

TruBass Audio Enhancement Processor

1 Overview

The **AP8111** is a bass enhancement processor based on SRS Labs, Inc.'s patented TruBass technology. TruBass is a revolutionary psychoacoustic bass enhancement technology that provides deep, rich bass to small speakers without the need for a subwoofer or additional extra physical components. Deep bass now becomes possible even through speakers with limitations in driver and cabinet design. TruBass circuitry actively monitors the low-frequency content of an audio signal and optimizes the frequency and amplitude spectrum of the output signal to enhance bass perception. For systems with a subwoofer, TruBass complements and enhances bass performance.

TruBass is therefore most suitable for applications that use small size speakers yet need to deliver the best audio quality or home theatre effect: Mini or Micro Stereo Sound Systems, TV, CD, Boombox, Car Audio, DVD Receiver, Set-Top-Box, and other compact hi-fi systems such as Discman, MD, MP3 player, as well as PCs.

2 Features

- Operating Voltage 4.75V to 5.25V
- Low Operation Current 10mA typ
- Power down and Bypass mode selection
- Analog switch for mode and gain control
- External adjustment for speaker size setting (small, medium and large)
- Bipolar Technology
- Chip Package 28 pins SOP

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3 Device Pin Out and Pin Descriptions

Pin #	Pin Name	Type	Descriptions
1	LOUT	AOUT	Left channel audio line output
2	LIN	AIN	Left channel audio line input
3	VREF	AOUT	2.25V analog reference
4	NC	-	Not used
5	CB1A	AI/O	100Hz band-pass filter circuit
6	CB1B	AI/O	100Hz band-pass filter circuit
7	CB1	AI/O	100Hz band-pass filter circuit
8	GND	PWR	Analog ground
9	TBGAIN	DIN	TruBass gain control. +6dB gain when this pin short to ground.
10	CB2B	AI/O	40/150Hz band-pass filter circuit
11	CB2A	AI/O	40/150Hz band-pass filter circuit
12	CB2	AI/O	40/150Hz band-pass filter circuit
13	BYPASS	DIN	Power down/ Bypass / TruBass-enable selection
14	COMPI	AIN	Compressor input
15	CL1	AI/O	Low-pass filter capacitor
16	FOUT	AOUT	Filter output
17	COMPC2	AI/O	Compressor capacitor
18	NC	-	Not used.
19	VCC	PWR	5 volts power supply
20	COMPC1	AI/O	Compressor output
21	CB3B	AI/O	60/200Hz band-pass filter circuit
22	CB3A	AI/O	60/200Hz band-pass filter circuit
23	CB3	AI/O	60/200Hz band-pass filter circuit
24	CL2B	AI/O	Low-pass filter capacitor
25	NC	-	Not used
26	CL2A	AI/O	Low-pass filter capacitor
27	RIN	AIN	Right channel audio line input
28	ROUT	AOUT	Right channel audio line output

AOUT - analog output pin
 AIN - analog input pin
 AI/O - analog bi-directional pin
 DIN - digital input pin
 PWR - power pin

4 Pin Configuration

1	LOUT	ROUT	28
2	LIN	RIN	27
3	VREF	CL2A	26
4	NC	NC	25
5	CB1A	CL2B	24
6	CB1B	CB3	23
7	CB1	CB3A	22
8	GND	CB3B	21
9	TBGAIN	COMPC1	20
10	CB2B	VCC	19
11	CB2A	NC	18
12	CB2	COMPC2	17
13	BYPASS	FOUT	16
14	COMPI	CL1	15

5 Operating Modes

The chip can be configured in 3 modes of operations – Power down mode, bypass mode, TruBass mode.

In power down mode, the chip is power down and consumed minimal current.

In bypass mode, line in audio signal is pass directly to the output.

In TruBass mode, line in audio signal is enhanced with the TruBass algorithm.

The **Bypass** pin (pin 11) is used to select the operating mode. When the pin is forced to 0v, the chip is powered down and when the pin is at float (or Vcc/2) and at 5v, the mode is set to Bypass and TruBass Enabled respectively.

An additional +6dB gain is enabled by pulling the pin TBGAIN to ground.

6 Speaker Size and Filter Center Frequencies selection

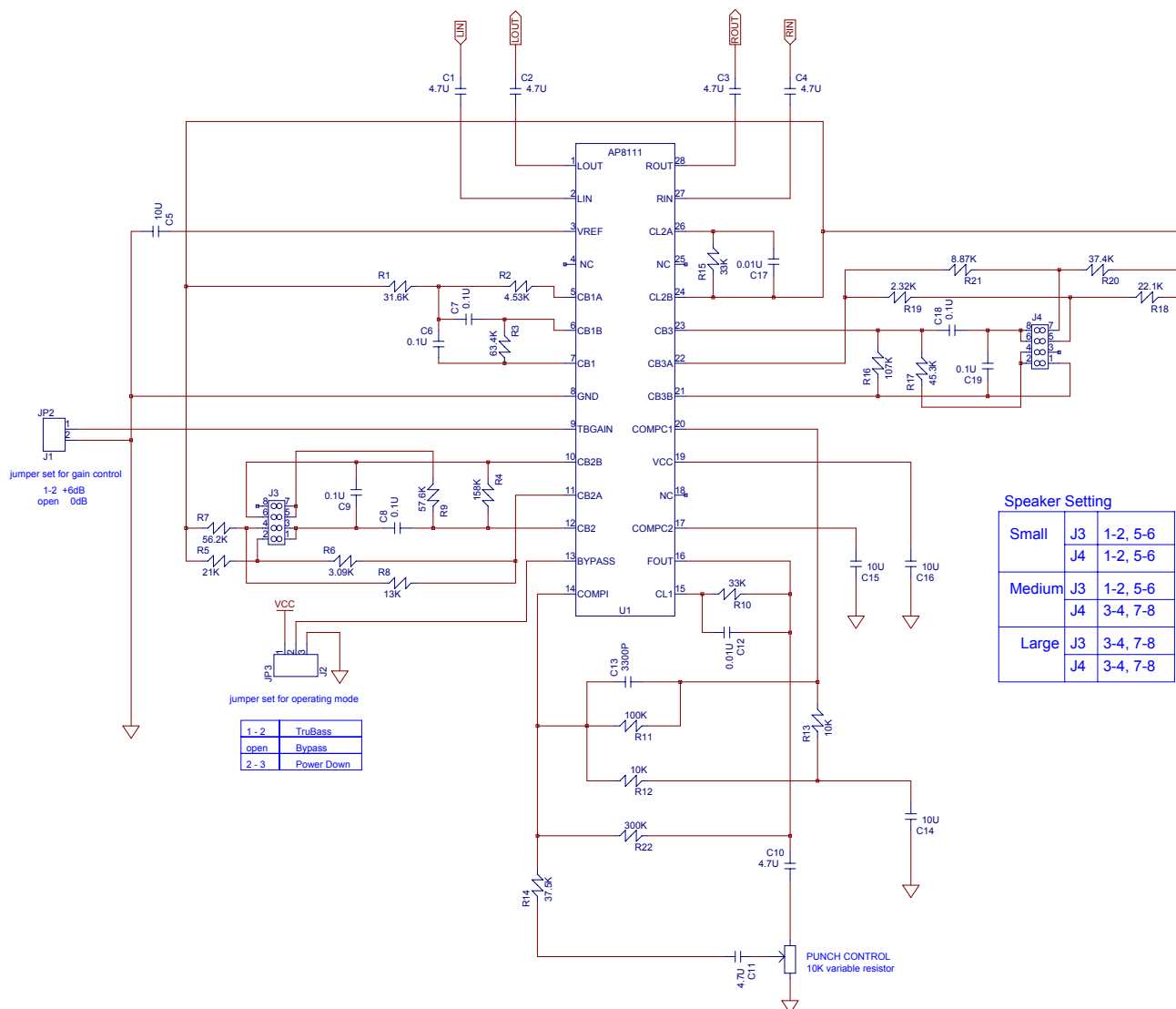
The configuration of the TruBass band-pass filters depends on the speaker size for the system. There are three configurations: small, medium and large. Each configuration uses three bandpass filters, but with different center frequencies for the filters as follows:

Speaker Size	Filter Center Frequencies
Small	100Hz
Medium	60Hz
Large	40Hz

The low pass filter cutoff frequency and the band pass filter center frequencies can be adjusted to match the frequency response of the speakers being used. Generally, the speaker size setting should be selected so that the lowest of the band pass center frequencies is just above the low cutoff frequency of the speaker system.

All configurations require the 100Hz filter, so its center frequency is fixed. The center frequencies of the other two filters are configured by the external resistors placed on pins CB2, CB2A, CB3, CB3A, CB3B.

7 Application circuit



Tolerance all resistors are $\pm 1\%$, capacitors are $\pm 10\%$

8 Recommended Operating Condition

The following is the recommended operating conditions for the TruBass analog processor

Symbol	Parameter	Min	Max	Unit
VCC	DC supply voltage	4.75	5.25	Volts
Vi	DC input voltage range	-0.3	VCC+0.3	Volts
Vo	DC output voltage range	0	VCC	Volts
Tamb	Operating ambient temperature range	0	70	°C

9 DC Electrical Specifications

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Vcc	Chip supply voltage		4.75	5	5.25	V
Icc	Operating current	Vcc = 5.0		10		mA
Ipd	Power down supply current	Vcc = 5.0		25	50	uA
Rin	Left/Right input impedance		10			kΩ
Vref	Analog reference voltage		2.02	2.25	2.48	V
Rload	Resistance load at Left/Right output		10			kΩ
Cload	Capacitance load at Left/Right output				50	pF
Vil	Digital input logic low				0.3	V
Vmid	Mid-level for Tri-level logic	If floated, internal reference will ensure Vmid	Vcc/2 – 10%	Vcc/2	Vcc/2 + 10%	V
Vih	Digital input logic high		Vcc – 0.3			V
Ileak	Digital input leakage (except TBGAIN)	Vcc = 5.0	-10		10	uA

10 AC Electrical Specifications

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Freq	Audio signal operating frequency		20		20000	Hz
Vrli	Audio input signal level (0dB level reference)	Inputs AC coupled			1	Vrms
Vrlo	Audio output level	Rload = 10kΩ			1	Vrms
Gerror	Output gain error	Bypass mode, input signal @ 0dB 1kHz	-0.5		0.5	dB
SNR	Signal to noise ratio	Bypass mode /A-weighted, input signal @ -60dB 1kHz	80			dB
THD	Total harmonic distortion	Bypass mode Input @ 0dB 1kHz			1	%
Xtalk	Channel Crosstalk	Bypass mode			-70	dB
Comp	TruBass Compressor Ratio	Punch at maximum gain		2:1		
Rate	Attack to decay time constant ratio	Absolute value set by external capacitor		10:1		

