1.25 Watt Fully Differential Audio Power Amplifier

General Description

The ETK4992 is a fully differential audio power amplifier designed for portable communication device applications. It is capable of delivering 1.25 watt of continuous average power to an 8Ω BTL load with less than 1% distortion (THD+N) from a 5V battery voltage. It operates from 2.2 to 5.5V.

Features like 90dB PSRR at 217Hz, improved RF-rectification immunity, the space-saving 8-bump WLCSP package, the advanced pop & click circuitry, a minimal count of external components and low-power shutdown mode make ETK4992 ideal for wireless handsets.

The ETK4992 is unity-gain stable, and the gain can be configured by external resistors.

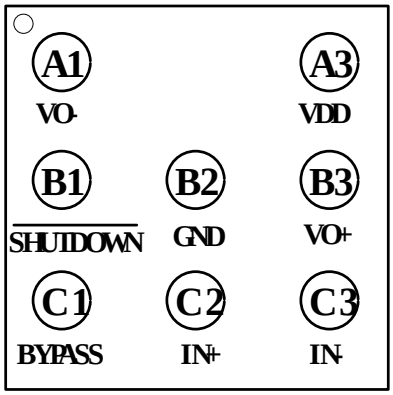
Features

- Fully differential amplifier
- Improved PSRR at 217Hz (VDD>3.0V) 90dB (typ)
- Power output at 5.0V & 1% THD&8Ω 1.25W (typ)
- Power output at 5.0V & 1% THD&4Ω 2.25W (typ)
- Power output at 4.2V & 1% THD&8Ω 0.92W (typ)
- Power output at 4.2V & 1% THD&4Ω 1.56W (typ)
- Power output at 3.6V & 1% THD&8Ω 0.7W (typ)
- Power output at 3.6V & 1% THD&4Ω 1.1W (typ)
- Ultra low shutdown current 0.01μA (typ)
- Improved pop & click circuitry eliminates noises during turn-on and turn-off transitions
- Thermal overload protection circuitry
- No output coupling capacitors, bootstrap capacitors required
- Unity-gain stable
- External gain configuration capability
- Available in space-saving package: 8-bump WLCSP

Applications

- Wireless handsets
- Portable electronic devices
- PDAs, Handheld computers

Pin Configuration



Top View

Pin Function

Pin No.	Name	I/O	Function
A1	VO-	O	Negative differential output.
B1	$\overline{\text{SHUTDOWN}}$	I	Shutdown Pin,active low.
C1	BYPASS	I	Common mode voltage. Connect a bypass capacitor to GND for common mode voltage filtering. The bypass capacitor is optional.
B2	GND	POWER	Ground.
C2	IN+	I	Positive differential input.
A3	VDD	POWER	Power supply.
B3	VO+	O	Positive differential output.
C3	IN-	I	Negative differential input.

Application Circuit

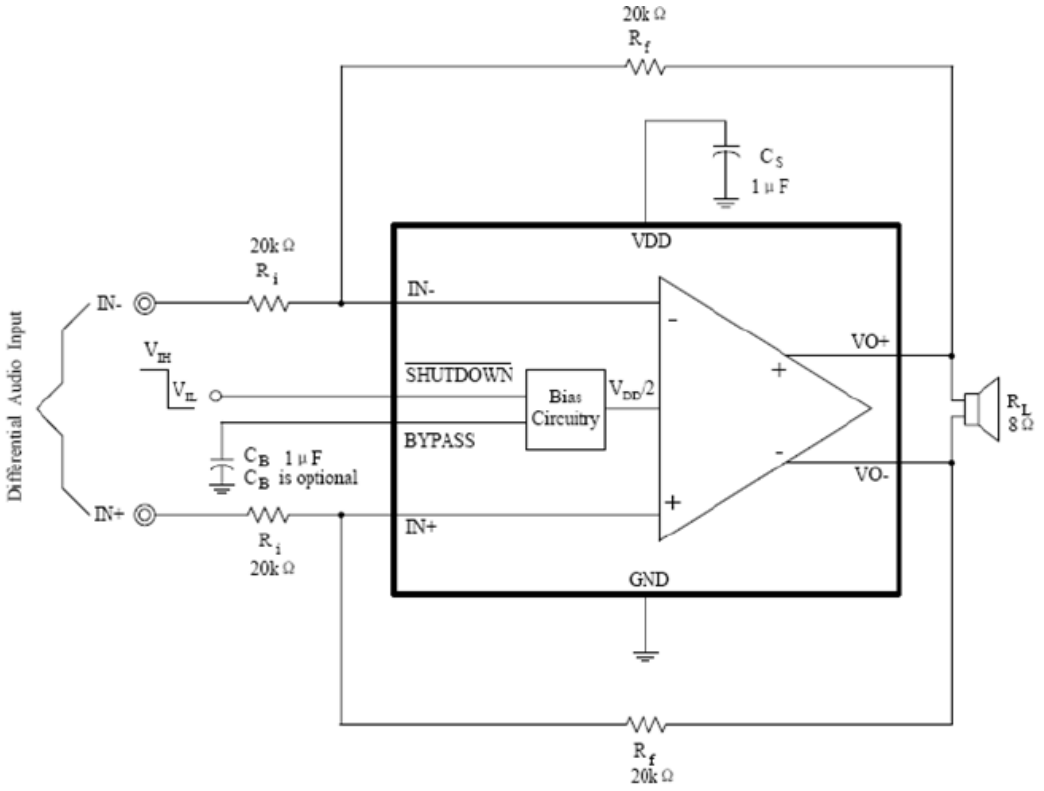


Figure1. Typical Differential Input Application

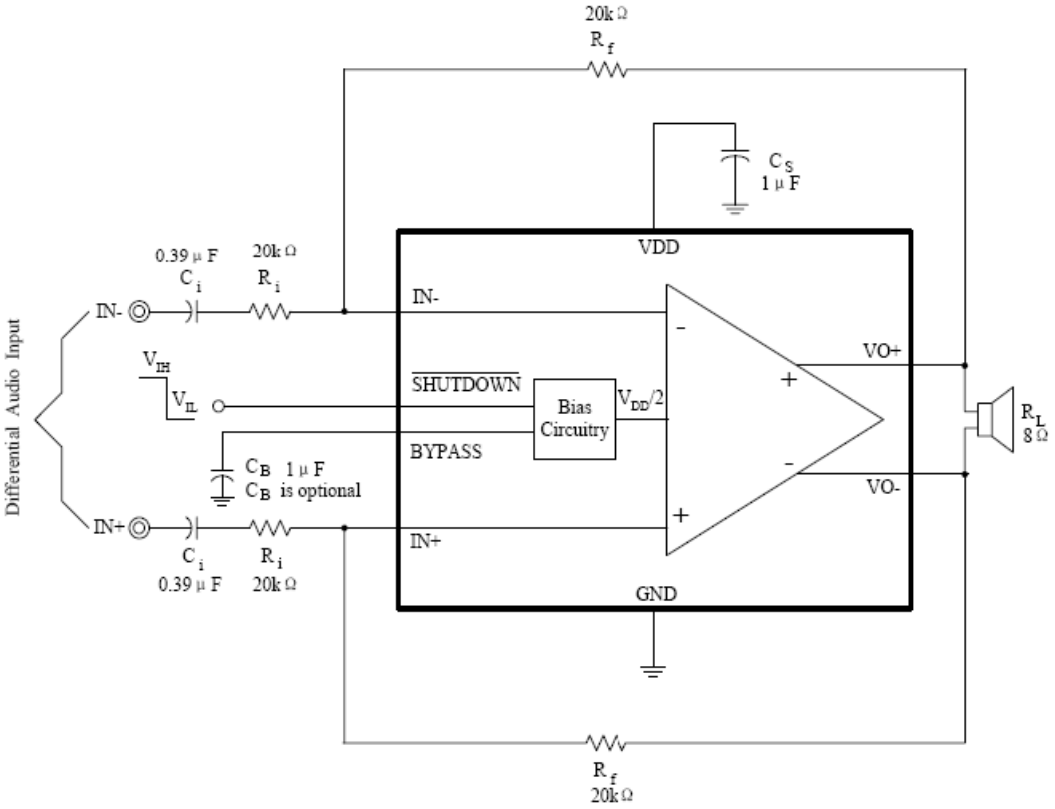


Figure2. Differential Input Application With Input Capacitors

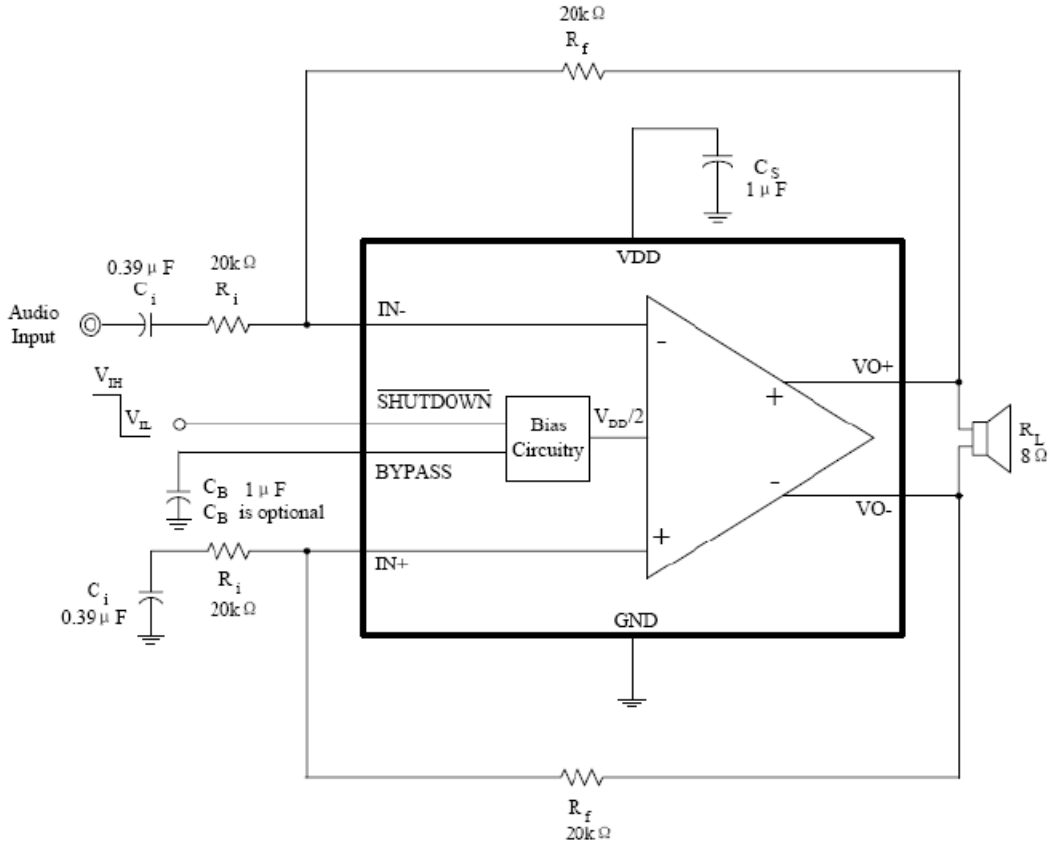


Figure3. Single-Ended Input Application

External Components Description

Components	Functional Description
Ri	The input (Ri) and feedback resistors (Rf) set the gain of the amplifier according to Equation :Gain=Rf / Ri , Rf and Ri should be in range from 10kΩ to 120kΩ, It is recommended to use 1% tolerance or better resistors to keep the performance optimized. *see figure 1~3
Ci	The ETK4992 does not require input coupling capacitor if using a differential input source that is biased from 0.5V to VDD-0.8V, In the single-ended input application, an input capacitor Ci is required to allow the amplifier to bias the input signal to the proper dc level. *see figure 1~3
Rf	Feedback resistance which sets the closed-loop gain in conjunction with Ri. *see figure 1~3
Cs	Supply bypass capacitor which provides power supply filtering. *see figure 1~3
C_B	Bypass pin capacitor which provides half-supply filtering. Refer to the section. *see figure 15,16

Absolute Maximum Ratings(note1)

Characteristic	Symbol	Range	Unit
Supply Voltage	V_{DD}	0.3～6	V
Input Voltage	V_{IN}	-0.3～VDD+0.3	V
Storage Temperature	T_{OPR}	-65～+150	℃
Power Dissipation(note2)		Internally Limited	
ESD Parameters:			
ESD Protection(HBM)		2000	V
ESD Protection(MM)		200	V
Junction Temperature	T_J	-40～150	℃
Thermal Resistance	θ_{JA}	220	℃/W

Note1: Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute maximum rated conditions for extended periods may affect device reliability.

Note2: The maximum power dissipation must be derated at elevated temperatures and is dictated by T_{JMAX}, θ_{JA}, and the ambient temperature T_A. The maximum allowable power dissipation is $P_{DMAX}=(T_{JMAX}-T_A)/\theta_{JA}$ or the number given in Absolute Maximum Ratings, whichever is lower.

Electrical Characteristics

The following specifications apply for the circuit shown in Figure 1, unless otherwise specified. Limits apply for T_A = 25℃.

VDD=5V

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Condition
Quiescent Power Supply Current	I_{DD}		1.6	4	mA	V_{IN}＝0V，no Load
			1.6	4		V_{IN}＝0V，R_L＝8Ω
Shutdown Current	I_{SD}		0.01	1	μA	$V_{SHUTDOWN}$＝GND
Output Power	P_O		1.25		W	THD＝1%(max)，f=1kHz, R_L＝8Ω
			2.25			THD＝1%(max)，f=1kHz, R_L＝4Ω
Total Harmonic Distortion + Noise	THD＋N		0.02		%	f=1kHz，Po＝0.6Wrms,R_L＝8Ω
Wake-up Time	T_{WU}		170		ms	C_B=1uF
Power Supply Rejection Ratio	PSRR				dB	Vripple=200mV sine p-p
			-90			f=217Hz（note1）
			-85			f=1KHz(note1)
			-85			f=217Hz（note2）
			-85			f=1KHz(note2)
Common Mode Rejection Ratio	CMRR		-80		dB	f=217Hz,V_{CM}=200mVpp
Output Offset	V_{OS}		2	8	mV	VIN=0V

Shutdown Voltage Input High	V_{SDIH}	1.5			V	
Shutdown Voltage Input Low	V_{SDIL}			0.4	V	

Note1:Unterminated input

Note2:10Ω terminated input

VDD=4.2V

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Condition
Quiescent Power Supply Current	I_{DD}		1.5	3.8	mA	V_{IN}＝0V，no Load
			1.5	3.8		V_{IN}＝0V，R_L＝8Ω
Shutdown Current	I_{SD}		0.01	1	μA	$V_{SHUTDOWN}$＝GND
Output Power	P_O		0.92		W	THD＝1%(max)，f=1kHz, R_L＝8Ω
			1.56			THD＝1%(max)，f=1kHz, R_L＝4Ω
Total Harmonic Distortion + Noise	THD＋N		0.02		%	f=1kHz，Po＝0.5Wrms,R_L＝8Ω

VDD=3.6V

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Condition
Quiescent Power Supply Current	I_{DD}		1.3	3.5	mA	V_{IN}＝0V，no Load
			1.3	3.5		V_{IN}＝0V，R_L＝8Ω
Shutdown Current	I_{SD}		0.01	1	μA	$V_{SHUTDOWN}$＝GND
Output Power	P_O		0.7		W	THD＝1%(max)，f=1kHz, R_L＝8Ω
			1.1			THD＝1%(max)，f=1kHz, R_L＝4Ω
Total Harmonic Distortion + Noise	THD＋N		0.02		%	f=1kHz，Po＝0.4Wrms, R_L＝8Ω
Wake-up Time	T_{WU}		140		ms	C_B=1uF
Power Supply Rejection Ratio	PSRR				dB	Vripple=200mV sine p-p
			-88			f=217Hz（note1）
			-85			f=1KHz(note1)
			-85			f=217Hz（note2）
			-85			f=1KHz(note2)
Common Mode Rejection Ratio	CMRR		-78		dB	f=217Hz,V_{CM}=200mVpp
Output Offset	V_{OS}		2	8	mV	VIN=0V
Shutdown Voltage Input High	V_{SDIH}	1.5			V	
Shutdown Voltage Input Low	V_{SDIL}			0.4	V	

Note1:Unterminated input

Note2:10Ω terminated input

VDD=2.5V

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Condition
Quiescent Power Supply Current	I_{DD}		1.2	3.2	mA	V_{IN}＝0V，no Load
			1.2	3.2		V_{IN}＝0V，R_L＝8Ω
Shutdown Current	I_{SD}		0.01	1	μA	$V_{SHUTDOWN}$＝GND
Output Power	P_O		0.25		W	THD＝1%(max)，f=1kHz, R_L＝8Ω
			0.5			THD＝1%(max)，f=1kHz, R_L＝4Ω
Total Harmonic Distortion + Noise	THD＋N		0.02		%	f=1kHz，Po＝0.15Wrms, R_L＝8Ω
Wake-up Time	T_{WU}		100		ms	C_B=1uF
Power Supply Rejection Ratio	PSRR				dB	Vripple=200mV sine p-p
			-80			f=217Hz（note1）
			-75			f=1KHz(note1)
			-75			f=217Hz（note2）
			-75			f=1KHz(note2)
Common Mode Rejection Ratio	CMRR		-75		dB	f=217Hz,V_{CM}=200mVpp
Output Offset	V_{OS}		2	8	mV	VIN=0V
Shutdown Voltage Input High	V_{SDIH}	1.2			V	
Shutdown Voltage Input Low	V_{SDIL}			0.3	V	

Note1:Unterminated input

Note2:10Ω terminated input

Typical Performance Characteristics

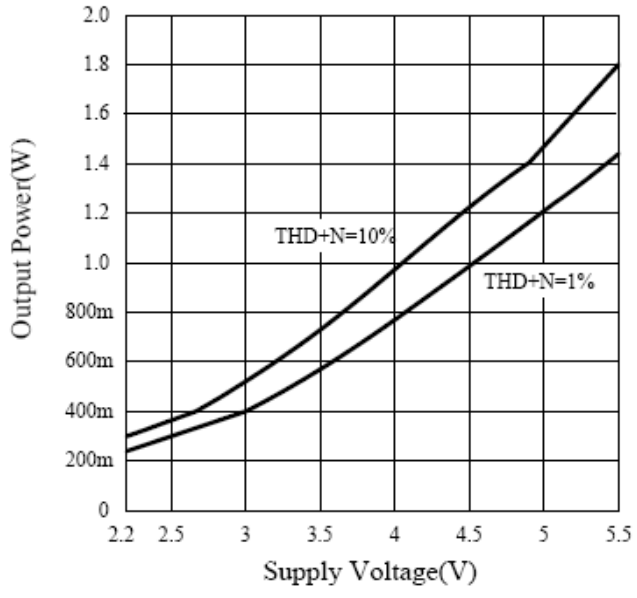


Figure5.Output Power vs Supply Voltage

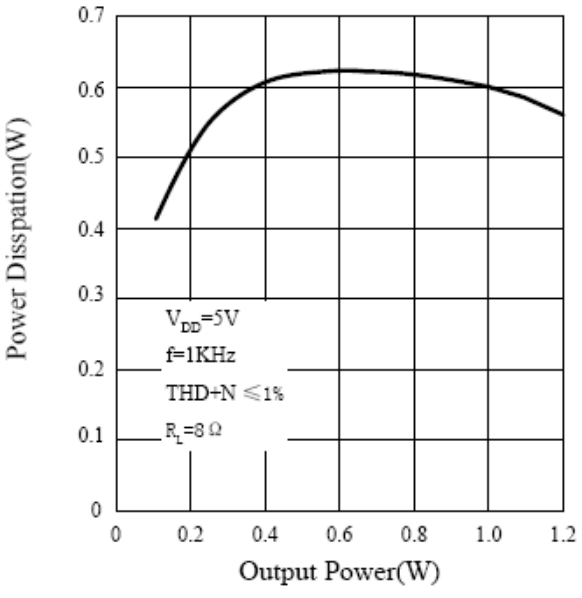


Figure6.Power Dissipation vs Output Power

RL=8 Ω

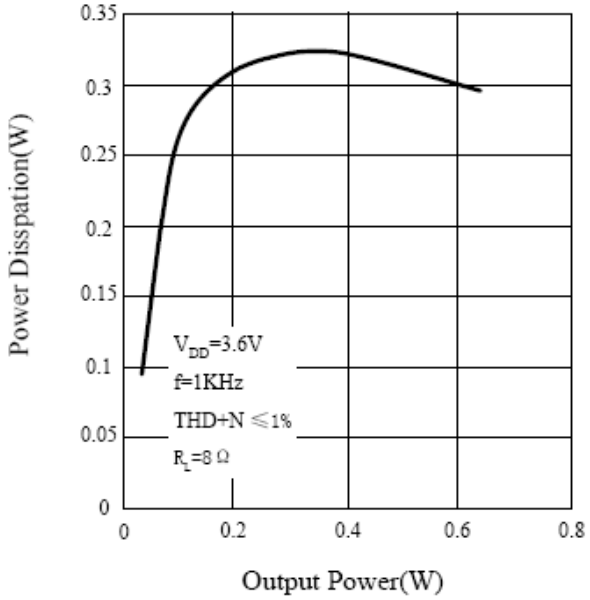


Figure7.Power Dissipation vs Output Power

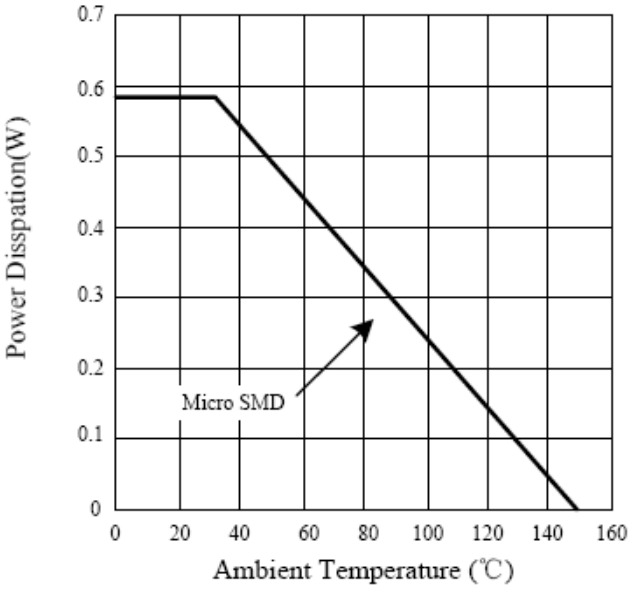


Figure8.Power Derating curve

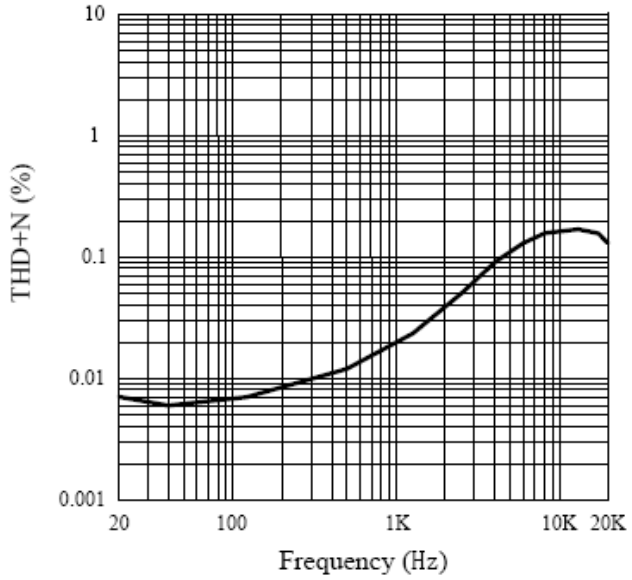


Figure9.THD+N vs Frequency
V_{DD}＝5V,R_L＝8Ω,P_O=600mW

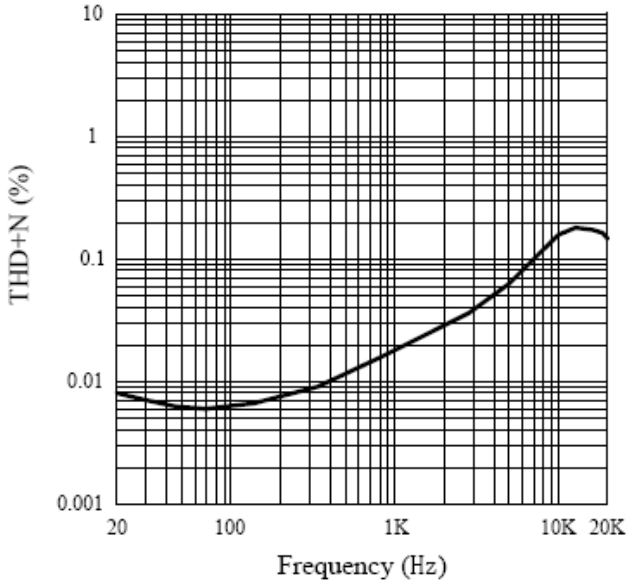


Figure10.THD+N vs Frequency
V_{DD}＝3.6V,R_L＝8Ω,P_O=400mW

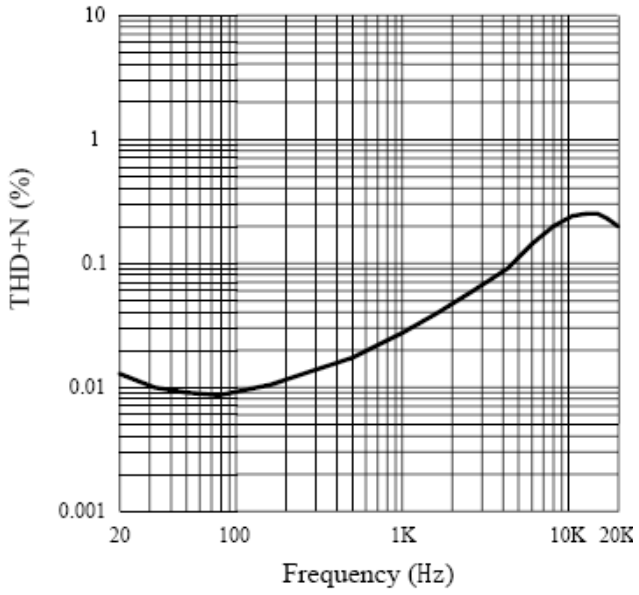


Figure11.THD+N vs Frequency
V_{DD}＝2.5V,R_L＝8Ω,P_O=1

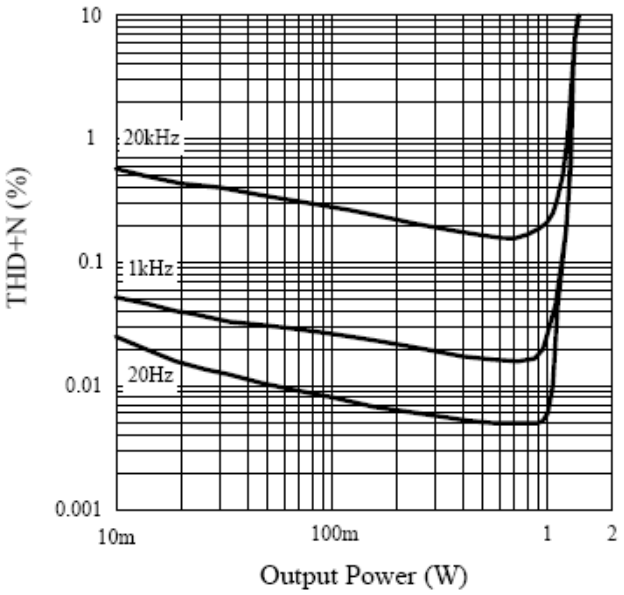


Figure12.THD+N vs Output Power
V_{DD}＝5V,R_L＝8Ω

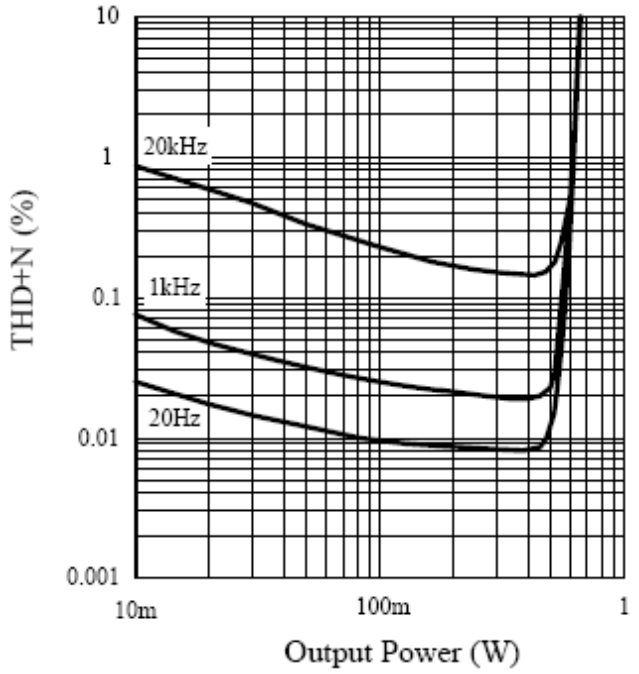


Figure13.THD+N vs Output Power
V_{DD}＝3.6V,R_L＝8Ω

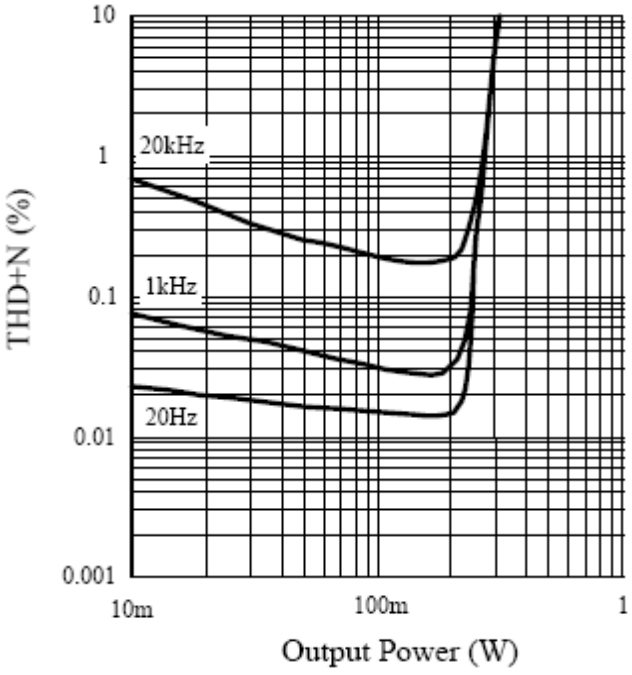


Figure14.THD+N vs Output Power
V_{DD}＝2.5V,R_L＝8Ω

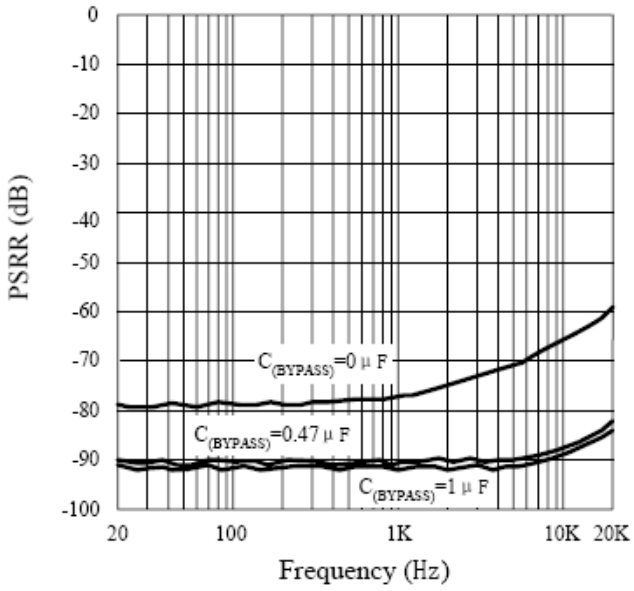


Figure15.PSRR vs Frequency
V_{DD}＝5V,R_L＝8Ω,input 10Ω Terminated

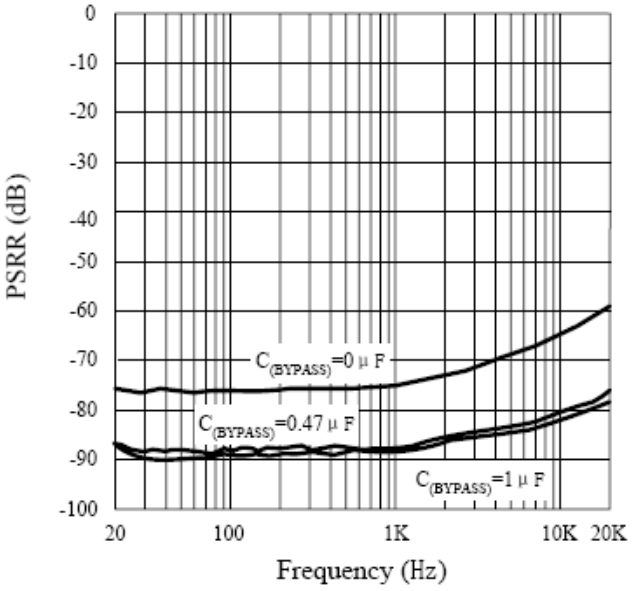


Figure16.PSRR vs Frequency
V_{DD}＝3.6V,R_L＝8Ω,input 10Ω Terminated

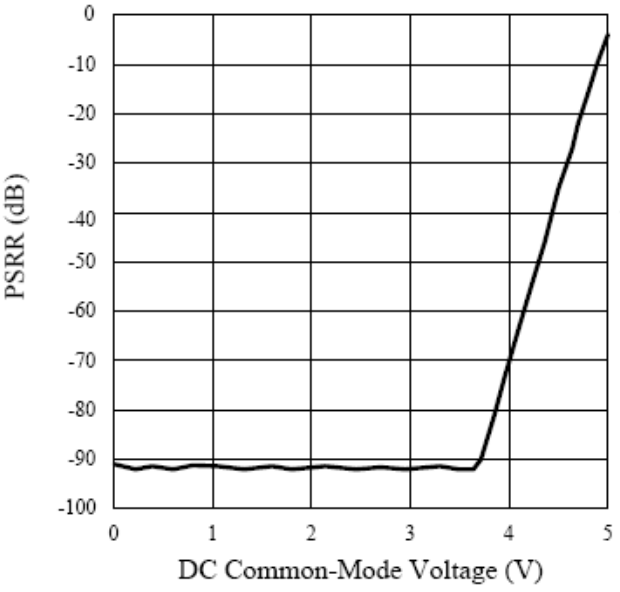


Figure17.PSRR vs Common Mode voltage
V_{DD}＝5V,R_L＝8Ω,217Hz,200mV_{PP}

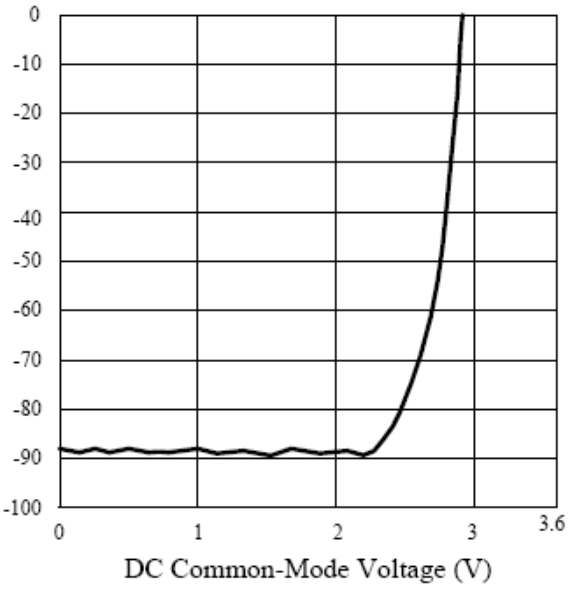


Figure18.PSRR vs Common Mode voltage
V_{DD}＝3.6V,R_L＝8Ω, 217Hz,200mV_{PP}

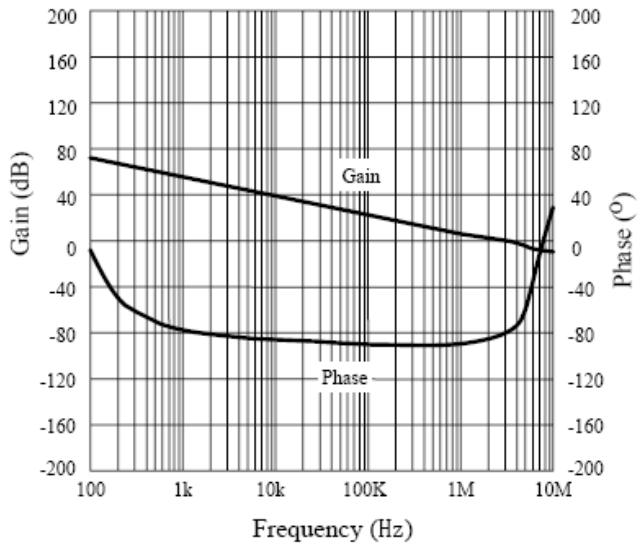


Figure19.Open Loop Frequency Response

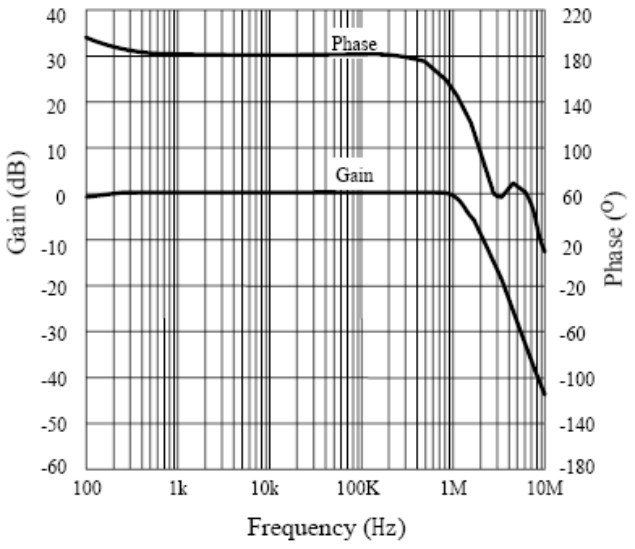


Figure20.Closed Loop Frequency Response

Package Dimension

WLCSP8

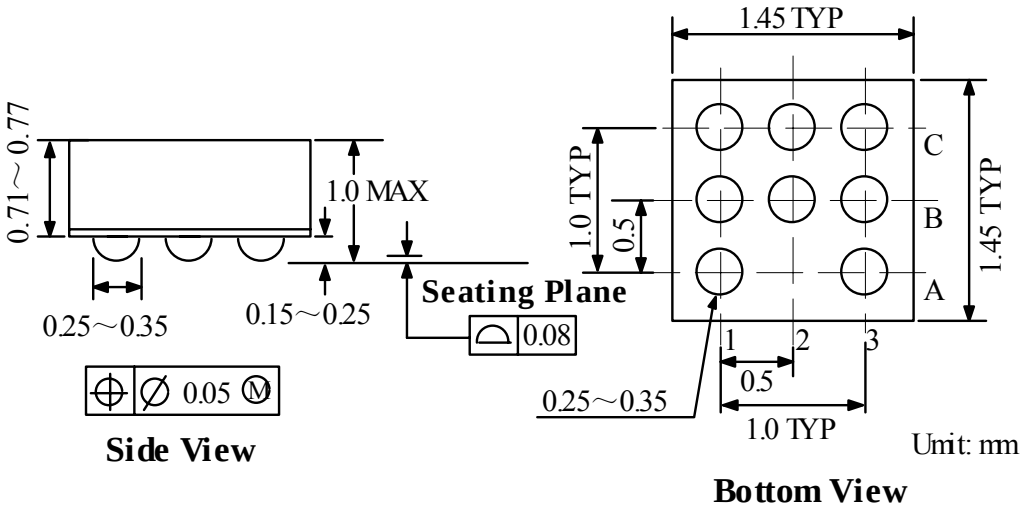


Figure 21. Package Dimension