NEXT Lab

Semiconductor Development Group

NXA2103Q

Capacitor less direct headphone driver with Charge pump & LDO

General Description

The NXA2103Q is a stereo headphone drivers designed to allow the removal of the output DC-blocking capacitors for reduced component count and cost. And it is composed to charge pump and LDO. The NXA2103Q is an ideal for small portable electronics where size and cost are critical design parameters. The NXA2103Q is capable of driving 60mW into a 16Ω load at 5.5V. NXA2103Q have a selectable Gain 0dB/6dB. Charge pump & headphone's power is supplied by output of LDO.

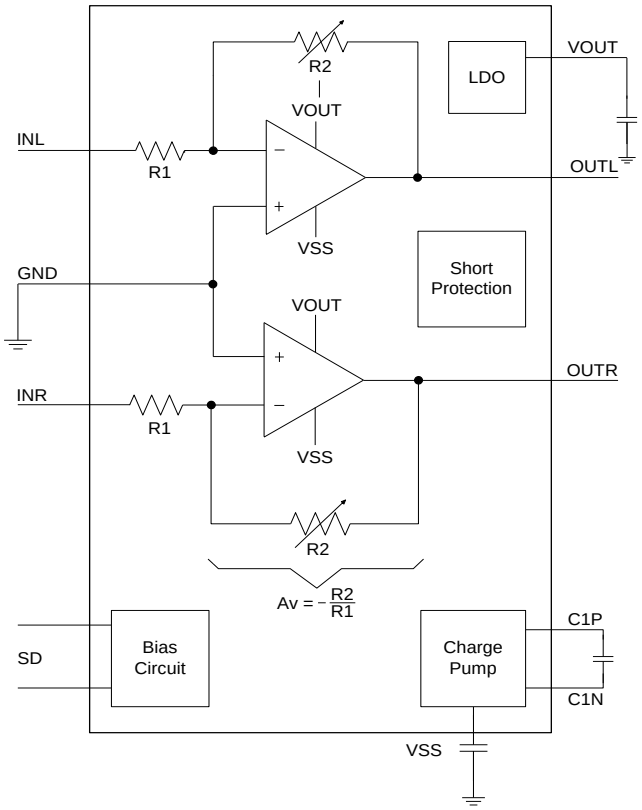
Feature

- Space Saving Package
- Ground-Referenced Outputs Eliminate DC-Bias Voltages on Headphone Ground Pin
- No Output DC-Blocking Capacitors
- Reduced Board Area
- Reduced Component Cost
- Improved THD+N Performance
- No Degradation of Low-Frequency Response Due to Output Capacitors
- Built in charge pump & LDO
- Power Supply Range : 2.5V~5.5V
- 60mW/Ch Output Power into 16Ω at 5.5V
- Selectable Gain
- Short-Circuit and Thermal Protection
- Click and Pop suppression circuit
- QFN-20 4mm*4mm

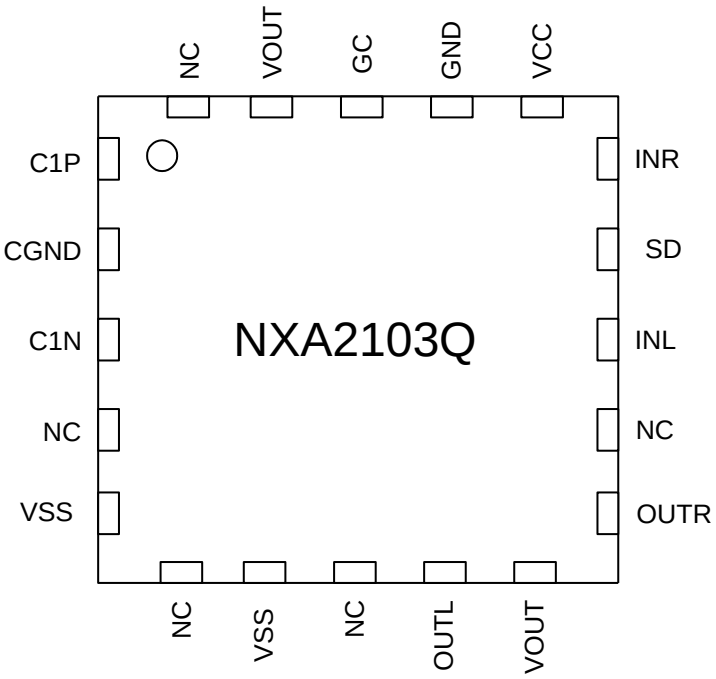
Application

- Notebook Computers
- CD / MP3 Players
- Smart Phones
- Cellular Phones

Block Diagram



Terminal assignment



Pin description

Pin Name	Pin No.	I/O	Description
C1P	1	I/O	Charge pump flying capacitor positive terminal
CGND	2	S	Power ground (connect to GND)
C1N	3	I/O	Charge pump flying capacitor negative terminal
NC	4		No connection
VSS	5	I/O	Output from negative charge pump / HP_amp negative supply
NC	6		No connection
VSS	7	I/O	Output from negative charge pump / HP_amp negative supply
NC	8		No connection
OUTL	9	O	Left audio channel output signal
VOUT	10	I/O	Regulator output / HP_amp positive supply
OUTR	11	O	Right audio channel output signal
NC	12		No connection
INL	13	I	Left audio channel input signal
SD	14	I	shutdown, active low logic
INR	15	I	Right audio channel input signal
VCC	16	S	Supply voltage
GND	17	I	Signal ground (connect to GND)
GC	18	I	Gain control (H:0dB, L:6dB, Pull-down)
VOUT	19	I/O	Regulator output / HP_amp positive supply
NC	20		No connection

Maximum Absolute ratings

over operation free-air temperature range, T_A=25℃ (unless otherwise noted)

Parameter	Symbol	Value	Unit
Supply voltage	VDD	-0.3~6.0	V
Input voltage	V_I	-0.3~V_{DD}+0.3	V
Operating free-air temperature range	T_A	-40~85	℃
Operating junction temperature range	T_J	-40~150	℃
Storage temperature range	T_{stg}	-65~85	℃

Recommended Operating Conditions

Parameter	Symbol	Value		Unit
		min	max	
Supply voltage	VDD	2.5	5.5	V
High-level input voltage (SD)	V_{IH}	1.4		V
Low-level input voltage (SD)	V_{IL}		0.4	V
Operating free-air temperature	T_A	-40	85	℃

Electrical Characteristics

Ta=25.0℃ (Unless otherwise noted)

Characteristics	Symbol	Condition	Value			Unit
			min	typ	max	
Output offset voltage	VOS	V_{DD}=1.8V~5.5V, Inputs grounded		± 1.0	± 5.0	mV
Power Supply Rejection Ratio	PSRR	V_{DD}=1.8V~5.5V		-95		dB
High-level output voltage	V_{OH}	V_{DD}=3V, R_L=16Ω		1.5		V
Low-level output voltage	V_{OL}	V_{DD}=3V, R_L=16Ω		-1.5		V
High-level input current(SD)	$\|I_{IH}\|$	V_{DD}=5.5V, VI=V_{DD}			1.0	uA
Low-level input current(SD)	$\|I_{IL}\|$	V_{DD}=5.5V, VI=0V			1.0	uA
Supply Current	I_{DD}	V_{DD}=1.8V, No load, SD=V_{DD}		4.8		mA
		V_{DD}=3V, No load, SD=V_{DD}		6.4		
		V_{DD}=5.5V, No load, SD=V_{DD}		6.4		
		Shutdown mode, V_{DD}=1.8V~5.5V			1.0	uA

Operating Characteristics

VDD=3V, TA=25℃, RL=16Ω (unless otherwise noted)

Characteristics	Symbol	Condition	Value			Unit
			min	typ	max	
Output power	Po	THD=1%, VDD=3V, f=1kHz		60		mW
		THD=1%, VDD=5.5V, f=1kHz		60		
		THD=1%, VDD=3V, f=1kHz, RL=32Ω		40		
Total harmonic distortion + Noise	THD+N	Po=10mW, f=1kHz		0.05		%
		Po=10mW, f=20Hz		0.02		
Cross Talk	CT	Po=20mW, f=1kHz		-75		dB
Closed-loop voltage gain	Av	0dB 6dB	-0.95 -1.90	-1.0 -2.0	-1.05 -2.10	V/V
Gain matching	△Av			1		%
Slew rate	SR			2.2		V/us
Noise output voltage	Vn	A-weighted, 0dB, inputs terminated to GND, output referred Gain=0dB,6dB		10 15		uVRMS
Start-up time from shutdown				100		us
Input impedance				15		kΩ
Signal-to-Noise-Ratio	SNR	Po=40mW		98		dB
Mute attenuation		Shutdown Mode		-80		dB
Thermal shutdown		Threshold		150		℃
		Hysteresis		30		℃

Charge Pump & LDO

Characteristics	Symbol	Condition	Value			Unit
			min	typ	max	
CHARGE PUMP						
Oscillator Frequency	fosc			450		kHz
LDO						
LDO Operating voltage			2.5		5.5	V
LDO Output voltage				2.5		V

Application Note

Headphone Amplifiers

Single-supply headphone amplifiers typically require dc-blocking capacitors. If the dc bias is not removed, the output signal is severely clipped, and large amounts of dc current rush through the headphones, potentially damaging them.

Input-Blocking Capacitors

DC input-blocking capacitors are required to be added in series with the audio signal into the input pins of the NXA2103Q. These capacitors block the DC portion of the audio source and allow the NXA2103Q inputs to be properly biased to provide maximum performance. These capacitors form a high-pass filter with the input impedance of the NXA2103Q. The capacitance used is the input-blocking capacitor and the resistance is the input impedance of the NXA2103Q. Because the gains of the NXA2103Q are fixed, the input impedance remains a constant value.

Charge Pump Flying Capacitor and VSS Capacitor

The NXA2103Q feature use charge pump. The charge pump flying capacitor serves to transfer charge during the generation of the negative supply voltage. The VSS capacitor must be at least equal to the charge pump flying capacitor in order to allow maximum charge transfer. Low ESR capacitors are an ideal selection, and a value of 2.2μF is typical.

Decoupling Capacitors

The NXA2103Q is direct path headphone amplifiers that require adequate power supply decoupling to ensure that the noise and total harmonic distortion(THD) are low. A good low ESR ceramic capacitor, typically 2.2uF, placed as close as possible to the device VDD lead works best. Placing this decoupling capacitor frequency noise signals, a greater capacitor placed near the audio power amplifier would also help.

Exposed Pad On NXA2103Q

The pad on the PCB should be allowed to float and not be connected to VSS or power. Connecting this pad to VSS or power prevents the device from working properly because it is connected internally to Ground.

GND and CGND Connections

The GND and CGND pins of the NXA2103Q must be routed separately back to the decoupling capacitor in order to provide proper device operation. If the GND and CGND pins are connected directly to each other, the part functions without risk of failure, but the noise and THD performance do not meet the specifications.

Application Circuit