Stereo 2.1W Non-Clip Audio Power Amplifiers

■ General Description

The LN2012 is a digital audio power amplifier IC with maximum output of 2.1W (R_L=4Ω)×2ch, which directly drives speakers while reducing distortion of pulse output signal and reducing noise on the signal, and realizes the highest standard low distortion rate characteristics and low noise characteristics .

The LN2012 detects output signal clip due to the over level input signal and suppress the output signal clip automatically. Also the non-clip output control function can adapt the output clip caused by power supply voltage down with battery. Attack time and release time can be freely set by external resistances or capacitances.

The independent power-down function for L channel and R channel minimizes consumption current at standby. As for protection function, short-current protection function for speaker output terminal, over-temperatue protection function for inside of the device, and low supply voltage malfunction preventing function are prepared.

■ Features

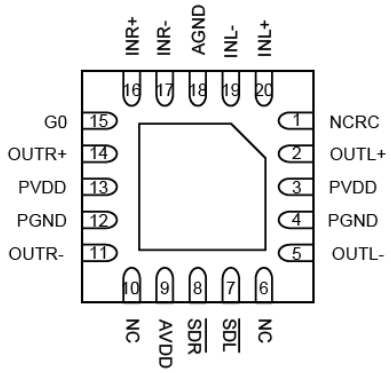
- Maximum output
  2.1 W×2ch (V_{DDP}=V_{DDA}=5.0V, R_L=4Ω, THD+N=1%)
  0.75 W×2ch (V_{DDP}=V_{DDA}=3.6V, R_L=8Ω, THD+N=10%)
- Distortion Rate (THD+N)
  0.03 % (V_{DDP}=V_{DDA}=3.6V, RL=8Ω, Po=0.4W, 1kHz)
- Efficiency
  84 % (V_{DDP}=V_{DDA}=3.6V, R_L=8Ω, P_o==600mW)
- Channel separation
  95dB (V_{DDP}=V_{DDA}=3.6V, R_L=8Ω, A_v=18dB, 1kHz)
- Non-clip output
- 2ch independent power-down control function
- Thermal Protection function

■ Applications

- Multimedia monitors
- Portable and desktop computers
- Portable televisions

■ Package

- QFNWB4×4-20L



QFNWB4*4-20L
(Bottom View)

■ Ordering Information

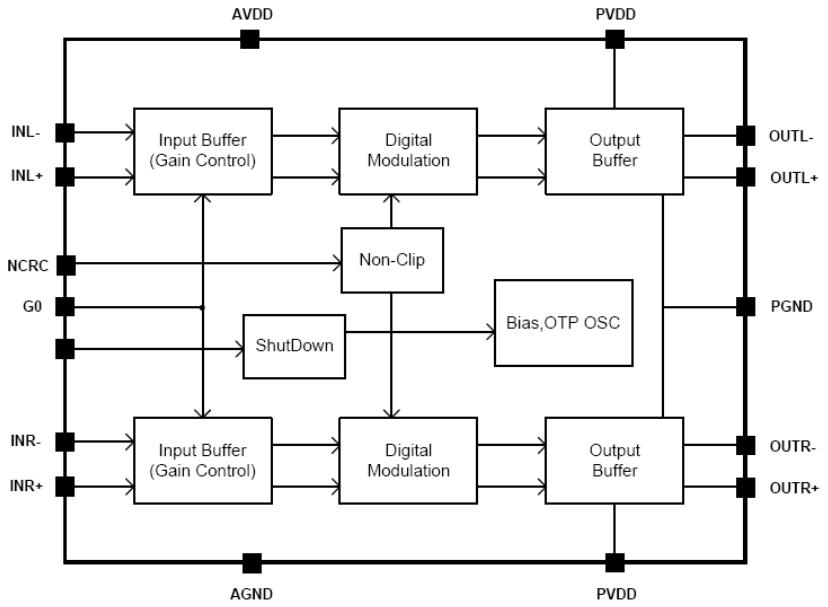
Ordering Number	Package
LN2012SQ	QFNWB4×4-20L

■ Pin Configuration

No.	Name	I/O	Function
1	NCRC	I/O	Non-Clip control terminal
2	OUTL+	O	Positive output terminal (differential +) Lch
3	PVDD	Power	Power supply for output
4	PGND	GND	GND for output
5	OUTL-	O	Negative output terminal (differential -) Lch
6	NC		Non connection or connect to AGND
7	SDL	I	Shut-down terminal for Lch
8	SDR	I	Shut-down terminal for Rch
9	AVDD	Power	Power supply for analog circuits
10	NC		Non connection or connect to AGND
11	OUTR-	O	Negative output terminal (differential -) Rch
12	PGND	GND	GND for output
13	PVDD	Power	Power supply for output
14	OUTR+	O	Positive output terminal (differential +) Rch
15	G0	I	Gain setting terminal
16	INR+	A	Positive input terminal (differential +) Rch
17	INR-	A	Negative output terminal (differential -) Rch
18	AGND	GND	GND for analog circuits
19	INL-	A	Negative input terminal (differential -) Lch
20	INL+	A	Positive input terminal (differential +) Lch

(Note) I: Input terminal ; O: Output terminal ; A: Analog terminal.

■ Function Block Diagram



■ Operating Function

- **First Stage Amplifier Gain Setting Function**

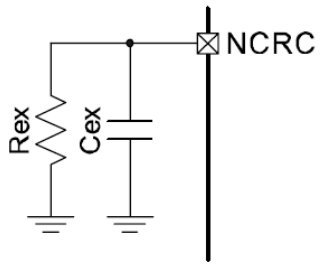
G0 terminal can set the Gain of LN2012. When Non-Clip function is disabled, the relation between G0 terminal setting and Gain is as follows.

G0	Gain	Input Impedance(Z_{in})
L	12dB	44k Ω
H	18dB	28k Ω

- **Non-Clip control Function**

This is the function to control the output in order to obtain a maximum output level without distortion when an excessive input which causes clipping at the differential signal output is applied. LN2012 follows also to the clip of the output wave form due to the decrease in the power-supply voltage.

Connecting a resistor (Rex) and a capacitor (Cex) to NCRC terminal can set Attack Time and Release Time of the Non-Clip control.



Rex(MΩ)	1	4.7	1	1
Cex(uF)	1	1	0.47	4.7
Attack Time (ms)	10	10	4.7	47
Release Time (s)	0.8	3.8	0.38	3.8

■ Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	UNIT
PVDD Voltage Range	V_{DDP}	-0.3	6.0	V
AVDD Voltage Range	V_{DDA}	-0.3	6.0	V
Analog Input terminal Voltage Range	V_{IN}	-0.3	V_{DDA}+0.3	V
Junction Temperature	T_{JMAX}		125	℃
Storage Temperature	T_{STG}	-50	125	℃

■ Electrical Characteristics

- **DC Characteristics**

(V_{DDP}= V_{DDA} =2.7V to 5. 5V, Ta=－40° C to 85° C, unless otherwise specified)

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
AVDD consumption current	I_{DD}	V_{DDA}=3.6, no load		6.0		mA
PVDD consumption current	I_{DD}	V_{DDA}=3.6, no load No signal input		2.0		mA
Power-down current	I_{PD}	SDL=SDR=0			1	uA
SDL, SDR ,G0 H level input voltage	V_{IH}		1.35			V
SDL, SDR ,G0 L level input voltage	V_{IL}				0.35	V

- **AC Characteristics**

(V_{DDP}= V_{DDA} =2.7V to 5. 5V, Ta=－40° C to 85° C, unless otherwise specified)

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
Start-up time	T_{STUP}			3.5		ms
Input cut-off frequency	f_c	C_{IN}=0.1uF, A_V=18dB		57		Hz
Attack time	T_{AT}	V_{DDA}=3.6 A_V=10dB Cex=1uF, Rex=1MΩ		10		ms
Release time	T_{RL}	V_{DDA}=3.6 A_V=10dB Cex=1uF, Rex=1MΩ		0.8		s
Carrier clock frequency	f_{PWM}			500		kHz

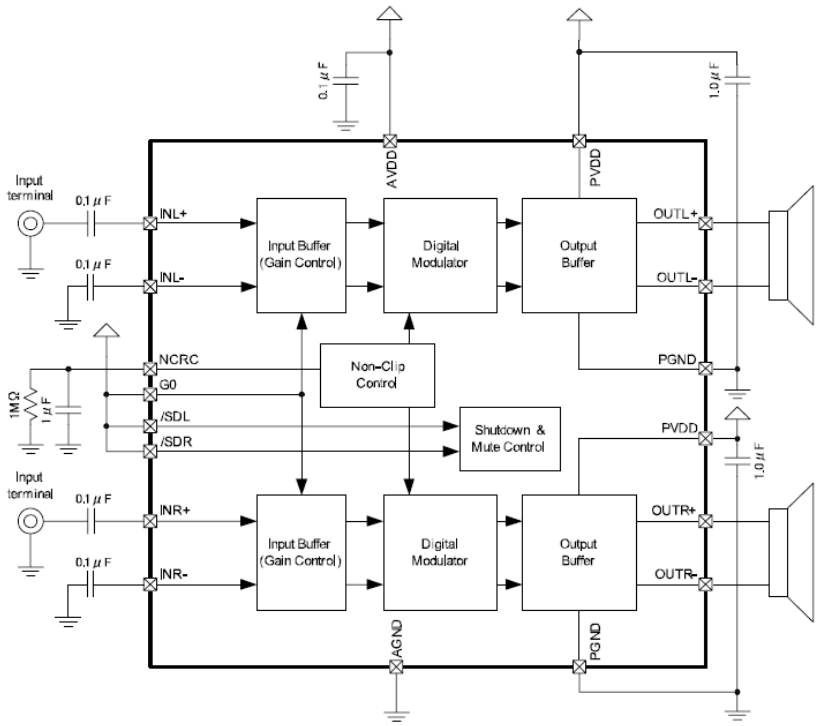
- **Analog Characteristics**

(V_{DDP}= V_{DDA} =3.6V, Ta=25° C, R_L =8Ω, Non-clip off ,unless otherwise specified)

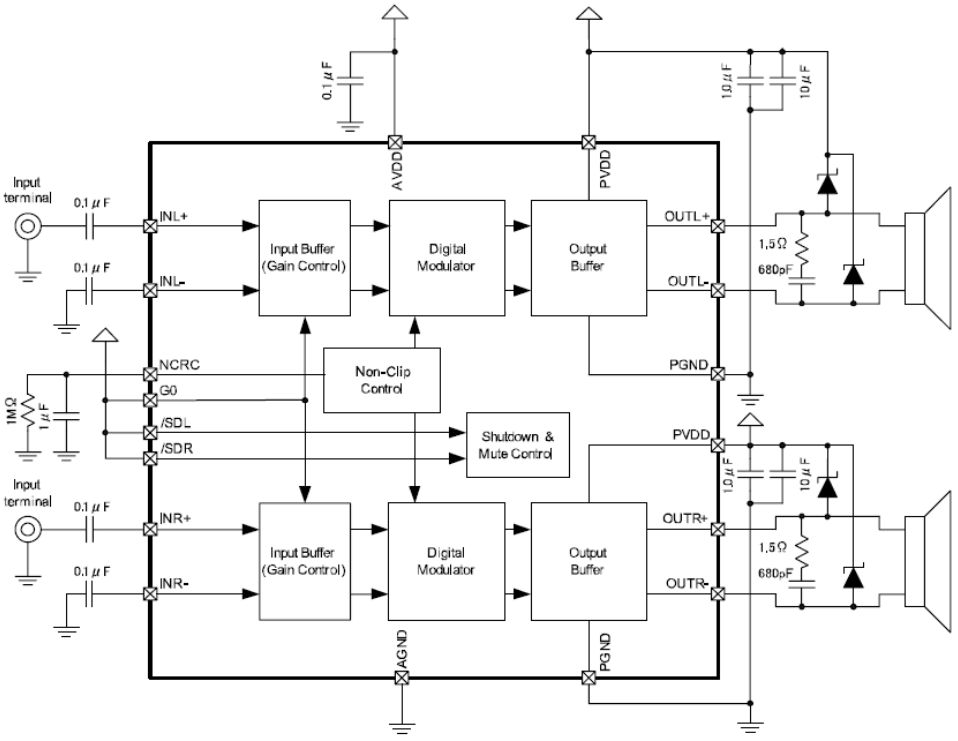
Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
Maximum output	P_O	R_L=4Ω f=1kHz THD+N=10% V_{DDA}=V_{DDP}=5		2.1		W
Voltage Gain	A_V	G0=L		12		dB
		G0=H		18		
THD+Noise		V_{DDA}=3.6 A_V=10dB Cex=1uF, Rex=1MΩ		0.03		%
PSRR		217Hz to PVDD		-85		dB
Non-Clip maximum attenuation gain	A_a			-10		dB

■ Typical Application Circuit

- **Application 1. (2.7V≦PVDD≦4.5V)**

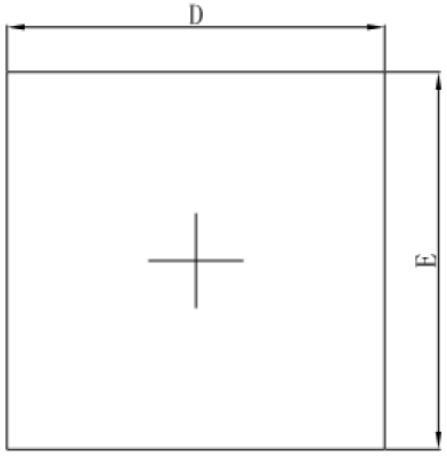


- **Application 2. (4.5V≦PVDD)**

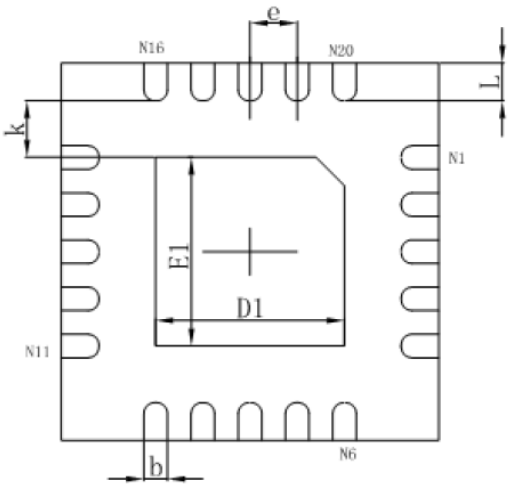


■ Package Information

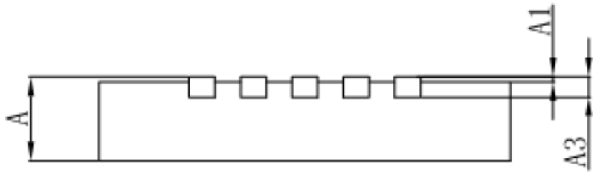
- QFNWB4×4-20L



Top View



Bottom View



Side View

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	0.700/0.800	0.800/0.900	0.028/0.031	0.031/0.035
A1	0.000	0.050	0.000	0.002
A3	0.203REF.		0.008REF.	
D	3.900	4.100	0.154	0.161
E	3.900	4.100	0.154	0.161
D1	1.900	2.100	0.075	0.083
E1	1.900	2.100	0.075	0.083
k	0.200MIN.		0.008MIN.	
b	0.180	0.300	0.007	0.012
e	0.500TYP.		0.020TYP.	
L	0.300	0.500	0.012	0.020