



MD3203N
Filterless 3W Class-D Stereo Audio Amplifier

MD3203N
Class-D Stereo Audio Amplifier
Datasheet
Version 2.1

ShenZhen ChipSourceTek Technology Co. ,Ltd.

TEL: +86-0755-27595155 27595165 FAX: +86-0755-27594792

Room 613, No B Xingxinyuan Business Building, baomin 2nd road, Bao'an Zone, Shenzhen city, China

For detailed product information, please contact wyl_use@163.com Tony.Wang@ChipSourceTek.com

Tel: +86-0755-27595155 27595165

Fax: +86-0755-27594792

Address: Room 613, No B Xingxinyuan Business Building, baomin 2nd road, Bao'an Zone, Shenzhen city, China

Web: [Http:// www.ChipSourceTek.com](http://www.ChipSourceTek.com)



MD3203N Filterless 3W Class-D Stereo Audio Amplifier

Key Features

- ✧ 3W Output at 10% THD with a 4Ω Load and 5V Power Supply
- ✧ Filterless, Low Quiescent Current and Low EMI
- ✧ High Efficiency up to 90%
- ✧ Superior Low Noise
- ✧ Short Circuit Protection
- ✧ Thermal Shutdown
- ✧ Mute ON/OFF
- ✧ Few External Components to Save Space and Cost
- ✧ SOP-16 Packages Available
- ✧ Pb-Free Package

General Description

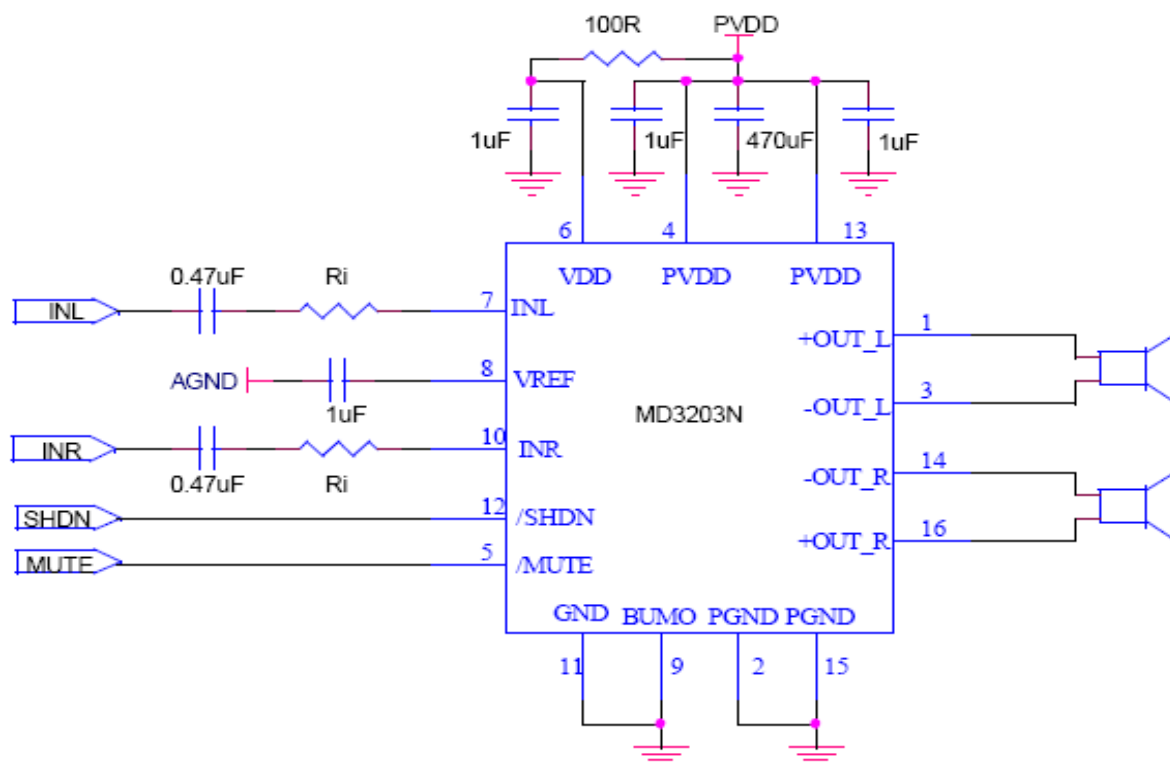
The MD3203N is a 3w class-D audio amplifier. Its low THD+N feature offers high-quality sound reproduction. The new filterless architecture allows the device to drive speaker directly instead of using low-pass output filters, therefore save system cost and PCB area.

With the same number of external components, the efficiency of the MD3203N is much better than that of class-AB cousins. It can optimize battery life thus is ideal for portable applications.

Applications

- ✧ LCD Monitors / TV Projectors
- ✧ Notebook Computers
- ✧ Portable Speakers
- ✧ Walkie Talkie
- ✧ Handsfree phones/Speaker Phones
- ✧ Cellular Phones

Common Application



Tel: +86-0755-27595155 27595165

Fax: +86-0755-27594792

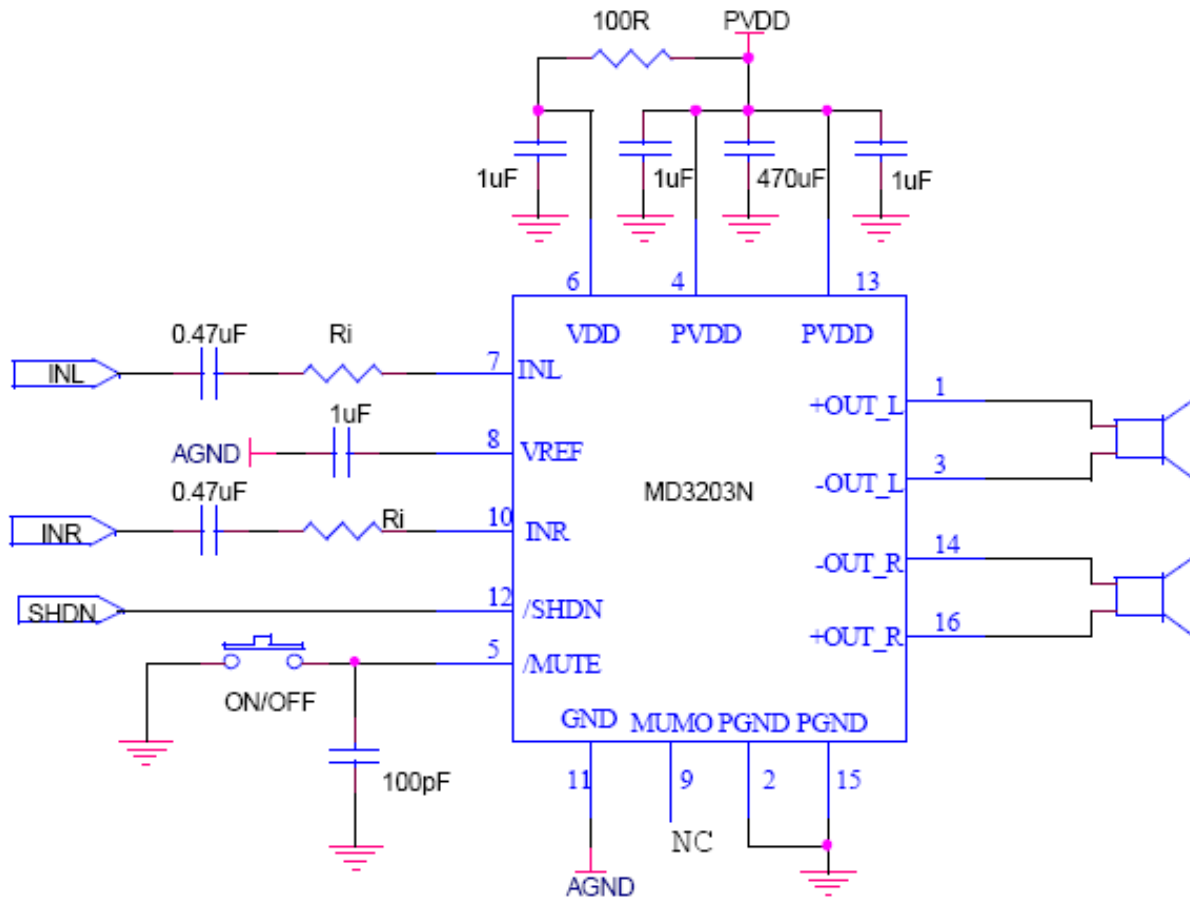
Address: Room 613, No B Xingxinyuan Business Building, Baomin 2nd road, Bao'an Zone, Shenzhen city, China

Web: [Http:// www.ChipSourceTek.com](http://www.ChipSourceTek.com)



MD3203N Filterless 3W Class-D Stereo Audio Amplifier

Mute ON/OFF Application



Tel: +86-0755-27595155 27595165

Fax: +86-0755-27594792

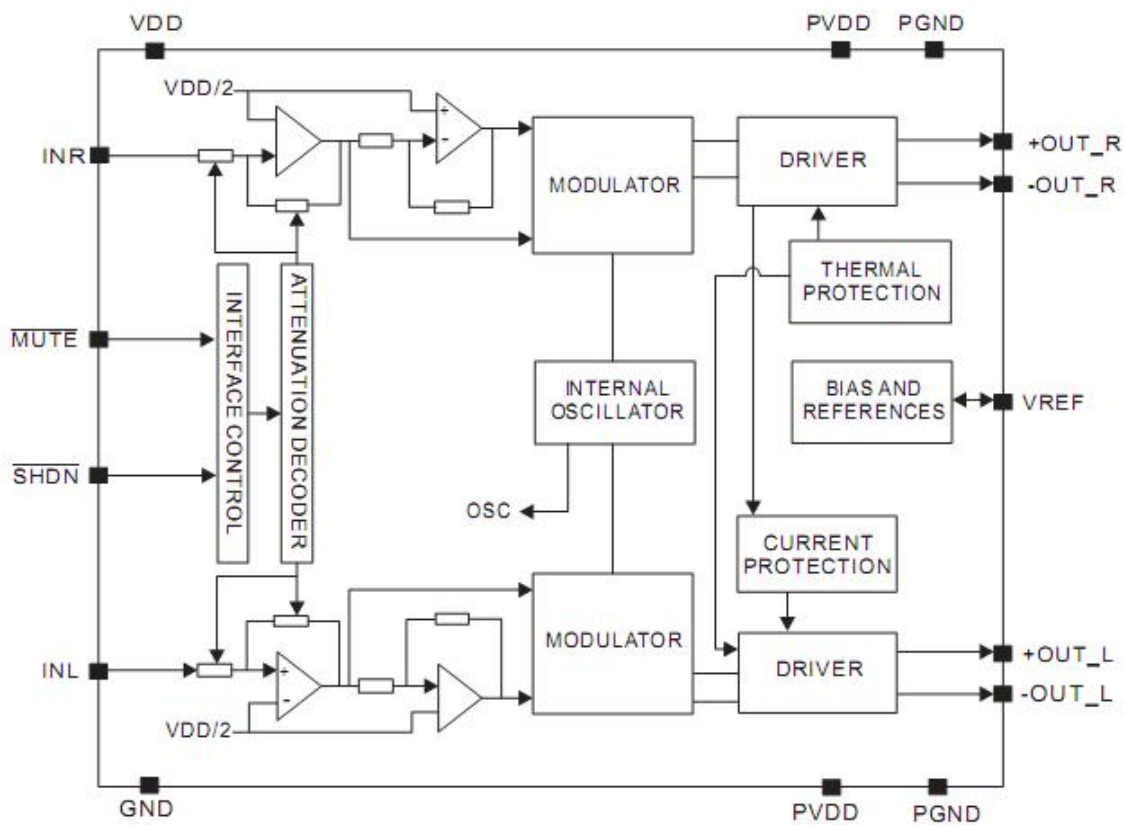
Address: Room 613, No B Xingxinyuan Business Building, baomin 2nd road, Bao'an Zone, Shenzhen city, China

Web: [Http:// www.ChipSourceTek.com](http://www.ChipSourceTek.com)



MD3203N Filterless 3W Class-D Stereo Audio Amplifier

Block Diagram



Pin Configuration & Marking Information

Tel: +86-0755-27595155 27595165

Fax: +86-0755-27594792

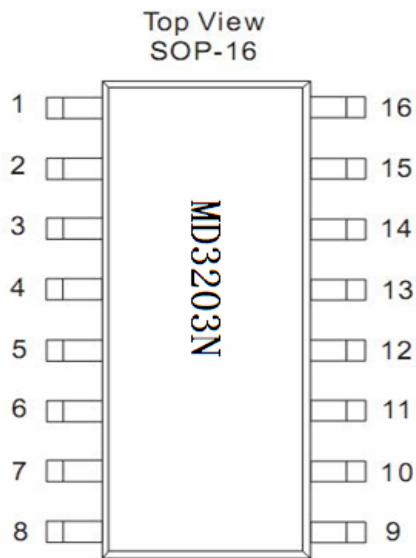
Address: Room 613, No B Xingxinyuan Business Building, Baomin 2nd road, Bao'an Zone, Shenzhen city, China

Web: [Http:// www.ChipSourceTek.com](http://www.ChipSourceTek.com)



MD3203N

Filterless 3W Class-D Stereo Audio Amplifier



4J

Pin Descriptions

MD3203N SOP16		
Pin Numbe	Pin Name	Description
1	+ OUT_L	Left Channel Positive Output
2	PGND	Power GND
3	-OUT_L	Left Channel Negative Output
4	PVDD	Power VDD
5	/MUTE	When BUMO is NC, Mute Control Input; When BUMO is connect to GND, Mute ON/OFF Mode
6	VDD	Analog VDD
7	INL	Left Channel Input
8	VREF	Internal analog reference, connect a bypass capacitor from VREF to GND
9	BUMO	Mute ON/OFF Mode(active when it NC)
10	INR	Right Channel Input
11	GND	Analog GND
12	/SHDN	Shutdown Control Input(active low), pull-down
13	PVDD	Power VDD
14	-OUT_R	Right Channel Negative Output
15	PGND	Power GND
16	+OUT_R	Right Channel Positive Output

Tel:+86-0755-27595155 27595165

Fax:+86-0755-27594792

Address:: Room 613, No B Xingxinyuan Business Building, baomin 2nd road, Bao'an Zone, Shenzhen city, China

Web:Http:// www.ChipSourceTek.com



MD3203N

Filterless 3W Class-D Stereo Audio Amplifier

Absolute Maximum Ratings

These are stress ratings only and functional operation is not implied. Exposure to absolute maximum ratings

Supply Voltage6.0V
Input Voltage.....-0.3V to $V_{DD}+0.3V$
Operation Temperature Range.....-40°C to 85°C
Maximum Junction Temperature.....150°C

periods may affect device reliability. All voltages are with respect to ground. for prolonged time

Operation Junction Temperature.....-40°C to 125°C
Storage Temperature.....-65°C to 150°C
Soldering Temperature.....300°C, 5sec

Recommended Operating Conditions

Supply voltage Range.....2.5V to 5.5V

Operation Temperature Range.....-40°C to 85°C
Junction Temperature Range.....-40°C to 125°C

Thermal Information

Parameter	Symbol	Package	Maximum	Unit
Thermal Resistance (Junction to Ambient)	θ_{JA}	SOP-16	110	°C/W
Thermal Resistance (Junction to Case)	θ_{JC}	SOP-16	23	°C/W

Symbol	Parameter	Test Conditions		MIN	TYP	MAX	UNIT
V_{IN}	Supply Power			2.5		5.5	V
P_o	Output Power	THD+N=10%,f=1kHz, R=4 Ω	VDD=5.0V		3.2		W
			VDD=3.6V		1.6		
			VDD=3.0V		1.3		
		THD+N=1%,f=1kHz, R=4 Ω	VDD=5.0V		2.5		W
			VDD=3.6V		1.3		
			VDD=3.0V		0.85		
		THD+N=10%,f=1kHz,R=8 Ω	VDD=5.0V		1.8		W
			VDD=3.6V		0.9		
			VDD=3.0V		0.6		
		THD+N=1%,f=1kHz,R=8 Ω	VDD=5.0V		1.4		W
			VDD=3.6V		0.72		
			VDD=3.0V		0.45		
THD+N	Total Harmonic Distortion Plus Noise	VDD=5.0V,Po=0.5W,R=8 Ω	f=1kHz		0.15		%
		VDD=3.6V,Po=0.5W,R=8 Ω			0.11		
		VDD=5.0V,Po=1W,R=4 Ω	f=1kHz		0.15		%
		VDD=3.6V,Po=1W,R=4 Ω			0.11		
Gv	Gain				24		dB

Tel:+86-0755-27595155 27595165

Fax:+86-0755-27594792

Address:: Room 613,No B Xingxinyuan Business Building,baomin 2nd road,Bao'an Zone,Shenzhen city,China

Web:Http:// www.ChipSourceTek.com



MD3203N

Filterless 3W Class-D Stereo Audio Amplifier

PSRR	PSRR Power Supply Ripple Rejection	$V_{DD}=5V$, Inputs ac-grounded with $C_{IN}=0.47\mu F$	$f=100Hz$		-59		dB
			$f=1kHz$		-58		
Cs	Crosstalk	$V_{DD}=3.6V, P_o=1W, R_L=4\Omega$	$f=1kHz$		-95		dB
SNR	Signal-to-noise ratio	$V_{DD}=5V, V_{rms}=1V, G_v=20dB$	$f=1kHz$		80		dB
Vn	Output noise	$V_{DD}=5V$, Inputs ac-grounded with $C_{IN}=0.47\mu F$	A-weighting		100		μV
			NoA-weighting		150		
Dyn	Dynamic range	$V_{DD}=5.0V, THD=1\%$	$f=1kHz$		90		dB
η	Efficiency	$R_L=8\Omega, THD=10\%$	$f=1kHz$		87		%
		$R_L=4\Omega, THD=10\%$			83		
IQ	Quiescent Current	$V_{DD}=5.0V$	Noload		16		mA
		$V_{DD}=3.6V$			10		
		$V_{DD}=3.0V$			8		

Electrical Characteristic (Continued)

$V_{DD}=5V$ Gain=24dB, $R_L=8\Omega$, $T_A=25^\circ C$, unless otherwise noted.

Symbol	Parameter	Test Conditions		MIN	TYP	MAX	UNIT
I_{MUTE}	Muting Current	$V_{DD}=5.0V$	$V_{MUTE}=0.3V$		3.5		mA
I_{SD}	Shutdown Current	$V_{DD}=2.5V$ to $5.5V$	$V_{SD}=0.3V$		<1		μA
Rdson	Static Drain-to-source On-state Resistor	$I_{DS}=500mA, V_{GS}=5V$	PMOS		180		m Ω
			NMOS		140		
fsw	Switching Frequency	$V_{DD}=3V$ to $5V$			260		kHz
Vos	Output Offset Voltage	$V_{in}=0V, V_{DD}=5V$			10		mV
V _{IH}	Enable Input High Voltage	$V_{DD}=5.0V$		1.5	1.4		V
V _{IL}	Enable Input Low Voltage	$V_{DD}=5.0V$			0.7	0.4	
V _{IH}	MUTE Input High Voltage	$V_{DD}=5.0V$		1.5	1.4		V
V _{IL}	MUTE Input Low Voltage	$V_{DD}=5.0V$			0.7	0.4	
OTP	Over Temperature Protection	No Load, Junction Temperature	$V_{DD}=5V$		140		$^\circ C$
OTH	Over Temperature Hysteresis				30		

Tel: +86-0755-27595155 27595165

Fax: +86-0755-27594792

Address: Room 613, No B Xingxinyuan Business Building, Baomin 2nd road, Bao'an Zone, Shenzhen city, China

Web: [Http:// www.ChipSourceTek.com](http://www.ChipSourceTek.com)

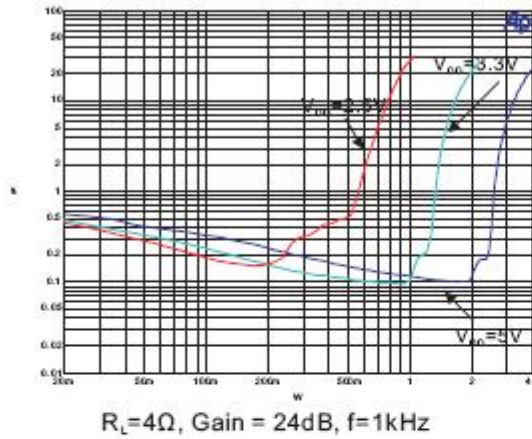


MD3203N

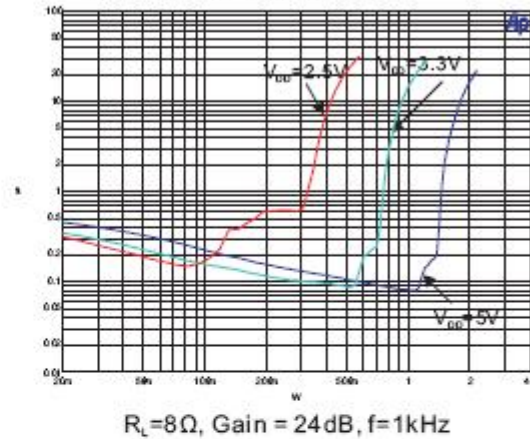
Filterless 3W Class-D Stereo Audio Amplifier

Typical Operating Characteristics ($T_A=25^\circ\text{C}$)

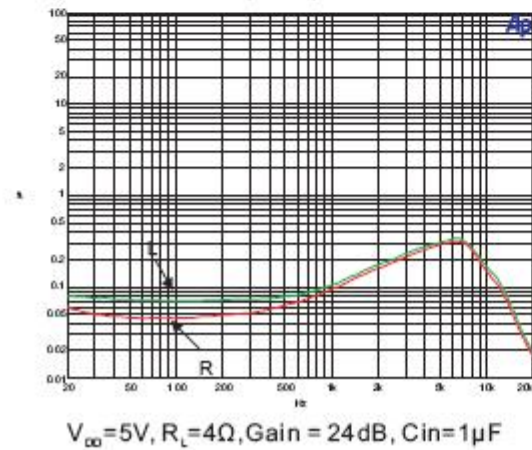
1. THD+N vs Output Power



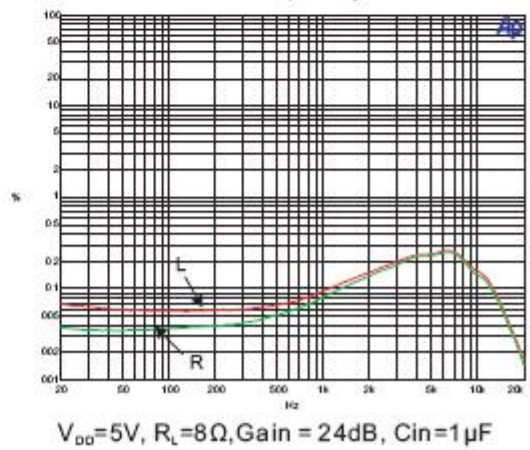
2. THD+N vs Output Power



3. THD+N vs Frequency



4. THD+N vs Frequency

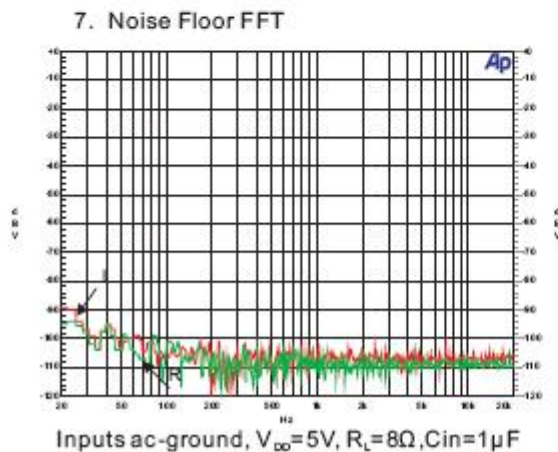
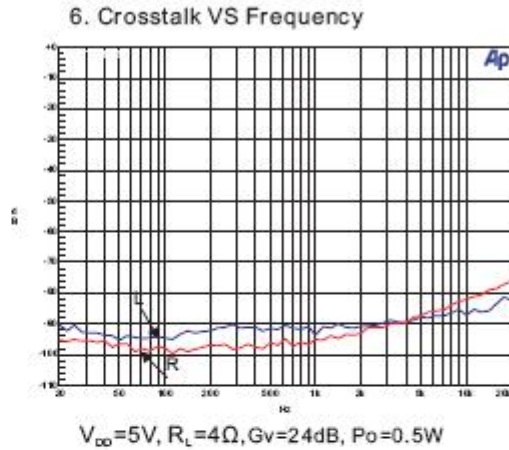
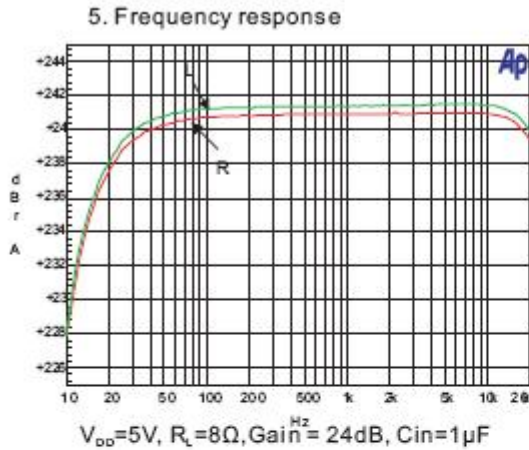




MD3203N

Filterless 3W Class-D Stereo Audio Amplifier

Typical Operating Characteristics (continued)



Application Notes

1. When the MD3203N works with LC filters, it should be connected with the speaker before it's powered on, otherwise it will be damaged easily.
2. When the MD3203N works without LC filters, it's better to add a ferrite chip bead at the outgoing line of speaker for suppressing the possible electromagnetic interference.
3. The recommended operating voltage is 5.5V. When the MD3203N is powered with 4 battery cells, it should be noted that the voltage of 4 new dry or alkaline batteries is over 6.0V, higher than its operation voltage, which will

device. Therefore, it's recommended to use either 4 NI-MH(Nickel Metal Hydride)rechargeable batteries or 3 dry or alkaline batteries.

4. One should not make the input signal too large. Large signal can cause the clipping of output signal when increasing the volume. This will damage the device because of big gain of the MD3203N

5. When testing the MD3203N without LC filters by using resistor instead of speaker as the output load, the test results, e.g. THD or efficiency, will be worse than those of using speaker as load.

Tel: +86-0755-27595155 27595165

Fax: +86-0755-27594792

Address: Room 613, No B Xingxinyuan Business Building, baomin 2nd road, Bao'an Zone, Shenzhen city, China

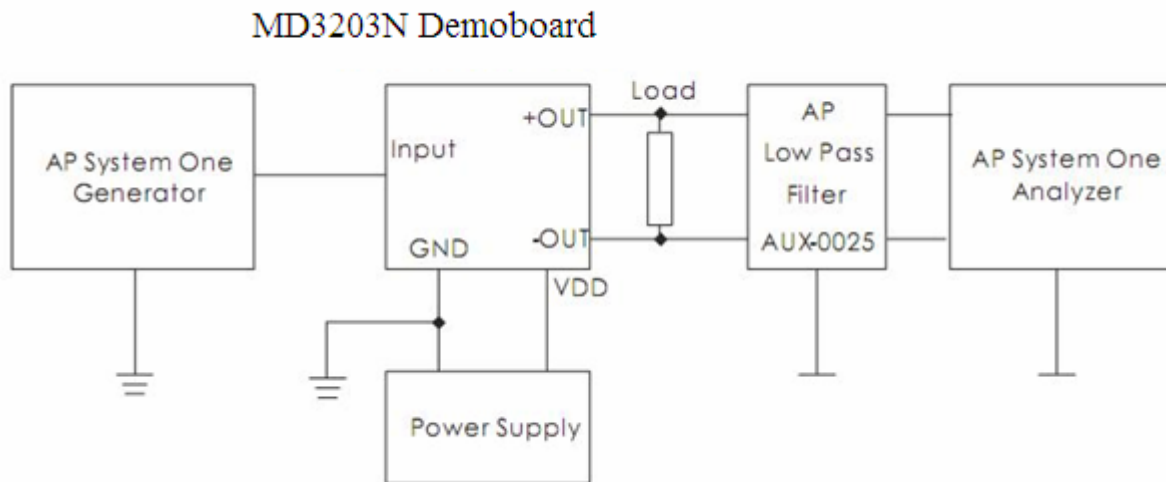
Web: [Http:// www.ChipSourceTek.com](http://www.ChipSourceTek.com)



MD3203N

Filterless 3W Class-D Stereo Audio Amplifier

Test Setup for Performance Testing



Notes

1. The AP AUX-0025 low pass filter is necessary for class-D amplifier measurement with AP analyzer.

2. Two 22μH inductors are used in series with load resistor to emulate the small speaker for efficiency measurement.

Application Information

Maximum Gain

As shown in block diagram (page 2), the MD3203N has two internal amplifier stages. The first stage's gain is externally configurable, while the second stage's is internally fixed. The closed-loop gain of the first stage is set by selecting the ratio of R_f to R_i while the second stage's gain is fixed at 2x. The output of amplifier 1 serves as the

input to amplifier 2, thus the two amplifiers produce signals identical in magnitude, but different in phase by 180°. Consequently, the differential gain for the IC is $A_{vd} = 20 \cdot \log[2 \cdot (R_f/R_i)]$. The MD3203 sets maximum $R_f = 142k\Omega$, minimum $R_i = 18k\Omega$, so the maximum closed-gain is 24dB.

Mute Operation

The MUTE pin is an input for controlling the output state of the MD3203N. When the BUMO is connected to GND, a logic low on this pin disables the outputs, and a logic high on this pin enables the outputs. This pin may be used as quick disable or

enable of the outputs without a volume fade. When the BUMO is NC, into Mute ON/OFF mode. Quiescent current is listed in the electrical characteristic table. The MUTE pin can be left floating due to the internal pull-up.

Shutdown operation

In order to reduce power consumption while not in use, the MD3203N contains shutdown circuitry to turn off the amplifier's bias circuitry. This shutdown

is applied to the SHDN pin. By switching the SHDN pin connected to GND, the MD3203N supply current draw will be minimized in idle mode. The SHDN pin can be left

Tel: +86-0755-27595155 27595165

Fax: +86-0755-27594792

Address: Room 613, No B Xingxinyuan Business Building, Baomin 2nd road, Bao'an Zone, Shenzhen city, China

Web: [Http:// www.ChipSourceTek.com](http://www.ChipSourceTek.com)



MD3203N

Filterless 3W Class-D Stereo Audio Amplifier

feature turns the amplifier off when logic low is

Power supply decoupling

The MD3203N is a high performance CMOS audio amplifier that requires adequate power supply decoupling to ensure the output THD and PSRR as low as possible. Power supply decoupling affects low as possible. Power supply decoupling affects low frequency response. Optimum decoupling is achieved by using two capacitors of different types targeting to different types of noise on the power supply leads. For higher

Input Capacitor (C_i)

Large input capacitors are both expensive and space hungry for portable designs. Clearly, a certain sized capacitor is needed to couple in low frequencies without severe attenuation. But in many cases the speakers used in portable systems, whether internal or external, have little ability to reproduce signals below 100Hz to 150Hz. Thus, using a large input capacitor may not increase actual system performance. In this case, input capacitor (C_i) and input resistance (R_i) of the amplifier form a high-pass

Analog Reference Bypass Capacitor (C_{BYP})

The analog Reference Bypass Capacitor (C_{BYP}) is the most critical capacitor and serves several important functions. During start-up or recovery from shutdown mode, C_{BYP} determines the rate at which the amplifier starts up. The second function is to reduce noise caused by the power supply coupling into the output drive signal. This noise is from the internal analog

floating due to the internal pull-up.

frequency transients, spikes, or digital has on the line, a good low equivalent-series-resistance (ESR) ceramic capacitor, typically 1.0 μ F, works best, placing it as close as possible to the device V_{DD} terminal. For filtering lower-frequency noise signals, a large capacitor of 20 μ F (ceramic) or greater is recommended, placing it near the audio power amplifier.

filter with the corner frequency determined by equation below, $f_c = 1/2\pi R_i C_i$ in addition to system cost and size, click and pop performance is affected by the size of the input coupling capacitor C_i . A larger input coupling capacitor requires more charge to reach its quiescent DC voltage (nominally $1/2 V_{DD}$). This charge comes from the internal circuit via the feedback and is apt to create pops upon device enable. Thus, by minimizing the capacitor size based on necessary low frequency response, turn-on pops can be minimized.

reference to the amplifier, which appears as degraded PSRR and THD+N.

A ceramic bypass capacitor (C_{BYP}) with values of 0.47 μ F to 1.0 μ F is recommended for the best THD and noise performance. Increasing the bypass capacitor reduces clicking and popping noise from power on/off and entering and leaving shutdown.



MD3203N

Filterless 3W Class-D Stereo Audio Amplifier

Under Voltage Lock-out (UVLO)

The MD3203N incorporates circuitry designed to detect low supply voltage. When the supply voltage drops to 2.0V or below, the MD3203 outputs are disabled, and the device comes out of this state and starts to normal function when $V_{CC} \geq 2.2V$.

Short Circuit Protection (SCP)

The MD3203N has short circuit protection circuitry on the outputs to prevent damage to the device when output-to-output or output-to-GND short occurs. When a short circuit is detected on the outputs, the outputs are disabled immediately. If the short was removed, the device activates again.

Over Temperature Protection

Thermal protection on the MD3203N prevents the device from damage when the internal die temperature exceeds 140°C. There is a 15 degree tolerance on this trip point from device to device. Once the die temperature exceeds the thermal set point, the device outputs are disabled. This is not a latched fault. The thermal fault is cleared once the temperature of the die is reduced by 30°C. This large hysteresis will prevent motor boating sound well and the device begins normal operation at this point without external system intervention.

How to Reduce EMI (Electro Magnetic Interference)

A simple solution is to put an additional capacitor 1000μF at power supply terminal for power line coupling if the traces from amplifier to speakers are short (<20cm).

Most applications require a ferrite bead filter as shown in Figure 2. The ferrite filter reduces EMI of around 1 MHz and higher. When selecting a ferrite bead, choose one with high impedance at high frequencies, and low impedance at low frequencies.

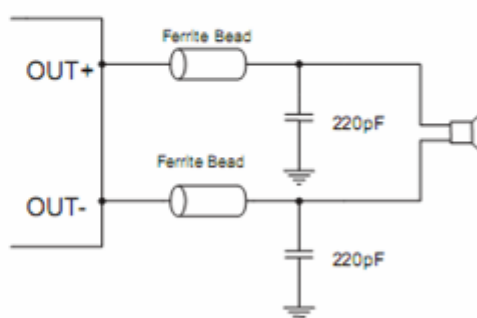


Figure 2: Ferrite Bead Filter to reduce EMI

Ordering Information

MD3203N X.X

Shipping Package

Package Type

Part Number	Marking	Package Type	MOQ/Shipping Package
MD3203N	MD3203N 1030Y	SOP-16	2,500 Units/Tape&Reel

Tel:+86-0755-27595155 27595165

Fax:+86-0755-27594792

Address: Room 613, No B Xingxinyuan Business Building, baomin 2nd road, Bao'an Zone, Shenzhen city, China

Web: Http:// www.ChipSourceTek.com

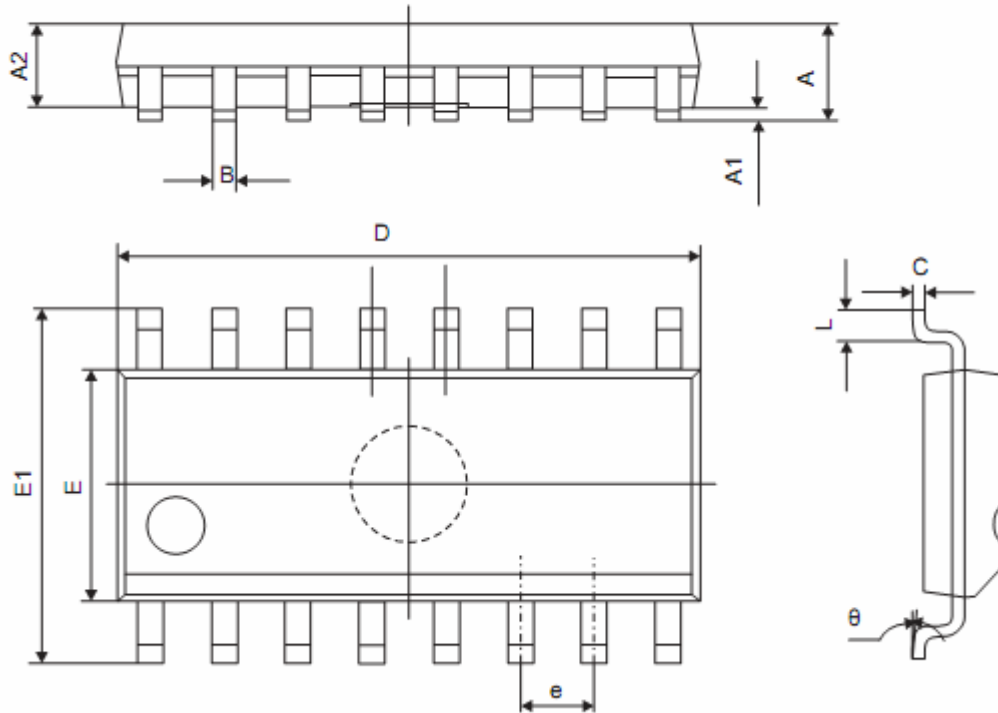


MD3203N

Filterless 3W Class-D Stereo Audio Amplifier

Outline Dimension

SOP-16



Symbol	Dimensions Millimeters	
	Min	Max
A	1.350	1.750
A1	0.100	0.250
A2	1.350	1.550
B	0.330	0.510
C	0.190	0.250
D	9.800	10.000
E	3.800	4.000
E1	5.800	6.300
e	1.270 (TYP)	
L	0.400	1.270
θ	0°	8°

Tel:+86-0755-27595155 27595165

Fax:+86-0755-27594792

Address:: Room 613,No B Xingxinyuan Business Building,baomin 2nd road,Bao'an Zone,Shenzhen city,China

Web:Http:// www.ChipSourceTek.com