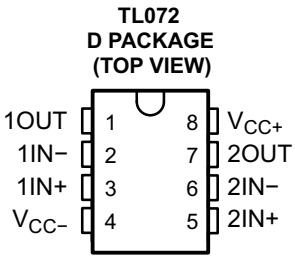
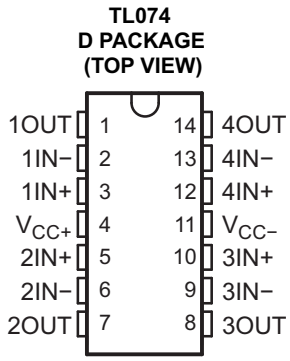
低噪声 JFET 输入运算放大器

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 kHz**时的典型值 **V_n = 18 nV/√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°C/125°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。

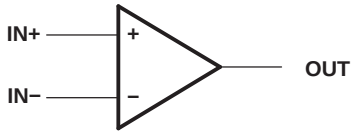
TL07x 额定工作温度范围为 –40°C 至 125°C。

ORDERING INFORMATION(1)

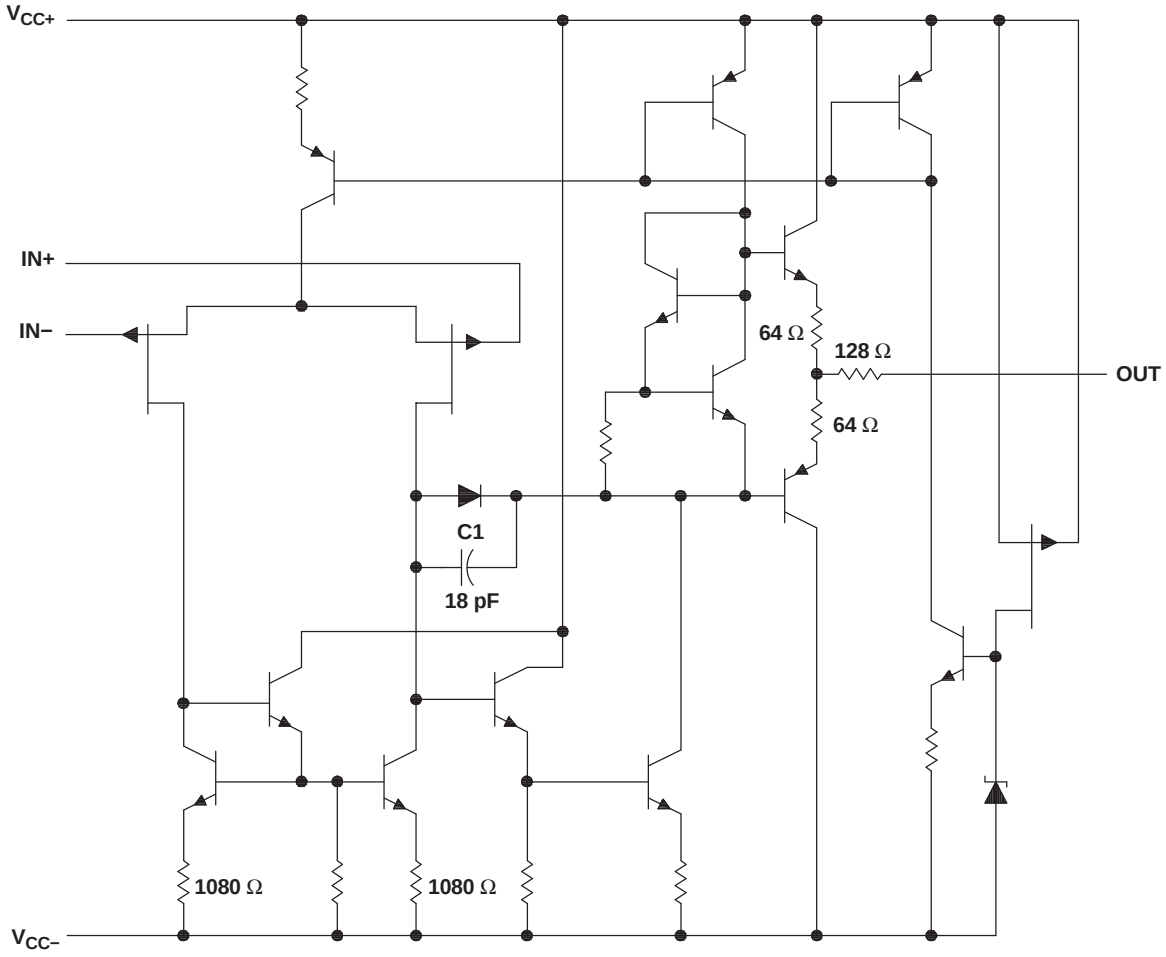
T_A	V_{IO}maX AT 25°C	PACKAGE		ORDERABLE PART NUMBER	TOP-SIDE MARKING	VID NUMBER
–40°C to 125°C	9 mV	SOIC – D	Reel of 2500	TL072QDREP	TL072Q	V62/12604-01XE
				TL074QDREP	TL074Q	V62/11621-03XE

(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.

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

$V_{CC\pm}$ = ±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			9			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		±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_{ICR}min, V_O = 0, R_S = 50 Ω	25°C	80	86		75			dB
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{CC\pm}/\Delta V_{IO}$)	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

$V_{CC\pm}$ = ±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, RS ≤ 1 kΩ,		0.003			0.003		%

PARAMETER MEASUREMENT INFORMATION

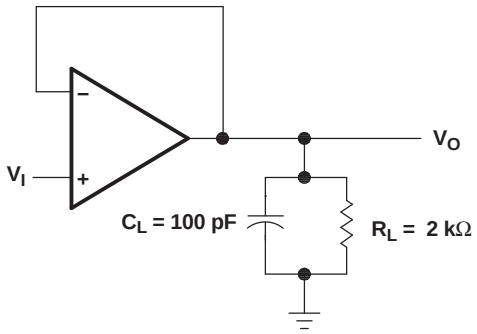


Figure 1. Unity-Gain Amplifier

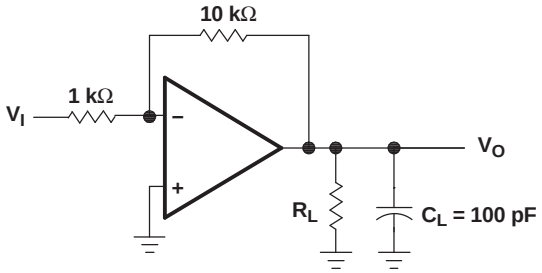


Figure 2. Gain-of-10 Inverting Amplifier

TYPICAL CHARACTERISTICS

Table of Graphs

			FIGURE
I_{IB}	Input bias current	vs Free-air temperature	3
V_{OM}	Maximum peak output voltage	vs Frequency vs Free-air temperature vs Load resistance vs Supply voltage	4, 5, 6 7 8 9
A_{VD}	Large-signal differential voltage amplification	vs Free-air temperature vs Frequency	10 11
	Phase shift	vs Frequency	11
	Normalized unity-gain bandwidth	vs Free-air temperature	12
	Phase shift	vs Free-air temperature	12
CMRR	Common-mode rejection ratio	vs Free-air temperature	13
I_{CC}	Supply current per amplifier	vs Supply voltage vs Free-air temperature	14 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.

INPUT BIAS CURRENT vs FREE-AIR TEMPERATURE

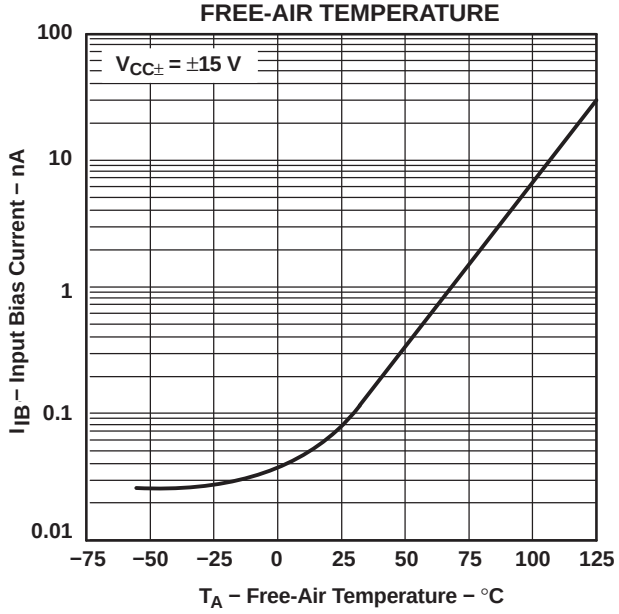


Figure 3.

MAXIMUM PEAK OUTPUT VOLTAGE vs FREQUENCY

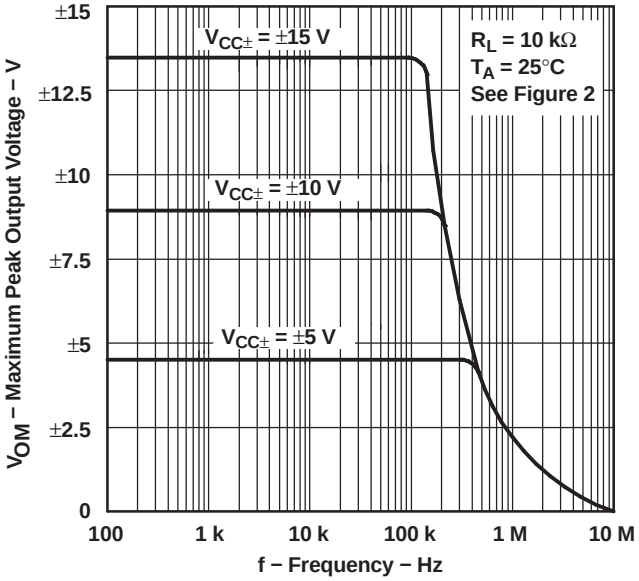


Figure 4.

MAXIMUM PEAK OUTPUT VOLTAGE vs FREQUENCY

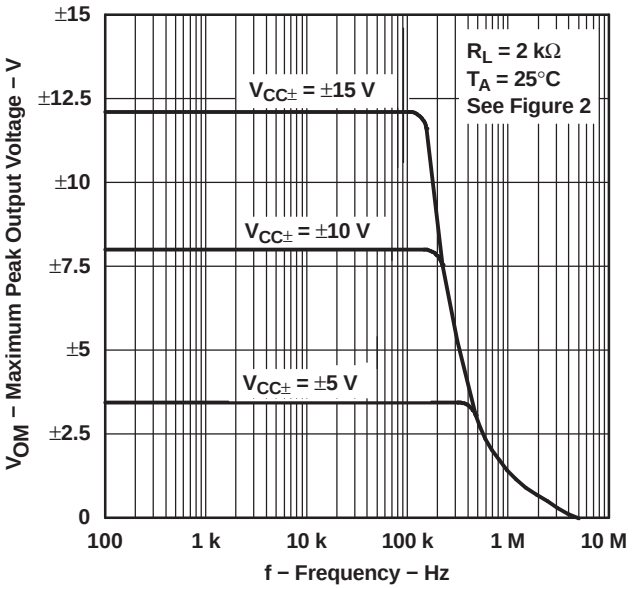


Figure 5.

MAXIMUM PEAK OUTPUT VOLTAGE vs FREQUENCY

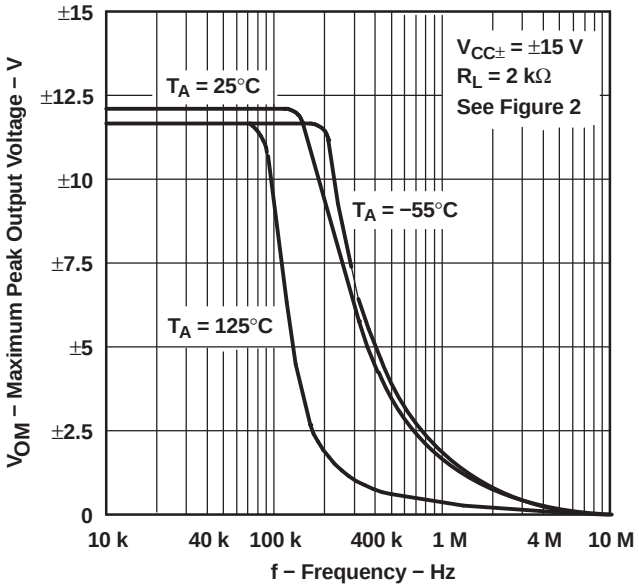


Figure 6.

TYPICAL CHARACTERISTICS (continued)

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

MAXIMUM PEAK OUTPUT VOLTAGE
vs
FREE-AIR TEMPERATURE

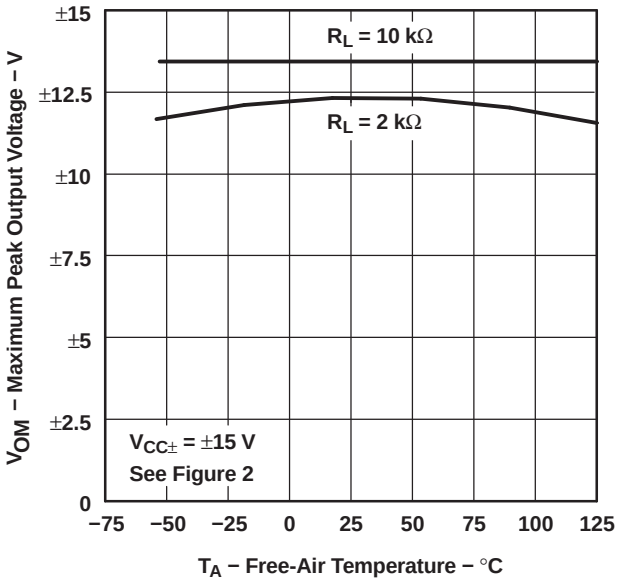


Figure 7.

MAXIMUM PEAK OUTPUT VOLTAGE
vs
LOAD RESISTANCE

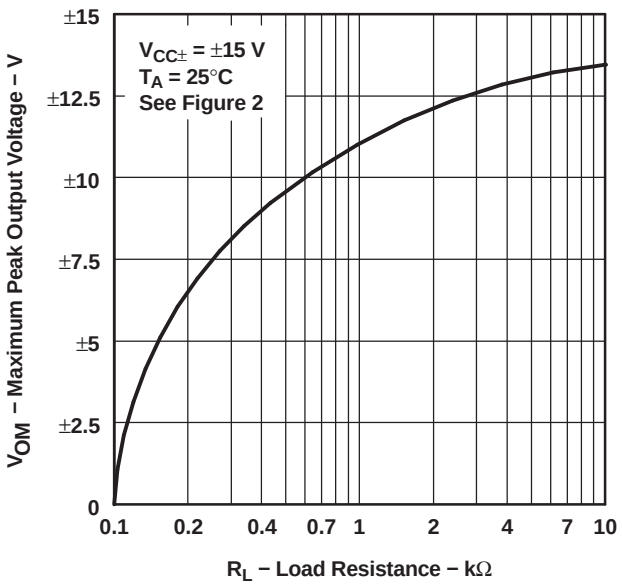


Figure 8.

MAXIMUM PEAK OUTPUT VOLTAGE
vs
SUPPLY VOLTAGE

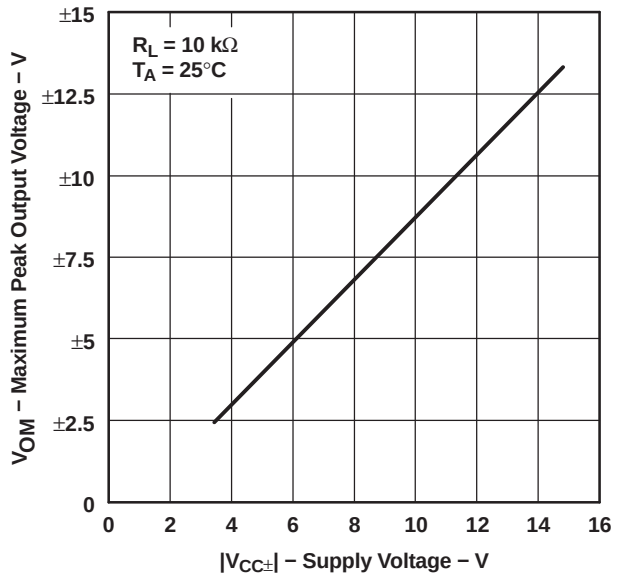


Figure 9.

LARGE-SIGNAL
DIFFERENTIAL VOLTAGE AMPLIFICATION
vs
FREE-AIR TEMPERATURE

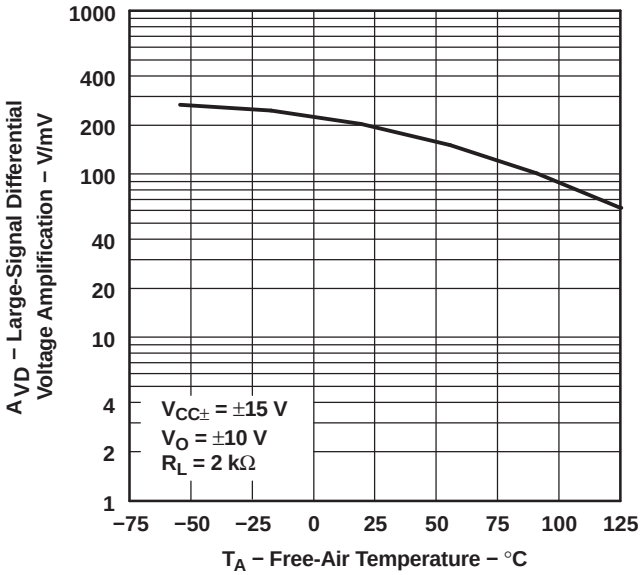


Figure 10.

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

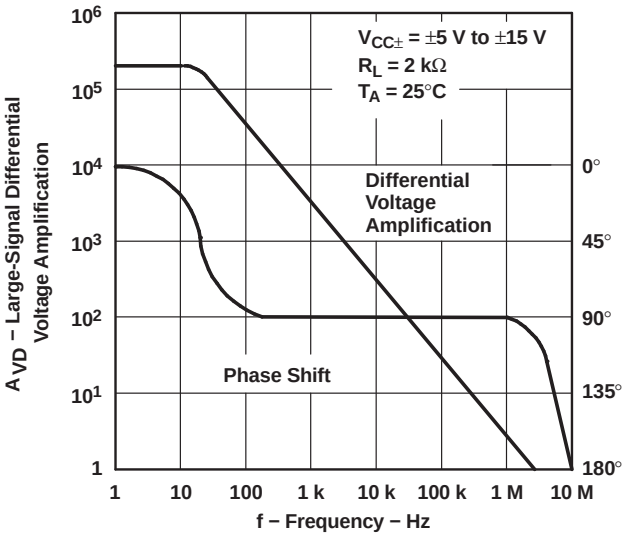


Figure 11.

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

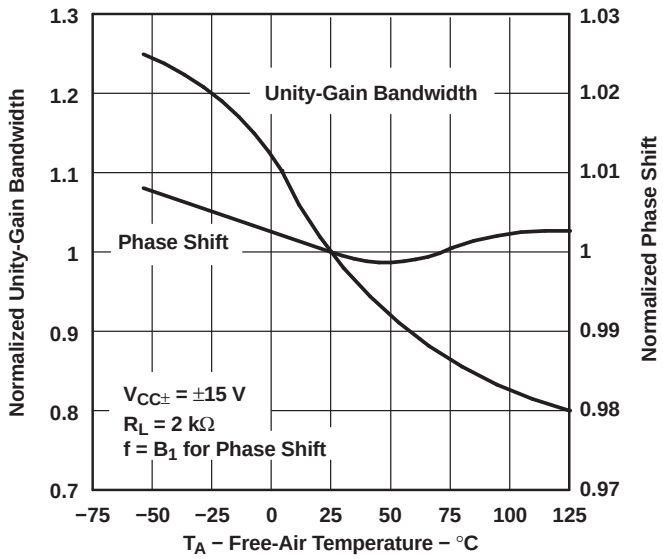


Figure 12.

COMMON-MODE REJECTION RATIO vs FREE-AIR TEMPERATURE

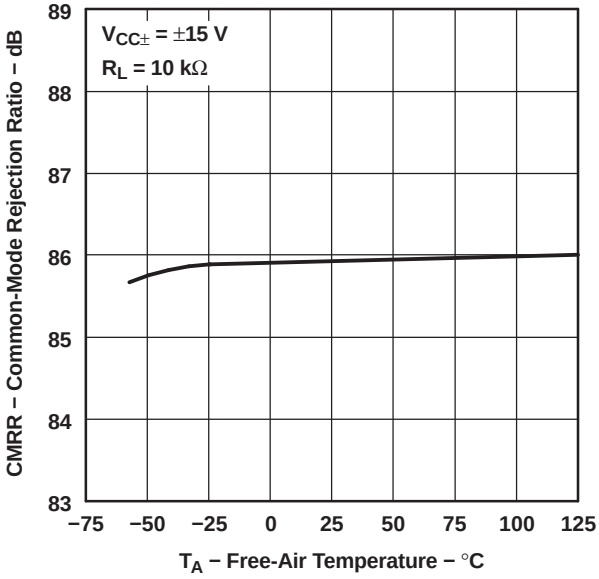


Figure 13.

SUPPLY CURRENT PER AMPLIFIER vs SUPPLY VOLTAGE

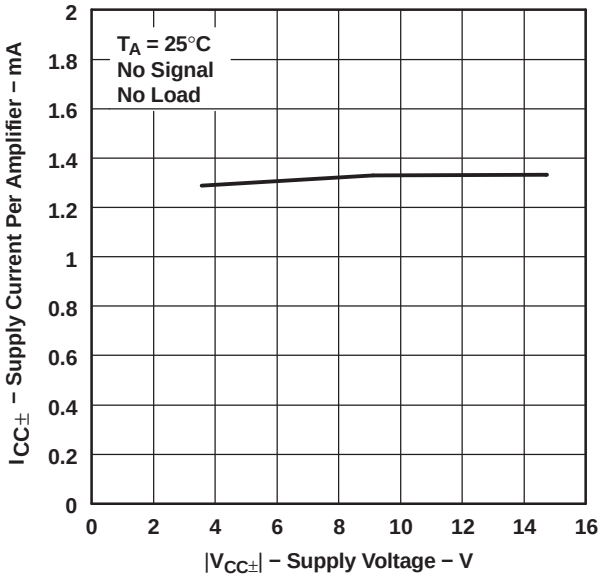


Figure 14.

TYPICAL CHARACTERISTICS (continued)

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

SUPPLY CURRENT PER AMPLIFIER vs FREE-AIR TEMPERATURE

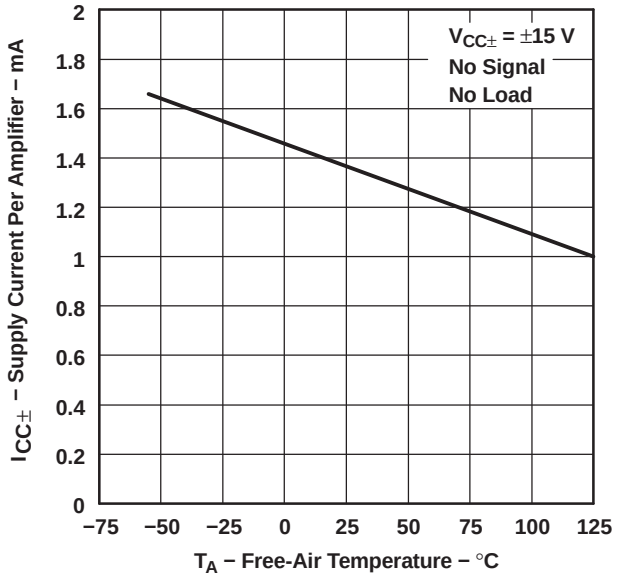


Figure 15.

TOTAL POWER DISSIPATION vs FREE-AIR TEMPERATURE

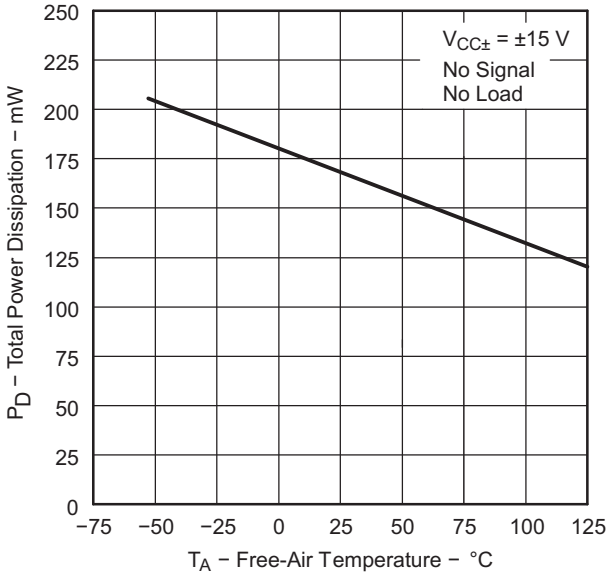


Figure 16.

NORMALIZED SLEW RATE vs FREE-AIR TEMPERATURE

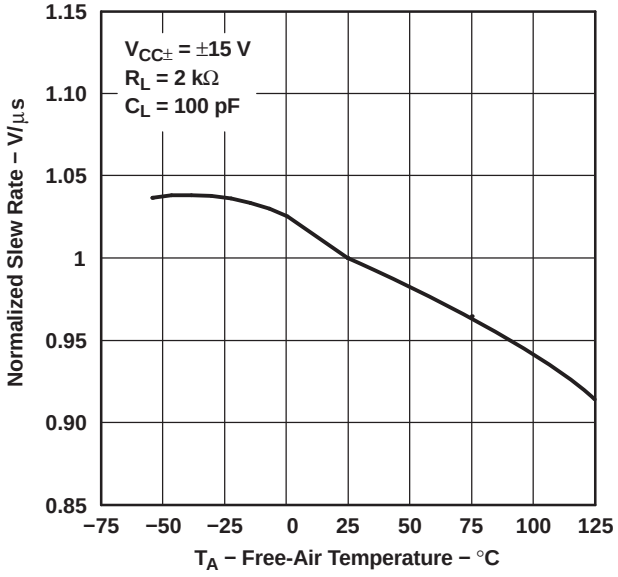


Figure 17.

EQUIVALENT INPUT NOISE VOLTAGE vs FREQUENCY

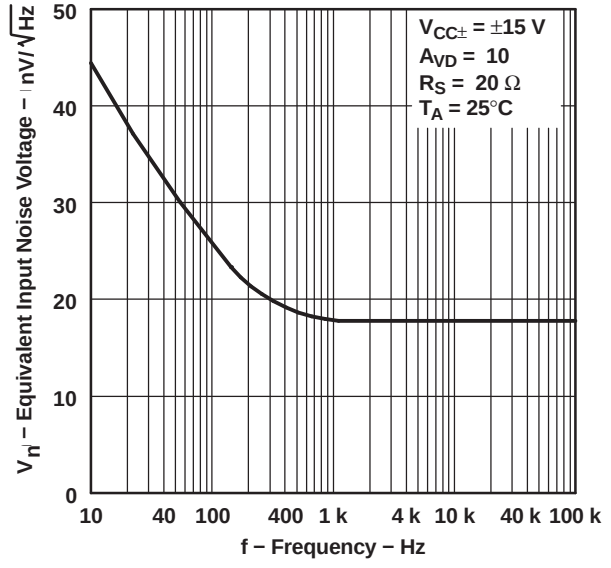


Figure 18.

TYPICAL CHARACTERISTICS (continued)

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

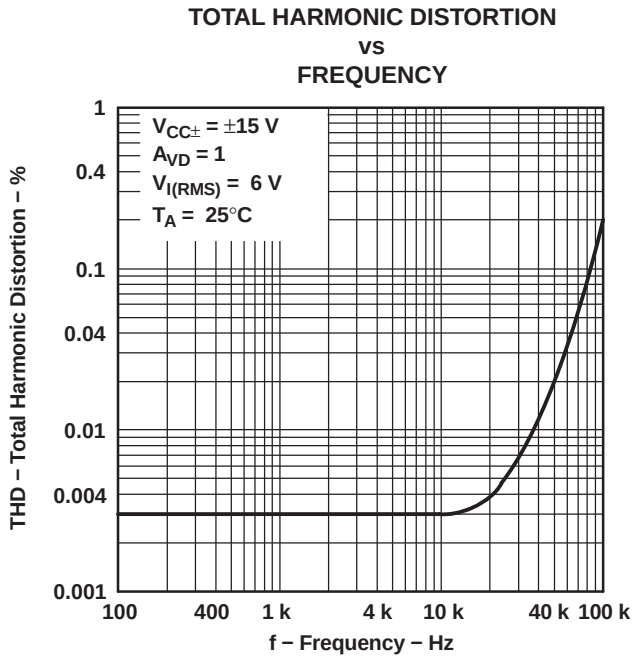


Figure 19.

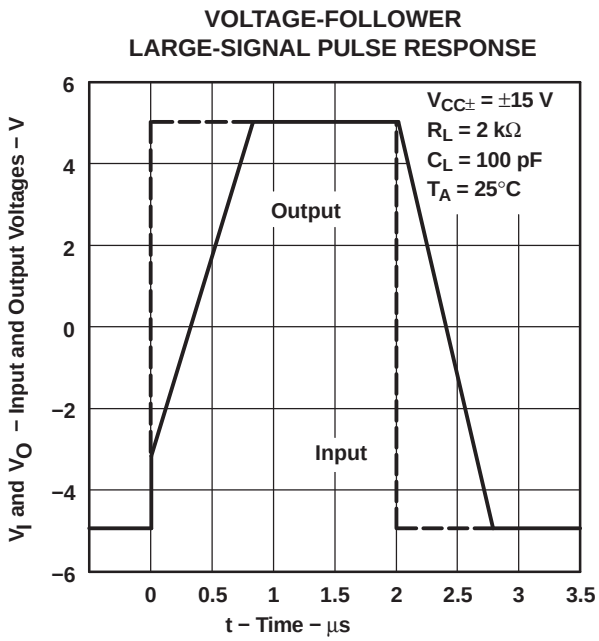


Figure 20.

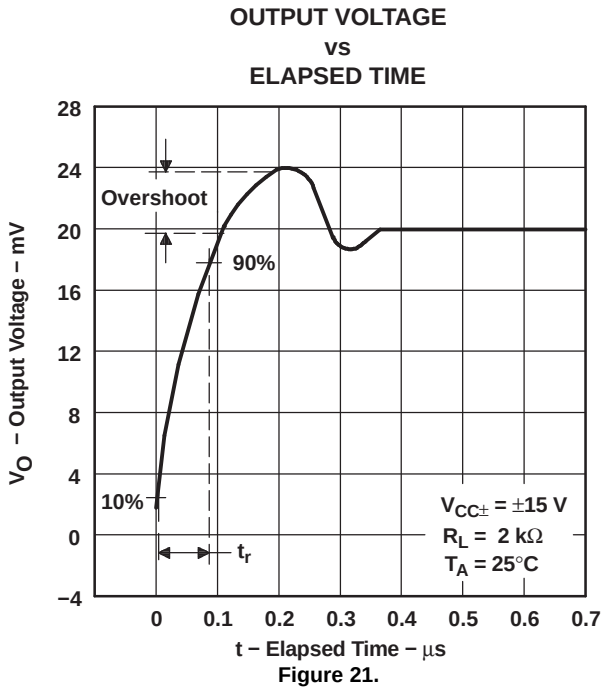
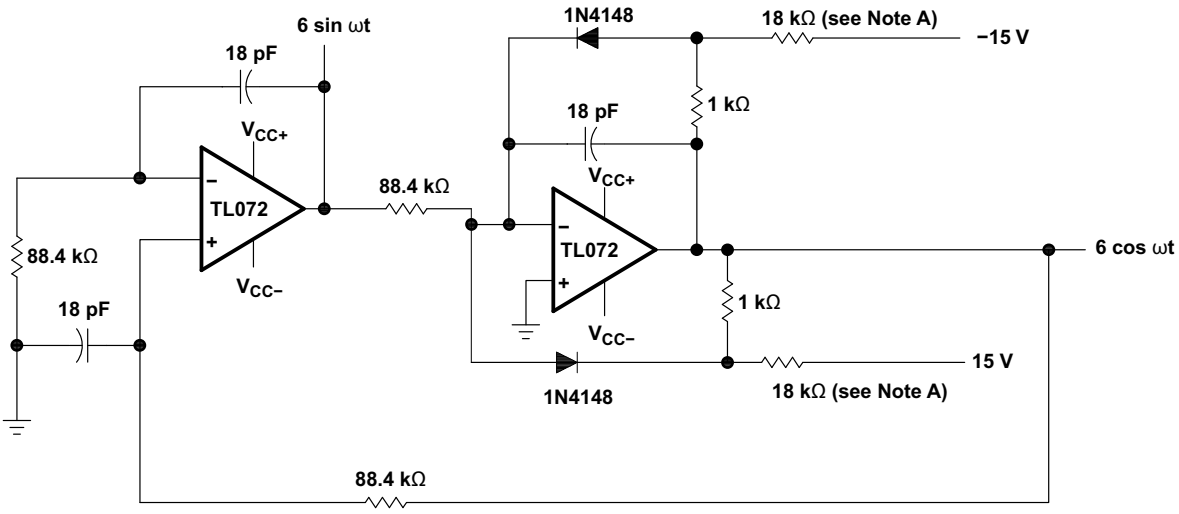


Figure 21.

APPLICATION INFORMATION



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

Figure 22. 100-kHz Quadrature Oscillator

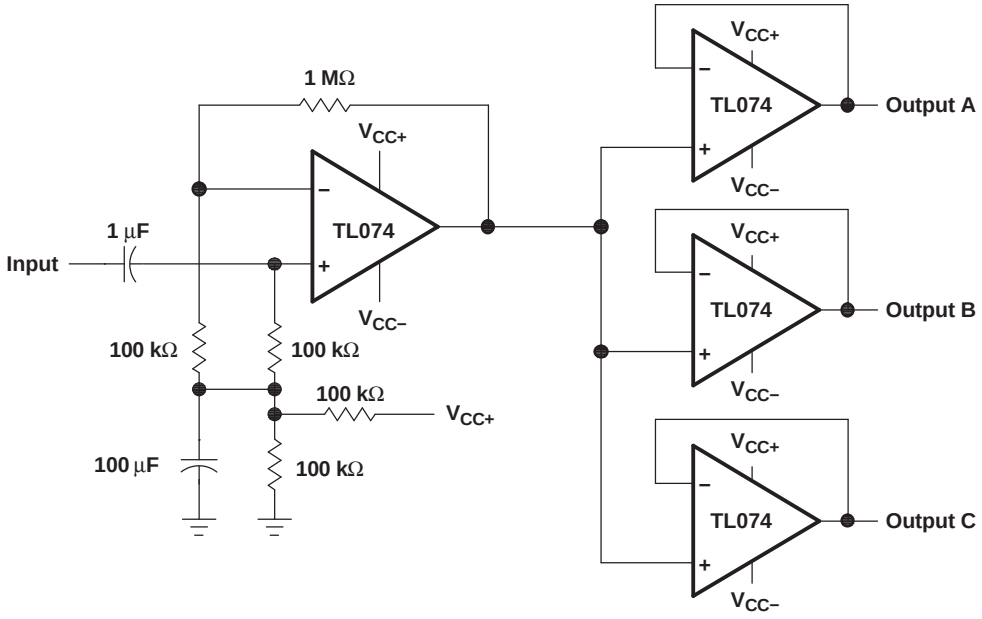


Figure 23. Audio-Distribution Amplifier

PACKAGING INFORMATION

Orderable 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.

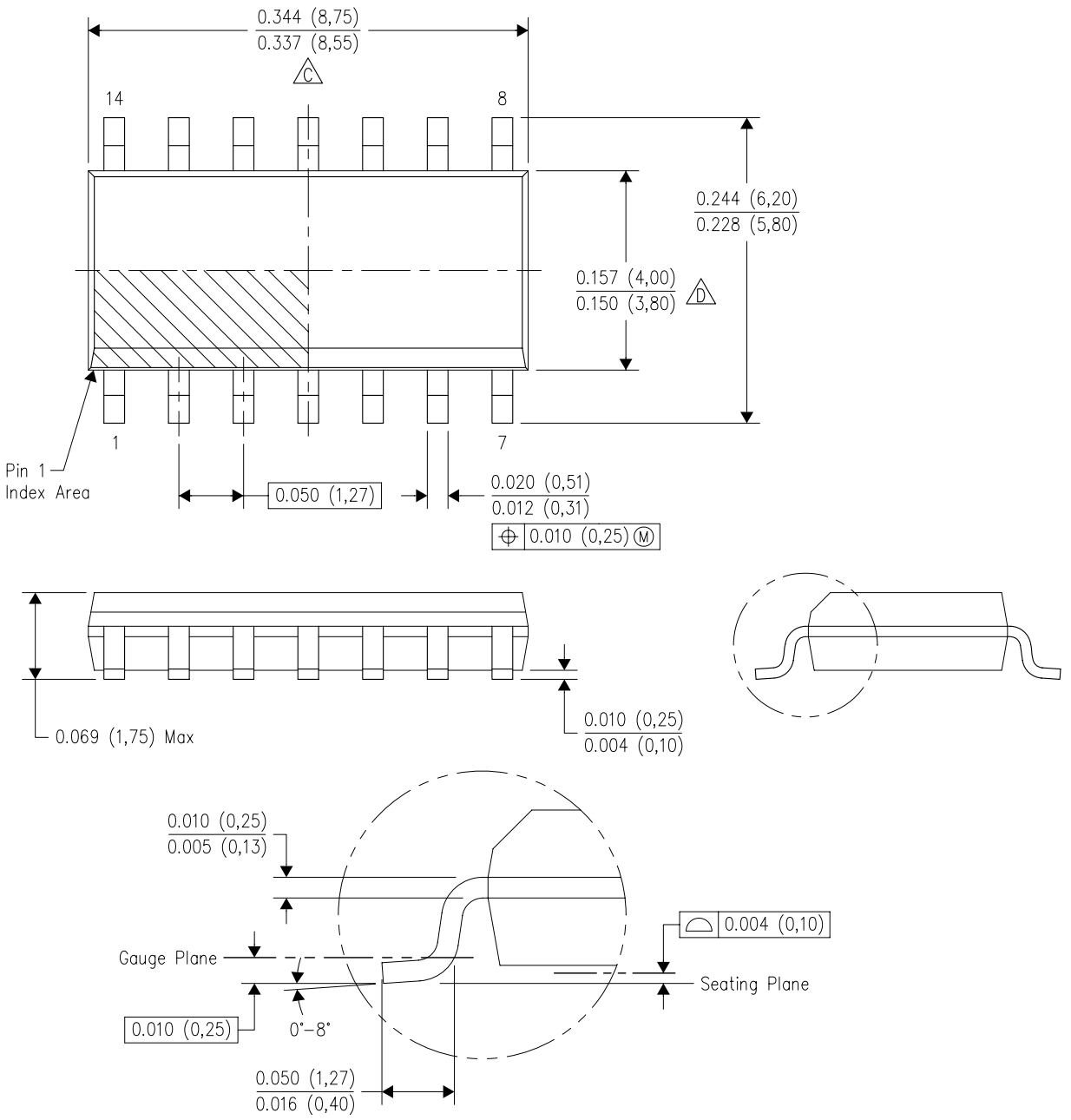
OTHER QUALIFIED VERSIONS OF TL072-EP, TL074-EP :

- Catalog: TL072, TL074
- Military: TL072M, TL074M

NOTE: Qualified Version Definitions:

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

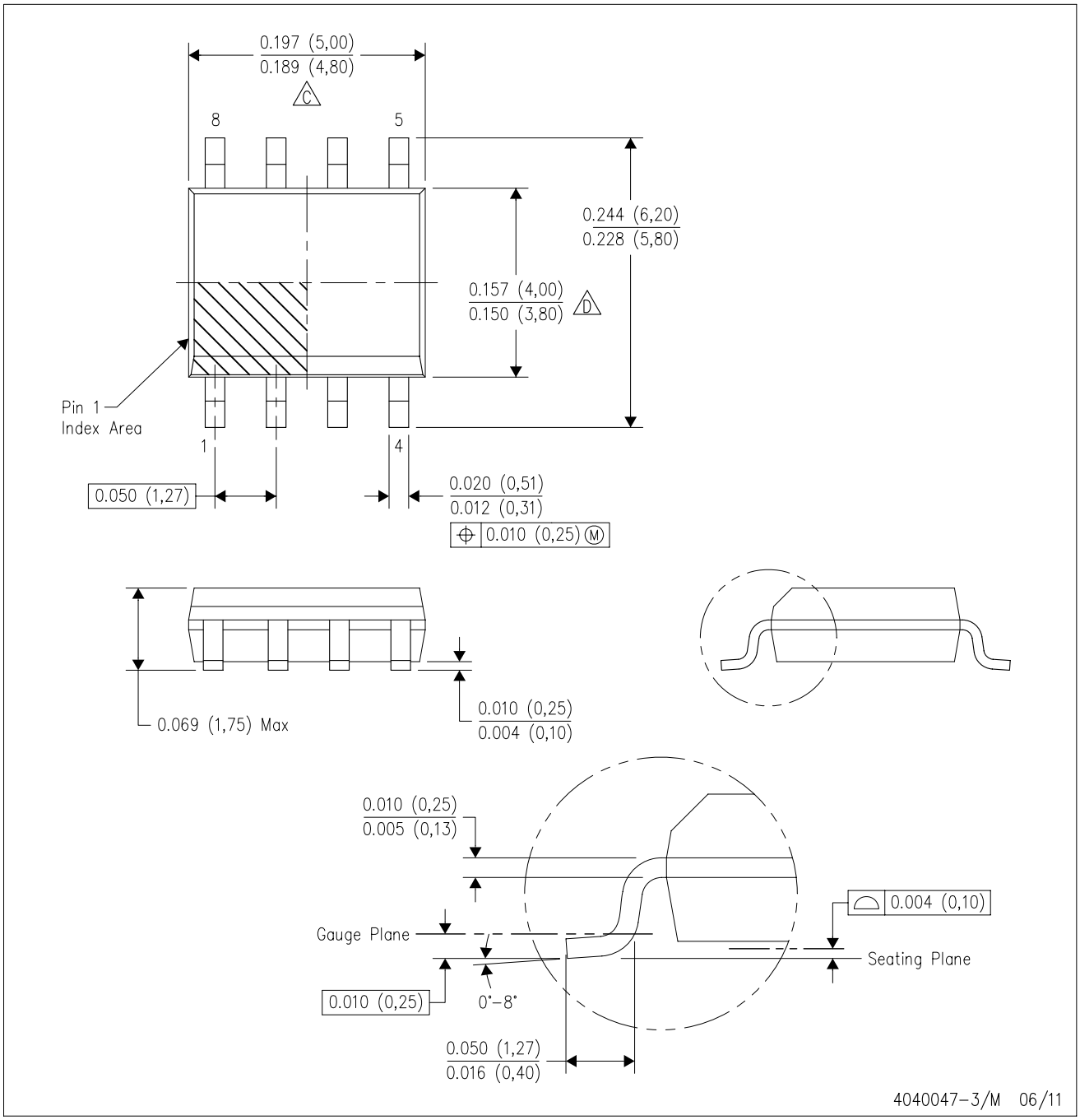
D (R–PDSO–G14) PLASTIC SMALL OUTLINE



4040047–5/M 06/11

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 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.

重要声明

德州仪器(TI) 及其下属子公司有权在不事先通知的情况下，随时对所提供的产品和服务进行更正、修改、增强、改进或其它更改，并有权随时中止提供任何产品和服务。客户在下订单前应获取最新的相关信息，并验证这些信息是否完整且是最新的。所有产品的销售都遵循在订单确认时所提供的TI 销售条款与条件。

TI 保证其所销售的硬件产品的性能符合TI 标准保修的适用规范。仅在TI 保证的范围内，且TI 认为有必要时才会使用测试或其它质量控制技术。除非政府做出了硬性规定，否则没有必要对每种产品的所有参数进行测试。

TI 对应用帮助或客户产品设计不承担任何义务。客户应对其使用TI 组件的产品和应用自行负责。为尽量减小与客户产品和应用相关的风险，客户应提供充分的设计与操作安全措施。

TI 不对任何TI 专利权、版权、屏蔽作品权或其它与使用了TI 产品或服务的组合设备、机器、流程相关的TI 知识产权中授予的直接或隐含权限作出任何保证或解释。TI 所发布的与第三方产品或服务有关的信息，不能构成从TI 获得使用这些产品或服务的许可、授权、或认可。使用此类信息可能需要获得第三方的专利权或其它知识产权方面的许可，或是TI 的专利权或其它知识产权方面的许可。

对于TI 的产品手册或数据表，仅在没有对内容进行任何篡改且带有相关授权、条件、限制和声明的情况下才允许进行复制。在复制信息的过程中对内容的篡改属于非法的、欺诈性商业行为。TI 对此类篡改过的文件不承担任何责任。

在转售TI 产品或服务时，如果存在对产品或服务参数的虚假陈述，则会失去相关TI 产品或服务的明示或暗示授权，且这是非法的、欺诈性商业行为。TI 对此类虚假陈述不承担任何责任。

TI 产品未获得用于关键的安全应用中的授权，例如生命支持应用（在该类应用中一旦TI 产品故障将预计造成重大的人员伤亡），除非各方官员已经达成了专门管控此类使用的协议。购买者的购买行为即表示，他们具备有关其应用安全以及规章衍生所需的所有专业技术和知识，并且认可和同意，尽管任何应用相关信息或支持仍可能由TI 提供，但他们将独力负责满足在关键安全应用中使用其产 品及TI 产品所需的所有法律、法规和安全相关要求。此外，购买者必须全额赔偿因在此类关键安全应用中使用TI 产品而对TI 及其 代表造成的损失。

TI 产品并非设计或专门用于军事/航空应用，以及环境方面的产品，除非TI 特别注明该产品属于“军用”或“增强型塑料”产品。只 有TI 指定的军用产品才满足军用规格。购买者认可并同意，对TI 未指定军用的产品进行军事方面的应用，风险由购买者单独承担，并且独力负责在此类相关使用中满足所有法律和法规要求。

TI 产品并非设计或专门用于汽车应用以及环境方面的产品，除非TI 特别注明该产品符合ISO/TS 16949 要求。购买者认可并同意，如果他们在汽车应用中使用任何未被指定的产品，TI 对未能满足应用所需要求不承担任何责任。

可访问以下URL 地址以获取有关其它TI 产品和应用解决方案的信息：

	产品		应用
数字音频	www.ti.com.cn/audio	通信与电信	www.ti.com.cn/telecom
放大器和线性器件	www.ti.com.cn/amplifiers	计算机及周边	www.ti.com.cn/computer
数据转换器	www.ti.com.cn/dataconverters	消费电子	www.ti.com/consumer-apps
DLP® 产品	www.dlp.com	能源	www.ti.com/energy
DSP - 数字信号处理器	www.ti.com.cn/dsp	工业应用	www.ti.com.cn/industrial
时钟和计时器	www.ti.com.cn/clockandtimers	医疗电子	www.ti.com.cn/medical
接口	www.ti.com.cn/interface	安防应用	www.ti.com.cn/security
逻辑	www.ti.com.cn/logic	汽车电子	www.ti.com.cn/automotive
电源管理	www.ti.com.cn/power	视频和影像	www.ti.com.cn/video
微控制器 (MCU)	www.ti.com.cn/microcontrollers		
RFID 系统	www.ti.com.cn/rfidsys		
OMAP 机动性处理器	www.ti.com/omap		
无线连通性	www.ti.com.cn/wirelessconnectivity		
	德州仪器在线技术支持社区	www.deyisupport.com	

邮寄地址： 上海市浦东新区世纪大道 1568 号，中建大厦 32 楼 邮政编码： 200122