LM4861 Boomer® Audio Power Amplifier Series 1.1W Audio Power Amplifier with Shutdown Mode

Check for Samples: LM4861

FEATURES

- **No output coupling capacitors, bootstrap capacitors, or snubber circuits are necessary**
- **Small Outline (SOIC) packaging**
- **Compatible with PC power supplies**
- **Thermal shutdown protection circuitry**
- **Unity-gain stable**
- **External gain configuration capability**

APPLICATIONS

- **Personal computers**
- **Portable consumer products**
- **Self-powered speakers**
- **Toys and games**

KEY SPECIFICATIONS

- **THD+N for 1kHz at 1W continuous average output power into 8Ω 1.0% (max)**
- **Output power at 10% THD+N at 1kHz into 8Ω 1.5 W (typ)**
- **Shutdown Current 0.6µA (typ)**

DESCRIPTION

The LM4861 is a bridge-connected audio power amplifier capable of delivering 1.1W of continuous average power to an 8Ω load with 1% THD+N using a 5V power supply.

Boomer audio power amplifiers were designed specifically to provide high quality output power with a minimal amount of external components using surface mount packaging. Since the LM4861 does not require output coupling capacitors, bootstrap capacitors, or snubber networks, it is optimally suited for low-power portable systems.

The LM4861 features an externally controlled, low-power consumption shutdown mode, as well as an internal thermal shutdown protection mechanism.

The unity-gain stable LM4861 can be configured by external gain-setting resistors for differential gains of up to 10 without the use of external compensation components. Higher gains may be achieved with suitable compensation.

Connection Diagram

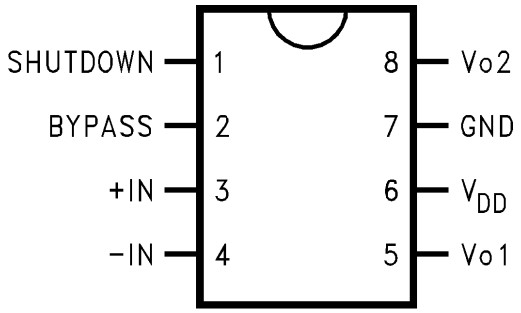


Figure 1. 8-Lead SOIC - Top View
See D Package

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Typical Application

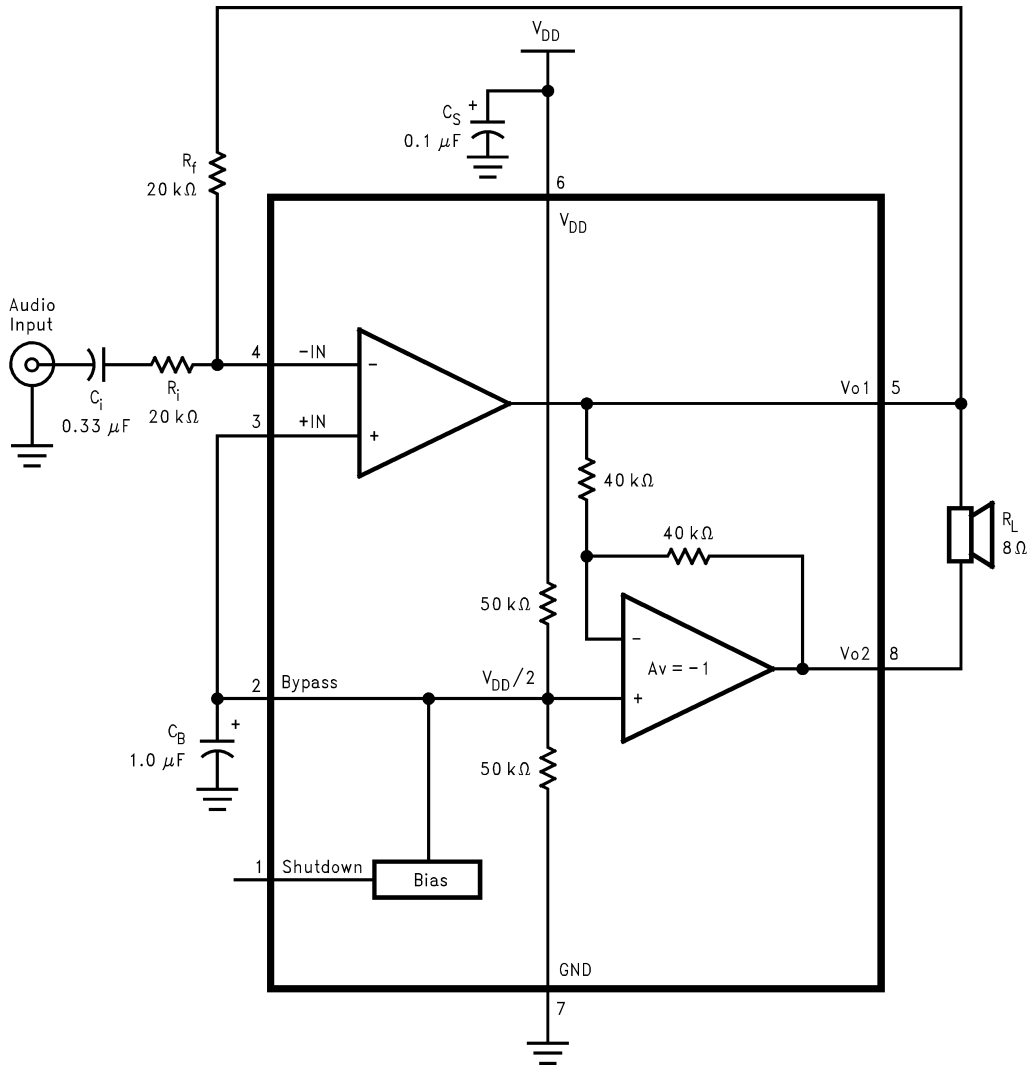


Figure 2. Typical Audio Amplifier Application Circuit

These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

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Absolute Maximum Ratings (1)(2)

Supply Voltage			6.0V
Storage Temperature			−65°C to +150°C
Input Voltage			−0.3V to V_{DD} + 0.3V
Power Dissipation (3)			Internally limited
ESD Susceptibility (4)			3000V
ESD Susceptibility (5)			250V
Junction Temperature			150°C
Soldering Information	SOIC Package	Vapor Phase (60 sec.)	215°C
		Infrared (15 sec.)	220°C

(1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is functional, but do not ensure specific performance limits. Electrical Characteristics state DC and AC electrical specifications under particular test conditions which ensure specific performance limits. This assumes that the device is within the Operating Ratings. Specifications are not ensured for parameters where no limit is given, however, the typical value is a good indication of device performance.
(2) Military/Aerospace specified devices are required, please contact the Texas Instruments Sales Office/ Distributors for availability and specifications.
(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 $P_{DMAX} = (T_{JMAX} - T_A)/\theta_{JA}$ or the number given in the Absolute Maximum Ratings, whichever is lower. For the LM4861, T_{JMAX} = 150°C, and the typical junction-to-ambient thermal resistance, when board mounted, is 140°C/W.
(4) Human body model, 100pF discharged through a 1.5kΩ resistor.
(5) Machine Model, 220pF–240pF discharged through all pins.

Operating Ratings

Temperature Range	$T_{MIN} \le T_A \le T_{MAX}$	−40°C ≤ T_A ≤ +85°C
Supply Voltage		2.0V ≤ V_{DD} ≤ 5.5V
Thermal Resistance	θ_{JC} (typ)—M08A	35°C/W
	θ_{JA} (typ)—M08A	140°C/W
	θ_{JC} (typ)—N08E	37°C/W
	θ_{JA} (typ)—N08E	107°C/W

Electrical Characteristics (1)(2)

The following specifications apply for V_{DD} = 5V, unless otherwise specified. Limits apply for T_A = 25°C.

Symbol	Parameter	Conditions	LM4861		Units (Limits)
			Typical (3)	Limit (4)	
V_{DD}	Supply Voltage			2.0	V (min)
				5.5	V (max)
I_{DD}	Quiescent Power Supply Current	V_{IN} = 0V, I_O = 0A (5)	6.5	10.0	mA (max)
I_{SD}	Shutdown Current	$V_{SHUTDOWN}$ = V_{DD}	0.6	10.0	µA (max)
V_{OS}	Output Offset Voltage	V_{IN} = 0V	5.0	50.0	mV (max)
P_O	Output Power	THD = 1% (max); f = 1 kHz	1.1	1.0	W (min)
THD+N	Total Harmonic Distortion + Noise	P_O = 1Wrms; 20 Hz ≤ f ≤ 20 kHz	0.72		%
PSRR	Power Supply Rejection Ratio	V_{DD} = 4.9V to 5.1V	65		dB

(1) All voltages are measured with respect to the ground pin, unless otherwise specified.
(2) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is functional, but do not ensure specific performance limits. Electrical Characteristics state DC and AC electrical specifications under particular test conditions which ensure specific performance limits. This assumes that the device is within the Operating Ratings. Specifications are not ensured for parameters where no limit is given, however, the typical value is a good indication of device performance.
(3) Typicals are measured at 25°C and represent the parametric norm.
(4) Limits are specified to TI's AOQL (Average Outgoing Quality Level).
(5) The quiescent power supply current depends on the offset voltage when a practical load is connected to the amplifier.

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High Gain Application Circuit

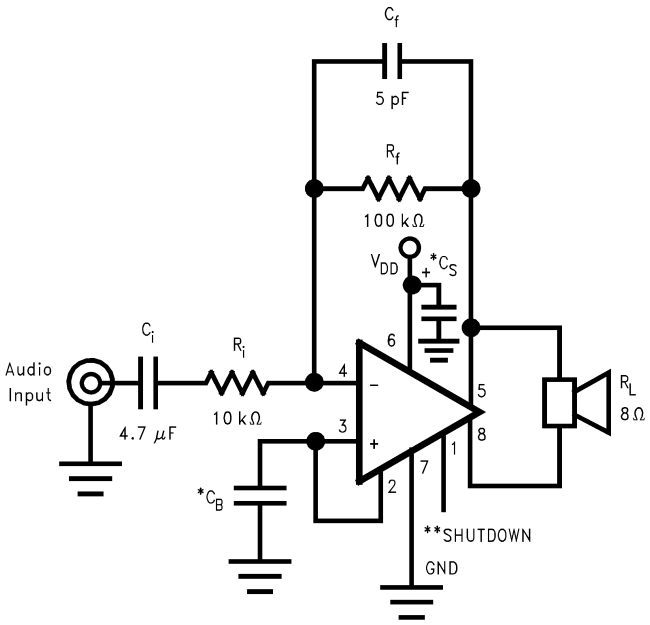
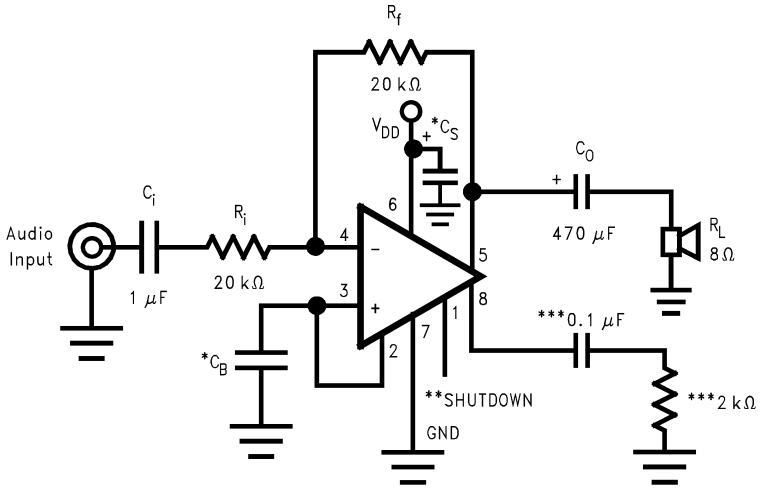


Figure 3. Audio Ampiifier with A_{VD} = 20

Single Ended Application Circuit



*C_S and C_B size depend on specific application requirements and constraints. Typical vaiues of C_S and C_B are 0.1 μF.
**Pin 1 should be connected to V_{DD} to disable the amplifier or to GND to enable the amplifier. This pin should not be left floating.
***These components create a “dummy” load for pin 8 for stability purposes.

Figure 4. Single-Ended Amplifier with A_V = −1

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External Components Description

(Figure 2 and Figure 3)

Components	Functional Description
1. R_i	Inverting input resistance which sets the closed-loop gain in conjunction with R_f. This resistor also forms a high pass filter with C_i at $f_C = 1 / (2\pi R_i C_i)$.
2. C_i	Input coupling capacitor which blocks DC voltage at the amplifier's input terminals. Also creates a high pass filter with R_i at $f_C = 1 / (2\pi R_i C_i)$.
3. R_f	Feedback resistance which sets closed-loop gain in conjunction with R_i.
4. C_SApplication Information	Supply bypass capacitor which provides power supply filtering. Refer to for proper placement and selection of supply bypass capacitor.
5. C_B	Bypass pin capacitor which provides half supply filtering. Refer to Application Information for proper placement and selection of bypass capacitor.
6. C_f(1)	C_f in conjunction with R_f creates a low-pass filter which bandwidth limits the amplifier and prevents possible high frequency oscillation bursts. $f_C = 1 / (2\pi R_f C_f)$

(1) Optional component dependent upon specific design requirements. Refer to Application Information for more information.

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Typical Performance Characteristics

THD+N vs Frequency

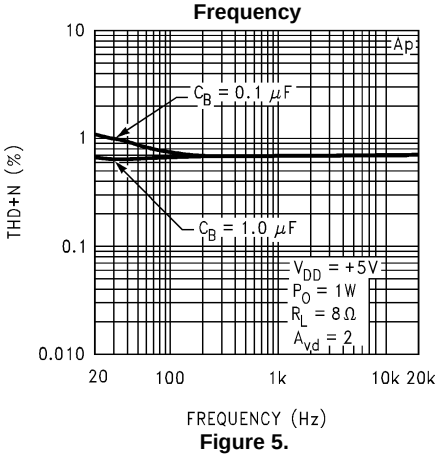


Figure 5.

THD+N vs Frequency

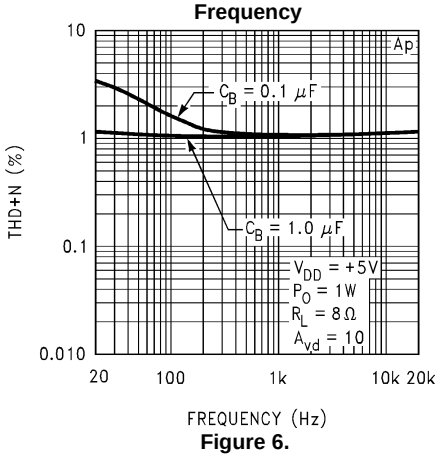


Figure 6.

THD+N vs Frequency

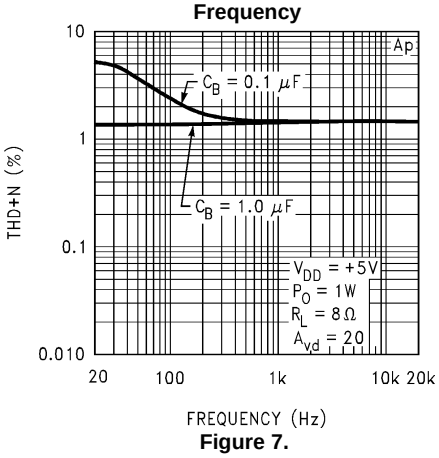


Figure 7.

THD+N vs Output Power

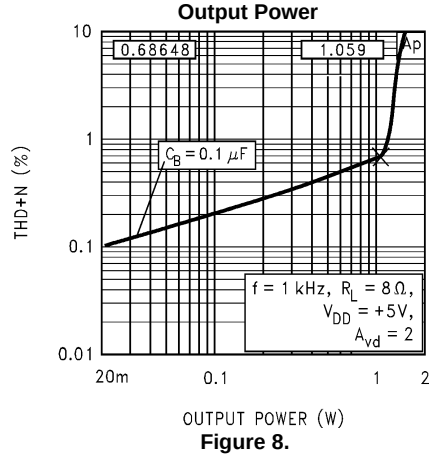


Figure 8.

THD+N vs Output Power

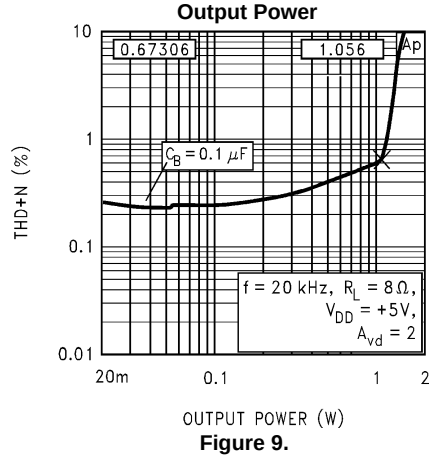


Figure 9.

Output Power vs Load Resistance

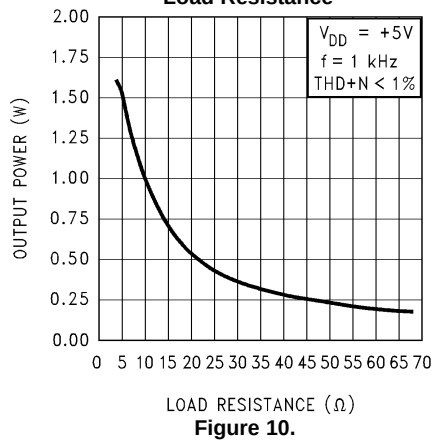


Figure 10.

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Typical Performance Characteristics (continued)

Output Power vs Supply Voltage

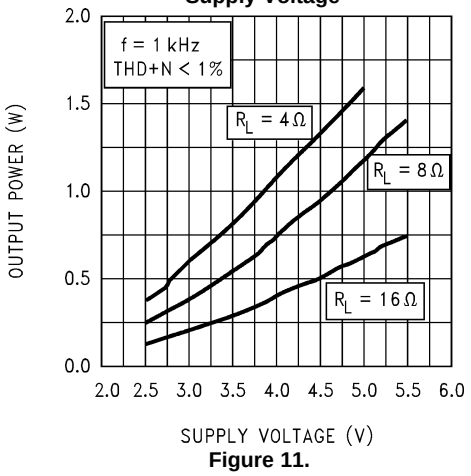


Figure 11.

Power Dissipation vs Output Power

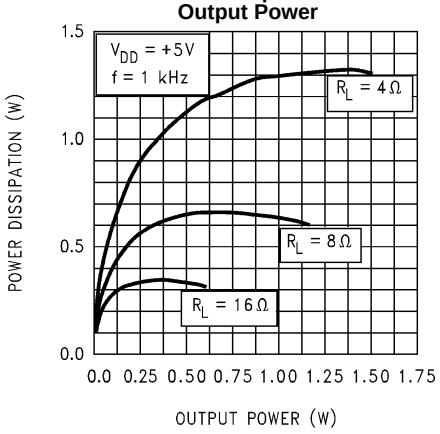


Figure 12.

Noise Floor vs Frequency

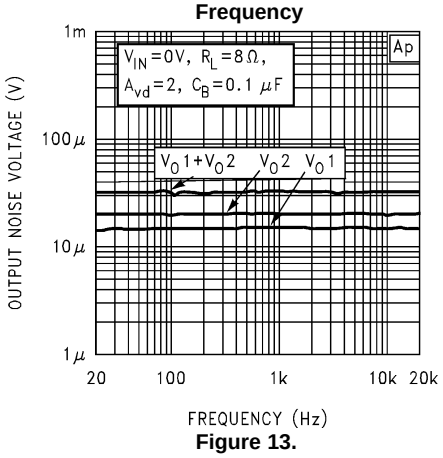


Figure 13.

Supply Current Distribution vs Temperature

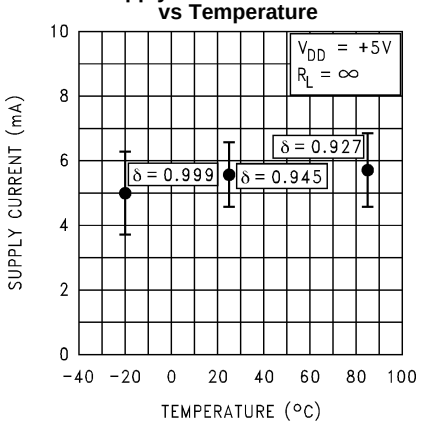


Figure 14.

Supply Current vs Supply Voltage

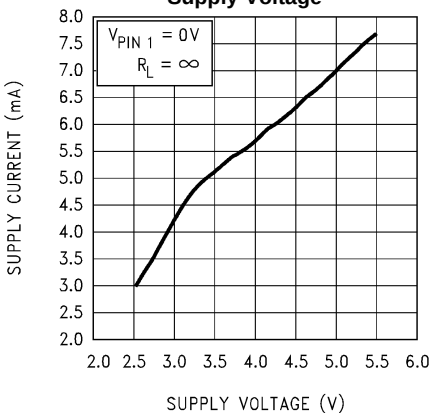


Figure 15.

Power Derating Curve

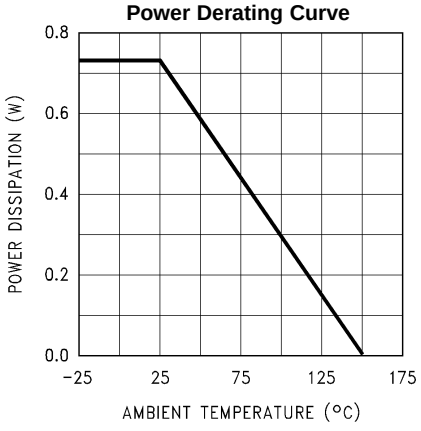


Figure 16.

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Typical Performance Characteristics (continued)

Power Supply Rejection Ratio

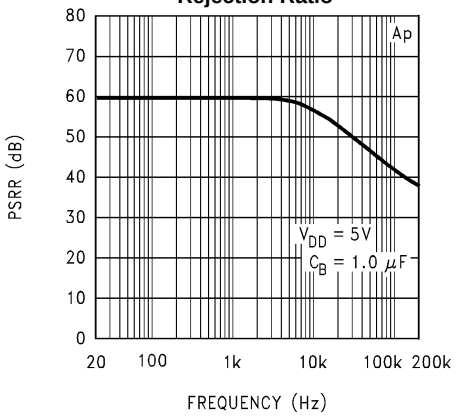


Figure 17.

Open Loop Frequency Response

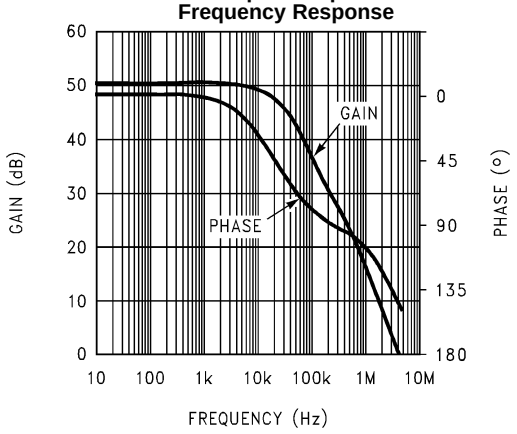


Figure 18.

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APPLICATION INFORMATION

BRIDGE CONFIGURATION EXPLANATION

As shown in *Figure 2* , the LM4861 has two operational amplifiers internally, allowing for a few different amplifier configurations. The first amplifier's gain is externally configurable, while the second amplifier is internally fixed in a unity-gain, inverting configuration. The closed-loop gain of the first amplifier is set by selecting the ratio of R_f to R_i while the second amplifier's gain is fixed by the two internal 40kΩ resistors. *Figure 2* shows that the output of amplifier one serves as the input to amplifier two which results in both amplifiers producing signals identical in magnitude, but out of phase 180°. Consequently, the differential gain for the IC is:

$$A_{vd} = 2 * (R_f / R_i) \quad (1)$$

By driving the load differentially through outputs V_{O1} and V_{O2}, an amplifier configuration commonly referred to as “bridged mode” is established. Bridged mode operation is different from the classical single-ended amplifier configuration where one side of its load is connected to ground.

A bridge amplifier design has a few distinct advantages over the single-ended configuration, as it provides differential drive to the load, thus doubling output swing for a specified supply voltage. Consequently, four times the output power is possible as compared to a single-ended amplifier under the same conditions. This increase in attainable output power assumes that the amplifier is not current limited or clipped. In order to choose an amplifier's closed-loop gain without causing excessive clipping which will damage high frequency transducers used in loudspeaker systems, please refer to AUDIO POWER AMPLIFIER DESIGN.

A bridge configuration, such as the one used in Boomer Audio Power Amplifiers, also creates a second advantage over single-ended amplifiers. Since the differential outputs, V_{O1} and V_{O2}, are biased at half-supply, no net DC voltage exists across the load. This eliminates the need for an output coupling capacitor which is required in a single supply, single-ended amplifier configuration. Without an output coupling capacitor in a single supply, single-ended amplifier, the half-supply bias across the load would result in both increased internal IC power dissipation and also permanent loudspeaker damage. An output coupling capacitor forms a high pass filter with the load requiring that a large value such as 470µF be used with an 8Ω load to preserve low frequency response. This combination does not produce a flat response down to 20Hz, but does offer a compromise between printed circuit board size and system cost, versus low frequency response.

POWER DISSIPATION

Power dissipation is a major concern when designing a successful amplifier, whether the amplifier is bridged or single-ended. A direct consequence of the increased power delivered to the load by a bridge amplifier is an increase in internal power dissipation. Equation 3 states the maximum power dissipation point for a bridge amplifier operating at a given supply voltage and driving a specified output load.

$$P_{DMAX} = 4*(V_{DD})^2 / (2\pi^2 R_L) \quad (2)$$

Since the LM4861 has two operational amplifiers in one package, the maximum internal power dissipation is 4 times that of a single-ended amplifier. Even with this substantial increase in power dissipation, the LM4861 does not require heatsinking. From Equation 3, assuming a 5V power supply and an 8Ω load, the maximum power dissipation point is 625mW.The maximum power dissipation point obtained from Equation 3 must not be greater than the power dissipation that results from Equation 3:

$$P_{DMAX} = (T_{JMAX} - T_A) / \theta_{JA} \quad (3)$$

For the LM4861 surface mount package, θ_{JA} = 140°C/W and T_{JMAX} = 150°C. Depending on the ambient temperature, T_A, of the system surroundings, Equation 3 can be used to find the maximum internal power dissipation supported by the IC packaging. If the result of Equation 3 is greater than that of Equation 3, then either the supply voltage must be decreased or the load impedance increased. For the typical application of a 5V power supply, with an 8Ω load, the maximum ambient temperature possible without violating the maximum junction temperature is approximately 62.5°C provided that device operation is around the maximum power dissipation point. Power dissipation is a function of output power and thus, if typical operation is not around the maximum power dissipation point, the ambient temperature can be increased. Refer to the Typical Performance Characteristics curves for power dissipation information for lower output powers.

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POWER SUPPLY BYPASSING

As with any power amplifier, proper supply bypassing is critical for low noise performance and high power supply rejection. The capacitor location on both the bypass and power supply pins should be as close to the device as possible. As displayed in the Typical Performance Characteristics, the effect of a larger half supply bypass capacitor is improved low frequency THD+N due to increased half-supply stability. Typical applications employ a 5V regulator with 10µF and a 0.1µF bypass capacitors which aid in supply stability, but do not eliminate the need for bypassing the supply nodes of the LM4861. The selection of bypass capacitors, especially C_B, is thus dependant upon desired low frequency THD+N, system cost, and size constraints.

SHUTDOWN FUNCTION

In order to reduce power consumption while not in use, the LM4861 contains a shutdown pin to externally turn off the amplifier's bias circuitry. The shutdown feature turns the amplifier off when a logic high is placed on the shutdown pin. Upon going into shutdown, the output is immediately disconnected from the speaker. A typical quiescent current of 0.6µA results when the supply voltage is applied to the shutdown pin. In many applications, a microcontroller or microprocessor output is used to control the shutdown circuitry which provides a quick, smooth transition into shutdown. Another solution is to use a single-pole, single-throw switch that when closed, is connected to ground and enables the amplifier. If the switch is open, then a soft pull-up resistor of 47kΩ will disable the LM4861. There are no soft pull-down resistors inside the LM4861, so a definite shutdown pin voltage must be applied externally, or the internal logic gate will be left floating which could disable the amplifier unexpectedly.

HIGHER GAIN AUDIO AMPLIFIER

The LM4861 is unity-gain stable and requires no external components besides gain-setting resistors, an input coupling capacitor, and proper supply bypassing in the typical application. However, if a closed-loop differential gain of greater than 10 is required, a feedback capacitor may be needed, as shown in Figure 3, to bandwidth limit the amplifier. This feedback capacitor creates a low pass filter that eliminates possible high frequency oscillations. Care should be taken when calculating the −3dB frequency in that an incorrect combination of R_f and C_f will cause rolloff before 20kHz. A typical combination of feedback resistor and capacitor that will not produce audio band high frequency rolloff is R_f = 100kΩ and C_f = 5pF. These components result in a −3dB point of approximately 320kHz. Once the differential gain of the amplifier has been calculated, a choice of R_f will result, and C_f can then be calculated from the formula stated in External Components Description .

VOICE-BAND AUDIO AMPLIFIER

Many applications, such as telephony, only require a voice-band frequency response. Such an application usually requires a flat frequency response from 300Hz to 3.5kHz. By adjusting the component values of Figure 3, this common application requirement can be implemented. The combination of R_i and C_i form a highpass filter while R_f and C_f form a lowpass filter. Using the typical voice-band frequency range, with a passband differential gain of approximately 100, the following values of R_i, C_i, R_f, and C_f follow from the equations stated in External Components Description .

$$R_i = 10k\Omega,\ R_f = 510k,\ C_i = 0.22\mu F,\ \text{and}\ C_f = 15pF \quad (4)$$

Five times away from a −3dB point is 0.17dB down from the flatband response. With this selection of components, the resulting −3dB points, f_L and f_H, are 72Hz and 20kHz, respectively, resulting in a flatband frequency response of better than ±0.25dB with a rolloff of 6dB/octave outside of the passband. If a steeper rolloff is required, other common bandpass filtering techniques can be used to achieve higher order filters.

SINGLE-ENDED AUDIO AMPLIFIER

Although the typical application for the LM4861 is a bridged monoaural amp, it can also be used to drive a load single-endedly in applications, such as PC cards, which require that one side of the load is tied to ground. Figure 4 shows a common single-ended application, where V_{O1} is used to drive the speaker. This output is coupled through a 470µF capacitor, which blocks the half-supply DC bias that exists in all single-supply amplifier configurations. This capacitor, designated C_O in Figure 4, in conjunction with R_L, forms a highpass filter. The −3dB point of this high pass filter is $1/(2\pi R_L C_O)$, so care should be taken to make sure that the product of R_L and C_O is large enough to pass low frequencies to the load. When driving an 8Ω load, and if a full audio spectrum reproduction is required, C_O should be at least 470µF. V_{O2}, the output that is not used, is connected through a 0.1 µF capacitor to a 2kΩ load to prevent instability. While such an instability will not affect the waveform of V_{O1}, it is good design practice to load the second output.

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AUDIO POWER AMPLIFIER DESIGN

Design a 1W / 8Ω Audio Amplifier

Given:	
Power Output	1 Wrms
Load Impedance	8Ω
Input Level	1 Vrms
Input Impedance	20 kΩ
Bandwidth	100 Hz–20 kHz ± 0.25 dB

A designer must first determine the needed supply rail to obtain the specified output power. By extrapolating from Figure 11 in Typical Performance Characteristics, the supply rail can be easily found. A second way to determine the minimum supply rail is to calculate the required V_{opeak} using Equation 5 and add the dropout voltage. Using this method, the minimum supply voltage would be (V_{opeak} + V_{OD} , where V_{OD} is typically 0.6V.

$$V_{opeak} = \sqrt{(2 R_L P_O)} \quad (5)$$

For 1W of output power into an 8Ω load, the required V_{opeak} is 4.0V. A minumum supply rail of 4.6V results from adding V_{opeak} and V_{od}. But 4.6V is not a standard voltage that exists in many applications and for this reason, a supply rail of 5V is designated. Extra supply voltage creates dynamic headroom that allows the LM4861 to reproduce peaks in excess of 1Wwithout clipping the signal. At this time, the designer must make sure that the power supply choice along with the output impedance does not violate the conditions explained in the POWER DISSIPATION.

Once the power dissipation equations have been addressed, the required differential gain can be determined from Equation 6.

$$A_{VD} \geq \sqrt{(P_O R_L)} / (V_{IN}) = V_{orms} / V_{inrms} \quad (6)$$

$$R_f / R_i = A_{VD} / 2 \quad (7)$$

From Equation 6, the minimum A_{vd} is 2.83: A_{vd} = 3

Since the desired input impedance was 20kΩ, and with a A_{vd} of 3, a ratio of 1:1.5 of R_f to R_i results in an allocation of R_i = 20kΩ, R_f = 30kΩ. The final design step is to address the bandwidth requirements which must be stated as a pair of −3dB frequency points. Five times away from a −3db point is 0.17dB down from passband response which is better than the required ±0.25dB specified. This fact results in a low and high frequency pole of 20Hz and 100kHz respectively. As stated in External Components Description , R_i in conjunction with C_i create a highpass filter.

$$C_i \geq 1 / (2\pi * 20k\Omega * 20Hz) = 0.397\mu F; \text{ use } 0.39\mu F. \quad (8)$$

The high frequency pole is determined by the product of the desired high frequency pole, f_H, and the differential gain, A_{vd}. With a A_{vd} = 2 and f_H = 100kHz, the resulting GBWP = 100kHz which is much smaller than the LM4861 GBWP of 4MHz. This figure displays that if a designer has a need to design an amplifier with a higher differential gain, the LM4861 can still be used without running into bandwidth problems.

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LM4861 MDA MWA
1.1W Audio Power Amplifier with Shutdown Mode

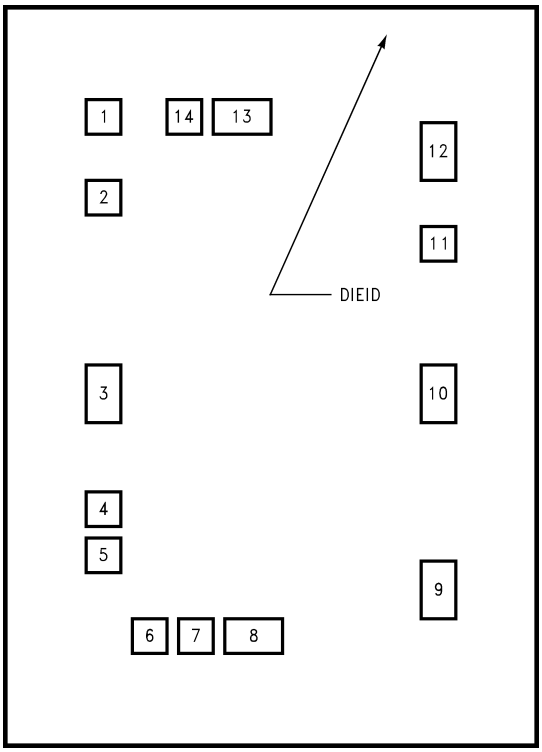


Figure 19. Die Layout (B - Step)

Table 1. DIE/WAFER CHARACTERISTICS

Fabrication Attributes		General Die Information	
Physical Die Identification	LM4861B	Bond Pad Opening Size (min)	83µm x 83µm
Die Step	B	Bond Pad Metalization	ALUMINUM
Physical Attributes		Passivation	VOM NITRIDE
Wafer Diameter	150mm	Back Side Metal	BARE BACK
Dise Size (Drawn)	1372µm x 2032µm 54.0mils x 80.0mils	Back Side Connection	GND
Thickness	406µm Nominal		
Min Pitch	108µm Nominal		

Special Assembly Requirements:
Note: Actual die size is rounded to the nearest micron.

Die Bond Pad Coordinate Locations (B - Step)						
(Referenced to die center, coordinates in µm) NC = No Connection, N.U. = Not Used						
SIGNAL NAME	PAD# NUMBER	X/Y COORDINATES		PAD SIZE		
		X	Y	X		Y
SHUTDOWN	1	-425	710	83	x	83
BYPASS	2	-445	499	83	x	83
NC	3	-445	-34	83	x	170
NC	4	-445	-383	83	x	83
INPUT +	5	-445	-492	83	x	83

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INPUT -	6	-352	-710	83	x	83
GND	7	-243	-710	83	x	83
Vo1	8	-91	-710	170	x	83
GND	9	445	-574	83	x	170
VDD	10	445	-2	83	x	170
NC	11	445	387	83	x	83
GND	12	445	633	83	x	170
Vo2	13	-63	710	170	x	83
GND	14	-215	710	83	x	83

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REVISION HISTORY

Changes from Revision B (May 2013) to Revision C	Page
• Changed layout of National Data Sheet to TI format	13

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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)
LM4861M/NOPB	Active	Production	SOIC (D) | 8	95 | TUBE	Yes	SN	Level-1-260C-UNLIM	-40 to 85	LM 4861M
LM4861M/NOPB.A	Active	Production	SOIC (D) | 8	95 | TUBE	Yes	SN	Level-1-260C-UNLIM	-40 to 85	LM 4861M
LM4861MX/NOPB	Active	Production	SOIC (D) | 8	2500 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 85	LM 4861M
LM4861MX/NOPB.A	Active	Production	SOIC (D) | 8	2500 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 85	LM 4861M

(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.

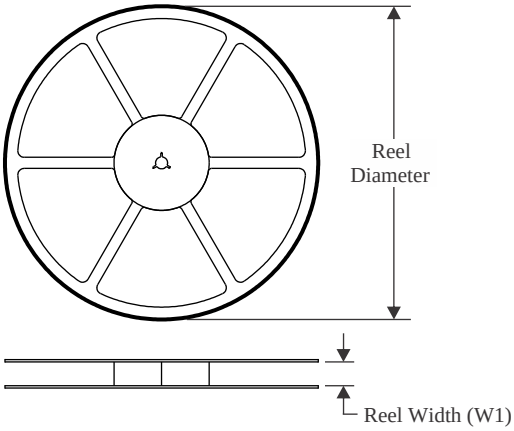
Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

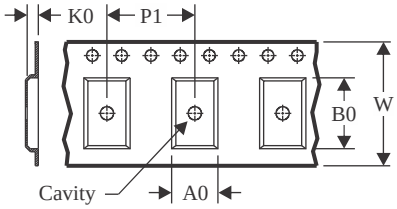
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

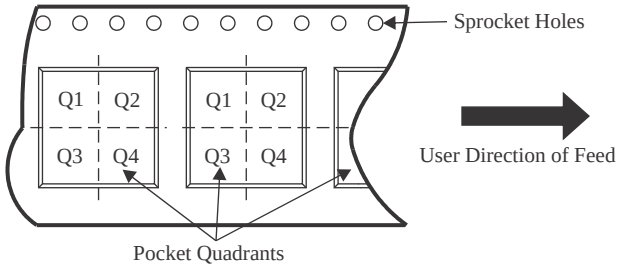


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

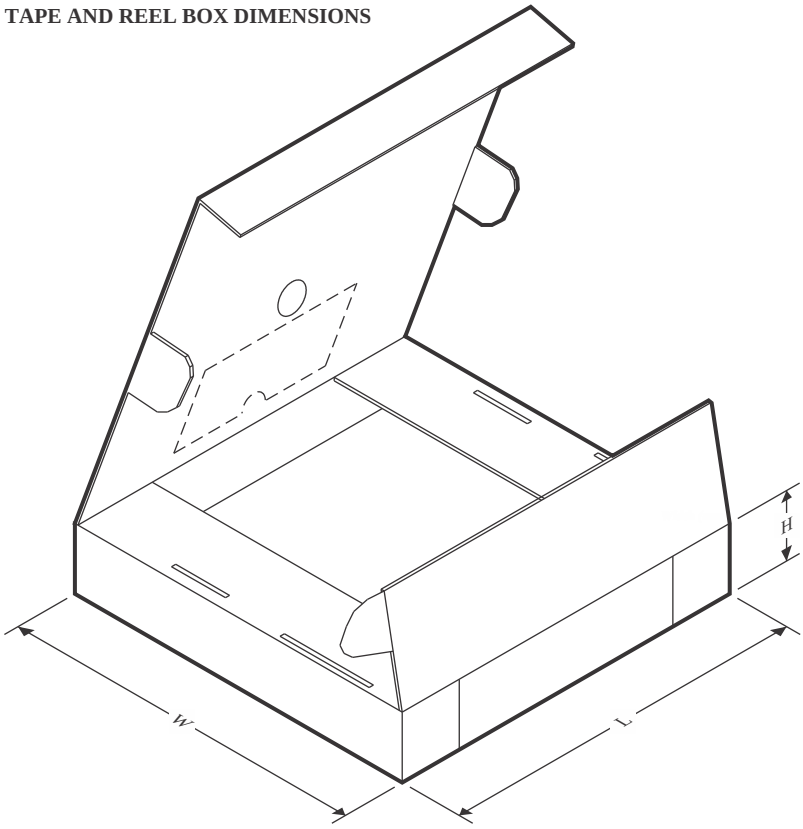
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
LM4861MX/NOPB	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1

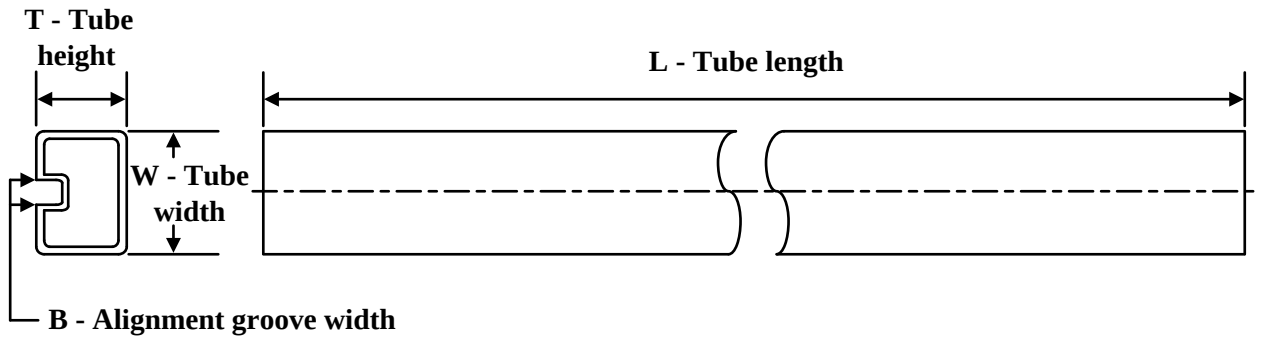
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

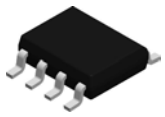
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
LM4861MX/NOPB	SOIC	D	8	2500	367.0	367.0	35.0

TUBE



*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (µm)	B (mm)
LM4861M/NOPB	D	SOIC	8	95	495	8	4064	3.05
LM4861M/NOPB.A	D	SOIC	8	95	495	8	4064	3.05

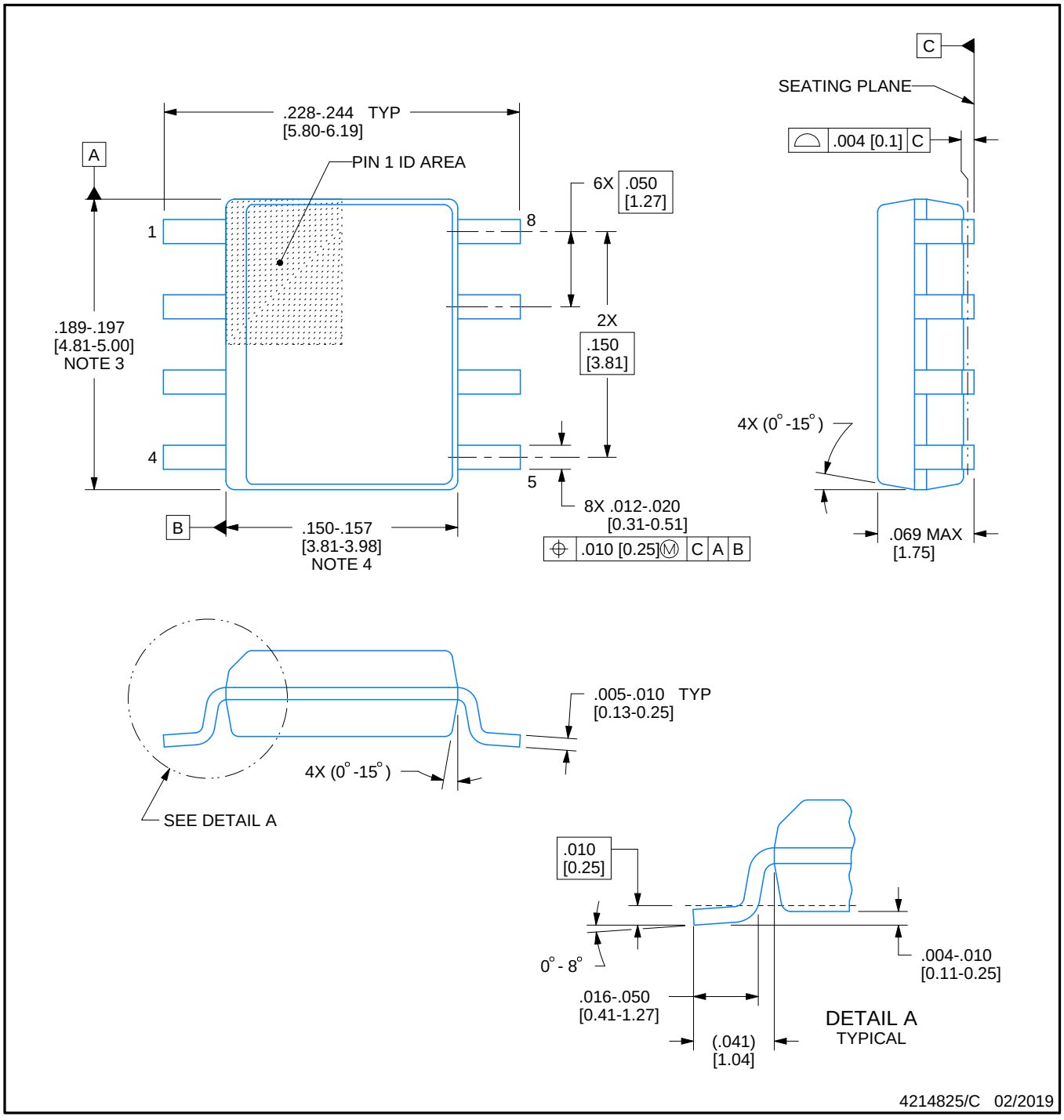


PACKAGE OUTLINE

D0008A

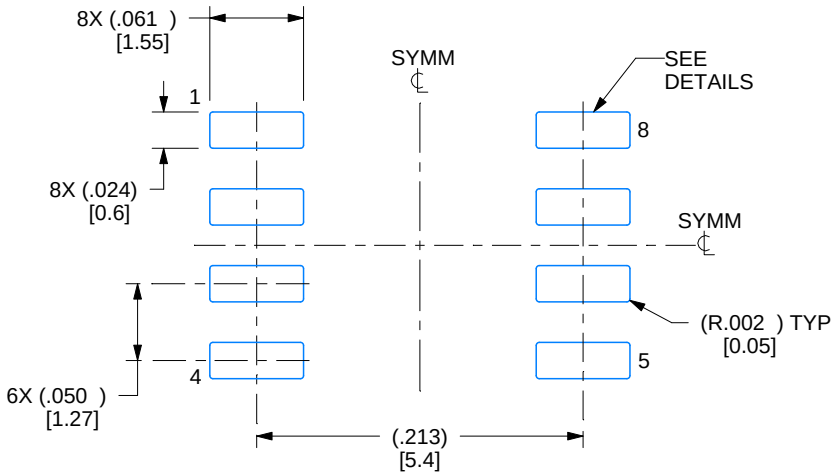
SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT

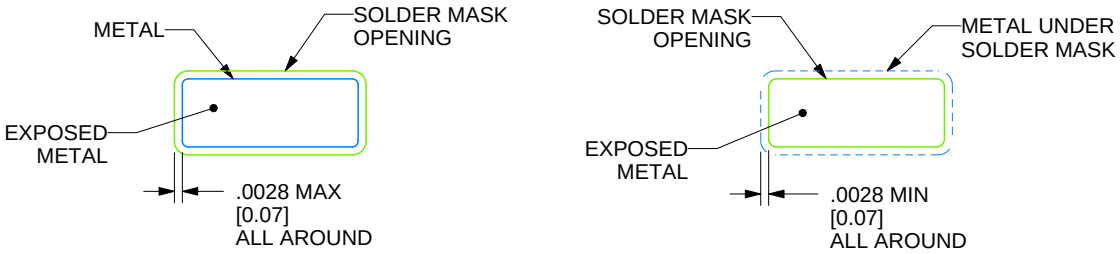


NOTES:

1. Linear dimensions are in inches [millimeters]. Dimensions in parenthesis are for reference only. Controlling dimensions are in inches. 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 .006 [0.15] per side.
4. This dimension does not include interlead flash.
5. Reference JEDEC registration MS-012, variation AA.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:8X



SOLDER MASK DETAILS

4214825/C 02/2019

NOTES: (continued)

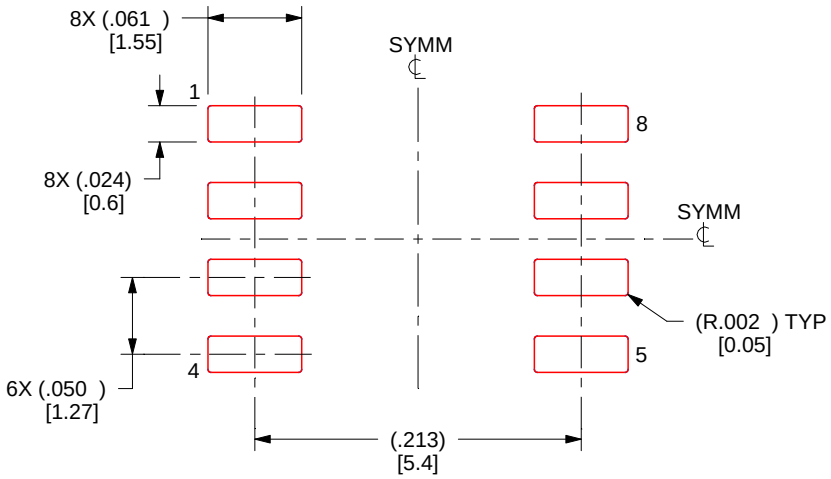
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



SOLDER PASTE EXAMPLE
BASED ON .005 INCH [0.125 MM] THICK STENCIL
SCALE:8X

4214825/C 02/2019

NOTES: (continued)

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

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