

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
- 输出短路保护功能
- 低总谐波失真... 典型值 **0.003%**
- 低噪音, 在 $f = 1 \text{ kHz}$ 时的典型值
 $V_n = 18 \text{ nV}/\sqrt{\text{Hz}}$
- 高输入阻抗... JFET 输入级
- 内部频率补偿
- 无闭锁运行
- 高转换率... 典型值 **13 V/μs**
- 共模输入电压范围包括 V_{CC+}

支持国防、航天和医疗应用

- 受控基线
- 一个组装/测试场所
- 一个制造场所
- 可在更广的温度范围内 ($-40^\circ\text{C}/125^\circ\text{C}$) 工作
- 产品生命周期有所延长
- 拓展的产品变更通知
- 产品可追溯性

说明/订购信息

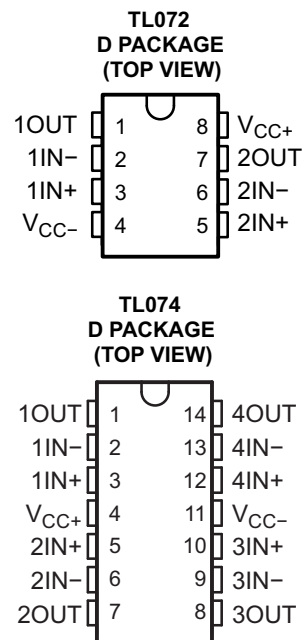
在 TL07x 中的 JFET-输入运算放大器与 TL08x 系列产品类似, 具有低输入偏压和偏移电流以及快速转换率。TL07x 的低谐波失真和低噪音使得它非常适合高保真和音频前置功放应用。每个放大器特有与双极输出级耦合的 JFET 输入 (用于高输入阻抗), 这个双极输入级集成在一个单一的整体式芯片上。

TL07x 额定工作温度范围为 -40°C 至 125°C 。

ORDERING INFORMATION⁽¹⁾

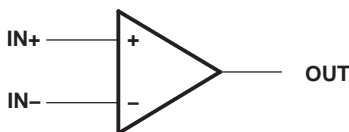
T_A	$V_{IO\text{max}}$ AT 25°C	PACKAGE		ORDERABLE PART NUMBER	TOP-SIDE MARKING	VID NUMBER
-40°C to 125°C	9 mV	SOIC – D	Reel of 2500	TL072QDREP	TL072Q	V62/12604-01XE
				TL074QDREP	TL074Q	V62/11621-03XE

(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.

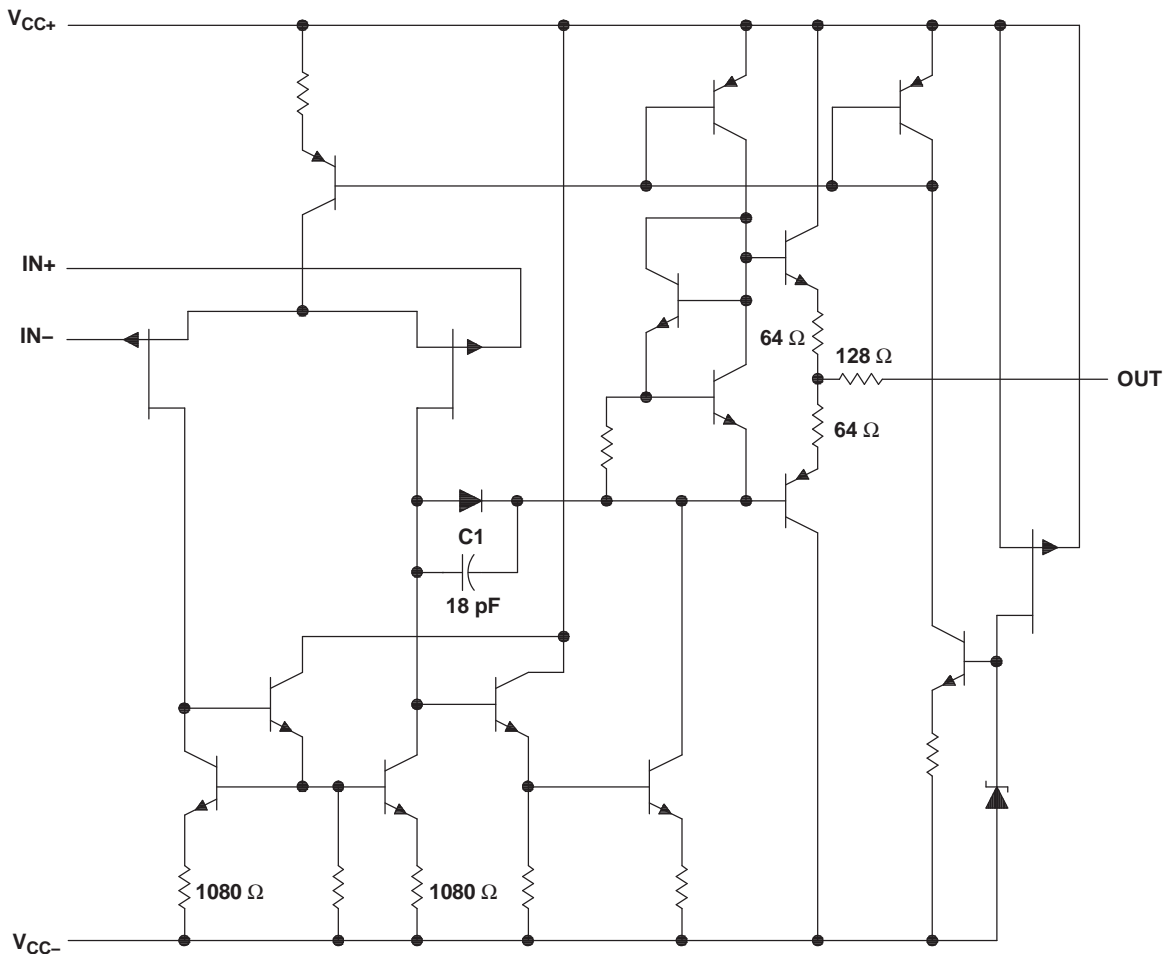


Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

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±} = ±15 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		9	mV	
		Full range					15				
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	
		Full range					20		20	nA	
I _{IB}	Input bias current	V _O = 0	25°C		65	200	65		200	pA	
		Full range					50		50	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	Full range		±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		75		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	

- (1) 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.
- (2) All characteristics are measured under open-loop conditions with zero common-mode voltage, unless otherwise specified. Full range is T_A = –40°C to 125°C.

OPERATING CHARACTERISTICS

V_{CC±} = ±15 V, T_A = 25°C

PARAMETER	TEST CONDITIONS		TL072			TL074			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
SR	Slew rate at unity gain	V _I = 10 V, C _L = 100 pF, R _L = 2 kΩ, See Figure 1	5	13		5	13		V/μs
t _r	Rise-time overshoot factor	V _I = 20 V, C _L = 100 pF, R _L = 2 kΩ, See Figure 1	0.1			0.1			μs
			20			20			%
V _n	Equivalent input noise voltage	R _S = 20 Ω	f = 1 kHz		18		18		nV/√Hz
			f = 10 Hz to 10 kHz		4		4		μV
I _n	Equivalent input noise current	R _S = 20 Ω, f = 1 kHz	0.01			0.01			pA/√Hz
THD	Total harmonic distortion	V _{I rms} = 6 V, R _L ≥ 2 kΩ, f = 1 kHz, A _{VD} = 1, R _S ≤ 1 kΩ,	0.003			0.003			%

PARAMETER MEASUREMENT INFORMATION

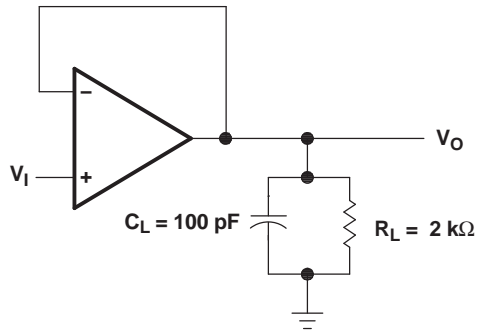


Figure 1. Unity-Gain Amplifier

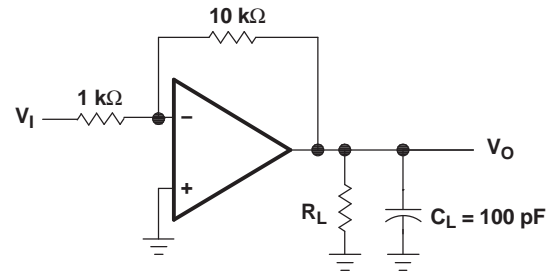


Figure 2. Gain-of-10 Inverting Amplifier

TYPICAL CHARACTERISTICS

Table of Graphs

			FIGURE
I_{IB}	Input bias current	vs Free-air temperature	3
V_{OM}	Maximum peak output voltage	vs Frequency	4, 5, 6
		vs Free-air temperature	7
		vs Load resistance	8
		vs Supply voltage	9
A_{VD}	Large-signal differential voltage amplification	vs Free-air temperature	10
		vs Frequency	11
	Phase shift	vs Frequency	11
	Normalized unity-gain bandwidth	vs Free-air temperature	12
CMRR	Common-mode rejection ratio	vs Free-air temperature	13
I_{CC}	Supply current per amplifier	vs Supply voltage	14
		vs Free-air temperature	15
P_D	Total power dissipation	vs Free-air temperature	16
	Normalized slew rate	vs Free-air temperature	17
V_n	Equivalent input noise voltage	vs Frequency	18
THD	Total harmonic distortion	vs Frequency	19
	Voltage-follower large-signal pulse response	vs Time	20
V_O	Output voltage	vs Elapsed time	21

TYPICAL CHARACTERISTICS

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

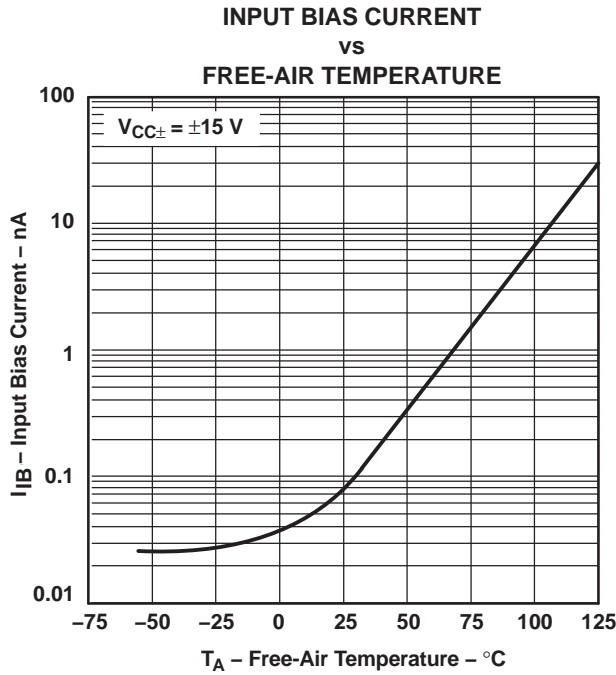


Figure 3.

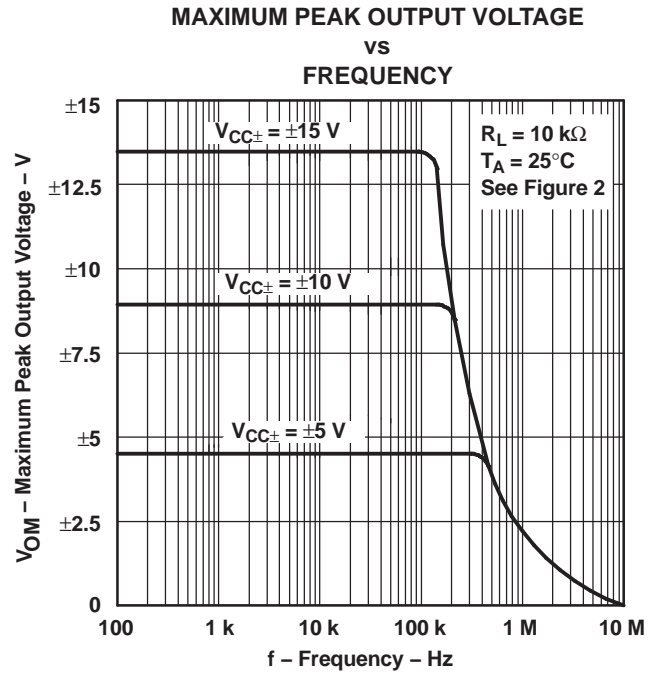


Figure 4.

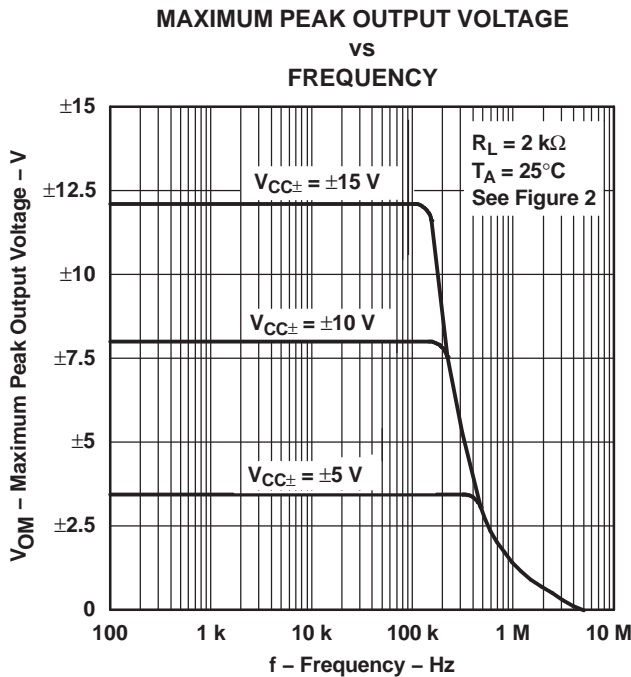


Figure 5.

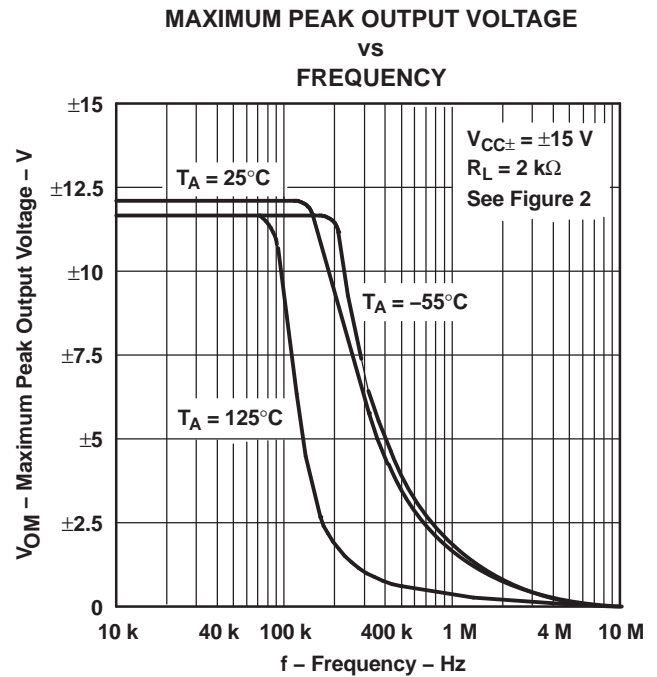
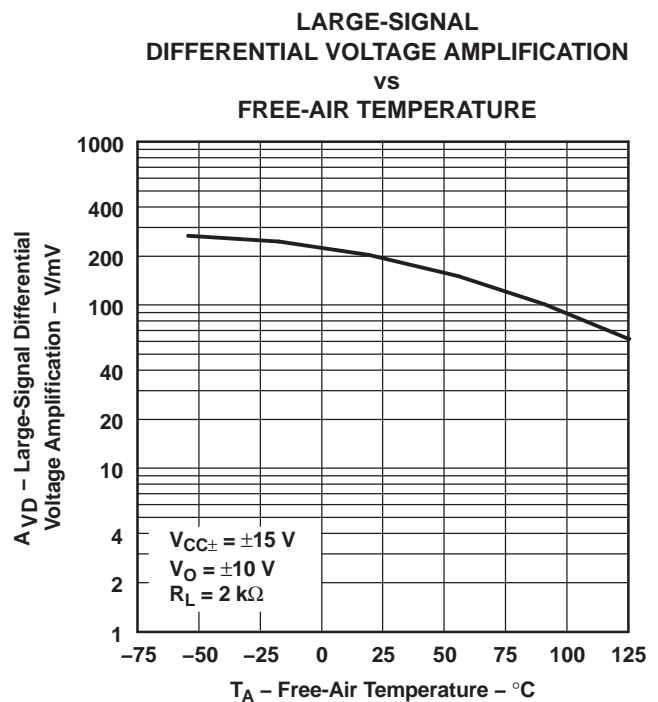
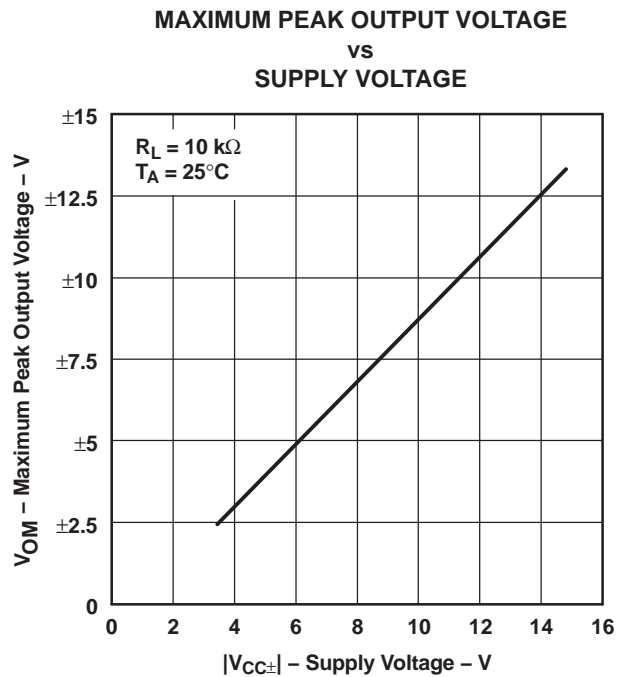
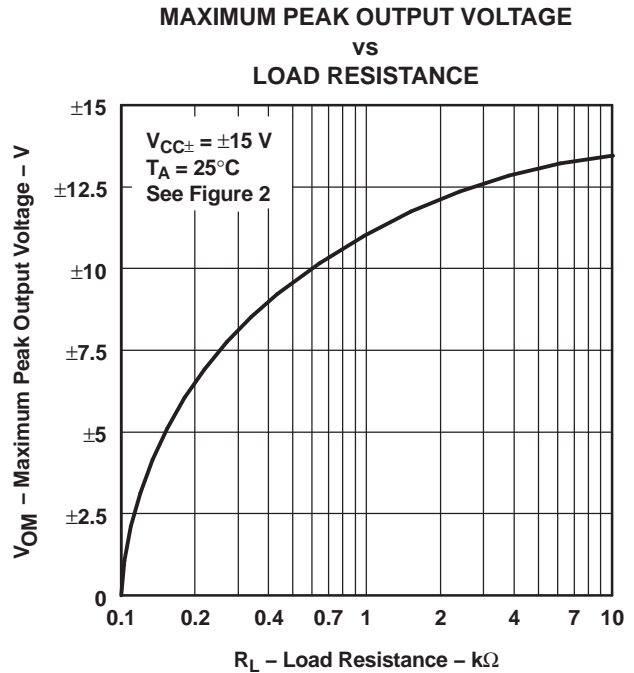
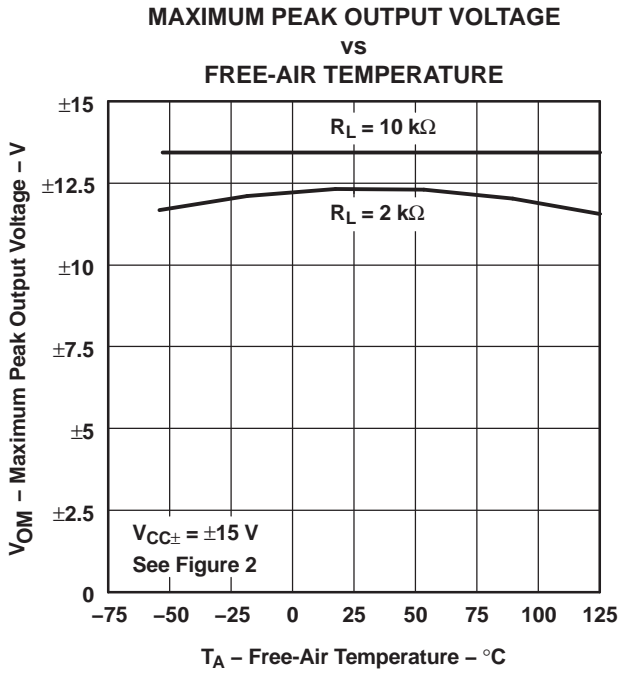


Figure 6.

TYPICAL CHARACTERISTICS (continued)

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



TYPICAL CHARACTERISTICS (continued)

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

LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION AND PHASE SHIFT vs FREQUENCY

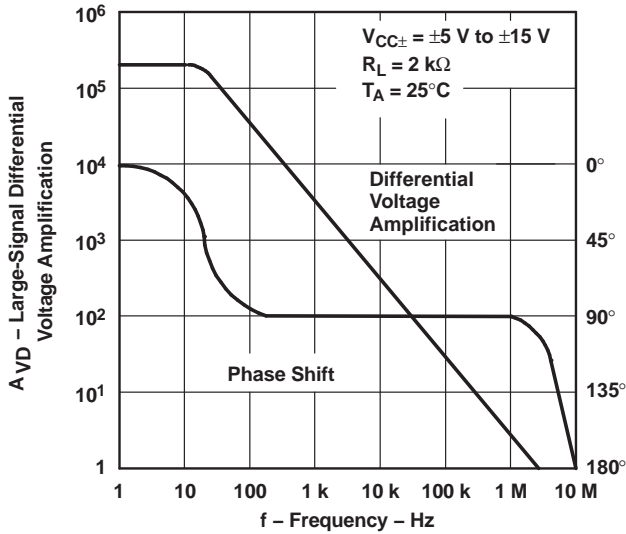


Figure 11.

NORMALIZED UNITY-GAIN BANDWIDTH AND PHASE SHIFT vs FREE-AIR TEMPERATURE

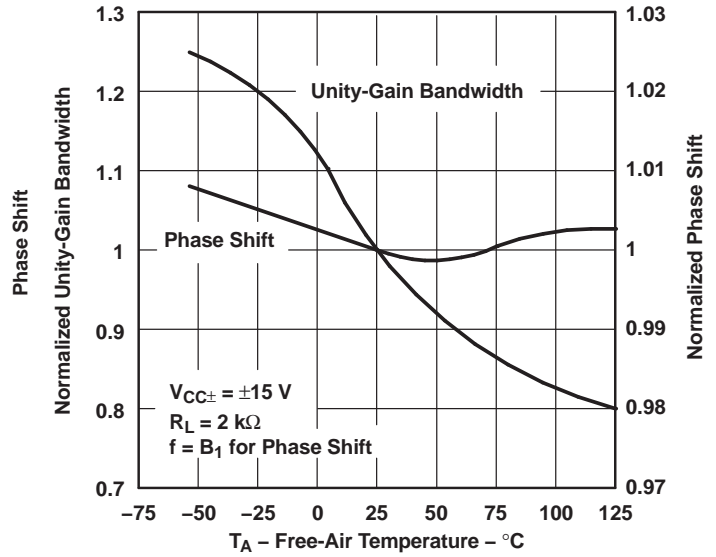


Figure 12.

COMMON-MODE REJECTION RATIO vs FREE-AIR TEMPERATURE

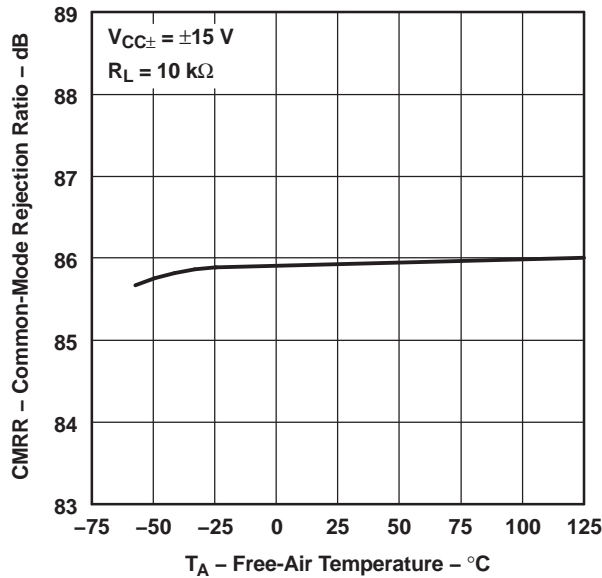


Figure 13.

SUPPLY CURRENT PER AMPLIFIER vs SUPPLY VOLTAGE

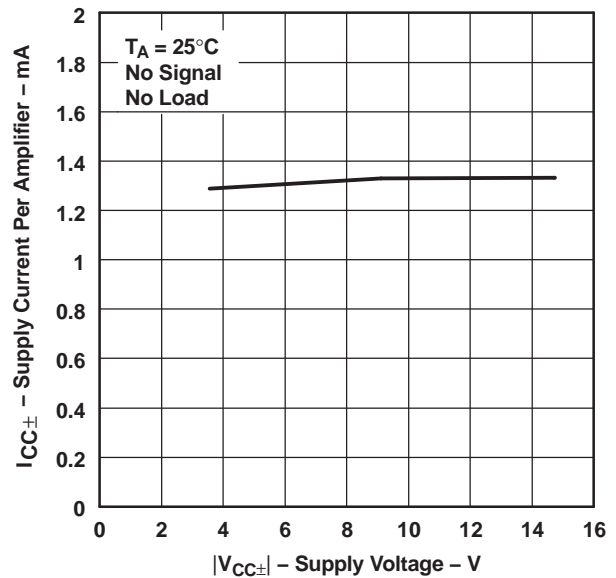


Figure 14.

TYPICAL CHARACTERISTICS (continued)

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

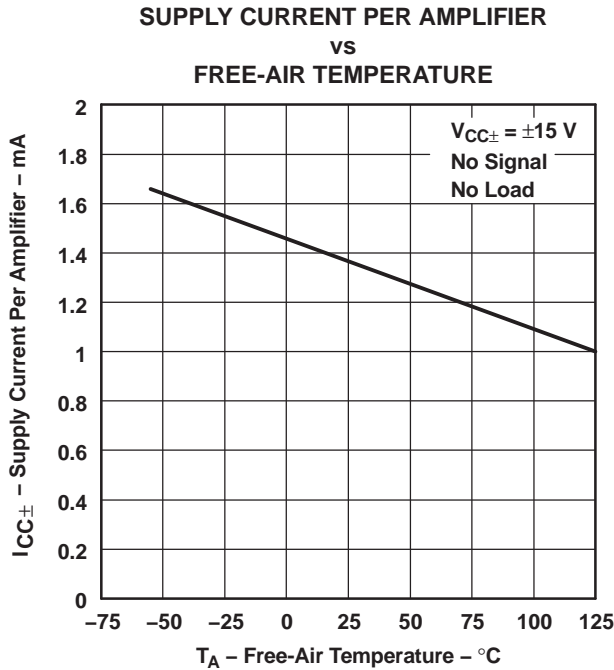


Figure 15.

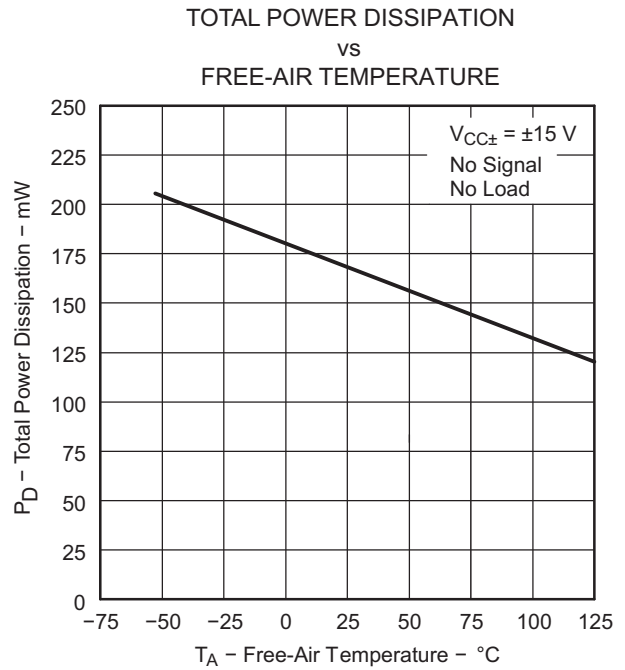


Figure 16.

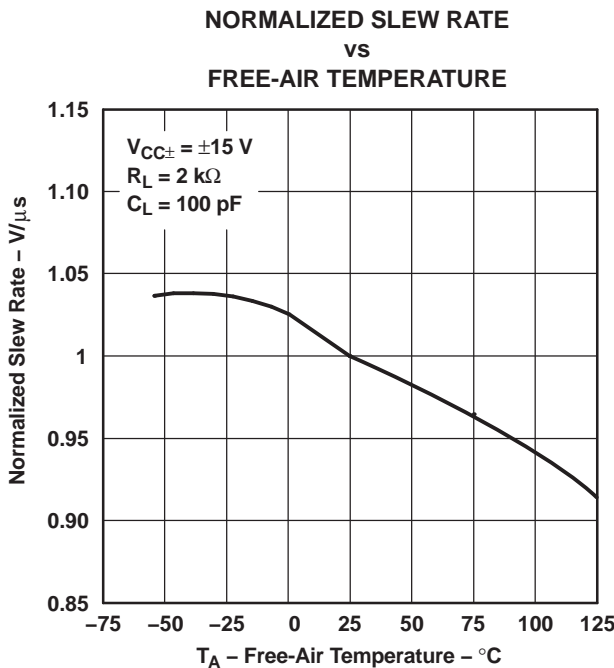


Figure 17.

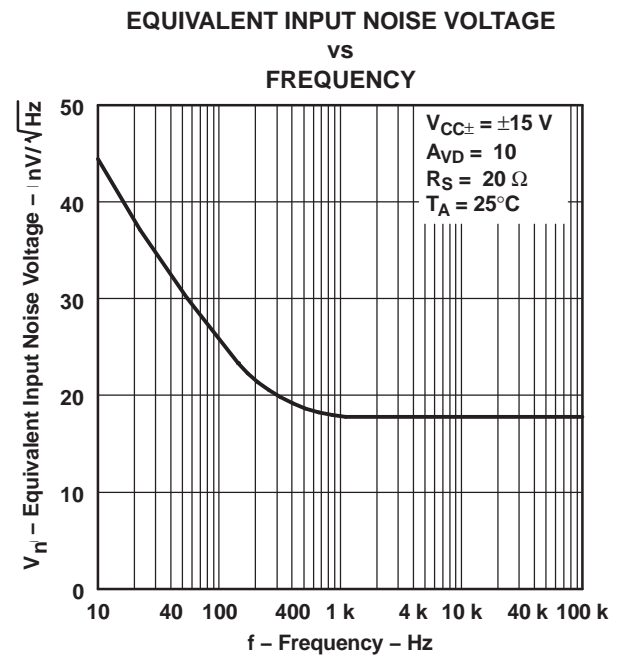


Figure 18.

TYPICAL CHARACTERISTICS (continued)

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

**TOTAL HARMONIC DISTORTION
vs
FREQUENCY**

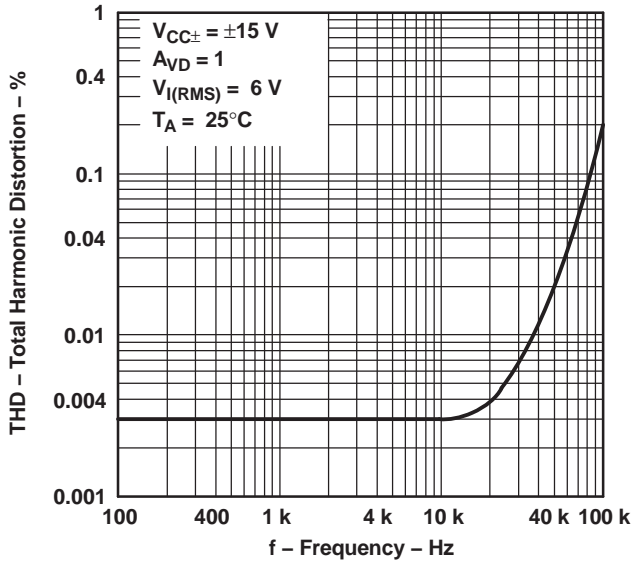


Figure 19.

**VOLTAGE-FOLLOWER
LARGE-SIGNAL PULSE RESPONSE**

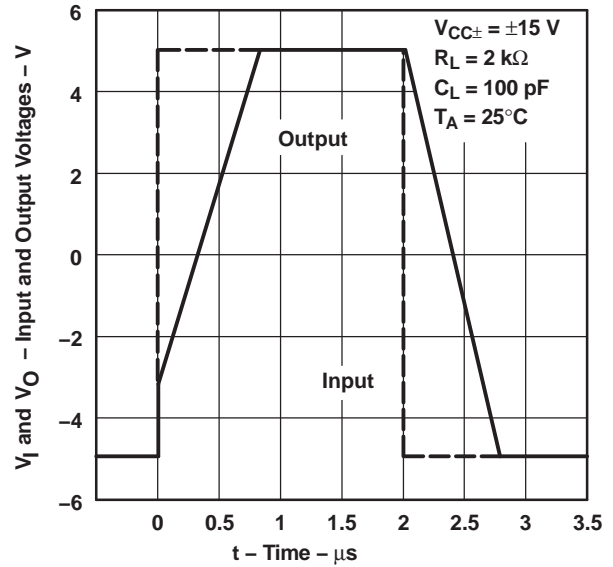


Figure 20.

**OUTPUT VOLTAGE
vs
ELAPSED TIME**

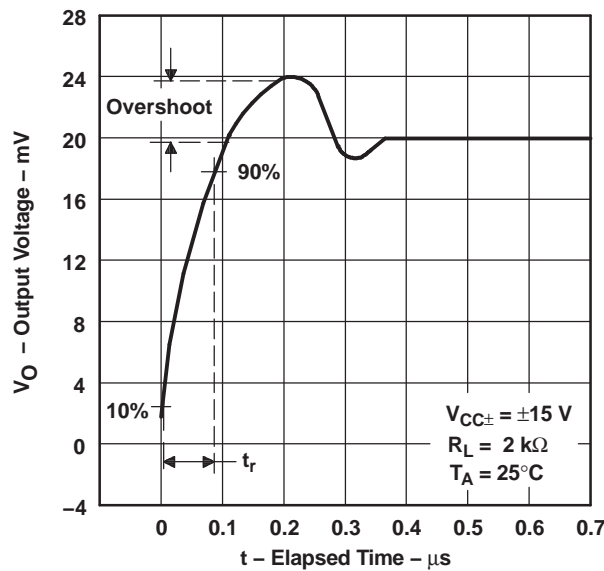
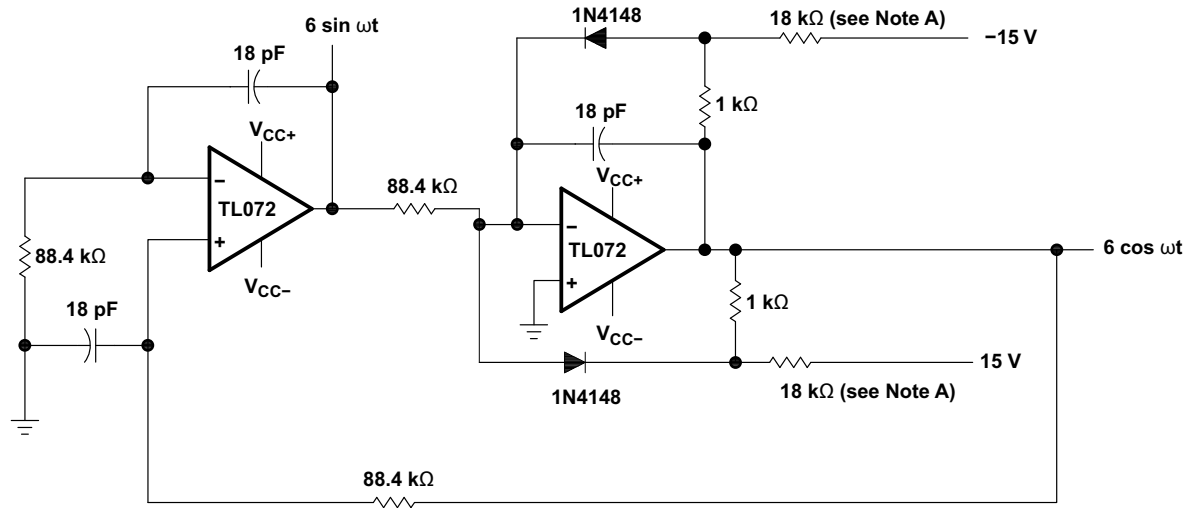


Figure 21.

APPLICATION INFORMATION



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

Figure 22. 100-kHz Quadrature Oscillator

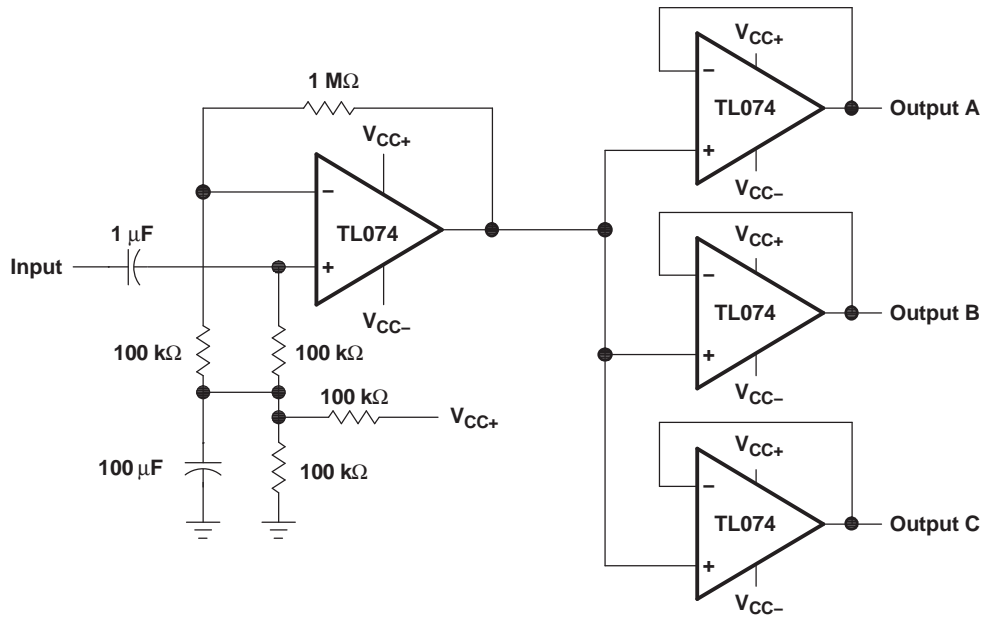


Figure 23. Audio-Distribution Amplifier

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/ Ball Finish	MSL Peak Temp ⁽³⁾	Samples (Requires Login)
TL072QDREP	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
TL074QDREP	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	

⁽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⁾ Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

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

● Catalog: [TL072](#), [TL074](#)

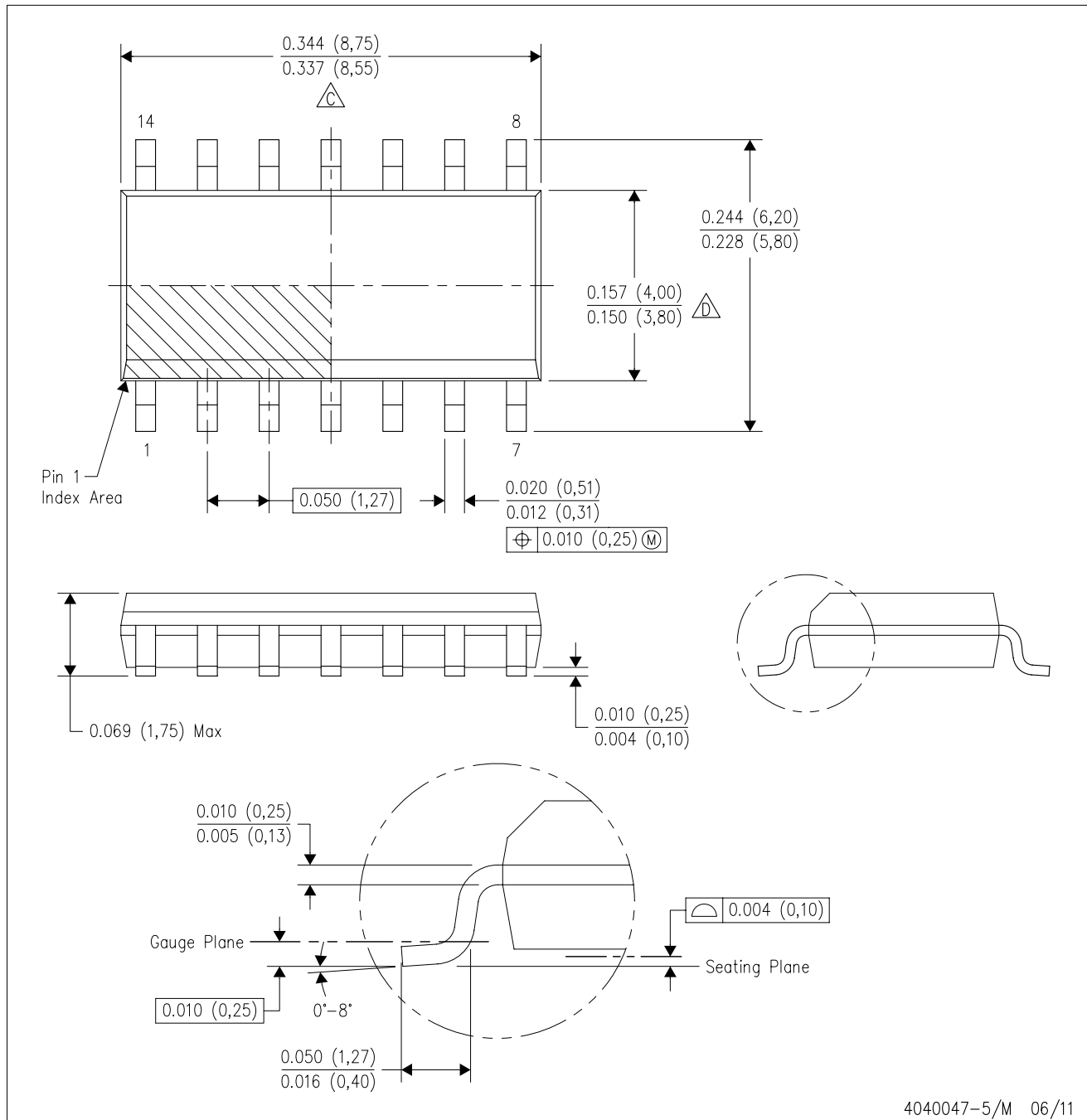
● Military: [TL072M](#), [TL074M](#)



NOTE: Qualified Version Definitions:

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

D (R-PDSO-G14)

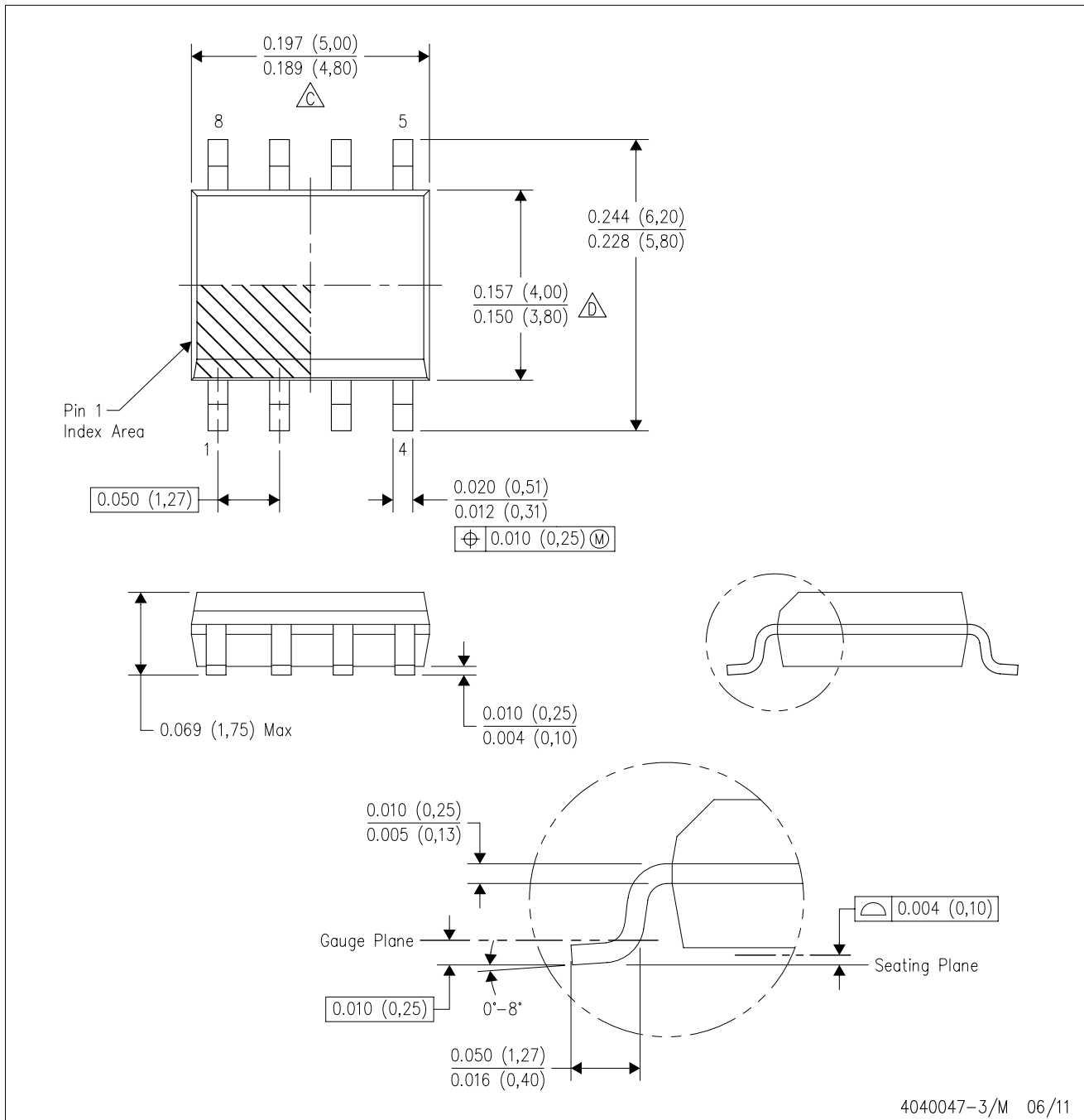
PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 -  Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
 -  Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
 - E. Reference JEDEC MS-012 variation AB.

D (R-PDSO-G8)

PLASTIC SMALL OUTLINE



NOTES: A. All linear dimensions are in inches (millimeters).
 B. This drawing is subject to change without notice.
 C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
 D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
 E. Reference JEDEC MS-012 variation AA.

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