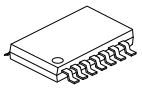
ALDR6138

CMOS IC

DIRECT HEADPHONE DRIVER WITH ADJUSTABLE GAIN



TSSOP-14

■ DESCRIPTION

The UTC **ALDR6138** is a pop-free stereo headphone amplifier with the integrated charge pump generating the negative supply rail which allows the removal of the output DC-blocking capacitors. The UTC **ALDR6138** provides a clean, pop-free ground-biased audio signal. The UTC **ALDR6138** is capable of driving 25mW into a 32-Ω load with 3.3-V supply voltage. The device has differential inputs and uses external resistors for flexible gain setting. Gain can be configured individually for each channel. The device can also be configured as a second-order low-pass filter and is ideal for interfacing with PWM audio sources.

The UTC **ALDR6138** has built-in active-mute control for pop-free audio on/off control. The UTC **ALDR6138** has an external under-voltage detector that mutes the output when monitored voltage drop below set value.

Using the UTC **ALDR6138** in audio products can reduce component count considerably compared to traditional headphone amplifiers.

■ FEATURES

* Low THD+N<0.01% at 10mW Into 32Ω
* Stereo Direct Headphone Amplifier driver 40 mW Into 32Ω With 3.3-V Supply
* Integrated charge pump Generates Negative Supply Rail
* High SNR, >90dB
* Ground-Referenced Outputs Eliminate DC-Blocking Capacitors
* Differential Input and Single-Ended Output
* Adjustable Gain by External Gain-Setting Resistors
* Pop-Free Under-Voltage Protection
* Configurable as a Second-Order Low-Pass Filter Ideal for PWM Audio Sources
* Short-Circuit Protection
* Click- and Pop-Reduction Circuitry
* Active Mute Control for Pop-Free Audio On/Off Control

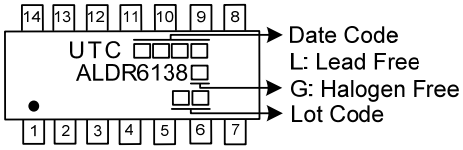
■ ORDERING INFORMATION

Ordering Number		Package	Packing
Lead Free	Halogen Free		
ALDR6138L-P14-R	ALDR6138G-P14-R	TSSOP-14	Tape Reel

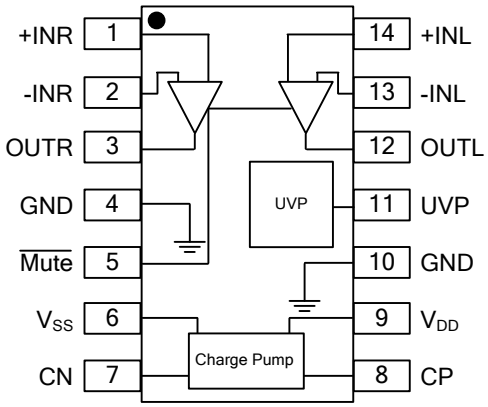
ALDR6138G-P14-R

(1) Packing Type	(1) R: Tape Reel
(2) Package Type	(2) P14: TSSOP-14
(3) Green Package	(3) G: Halogen Free and Lead Free, L: Lead Free

■ MARKING



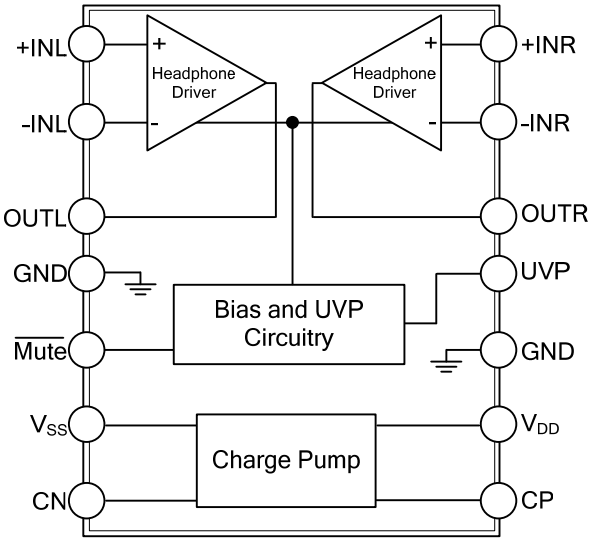
■ PIN CONFIGURATION



■ PIN DESCRIPTION

PIN NO.	PIN NAME	DESCRIPTION
1	+INR	Right-channel OPAMP positive input
2	-INR	Right-channel OPAMP negative input
3	OUTR	Right-channel OPAMP output
4, 10	GND	Ground
5	Mute	Mute, active-low
6	V_{SS}	Supply voltage
7	CN	Charge-pump flying capacitor negative connection
8	CP	Charge-pump flying capacitor positive connection
9	V_{DD}	Positive supply
11	UVP	Under-voltage protection; internal pull-up, unconnected if UVP function is unused.
12	OUTL	Left-channel OPAMP output
13	-INL	Left-channel OPAMP negative input
14	+INL	Left-channel OPAMP positive input

■ BLOCK DIAGRAM



■ ABSOLUTE MAXIMUM RATING over operating free-air temperature range (unless otherwise noted)

PARAMETER	SYMBOL	RATINGS	UNIT
V_{DD} to GND		-0.3 ~ 4	V
Input Voltage	V_{IN}	V_{SS}-0.3 ~ V_{DD}+0.3	V
Minimum Load Impedance-Line Outputs-OUTL, OUTR		12.8	Ω
Mute to GND, UVP to GND		-0.3 ~ V_{DD}+0.3	V
Maximum Operating Junction Temperature Range	T_J	-40 ~ +150	°C
Storage Temperature Range	T_{STG}	-40 ~ +150	°C

Note: Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.

■ THERMAL DATA

PARAMETER	SYMBOL	RATINGS	UNIT
Junction-to-Ambient	θ_{JA}	130	°C/W
Junction-to-Case (top)	θ_{JC}	49	°C/W

Note: For more information about traditional and new thermal metrics, see the IC Package Thermal Metrics application report, SPRA953.

■ RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Power Supply	V_{DD}	DC supply voltage	3	3.3	3.6	V
Load Impedance	R_L		16	32		Ω
Low-Level Input Voltage	V_{IL}	$\overline{\text{Mute}}$		40		%V_{DD}
High-Level Input Voltage	V_{IH}	$\overline{\text{Mute}}$		60		%V_{DD}
Ambient Temperature	T_A		-40	25	+85	°C

■ ELECTRICAL CHARACTERISTICS

V_{DD}=3.3V, R_{DL}=32Ω, R_{fb}=30kΩ, R_{IN}=15kΩ, T_A=25°C, Charge pump: C_P=1μF (unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Output Offset Voltage	$\|V_{OS}\|$	V_{DD}=3.3V		0.5	1	mV
Power-Supply Rejection Ratio	PSRR			65		dB
High-Level Output Voltage	V_{OH}	V_{DD}=3.3V	3.1			V
Low-Level Output Voltage	V_{OL}	V_{DD}=3.3V			-3.05	V
External UVP Detect Voltage	V_{UVP_EX}			1.25		V
External UVP Detect Hysteresis Current	$V_{UVP\_EX\_HYSTERESIS}$			5		μA
Charge-pump Switching Frequency	f_{CP}		200	300	400	kHz
High-Level Input Current, $\overline{\text{Mute}}$	$\|I_{IH}\|$	V_{DD}=3.3V, V_{IH}=V_{DD}			1	μA
Low-Level Input Current, $\overline{\text{Mute}}$	$\|I_{IL}\|$	V_{DD}=3.3V, V_{IL}=0V			1	μA
Supply Current	I_{DD}	V_{DD}=3.3V, no load, $\overline{\text{Mute}}$ = V_{DD}	5	14	25	mA
		V_{DD}=3.3V, no load, $\overline{\text{Mute}}$ = GND, disabled		1		mA

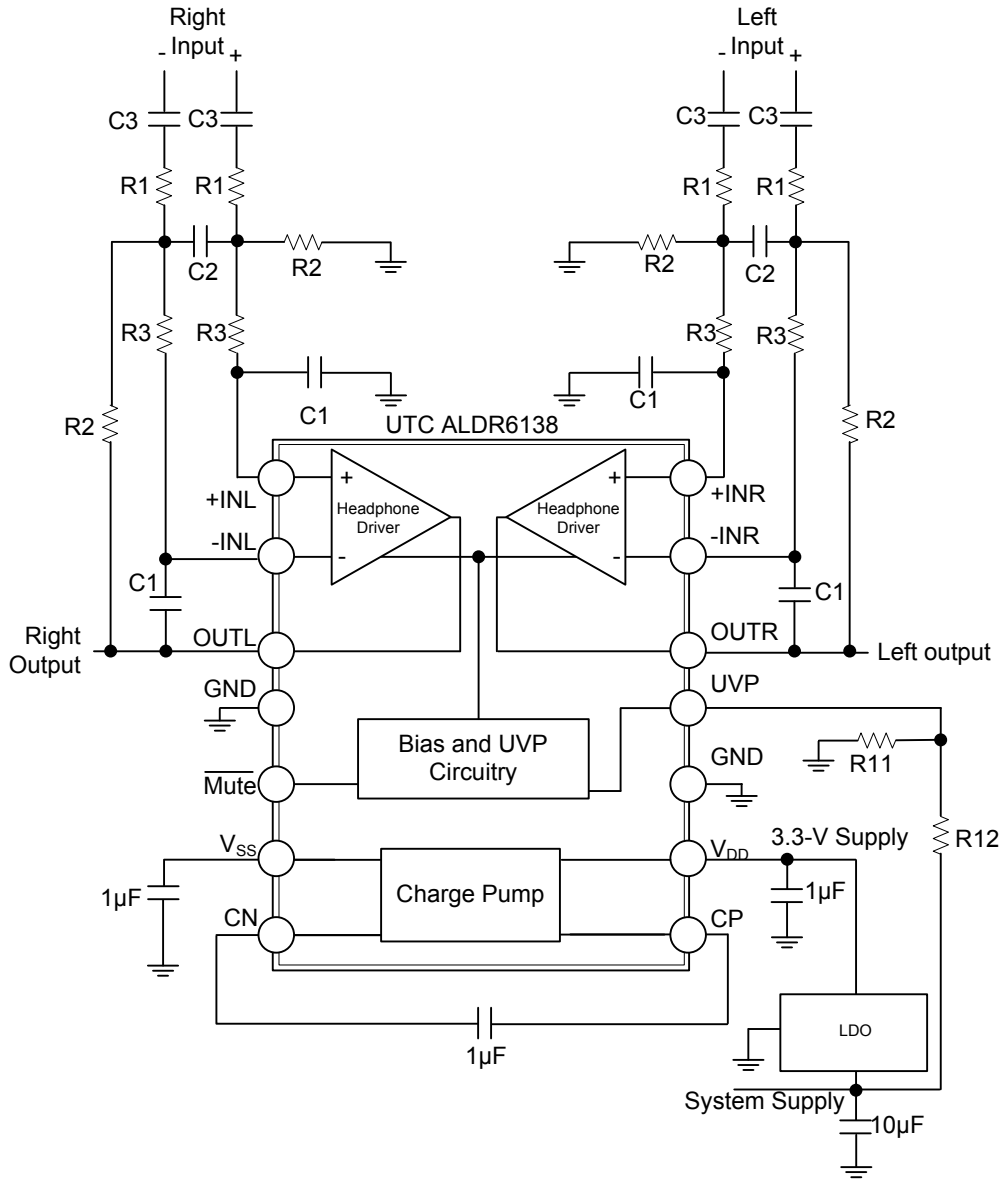
■ OPERATING CHARACTERISTICS

V_{DD}=3.3V, R_{DL}=32Ω, R_{fb}=30kΩ, R_{IN}=15kΩ, T_A=25°C, Charge pump: C_P=1μF (unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Output Power, Outputs in Phase	P_O	THD+N=1%, V_{DD}=3.3V, f=1kHz, R_L=32Ω		30		mW
Total Harmonic Distortion Plus Noise	THD+N	V_{DD}=3.3V, f=1kHz, R_{LD}=32Ω, P_O= 10mW		0.01%		
Signal-to-Noise Ratio (Note 1)	SNR	A-weighted		96		dB
Dynamic Range (Note 2)	DNR	A-weighted	90	100		dB
Noise Voltage	V_N	A-weighted		13		μV
Output Impedance When Muted	Z_O	$\overline{\text{Mute}}$ =GND		110		Ω
Input-to-Output Attenuation When Muted		$\overline{\text{Mute}}$ =GND		80		dB
Crosstalk-L to R, R to L		Po=20mW		-65		dB
Current Limit	I_{LIMIT}	PV_{DD}=3.3V		50		mA

Notes: 1. SNR is calculated relative to 25-mW output.
2. DNR is calculated relative to output at 1% THD+N.

■ TYPICAL APPLICATION CIRCUIT

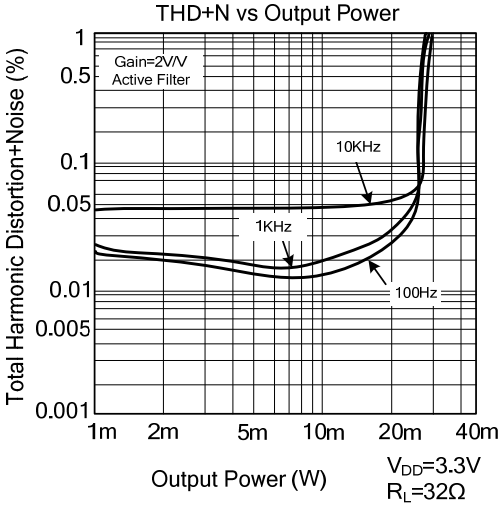


R1=15kΩ, R2=30kΩ, R3=43kΩ, C1=47pF, C2=180pF

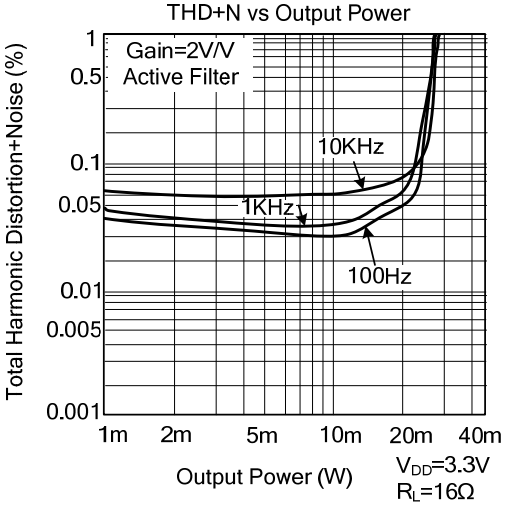
■ TYPICAL CHARACTERISTICS

V_{DD}=3.3 V, T_A=25°C, C (PUMP) =C (V_{SS}) =1μF, C_{IN}=2.2μF, R_{IN}=15kΩ, R_{FB}=30kΩ (unless otherwise noted)

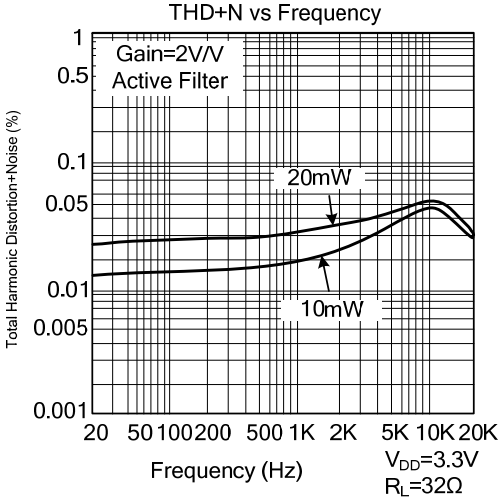
THD+N vs Output Power



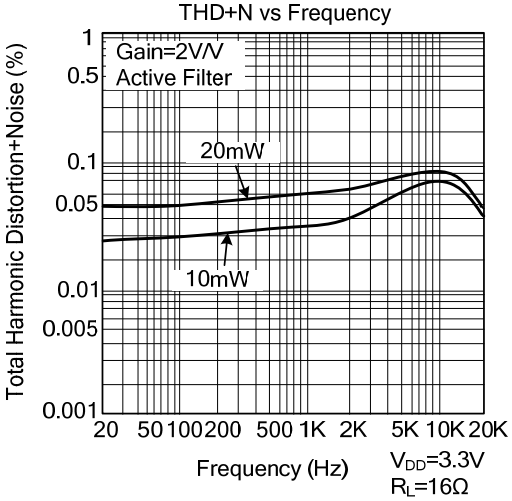
THD+N vs Output Power



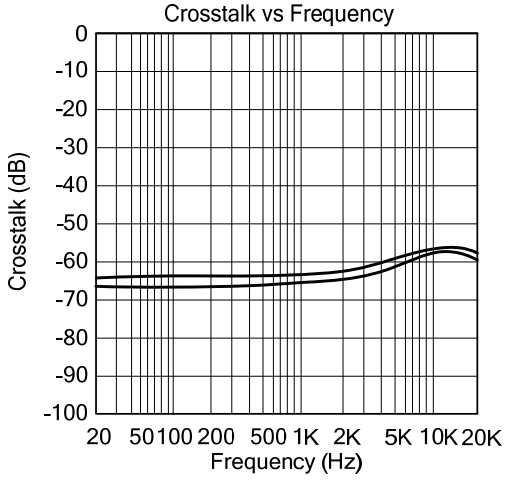
THD+N vs Frequency



THD+N vs Frequency



Crosstalk vs Frequency



PSRR vs Frequency