Description

The MIX3001 is a high efficiency, 3W/channel stereo class-D audio power amplifier. A Low noise, filterless architecture eliminates the out filter, it required few external components for operation to save the board space and cost.

Operating from a single 5V supply, the MIX3001 is capable of driving 3.2W/CH into 3 Ω at 5V.

The MIX3001 features shutdown and mute controls functions. High PSRR and differential architecture provide increased immunity to noise and RF rectification.

The MIX3001 is available in SOP-16 PB-Free package.

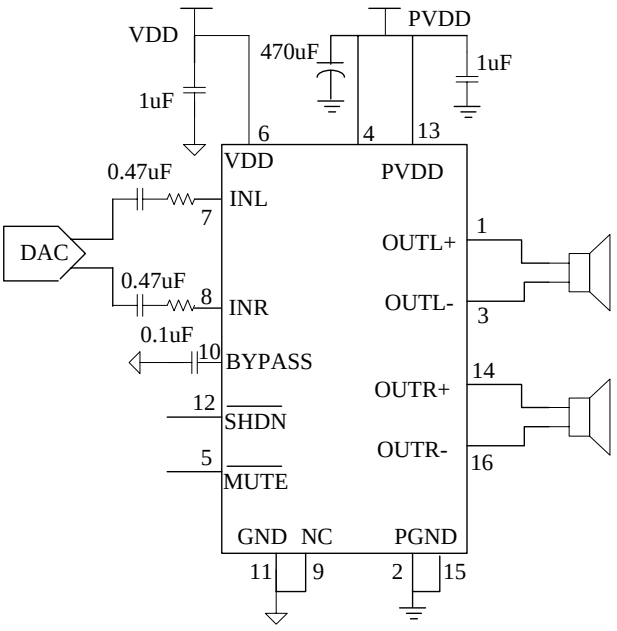
Features

- Low EMI Emission
- FM Non-Interference
- Filterless Class-D Architecture
- Output Power
  - 3.2W/ch into 3Ω at 5V
  - 1.7W/ch into 8Ω at 5V
- Supply Voltage:2.2V to 5.0V
- Low THD+N and Low Noise
- High Efficiency up to 85%
- Short Circuit auto Recovery and Thermal Protection
- Few External Components to Save the Space and Cost

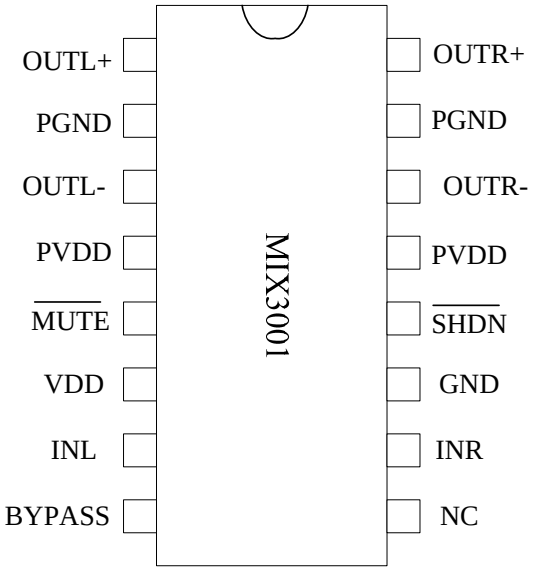
Applications

- Portable DVD Players
- Notebook PC
- USB Speakers, Portable Speaker
- LCD TV/LCD Monitor

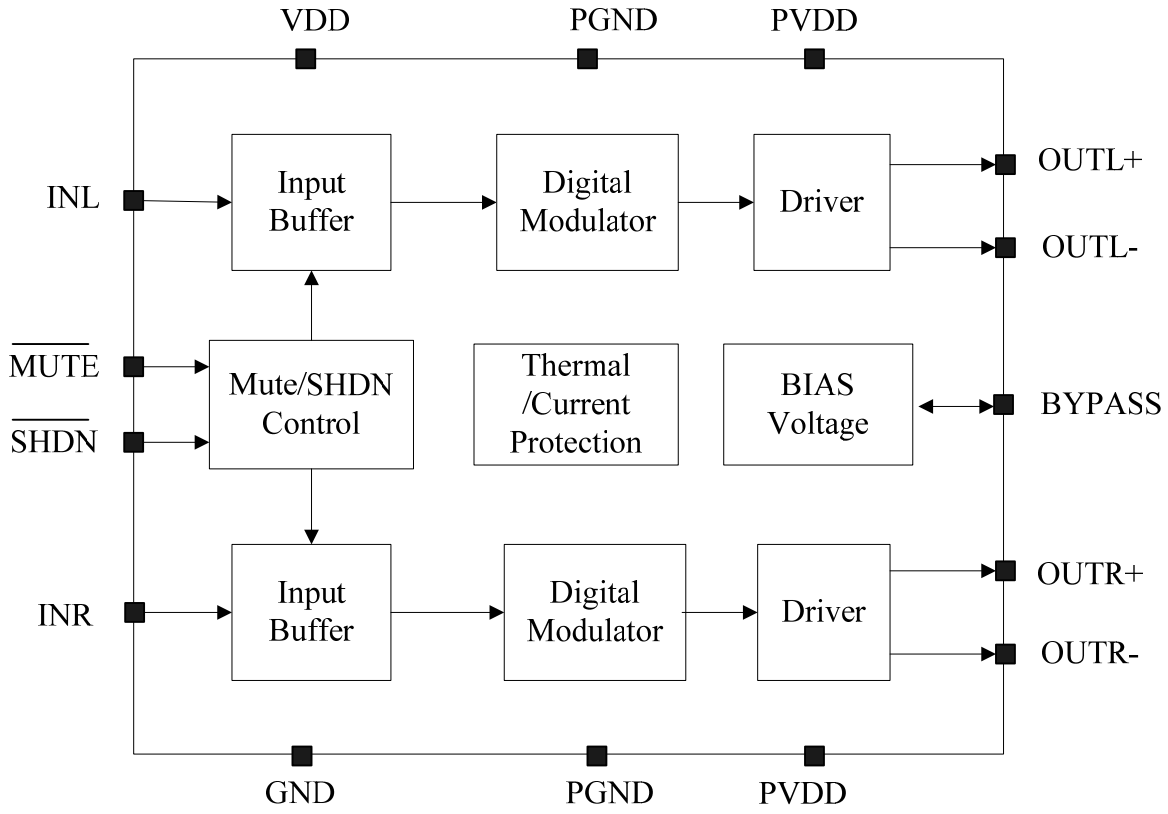
Typical Application



Pin Configuration



Block Diagram



Pin Descriptions

Name	Pin No.	I/O	Pin Description
1	OUTL+	O	Left Channel Positive Audio Output
2,15	PGND		Power Ground
3	OUTL-	O	Left Channel Negative Audio Output
4,13	PVDD		Supply Voltage Terminal for Power Stage
5	$\overline{\text{MUTE}}$	I	Mute Control Input Pin（active low）
6	VDD		Analog Supply Voltage Terminal
7	INL	I	Left Channel Input Pin
8	BYPASS	I	Tap to voltage divider for internal midsupply bias generator used for analog reference
9	NC		No Connection
10	INR	I	Right Channel Input Pin
11	GND		Analog Power Supply Ground
12	$\overline{\text{SHDN}}$	I	Shutdown Control Input Pin (active low)
14	OUTR-	O	Right Channel Negative Audio Output
16	OUTR+	O	Right Channel Positive Audio Output

Ordering Information

Order Number	Package Type	Marking	Packing
MIX3001	SOP-16	MIX3001 XXXXXXX	Reel Tape
			Tube

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

Vss	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 85°C
T_J	Operation free-air junction temperature	-40°C to 125°C
T_{STG}	Storage temperature range	-65°C to 150°C
T_{SLD}	Soldering temperature	300°C, 5sec

Recommended Operating Conditions

			MIN	MAX	UNIT
V_{SS}	Supply Voltage	AVDD, PVDD	2.2	5.0	V
V_{IH}	Enable Input High Voltage	V_{DD}=5.0V	1.3		V
V_{IL}	Enable Input Low Voltage	V_{DD}=5.0V		0.4	
V_{IH}	Mute Input High Voltage	V_{DD}=5.0V	1.3		V
V_{IL}	Mute Input Low Voltage	V_{DD}=5.0V		0.4	

Thermal Information

Parameter	Symbol	Package	MAX	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

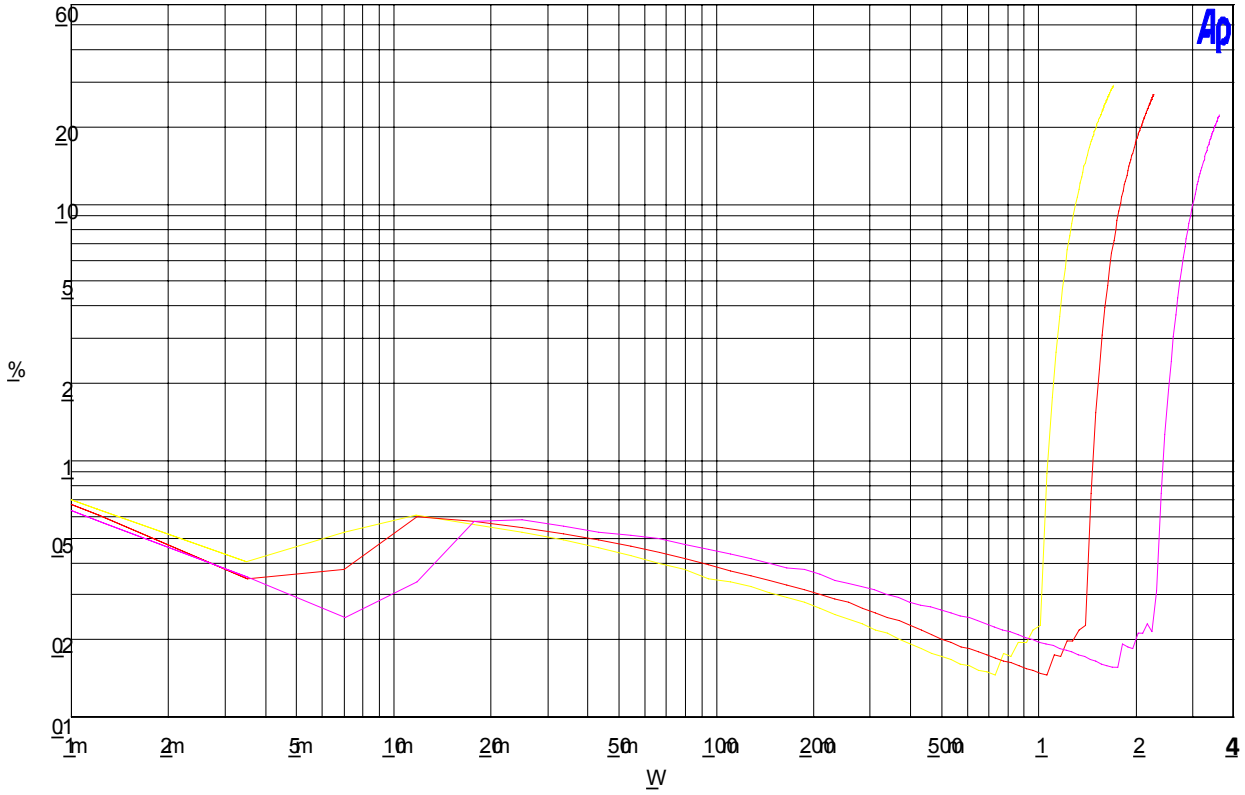
Electrical Characteristics (V_{DD} =5V, Gain=25dB, R =8Ω, T =25°C, unless otherwise noted.)

Symbol	Parameter	Test Conditions		MIN	TYP	MAX	UNIT
V_{IN}	Supply Power			2.2		5.0	V
P_O	Output Power	THD+N=10%,f=1KHZ,R_L=4Ω	V_{DD}=5.0V		2.8		W
			V_{DD}=3.6V		1.3		
		THD+N=1%,f=1KHZ,R_L=4Ω	V_{DD}=5.0V		2.1		W
			V_{DD}=3.6V		1		
		THD+N=10%,f=1KHZ,R_L=8Ω	V_{DD}=5.0V		1.7		W
			V_{DD}=3.6V		0.8		
		THD+N=1%,f=1KHZ,R_L=8Ω	V_{DD}=5.0V		1.20		W
			V_{DD}=3.6V		0.6		
THD+N	Total Harmonic Distortion Plus Noise	V_{DD}=5.0V, P_O=0.5W, R_L=8Ω	f=1KHz		0.15		%
		V_{DD}=3.6V, P_O=0.5W, R_L=8Ω			0.14		
		V_{DD}=5.0V, P_O=1W, R_L=4Ω	f=1KHz		0.18		%
		V_{DD}=3.6V, P_O=1W, R_L=4Ω			0.16		

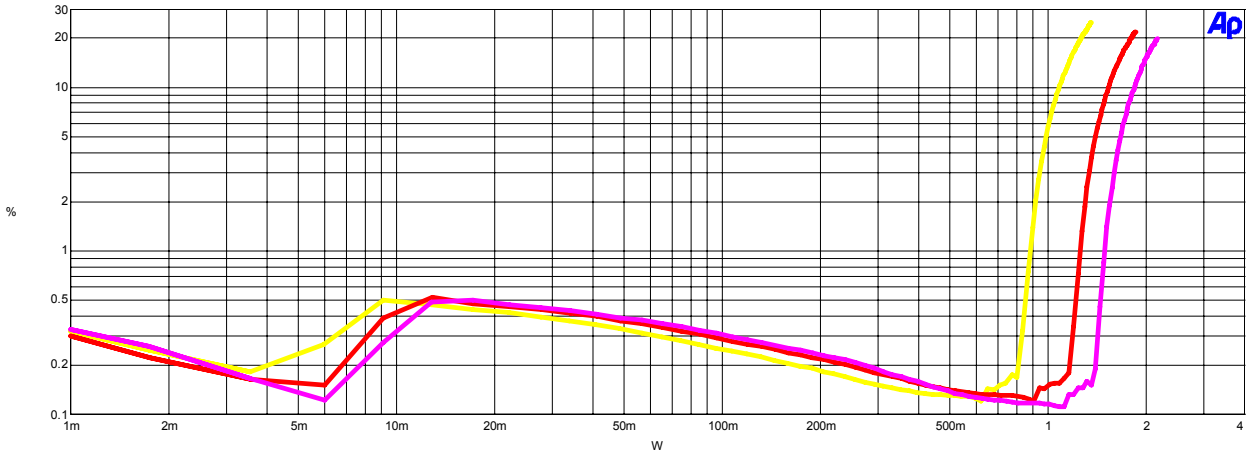
Continued

Symbol	Parameter	Test Conditions		MIN	TYP	MAX	UNIT
G_V	Gain				25		dB
PSRR	Power Supply Ripple Rejection	VDD=5.0V, Inputs ac-grounded with CIN=0.47μF	f=1KHz		-55		dB
C_S	Crosstalk	V_{DD}=5.0V,P_O=0.5W, R_L=8Ω, G_V=25dB	f=1KHz		-85		dB
SNR	Signal-to-Noise Ratio	V_{DD}=5.0V,Vorms=1V, G_V=25dB	f=1KHz		82		dB
Vn	Output Noise	V_{DD}=5.0V,Inputs floating with C_{IN}=0.47μF	A-weighting		87		μV
			No A-weighting		136		
Dyn	Dynamic range	V_{DD}=5.0V,THD=1%	f=1KHz		90		dB
η	Efficiency	R_L=8Ω,THD=10%	f=1KHz		85		%
		R_L=4Ω,THD=10%			80		
I_Q	Quiescent Current	V_{DD}=5.0V	No Load		5		mA
		V_{DD}=3.0V			3.6		
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
Vos	Output Offset Voltage	V_{IN}=0V, V_{DD}=5V			10		mV
OTP	Over Temperature Protection	No Load, Junction Temperature	V_{DD}=5.0V		135		°C
OTH	Over Temperature Hysterisis				20		

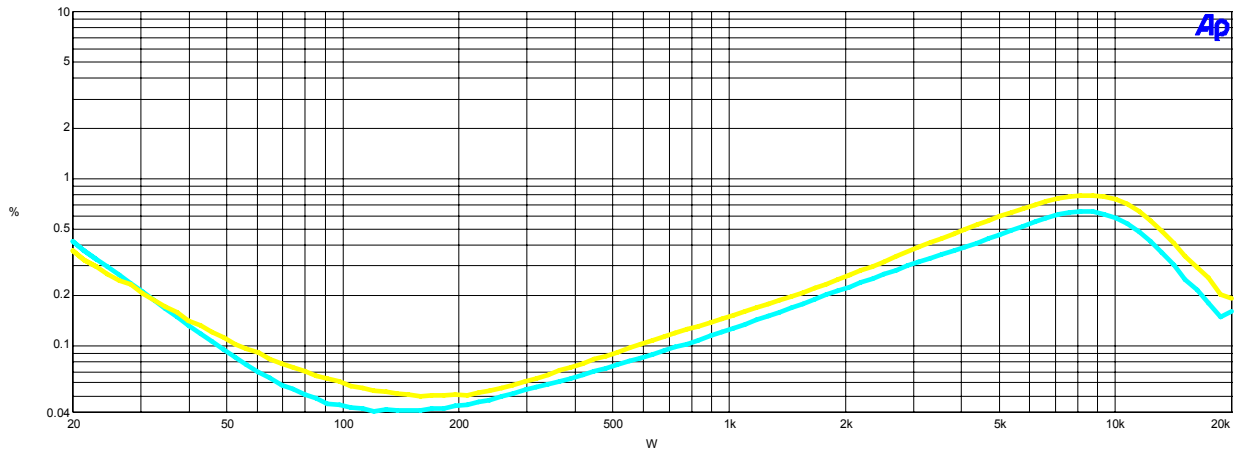
Typical Operating Characteristics (T =25°C)



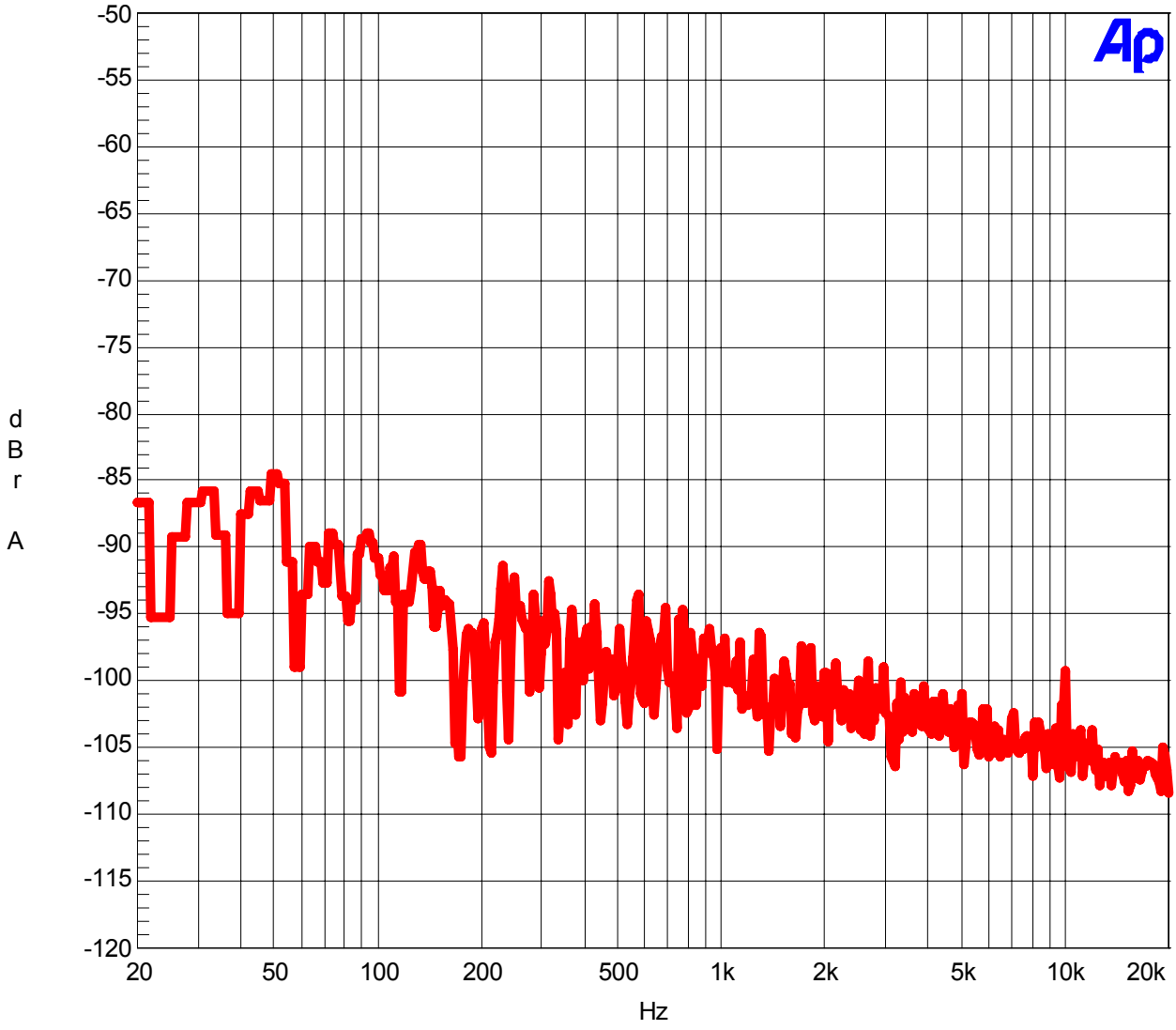
THD+N VS OUT POWER (RL=4ohm Gain=25dB,f=1kHz)



THD+N VS OUT POWER (RL=8ohm Gain=25dB,f=1kHz)



THD+N VS FREQUENCY(PO=1W,RL=8Ω Gain=25dB)



NOISE FLOOR FFT（VDD=5V,RL=8Ω Gain=25dB）

Application Information

Mute Operation

The $\overline{\text{MUTE}}$ pin is an input for controlling the output state of the MIX3001. A logic high on this pin enables the outputs, a logic low on this pin disables the outputs. The terminal may be used as a quick disable/enable of the outputs when changing channels between different audio sources. The $\overline{\text{MUTE}}$ pin can be left floating due to the internal pull-up.

Shutdown operation

The MIX3001 employs a shutdown mode of operation designed to reduce supply current to the absolute minimum level during periods of nonuse for power conservation. The $\overline{\text{SHDN}}$ input terminal should be held high during normal operation when the amplifier is in use. The $\overline{\text{SHDN}}$ pin can be left floating due to the internal pull-up.

Under Voltage Lock-out (UVLO)

The MIX3001 incorporates circuitry designed to detect low supply voltage. When the supply voltage drops to 1.8V or below, the MIX3001 outputs are disabled, and the device comes out of this state and starts to normal function when V_{DD} $\geqq$2.0V.

Short -Circuit Protection

The MIX3001 has short circuit protection circuitry on the outputs to prevent damage to the device during output-to-output shorts, output-to-GND and output-to-GND short occurs. When a short circuit is detected on the outputs, the part immediately disables the drive. This is an unlatched fault. Normal operation is restored when the fault is removed.

Thermal Protection

Thermal protection on the MIX3001 prevents damage to the device when the internal die temperature exceeds 135°C. There is a ±20°C tolerance on this trip point from device to device. Once the die temperature exceeds the thermal set point, the device enters into the shutdown state and the 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. The device begins normal operation at this point with no external system intervention.

Maximum Gain

The MIX3001 has two internal amplifier stages. The first stage's gain is externally configurable, while the second stage's is internally fixed. The differential gain for the IC is

$$A = 20*\log [2*((R_f /(R_i + R_e))]$$

Where R_e is externally resistor, The MIX3001 R_f =180kΩ, R_i =20kΩ, so the maximum closed-gain is 25dB (no externally resistor).

Decoupling Capacitor (C_s)

The MIX3001 is a high-performance Class-D audio amplifier that requires adequate power supply decoupling to ensure the efficiency is high and total harmonic distortion (THD) is low. For higher frequency transients, spikes, or digital hash on the line a good low equivalent series resistance (ESR) ceramic capacitor, typically 1 μF, placed as close as possible to the device PVDD lead works best. Placing this decoupling capacitor close to the MIX3001 is important for the efficiency of the Class-D amplifier, because any resistance or inductance in the trace between the device and the capacitor can cause a loss in efficiency. For filtering lower-frequency noise signals, a 4.7 μF or greater capacitor placed near the audio power amplifier would also help, but it is not required in most applications because of the high PSRR of this device.

Input Capacitors (C_i)

The MIX3001 does not require input coupling capacitors if the design uses a differential source that is biased from 0.5V to V_{DD}-0.8V. If the input signal is not biased within the recommended common-mode input range, if high pass filtering is needed, or if using a single-ended source, input coupling capacitors are required.

The input capacitors and input resistors from a

high-pass filter with the corner frequency, f_c, determined in below equation

$$f_C = \frac{1}{2\pi R_i C_i}$$

The value of input capacitor is important to consider as it directly affects the bass (low frequency) performance of the circuit. Speaker in wireless phones cannot usually respond well to low frequencies, so the corner frequency can be set to block low frequencies in this application. Not using input capacitors can increase out offset. Below equation is used to solve for the input coupling capacitance.

$$C_I = \frac{1}{(2\pi R_I f_C)}$$

If the corner frequency is within the audio band, the capacitors should have tolerance of ±10% or better, because any mismatch in capacitance causes an impedance mismatch at the corner frequency and below.

Analog Reference Bypass Capacitor (C_{BYP})

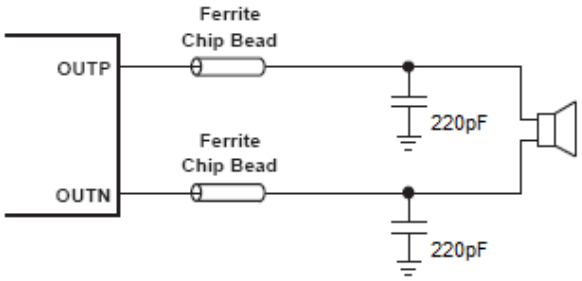
The Analog Reference Bypass Capacitor (C_{BYP}) is the most critical capacitor and serves several important functions. During start-up or recovery from shutdown mode, C determines the rate at which the amplifier starts up. The second function is to reduce noise caused by the power supply coupling into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

A ceramic bypass capacitor (C_{BYP}) with values of 0.47 μF to 1.0 μF 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.

Filter Free Operation and Ferrite Bead Filters

A ferrite bead filter can often be used if the design is failing radiated emissions without an LC filter and the frequency sensitive circuit is greater than 1MHz. This filter functions well for circuits that just have to pass FCC and CE because FCC and CE only test radiated emissions greater than 30MHz. When choosing a ferrite bead, choose one with high impedance at high frequencies, and very low impedance at low frequencies. In addition, select a ferrite bead with adequate current rating to prevent distortion of the output signal.

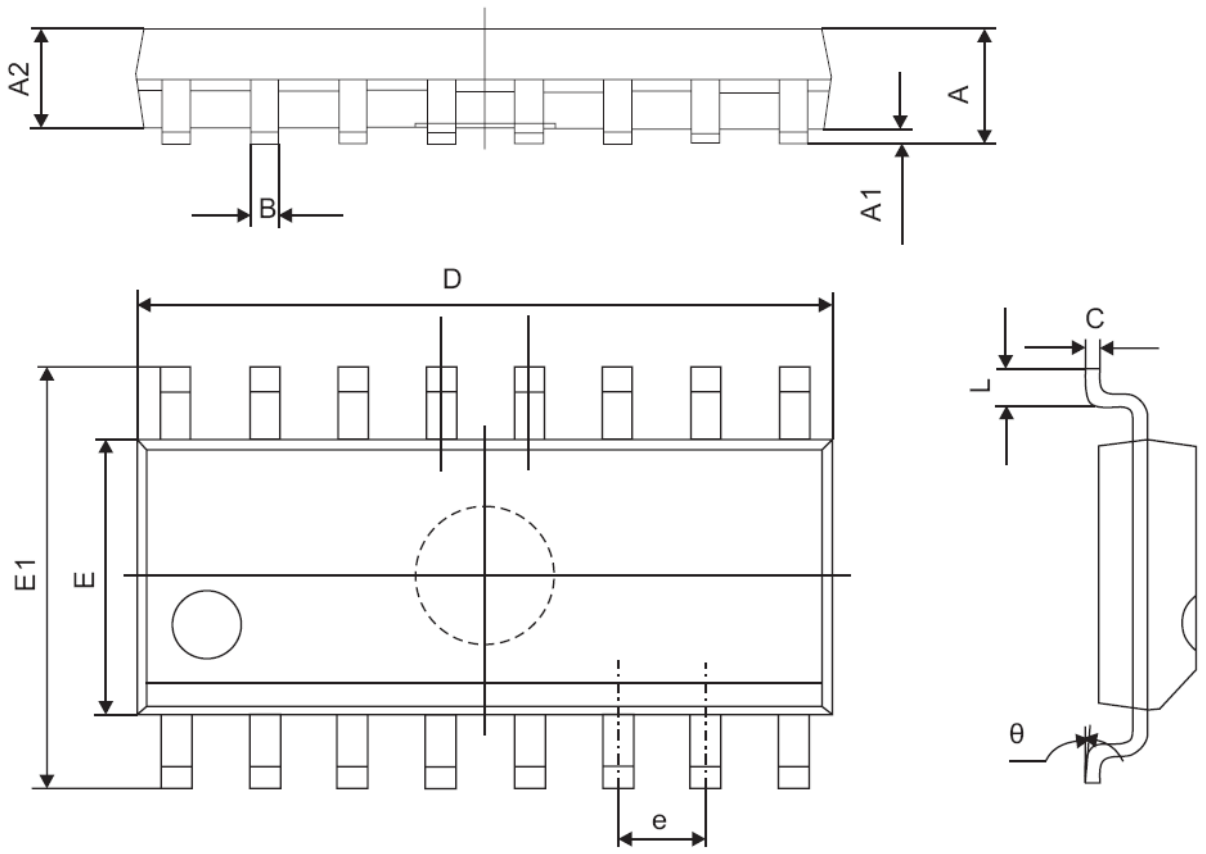
Use an LC output filter if there are low frequency (< 1 MHz) EMI sensitive circuits and/or there are long leads from amplifier to speaker.



Ferrite Bead Filter to reduce EMI

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°

IMPORTANT NOTICE

Shanghai Mixinno electronics and its subsidiaries (Mixinno) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to Mixinno's terms and conditions of sale supplied at the time of order acknowledgment.

Mixinno warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with Mixinno's standard warranty. Testing and other quality control techniques are used to the extent Mixinno deems necessary to support this warranty. Customers are responsible for their products and applications using Mixinno components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

Mixinno products are not authorized for use in safety-critical applications (such as life support) where a failure of the Mixinno product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of Mixinno products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by Mixinno. Further, Buyers must fully indemnify Mixinno and its representatives against any damages arising out of the use of Mixinno products in such safety-critical applications.