connection P240

Pin	Function	Description
1	GND	Ground Connection (Digital)
2	Gain	Connected to MP9 of the DSP
3	Freq	Connected to MP2 of the DSP
4	nc.	
5	nc.	
6	nc.	
7	nc.	

Pinheader and Jumper

Connection Enclosure Ground J1

With this jumper, an electrical ground connection may be established with the pcb board (ground-lift). It enables also a star-type ground distribution.

Pin	Function	Description
1	SGND	Ground Connection Bolt Holes to Enclosure
2	GND	Ground Connection (Common Ground)

Extension Connector J2

This is a connection to P212 and if for future extensions.

Pin	Function	Description
1		Reserved for extensions
2		
3		
3		

I/O Connector DSP J3

These pins are connected to some of the MP pins of the DSP.

Pin	Function	Description
1	DVDD	Internal Power Supply (digital)
2	DSP MP9	MP Pin of the DSP
3	DSP MP2	MP Pin of the DSP
4	DSP MP0	MP Pin of the DSP, with Pull-Up Resistor 10K
5	DSP MP1	MP-Pin of the DSP, with Pull-Up Resistor 10K
6	DSP MP3	MP-Pin of the DSP, with Pull-Up Resistor 10K
7	DSP MP4	MP-Pin of the DSP, with Pull-Up Resistor 10K
8	GND	Ground Connection (Digital)

I/O Connection DSP J4

These pins are connected with all MP pins of the DSP.

Pin	Function	Description
1	DSP MP0	MP Pin of the DSP, with Pull-Up Resistor 10K
2	DSP MP1	MP Pin of the DSP, with Pull-Up Resistor 10K
3	DSP MP2	MP Pin of the DSP, with Pull-Up Resistor 10K
4	DSP MP3	MP Pin of the DSP, with Pull-Up Resistor 10K
5	DSP MP4	MP Pin of the DSP
6	DSP MP5	MP Pin of the DSP
7	DSP MP6	MP Pin of the DSP
8	DSP MP7	MP Pin of the DSP
9	DSP MP8	MP Pin of the DSP
10	DSP MP9	MP Pin of the DSP
11	DSP MP10	MP Pin of the DSP

12	DSP MP11	MP Pin of the DSP
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Analog Output 3 J5

At this pin the analog output DAC of the DSP is connected.

ADDR1/CDATA/WB J6

This pin is connected with ADDR1/CDATA/WB of the DSP. For further informations of this pin refer to the user's manual of the ADAU170x.

SELFBOOT Function of the DSP J7

This pin is connected with the SELFBOOT input of the DSP. If set high, the DSP loads automatically program and data out of the EEPROM after RESET. For further informations of this pin refer to the user's manual of the ADAU170x.

Pin	Function	Description
1	DSP_SELFBOOT	SELFBOOT Pin of the DSP
2	DVDD	Internal Power Supply (Digital)

CLATCH/WP Function of the DSP J8

This pin is connected with CLATCH/WP of the DSP and the EEPROM. For further informations of this pin refer to the user's manual of the ADAU170x.

Pin	Function	Description
1	DSP_CLATCH/WP	CLATCH/WP Pin of the DSP
2	GND	Ground (Digital)

RESET Input J9

This pin is connected with the RESET input of the RESET generator. A sufficient long positive puls generates a RESET signal for the DSP and the Mikrocontroller.

I/O Pins of the Mikrocontroller J10 und J11

At the Jumpers J10 and J11 the I/O pins of the Mikrocontroller are accessible. They are for further extension, or for ISP programming of the Mikrocontroller.

J10:

Pin	Function	Description
1	MC PA2	Mikrocontroller Port A
2	MC PD0/RXD	Mikrocontroller Port D
3	MC PD1/TXD	Mikrocontroller Port D
4	MC PA1	Mikrocontroller Port A
5	MC PA0	Mikrocontroller Port A
6	MC PD2	Mikrocontroller Port D
7	MC PD3	Mikrocontroller Port D

8	MC PD4	Mikrocontroller Port D
9	MC PD5	Mikrocontroller Port D
10	GND	Masseanschluss (digital)

J11:

Pin	Function	Description
1	MC PD6	Mikrocontroller Port D
2	MC PB0	Mikrocontroller Port B
3	MC PB1	Mikrocontroller Port B
4	MC PB2	Mikrocontroller Port B
5	MC PB3	Mikrocontroller Port B
6	MC PB4	Mikrocontroller Port B
7	MC PB5	Mikrocontroller Port B
8	MC PB6 / I2C_SCL	Mikrocontroller Port B or I ² C Bus Clock Signal SCL
9	MC PB7 / I2C_SDA	Mikrocontroller Port B or I ² C Bus Data Signal SDA
10	MC VCC	Mikrocontroller VCC = Power Supply Digitalteil

I²C Connection DSP - Mikrocontroller SDA J12

This jumper connects the data signal of the I²C bus from the DSP and the Mikrocontroller. For the external control over the Mikrocontroller, this connection must be closed.

The I²C bus connectors allow an external control of the system with SigmaStudio over the ADUSB2Z, or USBi interface, respectively, from Analog Devices.

Pin	Function	Description
1	I2C_SDA	I ² C Bus Daten Signal SDA at the DSP
2	I2C_SDA	I ² C Bus Daten Signal SDA at the Mikrocontroller

I²C Connection DSP - Mikrocontroller SCL J13

This jumper connects the clock signal of the I²C bus from the DSP and the Mikrocontroller. For the external control over the Mikrocontroller, this connection must be closed.

The I²C bus connectors allow an external control of the system with SigmaStudio over the ADUSB2Z, or USBi interface, respectively, from Analog Devices.

Pin	Function	Description
1	I2C_SCL	I ² C-Bus Clock Signal SCL at the DSP
2	I2C_SCL	I ² C Bus Clock Signal SCL at the Mikrocontroller

Digital Signal Processing

The digital signal processing can be configured with SigmaStudio software from Analog Devices, and be downloaded into the DSP or the EEPROM. For using SigmaStudio, a license has to be obtained from Analog Devices.

Examples of Algorithms of SigmaStudio:

- Biquad filter

- FIR filter
- Bass, treble, low-/highpass, shelving-, peak-, notchfilter with variable Q
- Dynamic processors with softknee functionality and peak/RMS detector, single/multiband
- Delays
- Signal generators (sine, sawtooth, triangle, squarewave, noise)
- Mixers and splitters
- Volume control
- Surround virtualizer
- Bass enhancement
- Dolby® ProLogic® II
- Waves MaxxBass®
- SRS® TruSurround XT™

Furthermore, a customized signal processing can be developed.

External Control

I/O Pins of the DSP

The MP pins of the DSP allow an external control. Every pin can be configured as button, switch, analog potentiometer, rotary encoder or LED output in the DSP. The serial Audio interface is also available at the MP connectors.

PC Software

The system can be connected to a control computer via USB (virtual COM port). A control software includes the DSP control and a user interface. These two components build an Application.

The Application shipped with is a PC demo software (running on Microsoft Windows XP or later) and represents, together with the DSP firmware, an active Subwoofer Crossover with included Limiter.

Applications can be developed according to the customers specification.

Technical Data

The technical data is valid at a sample rate of 48 kHz of the ADAU170x.

Parameter	min.	typ.	max.	Unit	Measurement Conditions
Input Voltage		+4	+21	dBu	balanced
Output Voltage		+4	+21	dBu	balanced
Input Impedance		20		kΩ	balanced
		10		kΩ	unbalanced
Output Impedance		240		Ω	balanced
DNR	93	95	96	dB	relative +20 dBu B = 22 kHz
THD+N		0,0071	0,0085	%	f = 1 kHz

(+20 dBu)					V = 1 B = 22 kHz K2 ... K9
THD+N (+4 dBu)		0,011	0,017	%	f = 1 kHz V = 1 B = 22 kHz K2 ... K9
Sample Rate f_s		48	192	kHz	see footnote ¹
Frequency Response		20...20.000		Hz	+0 / -1,5 dB
Operating Voltage	+/-17	+/-18	24		
Current Consumption		+150 / -10	+180 / -30	mA	U = +/-18V
Operating Temperature	0		50	°C	

1 Spezifikation valid for 48 kHz Sample Rate, 96 and 192 kHz are also possible