

TL071, TL071A, TL071B, TL072
TL072A, TL072B, TL074, TL074A, TL074B
LOW-NOISE JFET-INPUT OPERATIONAL AMPLIFIERS

SLOS080I – SEPTEMBER 1978 – REVISED APRIL 2004

- Low Power Consumption
- Wide Common-Mode and Differential Voltage Ranges
- Low Input Bias and Offset Currents
- Output Short-Circuit Protection
- Low Total Harmonic Distortion . . . 0.003% Typ
- Low Noise
 $V_n = 18 \text{ nV}/\sqrt{\text{Hz}}$ Typ at $f = 1 \text{ kHz}$
- High Input Impedance . . . JFET Input Stage
- Internal Frequency Compensation
- Latch-Up-Free Operation
- High Slew Rate . . . $13 \text{ V}/\mu\text{s}$ Typ
- Common-Mode Input Voltage Range Includes V_{CC+}

description/ordering information

The JFET-input operational amplifiers in the TL07x series are similar to the TL08x series, with low input bias and offset currents and fast slew rate. The low harmonic distortion and low noise make the TL07x series ideally suited for high-fidelity and audio preamplifier applications. Each amplifier features JFET inputs (for high input impedance) coupled with bipolar output stages integrated on a single monolithic chip.

The C-suffix devices are characterized for operation from 0°C to 70°C. The I-suffix devices are characterized for operation from –40°C to 85°C. The M-suffix devices are characterized for operation over the full military temperature range of –55°C to 125°C.



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

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.



POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

Copyright © 2004, Texas Instruments Incorporated
On products compliant to MIL-PRF-38535, all parameters are tested unless otherwise noted. On all other products, production processing does not necessarily include testing of all parameters.

**TL071, TL071A, TL071B, TL072
TL072A, TL072B, TL074, TL074A, TL074B
LOW-NOISE JFET-INPUT OPERATIONAL AMPLIFIERS**

SLOS080I – SEPTEMBER 1978 – REVISED APRIL 2004

description/ordering information (continued)

ORDERING INFORMATION

TA	V _{IO} max AT 25°C	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
0°C to 70°C	10 mV	PDIP (P)	Tube of 50	TL071CP	TL071CP
			Tube of 50	TL072CP	TL072CP
		PDIP (N)	Tube of 25	TL074CN	TL074CN
			Tube of 75	TL071CD	TL071C
		SOIC (D)	Reel of 2500	TL071CDR	
			Tube of 75	TL072CD	TL072C
			Reel of 2500	TL072CDR	
			Tube of 50	TL074CD	TL074C
			Reel of 2500	TL074CDR	
		SOP (NS)	Reel of 2000	TL074CNSR	TL074
		SOP (PS)	Reel of 2000	TL071CPSR	TL071
			Reel of 2000	TL072CPSR	T072
		TSSOP (PW)	Reel of 2000	TL072CPWR	T072
			Tube of 90	TL074CPW	T074
			Reel of 2000	TL074CPWR	
	6 mV	PDIP (P)	Tube of 50	TL071ACP	TL071ACP
			Tube of 50	TL072CP	TL072CP
		PDIP (N)	Tube of 25	TL074ACN	TL074ACN
			Tube of 75	TL071ACD	071AC
		SOIC (D)	Reel of 2500	TL071ACDR	
			Tube of 75	TL072ACD	072AC
			Reel of 2500	TL072ACDR	
			Tube of 50	TL074ACD	TL074AC
			Reel of 2500	TL074ACDR	
		SOP (PS)	Reel of 2000	TL072ACPSR	T072A
		SOP (NS)	Reel of 2000	TL074ACNSR	TL074A
	3 mV	PDIP (P)	Tube of 50	TL071BCP	TL071BCP
			Tube of 50	TL072BCP	TL072BCP
		PDIP (N)	Tube of 25	TL074BCN	TL074BCN
			Tube of 75	TL071BCD	071BC
		SOIC (D)	Reel of 2500	TL071BCDR	
			Tube of 75	TL072BCD	072BC
			Reel of 2500	TL072BCDR	
			Tube of 50	TL074BCD	TL074BC
			Reel of 2500	TL074BCDR	
		SOP (NS)	Reel of 2000	TL074BCNSR	TL074B

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

TL071, TL071A, TL071B, TL072
TL072A, TL072B, TL074, TL074A, TL074B
LOW-NOISE JFET-INPUT OPERATIONAL AMPLIFIERS
 SLOS080I – SEPTEMBER 1978 – REVISED APRIL 2004

description/ordering information (continued)

ORDERING INFORMATION

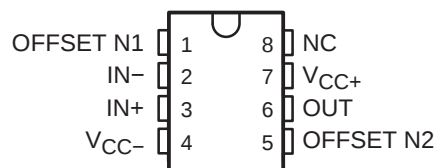
TA	V _{IOMAX} AT 25°C	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	6 mV	PDIP (P)	Tube of 50	TL071IP	TL071IP
			Tube of 50	TL072IP	TL072IP
		PDIP (N)	Tube of 25	TL074IN	TL074IN
		SOIC (D)	Tube of 75	TL071ID	TL071I
			Reel of 2500	TL071IDR	
			Tube of 75	TL072ID	TL072I
			Reel of 2500	TL072IDR	
			Tube of 50	TL074ID	TL074I
			Reel of 2500	TL074IDR	
–55°C to 125°C	6 mV	CDIP (JG)	Tube of 50	TL072MJGB	TL072MJGB
		CFP (U)	Tube of 150	TL072MUB	TL072MUB
		LCCC (FK)	Tube of 55	TL072MFKB	TL072MFKB
	9 mV	CDIP (J)	Tube of 25	TL074MJB	TL074MJB
		CFP (W)	Tube of 25	TL074MWB	TL074MWB
		LCCC (FK)	Tube of 55	TL074MFKB	TL074MFKB

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

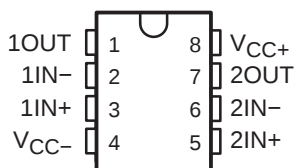
TL071, TL071A, TL071B, TL072 TL072A, TL072B, TL074, TL074A, TL074B LOW-NOISE JFET-INPUT OPERATIONAL AMPLIFIERS

SLOS080I – SEPTEMBER 1978 – REVISED APRIL 2004

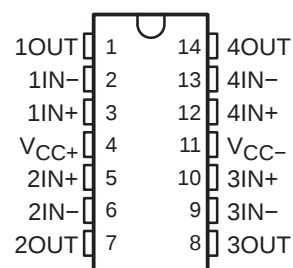
TL071, TL071A, TL071B
D, P, OR PS PACKAGE
(TOP VIEW)



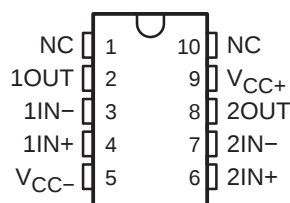
TL072, TL072A, TL072B
D, JG, P, PS, OR PW PACKAGE
(TOP VIEW)



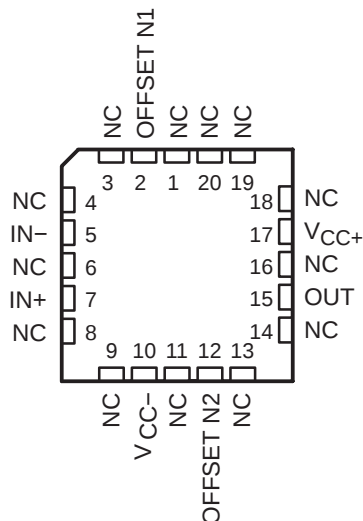
TL074A, TL074B
D, J, N, NS, OR PW PACKAGE
TL074 . . . D, J, N, NS, PW,
OR W PACKAGE
(TOP VIEW)



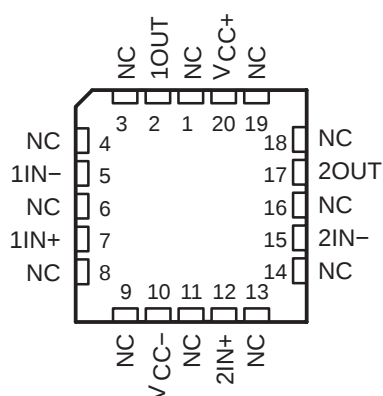
TL072
U PACKAGE
(TOP VIEW)



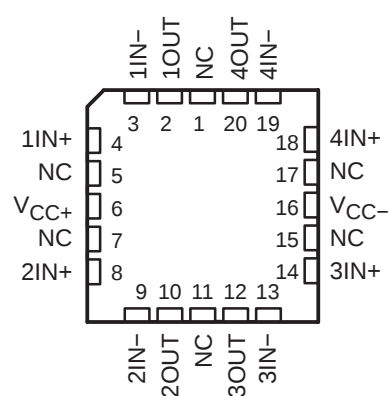
TL071
FK PACKAGE
(TOP VIEW)



TL072
FK PACKAGE
(TOP VIEW)

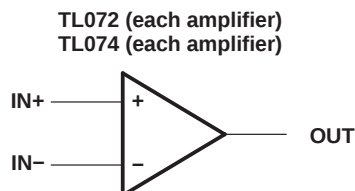
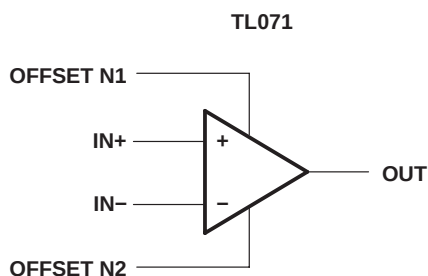


TL074
FK PACKAGE
(TOP VIEW)



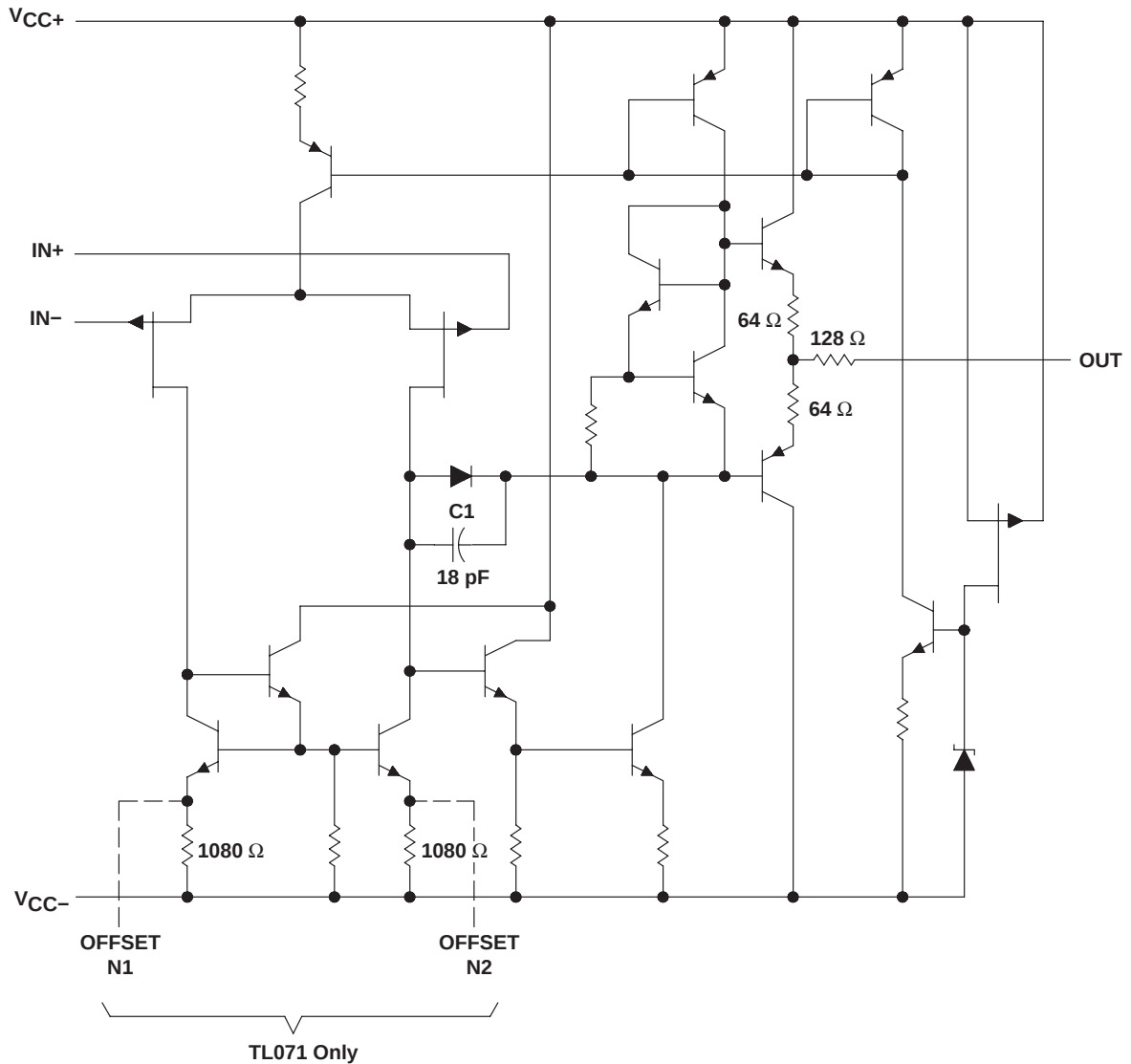
NC – No internal connection

symbols



TL071, TL071A, TL071B, TL072
TL072A, TL072B, TL074, TL074A, TL074B
LOW-NOISE JFET-INPUT OPERATIONAL AMPLIFIERS
 SLOS080I – SEPTEMBER 1978 – REVISED APRIL 2004

schematic (each amplifier)



All component values shown are nominal.

COMPONENT COUNT†			
COMPONENT TYPE	TL071	TL072	TL074
Resistors	11	22	44
Transistors	14	28	56
JFET	2	4	6
Diodes	1	2	4
Capacitors	1	2	4
epi-FET	1	2	4

† Includes bias and trim circuitry

**TL071, TL071A, TL071B, TL072
TL072A, TL072B, TL074, TL074A, TL074B
LOW-NOISE JFET-INPUT OPERATIONAL AMPLIFIERS**

SLOS080I – SEPTEMBER 1978 – REVISED APRIL 2004

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)[†]

Supply voltage (see Note 1): V_{CC+}	18 V
V_{CC-}	–18 V
Differential input voltage, V_{ID} (see Note 2)	±30 V
Input voltage, V_I (see Notes 1 and 3)	±15 V
Duration of output short circuit (see Note 4)	Unlimited
Package thermal impedance, θ_{JA} (see Notes 5 and 6): D package (8 pin)	97°C/W
D package (14 pin)	86°C/W
N package	80°C/W
NS package	76°C/W
P package	85°C/W
PS package	95°C/W
PW package (8 pin)	149°C/W
PW package (14 pin)	113°C/W
U package	185°C/W
Package thermal impedance, θ_{JC} (see Notes 7 and 8): FK package	5.61°C/W
J package	15.05°C/W
JG package	14.5°C/W
W package	14.65°C/W
Operating virtual junction temperature, T_J	150°C
Case temperature for 60 seconds: FK package	260°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds: J, JG, or W package	300°C
Storage temperature range, T_{stg}	–65°C to 150°C

[†] Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

- NOTES:
1. All voltage values, except differential voltages, are with respect to the midpoint between V_{CC+} and V_{CC-} .
 2. Differential voltages are at $IN+$, with respect to $IN-$.
 3. The magnitude of the input voltage must never exceed the magnitude of the supply voltage or 15 V, whichever is less.
 4. 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.
 5. Maximum power dissipation is a function of $T_J(\max)$, θ_{JA} , and T_A . The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(\max) - T_A)/\theta_{JA}$. Operating at the absolute maximum T_J of 150°C can affect reliability.
 6. The package thermal impedance is calculated in accordance with JESD 51-7.
 7. Maximum power dissipation is a function of $T_J(\max)$, θ_{JC} , and T_C . The maximum allowable power dissipation at any allowable case temperature is $P_D = (T_J(\max) - T_C)/\theta_{JC}$. Operating at the absolute maximum T_J of 150°C can affect reliability.
 8. The package thermal impedance is calculated in accordance with MIL-STD-883.

**TL071, TL071A, TL071B, TL072
TL072A, TL072B, TL074, TL074A, TL074B**
LOW-NOISE JFET-INPUT OPERATIONAL AMPLIFIERS

SLOS080I – SEPTEMBER 1978 – REVISED APRIL 2004

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

PARAMETER	TEST CONDITIONS†	TA‡	TL071C TL072C TL074C			TL071AC TL072AC TL074AC			TL071BC TL072BC TL074BC			TL071I TL072I TL074I			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO}	$V_O = 0$, $R_S = 50\ \Omega$	25°C	3	10	6	3	3	6	2	2	3	3	3	6	mV
		Full range			13			7.5			5			8	
αV_{IO}	$V_O = 0$, $R_S = 50\ \Omega$	Full range	18			18			18			18			$\mu\text{V}/^\circ\text{C}$
I_{IO}	$V_O = 0$	25°C	5	100		5	100		5	100		5	100		pA
		Full range			10			2			2			2	nA
I_{IB}	$V_O = 0$	25°C	65	200		65	200		65	200		65	200		pA
		Full range			7			7			7			20	nA
V_{ICR}	Common-mode input voltage range	25°C	-12 to 15			-12 to 15			-12 to 15			-12 to 15			V
V_{OM}	Maximum peak output voltage swing	25°C	± 12	± 13.5		± 12	± 13.5		± 12	± 13.5		± 12	± 13.5		V
			± 12			± 12			± 12			± 12			
		Full range	± 10			± 10			± 10			± 10			
A_{VD}	Large-signal differential voltage amplification	25°C	25	200		25	200		50	200		50	200		V/mV
		Full range	15			25			25			25			
B_1	Unity-gain bandwidth	25°C	3			3			3			3			MHz
r_i	Input resistance	25°C	10 ¹²			10 ¹²			10 ¹²			10 ¹²			Ω
CMRR	Common-mode rejection ratio	25°C	70	100		75	100		75	100		75	100		dB
KSVR	Supply-voltage rejection ratio ($\Delta V_{CC\pm}/\Delta V_{IO}$)	25°C	70	100		80	100		80	100		80	100		dB
I_{CC}	Supply current (each amplifier)	25°C	1.4	2.5		1.4	2.5		1.4	2.5		1.4	2.5		mA
V_{O1}/V_{O2}	Crosstalk attenuation	25°C	120			120			120			120			dB

† All characteristics are measured under open-loop conditions with zero common-mode voltage, unless otherwise specified.
‡ Full range is $T_A = 0^\circ\text{C}$ to 70°C for TL07_C, TL07_AC, TL07_BC and is $T_A = -40^\circ\text{C}$ to 85°C for TL07_I.

§ Input bias currents of an FET-input operational amplifier are normal junction reverse currents, which are temperature sensitive, as shown in Figure 4. Pulse techniques must be used that maintain the junction temperature as close to the ambient temperature as possible.

TL071, TL071A, TL071B, TL072
TL072A, TL072B, TL074, TL074A, TL074B
LOW-NOISE JFET-INPUT OPERATIONAL AMPLIFIERS

SLOS080I – SEPTEMBER 1978 – REVISED APRIL 2004

electrical characteristics, $V_{CC\pm} = \pm 15$ V (unless otherwise noted)

PARAMETER	TEST CONDITIONS†	T_A ‡	TL071M TL072M			TL074M			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO} Input offset voltage	$V_O = 0, R_S = 50 \Omega$	25°C		3	6		3	9	mV
		Full range			9			15	
$\alpha_{V_{IO}}$ Temperature coefficient of input offset voltage	$V_O = 0, R_S = 50 \Omega$	Full range		18			18		$\mu\text{V}/^\circ\text{C}$
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
					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	$R_L = 10 \text{ k}\Omega$	25°C	± 12	± 13.5		± 12	± 13.5		V
	$R_L \geq 10 \text{ k}\Omega$	Full range	± 12			± 12			
	$R_L \geq 2 \text{ k}\Omega$		± 10			± 10			
A_{VD} Large-signal differential voltage amplification	$V_O = \pm 10 \text{ V}, R_L \geq 2 \text{ k}\Omega$	25°C	35	200		35	200		V/mV
			15			15			
B_1 Unity-gain bandwidth	$T_A = 25^\circ\text{C}$			3			3		MHz
r_i Input resistance	$T_A = 25^\circ\text{C}$			10^{12}			10^{12}		Ω
CMRR Common-mode rejection ratio	$V_{IC} = V_{ICRmin}, V_O = 0, R_S = 50 \Omega$	25°C	80	86		80	86		dB
k_{SVR} Supply-voltage rejection ratio ($\Delta V_{CC\pm}/\Delta V_{IO}$)	$V_{CC} = \pm 9 \text{ V to } \pm 15 \text{ V}, V_O = 0, R_S = 50 \Omega$	25°C	80	86		80	86		dB
I_{CC} Supply current (each amplifier)	$V_O = 0, \text{ No load}$	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 4. 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 $T_A = -55^\circ\text{C}$ to 125°C .

**TL071, TL071A, TL071B, TL072
TL072A, TL072B, TL074, TL074A, TL074B**
LOW-NOISE JFET-INPUT OPERATIONAL AMPLIFIERS

SLOS080I – SEPTEMBER 1978 – REVISED APRIL 2004

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

PARAMETER	TEST CONDITIONS	TL07xM			ALL OTHERS			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	5	13		8	13		$\text{V}/\mu\text{s}$
t_r Rise-time overshoot factor	$V_I = 20\text{ mV}$, $C_L = 100\text{ pF}$, $R_L = 2\text{ k}\Omega$, See Figure 1	0.1			0.1			μs
		20%			20%			
V_n Equivalent input noise voltage	$R_S = 20\text{ }\Omega$	$f = 1\text{ kHz}$			18			$\text{nV}/\sqrt{\text{Hz}}$
		$f = 10\text{ Hz to }10\text{ kHz}$			4			μV
I_n Equivalent input noise current	$R_S = 20\text{ }\Omega$, $f = 1\text{ kHz}$	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

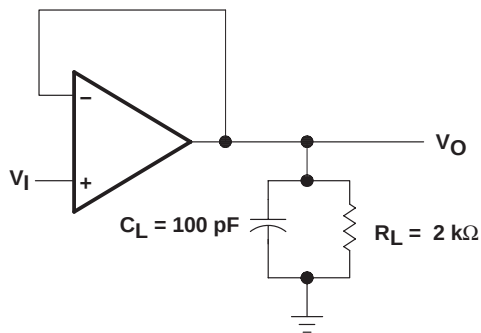


Figure 1. Unity-Gain Amplifier

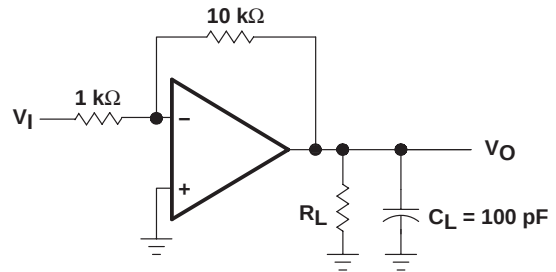


Figure 2. Gain-of-10 Inverting Amplifier

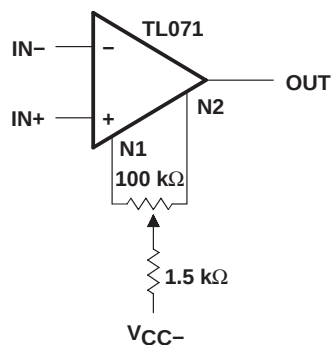


Figure 3. Input Offset-Voltage Null Circuit

**TL071, TL071A, TL071B, TL072
TL072A, TL072B, TL074, TL074A, TL074B
LOW-NOISE JFET-INPUT OPERATIONAL AMPLIFIERS**

SLOS080I – SEPTEMBER 1978 – REVISED APRIL 2004

TYPICAL CHARACTERISTICS

Table of Graphs

			FIGURE
I_{IB}	Input bias current	vs Free-air temperature	4
V_{OM}	Maximum output voltage	vs Frequency	5, 6, 7
		vs Free-air temperature	8
		vs Load resistance	9
		vs Supply voltage	10
A_{VD}	Large-signal differential voltage amplification	vs Free-air temperature	11
		vs Frequency	12
	Phase shift	vs Frequency	12
	Normalized unity-gain bandwidth	vs Free-air temperature	13
	Normalized phase shift	vs Free-air temperature	13
CMRR	Common-mode rejection ratio	vs Free-air temperature	14
I_{CC}	Supply current	vs Supply voltage	15
		vs Free-air temperature	16
P_D	Total power dissipation	vs Free-air temperature	17
	Normalized slew rate	vs Free-air temperature	18
V_n	Equivalent input noise voltage	vs Frequency	19
THD	Total harmonic distortion	vs Frequency	20
	Large-signal pulse response	vs Time	21
V_O	Output voltage	vs Elapsed time	22

TL071, TL071A, TL071B, TL072
TL072A, TL072B, TL074, TL074A, TL074B
LOW-NOISE JFET-INPUT OPERATIONAL AMPLIFIERS

SLOS080I – SEPTEMBER 1978 – REVISED APRIL 2004

TYPICAL CHARACTERISTICS†

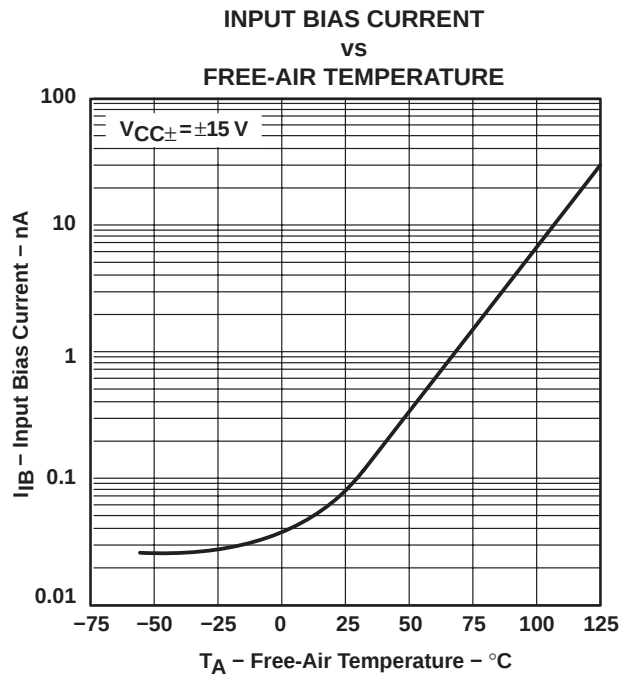


Figure 4

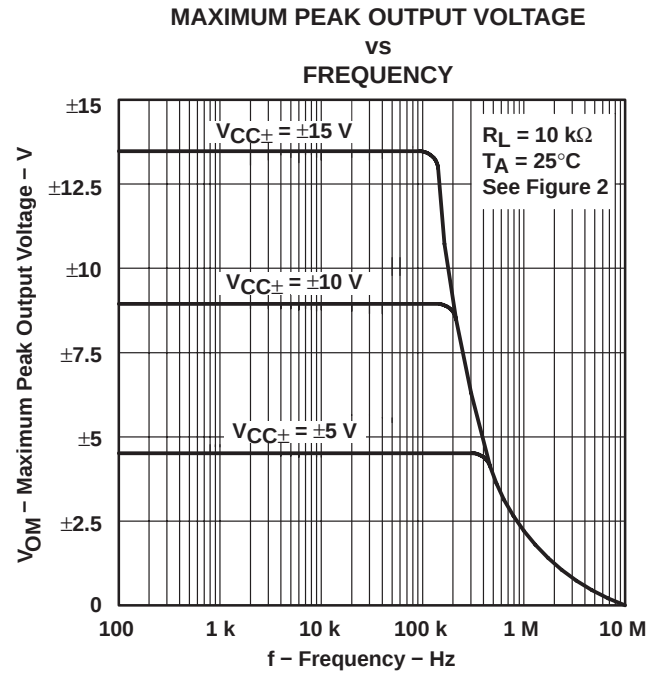


Figure 5

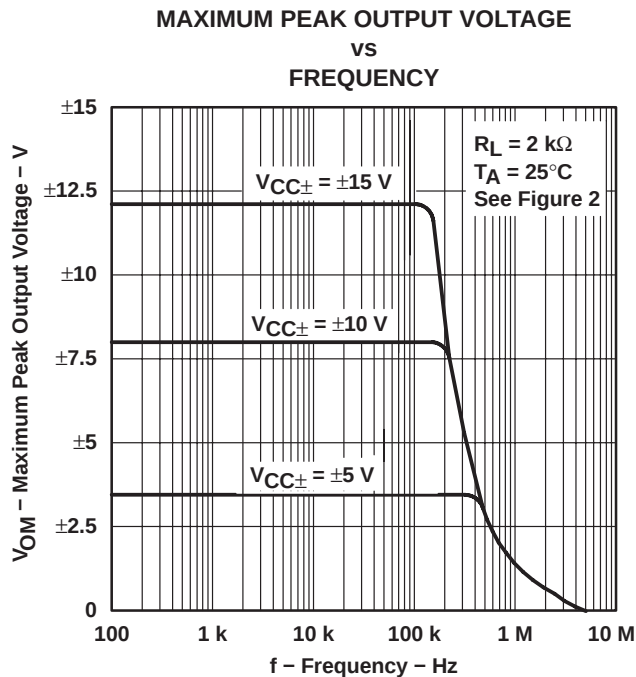


Figure 6

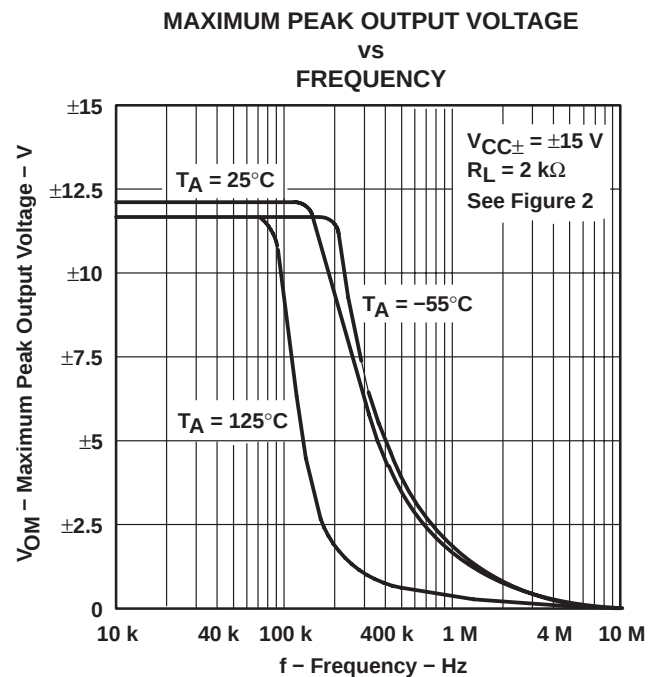


Figure 7

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

**TL071, TL071A, TL071B, TL072
TL072A, TL072B, TL074, TL074A, TL074B
LOW-NOISE JFET-INPUT OPERATIONAL AMPLIFIERS**

SLOS080I – SEPTEMBER 1978 – REVISED APRIL 2004

TYPICAL CHARACTERISTICS†

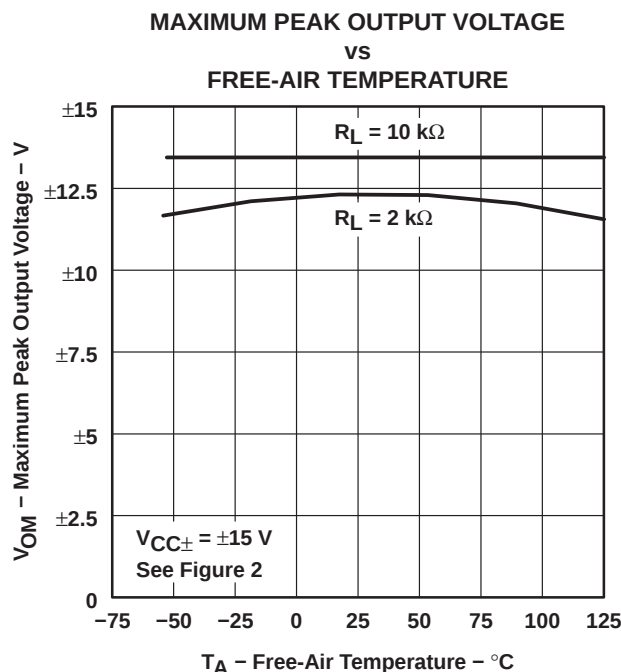


Figure 8

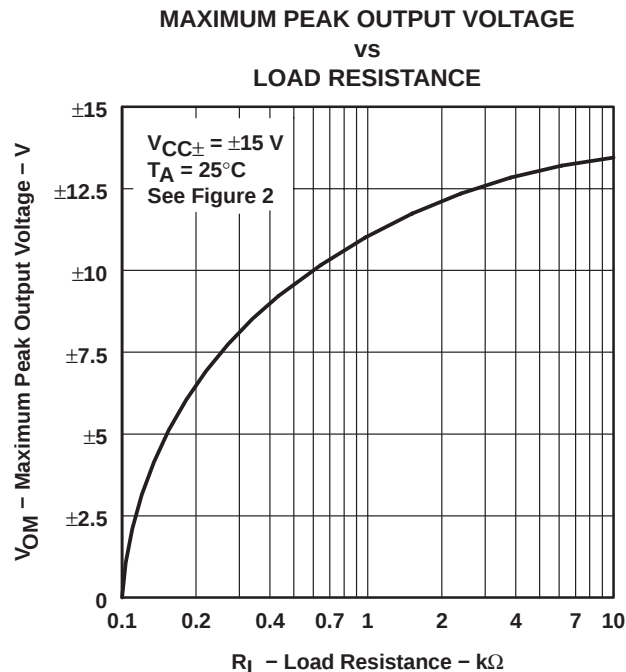


Figure 9

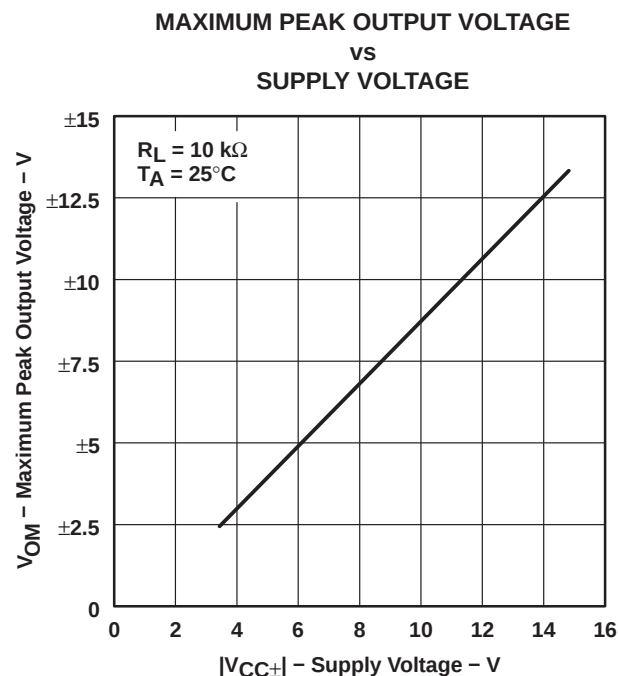


Figure 10

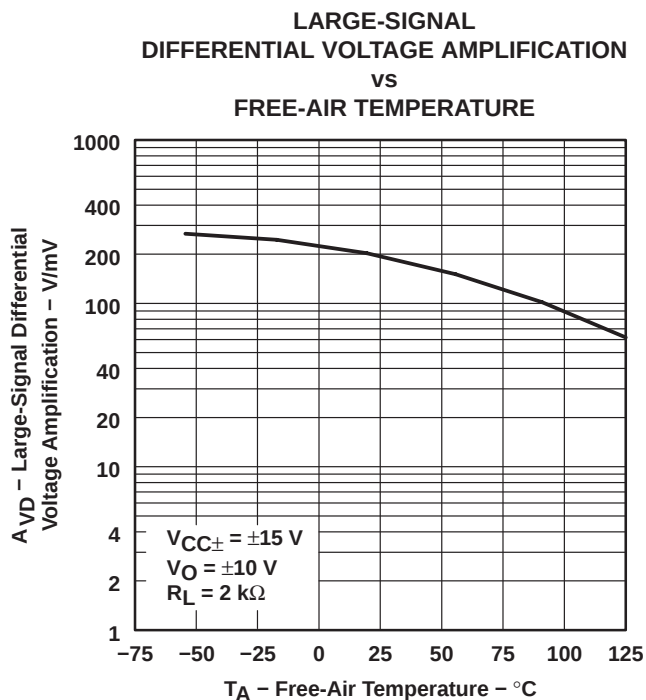


Figure 11

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

TYPICAL CHARACTERISTICS†

LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION AND PHASE SHIFT VS FREQUENCY

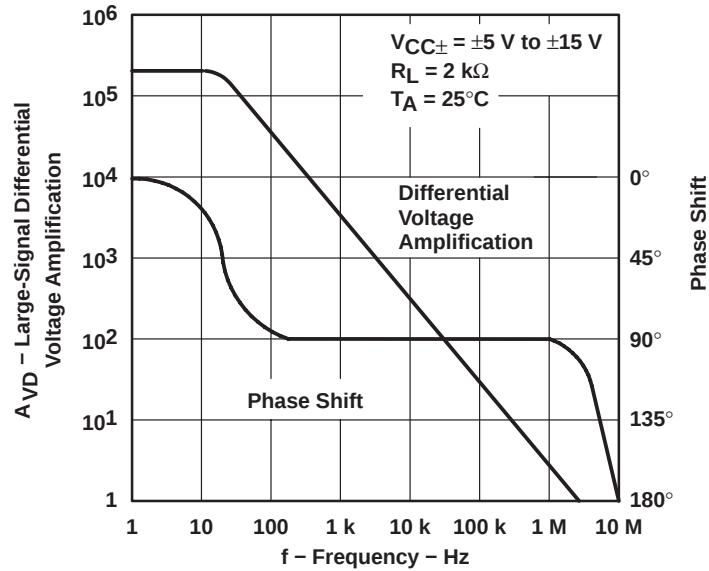


Figure 12

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

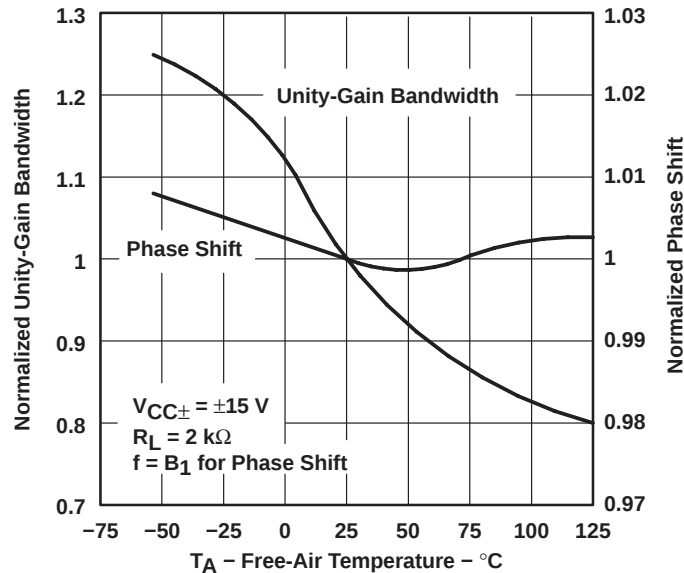


Figure 13

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

**TL071, TL071A, TL071B, TL072
TL072A, TL072B, TL074, TL074A, TL074B
LOW-NOISE JFET-INPUT OPERATIONAL AMPLIFIERS**

SLOS080I – SEPTEMBER 1978 – REVISED APRIL 2004

TYPICAL CHARACTERISTICS†

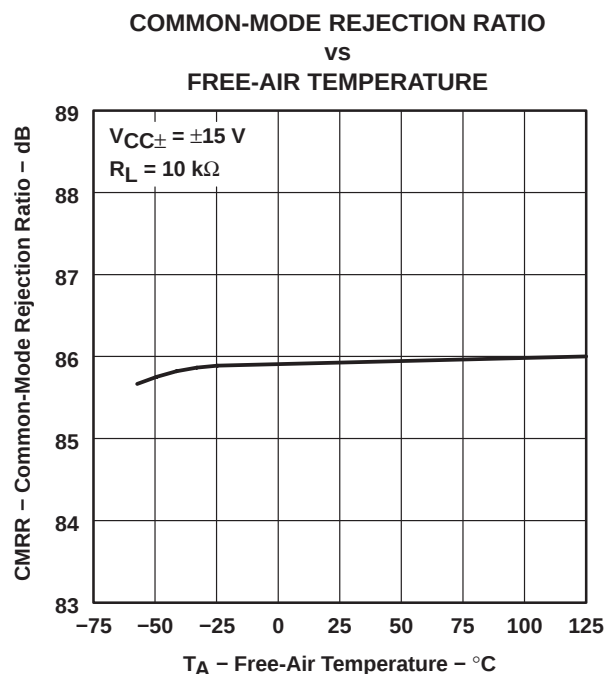


Figure 14

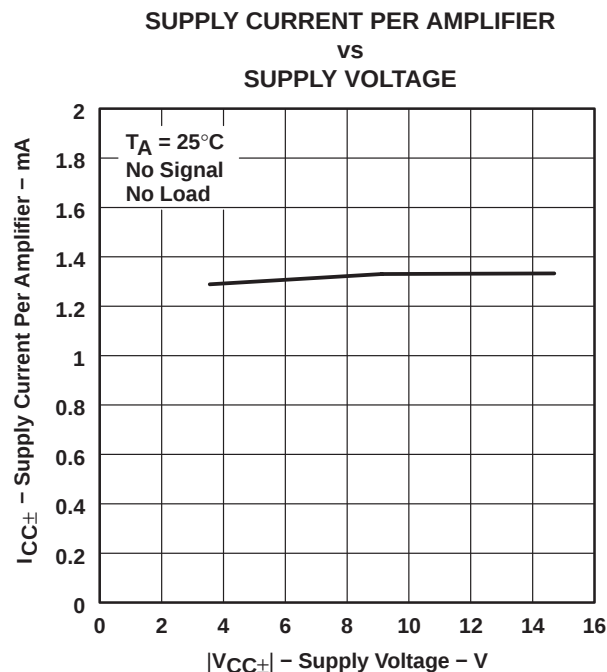


Figure 15

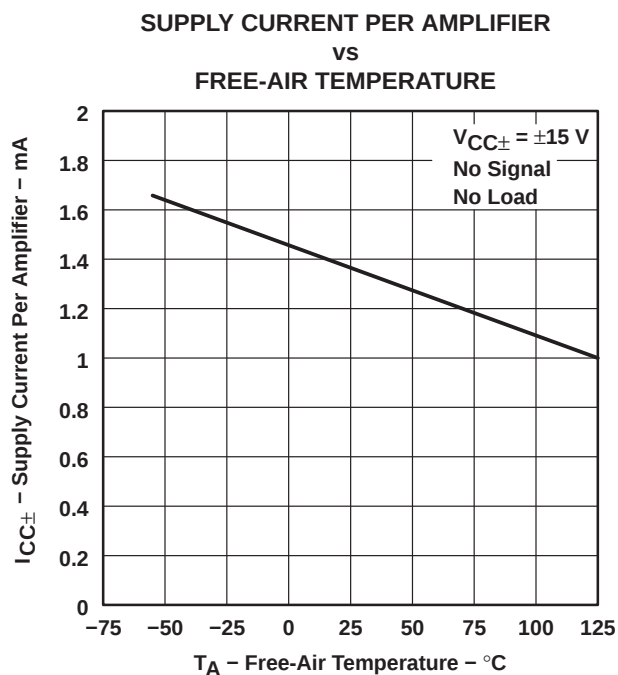


Figure 16

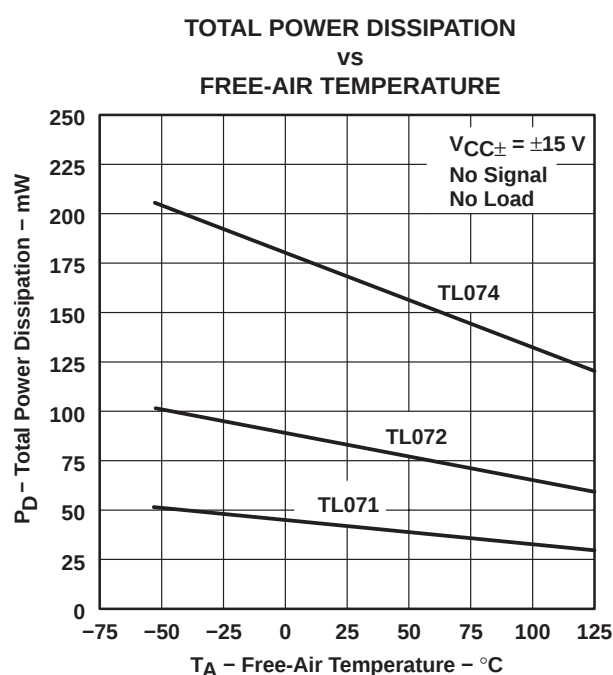


Figure 17

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

TYPICAL CHARACTERISTICS

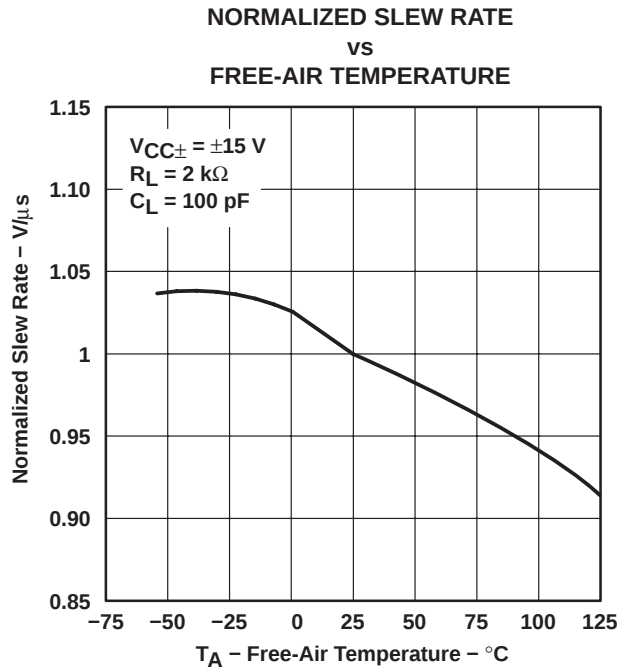


Figure 18

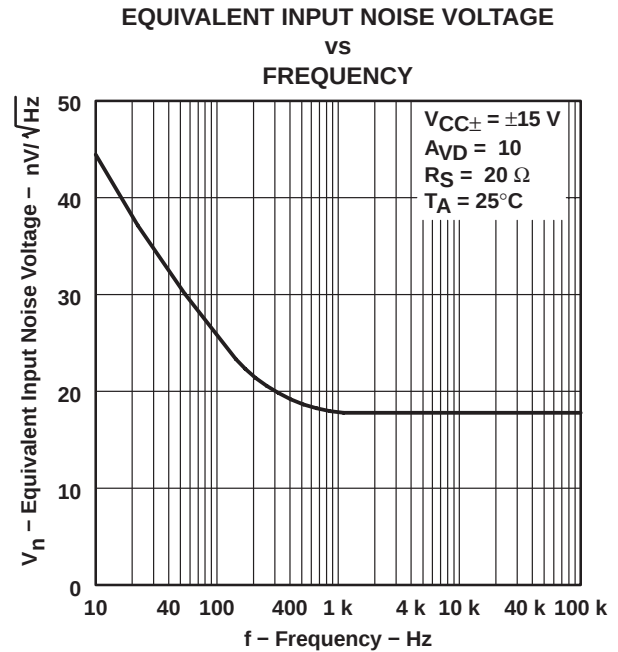


Figure 19

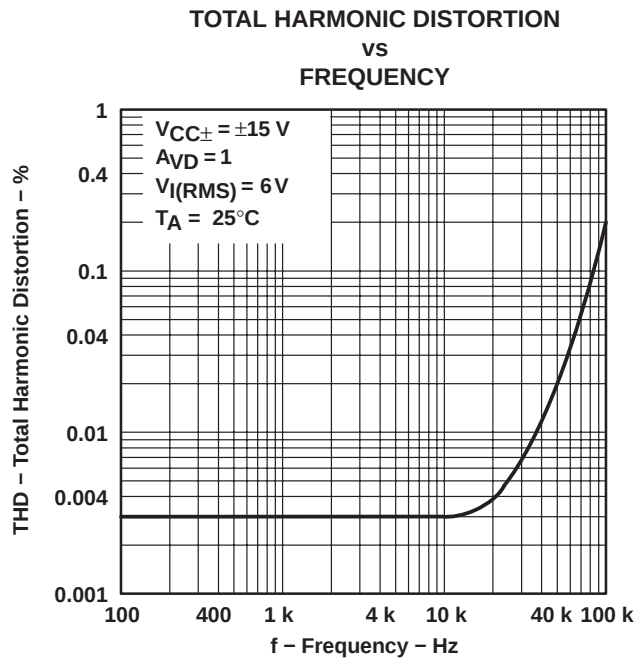


Figure 20

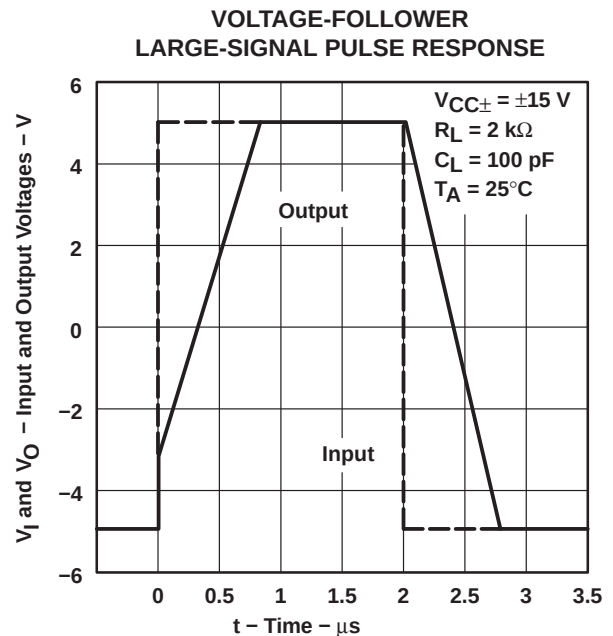


Figure 21

TL071, TL071A, TL071B, TL072
TL072A, TL072B, TL074, TL074A, TL074B
LOW-NOISE JFET-INPUT OPERATIONAL AMPLIFIERS

SLOS080I – SEPTEMBER 1978 – REVISED APRIL 2004

TYPICAL CHARACTERISTICS

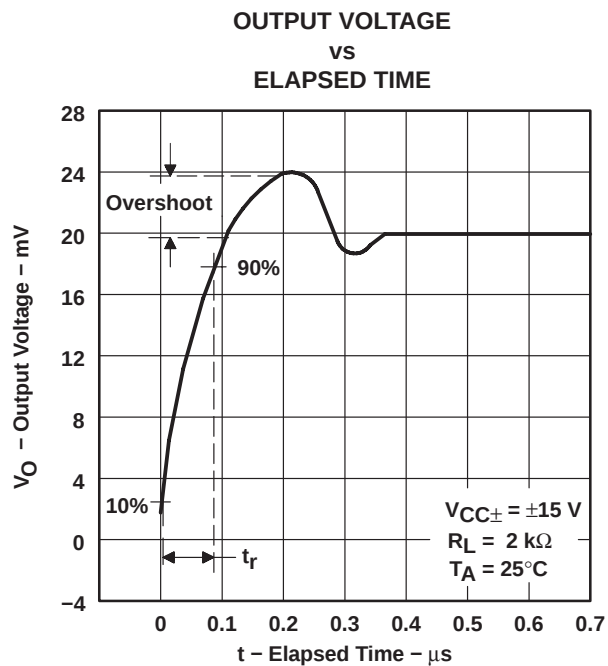


Figure 22

APPLICATION INFORMATION

Table of Application Diagrams

APPLICATION DIAGRAM	PART NUMBER	FIGURE
0.5-Hz square-wave oscillator	TL071	23
High-Q notch filter	TL071	24
Audio-distribution amplifier	TL074	25
100-kHz quadrature oscillator	TL072	26
AC amplifier	TL071	27

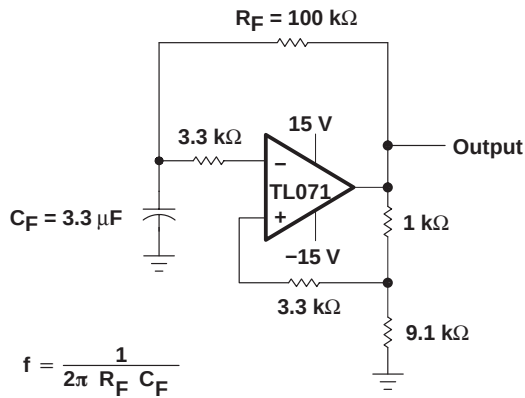


Figure 23. 0.5-Hz Square-Wave Oscillator

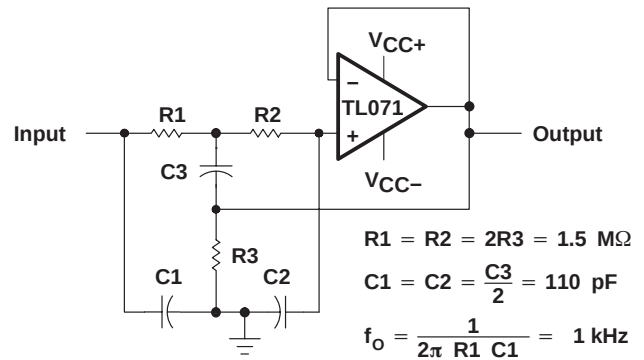


Figure 24. High-Q Notch Filter

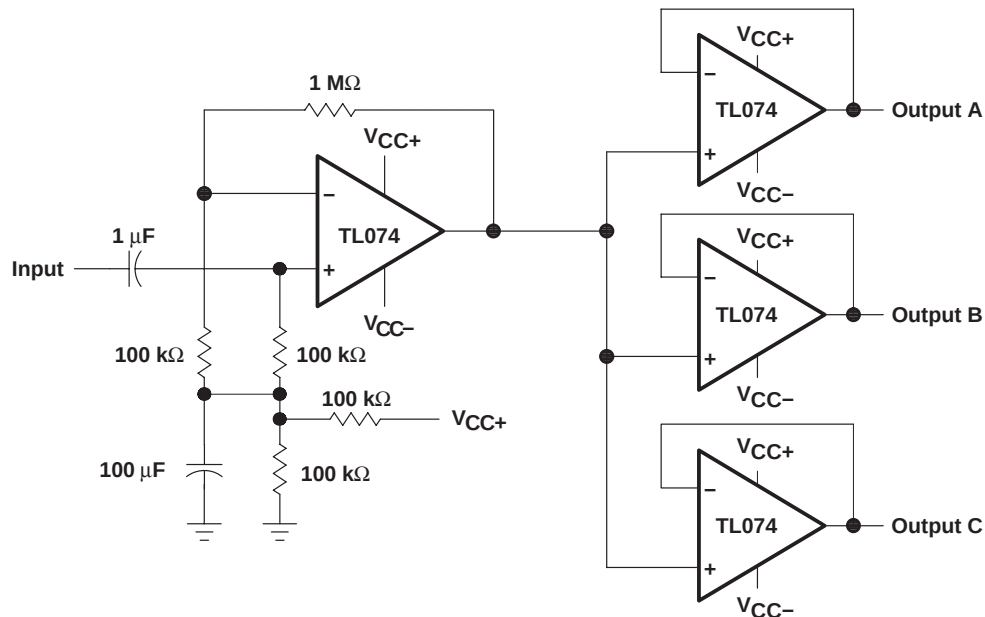
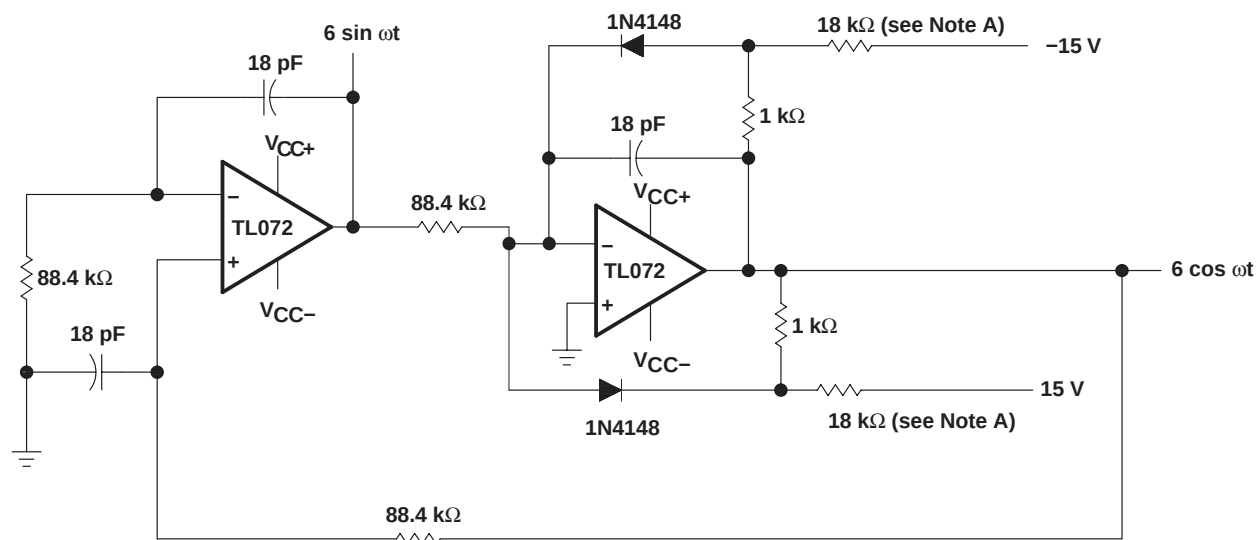


Figure 25. Audio-Distribution Amplifier

TL071, TL071A, TL071B, TL072
TL072A, TL072B, TL074, TL074A, TL074B
LOW-NOISE JFET-INPUT OPERATIONAL AMPLIFIERS

SLOS080I – SEPTEMBER 1978 – REVISED APRIL 2004

APPLICATION INFORMATION



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

Figure 26. 100-kHz Quadrature Oscillator

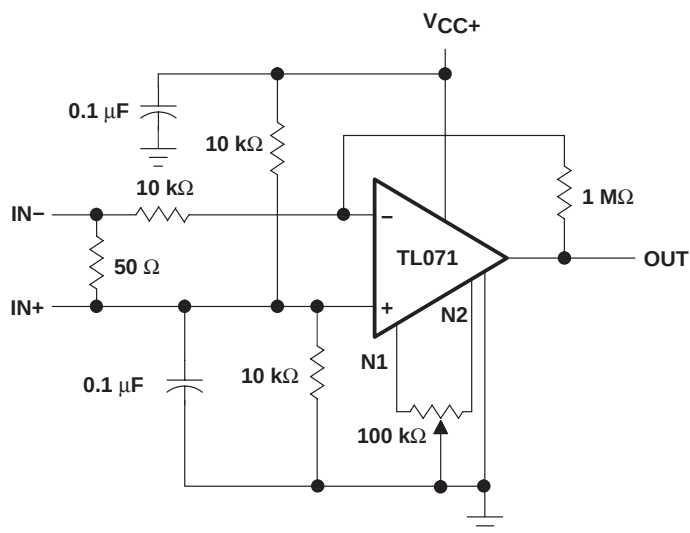


Figure 27. AC Amplifier

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
8102304HA	OBSOLETE			10		None	Call TI	Call TI
81023052A	ACTIVE	LCCC	FK	20	1	None	POST-PLATE	Level-NC-NC-NC
8102305HA	ACTIVE	CFP	U	10	1	None	A42 SNPB	Level-NC-NC-NC
8102305PA	ACTIVE	CDIP	JG	8	1	None	A42 SNPB	Level-NC-NC-NC
81023062A	ACTIVE	LCCC	FK	20	1	None	POST-PLATE	Level-NC-NC-NC
8102306CA	ACTIVE	CDIP	J	14	1	None	A42 SNPB	Level-NC-NC-NC
8102306DA	ACTIVE	CFP	W	14	1	None	A42 SNPB	Level-NC-NC-NC
JM38510/11905BPA	ACTIVE	CDIP	JG	8	1	None	A42 SNPB	Level-NC-NC-NC
JM38510/11906BCA	OBSOLETE	CDIP	J	14		None	Call TI	Call TI
TL071ACD	ACTIVE	SOIC	D	8	75	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
TL071ACDR	ACTIVE	SOIC	D	8	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
TL071ACP	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
TL071BCD	ACTIVE	SOIC	D	8	75	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
TL071BCDR	ACTIVE	SOIC	D	8	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
TL071BCP	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
TL071CD	ACTIVE	SOIC	D	8	75	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
TL071CDR	ACTIVE	SOIC	D	8	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
TL071CP	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
TL071CPSR	ACTIVE	SO	PS	8	2000	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
TL071CPWLE	OBSOLETE	TSSOP	PW	8		None	Call TI	Call TI
TL071ID	ACTIVE	SOIC	D	8	75	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
TL071IDR	ACTIVE	SOIC	D	8	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
TL071IJG	OBSOLETE	CDIP	JG	8		None	Call TI	Call TI
TL071IP	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
TL071MFKB	OBSOLETE	LCCC	FK	20		None	Call TI	Call TI
TL071MJG	OBSOLETE	CDIP	JG	8		None	Call TI	Call TI
TL071MJGB	OBSOLETE	CDIP	JG	8		None	Call TI	Call TI
TL072ACD	ACTIVE	SOIC	D	8	75	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR
TL072ACDR	ACTIVE	SOIC	D	8	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR
TL072ACJG	OBSOLETE	CDIP	JG	8		None	Call TI	Call TI
TL072ACP	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
TL072ACPSR	ACTIVE	SO	PS	8	2000	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
TL072BCD	ACTIVE	SOIC	D	8	75	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR
TL072BCDR	ACTIVE	SOIC	D	8	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR
TL072BCP	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
TL072CD	ACTIVE	SOIC	D	8	75	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR
TL072CDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL072CP	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
TL072CPSLE	OBSOLETE	SO	PS	8		None	Call TI	Call TI
TL072CPSR	ACTIVE	SO	PS	8	2000	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
TL072CPWR	ACTIVE	TSSOP	PW	8	2000	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM
TL072ID	ACTIVE	SOIC	D	8	75	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR
TL072IDR	ACTIVE	SOIC	D	8	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR
TL072IP	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
TL072MFKB	ACTIVE	LCCC	FK	20	1	None	POST-PLATE	Level-NC-NC-NC
TL072MJG	ACTIVE	CDIP	JG	8	1	None	A42 SNPB	Level-NC-NC-NC
TL072MJGB	ACTIVE	CDIP	JG	8	1	None	A42 SNPB	Level-NC-NC-NC
TL072MUB	ACTIVE	CFP	U	10	1	None	A42 SNPB	Level-NC-NC-NC
TL074ACD	ACTIVE	SOIC	D	14	50	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR
TL074ACDR	ACTIVE	SOIC	D	14	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR
TL074ACJ	OBSOLETE	CDIP	J	14		None	Call TI	Call TI
TL074ACN	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
TL074ACNSR	ACTIVE	SO	NS	14	2000	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
TL074BCD	ACTIVE	SOIC	D	14	50	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR
TL074BCDR	ACTIVE	SOIC	D	14	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR
TL074BCN	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
TL074BCNSR	ACTIVE	SO	NS	14	2000	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
TL074CD	ACTIVE	SOIC	D	14	50	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR
TL074CDR	ACTIVE	SOIC	D	14	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
TL074CN	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
TL074CNSR	ACTIVE	SO	NS	14	2000	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
TL074CPW	ACTIVE	TSSOP	PW	14	90	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM
TL074CPWLE	OBSOLETE	TSSOP	PW	14		None	Call TI	Call TI
TL074CPWR	ACTIVE	TSSOP	PW	14	2000	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM
TL074ID	ACTIVE	SOIC	D	14	50	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR
TL074IDR	ACTIVE	SOIC	D	14	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR
TL074IJ	OBSOLETE	CDIP	J	14		None	Call TI	Call TI
TL074IN	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
TL074MFK	ACTIVE	LCCC	FK	20	1	None	POST-PLATE	Level-NC-NC-NC
TL074MFKB	ACTIVE	LCCC	FK	20	1	None	POST-PLATE	Level-NC-NC-NC
TL074MJ	ACTIVE	CDIP	J	14	1	None	A42 SNPB	Level-NC-NC-NC
TL074MJB	ACTIVE	CDIP	J	14	1	None	A42 SNPB	Level-NC-NC-NC
TL074MWB	ACTIVE	CFP	W	14	1	None	A42 SNPB	Level-NC-NC-NC

⁽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 - May not be currently available - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

None: Not yet available Lead (Pb-Free).

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.

Green (RoHS & no Sb/Br): TI defines "Green" to mean "Pb-Free" and in addition, uses package materials that do not contain halogens, including bromine (Br) or antimony (Sb) above 0.1% of total product weight.

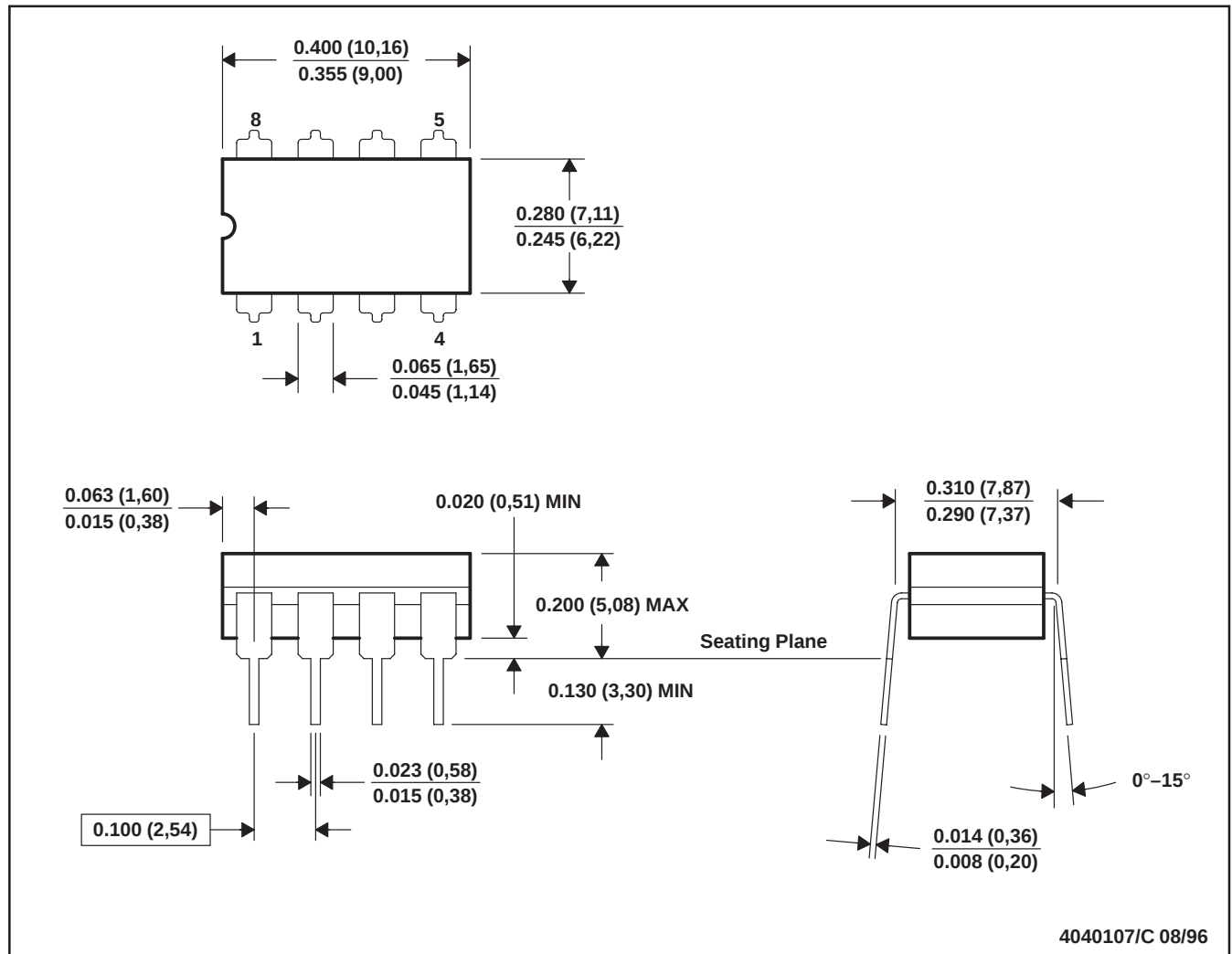
⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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.

JG (R-GDIP-T8)

CERAMIC DUAL-IN-LINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. This package can be hermetically sealed with a ceramic lid using glass frit.
 - D. Index point is provided on cap for terminal identification.
 - E. Falls within MIL STD 1835 GDIP1-T8

J (R-GDIP-T**)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



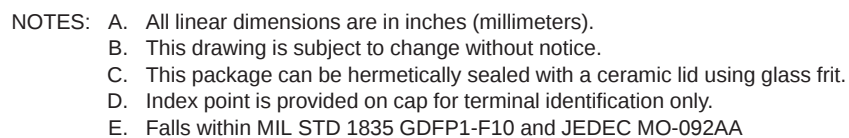
PINS ** DIM	14	16	18	20
A	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC
B MAX	0.785 (19,94)	.840 (21,34)	0.960 (24,38)	1.060 (26,92)
B MIN	—	—	—	—
C MAX	0.300 (7,62)	0.300 (7,62)	0.310 (7,87)	0.300 (7,62)
C MIN	0.245 (6,22)	0.245 (6,22)	0.220 (5,59)	0.245 (6,22)



4040083/F 03/03

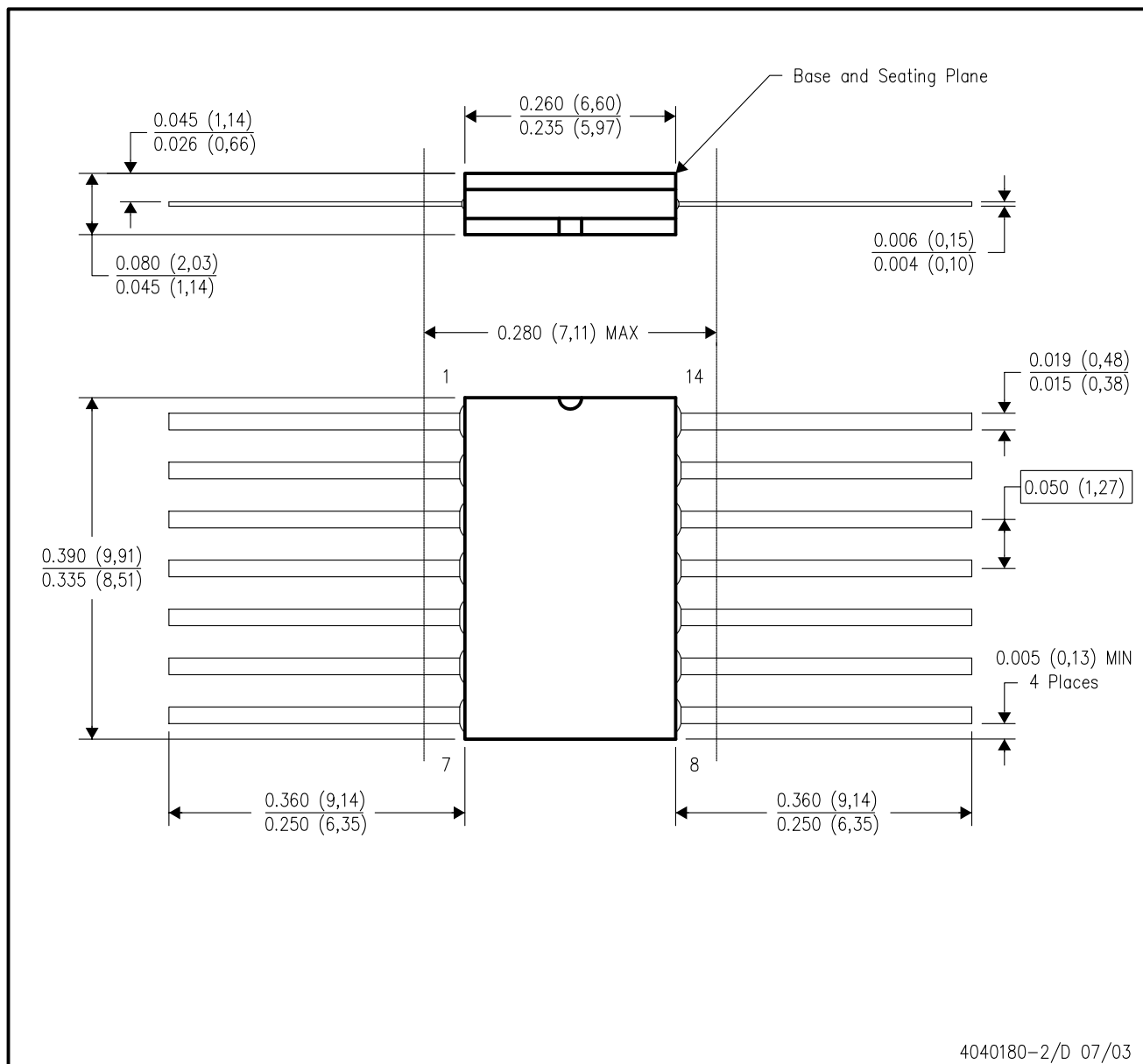
- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. This package is hermetically sealed with a ceramic lid using glass frit.
 - D. Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
 - E. Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18 and GDIP1-T20.

CERAMIC DUAL FLATPACK



W (R-GDFP-F14)

CERAMIC DUAL FLATPACK

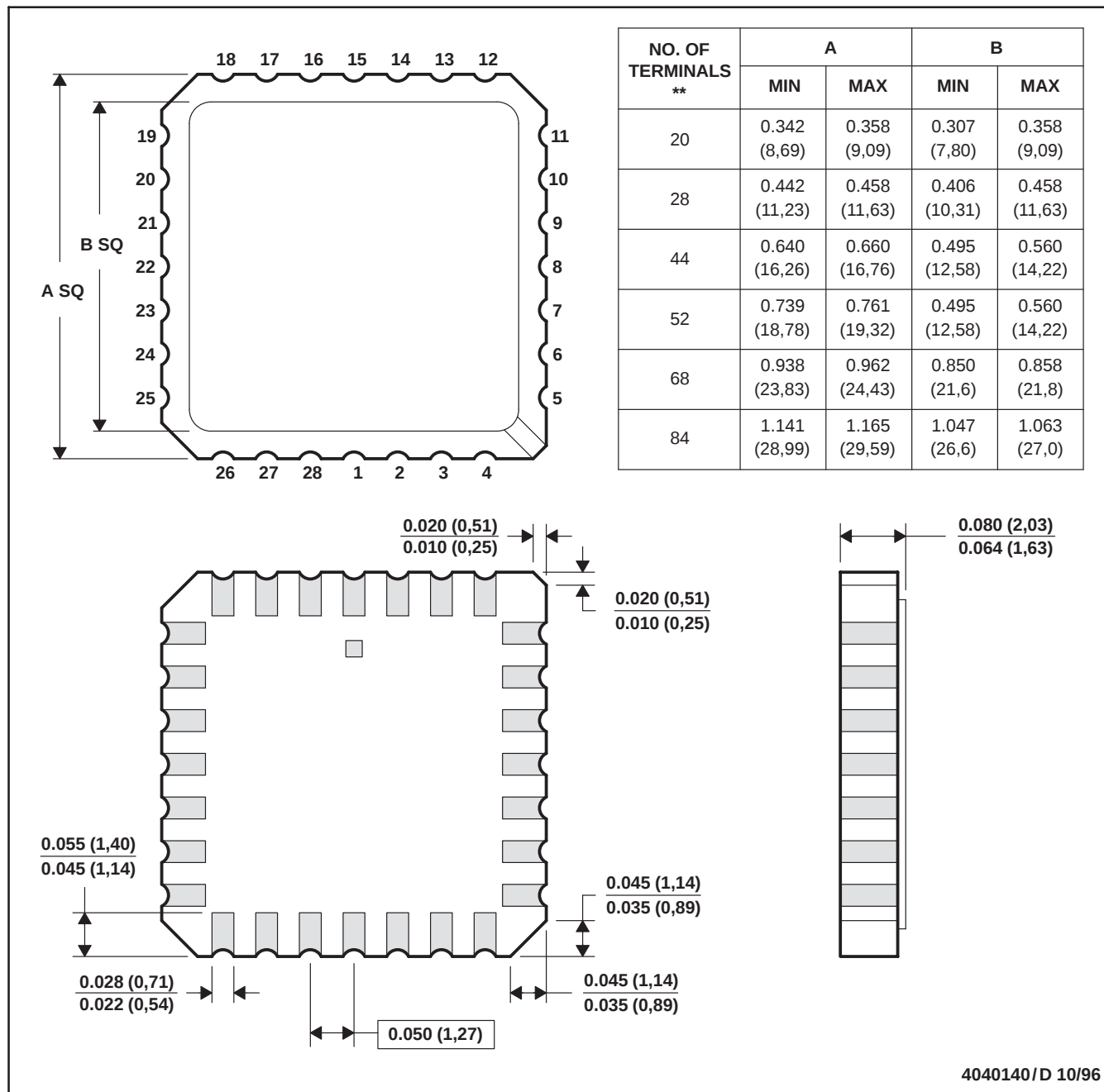


- NOTES:
- All linear dimensions are in inches (millimeters).
 - This drawing is subject to change without notice.
 - This package can be hermetically sealed with a ceramic lid using glass frit.
 - Index point is provided on cap for terminal identification only.
 - Falls within MIL STD 1835 GDFP1-F14 and JEDEC MO-092AB

FK (S-CQCC-N**)

LEADLESS CERAMIC CHIP CARRIER

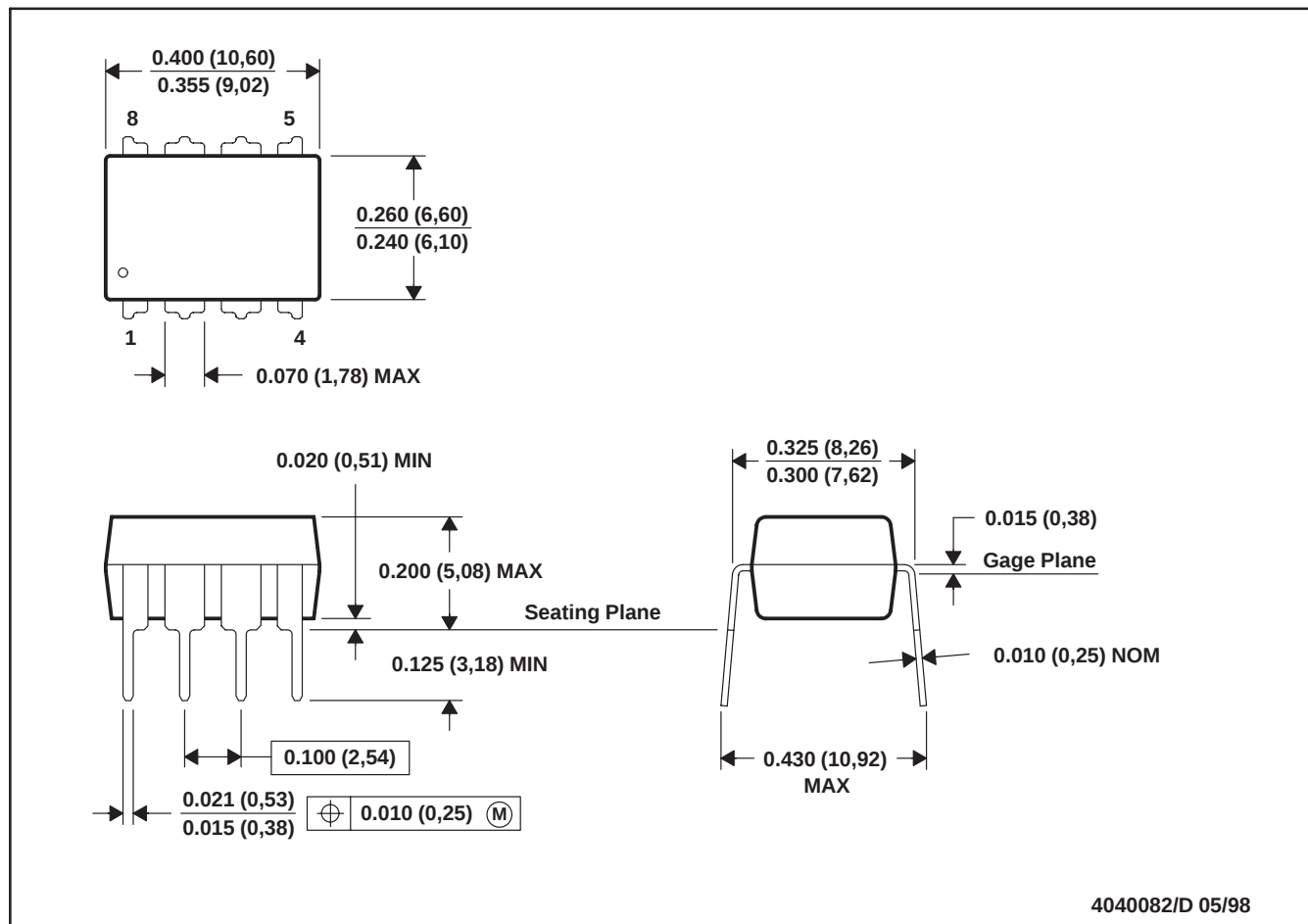
28 TERMINAL SHOWN



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. This package can be hermetically sealed with a metal lid.
 - D. The terminals are gold plated.
 - E. Falls within JEDEC MS-004

P (R-PDIP-T8)

PLASTIC DUAL-IN-LINE



- NOTES: A. All linear dimensions are in inches (millimeters).
 B. This drawing is subject to change without notice.
 C. Falls within JEDEC MS-001

For the latest package information, go to http://www.ti.com/sc/docs/package/pkg_info.htm



POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

N (R-PDIP-T**)

16 PINS SHOWN

PLASTIC DUAL-IN-LINE PACKAGE



PINS ** DIM	14	16	18	20
A MAX	0.775 (19,69)	0.775 (19,69)	0.920 (23,37)	1.060 (26,92)
A MIN	0.745 (18,92)	0.745 (18,92)	0.850 (21,59)	0.940 (23,88)
MS-001 VARIATION	AA	BB	AC	AD



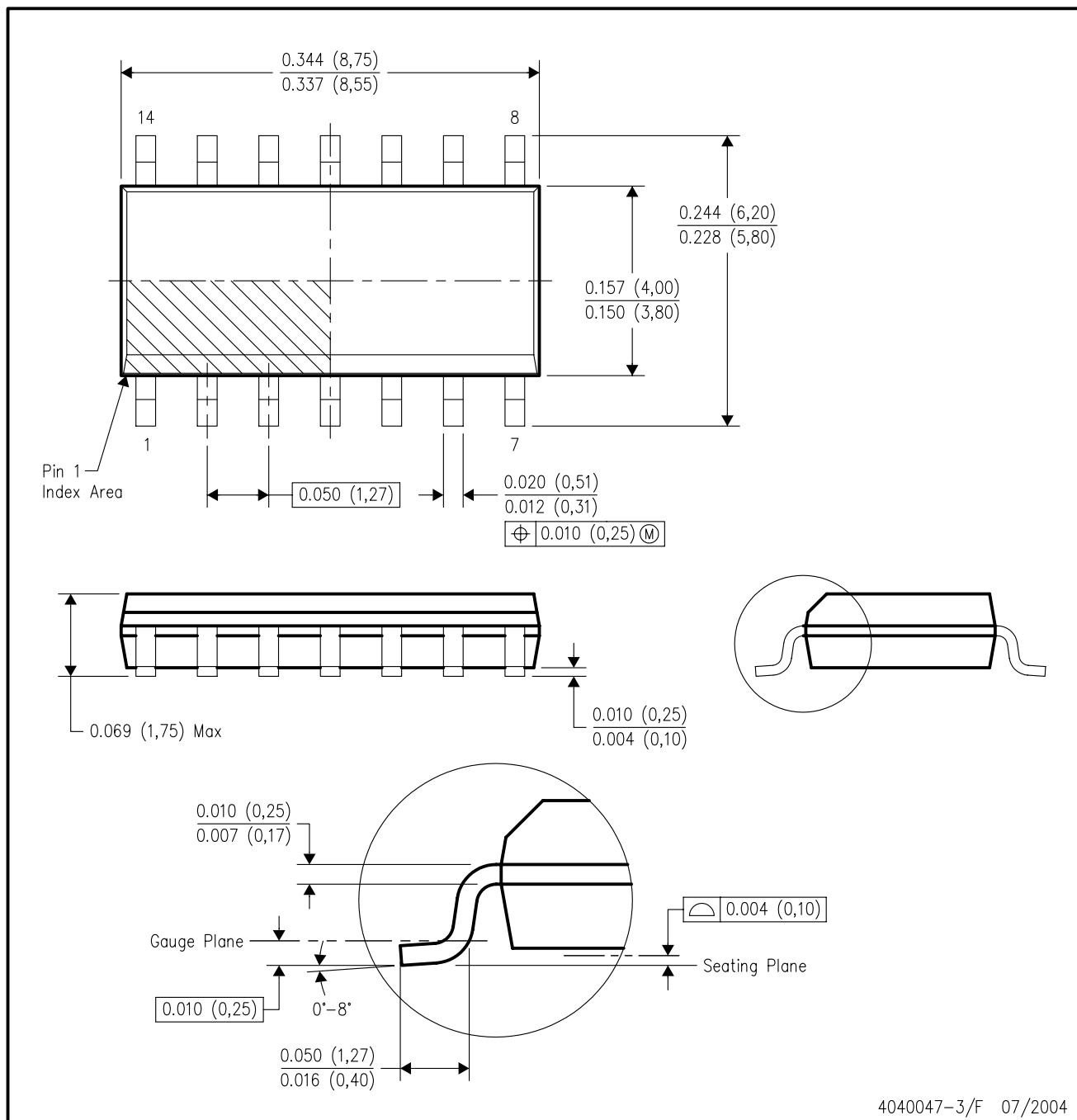
4040049/E 12/2002

NOTES:

- A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
-  Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
 The 20 pin end lead shoulder width is a vendor option, either half or full width.

D (R-PDSO-G14)

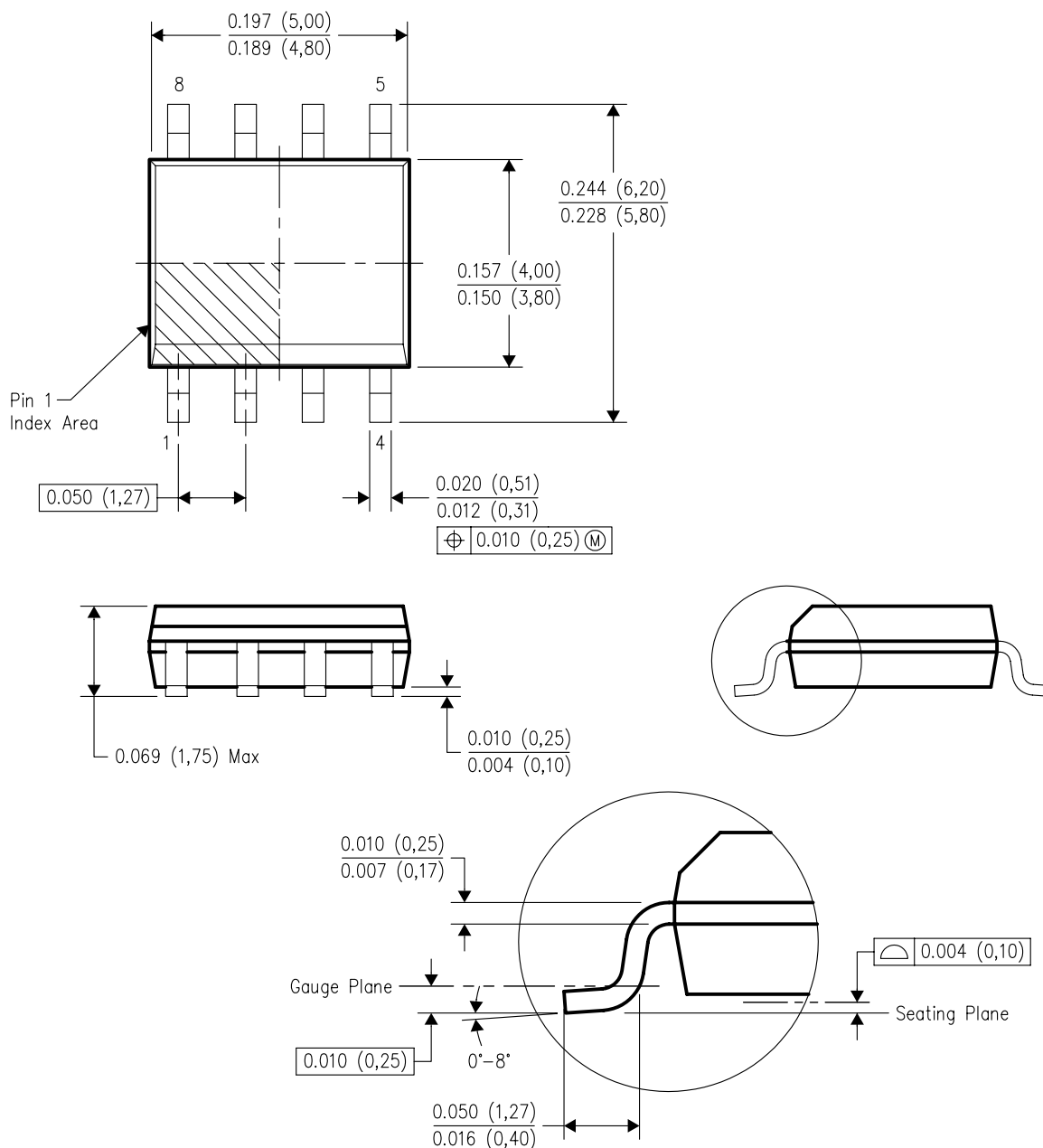
PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- All linear dimensions are in inches (millimeters).
 - This drawing is subject to change without notice.
 - Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
 - Falls within JEDEC MS-012 variation AB.

D (R-PDSO-G8)

PLASTIC SMALL-OUTLINE PACKAGE



4040047-2/F 07/2004

- NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
D. Falls within JEDEC MS-012 variation AA.

MECHANICAL DATA

PS (R-PDSO-G8)

PLASTIC SMALL-OUTLINE PACKAGE



4040063/C 03/03

- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

MECHANICAL DATA

NS (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN



DIM \ PINS **	14	16	20	24
A MAX	10,50	10,50	12,90	15,30
A MIN	9,90	9,90	12,30	14,70

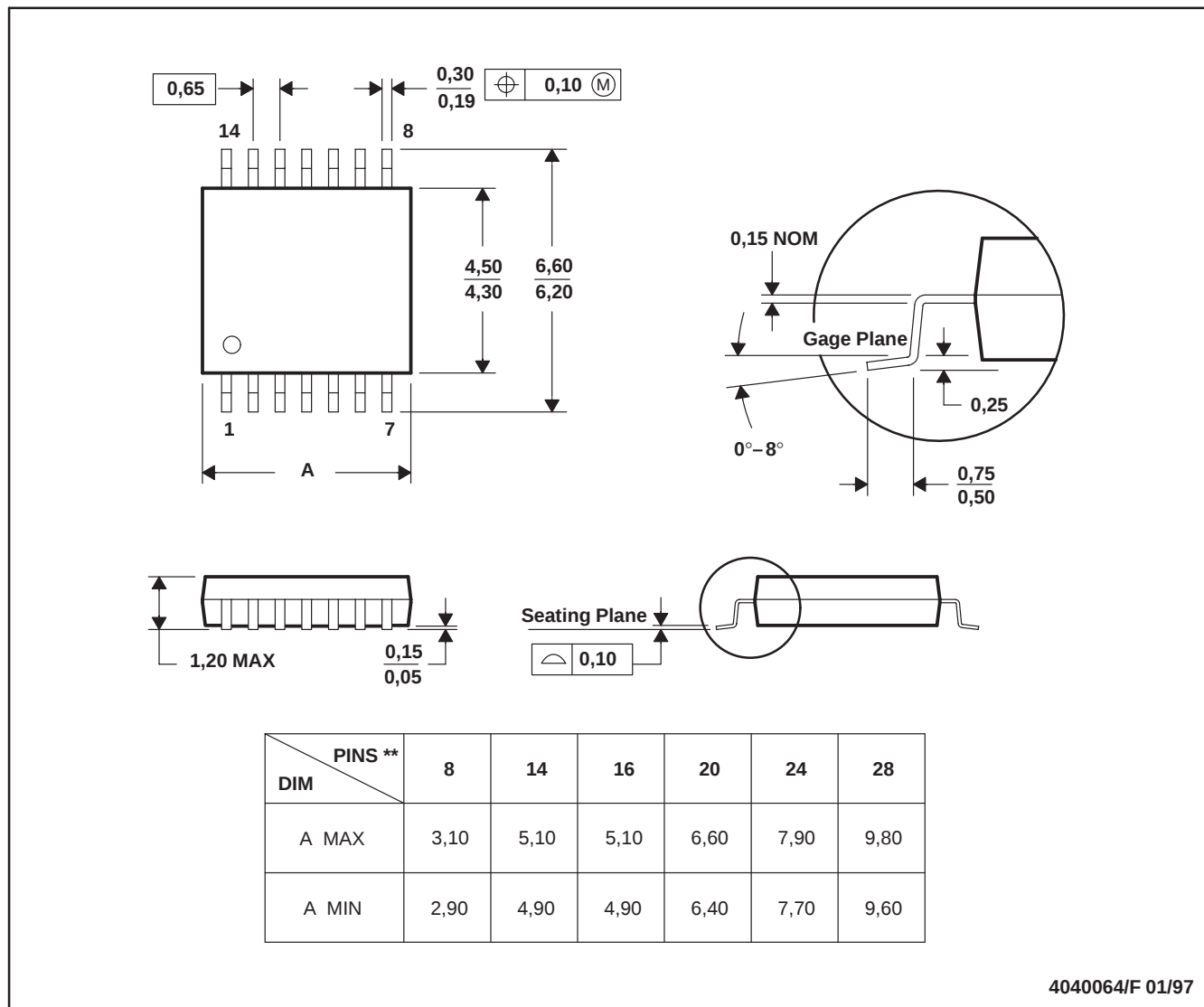
4040062/C 03/03

- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

PW (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

14 PINS SHOWN



- NOTES: A. All linear dimensions are in millimeters.
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.
 D. Falls within JEDEC MO-153

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products		Applications	
Amplifiers	amplifier.ti.com	Audio	www.ti.com/audio
Data Converters	dataconverter.ti.com	Automotive	www.ti.com/automotive
DSP	dsp.ti.com	Broadband	www.ti.com/broadband
Interface	interface.ti.com	Digital Control	www.ti.com/digitalcontrol
Logic	logic.ti.com	Military	www.ti.com/military
Power Mgmt	power.ti.com	Optical Networking	www.ti.com/opticalnetwork
Microcontrollers	microcontroller.ti.com	Security	www.ti.com/security
		Telephony	www.ti.com/telephony
		Video & Imaging	www.ti.com/video
		Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments
Post Office Box 655303 Dallas, Texas 75265

Copyright © 2005, Texas Instruments Incorporated