DESCRIPTION

The A2422 is a high efficiency, 2.6W/channel stereo class-D audio power amplifier with 64-step DC volume control, minimizes external components and allows speaker volume control. It offers low THD+N, to produce high-quality sound reproduction. A Low noise, filterless architecture eliminates the out filter, it required few external components for operation to save the board space and cost.

The A2422 features shutdown controls functions. High PSRR and differential architecture provide increased immunity to noise and RF rectification.

The A2422 is available in SOP16 package.

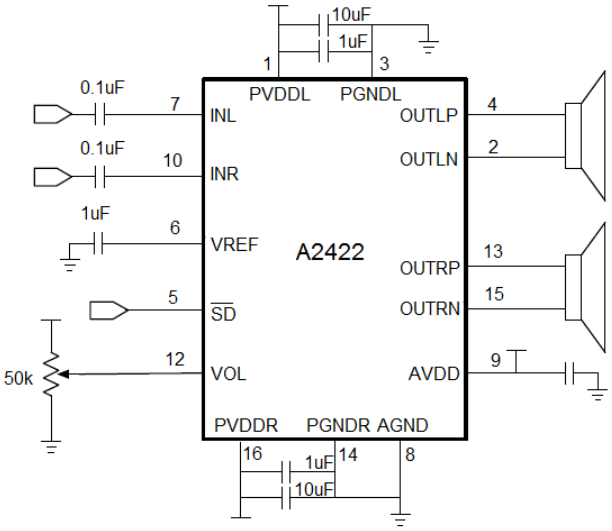
FEATURES

- Low EMI Emission
- Output Power
  2.6W/ch into 4Ω at 5V
  1.6W/ch into 8Ω at 5V
- Supply Voltage: 2.5V to 5.5V
- Low THD+N < 0.04% (V_{DD}=5.0V, P_O=1W,R_L=4Ω)
- High Efficiency up to 90%
- 64-step DC Volume Control
- Short Circuit auto Recovery and Thermal Protection
- Few External Components to Save the Space and Cost
- Available in SOP16 Package

APPLICATION

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

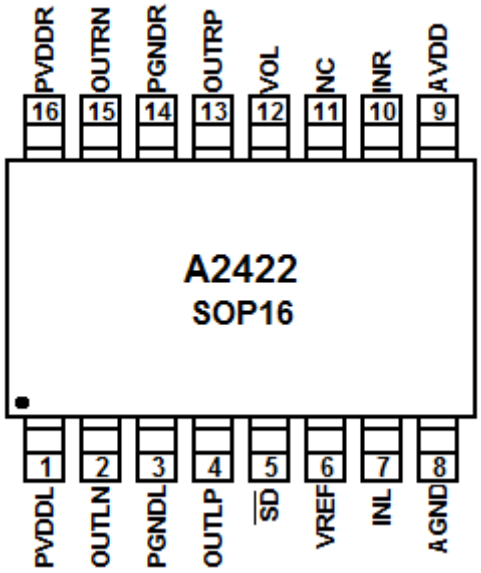
TYPICAL APPLICATION



ORDERING INFORMATION

Package Type	Part Number	
SOP16 SPQ: 2,500pcs/Reel	M16	A2422M16R
		A2422M16VR
Note	V: Halogen free Package R: Tape & Reel	
AiT provides all RoHS products		

PIN DESCRIPTION



Top View

Pin #	Symbol	I/O	Function
1	PVDDL	POWER	Left Channel Power Supply
2	OUTLN	O	Left Channel Negative Audio Output
3	PGNDL	GND	Left Channel Power Ground
4	OUTLP	O	Left Channel Positive Audio Output
5	$\overline{SD}$	I	Shutdown Control Input Pin (active low)
6	VREF	IO	Internal analog reference
7	INL	I	Left Channel Input
8	AGND	GND	Analog Power Supply Ground
9	AVDD	POWER	Analog Supply Voltage Terminal
10	INR	I	Right Channel Input
11	NC		No Connected
12	VOL	I	DC volume control to set the gain
13	OUTRP	O	Right Channel Positive Audio Output
14	PGNDR	GND	Right Channel Power Ground
15	OUTRN	O	Right Channel Negative Audio Output
16	PVDDR	POWER	Right Channel Power Supply

ABSOLUTE MAXIMUM RATINGS

T_A=25°C, unless Otherwise Noted

V_{DD}, Supply Voltage	-0.3V~6V
V_I, Input Voltage	-0.3V ~ V_{DD}+0.3V
T_A, Operation Free-air Temperature Range	-40℃~85℃
T_J, Operation Free-air Junction Temperature	-40℃~125℃
T_{STG}, Storage Temperature Range	-65℃~150℃
T_{SOLD}, Soldering Temperature	300℃, 5sec

Stress beyond above listed “Absolute Maximum Ratings” may lead permanent damage to the device. These are stress ratings only and operations of the device at these or any other conditions beyond those indicated in the operational sections of the specifications are not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Conditions	Min	Max	Units
Power supply voltage	V_{DD}	AVDD, PVDD	2.5	5.5	V
$\overline{SD}$ Input High Voltage	V_{IH}	V_{DD}=5.0V	1.3	-	V
$\overline{SD}$ Input Low Voltage	V_{IL}	V_{DD}=5.0V	-	0.4	V

THERMAL INFORMATION

Parameter	Symbol	Package	Max	Units
Thermal Resistance (Junction to Ambient)	θ_{JA}	SOP16	110	℃/W
Thermal Resistance (Junction to Case)	θ_{JC}	SOP16	23	℃/W

ELECTRICAL CHARACTERISTICS

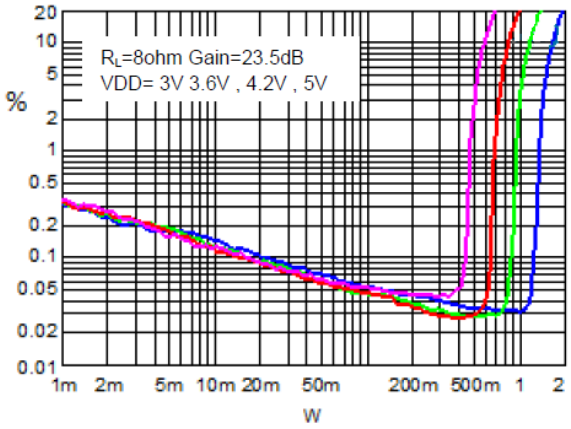
V_{DD} =5V, Gain=23.5dB, R_L =8Ω, T =25°C, unless otherwise noted.

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
Supply Power	V_{DD}			2.5		5.5	V
Shutdown Current	I_{SD}	V_{DD}=2.5V to 5.5V	V_{SD}=0.3V			20	μA
Output Power	P_O	f=1kHz, THD+N=10%, R_L=4Ω	V_{DD}=5.0V		2.6		W
			V_{DD}=3.6V		1.36		
		f=1kHz, THD+N=10%, R_L=8Ω	V_{DD}=5.0V		1.62		
			V_{DD}=3.6V		0.85		
		f=1kHz, THD+N=1%, R_L=4Ω	V_{DD}=5.0V		2.12		
			V_{DD}=3.6V		1.1		
		f=1kHz, THD+N=1%, R_L=8Ω	V_{DD}=5.0V		1.3		
			V_{DD}=3.6V		0.68		
Total Harmonic Distortion Plus Noise	THD+N	V_{DD}=5.0V, P_O=0.5W, R_L=8Ω	f=1kHz		0.033		%
		V_{DD}=3.6V, P_O=0.5W, R_L=8Ω	f=1kHz		0.03		
		V_{DD}=5.0V, P_O=1W, R_L=4Ω	f=1kHz		0.04		
		V_{DD}=3.6V, P_O=1W, R_L=4Ω	f=1kHz		0.05		
Power Supply Ripple Rejection	PSRR	Inputs ac-grounded with C_{IN}=0.1μF	f=100Hz		-68		dB
			f=1kHz		-70		
Crosstalk	C_S	V_{DD}=5.0V,P_O=0.5W, R_L=8Ω,G_V=23.5dB	f=1kHz		-80		dB
Signal/Noise Ratio	SNR	f=20Hz to 20kHz, THD=1%, R_L=8Ω			-86		dB
Switching Frequency	f_{SW}	V_{DD} = 2.5V to 5.5V		270	320	370	kHz
Output Noise	V_N	Inputs ac-grounding with C_{IN}=0.1μF	A-weighting		40		μV
Dynamic Range	D_{YN}	V_{DD}=5.0V,THD=1%	f=1kHz		92		dB
Quiescent Current	I_Q	V_{DD}=5.0V	No Load		5.3	7.0	mA
		V_{DD}=3.6V			4.4	6.0	
		V_{DD}=3.0V			4.0	5.5	
Efficiency	η	R_L=8Ω, P_O=0.6W			85		%
		R_L=8Ω, P_O=0.1W			80		
Output Offset Voltage	V_{OS}	V_{IN}=0V	No Load		10		mV
Over Temperature Protection	T_{OTP}	No Load, Junction Temperature	V_{DD}=5.0V		165		℃
Over Temperature Hysteresis	T_{OTH}				40		

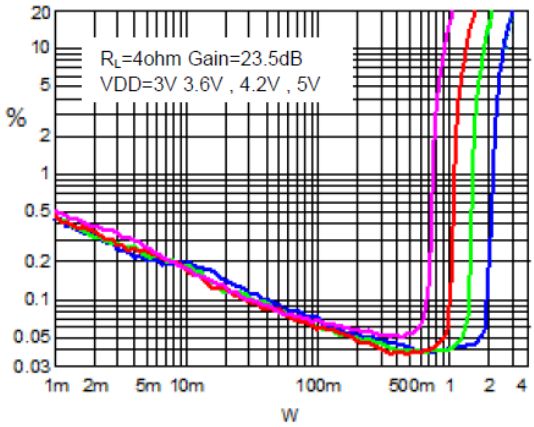
TYPICAL PERFORMANCE CHARACTERISTICS

V_{DD}=5V, Gain=23.5dB, T=25°C, unless Otherwise Noted

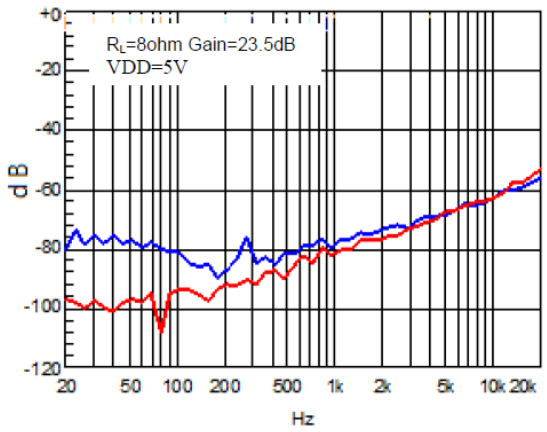
1. THD+N vs. Output Power



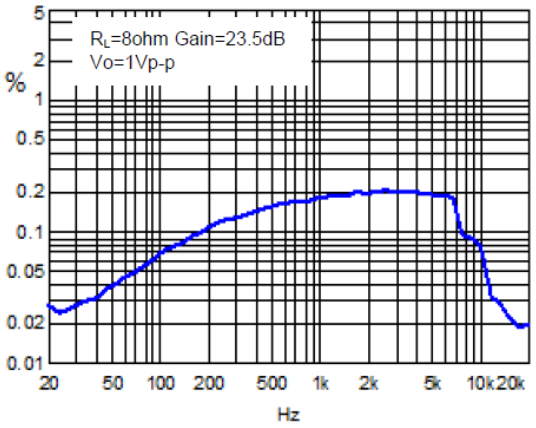
2. THD+N vs. Output Power



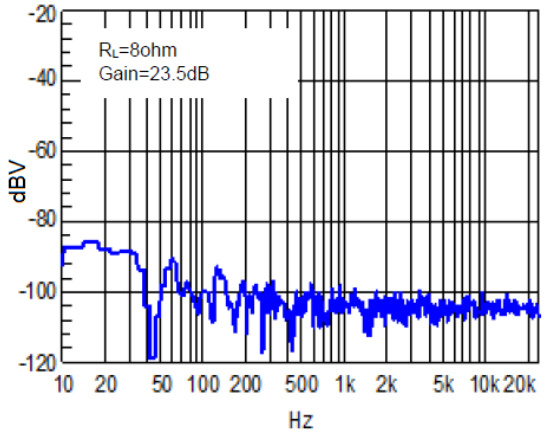
3. Cross Talk



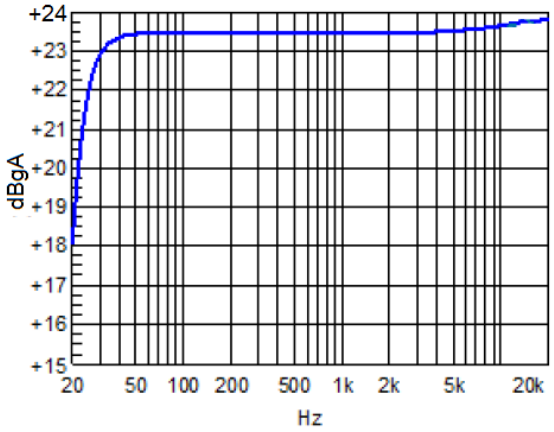
4. THD+N vs. Frequency



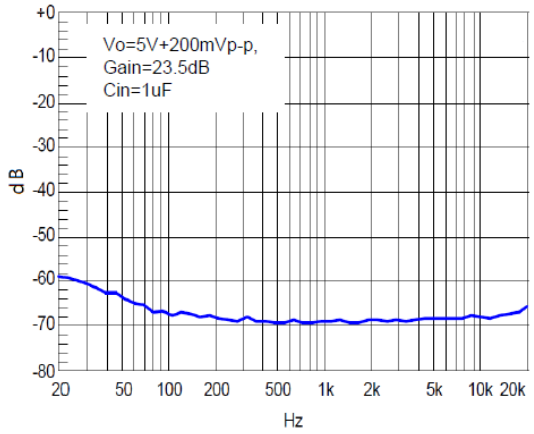
5. Noise Floor FET



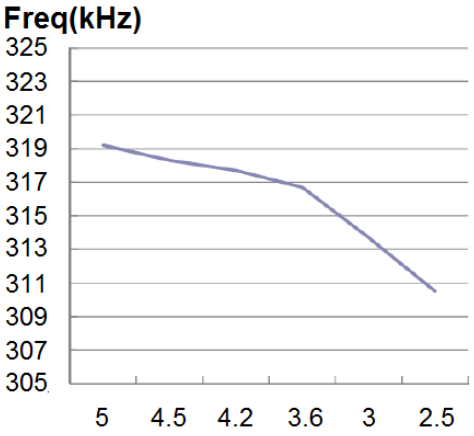
6. Frequency Response



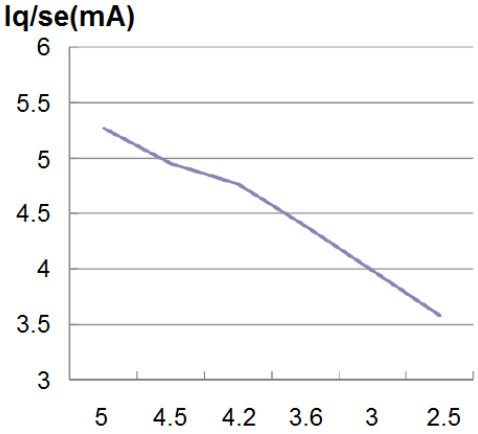
7. PSRR



8. Switching Frequency



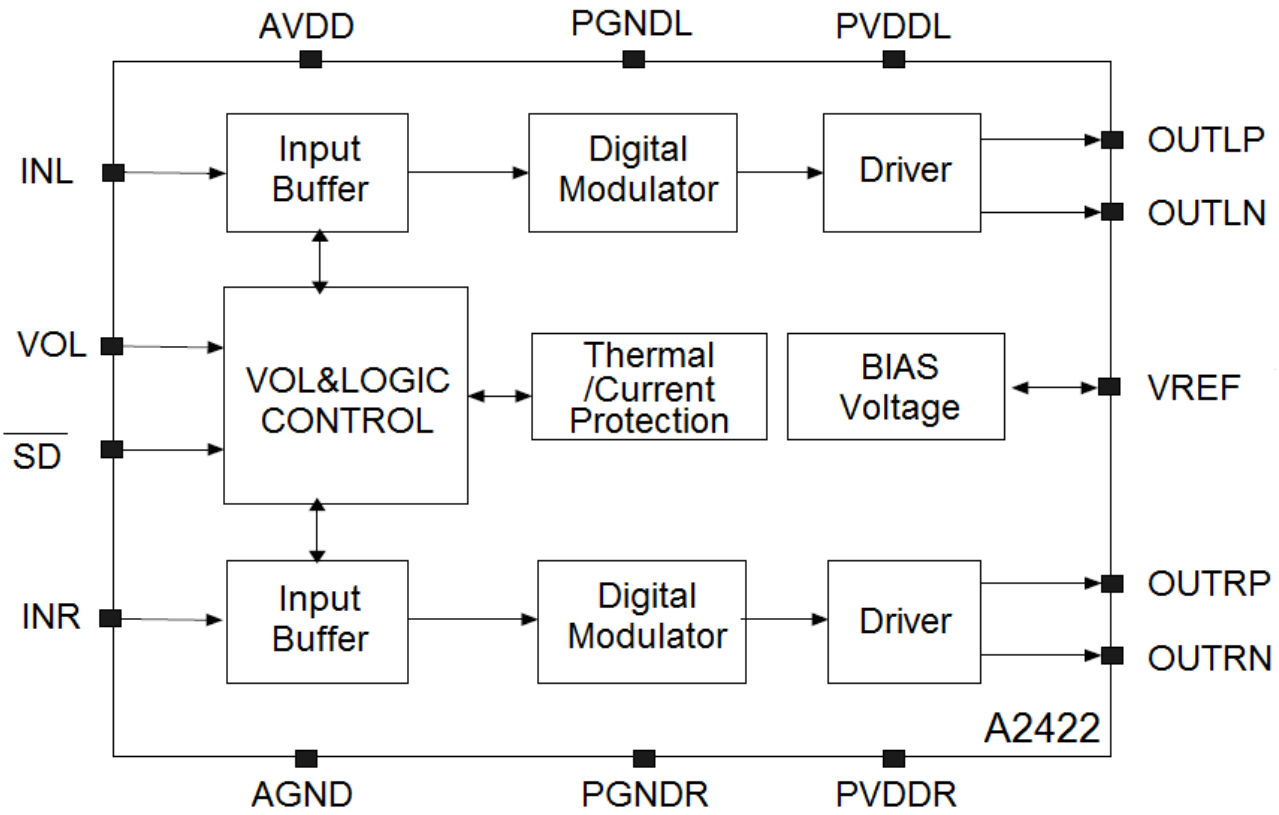
9. Quiescent Current



DC VOLUME CONTROL

STEP	Vol(V)	GAIN(dB)	STEP	Vol(V)	GAIN(dB)
1	0.00-0.23	-80.0	33	2.46-2.49	11.5
2	0.25-0.28	-40.5	34	2.52-2.55	11.9
3	0.33-0.36	-34.5	35	2.60-2.63	12.3
4	0.41-0.44	-28.4	36	2.66-2.69	12.7
5	0.49-0.52	-22.4	37	2.74-2.77	13.1
6	0.56-0.59	-16.3	38	2.82-2.85	13.5
7	0.62-0.65	-10.3	39	2.87-2.90	13.9
8	0.69-0.72	-7.8	40	2.95-2.98	14.3
9	0.75-0.78	-5.2	41	3.02-3.05	14.7
10	0.82-0.85	-2.7	42	3.08-3.11	15.1
11	0.90-0.93	-0.2	43	3.15-3.18	15.5
12	0.96-0.99	1.4	44	3.23-3.26	15.9
13	1.04-1.07	2.9	45	3.30-3.33	16.3
14	1.12-1.15	3.9	46	3.37-3.40	16.7
15	1.18-1.21	4.3	47	3.44-3.47	17.0
16	1.25-1.28	4.7	48	3.50-3.53	17.4
17	1.32-1.35	5.1	49	3.58-3.61	17.8
18	1.39-1.42	5.5	50	3.65-3.68	18.2
19	1.46-1.49	5.9	51	3.73-3.76	18.6
20	1.54-1.57	6.3	52	3.81-3.84	19.0
21	1.60-1.63	6.7	53	3.87-3.90	19.4
22	1.68-1.71	7.1	54	3.93-3.96	19.8
23	1.75-1.78	7.5	55	4.00-4.03	20.2
24	1.80-1.83	7.9	56	4.06-4.09	20.6
25	1.89-1.92	8.3	57	4.14-4.17	21.0
26	1.96-1.99	8.7	58	4.21-4.24	21.4
27	2.03-2.06	9.1	59	4.27-4.30	21.8
28	2.11-2.14	9.5	60	4.34-4.37	22.2
29	2.18-2.21	9.9	61	4.41-4.44	22.6
30	2.24-2.27	10.3	62	4.49-4.52	22.9
31	2.32-2.35	10.7	63	4.56-4.59	23.3
32	2.39-2.42	11.1	64	4.63-5.00	23.7

BLOCK DIAGRAM



DETAILED INFORMATION

Shutdown operation

The A2422 employs a shutdown mode of operation designed to reduce supply current to the absolute minimum level during periods of nonuse for power conservation. The $\overline{SD}$ input terminal should be held high during normal operation when the amplifier is in use. The $\overline{SD}$ pin can be left floating due to the internal pull-up.

Under Voltage Lock-out (UVLO)

The A2422 incorporates circuitry designed to detect low supply voltage. When the supply voltage drops to 1.8V or below, the A2422 outputs are disabled, and the device comes out of this state and starts to normal function when V_{DD} ≧2.0V.

Short -Circuit Protection

The A2422 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 A2422 prevents damage to the device when the internal die temperature exceeds 160℃. There is a ±20℃ 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 25℃. The device begins normal operation at this point with no external system intervention.

Decoupling Capacitor (Cs)

The A2422 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 1μF, placed as close as possible to the device PVDD lead works best. Placing this decoupling capacitor close to the A2422 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 4.7μF 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 A2422 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_{REF})

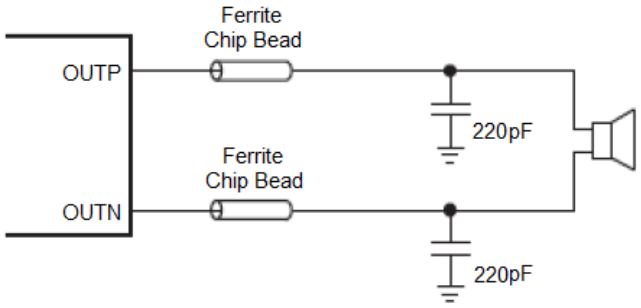
The Analog Reference Bypass Capacitor (C_{REF}) is the most critical capacitor and serves several important functions. During start-up or recovery from shutdown mode, C determines the rate at which the amplifier starts up. The second function is to reduce noise caused by the power supply coupling into 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 0.47μF to 1.0μF 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.

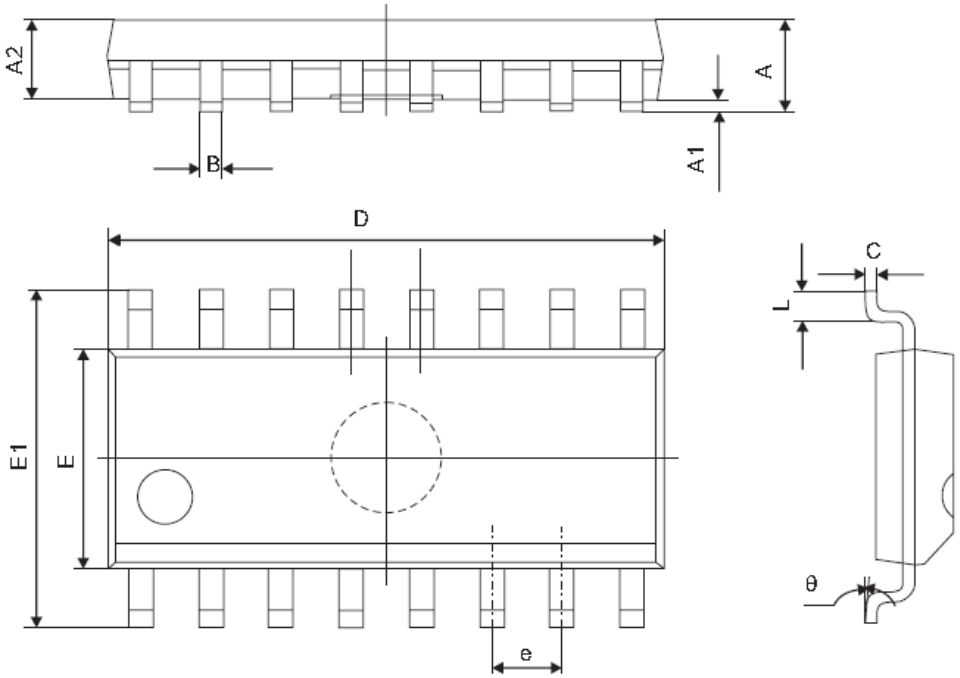
Use an LC output filter if there are low frequency (< 1 MHz) EMI sensitive circuits and/or there are long leads from amplifier to speaker.



Ferrite Bead Filter to reduce EMI

PACKAGE INFORMATION

Dimension in SOP16 Package (Unit: mm)



Symbol	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°

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