

3W Anti-Clip Class-D Audio Power Amplifier

Features

- Output Power
 - 3.0W ($V_{DD}=5.0V$, $R_L=4\Omega$, THD+N=10%)
 - 1.8W ($V_{DD}=5.0V$, $R_L=8\Omega$, THD+N=10%)
- Low THD+N and Low Noise
- High S/N Ratio to 95dB
- Low EMI
- Improved PSRR (-80dB) and Wide Supply Voltage (2.5 V to 5.0V) Eliminates Need for a Voltage Regulator
- Over-current and Thermal Protection function
- Pop noise reduction function
- Available in space-saving package: 9-Bump WLCSP

Applications

- Mobile phone, PDA
- MP3/4, PMP, GPS
- Portable electronic devices

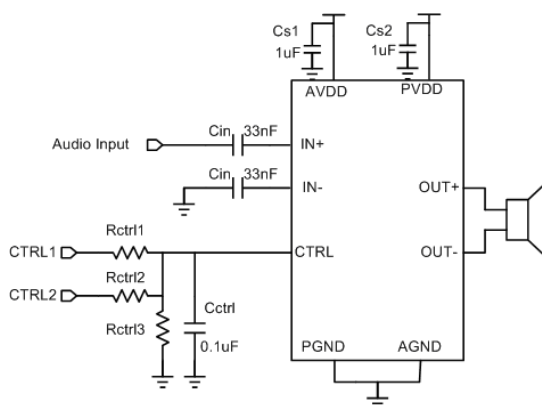
General Description

BL6332 is a 3-W ($V_{DD}=5.0V$, $R_L=4\Omega$) high efficiency filter-free class-D audio power amplifier in a wafer chip scale package (WLCSP).

BL6332 has a "Professional Anti-Clip output control circuit" which reducing distortion of output signal due to either the over level input signal or power supply voltage down with battery.

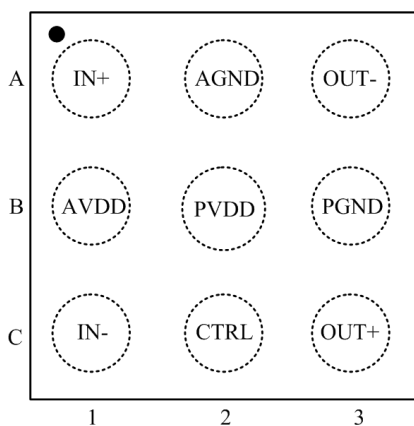
Features like high efficiency, -80dB PSRR, over-current protection and thermal protection function make the BL6332 ideal for cellular handsets.

Typical Application Circuit



Pin Description

Pin Diagrams

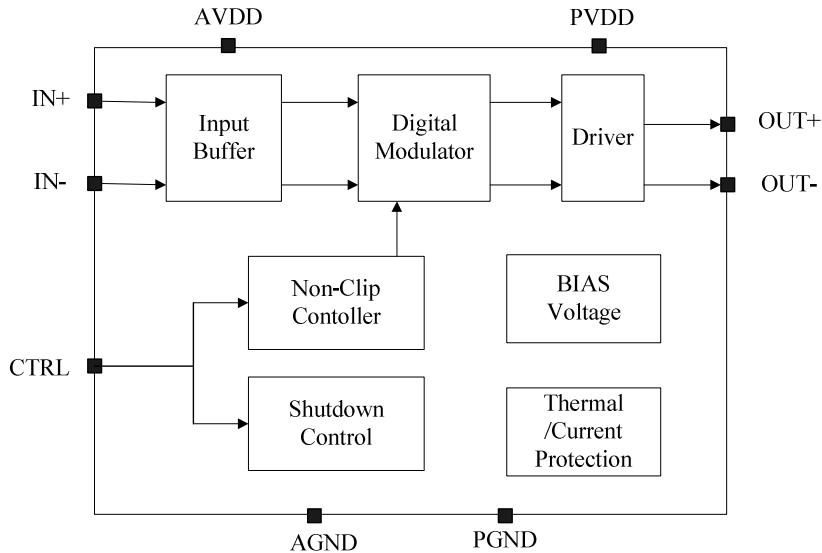


PIN #	Name	Description
A1	IN+	Positive differential input
A2	AGND	Analog GND
A3	OUT-	Negative output terminal
B1	AVDD	Analog Power Supply
B2	PVDD	Power Supply
B3	PGND	Power Ground
C1	IN-	Negative input terminal
C2	CTRL	Mode select
C3	OUT+	Positive output terminal

Order Information

Part Number	Package	Shipping
BL6332	9-Bump WLCSP	3000 pcs / Tape & Reel

Function Block Diagram



Absolute Maximum Ratings (Over operating free-air temperature, unless otherwise noted)

V_{DD}	Supply voltage	-0.3V to 5.5V
V_I	Input voltage	-0.3V to $V_{DD}+0.3V$
T_A	Operation free-air temperate range	-40°C to 120°C
T_J	Operation free-air junction temperature	-40°C to 150°C
T_{STG}	Storage temperature range	-65°C to 150°C
T_{SLD}	Soldering temperature	300°C, 5sec

Recommended Operating Conditions

Symbol	Parameter	Conditions	MIN	TYP	MAX	UNIT
V_{DD}	Power Supply Voltage		2.5		5.0	V
T_a	Operating Ambient Temperature		-20		85	°C
R_L	Speaker Impedance		4			Ω

DC Characteristics ($V_{DD}=2.5V$ to 5 V, $T_a=25^\circ C$, unless otherwise noted.)

Symbol	Parameter	Test Conditions	MIN	TYP	MAX	UNIT
V_{UVLH}	Power Supply Start-up threshold voltage			2.5		V
V_{UVLL}	Power Supply shut-down threshold voltage			1.8		V
V_{MOD1}	Anti-Clip1 mode setting threshold voltage		1.3		V_{DD}	V
V_{MOD2}	Anti-Clip2 mode setting threshold voltage		0.85		1.15	V
V_{MOD3}	Anti-Clip off mode setting threshold voltage		0.5		0.72	V
V_{MOD4}	Power-down mode setting threshold voltage		V_{SS}		0.14	V
I_{DD}	Consumption current	$V_{DD}=3.6V$, no load, no signal input		5		mA
I_{PD}	Consumption current in power-down mode	$CTRL < 0.2V$			1	μA

AC Characteristics ($V_{DD}=2.5V$ to $5V$, $T_a=25^{\circ}C$, unless otherwise noted.)

Symbol	Parameter	Test Conditions	MIN	TYP	MAX	UNIT
t_{STUP}	Start-up time	$V_{DD}=5V$		30		ms
f_c	Input cut-off frequency	$C_{IN}=33nF, A_v=17.5dB$		120		Hz
t_{AT1}	Attack time 1	$V_{DD}=5V, g=10dB$		45		ms
T_{RL1}	Release time 1	$V_{DD}=5V, g=10dB$		3.1		s
t_{AT2}	Attack time 2	$V_{DD}=5V, g=10dB$		10		ms
T_{RL2}	Release time 2	$V_{DD}=5V, g=10dB$		1.8		s
t_{MOD}	Each mode setting time(Except power down)		0.1			ms

Analog Characteristics

($V_{DD}=3.6V$, $A_v=17.5dB$, $T_a=25^{\circ}C$, $C_{IN}=100nF$, Anti-Clip off, unless otherwise noted.)

Symbol	Parameter	Test Conditions	MIN	TYP	MAX	UNIT
P_o	Maximum output	$R_L=4\Omega, V_{DD}=5V$		3		W
		$R_L=8\Omega, V_{DD}=5V$		1.8		W
THD+N	Total Harmonic Distortion Rate	$R_L=4\Omega, P_o=0.5W, f=1KHz$		0.09		%
		$R_L=8\Omega, P_o=0.5W, f=1KHz$		0.09		%
N	Residual Noise	$A_v=17.5dB$ A-Weighted		60		μV_{rms}
SNR	Signal/Noise Ratio	$A_v=17.5dB$ A-Weighted		95		dB
PSRR	Power supply rejection ratio	217Hz		-80		dB
η	Maximum Efficiency	$R_L=8\Omega, P_o=0.6W,$		85		%
		$R_L=8\Omega, P_o=0.1W,$		80		%
V_o	Output offset voltage			± 10		mV
f_{RES}	Frequency characteristics	$C_{IN}=0.1\mu F, f=100Hz$ to $20KHz$	-3		1	dB
GV	Closed Loop Gain	$V_{DD}=5V$ Anti-Clip Off		17.5		dB

Application Information
Anti-Clip Control Function

This is the function to control the output in order to obtain a maximum output level without distortion when an excess input which causes clipping at the differential signal output is applied. That is, with the Anti-Clip function, BL6332 lowers the Gain of the amplifier to an appropriate value so as not to cause the clipping at the differential signal output. And, BL6332 follows also to the clip of the output wave form due to the decrease in the power-supply voltage.

The Attack time and the release time of Anti-Clip control are fixation two levels, and selects with the CTRL terminal. The Attack time is a time interval until from gain falls to target attenuation gain -3dB with a big signal input enough. And the Release time is a time from target attenuation gain to not working of Anti-Clip.

Attack time and Release time

Anti-Clip mode	Attack time	Release time
1(Recommendation)	45ms	3.1s
2	10ms	1.8s

Over-current Protection function

This is the function to establish the over-current protection mode when detecting a short circuit between BL6332 differential output terminal and VSS, VDD, or another differential output. In the over current protection mode, the

differential output terminal becomes a high impedance state. Once the short is removed, the device will be reactivated..

Thermal Protection function

Thermal protection on the BL6332 prevents damage to the device when the internal die temperature exceeds 150°C. There is a $\pm 20^{\circ}\text{C}$ tolerance on this trip point from device to device. Once the die temperature exceeds the thermal set point, the outputs are disabled. This is not a latched fault. The thermal fault is cleared once the temperature of the die is reduced by 20°C. The device begins normal operation at this point with no external system intervention.

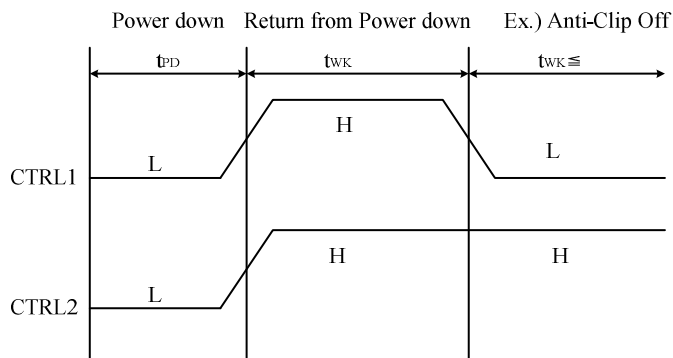
Under Voltage Lock-out (UVLO)

The BL6332 incorporates circuitry designed to detect low supply voltage. When the supply voltage drops to 1.8V or below, the BL6332 outputs are disabled, and the device comes out of this state and starts to normal function when $V_{DD} \geq 2.5\text{V}$.

Power down and Initialization function

When CTRL terminal is connected to the GND potential, the IC goes to the power-down mode. In the mode, all the circuit functions stop and its current consumption becomes the lowest.

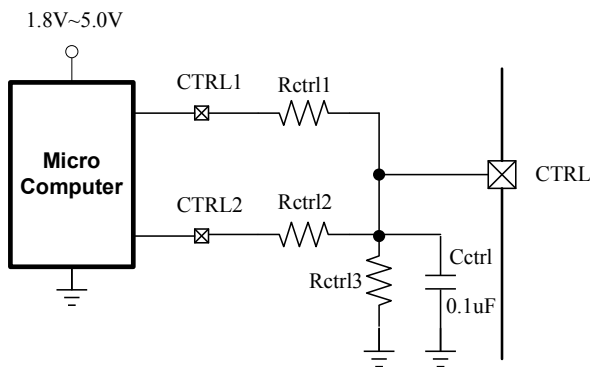
when CTRL terminal is set to H level, the power-down mode is canceled and the IC starts up after startup time (t_{STUP}). In order to return from the power-down mode a desired mode needs to be set after setting both CTRL1 and CTRL2 to H level during t_{WK} . In addition, at startup, cancel the power-down mode after supply voltages has been sufficiently stabilized.



CTRL terminal function

By connection external resistors (R_{ctrl1} , R_{ctrl2} , and R_{ctrl3} : Accuracy of 1%) to CTRL terminal, and impression setting threshold voltage of each mode to CTRL terminal, the followings can be set: Anti-Clip1, Anti-Clip2, Anti-Clip OFF, and power-down mode. When turning on the supply voltage or cancelling the power-down mode, control the CTRL terminal according to the procedure for cancelling power-down.

Connect the terminal to the ground through a capacitor C_{ctrl} (a ceramic capacitor of 0.1 μF or more)



CTRL1	CTRL2	Function
H	H	Anti-Clip 1 mode
H	GND	Anti-Clip 2 mode
GND	H	Anti-Clip off mode
GND	GND	Power-down mode

“H” level indicates a microcomputer’s I/O port H level output voltage that is input to CTRL1 and CTRL2 terminals and GND indicates GND of the microcomputer.

GND level of the microcomputer must be the same as that of BL6332.

The control of CTRL terminal is based on I/O port H level output voltage of microcomputer that is connected.

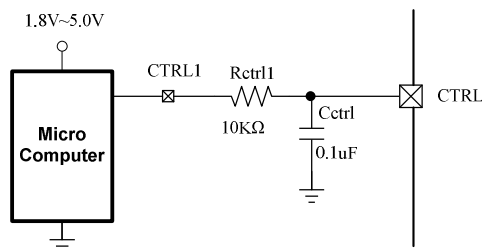
Set resistance constants according the I/O port H level output voltage of each microcomputer as shown below.

I/O port H level output voltage of Microcomputer	1.8V	2.6V	3.0V	3.3V	5.0V
Rctrl1	27KΩ	33KΩ	33KΩ	33KΩ	56KΩ
Rctrl2	43KΩ	51KΩ	51KΩ	51KΩ	82KΩ
Rctrl3	82KΩ	27KΩ	22KΩ	18KΩ	15KΩ

Functions of CTRL pin are designed with their control by two control pins (CTRL1 and CTRL2)

Only a Switching control between Anti-Clip1 mode and Power-down is available when a single control terminal used.

A setting voltage should be set according to VMOD1 and VMOD4, and use a RC filter with time constant of 1msec or more in order to eliminate noise at transmission side such as Micon etc. (Example. Rctrl1=10KΩ and Cctrl=0.1μF).



CTRL1	Function
H	Anti-Clip 1 mode
GND	Power-down mode

POP and Click Circuitry

The BL6332 contains circuitry to minimize click and pops. For the best power-off pop performance, the amplifier should be set in shutdown mode prior to removing the power supply voltage.

Package Information

Unit: Millimeter

