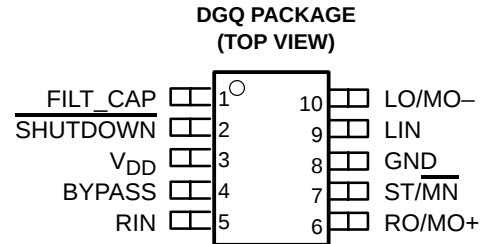


TPA0253

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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SLOS280D – JANUARY 2000 – REVISED NOVEMBER 2002

The schematic diagram illustrates the internal architecture of the AD1875 audio codec. It is divided into three main functional blocks by vertical dashed lines: Input/Filtering, Core Processing, and Output/Control.

- Input/Filtering Block (Left):**
 - Right Audio Input:** Connected to pin 1 (FILT_CAP, 1 μ F) and pin 5 (RIN). It includes a coupling capacitor C_i and a resistor R_i .
 - Left Audio Input:** Connected to pin 9 (LIN). It also includes a coupling capacitor C_i and a resistor R_i .
- Core Processing Block (Middle):**
 - Multiplexers (MUX):** Two MUXes are present. The top MUX selects between the Right Audio Input and a feedback path from the RO/MO+ output. The bottom MUX selects between the Left Audio Input and a feedback path from the LO/MO- output.
 - Op-Amp Buffers:** Two op-amp buffers are used. The top buffer takes the output of the top MUX and drives the RO/MO+ output. The bottom buffer takes the output of the bottom MUX and drives the LO/MO- output. Both buffers have a feedback resistor R and a gain resistor of $1.25 \times R$.
 - BYPASS:** A common BYPASS signal (pin 4) is connected to the non-inverting inputs of both op-amp buffers and to the inputs of both MUXes.
 - Stereo/Mono Control:** A block that takes the ST/MN control signal (pin 7) and provides control to the MUXes and op-amp buffers.
- Output/Control Block (Right):**
 - Outputs:** The RO/MO+ (pin 6) and LO/MO- (pin 10) outputs are connected to the speaker terminals. Each output has a series resistor of $100 \text{ k}\Omega$ and a coupling capacitor C_C .
 - Control:** The SHUTDOWN signal (pin 2) is connected to the Shutdown and Depop Circuitry block.

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.

TPA0253
1-W MONO AUDIO POWER AMPLIFIER
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SLOS280D – JANUARY 2000 – REVISED NOVEMBER 2002

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
	Supply 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		μV_{RMS}
			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

SLOS280D – JANUARY 2000 – REVISED NOVEMBER 2002

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 Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
TPA0253DGQ	ACTIVE	HVSSOP	DGQ	10	80	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	AEL	Samples
TPA0253DGQG4	ACTIVE	HVSSOP	DGQ	10	80	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	AEL	Samples
TPA0253DGQR	ACTIVE	HVSSOP	DGQ	10	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	AEL	Samples
TPA0253DGQRG4	ACTIVE	HVSSOP	DGQ	10	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	AEL	Samples

⁽¹⁾ The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBsolete: TI has discontinued the production of the device.

⁽²⁾ **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

⁽³⁾ MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

⁽⁴⁾ There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

⁽⁵⁾ Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "-" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

⁽⁶⁾ Lead finish/Ball material - Orderable Devices 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.

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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

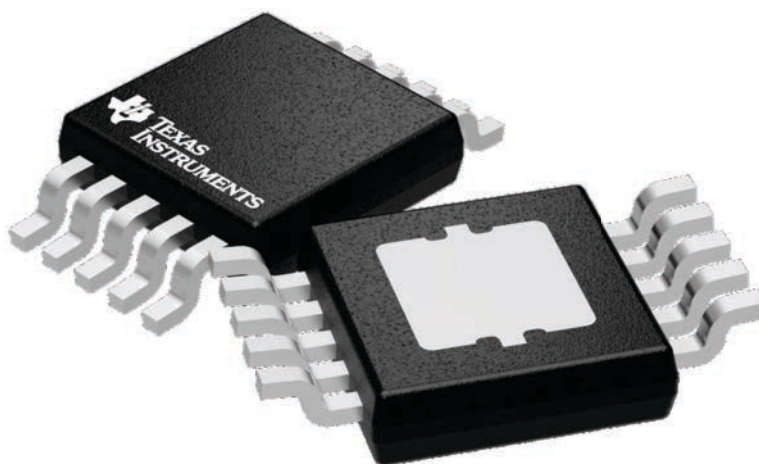
GENERIC PACKAGE VIEW

DGQ 10

PowerPAD™ HVSSOP - 1.1 mm max height

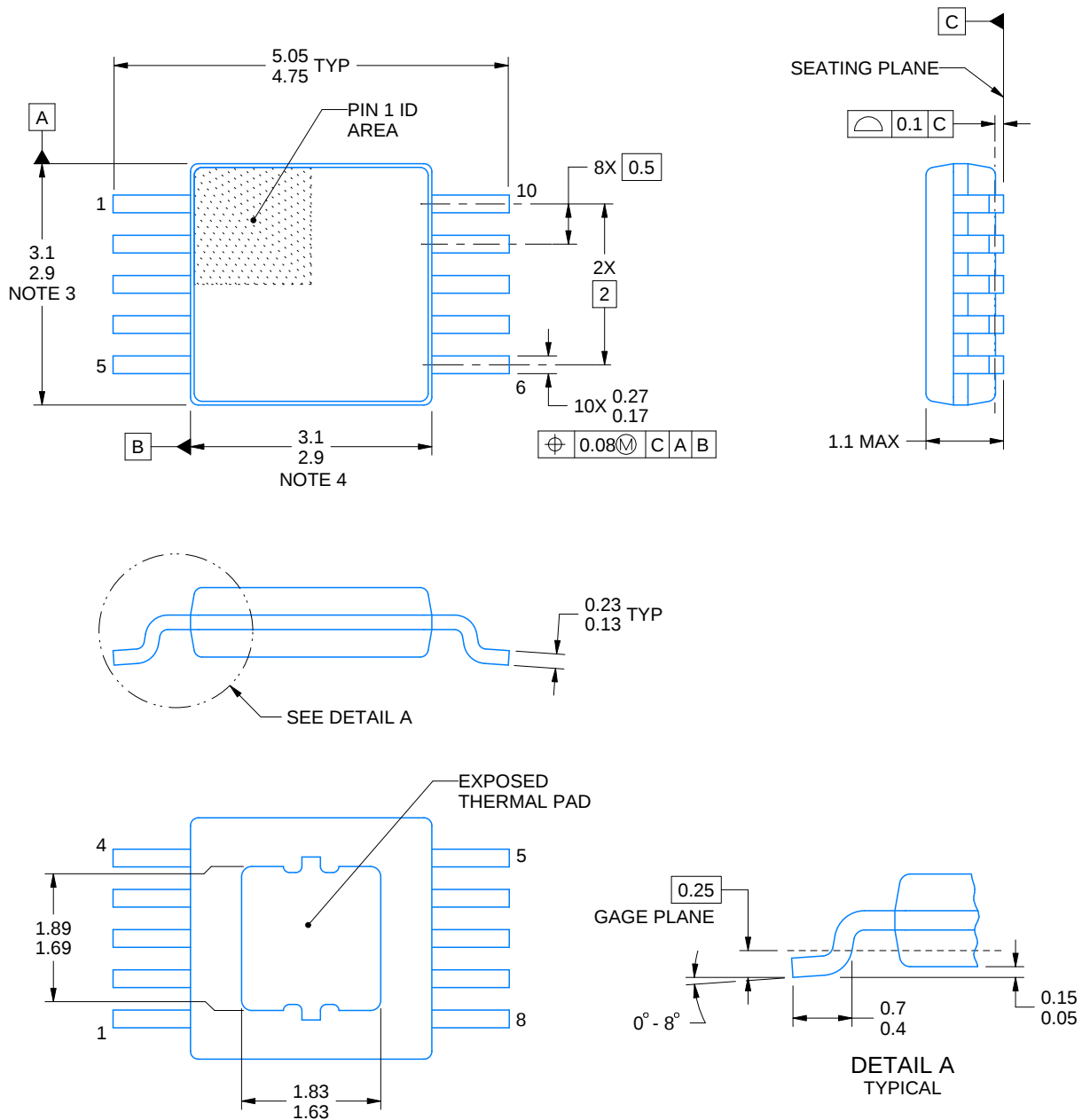
3 x 3, 0.5 mm pitch

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/A 01/2019

PowerPAD is a trademark of Texas Instruments.

NOTES:

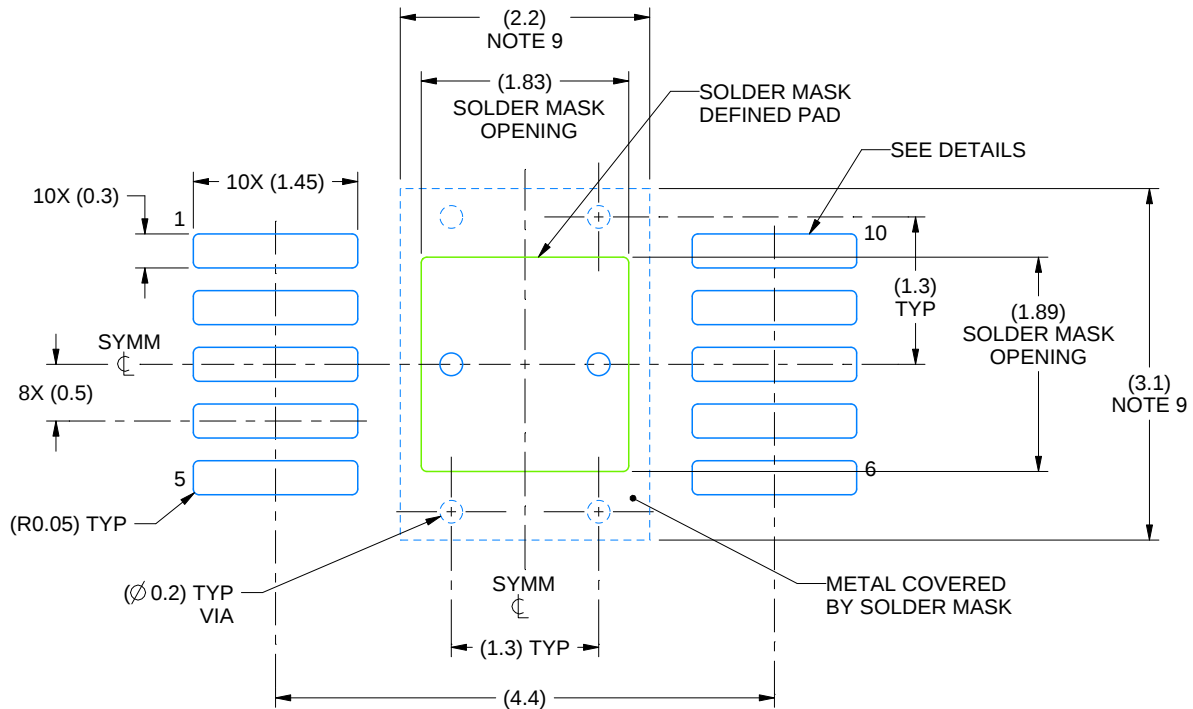
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or 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

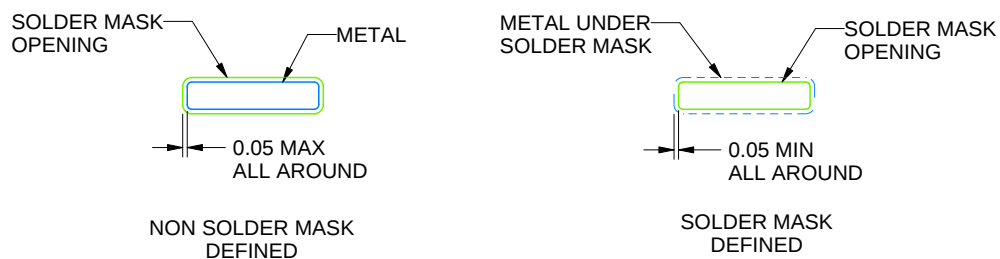
DGQ0010D

PowerPAD™ - 1.1 mm max height

PLASTIC SMALL OUTLINE



LAND PATTERN EXAMPLE
SCALE:15X



SOLDER MASK DETAILS

4218842/A 01/2019

NOTES: (continued)

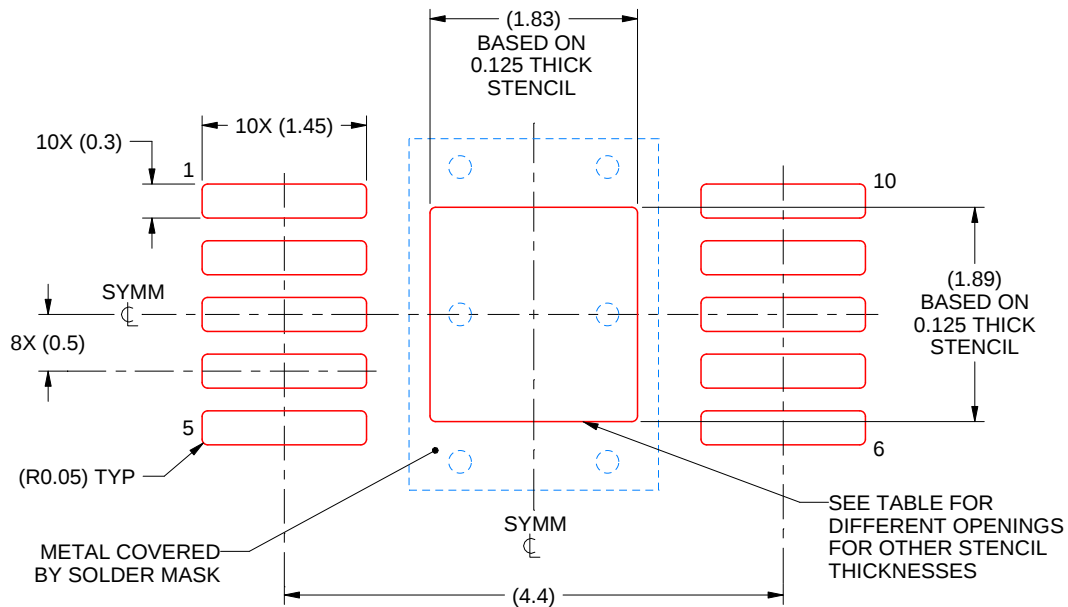
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.
8. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature numbers SLMA002 (www.ti.com/lit/slma002)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

4218842/A 01/2019

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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