

0.9V, Mono 85mW BTL Output, 14mW Stereo Headphone Audio Amplifier

DESCRIPTION

The unity gain stable ZTA4541 is both a mono differential output (for bridge-tied loads or BTL) audio power amplifier and a Single Ended (SE) stereo supply, the mono BTL mode delivers 85mW into an 8Ω load at 1% THD+N. In Single Ended stereo headphone mode, the amplifier delivers 14mW per channel into a 16Ω load at 1% THD+N.

With the ZTA4541 packaged in the WLCSP-6, TDFN 3X3-10L and TDFN 2X2-8L packages. The package minimizes PCB area and maximizes output power.

The ZTA4541 features circuitry that reduces output transients (“clicks” and “pops”) during device turn-on and turn-off, an externally controlled, low-power consumption, active-low shutdown mode, and thermal shutdown. Zilltek audio power amplifiers are designed specifically to use few external components and provide high quality output power in a surface mount package.

FEATURES

- Single-Cell 0.9V to 3.6V Battery Operation
- BTL Mode for Mono Speaker
- Single-Ended Headphone Operation with Coupling Capacitors
- Unity-Gain Stable
- Ultra Low Power Consumption 750uA
- "Click and Pop" Suppression Circuitry
- Active-Low Micropower Shutdown
- Low Current, Active-Low Mute Mode
- Thermal Shutdown Protection Circuitry
- Available in the WLCSP-6, TDFN 3X3-10L TDFN2x2-8L packages

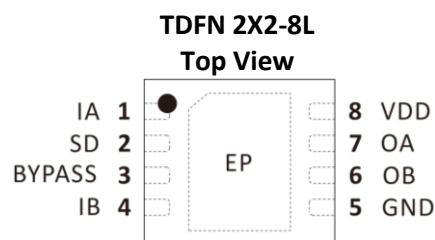
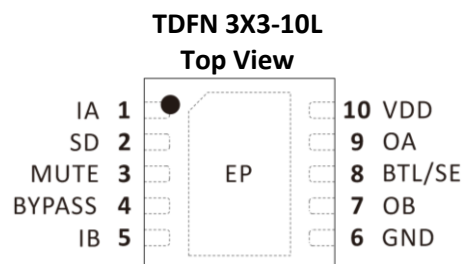
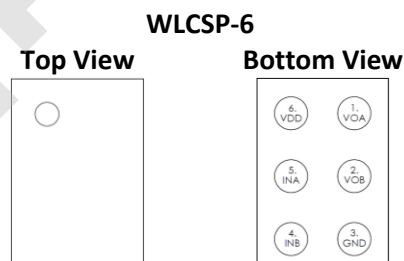
APPLICATIONS

- Portable One-Cell Audio Products
- Portable One-Cell Electronic Devices

ORDERING INFORMATION

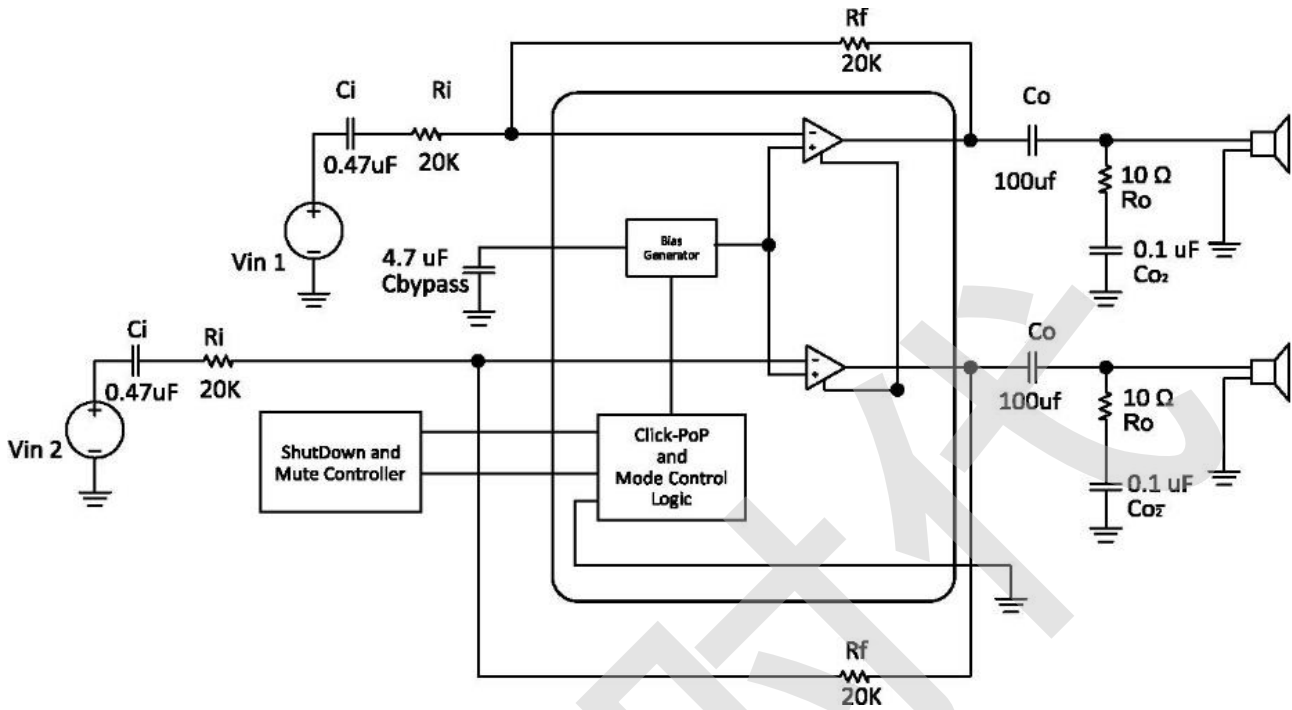
PART	PACKAGE	RoHS	Ship, Quantity
ZTA4541C	WLCSP-6	Yes	Tape & Reel
ZTA4541D	TDFN 3X3-10L	Yes	Tape & Reel, 5K
ZTA4541DS	TDFN 2X2-8L	Yes	Tape & Reel, 3K
ZTA4541DE	TDFN 3X3-10L	Yes	Tape & Reel, 5K
ZTA4541DSE	TDFN 2X2-8L	Yes	Tape & Reel, 3K

Pins Configuration

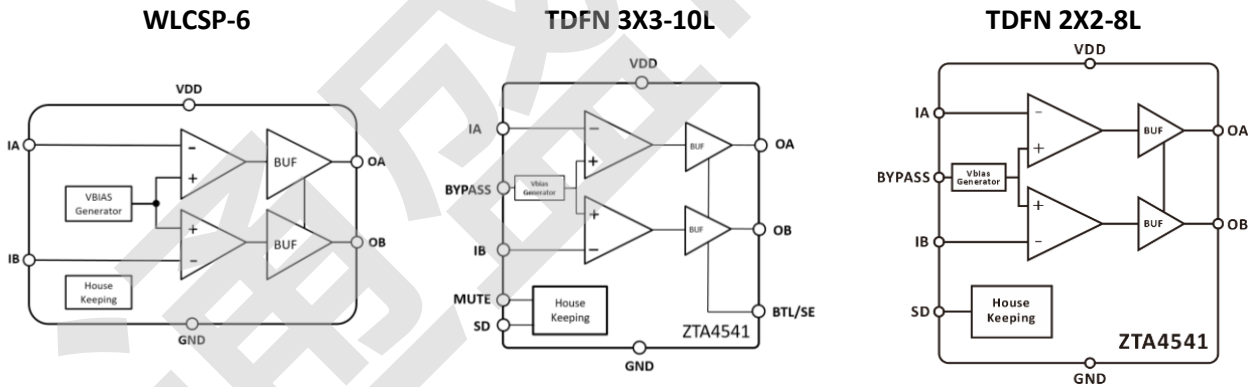


Typical Connections

Typical Single Ended Output Configuration Circuit



Typical Application



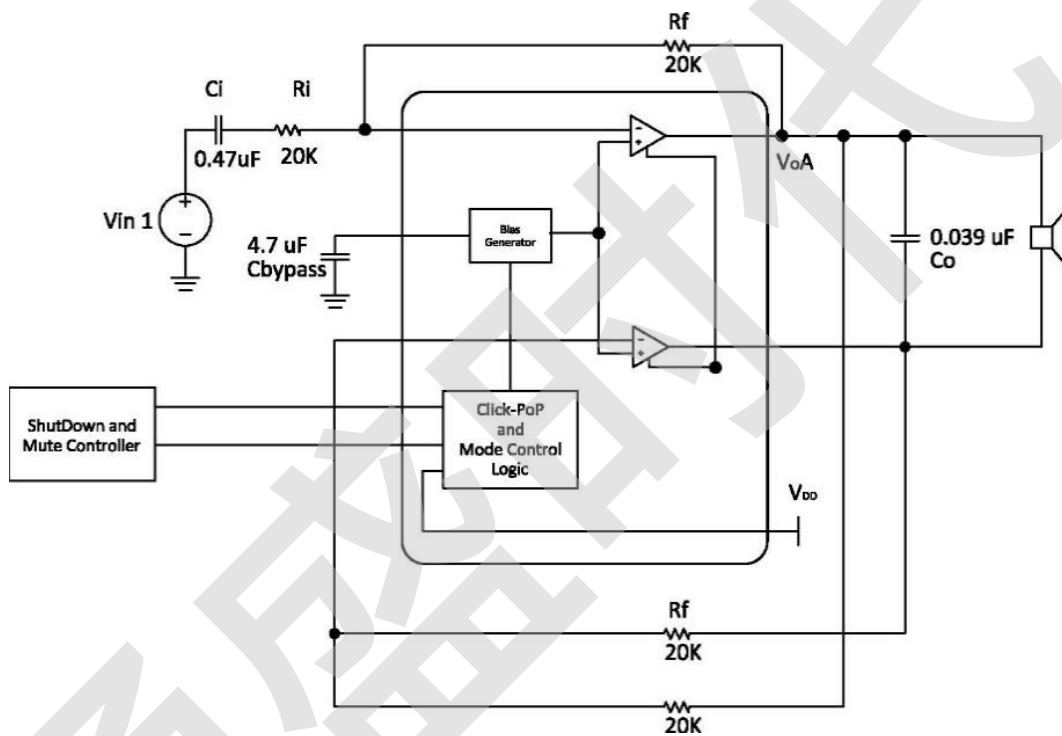
EQ adjustment:

Adjust the RF value to change the Rf/Ri value:

For example the Bom:

EQ/dB	Rf/Ri
0	1(Rf=Ri=20k)
+20	10(Rf=200k;Ri=20k)
+29.5	30(Rf=600k;Ri=20k)
$20\lg(Rf/Ri)$	XXX

Typical BTL Speaker Configuration Circuit



Absolute Maximum Ratings

Supply Voltage	0.9V to 3.6V
Input Voltage.....	-0.3V to VDD +0.3V
Power Dissipation	Internally limited
ESD Susceptibility (4)	2000V
ESD Susceptibility (5)	200V
Junction Temperature.....	+150°C
Soldering Information (Small Outline Package Vapor Phase (60sec)).....	+215°C
Soldering Information (Infrared(15sec)).....	+220°C
Storage Temperature Range	-65°C to +150°C
Thermal Resistance (θJA (typ) DGS0010A).....	175°C/W
Thermal Resistance (θJA (typ) NGY0010A).....	73°C/W

Operating Ratings

Temperature Range(TMIN ≤ TA ≤ TMAX).....	-40°C ≤ TA ≤ 85°C
Supply Voltage(1).....	0.9V ≤ VDD ≤ 3.6V

When operating on a power supply voltage of 0.9V, the ZTA4541 will not function below 0°C. At a power supply voltage of 1V or greater, the ZTA4541 will operate down to -40°C.

CAUTION: Stresses above those listed in “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

Electro-Static Discharge Sensitivity



This integrated circuit can be damaged by ESD. It is recommended that all integrated circuits be handled with proper precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure.

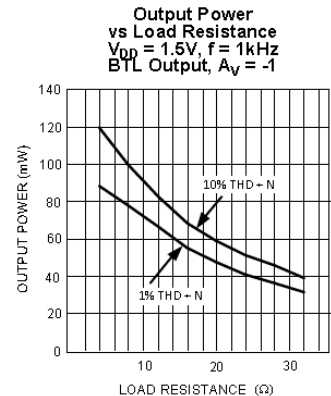
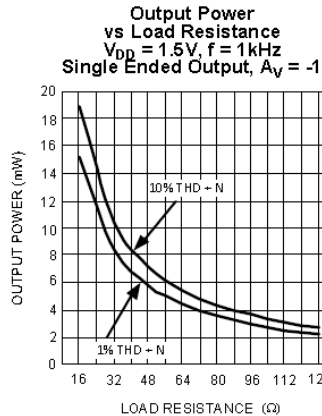
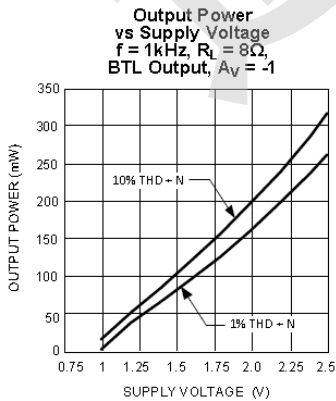
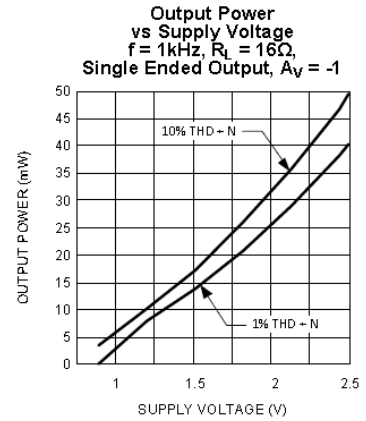
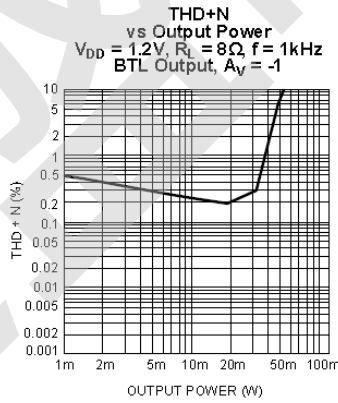
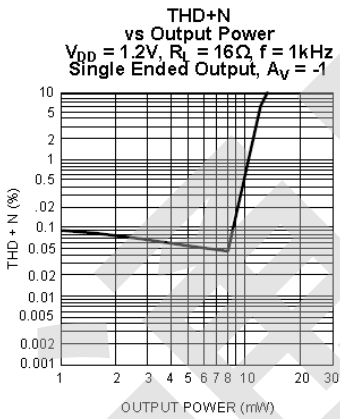
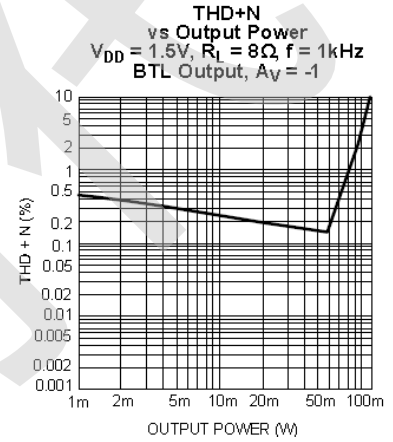
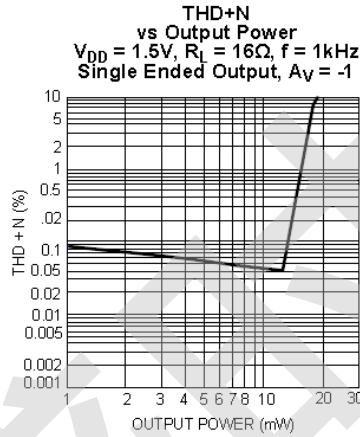
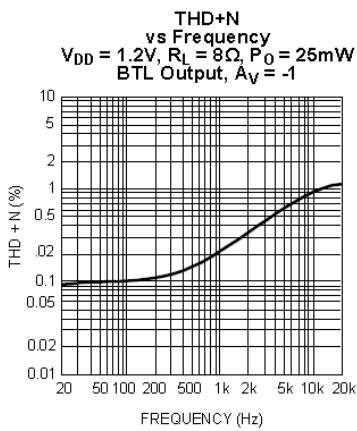
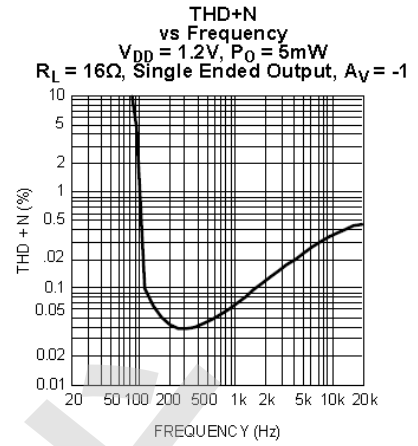
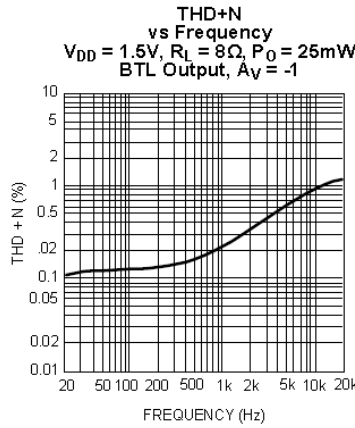
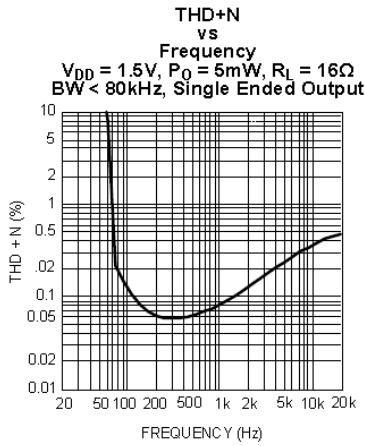
Electrical Specifications

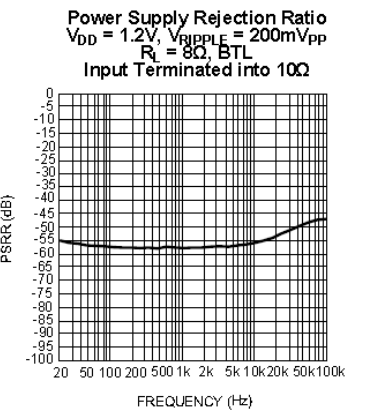
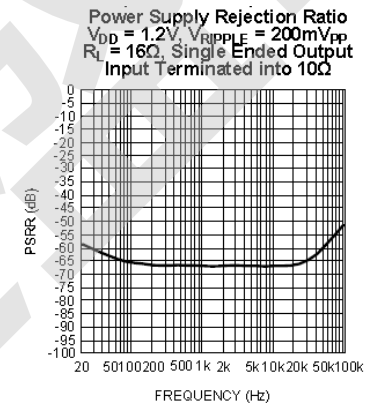
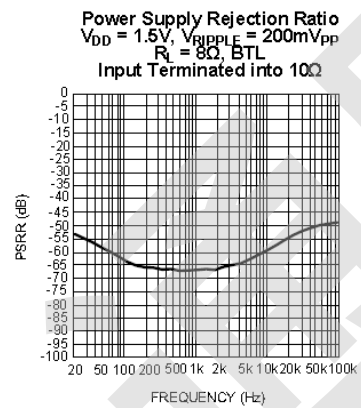
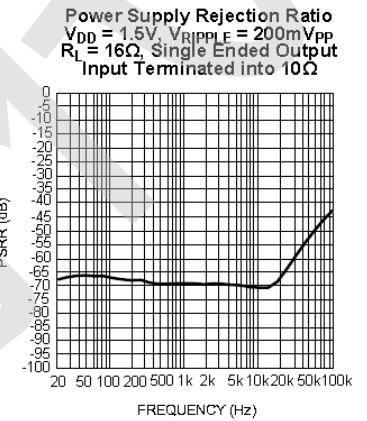
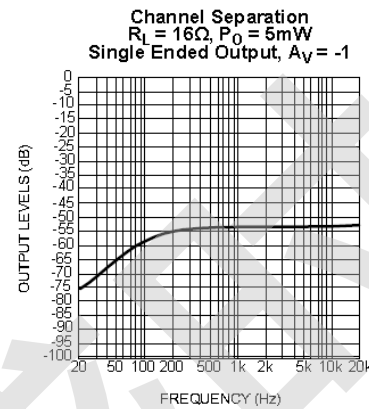
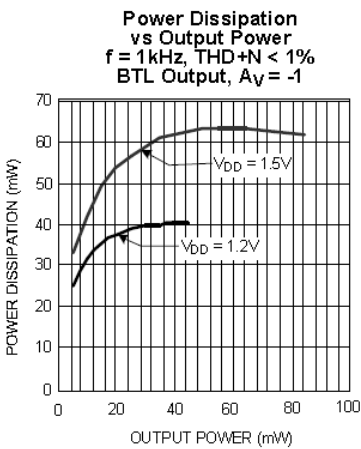
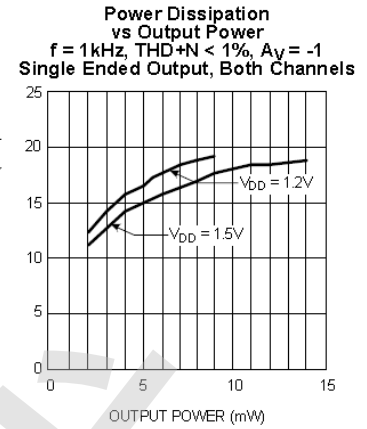
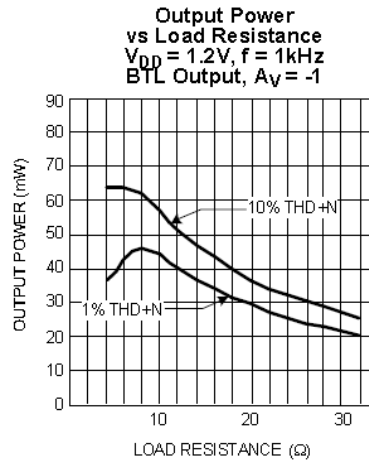
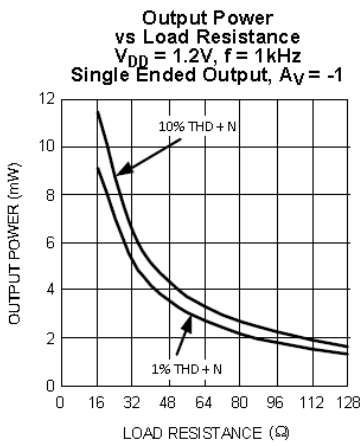
The following specifications apply for the circuit operating with VDD = 1.5V, unless otherwise specified. Limits apply for TA = 25°C.

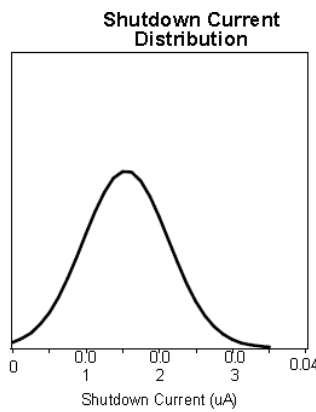
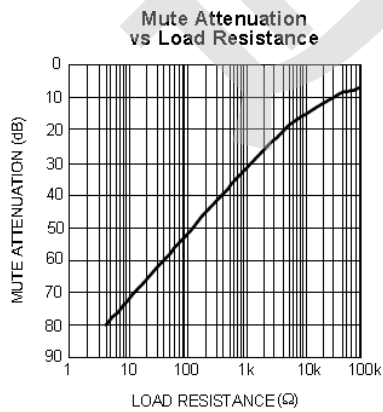
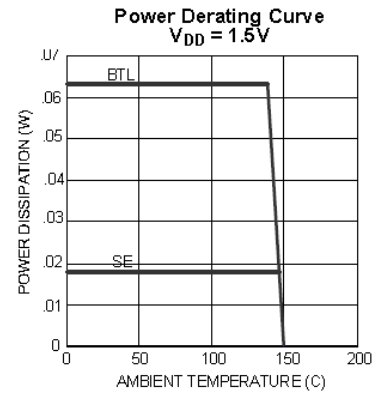
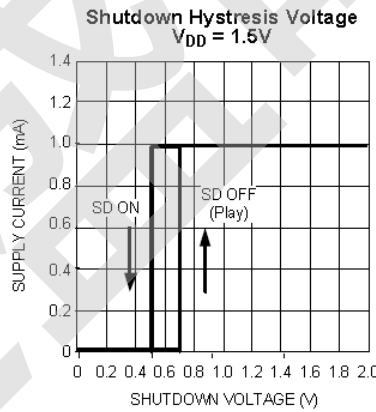
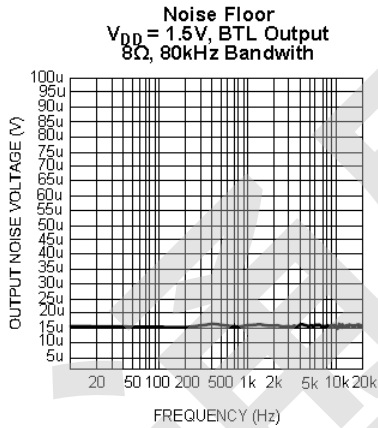
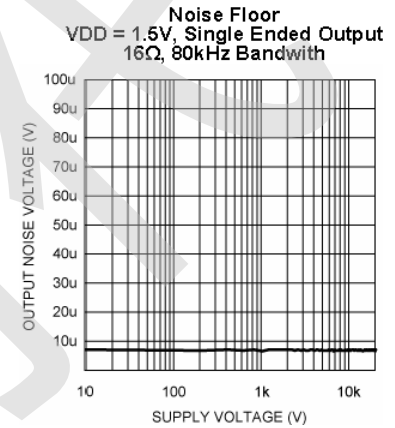
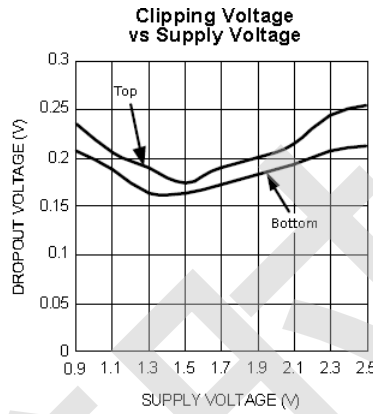
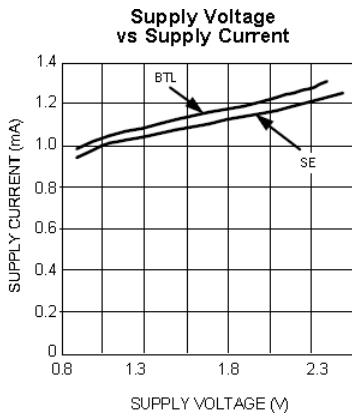
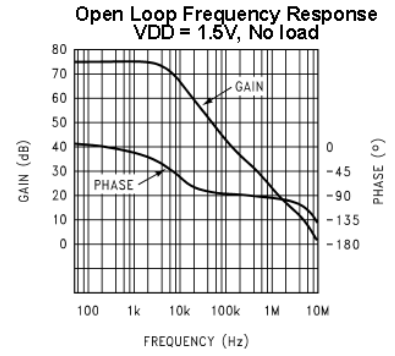
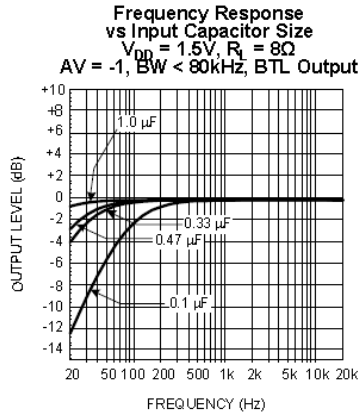
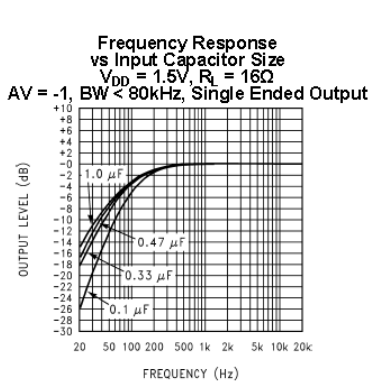
Parameter		Test Conditions	ZTA4541		Units (Limits)
			Typ(3)	Limit(4)	
VDD	Supply Voltage ⁽⁵⁾⁽⁶⁾			0.9	V (min)
				3.6	V (max)
IDD	Quiescent Power Supply Current	4541D/4541DS	0.75	1	mA (max)
		4541DE/4541DSE	160	220	μA
ISD	Shutdown Current	VSHUTDOWN = GND	0.3		μA (max)
VOS	Output Offset Voltage	BTL	0.2	2	mV (max)
PO	Output Power ⁽⁸⁾	f = 1kHz			
		RL = 8Ω BTL, THD+N = 1%	85	70	mW (min)
		RL = 16Ω SE, THD+N = 1%	14		mW
THD+N	Total Harmonic Distortion + Noise	RL = 8Ω, BTL, PO = 25mW, f = 1kHz	0.1	0.5	%
		RL = 16Ω, SE, PO = 5mW, f = 1kHz	0.2		
VNO	Output Voltage Noise	20Hz to 20kHz, A-weighted	5		μVRMS
IMUTE	Mute Current	VMUTE = 0, SE	15		μA
Crosstalk		RL = 16Ω, SE	55		dB (min)
PSRR	Power Supply Rejection Ratio	V _{RIPPLE} = 200mV _{P-P} C _{BYPASS} = 4.7μF, RL = 8Ω f = 1kHz, BTL	65		dB
		V _{RIPPLE} = 200mV _{P-P} sine wave C _{BYPASS} = 4.7μF, RL = 16Ω f = 1kHz, SE	70		dB (min)
VIH	Control Logic High		0.8		V (min)
VIL	Control Logic Low		0.6		V (max)

1. Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is functional, but do not ensure specific performance limits. Electrical Characteristics state DC and AC electrical specifications under particular test conditions which ensure specific performance limits. This assumes that the device is within the Operating Ratings. Specifications are not ensured for parameters where no limit is given, however, the typical value is a good indication of device performance.
2. All voltages are measured with respect to the ground (GND) pins unless otherwise specified.
3. Typicals are measured at 25°C and represent the parametric norm.
4. Datasheet min/max specification limits are specified by design, test, or statistical analysis.
5. When operating on a power supply voltage of 0.9V, the ZTA4541 will not function below 0°C. At a power supply voltage of 1V or greater, the ZTA4541 will operate down to -40°C.
6. Ripple on power supply line should not exceed 400mVpp.
7. The quiescent power supply current depends on the offset voltage when a practical load is connected to the amplifier.
8. Output power is measured at the device terminals.

TYPICAL PERFORMANCE CHARACTERISTICS







APPLICATION

Single Ended (Se) Configuration Explanation

The ZTA4541 has two operational amplifiers internally, which have externally configurable gain. The closed loop gain of the two configurable amplifiers is set by selecting the ratio of R_f to R_i . Consequently, the gain for each channel of the IC is

$$A_{VD} = -(R_f / R_i)$$

When the ZTA4541 operates in Single Ended mode, coupling capacitors are used on each output (VoA and VoB) and the SE/BTL pin (Pin 8) is connected to ground. These output coupling capacitors blocks the half supply voltage to which the output amplifiers are typically biased and couples the audio signal to the headphones or other single-ended (SE) loads. The signal return to circuit ground is through the headphone jack's sleeve.

Bridged (Btl) Configuration Explanation

The ZTA4541 has two internal operational amplifiers. The first amplifier's gain is externally configurable, while the second amplifier should be externally fixed in a unity-gain, inverting configuration. The closed-loop gain of the first amplifier is set by selecting the ratio of R_f to R_i while the second amplifier's gain should be fixed by the two external 20k Ω resistors. the output of amplifier one serves as the input to amplifier two which results in both amplifiers producing signals identical in magnitude, but out of phase by 180°. Consequently, the differential gain for the IC is

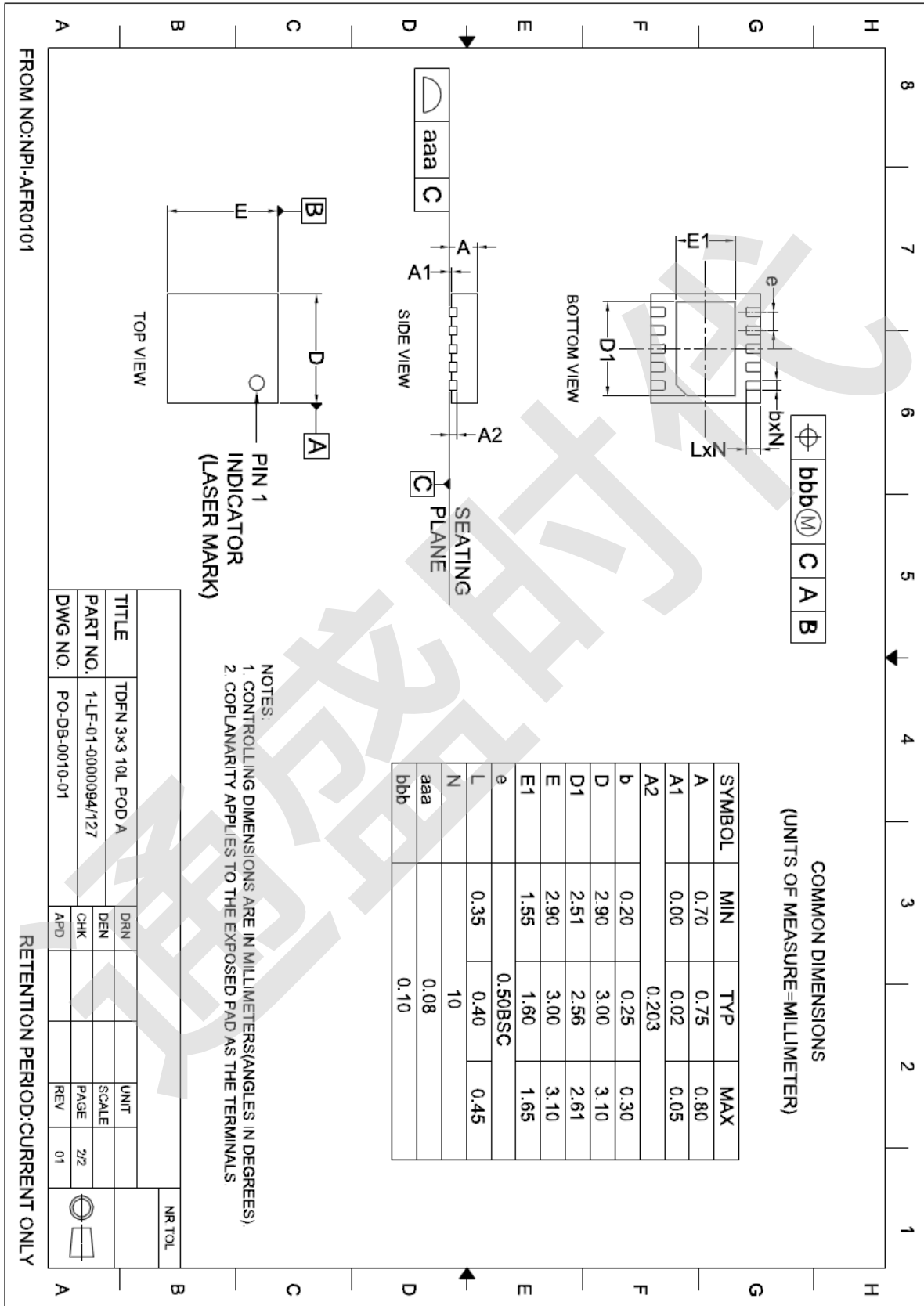
$$A_{VD} = 2 * (R_f / R_i).$$

By driving the load differentially through outputs Vo1 and Vo2, an amplifier configuration commonly referred to as "bridged mode" is established. Bridged mode operation is different from the classical single-ended amplifier configuration where one side of the load is connected to ground. A bridge amplifier design has a few distinct advantages over the single-ended configuration. It provides a differential drive to the load, thus doubling output swing for a specified supply voltage. Four times the output power is possible as compared to a single-ended amplifier under the same conditions. This increase in attainable output power assumes that the amplifier is not current limited or clipped.

A bridge configuration, such as the one used in ZTA4541, also creates a second advantage over single-ended amplifiers. Since the differential outputs, Vo1 and Vo2, are biased at half-supply, no net DC voltage exists across the load. This eliminates the need for an output coupling capacitor which is required in a single supply, single-ended amplifier configuration.

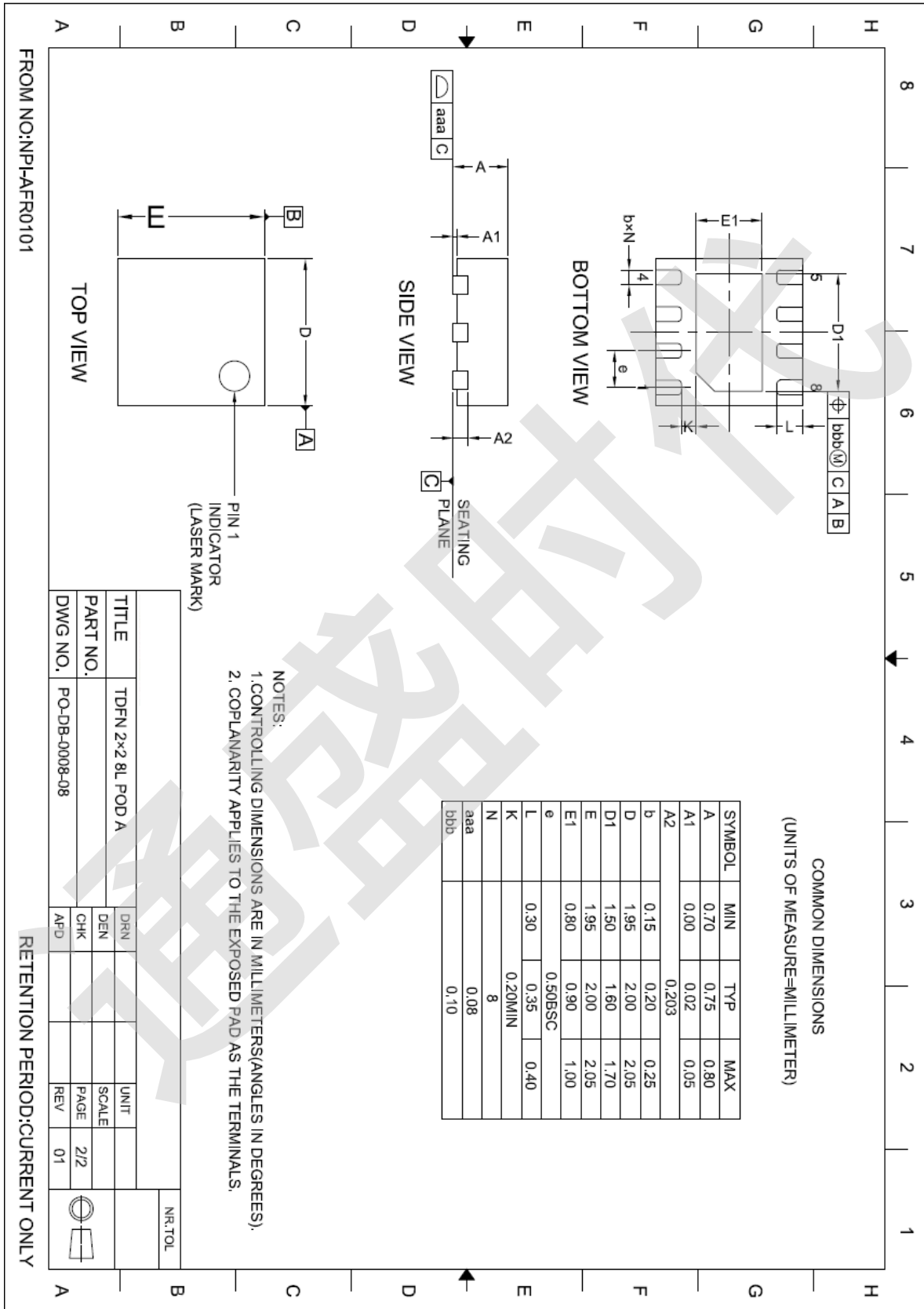
Packaging Information

TDFN 3X3-10L



Packaging Information

TDFN 2X2-8L

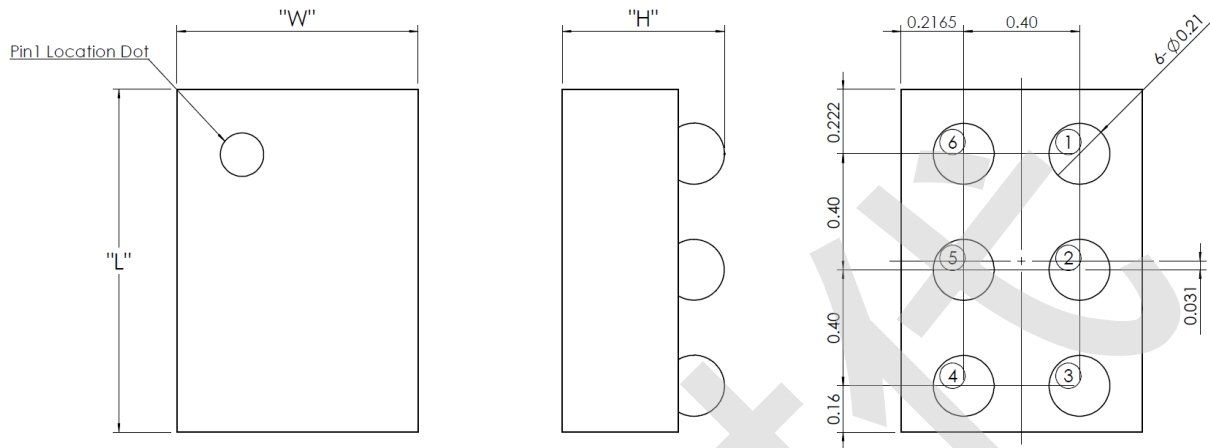


Packaging Information

WLCSP-6

CSP Form: ZTA4541C

1. Package size: 0.833 X 1.182 X 0.56±0.035 mm
2. Ball size: $\varnothing 0.210 \pm 0.020$ mm



CSP Package Coordinates

Units: mm,
(0,0) at Center of Package

Pad No	Pad Name	X Coordinate	Y Coordinate
1	VOA	0.20	0.369
2	VOB	0.20	-0.031
3	GND	0.20	-0.431
4	INB	-0.20	-0.431
5	INA	-0.20	-0.031
6	VDD	-0.20	0.369

RECOMMENDED CUSTOMER LAND PATTERN

The recommended PCB land pattern should have a 1:1 ratio to the solder pads on the microphone package. Care should be taken to avoid applying solder paste to the sound hole in PCB. The dimensions of suggested solder paste pattern refer to the land pattern which should be shrunk by 0.025 mm per side.

