HWD2038 ——

Mono 2W Audio Power Amplifiers with DC Volume Control

● General Description

---The HWD2038 is a monolithic integrated circuit that provides DC volume control, and mono bridged audio power amplifiers capable of producing 2W into 4Ω with less than1.0% THD or 2.2W into 3Ω with less than 1.0%THD.
---The HWD2038 is designed specifically to provide high quality audio from a surface mount package while requiring few external components. It incorporates a DC volume control that consists of 31 steps that are individually selected by a variable DC voltage level on the volume control pin. The range of the steps are from 0dB - 78dB. Each gain step corresponds to a specific input voltage range.
---The HWD2038 features an externally controlled, low-power consumption shutdown mode, and thermal shutdown protection. It also utilizes circuitry to reduce "clicks and pops" during device turn-on.

● Key Specifications

• P_O at（1% THD＋N）		
	into 3Ω	2.2W （typ）
	into 4Ω	2.0W （typ）
	into 8Ω	1.1W （typ）
• Shutdown current		0.7 uA（typ）

● Features

- DC Volume Control Interface
- Stereo switchable bridged
- No output coupling capacitors, or snubber circuits required
- "Click and pop" suppression circuitry
- Thermal shutdown protection circuitry
- TSSOP-20 packaging

● Applications

- Portable and Desktop Computers
- Multimedia Monitors
- Portable Radios, PDAs, and Portable TVs

● Operating Ratings（Note 1）

- Temperature Range －40℃～85℃
- Supply Voltage 2.5V≤V_{DD}≤5.5V

● Typical Application

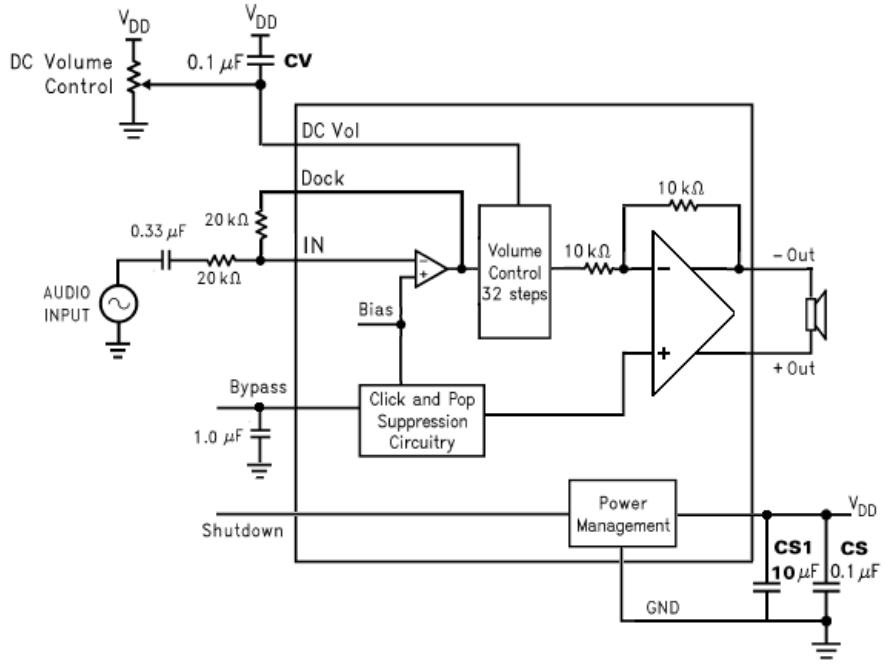
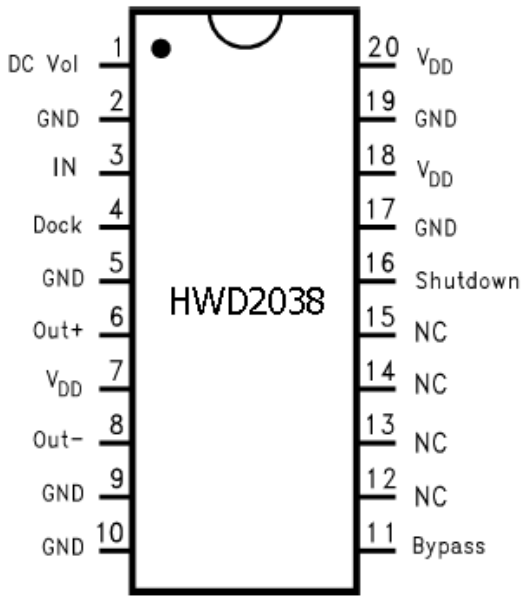


FIGURE 1. HWD2038 Block Diagram



TOP VIEW

Order Number HWD2038MTE

● Absolute Maximum Ratings（Note 2）

- Supply Voltage 6.0V
- Storage Temperature －65℃～＋150℃
- Input Voltage －0.3V～V_{DD}＋0.3V
- Power Dissipation（Note 3） Internally limited
- ESD Susceptibility（Human body model） 2000V（Note 4）
- ESD Susceptibility（Machine model） 200V（Note 5）
- Junction Temperature 150℃
- Soldering Information
  - Small Outline Package
    - Vapor Phase (60 sec.) 215°C
    - Infrared (15 sec.) 220°C
- Thermal Resistance
  - θ_{JC} (typ)—MXA20A 2°C/W
  - θ_{JA} (typ)—MXA20A 41°C/W (Note 6)
  - θ_{JA} (typ)—MXA20A 51°C/W (Note 7)
  - θ_{JA} (typ)—MXA20A 90°C/W (Note 8)

● Electrical Characteristics（V_{DD}＝5V）(Notes 1，2，9-12)

·For Entire IC

Unless otherwise specified. Limits apply for T_A =25°C

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{DD}	Supply Voltage		2.5		5.5	V
I_{DD}	Quiescent Power Supply Current	V_{IN}＝0V，I_O＝0A		9	15	mA
I_{SD}	Shutdown Current	$V_{SHUTDOWN}$＝V_{DD}		0.7	2.0	uA
V_{IH}	Headphone Sense High Input Voltage		4			V
V_{IL}	Headphone Sense Low Input Voltage				0.8	V

·For Volume Attenuators

Unless otherwise specified. Limits apply for T_A =25°C

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
C_{RANGE}	Attenuator Range	Gain with VDCVol = 5V, No Load	-0.75		0.75	dB
A_M	Mute Attenuation	Vmute = 5V (BTL)	- 78			dB

· For Bridged Mode Operation

Unless otherwise specified. Limits apply for T_A =25°C

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
P_O	Output Power (Note 13)	THD+N=1.0%; f=1kHz; R_L=3Ω(Note 14)		2.2		W
		THD+N=1.0%; f=1kHz; R_L=4Ω(Note 15)		2		W
		THD=1.0%; f=1kHz; R_L=8Ω	1.0	1.1		W
		THD+N=10%; f=1kHz; R_L=8Ω		1.5		W
V_{OS}	Output Offset Voltage	V_{IN}=0V, no load	-50	5	50	mV
THD+N	Total Harmonic Distortion+Noise	P_O=1W, 20Hz<f<20kHz, R_L=8Ω, A_{VD}=2		0.3		%
PSRR	Power Supply Rejection Ratio	C_B=1.0uF, f=120Hz, V_{RIPPLE}=200mV_{RMS} ; R_L=8Ω		74		dB
SNR	Signal to Noise Ratio	V_{DD}=5V, P_{OUT}=1.1W, R_L=8Ω, A-Wtd Filter		93		dB
X_{talk}	Channel Separation	f=1kHz, C_B=1.0uF		70		dB

Note 1: Operating Ratings indicate conditions for which the device is functional, but do not guarantee specific performance limits.

Note 2: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur.

Note 3: 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 $P_{DMAX} = (T_{JMAX} - T_A)/\theta_{JA}$. For the HWD2038, T_{JMAX} = 150°C, and the typical junction-to-ambient thermal resistance for each package can be found in the Absolute Maximum Ratings section above.

Note 4: Human body model, 100 pF discharged through a 1.5kΩ resistor.

Note 5: Machine model, 220pF – 240pF discharged through all pins.

Note 6: The given θ_{JA} is for an TSSOP-20 packaged with the exposed-DAP soldered to an exposed 2in^2 area of 1oz printed circuit board copper.

Note 7: The given θ_{JA} is for an TSSOP-20 packaged with the exposed-DAP soldered to an exposed 1in^2 area of 1oz printed circuit board copper.

Note 8: The given θ_{JA} is for an TSSOP-20 packaged with the exposed-DAP not soldered to printed circuit board copper.

Note 9: All voltages are measured with respect to the ground pins, unless otherwise specified. All specifications are tested using the typical application as shown in Figure 1.

Note 10: Electrical Characteristics state DC and AC electrical specifications under

particular test conditions which guarantee specific performance limits. This assumes that the device is within the Operating Ratings. Specifications are not guaranteed for parameters where no limit is given, however, the typical value is a good indication of device performance.

Note 11: Typicals are measured at 25°C and represent the parametric norm.

Note 12: Datasheet min/max specification limits are guaranteed by design, test, or statistical analysis.

Note 13: Output power is measured at the device terminals.

Note 14: When driving 3Ω loads from a 5V supply the HWD2038MTE must be mounted to the circuit board and forced-air cooled.

Note 15: When driving 4Ω loads from a 5V supply the HWD2038MTE must be mounted to the circuit board.

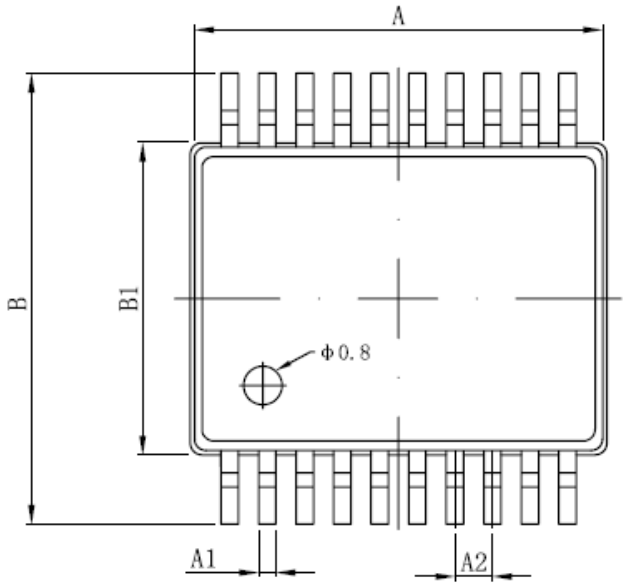
● VOLUME CONTROL TABLE

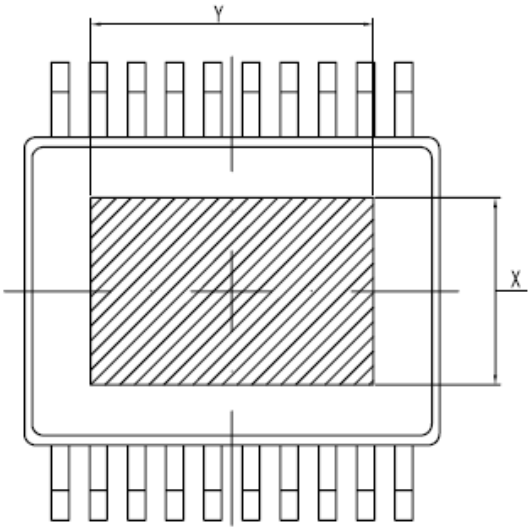
Gain (dB)	Voltage Range (% of V_{DD})			Voltage Range (V_{DD} = 5)			Voltage Range (V_{DD} = 3)		
	Low	High	Recom-mended	Low	High	Recom-mended	Low	High	Recom-mended
0	77.5%	100.0%	100.00%	3.875	5.000	5.000	2.325	3.000	3.000
-1	75.0%	78.50%	76.875%	3.750	3.938	3.844	2.250	2.363	2.306
-2	72.5%	76.25%	74.375%	3.625	3.813	3.719	2.175	2.288	2.231
-3	70.0%	73.75%	71.875%	3.500	3.688	3.594	2.100	2.213	2.156
-4	67.5%	71.25%	69.375%	3.375	3.563	3.469	2.025	2.138	2.081
-5	65.0%	68.75%	66.875%	3.250	3.438	3.344	1.950	2.063	2.006
-6	62.5%	66.25%	64.375%	3.125	3.313	3.219	1.875	1.988	1.931
-8	60.0%	63.75%	61.875%	3.000	3.188	3.094	1.800	1.913	1.856
-10	57.5%	61.25%	59.375%	2.875	3.063	2.969	1.725	1.838	1.781
-12	55.0%	58.75%	56.875%	2.750	2.938	2.844	1.650	1.763	1.706
-14	52.5%	56.25%	54.375%	2.625	2.813	2.719	1.575	1.688	1.631
-16	50.0%	53.75%	51.875%	2.500	2.688	2.594	1.500	1.613	1.556
-18	47.5%	51.25%	49.375%	2.375	2.563	2.469	1.425	1.538	1.481
-20	45.0%	48.75%	46.875%	2.250	2.438	2.344	1.350	1.463	1.406
-22	42.5%	46.25%	44.375%	2.125	2.313	2.219	1.275	1.388	1.331
-24	40.0%	43.75%	41.875%	2.000	2.188	2.094	1.200	1.313	1.256
-26	37.5%	41.25%	39.375%	1.875	2.063	1.969	1.125	1.238	1.181
-28	35.0%	38.75%	36.875%	1.750	1.938	1.844	1.050	1.163	1.106
-30	32.5%	36.25%	34.375%	1.625	1.813	1.719	0.975	1.088	1.031
-32	30.0%	33.75%	31.875%	1.500	1.688	1.594	0.900	1.013	0.956
-34	27.5%	31.25%	29.375%	1.375	1.563	1.469	0.825	0.937	0.881
-36	25.0%	28.75%	26.875%	1.250	1.438	1.344	0.750	0.862	0.806
-39	22.5%	26.25%	24.375%	1.125	1.313	1.219	0.675	0.787	0.731
-42	20.0%	23.75%	21.875%	1.000	1.188	1.094	0.600	0.712	0.656
-45	17.5%	21.25%	19.375%	0.875	1.063	0.969	0.525	0.637	0.581
-47	15.0%	18.75%	16.875%	0.750	0.937	0.844	0.450	0.562	0.506
-51	12.5%	16.25%	14.375%	0.625	0.812	0.719	0.375	0.487	0.431
-56	10.0%	13.75%	11.875%	0.500	0.687	0.594	0.300	0.412	0.356
-61	7.5%	11.25%	9.375%	0.375	0.562	0.469	0.225	0.337	0.281
-66	5.0%	8.75%	6.875%	0.250	0.437	0.344	0.150	0.262	0.206
-78	0.0%	6.25%	0.000%	0.000	0.312	0.000	0.000	0.187	0.000

● Physical Dimensions

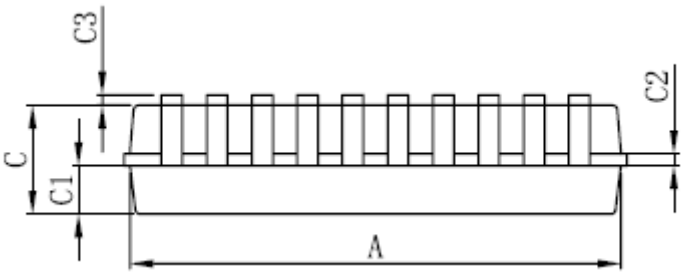
<TSSOP>: inches (millimeters) unless otherwise noted

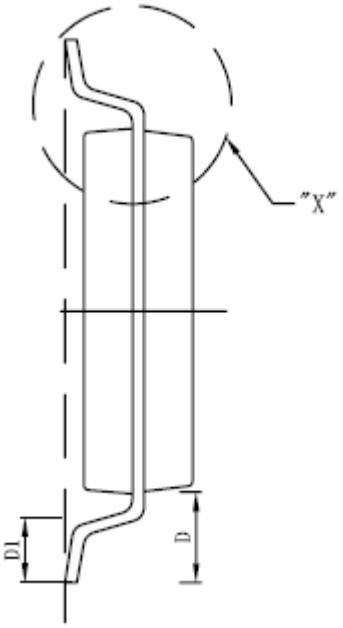
HWD2038MTE （DIMENSIONS ARE IN MILLIMETERS）

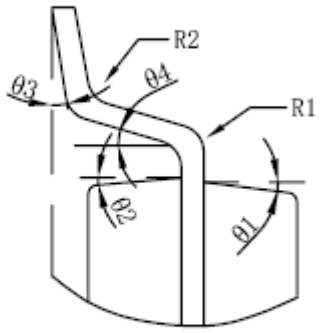




BOTTOM VIEW







DETAIL "X"

尺寸 / 标注	最小（mm）	最大（mm）	尺寸 / 标注	最小（mm）	最大（mm）
A	6.40	6.60	C3	0.025	0.102
A1	0.20	0.30	D	1.0TYP	
A2	0.65TYP		D1	0.50	0.75
B	6.30	6.50	R1	0.15TYP	
B1	4.30	4.50	R2	0.15TYP	
C	0.90	1.05	θ1	12° TYP	
C1	0.4365TYP		θ2	12° TYP	
C2	0.09	0.2	θ3	0° TYP	8° TYP
			θ4	10° TYP	

OPTION	PAD SIZE	SYMBOL	DIMENSION	MARK
1	3(118)	X	MIN.2.60	NORMAL
			MAX.3.10	
	4.2(165)	Y	MIN.3.80	
			MAX.4.30	
2	2.11(83)	X	MIN.1.71	SPECIAL CUSTOMER
			MAX.2.21	
	3.15(124)	Y	MIN.2.75	
			MAX.3.25	

20-Lead Molded TSSOP, Exposed Pad

Order Number HWD2038MTE