

低噪声 JFET 输入运算放大器

查询样品: [TL072-EP](#), [TL074-EP](#)

特性

- 低功耗
- 宽共模和差分电压范围
- 低输入偏压和偏移电流
- 输出短路保护
- 低总谐波失真: 典型值 **0.003%**
- 低噪声, $f=1\text{kHz}$ 时, 典型值为 $V_n=18\text{nV}/\sqrt{\text{Hz}}$
- 高输入阻抗: JFET 输入级
- 内部频率补偿
- 无锁存运行
- 高转换率: 典型值为 **13 V/ μs**
- 共模输入电压范围包括 V_{CC+}

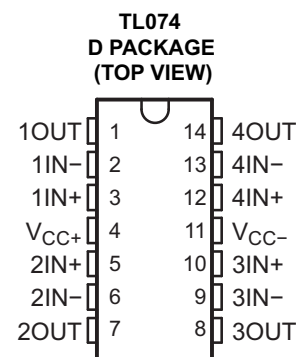
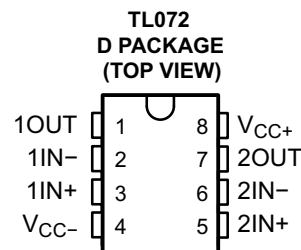
支持国防、航空航天、和医疗应用

- 受控基线
- 一个组装和测试场所
- 一个制造场所
- 扩展温度范围 (**-40°C 至 125°C**) 或军用 (**-55°C 至 125°C**) 温度范围内可用
- 延长的产品生命周期
- 拓展的产品变更通知
- 产品可追溯性

说明/订购信息

在 TL07x 中的 JFET-输入运算放大器与 TL08x 系列产品类似, 具有低输入偏压和偏移电流以及快速转换率。TL07x 的低谐波失真和低噪音使得它非常适合高保真和音频前置功放应用。每个放大器特有 JFET 输入 (用于高输入阻抗), 此输入与集成在一个单片芯片上的双极输出级耦合在一起。

TL07x 可在扩展温度范围 (-40°C 至 125°C) 或军用温度范围 (-55°C 至 125°C) 内运行。



ORDERING INFORMATION⁽¹⁾

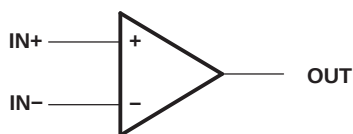
T _A	V _{IO} max AT 25°C	PACKAGE		ORDERABLE PART NUMBER	TOP-SIDE MARKING	VID NUMBER
-40°C to 125°C	6 mV	SOIC – D	Reel of 2500	TL072QDREP	TL072Q	V62/12604-01XE
				TL074QDREP	TL074Q	V62/11621-01XE
-55°C to 125°C	6 mV	SOIC – D	Reel of 2500	TL074MDREP	TL074M	V62/11621-02XE
			Tube of 75	TL074MDEP	TL074M	V62/11621-02XE-T

(1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI website at www.ti.com.

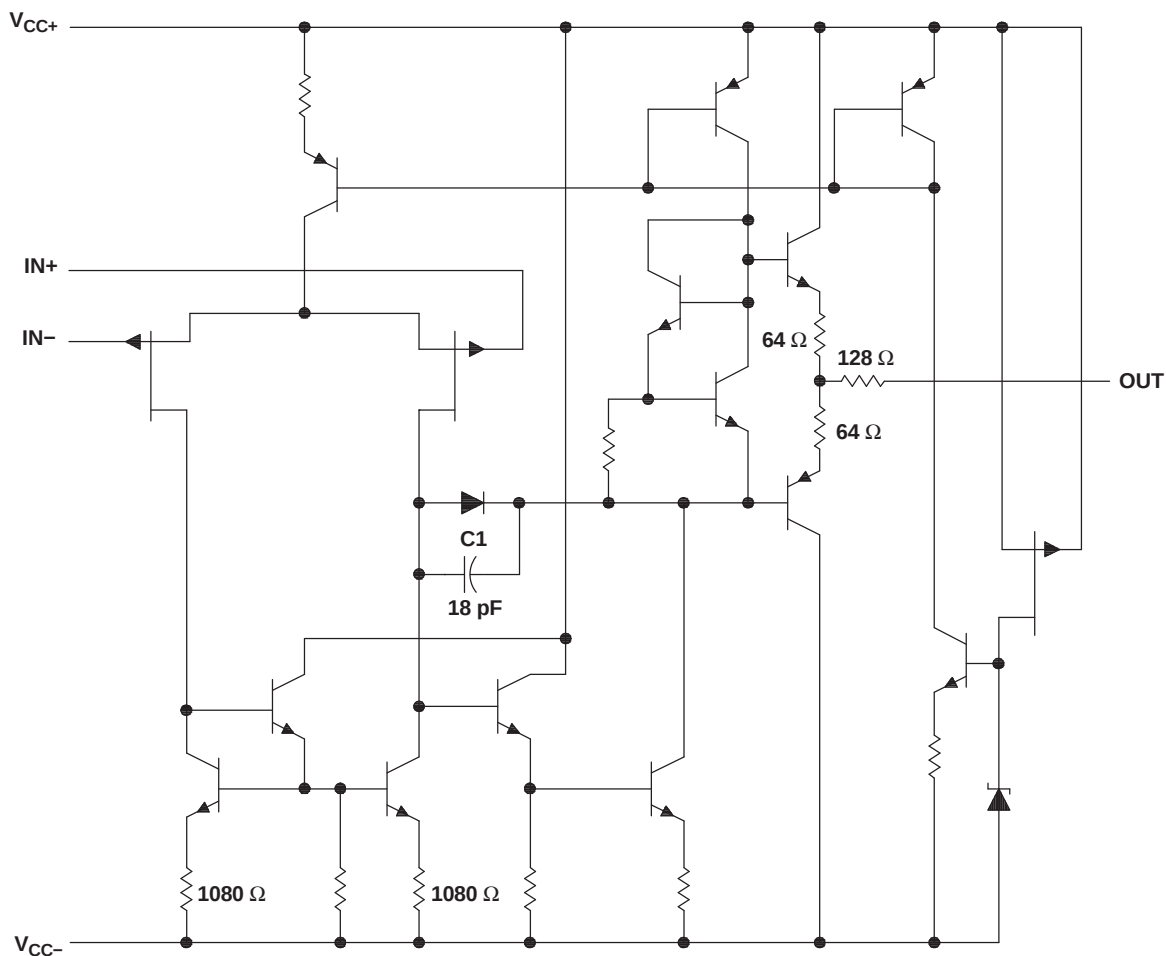


Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

TL072 and TL074 SYMBOL (EACH AMPLIFIER)



SCHEMATIC (EACH AMPLIFIER)



All component values shown are nominal.

COMPONENT COUNT ⁽¹⁾		
COMPONENT TYPE	TL072	TL074
Resistors	22	44
Transistors	28	56
JFET	4	6
Diodes	2	4
Capacitors	2	4
epi-FET	2	4

(1) Includes bias and trim circuitry

ABSOLUTE MAXIMUM RATINGS⁽¹⁾

over operating free-air temperature range (unless otherwise noted)

			MIN	MAX	UNIT
V _{CC+}	Supply voltage ⁽²⁾			18	V
V _{CC-}				18	
V _{ID}	Differential input voltage ⁽³⁾			±30	V
V _I	Input voltage ^{(2) (4)}			±15	V
	Duration of output short circuit ⁽⁵⁾			Unlimited	
θ_{JA}	Thermal resistance, junction-to-ambient ^{(6) (7)}	TL072		97.5	°C/W
		TL074		86	
θ_{JC}	Thermal resistance, junction-to-case ⁽⁷⁾	TL072		38.3	°C/W
		TL074		51.5	
T _J	Operating virtual junction temperature			150	°C
T _{stg}	Storage temperature range		-65	150	°C

- (1) 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.
- (2) All voltage values, except differential voltages, are with respect to the midpoint between V_{CC+} and V_{CC-}.
- (3) Differential voltages are at IN+, with respect to IN-.
- (4) The magnitude of the input voltage must never exceed the magnitude of the supply voltage or 15 V, whichever is less.
- (5) The output may be shorted to ground or to either supply. Temperature and/or supply voltages must be limited to ensure that the dissipation rating is not exceeded.
- (6) Operating at the absolute maximum T_J of 150°C can affect reliability.
- (7) The package thermal impedance is calculated in accordance with JESD 51-7.

ELECTRICAL CHARACTERISTICS

$V_{CC\pm} = \pm 15\text{ V}$ (unless otherwise noted)

PARAMETER		TEST CONDITIONS ⁽¹⁾	T _A ⁽²⁾	TL072			TL074			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
V _{IO}	Input offset voltage	V _O = 0, R _S = 50 Ω	25°C	3		6	3		6	mV
			Full range	8			8			
α _{VIO}	Temperature coefficient of input offset voltage	V _O = 0, R _S = 50 Ω	Full range	18			18		μV/°C	
I _{IO}	Input offset current	V _O = 0	25°C	5	100		5	100		pA
			125°C	2			2		nA	
I _{IB}	Input bias current	V _O = 0	25°C	65	200		65	200		pA
			125°C	20			20		nA	
V _{ICR}	Common-mode input voltage range		25°C	±11	–12 to 15		±11	–12 to 15		V
V _{OM}	Maximum peak output voltage swing	R _L = 10 kΩ	25°C	±12	±13.5		±12	±13.5		V
		R _L ≥ 10 kΩ	Full range	±12			±12			
		R _L ≥ 2 kΩ		±10			±10			
A _{VD}	Large-signal differential voltage amplification	V _O = ±10 V, R _L ≥ 2 kΩ	25°C	35	200		35	200		V/mV
			Full range	15			15			
B ₁	Unity-gain bandwidth		25°C	3			3		MHz	
r _i	Input resistance		25°C	10 ¹²			10 ¹²		Ω	
CMRR	Common-mode rejection ratio	V _{IC} = V _{ICRmin} , V _O = 0, R _S = 50 Ω	25°C	80	86		80	86		dB
k _{SVR}	Supply-voltage rejection ratio (ΔV _{CC±} /ΔV _{IO})	V _{CC} = ±9 V to ±15 V, V _O = 0, R _S = 50 Ω	25°C	80	86		80	86		dB
I _{CC}	Supply current (each amplifier)	V _O = 0, No load	25°C	1.4	2.5		1.4	2.5		mA
V _{O1} /V _{O2}	Crosstalk attenuation	A _{VD} = 100	25°C	120			120		dB	

- Input bias currents of an FET-input operational amplifier are normal junction reverse currents, which are temperature sensitive, as shown in Figure 3. Pulse techniques must be used that will maintain the junction temperature as close to the ambient temperature as possible.
- All characteristics are measured under open-loop conditions with zero common-mode voltage, unless otherwise specified. Full range is $T_A = -40^\circ\text{C}$ to 125°C for TL072xQ and $T_A = -55^\circ\text{C}$ to 125°C for TL074xM.

OPERATING CHARACTERISTICS

$V_{CC\pm} = \pm 15\text{ V}$, $T_A = 25^\circ\text{C}$

PARAMETER	TEST CONDITIONS		TL072			TL074			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
SR	Slew rate at unity gain	$V_I = 10\text{ V}$, $C_L = 100\ \text{pF}$, $R_L = 2\ \text{k}\Omega$, See Figure 1	8	13		8	13		V/ μs
t_r	Rise-time overshoot factor	$V_I = 20\text{ V}$, $C_L = 100\ \text{pF}$, $R_L = 2\ \text{k}\Omega$, See Figure 1	0.1			0.1			μs
			20			20			%
V_n	Equivalent input noise voltage	$R_S = 20\ \Omega$	18			18			$\text{nV}/\sqrt{\text{Hz}}$
		$f = 10\text{ Hz}$ to 10 kHz	4			4			μV
I_n	Equivalent input noise current	$R_S = 20\ \Omega$, $f = 1\text{ kHz}$	0.01			0.01			$\text{pA}/\sqrt{\text{Hz}}$
THD	Total harmonic distortion	$V_{I\text{rms}} = 6\text{ V}$, $R_L \geq 2\ \text{k}\Omega$, $f = 1\text{ kHz}$, $A_{VD} = 1$, $R_S \leq 1\ \text{k}\Omega$	0.003			0.003			%

PARAMETER MEASUREMENT INFORMATION

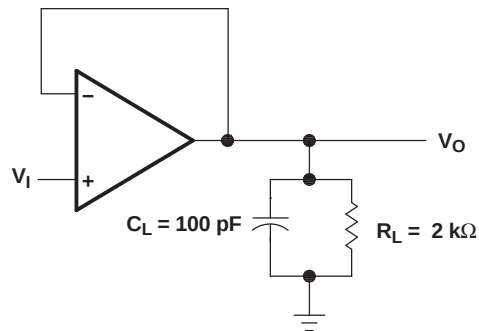


Figure 1. Unity-Gain Amplifier

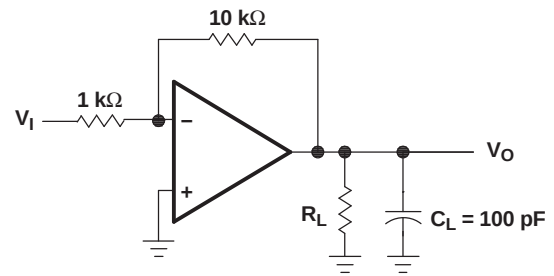


Figure 2. Gain-of-10 Inverting Amplifier

TYPICAL CHARACTERISTICS

Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

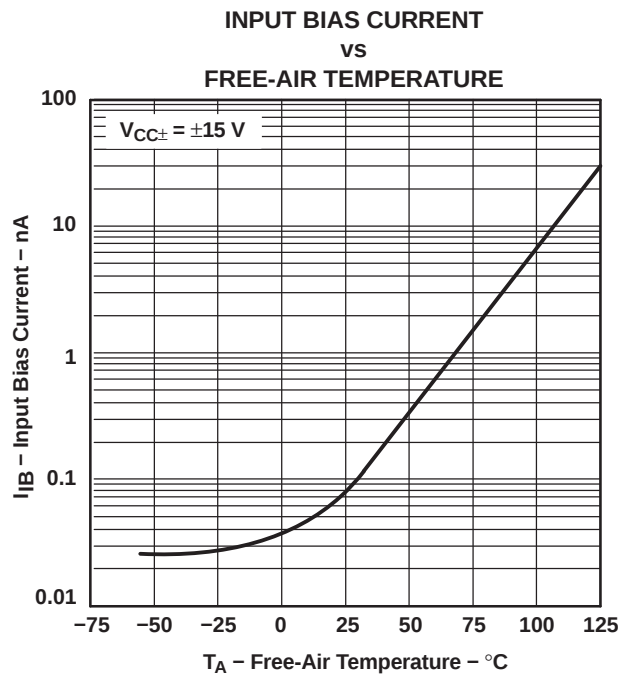


Figure 3.

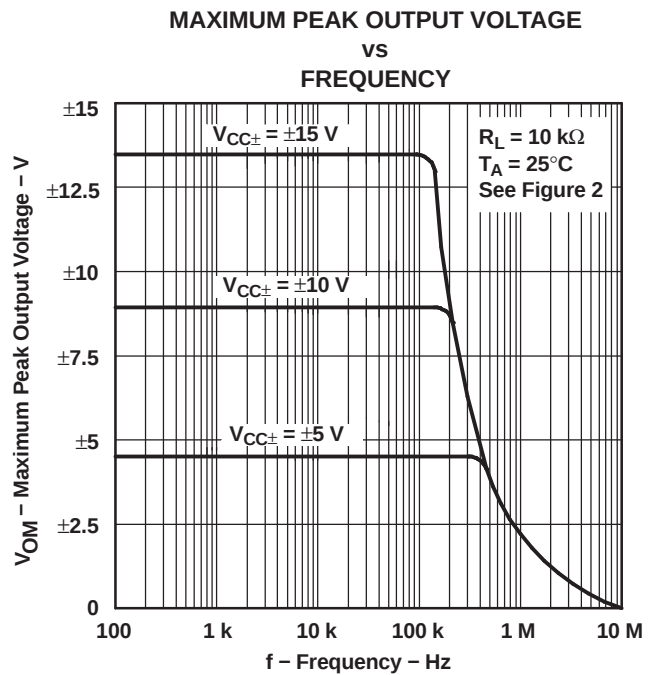


Figure 4.

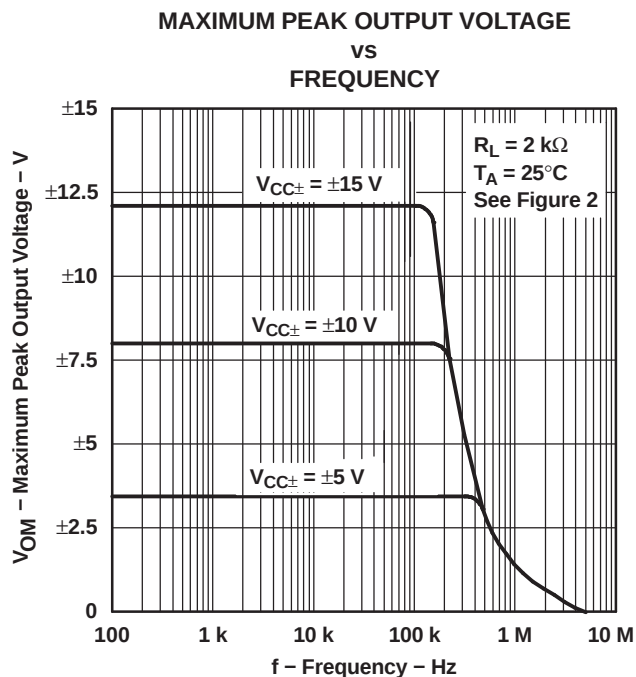


Figure 5.

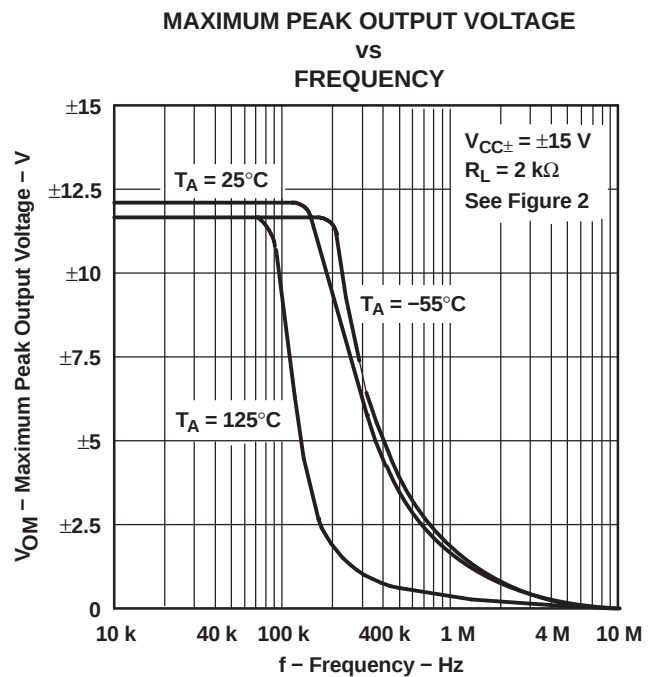


Figure 6.

TYPICAL CHARACTERISTICS (continued)

Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

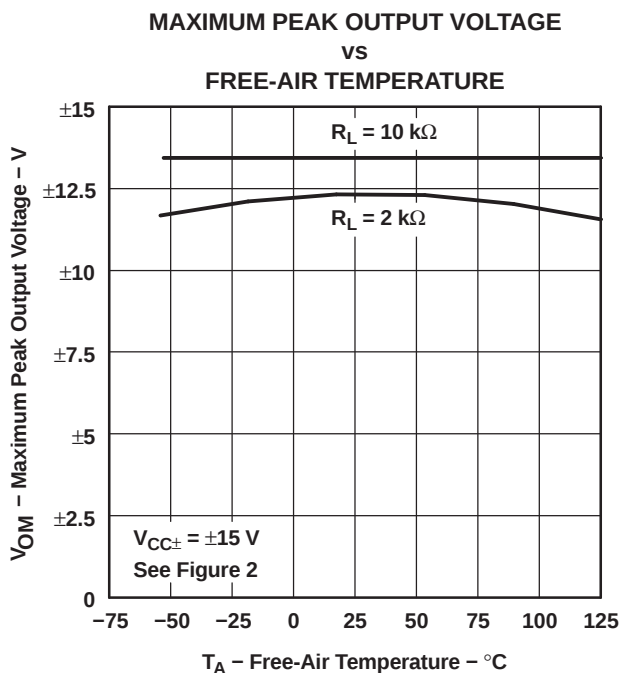


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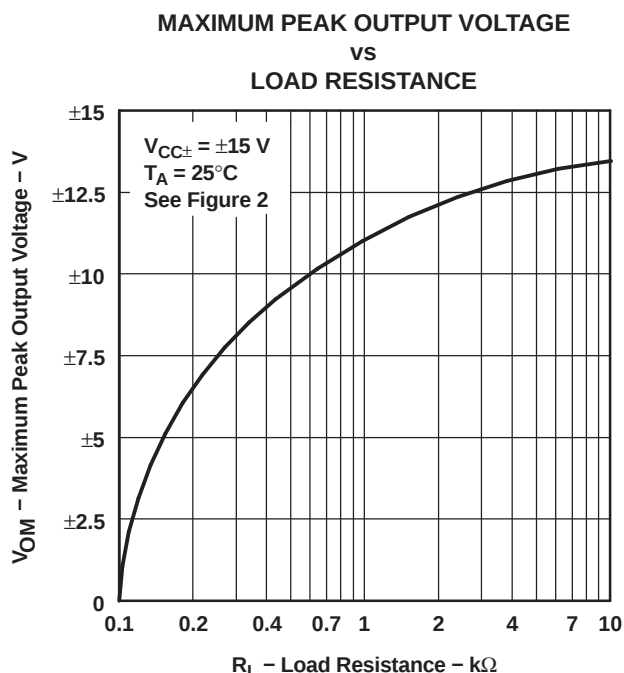


Figure 8.

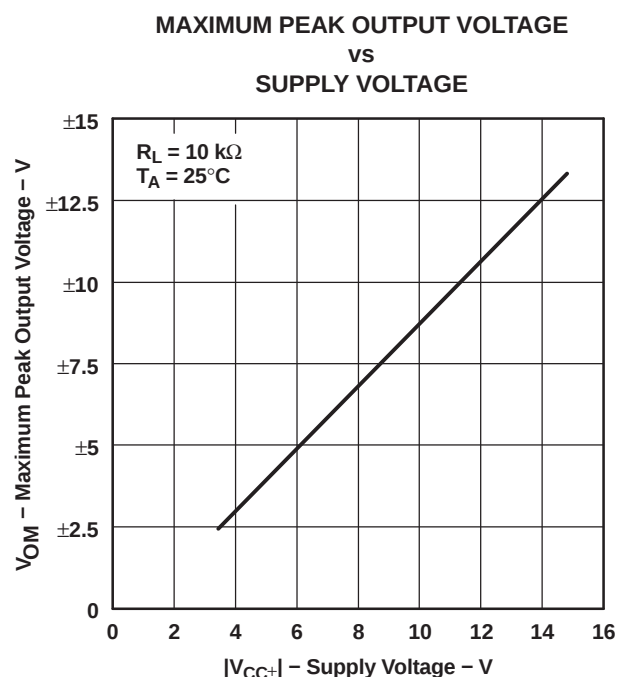


Figure 9.

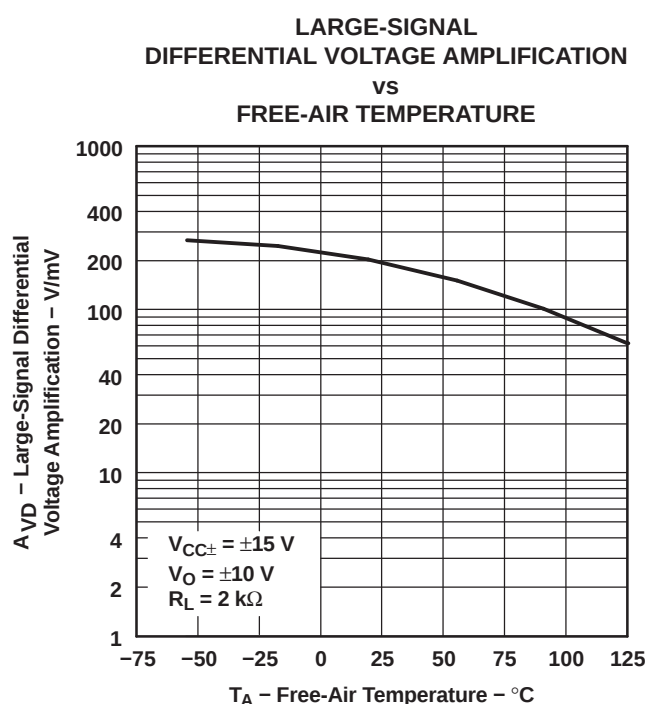


Figure 10.

TYPICAL CHARACTERISTICS (continued)

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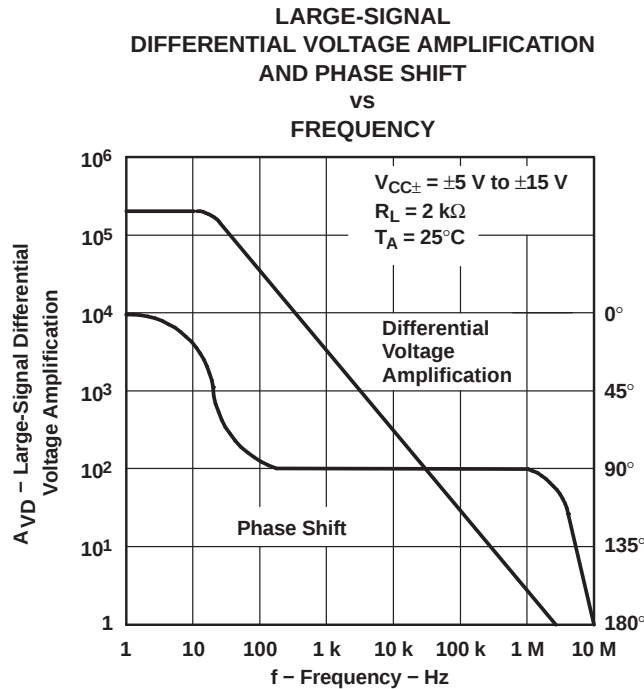


Figure 11.

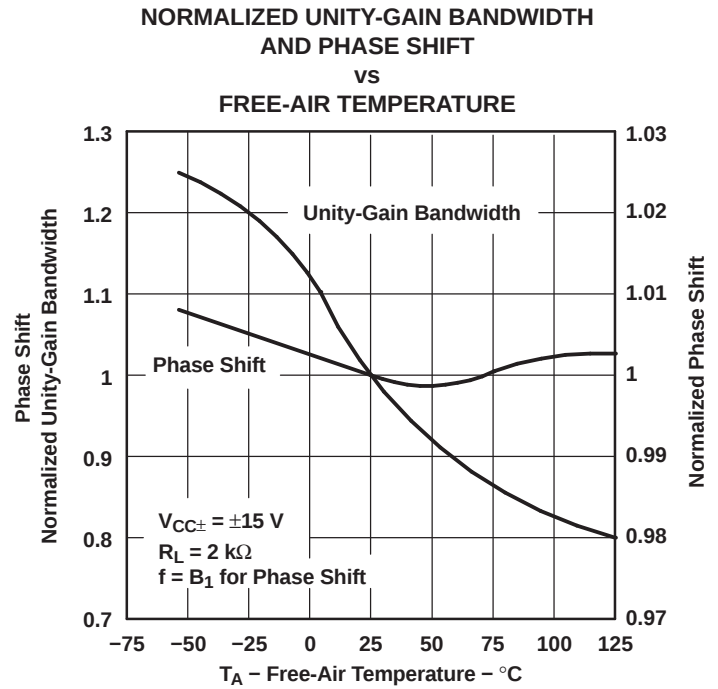


Figure 12.

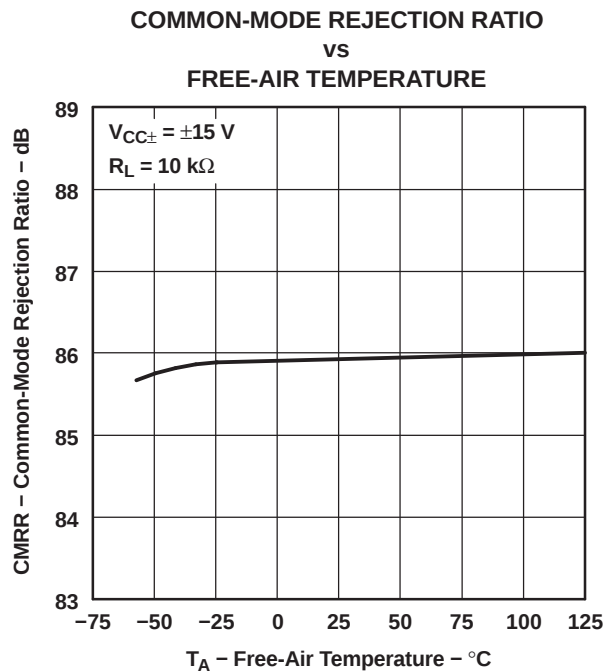


Figure 13.

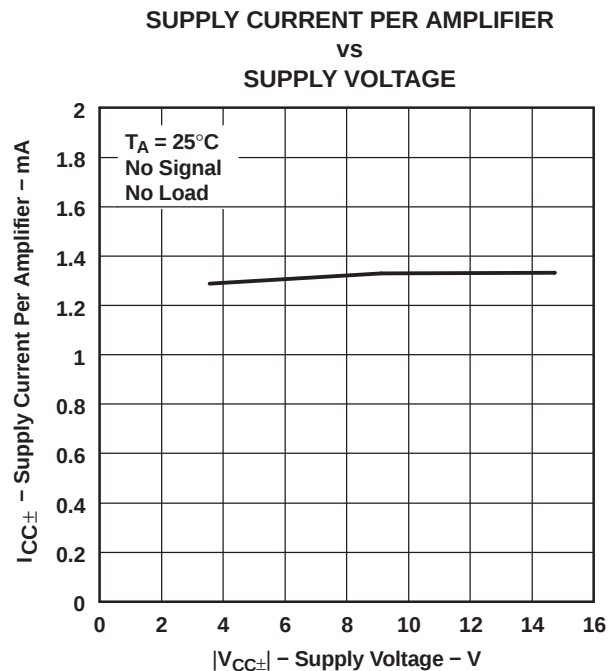


Figure 14.

TYPICAL CHARACTERISTICS (continued)

Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

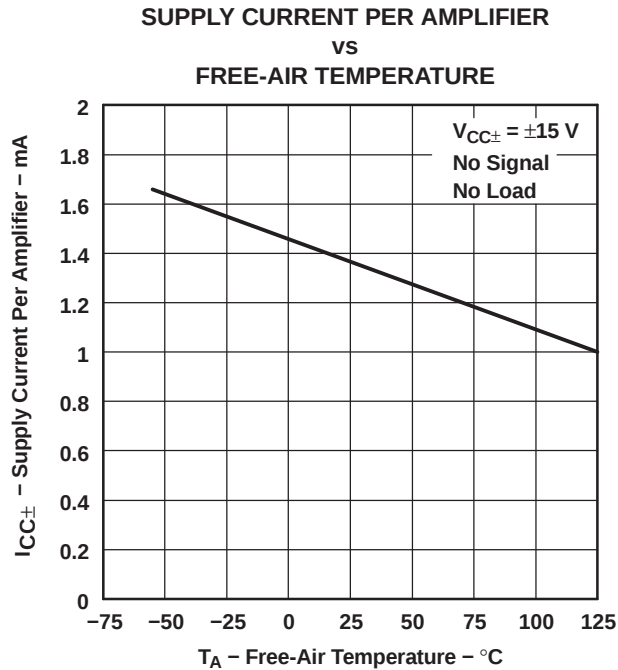


Figure 15.

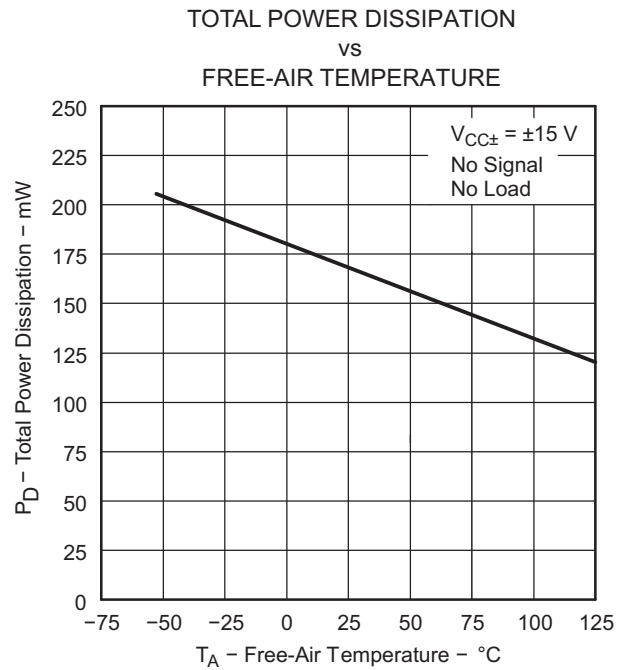


Figure 16.

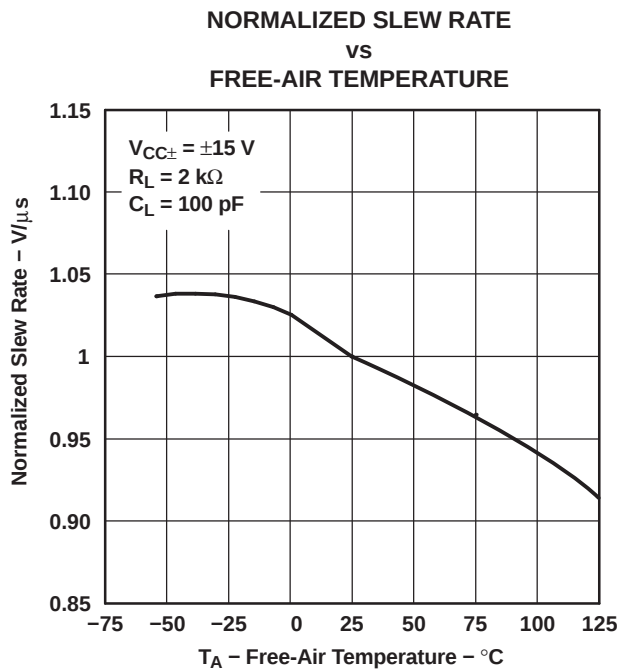


Figure 17.

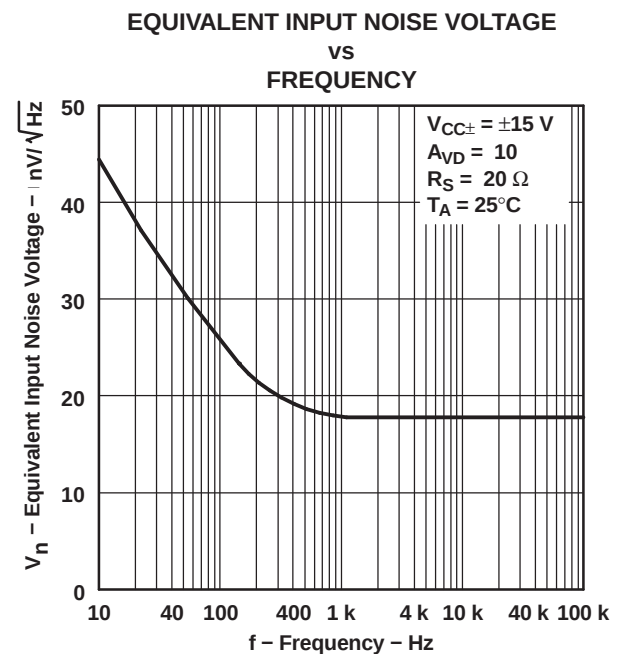


Figure 18.

TYPICAL CHARACTERISTICS (continued)

Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

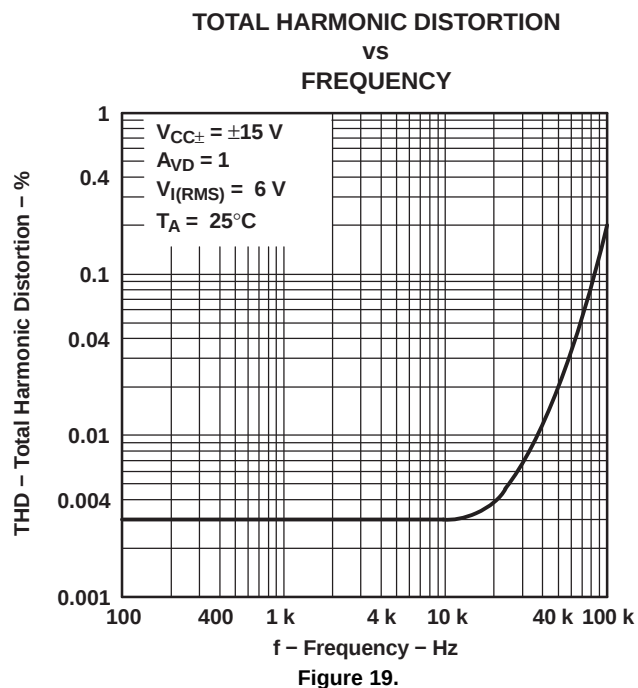


Figure 19.

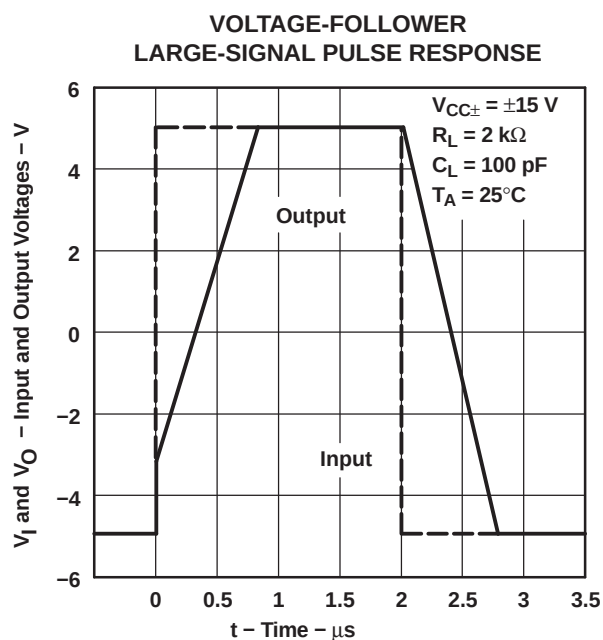


Figure 20.

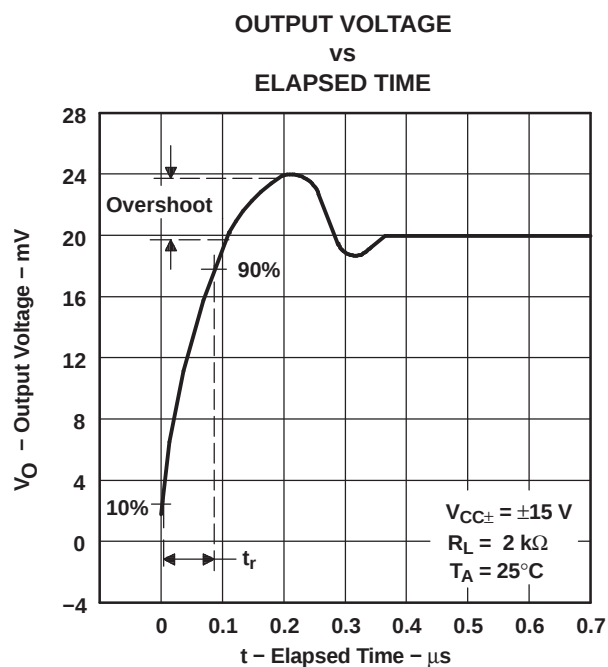
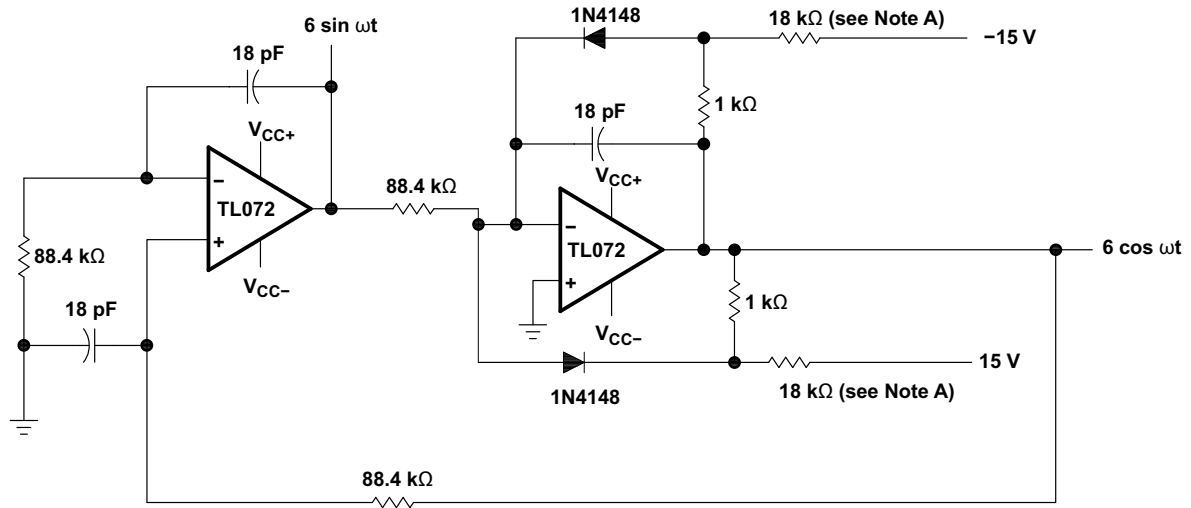


Figure 21.

APPLICATION INFORMATION



NOTE A: These resistor values may be adjusted for a symmetrical output.

Figure 22. 100-kHz Quadrature Oscillator

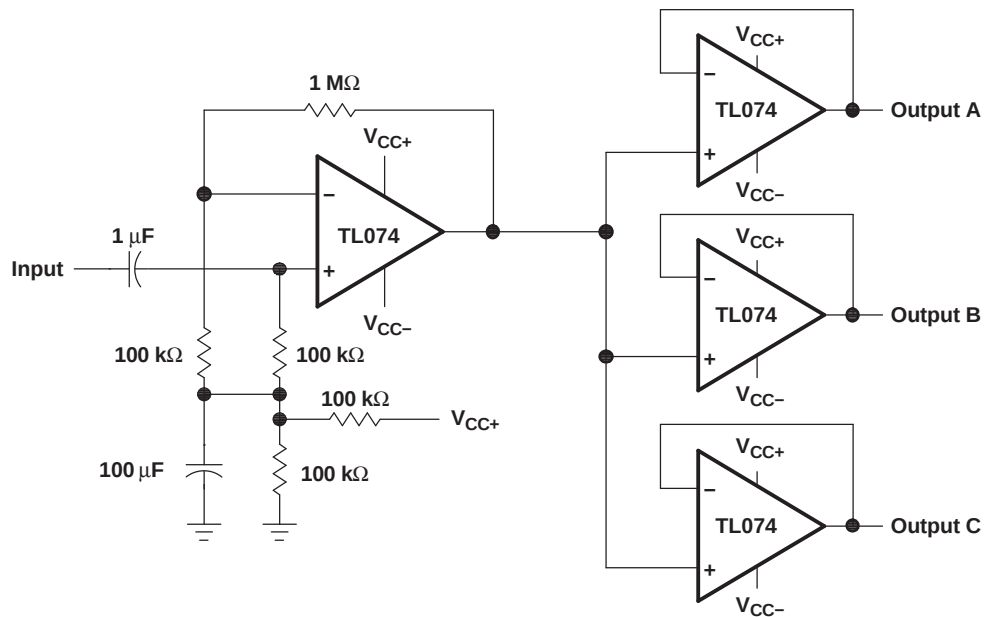


Figure 23. Audio-Distribution Amplifier

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)
TL072QDREP	Active	Production	SOIC (D) 8	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	TL072Q
TL072QDREP.A	Active	Production	SOIC (D) 8	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	TL072Q
TL074MDEP	Active	Production	SOIC (D) 14	50 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	TL074M
TL074MDEP.A	Active	Production	SOIC (D) 14	50 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	TL074M
TL074MDREP	Active	Production	SOIC (D) 14	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	TL074M
TL074MDREP.A	Active	Production	SOIC (D) 14	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	TL074M
TL074QDREP	Active	Production	SOIC (D) 14	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	TL074Q
TL074QDREP.A	Active	Production	SOIC (D) 14	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	TL074Q
V62/11621-01XE	Active	Production	SOIC (D) 14	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	TL074Q
V62/11621-02XE	Active	Production	SOIC (D) 14	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	TL074M
V62/11621-02XE-T	Active	Production	SOIC (D) 14	50 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	TL074M
V62/12604-01XE	Active	Production	SOIC (D) 8	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	TL072Q

⁽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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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.

OTHER QUALIFIED VERSIONS OF TL072-EP, TL074-EP :

- Catalog : [TL072](#), [TL074](#)
- Military : [TL072M](#), [TL074M](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications

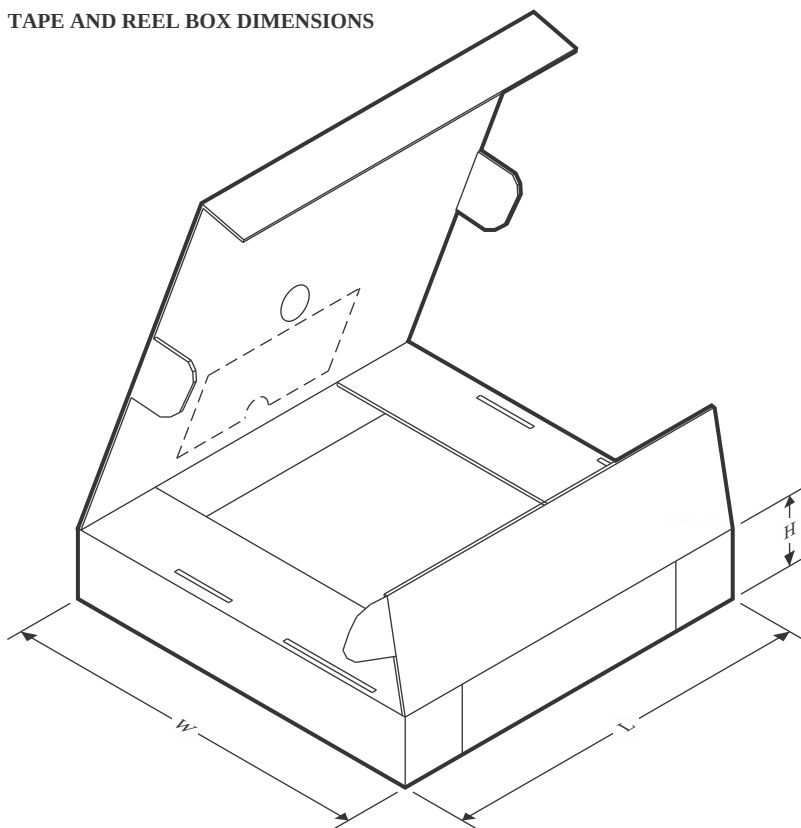
TAPE AND REEL INFORMATION



*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
TL072QDREP	SOIC	D	8	2500	330.0	12.5	6.4	5.2	2.1	8.0	12.0	Q1
TL074MDREP	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
TL074QDREP	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

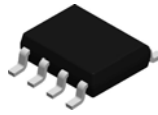
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TL072QDREP	SOIC	D	8	2500	340.5	338.1	20.6
TL074MDREP	SOIC	D	14	2500	340.5	336.1	32.0
TL074QDREP	SOIC	D	14	2500	353.0	353.0	32.0

TUBE



*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (μm)	B (mm)
TL074MDEP	D	SOIC	14	50	507	8	3940	4.32
TL074MDEP.A	D	SOIC	14	50	507	8	3940	4.32
V62/11621-02XE-T	D	SOIC	14	50	507	8	3940	4.32

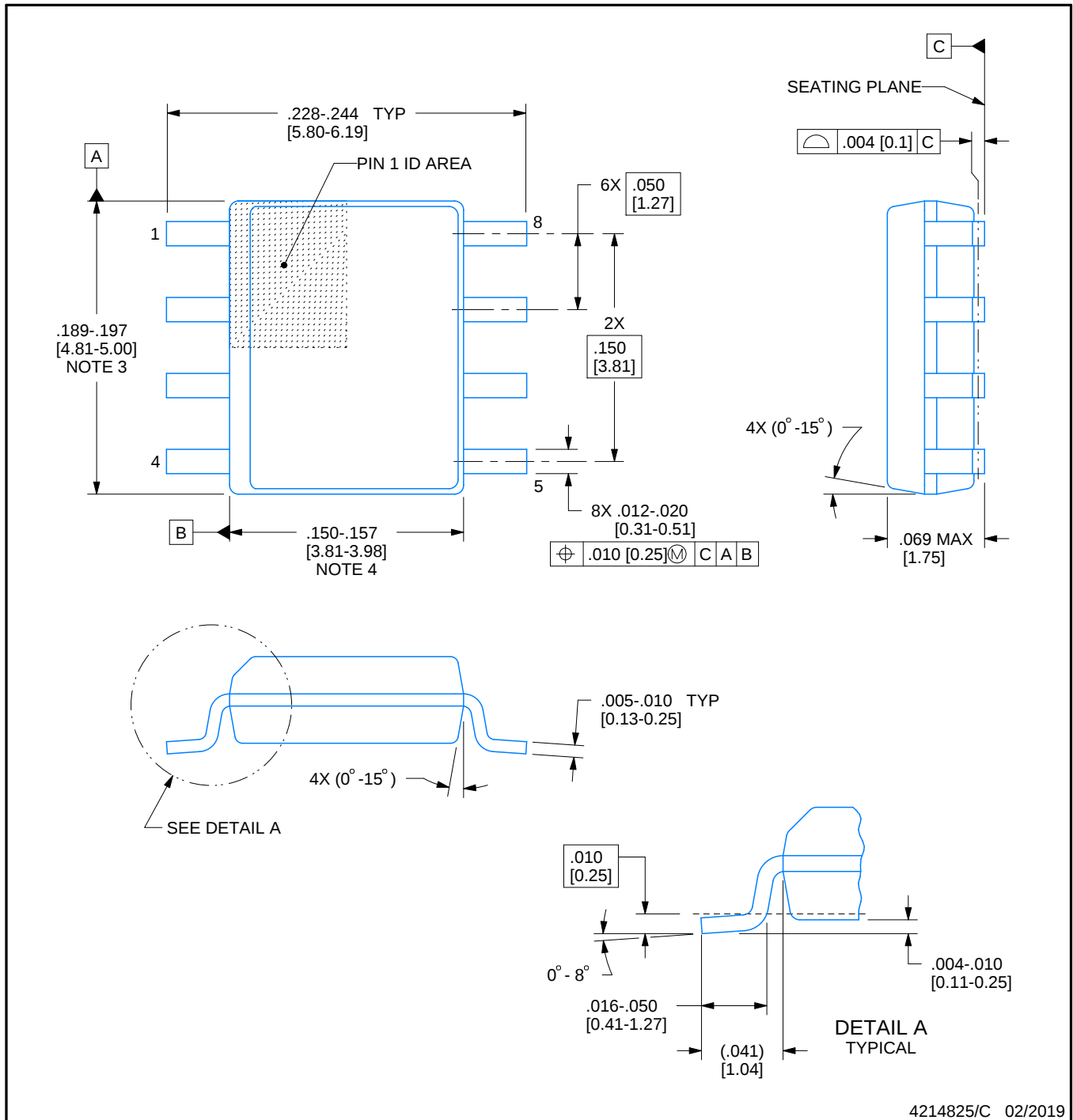


D0008A

PACKAGE OUTLINE

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



4214825/C 02/2019

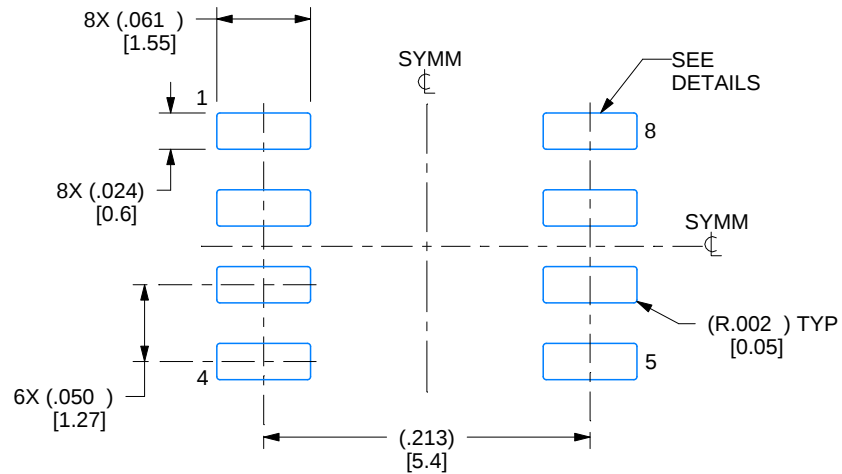
NOTES:

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.

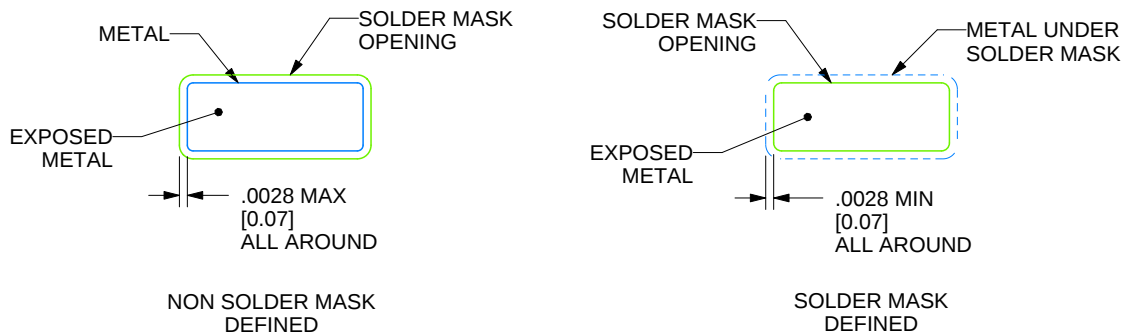
D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



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.

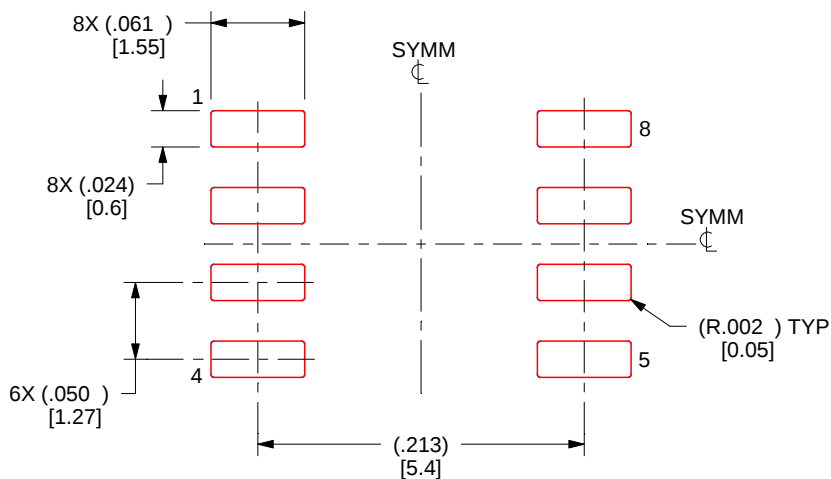
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT

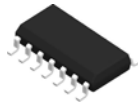


SOLDER PASTE EXAMPLE
BASED ON .005 INCH [0.125 MM] THICK STENCIL
SCALE:8X

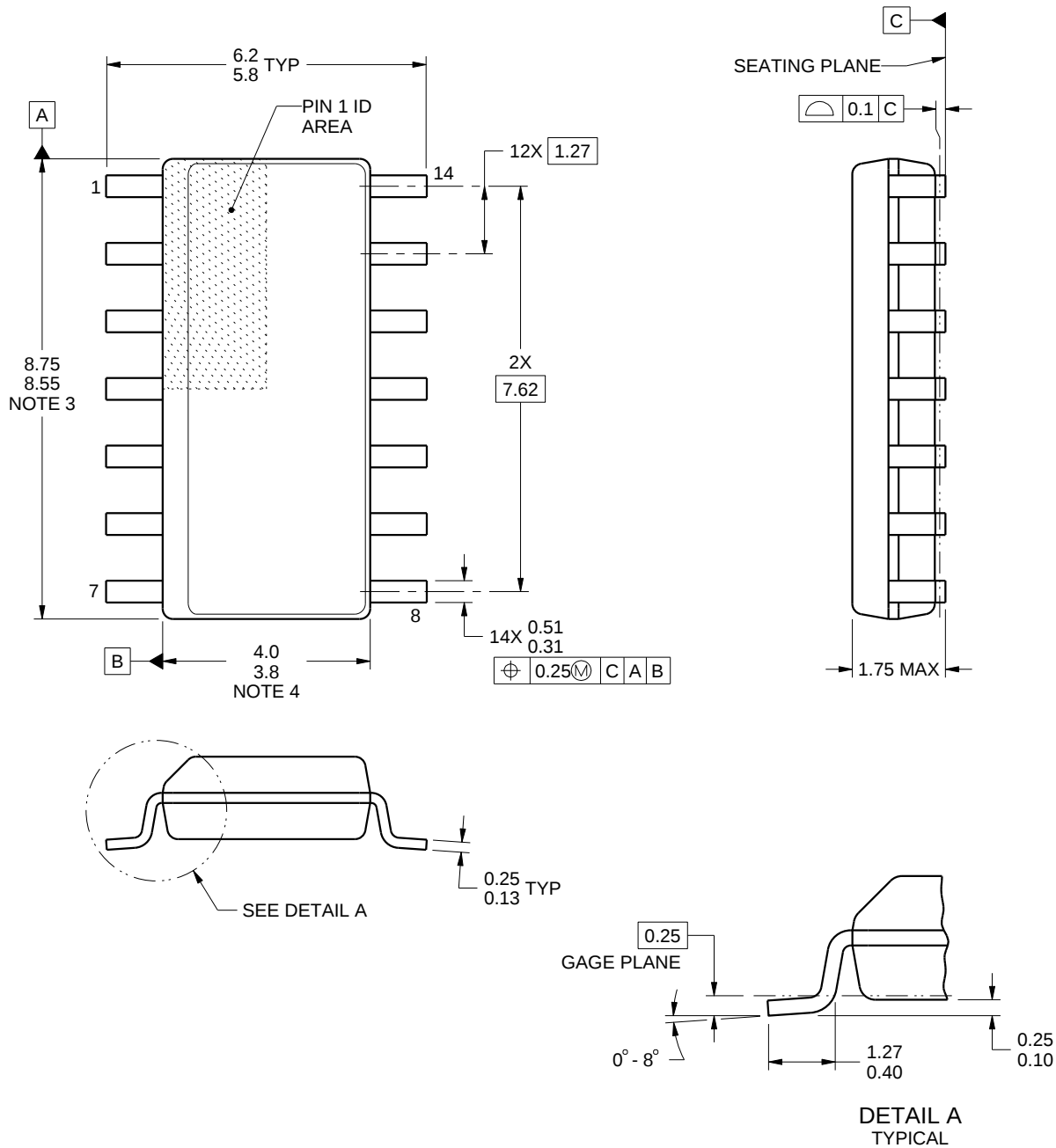
4214825/C 02/2019

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.

D0014A**PACKAGE OUTLINE****SOIC - 1.75 mm max height**

SMALL OUTLINE INTEGRATED CIRCUIT



4220718/A 09/2016

NOTES:

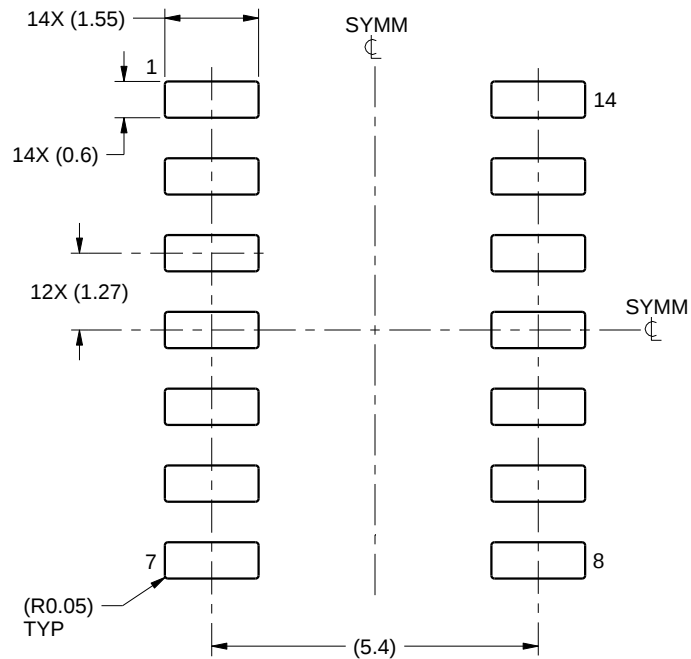
1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm, per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.43 mm, per side.
5. Reference JEDEC registration MS-012, variation AB.

EXAMPLE BOARD LAYOUT

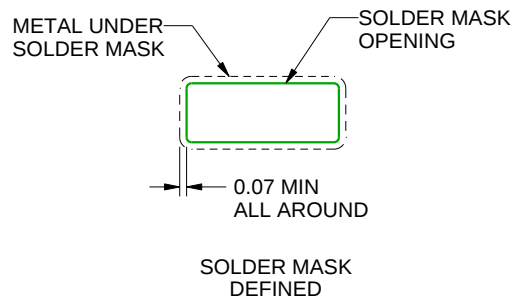
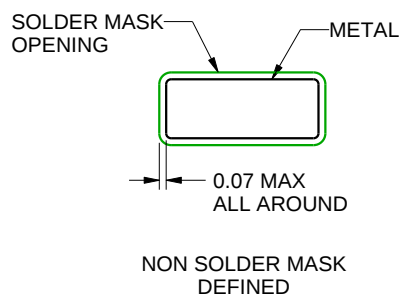
D0014A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



LAND PATTERN EXAMPLE
SCALE:8X



SOLDER MASK DETAILS

4220718/A 09/2016

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

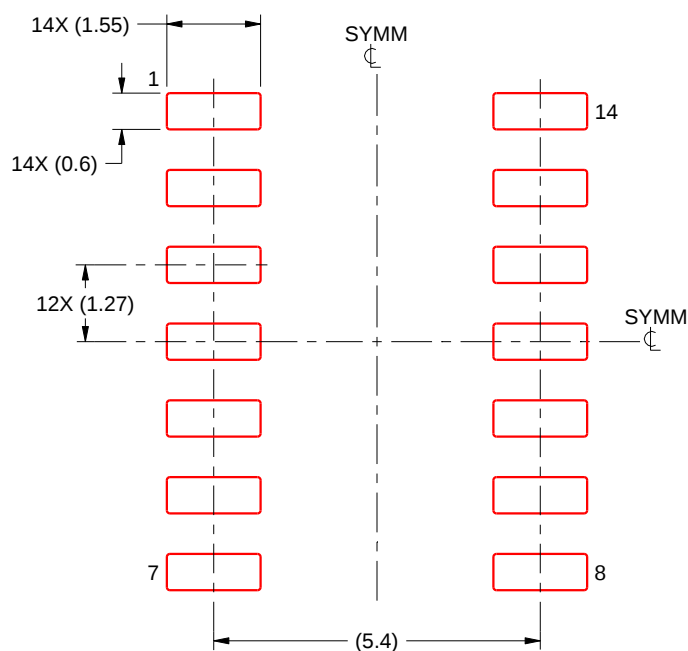
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

D0014A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:8X

4220718/A 09/2016

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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