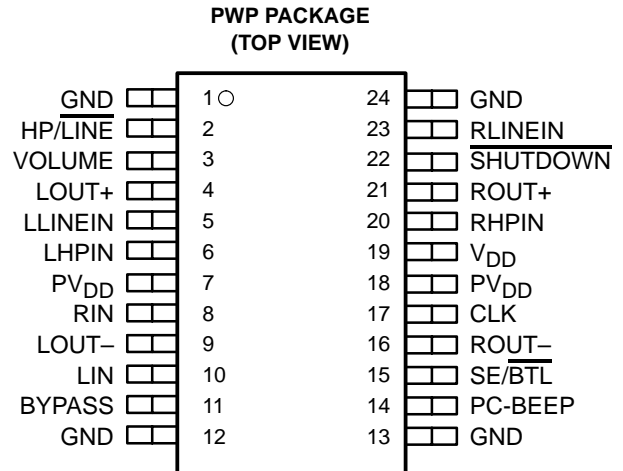


TPA0242

STEREO 2-W AUDIO POWER AMPLIFIER WITH DC VOLUME CONTROL AND MUX CONTROL

SLOS287B – NOVEMBER 1999 – REVISED MAY 2001

- Compatible With PC 99 Desktop Line-Out Into 10-k Ω Load
- Compatible With PC 99 Portable Into 8- Ω Load
- Internal Gain Control, Which Eliminates External Gain-Setting Resistors
- DC Volume Control From 20 dB to –40 dB
- 2-W/Ch Output Power Into 3- Ω Load
- Input MUX Select Terminal
- PC-Beep Input
- Depop Circuitry
- Stereo Input MUX
- Fully Differential Input
- Low Supply Current and Shutdown Current
- Surface-Mount Power Packaging
24-Pin TSSOP PowerPAD™



description

The TPA0242 is a stereo audio power amplifier in a 24-pin TSSOP thermally enhanced package capable of delivering 2 W of continuous RMS power per channel into 3- Ω loads. This device minimizes the number of external components needed, which simplifies the design and frees up board space for other features. When driving 1 W into 8- Ω speakers, the TPA0242 has less than 0.22% THD+N across its specified frequency range.

Included within this device is integrated depop circuitry that virtually eliminates transients that cause noise in the speakers.

Amplifier gain is controlled by a dc voltage input on the VOLUME terminal. There are 31 discrete steps covering the range of 20 dB (maximum volume setting) to –40 dB (minimum volume setting) in 2 dB steps. When the VOLUME terminal exceeds 3.54 V, the device is muted. An internal input MUX allows two sets of stereo inputs to the amplifier. The HP/LINE terminal allows the user to select which MUX input is active regardless of whether the amplifier is in SE or BTL mode. In notebook applications, where internal speakers are driven as BTL and the line outputs (often headphone drive) are required to be SE, the TPA0242 automatically switches into SE mode when the SE/BTL input is activated, and this effectively reduces the gain by 6 dB.

The TPA0242 consumes only 20 mA of supply current during normal operation. A miserly shutdown mode reduces the supply current to less than 150 μ A.

The PowerPAD package (PWP) delivers a level of thermal performance that was previously achievable only in TO-220-type packages. Thermal impedances of approximately 35°C/W are truly realized in multilayer PCB applications. This allows the TPA0242 to operate at full power into 8- Ω loads at ambient temperatures of 85°C.

AVAILABLE OPTIONS

T _A	PACKAGED DEVICE
	TSSOP† (PWP)
–40°C to 85°C	TPA0242PWP

† The PWP package is available taped and reeled. To order a taped and reeled part, add the suffix R to the part number (e.g., TPA0242PWPR).



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

PowerPAD is a trademark of Texas Instruments.

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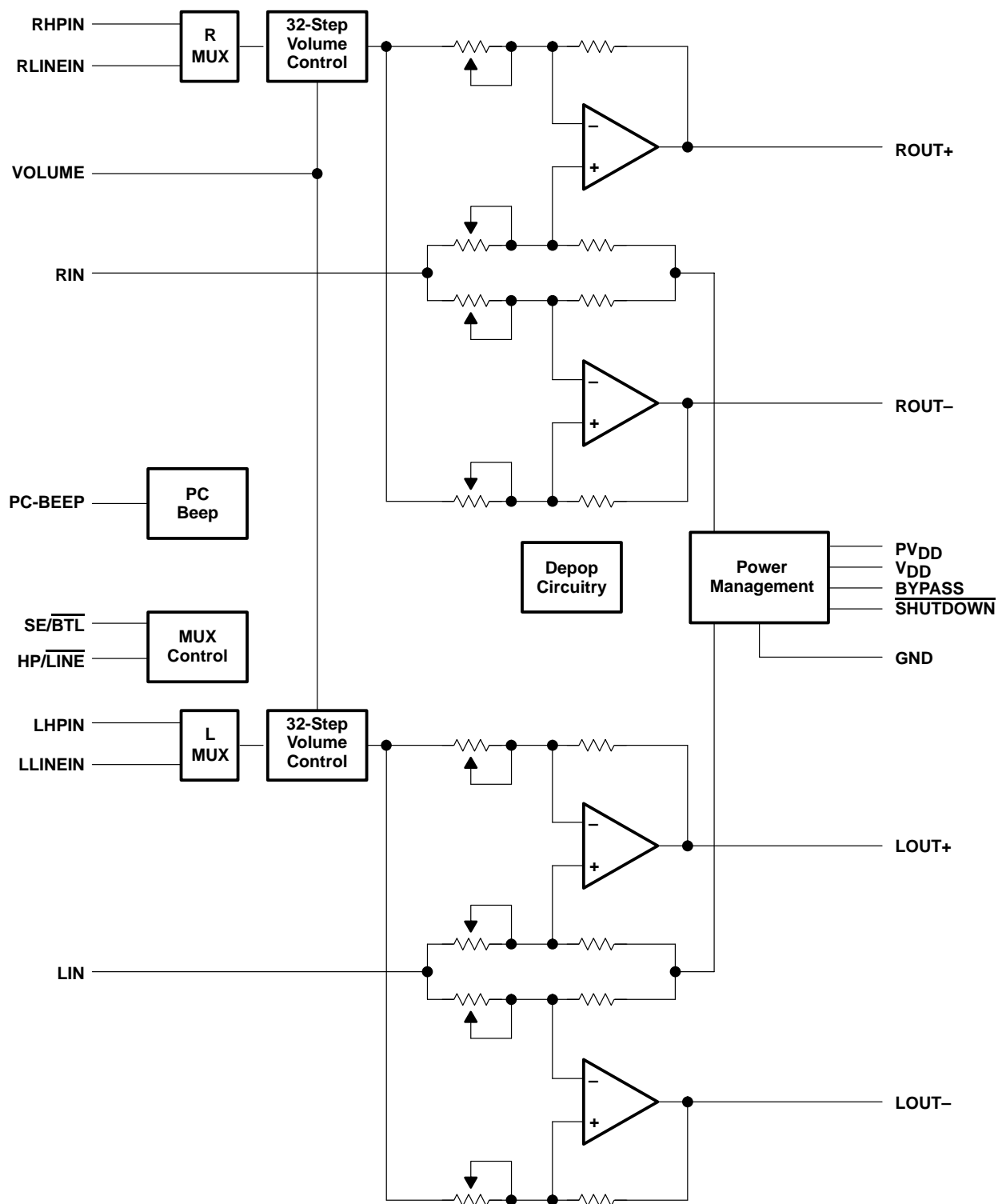
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functional block diagram



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Terminal Functions

TERMINAL NAME	NO.	I/O	DESCRIPTION
BYPASS	11		Tap to voltage divider for internal mid-supply bias generator
CLK	17	I	If a 47-nF capacitor is attached, the TPA0242 generates an internal clock. An external clock can override the internal clock input to this terminal.
GND	1, 12 13, 24		Ground connection for circuitry. Connected to thermal pad
LHPIN	6	I	Left channel headphone input, selected when $\overline{\text{SE/BTL}}$ is held high
LIN	10	I	Common left input for fully differential input. AC ground for single-ended inputs
LLINEIN	5	I	Left channel line negative input, selected when $\overline{\text{SE/BTL}}$ is held low
LOUT+	4	O	Left channel positive output in $\overline{\text{BTL}}$ mode and positive output in SE mode
LOUT–	9	O	Left channel negative output in $\overline{\text{BTL}}$ mode and high-impedance in SE mode
HP/ $\overline{\text{LINE}}$	2	I	HP/ $\overline{\text{LINE}}$ is the input MUX control input. When the HP/ $\overline{\text{LINE}}$ terminal is held high, the headphone inputs (LHPIN or RHPIN [6, 20]) are active. When the HP/ $\overline{\text{LINE}}$ terminal is held low, the line BTL inputs (LLINEIN or RLINEIN [5, 23]) are active.
PC-BEEP	14	I	The input for PC-beep mode. PC-BEEP is enabled when a > 1-V (peak-to-peak) square wave is input to PC-BEEP.
PVDD	7, 18	I	Power supply for output stage
RHPIN	20	I	Right channel headphone input, selected when $\overline{\text{SE/BTL}}$ is held high
RIN	8	I	Common right input for fully differential input. AC ground for single-ended inputs
RLINEIN	23	I	Right channel line input, selected when $\overline{\text{SE/BTL}}$ is held low
ROUT+	21	O	Right channel positive output in $\overline{\text{BTL}}$ mode and positive output in SE mode
ROUT–	16	O	Right channel negative output in $\overline{\text{BTL}}$ mode and high-impedance in SE mode
$\overline{\text{SE/BTL}}$	15	I	Hold $\overline{\text{SE/BTL}}$ low for BTL mode and hold high for SE mode.
$\overline{\text{SHUTDOWN}}$	22	I	When held low, this terminal places the entire device, except PC-BEEP detect circuitry, in shutdown mode.
VDD	19	I	Analog VDD input supply. This terminal needs to be isolated from PVDD to achieve highest performance.
VOLUME	3	I	VOLUME detects the dc level at the terminal and sets the gain for 31 discrete steps covering a range of 20 dB to –40 dB for dc levels of 0.15 V to 3.54. When the dc level is over 3.54 V, the device is muted.

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absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Supply voltage, V_{DD}	6 V
Input voltage, V_I	–0.3 V to V_{DD} 0.3 V
Continuous total power dissipation	internally limited (see Dissipation Rating Table)
Operating free-air temperature range, T_A	–40°C to 85°C
Operating junction temperature range, T_J	–40°C to 150°C
Storage temperature range, T_{stg}	–65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	260°C

† 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.

DISSIPATION RATING TABLE

PACKAGE	$T_A \leq 25^\circ\text{C}$	DERATING FACTOR	$T_A = 70^\circ\text{C}$	$T_A = 85^\circ\text{C}$
PWP	2.7 W†	21.8 mW/°C	1.7 W	1.4 W

† Please see the Texas Instruments document, *PowerPAD Thermally Enhanced Package Application Report* (literature number SLMA002), for more information on the PowerPAD package. The thermal data was measured on a PCB layout based on the information in the section entitled *Texas Instruments Recommended Board for PowerPAD* on page 33 of the before mentioned document.

recommended operating conditions

		MIN	MAX	UNIT
Supply voltage, V_{DD}		4.5	5.5	V
High-level input voltage, V_{IH}	SE/BTL, HP/LINE	4		V
	SHUTDOWN	2		
Low-level input voltage, V_{IL}	SE/BTL, HP/LINE		3	V
	SHUTDOWN		0.8	
Operating free-air temperature, T_A		–40	85	°C

electrical characteristics at specified free-air temperature, $V_{DD} = 5$ V, $T_A = 25^\circ\text{C}$ (unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
$ V_{OS} $ Output offset voltage (measured differentially)	$V_I = 0$, $A_V = 2$ V/V			25	mV
Supply ripple rejection ratio	$V_{DD} = 4.9$ V to 5.1 V		67		dB
$ I_{IH} $ High-level input current	$V_{DD} = 5.5$ V, $V_I = V_{DD}$			900	nA
$ I_{IL} $ Low-level input current	$V_{DD} = 5.5$ V, $V_I = 0$ V			900	nA
I_{DD} Supply current	BTL mode		20		mA
	SE mode		10		
$I_{DD(SD)}$ Supply current, shutdown mode			150	300	μA



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operating characteristics, $V_{DD} = 5\text{ V}$, $T_A = 25^\circ\text{C}$, $R_L = 4\ \Omega$, Gain = 2 V/V, BTL mode (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
P_O	Output power	THD = 1%, $f = 1\text{ kHz}$		2		W
THD+N	Total harmonic distortion plus noise	$P_O = 1\text{ W}$, $f = 20\text{ Hz to }15\text{ kHz}$		0.22%		
B_{OM}	Maximum output power bandwidth	THD = 5%		>15		kHz
Supply ripple rejection ratio		$f = 1\text{ kHz}$, $C_{(BYP)} = 0.47\ \mu\text{F}$	BTL mode		65	dB
			SE mode		60	
V_n	Noise output voltage	$C_{(BYP)} = 0.47\ \mu\text{F}$, $f = 20\text{ Hz to }20\text{ kHz}$	BTL mode		34	μVRMS
			SE mode		44	

TYPICAL CHARACTERISTICS

Table of Graphs

			FIGURE
THD+N	Total harmonic distortion plus noise	vs Output power	1, 4, 6, 8, 10
		vs Voltage gain	2
		vs Frequency	3, 5, 7, 9, 11
		vs Output voltage	12
V_n	Output noise voltage	vs Bandwidth	13
	Supply ripple rejection ratio	vs Frequency	14, 15
	Crosstalk	vs Frequency	16, 17, 18
	Shutdown attenuation	vs Frequency	19
SNR	Signal-to-noise ratio	vs Bandwidth	20
	Closed loop response		21, 22
P_O	Output power	vs Load resistance	23, 24
P_D	Power dissipation	vs Output power	25, 26
		vs Ambient temperature	27
Z_I	Input impedance	vs Gain	28



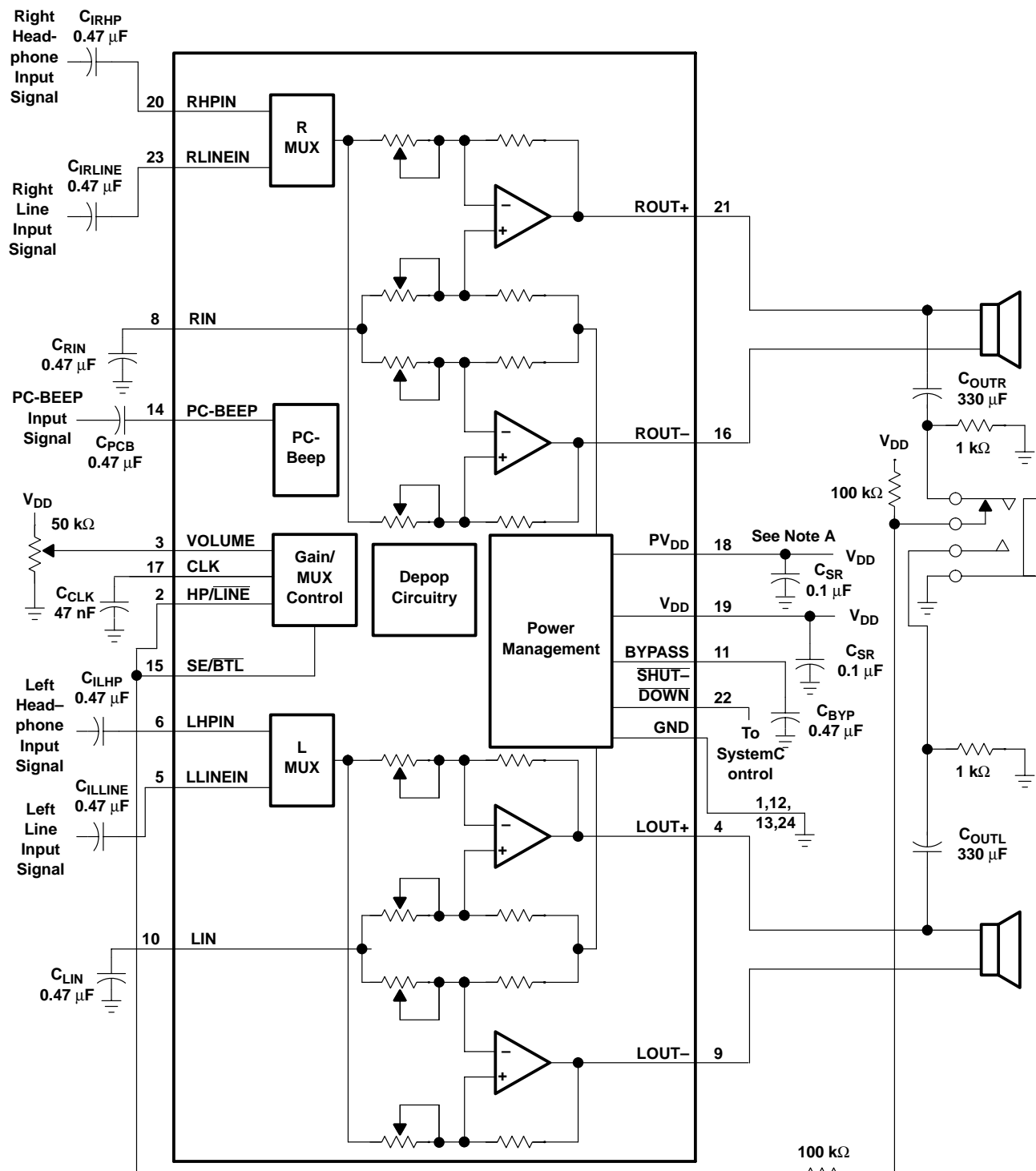
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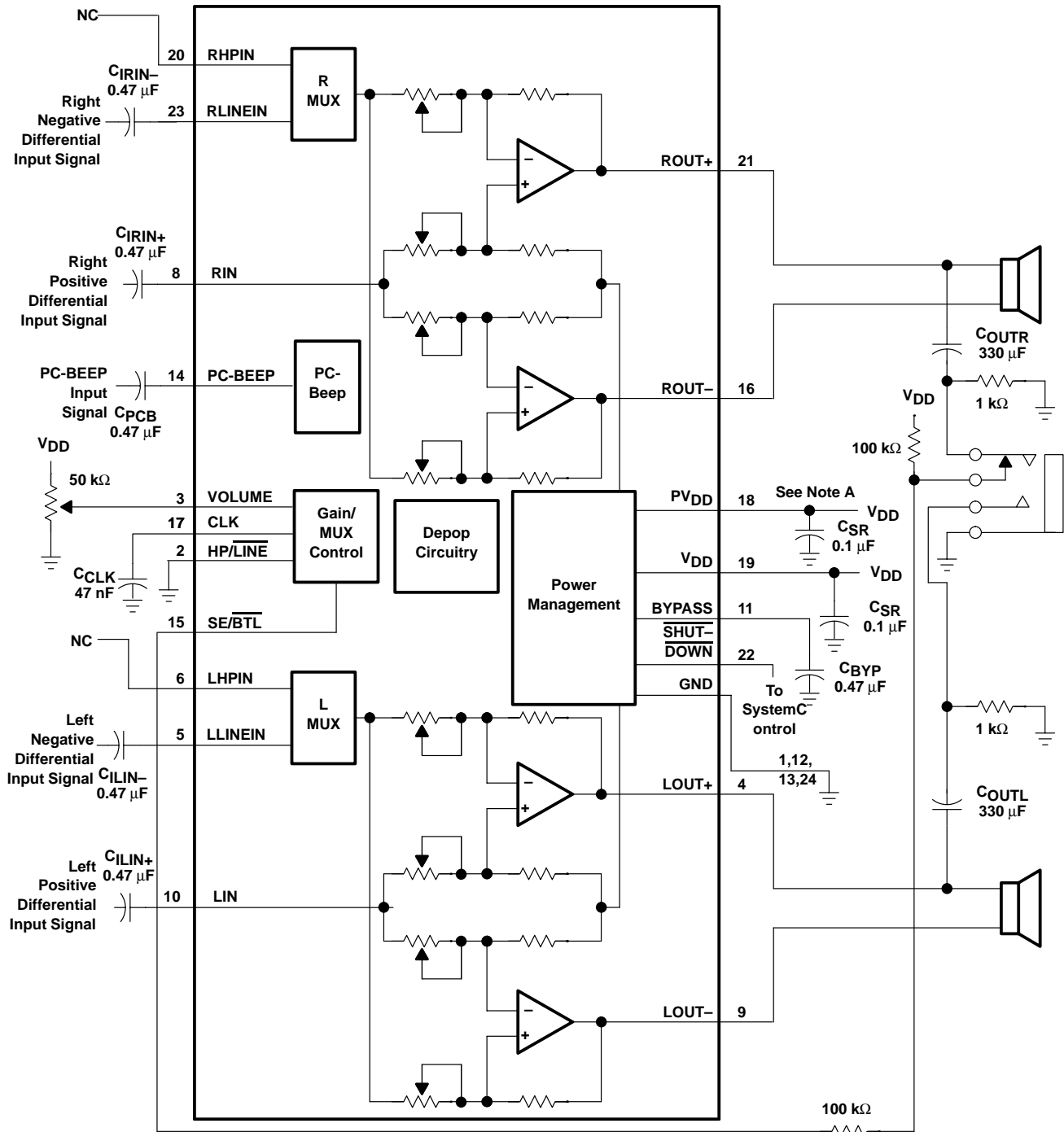
APPLICATION INFORMATION



NOTE A: A 0.1-μF ceramic capacitor should be placed as close as possible to the IC. For filtering lower-frequency noise signals, a larger electrolytic capacitor of 10 μF or greater should be placed near the audio power amplifier.

Figure 30. Typical TPA0242 Application Circuit Using Single-Ended Inputs and Input MUX

APPLICATION INFORMATION



NOTE A: A 0.1- μ F ceramic capacitor should be placed as close as possible to the IC. For filtering lower-frequency noise signals, a larger electrolytic capacitor of 10 μ F or greater should be placed near the audio power amplifier.

Figure 31. Typical TPA0242 Application Circuit Using Differential Inputs