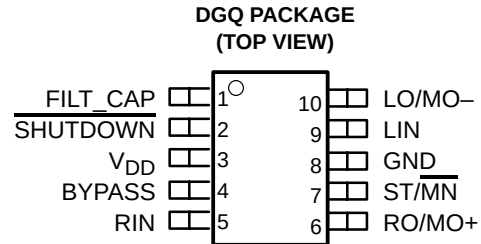


TPA0253

1-W MONO AUDIO POWER AMPLIFIER WITH HEADPHONE DRIVE

SLOS280D – JANUARY 2000 – REVISED NOVEMBER 2002

- Ideal for Notebook Computers, PDAs, and Other Small Portable Audio Devices
- 1 W Into 8- Ω From 5-V Supply
- 0.3 W Into 8- Ω From 3-V Supply
- Stereo Head Phone Drive
- Mono (BTL) Signal Created by Summing Left and Right Signals Internally
- Wide Power Supply Compatibility
2.5 V to 5.5 V
- Low Supply Current
 - 3.2 mA Typical at 5 V
 - 2.7 mA Typical at 3 V
- Shutdown Control . . . 1 μ A Typical
- Shutdown Pin Is TTL Compatible
- –40°C to 85°C Operating Temperature Range
- Space-Saving, Thermally-Enhanced MSOP Packaging



description

The TPA0253 is a 1-W mono bridge-tied-load (BTL) amplifier designed to drive speakers with as low as 8- Ω impedance. The mono signal is created by summing left and right inputs internally. The amplifier can be reconfigured on the fly to drive two stereo single-ended (SE) signals into headphones. This makes the device ideal for use in small notebook computers, PDAs, digital personal audio players, anyplace a mono speaker and stereo headphones are required. From a 5-V supply, the TPA0253 can deliver 1-W of power into an 8- Ω speaker.

The gain of the input stage is set by the user-selected input resistor and a 50-k Ω internal feedback resistor ($A_V = -R_F/R_I$). The power stage is internally configured with a gain of –1.25 V/V in SE mode, and –2.5 V/V in BTL mode. Thus, the overall gain of the amplifier is 62.5 k Ω / R_I in SE mode and 125 k Ω / R_I in BTL mode. The input terminals are high-impedance CMOS inputs, and can be used as summing nodes.

The TPA0253 is available in the 10-pin thermally-enhanced MSOP package (DGQ) and operates over an ambient temperature range of –40°C to 85°C.

AVAILABLE OPTIONS

T _A	PACKAGED DEVICES	MSOP SYMBOLIZATION
	MSOP [†] (DGQ)	
–40°C to 85°C	TPA0253DGQ	AEL

[†] The DGQ package are available taped and reeled. To order a taped and reeled part, add the suffix R to the part number (e.g., TPA0253DGQR).



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.

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.

**TEXAS
INSTRUMENTS**

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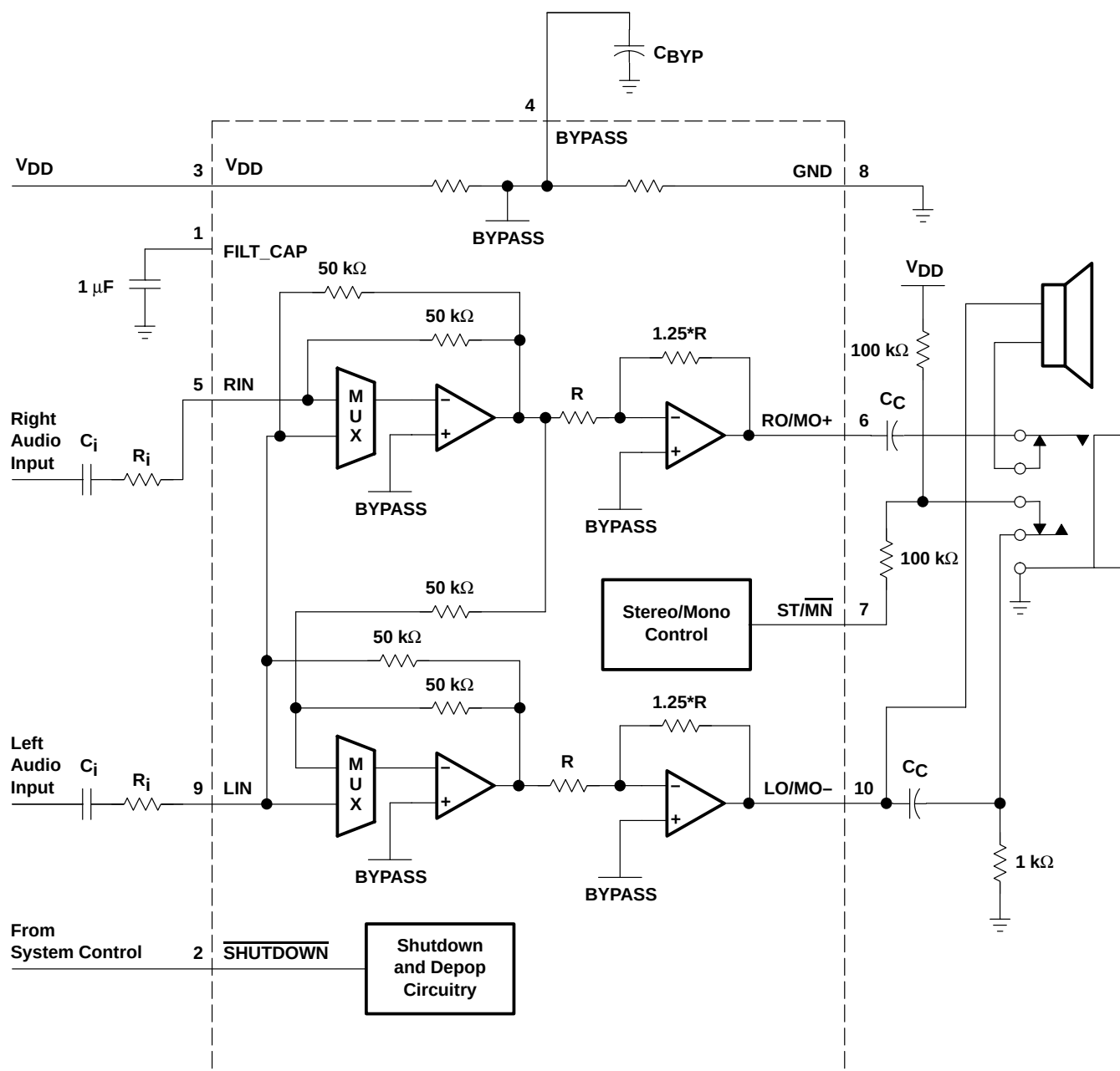
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TPA0253

1-W MONO AUDIO POWER AMPLIFIER WITH HEADPHONE DRIVE

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schematic



TPA0253
1-W MONO AUDIO POWER AMPLIFIER
WITH HEADPHONE DRIVE

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Terminal Functions

TERMINAL NAME	NO.	I/O	DESCRIPTION
BYPASS	4	I	Midrail bias voltage
FILT_CAP	1		Terminal used to filter power supply
GND	8		Ground terminal
LIN	9	I	Left-channel input terminal
LO/MO–	10	O	Left-output in SE mode and mono negative output in BTL mode.
RIN	5	I	Right-channel input terminal
RO/MO+	6	O	Right-output in SE mode and mono positive output in BTL mode
SHUTDOWN	2	I	TTL-compatible shutdown terminal
ST/MN	7	I	Selects between stereo and mono mode. When held high, the amplifier is in SE stereo mode; while held low, the amplifier is in BTL mono mode.
V _{DD}	3	I	Positive power supply

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

Supply voltage, V_{DD} 6 V
Input voltage range, 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 (see Table 3) –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 ≤ 25°C	DERATING FACTOR	T _A = 70°C	T _A = 85°C
DGQ	2.14 W [§]	17.1 mW/°C	1.37 W	1.11 W

[§] Please see the Texas Instruments document, *PowerPAD Thermally Enhanced Package Application Report* (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 that document.

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TPA0253

1-W MONO AUDIO POWER AMPLIFIER WITH HEADPHONE DRIVE

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recommended operating conditions

			MIN	MAX	UNIT
Supply voltage, V_{DD}			2.5	5.5	V
High-level input voltage, V_{IH}	ST/MN	$V_{DD} = 3\text{ V}$	2.7		V
		$V_{DD} = 5\text{ V}$	4.5		
	SHUTDOWN		2		
Low-level input voltage, V_{IL}	ST/MN	$V_{DD} = 3\text{ V}$		1.65	V
		$V_{DD} = 5\text{ V}$		2.75	
	SHUTDOWN			0.8	
Operating free-air temperature, T_A			-40	85	°C

electrical characteristics at specified free-air temperature, $V_{DD} = 3\text{ V}$, $T_A = 25^\circ\text{C}$ (unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
$ V_{OO} $ Output offset voltage (measured differentially)	$R_L = 4\ \Omega$, ST/MN = 0 V, SHUTDOWN = 2 V			30	mV
PSRR Power supply rejection ratio	$V_{DD} = 2.9\text{ V}$ to 3.1 V , BTL mode		65		dB
$ I_{IH} $ High-level input current	SHUTDOWN, $V_{DD} = 3.3\text{ V}$, $V_I = V_{DD}$			1	μA
	ST/MN, $V_{DD} = 3.3\text{ V}$, $V_I = V_{DD}$			1	
$ I_{IL} $ Low-level input current	SHUTDOWN, $V_{DD} = 3.3\text{ V}$, $V_I = 0\text{ V}$			1	μA
	ST/MN, $V_{DD} = 3.3\text{ V}$, $V_I = 0\text{ V}$			1	
Z_I Input impedance			50		k Ω
I_{DD} Supply current	$V_{DD} = 2.5\text{ V}$, SHUTDOWN = 2 V		2.7	4	mA
$I_{DD}(\text{SD})$ Supply current, shutdown mode	SHUTDOWN = 0 V		1	10	μA
R_F Feedback resistor	$V_{DD} = 2.5\text{ V}$, $R_L = 4\ \Omega$, ST/MN = 1.375 V, SHUTDOWN = 2 V	47	50	57	k Ω

operating characteristics, $V_{DD} = 3\text{ V}$, $T_A = 25^\circ\text{C}$, $R_L = 8\ \Omega$, $f = 1\text{ kHz}$ (unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
P_O Output power, see Note 1	THD = 0.1%, BTL mode, Gain = 14 dB		300		mW
	THD = 0.1% SE mode, $R_L = 32\ \Omega$ Gain = 1.9 dB		30		
THD + N Total harmonic distortion plus noise	$P_O = 250\text{ mW}$, $f = 20\text{ Hz}$ to 20 kHz		0.2%		
B_{OM} Maximum output power bandwidth	Gain = 1.9 dB, THD = 2%		20		kHz
Supple ripple rejection ratio	$f = 1\text{ kHz}$, $C_{(\text{BYP})} = 0.47\ \mu\text{F}$	BTL mode	46		dB
		SE mode	68		
V_n Noise output voltage	$C_{(\text{BYP})} = 0.47\ \mu\text{F}$, $f = 20\text{ Hz}$ to 20 kHz	BTL mode	83		μVRMS
		SE mode	33		

NOTE 1: Output power is measured at the output terminals of the device at $f = 1\text{ kHz}$.



TPA0253
1-W MONO AUDIO POWER AMPLIFIER
WITH HEADPHONE DRIVE

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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_{OO} $	Output offset voltage (measured differentially)	$R_L = 4\ \Omega$, $ST/\overline{MN} = 0\text{ V}$, $\overline{SHUTDOWN} = 2\text{ V}$			30	mV
PSRR	Power supply rejection ratio	$V_{DD} = 4.9\text{ V}$ to 5.1 V , BTL mode		62		dB
$ I_{IH} $	High-level input current	$\overline{SHUTDOWN}$, $V_{DD} = 5.5\text{ V}$, $V_I = V_{DD}$			1	μA
		$ST/\overline{MN}$, $V_{DD} = 5.5\text{ V}$, $V_I = V_{DD}$			1	
$ I_{IL} $	Low-level input current	$\overline{SHUTDOWN}$, $V_{DD} = 5.5\text{ V}$, $V_I = 0\text{ V}$			1	μA
		$ST/\overline{MN}$, $V_{DD} = 5.5\text{ V}$, $V_I = 0\text{ V}$			1	
Z_I	Input impedance			50		k Ω
I_{DD}	Supply current	$\overline{SHUTDOWN} = 2\text{ V}$		3.2	4.8	mA
$I_{DD(SD)}$	Supply current, shutdown mode	$\overline{SHUTDOWN} = 0\text{ V}$		1	10	μA

operating characteristics, $V_{DD} = 5\text{ V}$, $T_A = 25^\circ\text{C}$, $R_L = 8\ \Omega$, $f = 1\text{ kHz}$ (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
P_O	Output power (see Note 1)	THD = 0.1%, BTL mode		1		W
		THD = 0.1%, SE mode, $R_L = 32\ \Omega$		85		mW
THD + N	Total harmonic distortion plus noise	$P_O = 1\text{ W}$, $f = 20\text{ Hz}$ to 20 kHz		0.33%		
BOM	Maximum output power bandwidth	Gain = 8 dB, THD = 2%		20		kHz
	Supply ripple rejection ratio	$f = 1\text{ kHz}$, $C_{(BYP)} = 0.47\ \mu\text{F}$	BTL mode	46		dB
			SE mode	60		
V_N	Noise output voltage	$C_{(BYP)} = 0.47\ \mu\text{F}$, $f = 20\text{ Hz}$ to 20 kHz	BTL mode	85		μVRMS
			SE mode	34		

NOTE 1: Output power is measured at the output terminals of the device at $f = 1\text{ kHz}$.

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package Pins	Package qty Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
TPA0253DGQ	Active	Production	HVSSOP (DGQ) 10	80 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	AEL
TPA0253DGQ.A	Active	Production	HVSSOP (DGQ) 10	80 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	AEL
TPA0253DGQG4	Active	Production	HVSSOP (DGQ) 10	80 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	AEL
TPA0253DGQR	Active	Production	HVSSOP (DGQ) 10	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	AEL
TPA0253DGQR.A	Active	Production	HVSSOP (DGQ) 10	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	AEL

⁽¹⁾ **Status:** For more details on status, see our [product life cycle](#).

⁽²⁾ **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

⁽³⁾ **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

⁽⁴⁾ **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

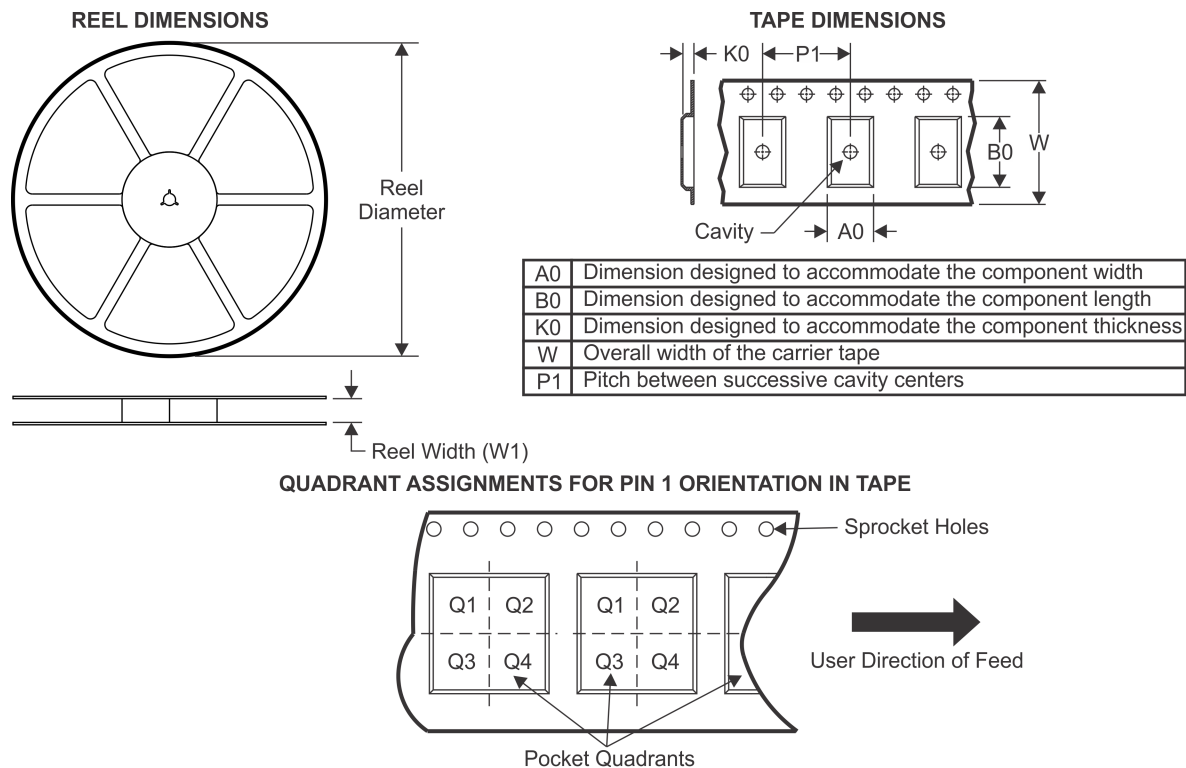
⁽⁵⁾ **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

⁽⁶⁾ **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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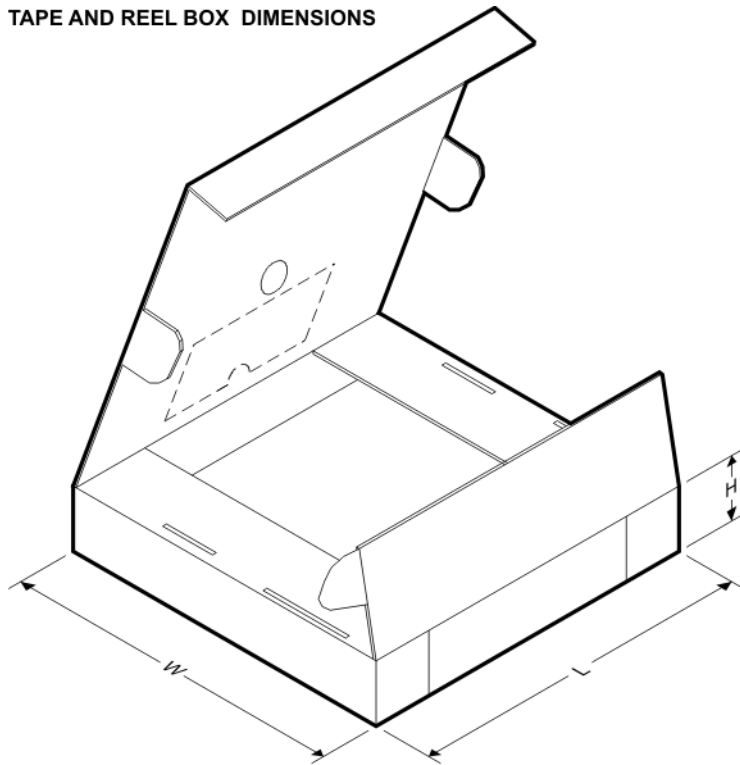
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TAPE AND REEL INFORMATION


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TPA0253DGQR	HVSSOP	DGQ	10	2500	330.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TPA0253DGQR	HVSSOP	DGQ	10	2500	358.0	335.0	35.0

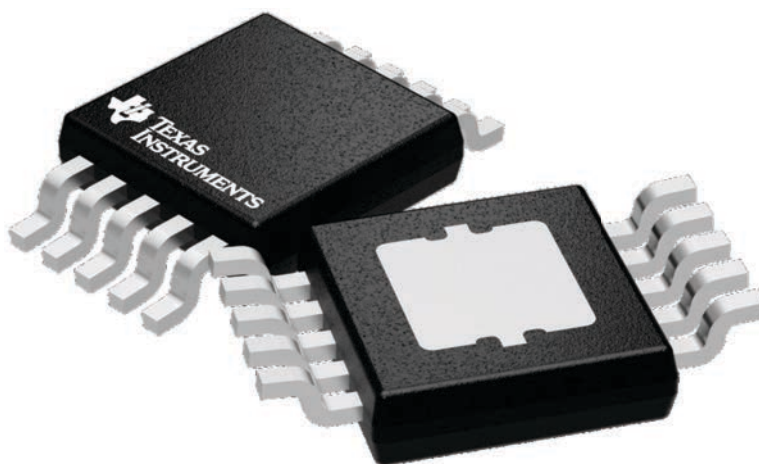
GENERIC PACKAGE VIEW

DGQ 10

PowerPAD™ HVSSOP - 1.1 mm max height

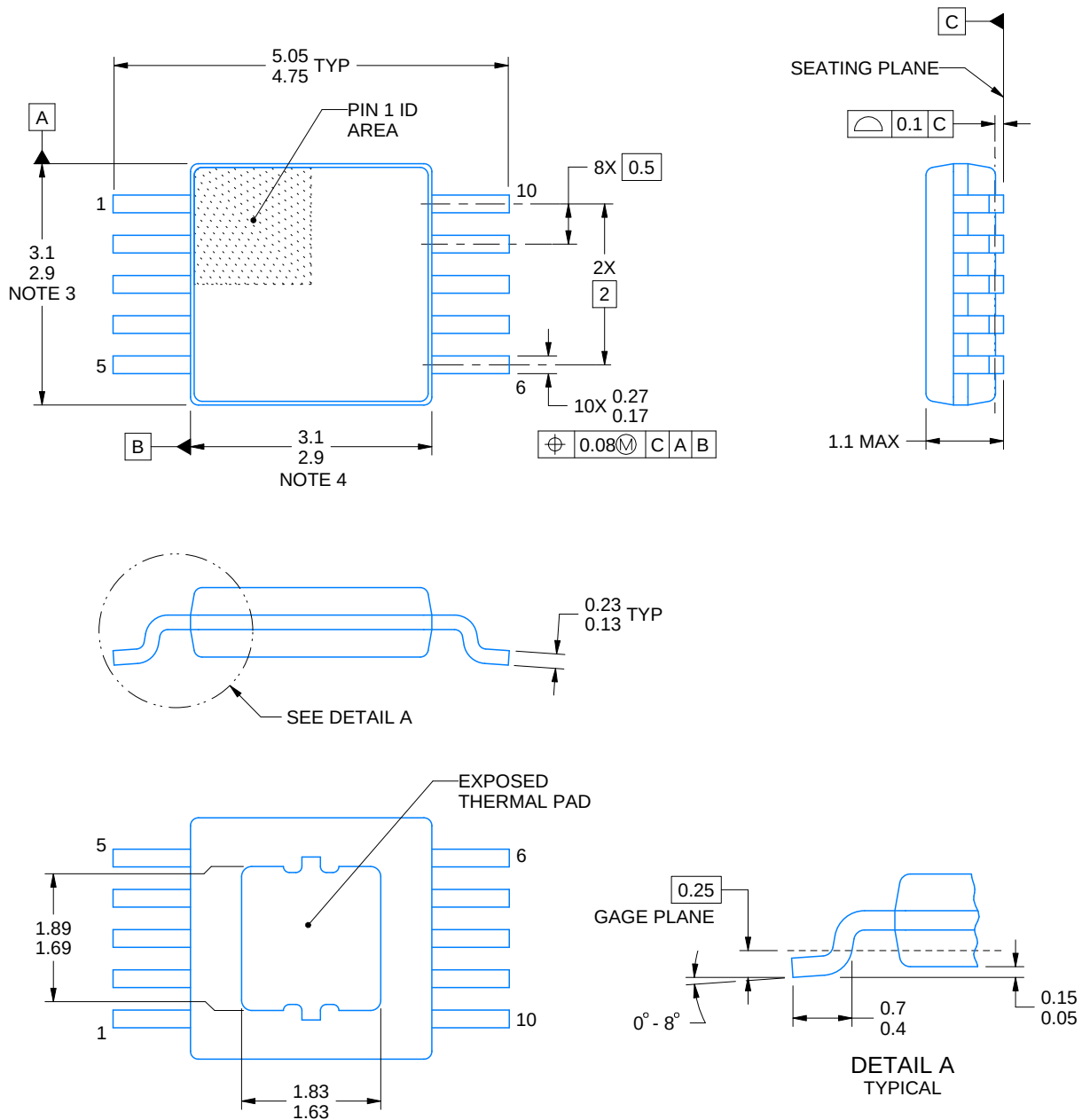
3 x 3, 0.5 mm pitch

PLASTIC SMALL OUTLINE



Images above are just a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.

4224775/A



4218842/B 04/2024

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NOTES:

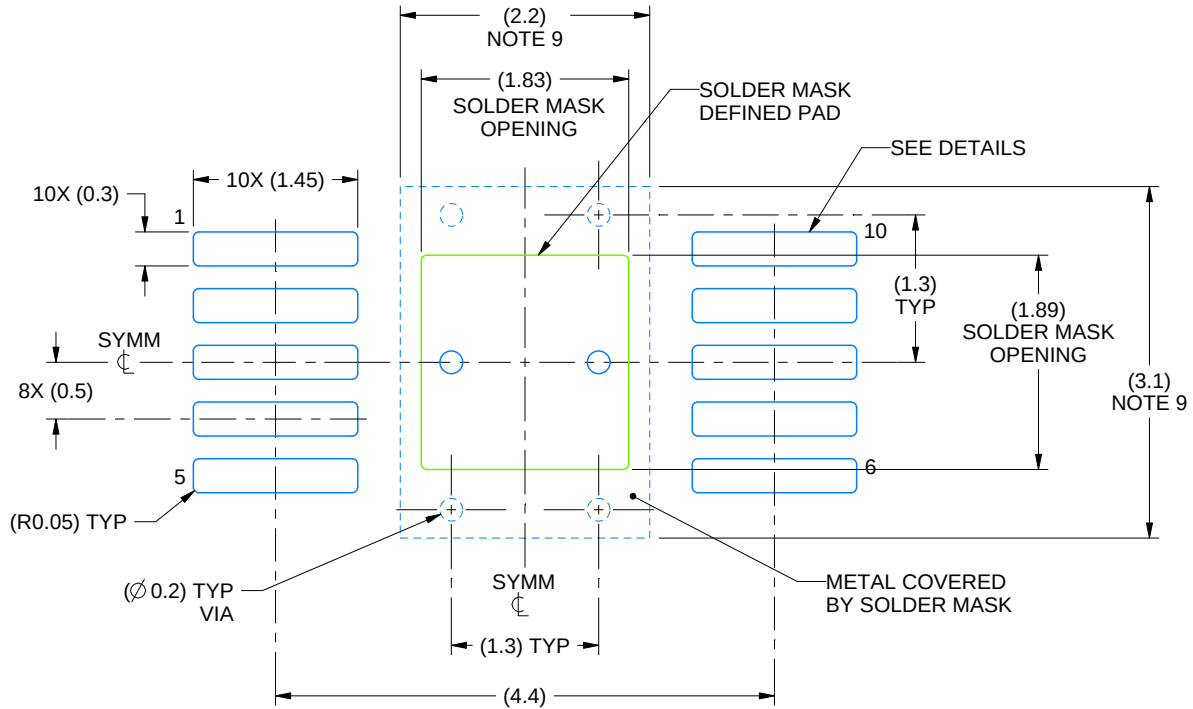
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-187, variation BA-T.

EXAMPLE BOARD LAYOUT

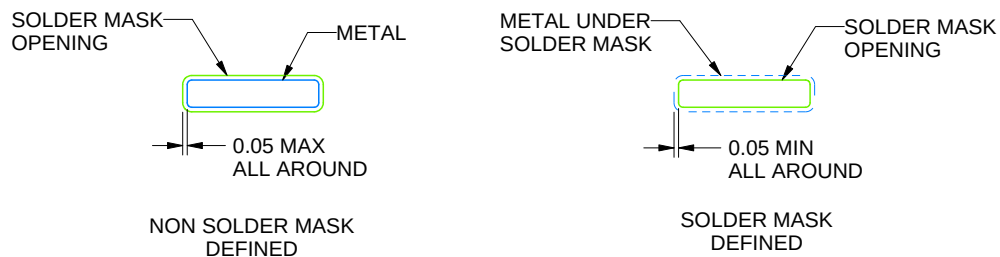
DGQ0010D

PowerPAD™ - 1.1 mm max height

PLASTIC SMALL OUTLINE



LAND PATTERN EXAMPLE
SCALE:15X



SOLDER MASK DETAILS

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NOTES: (continued)

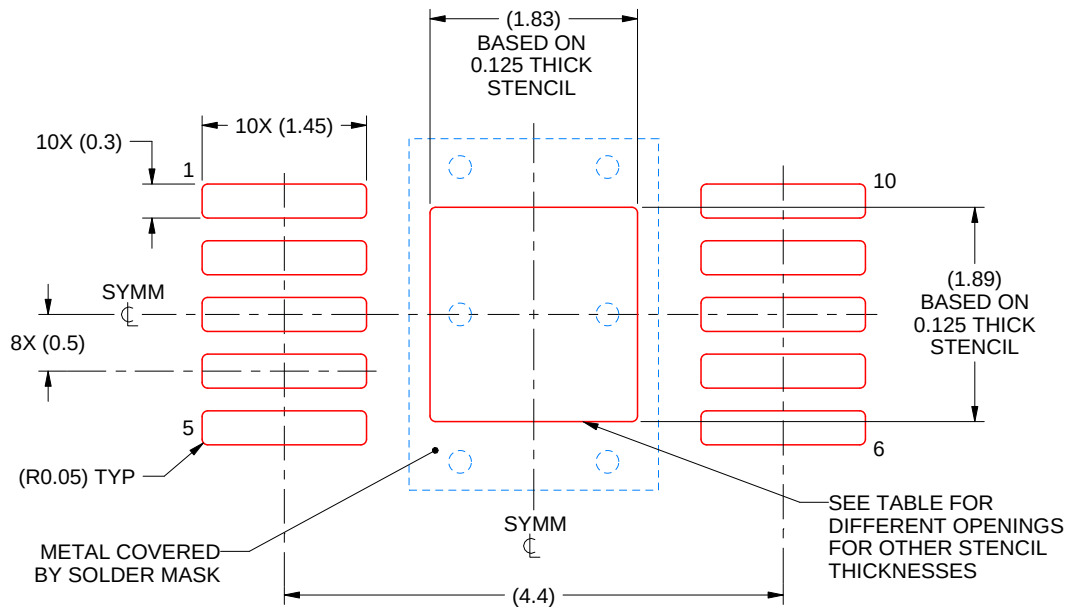
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.
8. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature numbers SLMA002 (www.ti.com/lit/slma002) and SLMA004 (www.ti.com/lit/slma004).
9. Size of metal pad may vary due to creepage requirement.

EXAMPLE STENCIL DESIGN

DGQ0010D

PowerPAD™ - 1.1 mm max height

PLASTIC SMALL OUTLINE



SOLDER PASTE EXAMPLE
EXPOSED PAD
100% PRINTED SOLDER COVERAGE BY AREA
SCALE:15X

STENCIL THICKNESS	SOLDER STENCIL OPENING
0.1	2.05 X 2.11
0.125	1.83 X 1.89 (SHOWN)
0.150	1.67 X 1.73
0.175	1.55 X 1.60

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NOTES: (continued)

10. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
11. Board assembly site may have different recommendations for stencil design.

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