



### 3W STEREO CLASS-D AUDIO POWER AMPLIFIER WITH DC VOLUME CONTROL

#### DESCRIPTION

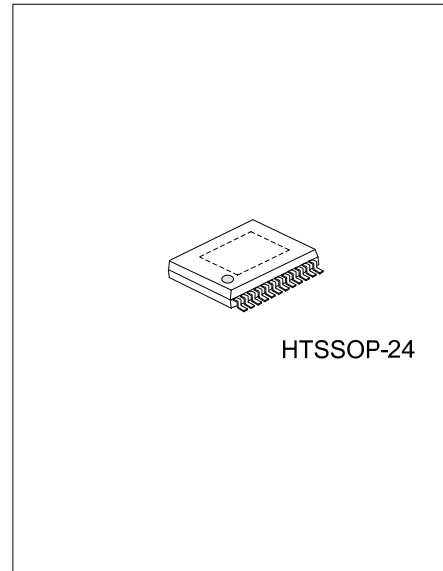
The UTC **UPA2008** is a third generation 5-V class-D amplifier which provides precise DC volume control, lower supply current, lower noise floor, higher efficiency, smaller packaging, and fewer external components. Designed using a new filter-free class-D modulation technique, the UTC **UPA2008** is capable of directly driving the speakers, without needing a low-pass output filter consisting of two inductors and three capacitors per channel. Eliminating this output filter saves approximately 30% in system cost and 75% in PCB area.

The UTC **UPA2008** improves the chip-level shutdown control, 1 $\mu$ A total supply current making the device ideal for battery-powered applications. It also protects the chip from being destroyed by over temperature and short current failure. To save battery power for more essential devices when battery voltage drops to low levels, undervoltage shutdown is designed in the UTC **UPA2008**.

In applications, class-D amplifier for LCD projectors, LCD monitors, powered speakers, the UTC **UPA2008** is also suitable for battery operated and space constrained systems.

#### FEATURES

- \* 3W per channel into 3 $\Omega$  speakers (THD+N=10%)
  - < 0.045% THD at 1.5W, 1kHz, 3 $\Omega$  load
- \* Filter free modulation scheme operates without a large and expensive LC output filter
- \* DC volume control with 2dB steps from -38dB to 20dB
- \* Extremely efficient third generation 5V Class-D technology
  - Low supply current, 7mA
  - Low shutdown control, 1 $\mu$ A
  - Low noise floor, -80dBV
  - Maximum efficiency into 3 $\Omega$ , 78%
  - Maximum efficiency into 8 $\Omega$ , 88%
  - PSRR, -70dB
- \* Operating temperature range, -40 $^{\circ}$ C~85 $^{\circ}$ C

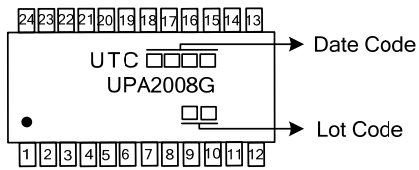


### ORDERING INFORMATION

Ordering Number	Package	Packing
UPA2008G-N24-R	HTSSOP-24	Tape Reel

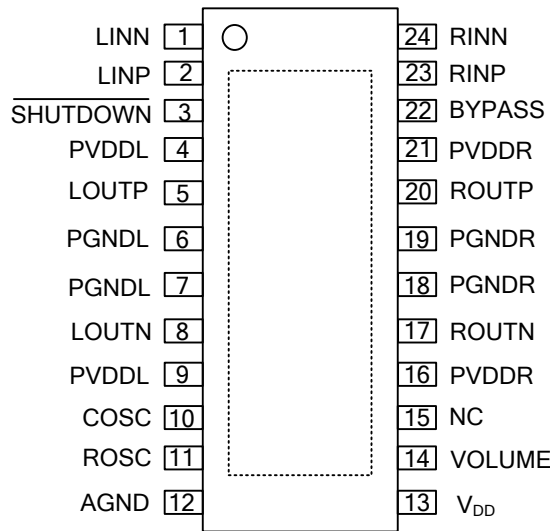
<p>UPA2008G-N24-R</p> <p>(1) Packing Type (2) Package Type (3) Green Package</p>	<p>(1) R: Tape Reel (2) N24: HTSSOP-24 (3) G: Halogen Free and Lead Free</p>
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### MARKING



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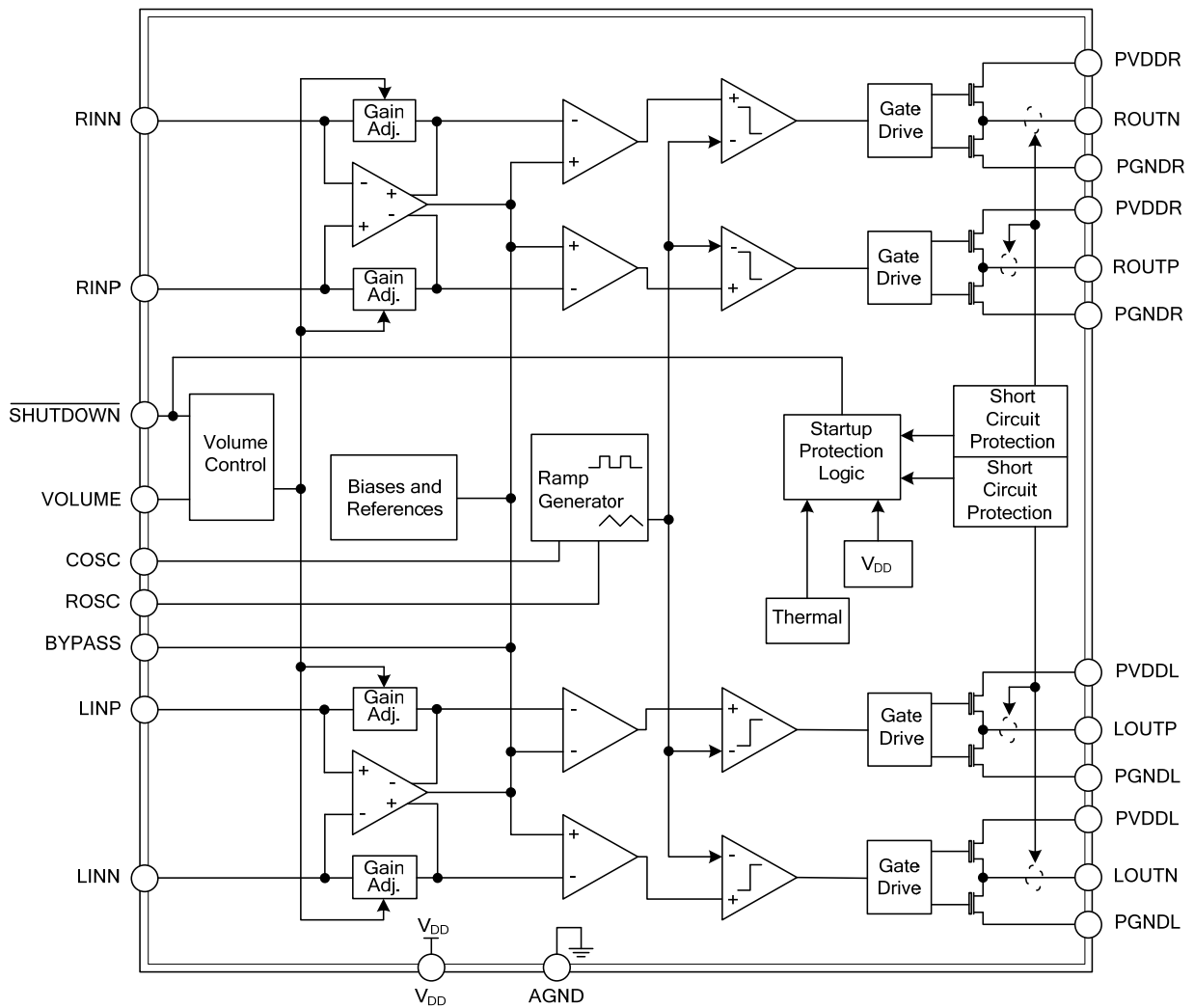
■ PIN CONFIGURATION



■ PIN DESCRIPTION

PIN NO.	PIN NAME	DESCRIPTION
1	LINN	Negative differential audio input for left channel
2	LINP	Positive differential audio input for left channel
3	SHUTDOWN	Places the amplifier in shutdown mode if a TTL logic low is placed on this terminal; normal operation if a TTL logic high is placed on this terminal.
4, 9	PV <sub>DDL</sub>	Power supply for left channel H-bridge
5	LOU TP	Positive audio output for left channel
6, 7	PGNDL	Power ground for left channel H-bridge
8	LOU TN	Negative audio output for left channel
10	COSC	A capacitor connected to this terminal sets the oscillation frequency in conjunction with ROSC. For proper operation, connect a 220pF capacitor from COSC to ground.
11	ROSC	A resistor connected to the ROSC terminal sets the oscillation frequency in conjunction with COSC. For proper operation, connect a 120k Ω resistor from ROSC to ground.
12	AGND	Analog ground
13	V <sub>DD</sub>	Analog power supply
14	VOLUME	DC volume control for setting the gain on the internal amplifiers. The dc voltage range is 0 to V <sub>DD</sub>
15	NC	No connection
16, 21	PV <sub>DDR</sub>	Power supply for right channel H-bridge
17	ROU TN	Negative output for right channel
18, 19	PGNDR	Power ground for right channel H-bridge
20	ROU TP	Positive output for right channel
22	BYPASS	Tap to voltage divider for internal mid-supply bias generator used for internal analog reference.
23	RINP	Negative differential audio input for right channel
24	RINN	Positive differential audio input for right channel
	Thermal Pad	Connect to analog ground and the power grounds must be soldered down in all applications to properly secure device on the PCB.

■ BLOCK DIAGRAM



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

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage Range	$V_{DD}, PV_{DD}$	-0.3~ 6	V
Input Voltage Range	$V_I$ (RINN, RINP, LINN, LINP, VOLUME)	0~ $V_{DD}$	V
Storage Temperature Range	$T_{STG}$	-65~85	°C
Lead Temperature 1.6mm (1/16 inch) from Case for 10 Seconds		260	°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.

■ RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
Supply Voltage	$V_{DD}$	4.5		5.5	V
Volume Terminal Voltage		0		$V_{DD}$	V
High-Level Input Voltage	$V_{IH}$	2			V
Low-Level Input Voltage	$V_{IL}$			0.8	V
PWM Frequency		200		300	kHz
Operating Free-Air Temperature	$T_A$	-40		85	°C
Operating Junction Temperature	$T_J$			125	°C

■ ELECTRICAL CHARACTERISTICS ( $T_A=25^\circ\text{C}$ ,  $V_{DD}=PV_{DD}=5\text{V}$ , unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Output Offset Voltage (Measured Differentially)	$ V_{OS} $	$V_I=0\text{V}$ , $A_V=20\text{dB}$ , $R_L=8\Omega$		5	25	mV
Power Supply Rejection Ratio	PSRR	$V_{DD}=PV_{DD}=4.5\text{V}\sim 5.5\text{V}$		-70		dB
High-Level Input Current	$ I_{IH} $	$V_{DD}=PV_{DD}=5.5\text{V}$ , $V_I=V_{DD}=PV_{DD}$			1	$\mu\text{A}$
Low-Level Input Current	$ I_{IL} $	$V_{DD}=PV_{DD}=5.5\text{V}$ , $V_I=0\text{V}$			1	$\mu\text{A}$
Supply Current	$I_{DD}$	No Filter (No Load)		7	15	mA
RMS Supply Current at Max Power	$I_{DD(max)}$	$R_L=3\Omega$ , $P_O=2.5\text{W/channel}$ (Stereo)		1.8		A
Supply Current in Shutdown Mode	$I_{DD(SD)}$	$\overline{\text{SHUTDOWN}}=0\text{V}$		0.05	1	$\mu\text{A}$
Drain-Source On-State Resistance	$R_{ds(on)}$	High Side		450	600	m $\Omega$
		Low Side		450	600	m $\Omega$

■ OPERATING CHARACTERISTICS

( $T_A=25^\circ\text{C}$ ,  $V_{DD}=PV_{DD}=5\text{V}$ ,  $R_L=3\Omega$ , Gain=0dB (unless otherwise noted))

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Output Power	$P_O$	f=1kHz, THD+N=1%		2.5		W
		$R_L=3\Omega$ , Stereo operation, THD+N=10%		3		W
Total Harmonic Distortion Plus Noise	THD+N	$P_O=2.2\text{W}$ , f=20Hz~20kHz		<0.3		%
		$P_O=1.5\text{W}$ , f=1kHz		0.045		%
Maximum Output Power Bandwidth	BOM	THD=5%		20		kHz
Signal-to-Noise Ratio	SNR	Maximum Output at THD+N<0.5%		96		dB
Thermal Trip Point				150		°C
Thermal Hysteresis				20		°C
Integrated Noise Floor	$V_N$	20Hz~20kHz, Volume=0dB		42		$\mu\text{V}_{rms}$
		Inputs ac Grounded, Volume=20dB		85		$\mu\text{V}_{rms}$

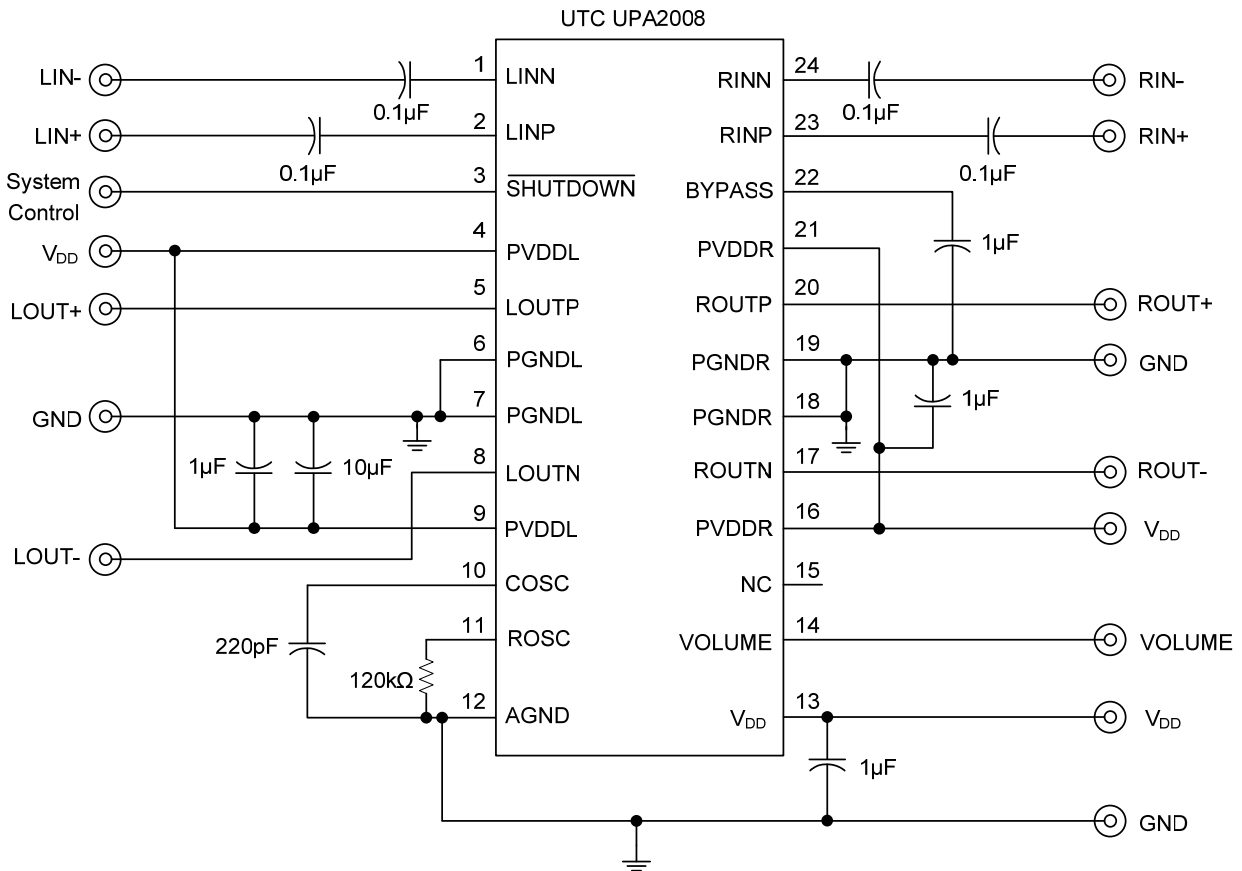
■ TYPICAL DC VOLUME CONTROL

VOLTAGE ON VOLUME PIN (V) (INCREASING OR FIXED GAIN)	VOLTAGE ON VOLUME PIN (V) (DECREASING GAIN)	TYPICAL GAIN OF AMPLIFIER (dB) (Note 1)
0-0.33	0.31-0	-38 (Note 2)
0.34-0.42	0.43-0.32	-37
0.43-0.52	0.54-0.44	-35
0.53-0.63	0.64-0.55	-33
0.64-0.75	0.75-0.65	-31
0.76-0.86	0.86-0.76	-29
0.87-0.97	0.97-0.87	-27
0.98-1.07	1.08-0.98	-25
1.08-1.18	1.19-1.09	-23
1.19-1.30	1.32-1.20	-21
1.31-1.41	1.42-1.33	-19
1.42-1.52	1.53-1.43	-17
1.53-1.63	1.63-1.54	-15
1.64-1.75	1.75-1.64	-13
1.76-1.85	1.84-1.76	-12
1.86-1.96	1.96-1.85	-10
1.97-2.07	2.09-1.97	-8
2.08-2.18	2.19-2.10	-6
2.19-2.30	2.33-2.20	-4
2.31-2.40	2.43-2.34	-2
2.41-2.52	2.49-2.44	0 (Note 2)
2.53-2.63	2.62-2.50	2
2.64-2.75	2.75-2.63	4
2.76-2.87	2.85-2.76	6
2.88-2.98	2.99-2.86	8
2.99-3.10	3.12-3.00	10
3.11-3.22	3.25-3.13	12
3.23-3.33	3.36-3.26	14
3.34-3.47	3.48-3.37	16
3.48-3.69	3.64-3.49	18
3.70-V <sub>DD</sub>	V <sub>DD</sub> -3.65	20 (Note 2)

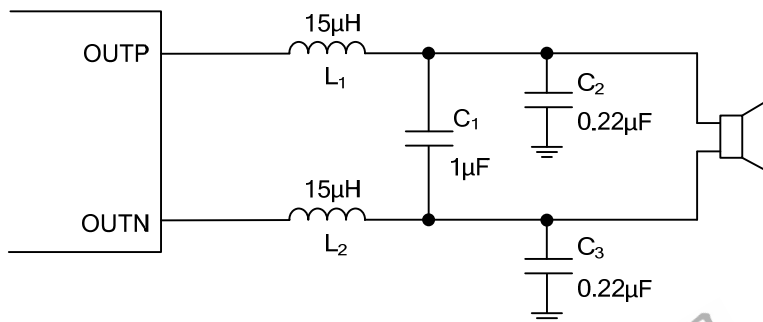
Notes: 1. The typical part-to-part gain variation can be as large as  $\pm 2$ dB (one gain step)

2. Tested in production

■ TYPICAL APPLICATION CIRCUIT

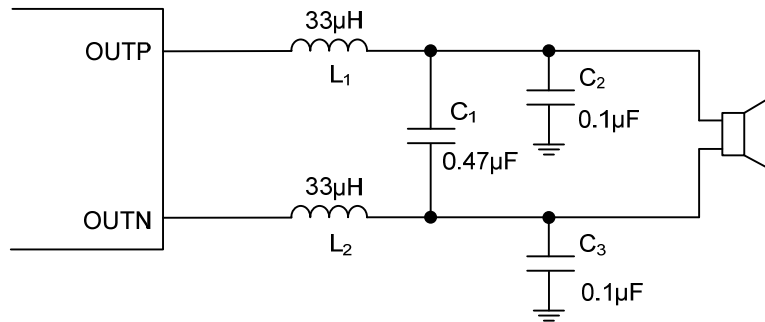


UTC UPA2008 In A Stereo Configuration With Differential Inputs

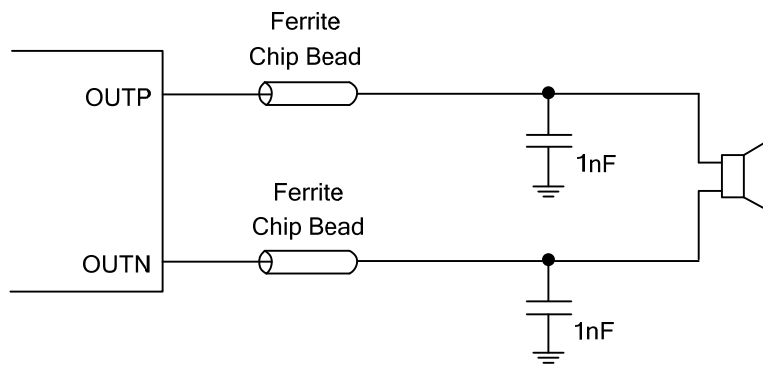


Typical LC Output Filter, Cutoff Frequency of 41kHz, Speaker Impedance = 4Ω

■ TYPICAL APPLICATION CIRCUIT (Cont.)



Typical LC Output Filter, Cutoff Frequency of 41kHz, Speaker Impedance = 8Ω



Typical Ferrite Chip Bead Filter

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