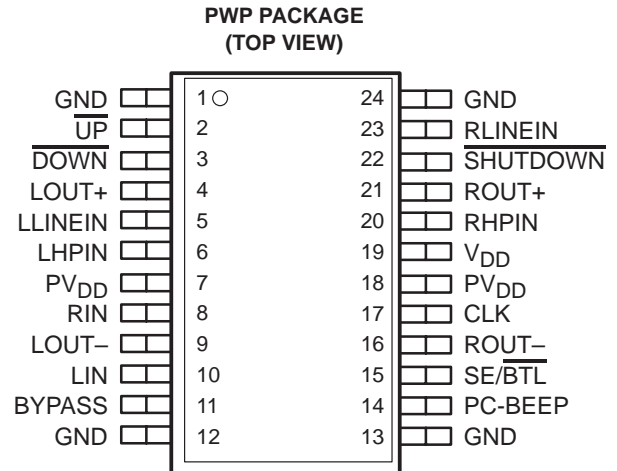


# TPA0152 STEREO 2-W AUDIO POWER AMPLIFIER WITH DIGITAL VOLUME CONTROL

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- **Compatible With PC 99 Desktop Line-Out Into 10-k $\Omega$  Load**
- **Compatible With PC 99 Portable Into 8- $\Omega$  Load**
- **Internal Gain Control, Which Eliminates External Gain-Setting Resistors**
- **Digital Volume Control From +20 dB to –40 dB**
- **2-W/Ch Output Power Into 3- $\Omega$  Load**
- **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 TPA0152 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- $\Omega$  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- $\Omega$  speakers, the TPA0152 has less than 0.3% 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 two terminals,  $\overline{\text{UP}}$  and  $\overline{\text{DOWN}}$ . There are 31 discrete steps covering the range of 20 dB (maximum volume setting) to –40 dB (minimum volume setting) in 2 dB steps. By pressing either button momentarily, the volume steps up or down 2 dB. By continuing to hold the button down, the device will start stepping through volume settings at a rate determined by the capacitor on the CLK terminal. An internal input MUX allows two sets of stereo inputs to the amplifier. In notebook applications, where internal speakers are driven as BTL and the line outputs (often headphone drive) are required to be SE, the TPA0152 automatically switches into SE mode when the SE/ $\overline{\text{BTL}}$  input is activated. This effectively reduces the gain by 6 dB.

The TPA0152 consumes only 10 mA of supply current during normal operation. A miserly shutdown mode is included that reduces the supply current to less than 150  $\mu\text{A}$ .

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 TPA0152 to operate at full power into 8- $\Omega$  loads at ambient temperatures of 85°C.



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.

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PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.



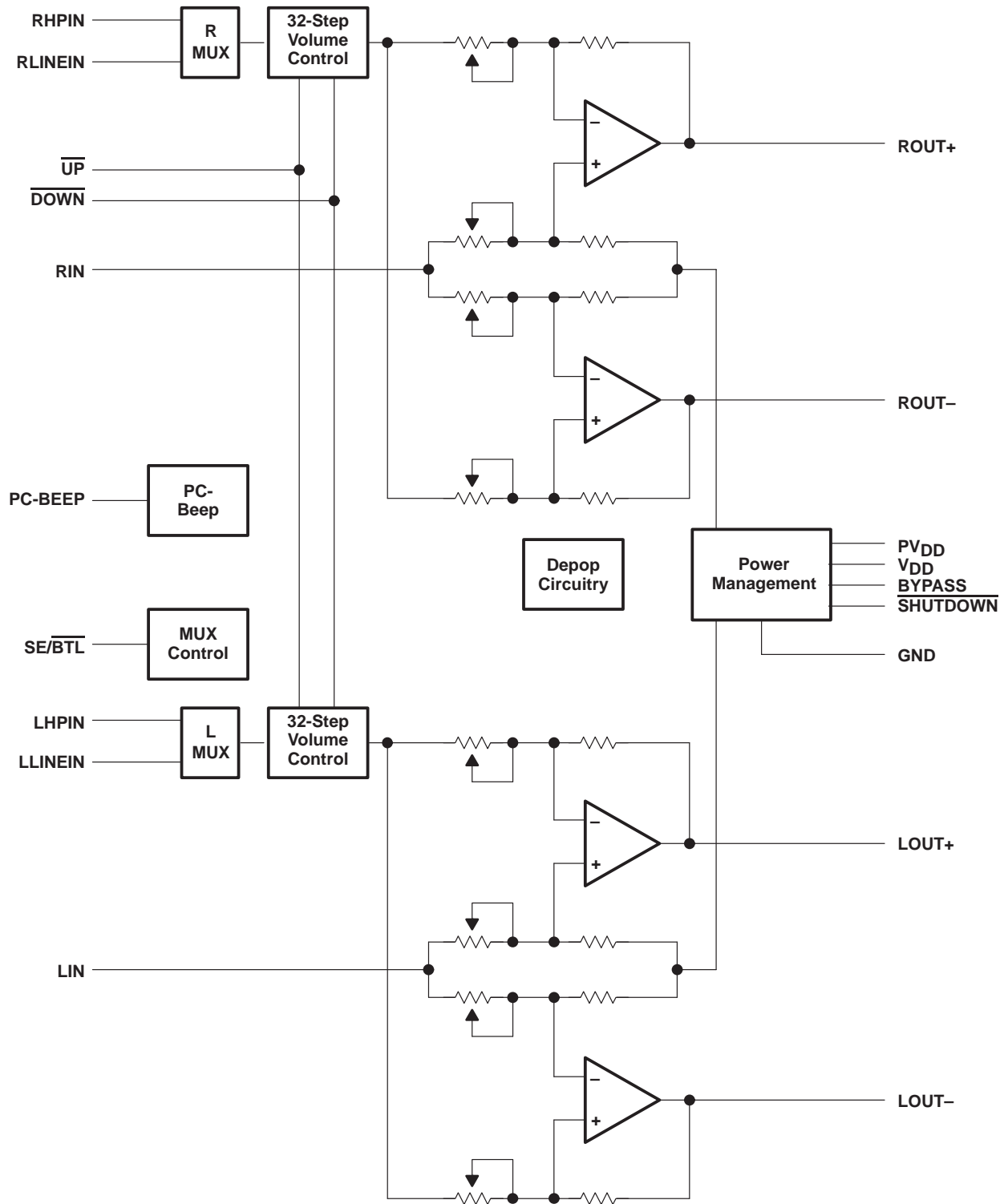
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## functional block diagram



**TPA0152**  
**STEREO 2-W AUDIO POWER AMPLIFIER**  
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**AVAILABLE OPTIONS**

T <sub>A</sub>	PACKAGED DEVICE
–40°C to 85°C	TPA0152PWP

† 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., TPA0152PWPR).

**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 TPA0152 generates an internal clock. An external clock can override the internal clock input to this terminal.
$\overline{\text{DOWN}}$	3	I	A momentary pulse on this terminal decreases the volume level by 2 dB. Holding the terminal low for a period of time will step the amplifier through the volume levels at a rate determined by the capacitor on the CLK 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 in SE mode
LOUT–	9	O	Left-channel negative output in $\overline{\text{BTL}}$ mode and high impedance in SE mode
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 or PCB ENABLE is high.
PV <sub>DD</sub>	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 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	Input MUX control input. When this terminal is held high, the LHPIN or RHPIN and SE output is selected. When this terminal is held low, the LLINEIN or RLINEIN and BTL output are selected.
$\overline{\text{SHUTDOWN}}$	22	I	When held low, this terminal places the entire device, except PC-BEEP detect circuitry, in shutdown mode.
$\overline{\text{UP}}$	2	I	A momentary pulse on this terminal increases the volume level by 2 dB. Holding the terminal low for a period of time will step the amplifier through the volume levels at a rate determined by the capacitor on the CLK terminal.
V <sub>DD</sub>	19	I	Analog V <sub>DD</sub> input supply. This terminal needs to be isolated from PV <sub>DD</sub> to achieve highest performance.



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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	4		V
	SHUTDOWN	2		
Low-level input voltage, $V_{IL}$	SE/BTL		3	V
	SHUTDOWN		0.8	
Operating free-air temperature, $T_A$		-40	85	°C



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

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$ V_{OD} $	Differential output voltage				25	mV
PSRR	Power supply rejection ratio	$V_{DD} = 4.9\text{ V to } 5.1\text{ V}$		67		dB
$ I_{IH} $	High-level input current	$V_{DD} = 5.5\text{ V}$ , $V_I = V_{DD}$			900	nA
$ I_{IL} $	Low-level input current	$V_{DD} = 5.5\text{ V}$ , $V_I = 0\text{ V}$			900	nA
$I_{DD}$	Supply current	BTL mode		10		mA
		SE mode		5		
$I_{DD(sd)}$	Supply current, shutdown mode			150	300	$\mu\text{A}$

**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	$P_O = 1\text{ W}$ ,	$f = 20\text{ Hz to } 15\text{ kHz}$		0.3%		
BOM	Maximum output power bandwidth	THD = 5%			>15		kHz
$k_{SVR}$	Supply ripple rejection ratio	$f = 1\text{ kHz}$ , $C_B = 0.47\ \mu\text{F}$	BTL mode		65		dB
			SE mode		60		
$V_n$	Noise output voltage	$C_B = 0.47\ \mu\text{F}$ , $f = 20\text{ Hz to } 20\text{ kHz}$	BTL mode		17		$\mu\text{VRMS}$
			SE mode		44		

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**APPLICATION INFORMATION**

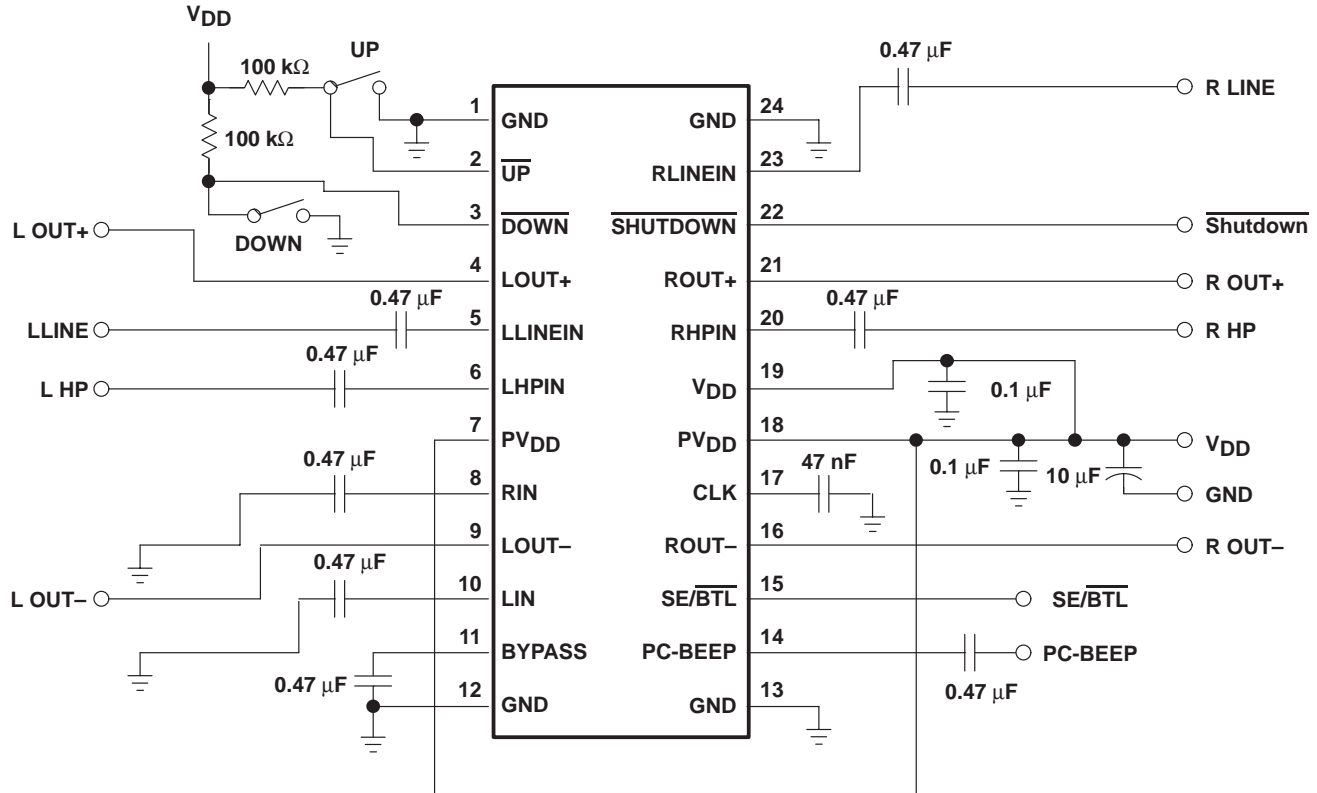


Figure 1. Typical TPA0152 Application Circuit

**TPA0152**  
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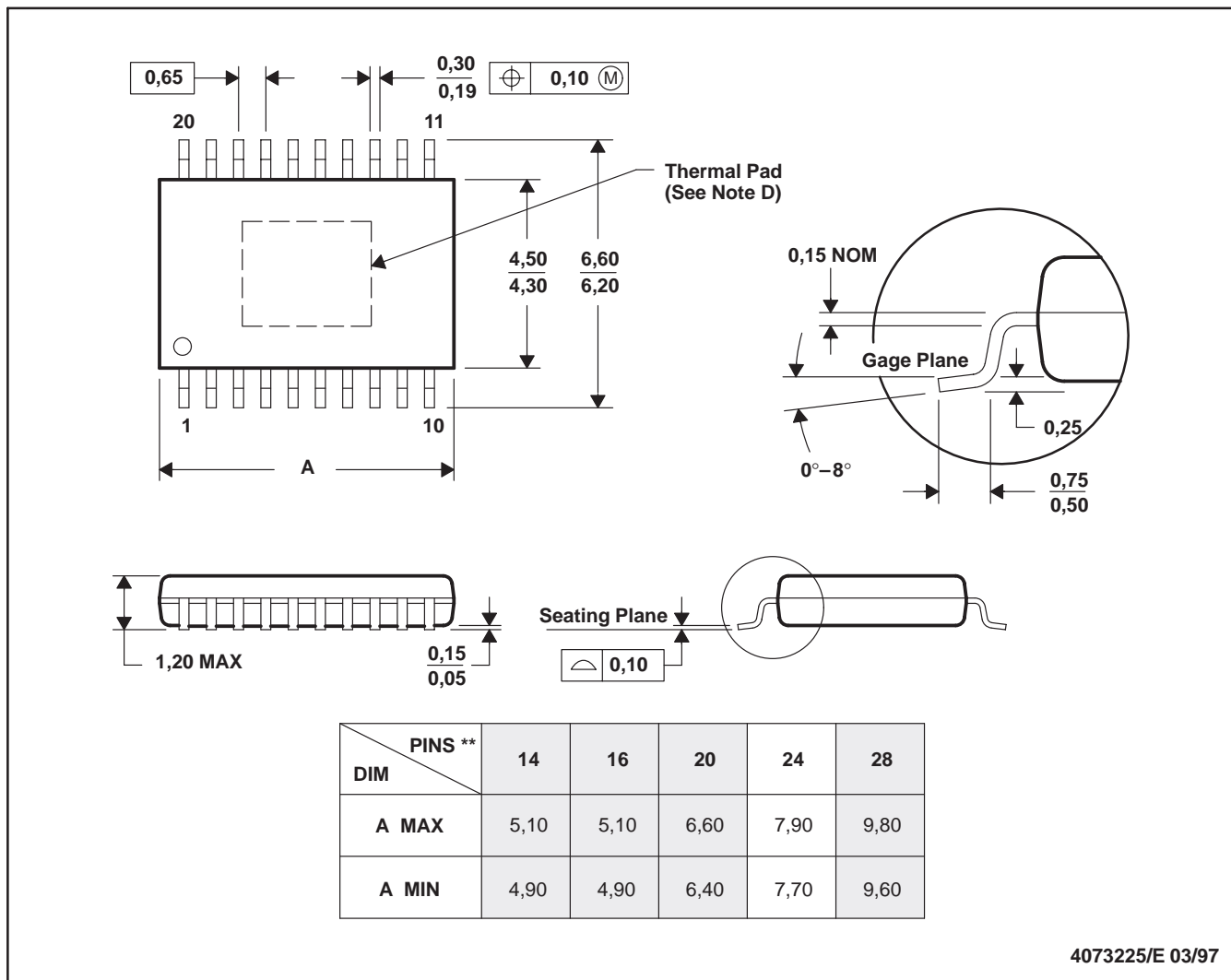
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**MECHANICAL DATA**

**PWP (R-PDSO-G\*\*)**

**PowerPAD™ PLASTIC SMALL-OUTLINE PACKAGE**

20-PIN SHOWN



- NOTES: A. All linear dimensions are in millimeters.  
 B. This drawing is subject to change without notice.  
 C. Body dimensions do not include mold flash or protrusions.  
 D. The package thermal performance may be enhanced by bonding the thermal pad to an external thermal plane. This pad is electrically and thermally connected to the backside of the die and possibly selected leads.  
 E. Falls within JEDEC MO-153

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