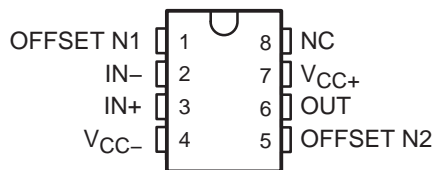


# TL061, TL061A, TL061B, TL062, TL062A TL062B, TL064, TL064A, TL064B LOW-POWER JFET-INPUT OPERATIONAL AMPLIFIERS

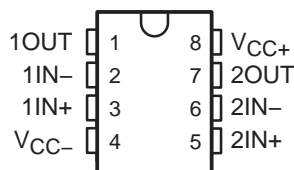
SLOS078J – NOVEMBER 1978 – REVISED SEPTEMBER 2004

- Very Low Power Consumption
- Typical Supply Current . . . 200  $\mu$ A (Per Amplifier)
- Wide Common-Mode and Differential Voltage Ranges
- Low Input Bias and Offset Currents
- Common-Mode Input Voltage Range Includes  $V_{CC+}$
- Output Short-Circuit Protection
- High Input Impedance . . . JFET-Input Stage
- Internal Frequency Compensation
- Latch-Up-Free Operation
- High Slew Rate . . . 3.5 V/ $\mu$ s Typ

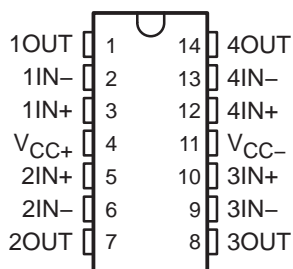
TL061, TL061A . . . D, P, OR PS PACKAGE  
TL061B . . . P PACKAGE  
(TOP VIEW)



TL062 . . . D, JG, P, PS, OR PW PACKAGE  
TL062A . . . D, P, OR PS PACKAGE  
TL062B . . . D OR P PACKAGE  
(TOP VIEW)

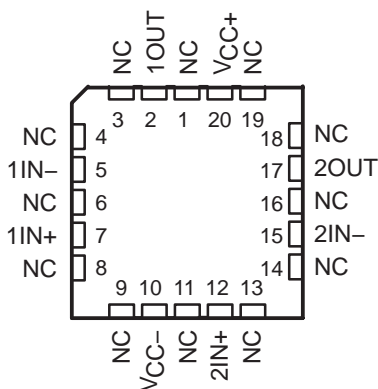


TL064 . . . D, J, N, NS, PW, OR W PACKAGE  
TL064A, TL064B . . . D OR N PACKAGE  
(TOP VIEW)

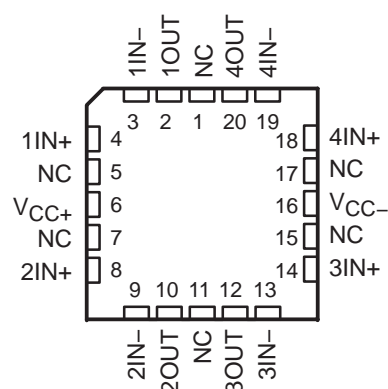


NC – No internal connection

TL062 . . . FK PACKAGE  
(TOP VIEW)



TL064 . . . FK PACKAGE  
(TOP VIEW)



## description/ordering information

The JFET-input operational amplifiers of the TL06\_ series are designed as low-power versions of the TL08\_ series amplifiers. They feature high input impedance, wide bandwidth, high slew rate, and low input offset and input bias currents. The TL06\_ series features the same terminal assignments as the TL07\_ and TL08\_ series. Each of these JFET-input operational amplifiers incorporates well-matched, high-voltage JFET and bipolar transistors in an integrated circuit.

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, and 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.

 **TEXAS  
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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.

**TL061, TL061A, TL061B, TL062, TL062A  
 TL062B, TL064, TL064A, TL064B  
 LOW-POWER JFET-INPUT OPERATIONAL AMPLIFIERS**

SLOS078J – NOVEMBER 1978 – REVISED SEPTEMBER 2004

**description/ordering information (continued)**

**ORDERING INFORMATION**

TA	V <sub>IO</sub> MAX AT 25°C	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING	
0°C to 70°C	15 mV	PDIP (P)	Tube of 50	TL061CP	TL061CP	
				TL062CP	TL062CP	
		PDIP (N)	Tube of 25	TL064CN	TL064CN	
		SOIC (D)	Tube of 75	TL061CD	TL061C	
				TL061CDR		
			Tube of 75	TL062CD	TL062C	
				TL062CDR		
			Tube of 50	TL064CD	TL064C	
				TL064CDR		
		SOP (PS)	Reel of 2000	TL061CPSR	T061	
				TL062CPSR	T062	
		SOP (NS)	Reel of 2000	TL064CNSR	TL064	
		TSSOP (PW)	Tube of 150	TL062CPW	T062	
				TL062CPWR		
			Tube of 90	TL064CPW	T064	
				TL064CPWR		
		6 mV	PDIP (P)	Tube of 50	TL061ACP	TL061ACP
					TL062ACP	TL062ACP
	PDIP (N)		Tube of 25	TL064ACN	TL064ACN	
				SOIC (D)	Tube of 75	TL061ACD
	TL061ACDR					
	Tube of 75		TL062ACD		062AC	
			TL062ACDR			
	Tube of 50		TL064ACD	TL064AC		
			TL064ACDR			
	SOP (PS)		Reel of 2000	TL061ACPSR	T061A	
				TL062ACPSR	T062A	
	3 mV		PDIP (P)	Tube of 50	TL061BCP	TL061BCP
		TL062BCP			TL062BCP	
		PDIP (N)	Tube of 25	TL064BCN	TL064BCN	
SOIC (D)				Tube of 75	TL062BCD	062BC
		TL062BCDR				
		Tube of 50	TL064BCD	TL064BC		
	TL064BCDR					

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



**TL061, TL061A, TL061B, TL062, TL062A  
TL062B, TL064, TL064A, TL064B  
LOW-POWER JFET-INPUT OPERATIONAL AMPLIFIERS**

SLOS078J – NOVEMBER 1978 – REVISED SEPTEMBER 2004

**description/ordering information (continued)**

**ORDERING INFORMATION (continued)**

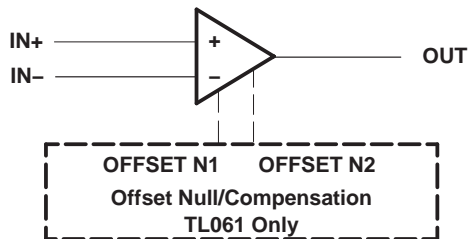
TA	V <sub>IO</sub> MAX AT 25°C	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	6 mV	PDIP (P)	Tube of 50	TL061IP	TL061IP
				TL062IP	TL062IP
		PDIP (N)	Tube of 25	TL064IN	TL064IN
		SOIC (D)	Tube of 75	TL061ID	TL061I
				TL061IDR	
			Tube of 75	TL062ID	TL062I
				TL062IDR	
			Tube of 50	TL064ID	TL064I
				TL064IDR	
		TSSOP (PW)	Reel of 2000	TL062IPWR	TL062I
–55°C to 125°C	6 mV	CDIP (JG)	Tube of 50	TL062MJG	TL062MJG
		LCCC (FK)	Tube of 55	TL062MFK	TL062MFK
	9 mV	CDIP (J)	Tube of 25	TL064MJ	TL064MJ
		CFP (W)	Tube of 150	TL064MW	TL064MW
		LCCC (FK)	Tube of 55	TL064MFK	TL064MFK

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

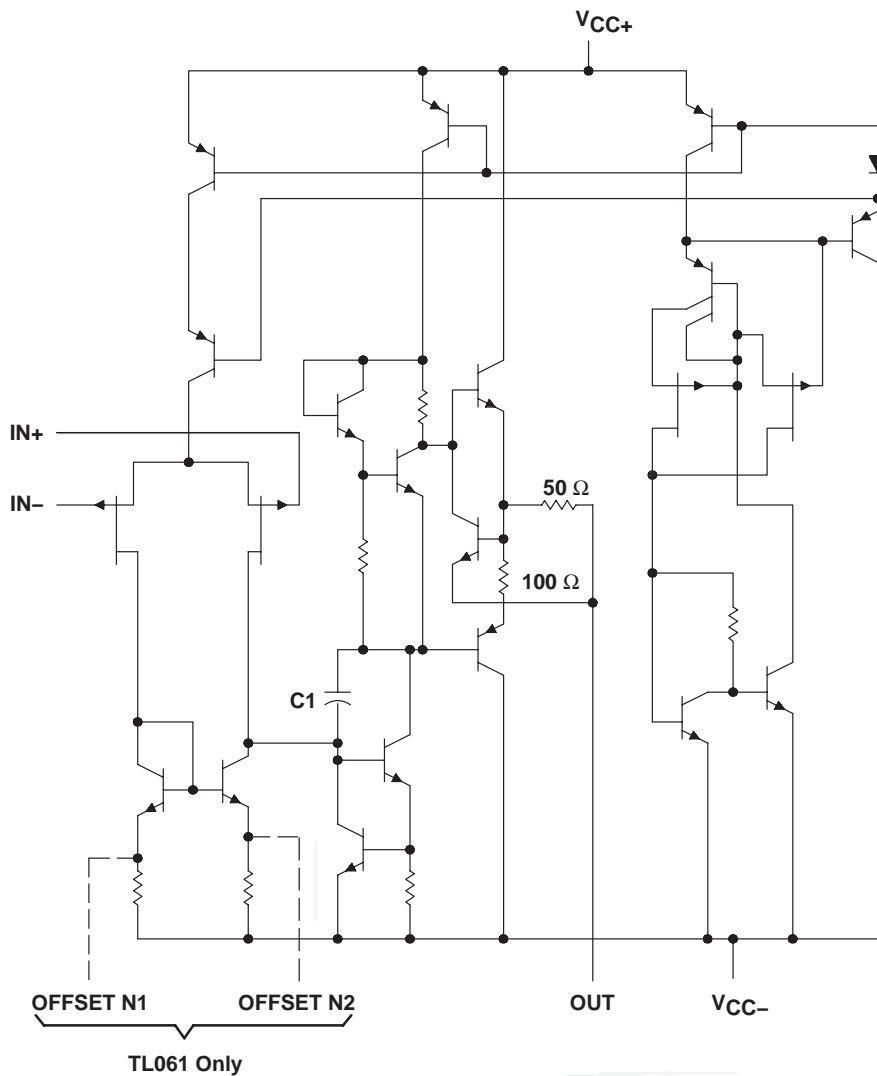
**TL061, TL061A, TL061B, TL062, TL062A  
 TL062B, TL064, TL064A, TL064B  
 LOW-POWER JFET-INPUT OPERATIONAL AMPLIFIERS**

SLOS078J – NOVEMBER 1978 – REVISED SEPTEMBER 2004

symbol (each amplifier)



schematic (each amplifier)



C1 = 10 pF on TL061, TL062, and TL064  
 Component values shown are nominal.

**TL061, TL061A, TL061B, TL062, TL062A  
TL062B, TL064, TL064A, TL064B  
LOW-POWER JFET-INPUT OPERATIONAL AMPLIFIERS**

SLOS078J – NOVEMBER 1978 – REVISED SEPTEMBER 2004

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

		TL06_C TL06_AC TL06_BC	TL06_I	TL06_M	UNIT
Supply voltage, $V_{CC+}$ (see Note 1)		18	18	18	V
Supply voltage, $V_{CC-}$ (see Note 1)		-18	-18	-18	V
Differential input voltage, $V_{ID}$ (see Note 2)		$\pm 30$	$\pm 30$	$\pm 30$	V
Input voltage, $V_I$ (see Notes 1 and 3)		$\pm 15$	$\pm 15$	$\pm 15$	V
Duration of output short circuit (see Note 4)		Unlimited	Unlimited	Unlimited	
Package thermal impedance, $\theta_{JA}$ (see Notes 5 and 6)	D (8-pin) package	97	97		°C/W
	D (14-pin) package	86	86		
	N package	80	80		
	NS package	76	76		
	P package	85	85		
	PS package	95	95		
	PW (8-pin) package	149	149		
Package thermal impedance, $\theta_{JC}$ (see Notes 7 and 8)	FK package			5.61	°C/W
	J package			15.05	
	JG package			14.5	
	W package			14.65	
Operating virtual junction temperature, $T_J$		150	150	150	°C
Case temperature for 60 seconds	FK package			260	°C
Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds	J, JG, U, or W package			300	°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	D, N, NS, P, PS, or PW package	260	260		°C
Storage temperature range, $T_{stg}$		-65 to 150	-65 to 150	-65 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:
- All voltage values except differential voltages are with respect to the midpoint between  $V_{CC+}$  and  $V_{CC-}$ .
  - Differential voltages are at  $IN+$  with respect to  $IN-$ .
  - The magnitude of the input voltage should never exceed the magnitude of the supply voltage or 15 V, whichever is less.
  - 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.
  - Maximum power dissipation is a function of  $T_J(\max)$ ,  $\theta_{JA}$ , 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.
  - The package thermal impedance is calculated in accordance with JESD 51-7.
  - Maximum power dissipation is a function of  $T_J(\max)$ ,  $\theta_{JC}$ , 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.
  - The package thermal impedance is calculated in accordance with MIL-STD-883.



**TL061, TL061A, TL061B, TL062, TL062A  
TL062B, TL064, TL064A, TL064B  
LOW-POWER JFET-INPUT OPERATIONAL AMPLIFIERS**

SLOS078J – NOVEMBER 1978 – REVISED SEPTEMBER 2004

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

PARAMETER	TEST CONDITIONS†	TL061C TL062C TL064C			TL061AC TL062AC TL064AC			UNIT	
		MIN	TYP	MAX	MIN	TYP	MAX		
$V_{IO}$	Input offset voltage	$V_O = 0,$ $R_S = 50\ \Omega$		$T_A = 25^\circ\text{C}$	3	15	3	6	mV
				$T_A = \text{Full range}$	20		7.5		
$\alpha_{V_{IO}}$	Temperature coefficient of input offset voltage	$V_O = 0, R_S = 50\ \Omega,$ $T_A = \text{Full range}$			10		10		$\mu\text{V}/^\circ\text{C}$
$I_{IO}$	Input offset current	$V_O = 0$		$T_A = 25^\circ\text{C}$	5	200	5	100	pA
				$T_A = \text{Full range}$	5		3		nA
$I_{IB}$	Input bias current‡	$V_O = 0$		$T_A = 25^\circ\text{C}$	30	400	30	200	pA
				$T_A = \text{Full range}$	10		7		nA
$V_{ICR}$	Common-mode input voltage range	$T_A = 25^\circ\text{C}$			$\pm 11$	-12 to 15	$\pm 11$	-12 to 15	V
$V_{OM}$	Maximum peak output voltage swing	$R_L = 10\ \text{k}\Omega,$		$T_A = 25^\circ\text{C}$	$\pm 10$	$\pm 13.5$	$\pm 10$	$\pm 13.5$	V
		$R_L \geq 10\ \text{k}\Omega,$		$T_A = \text{Full range}$	$\pm 10$		$\pm 10$		
$A_{VD}$	Large-signal differential voltage amplification	$V_O = \pm 10\ \text{V},$ $R_L \geq 10\ \text{k}\Omega$		$T_A = 25^\circ\text{C}$	3	6	4	6	V/mV
				$T_A = \text{Full range}$	3		4		
$B_1$	Unity-gain bandwidth	$R_L = 10\ \text{k}\Omega,$		$T_A = 25^\circ\text{C}$	1		1		MHz
$r_i$	Input resistance	$T_A = 25^\circ\text{C}$			$10^{12}$		$10^{12}$		$\Omega$
CMRR	Common-mode rejection ratio	$V_{IC} = V_{ICRmin}, V_O = 0,$ $R_S = 50\ \Omega, T_A = 25^\circ\text{C}$			70	86	80	86	dB
$k_{SVR}$	Supply-voltage rejection ratio ( $\Delta V_{CC\pm}/\Delta V_{IO}$ )	$V_{CC} = \pm 9\ \text{V to } \pm 15\ \text{V},$ $V_O = 0, R_S = 50\ \Omega,$ $T_A = 25^\circ\text{C}$			70	95	80	95	dB
$P_D$	Total power dissipation (each amplifier)	$V_O = 0,$ No load		$T_A = 25^\circ\text{C},$	6	7.5	6	7.5	mW
$I_{CC}$	Supply current (each amplifier)	$V_O = 0,$ No load		$T_A = 25^\circ\text{C},$	200	250	200	250	$\mu\text{A}$
$V_{O1}/V_{O2}$	Crosstalk attenuation	$A_{VD} = 100,$		$T_A = 25^\circ\text{C}$	120		120		dB

† All characteristics are measured under open-loop conditions with zero common-mode input voltage unless otherwise specified. Full range for  $T_A$  is  $0^\circ\text{C}$  to  $70^\circ\text{C}$  for TL06\_C, TL06\_AC, and TL06\_BC and  $-40^\circ\text{C}$  to  $85^\circ\text{C}$  for TL06\_I.

‡ Input bias currents of an FET-input operational amplifier are normal junction reverse currents, which are temperature sensitive, as shown in Figure 15. Pulse techniques are used to maintain the junction temperature as close to the ambient temperature as possible.



**TL061, TL061A, TL061B, TL062, TL062A  
TL062B, TL064, TL064A, TL064B  
LOW-POWER JFET-INPUT OPERATIONAL AMPLIFIERS**

SLOS078J – NOVEMBER 1978 – REVISED SEPTEMBER 2004

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

PARAMETER	TEST CONDITION <sup>†</sup>	TL061BC TL062BC TL064BC			TL061I TL062I TL064I			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	
$V_{IO}$	Input offset voltage	$V_O = 0,$ $R_S = 50 \Omega$	$T_A = 25^\circ\text{C}$		3		6	mV
			$T_A = \text{Full range}$		5		9	
$\alpha_{V_{IO}}$	Temperature coefficient of input offset voltage	$V_O = 0, R_S = 50 \Omega,$ $T_A = \text{Full range}$		10		10	$\mu\text{V}/^\circ\text{C}$	
$I_{IO}$	Input offset current	$V_O = 0$	$T_A = 25^\circ\text{C}$		5		100	pA
			$T_A = \text{Full range}$		3		10	nA
$I_{IB}$	Input bias current <sup>‡</sup>	$V_O = 0$	$T_A = 25^\circ\text{C}$		30		200	pA
			$T_A = \text{Full range}$		7		20	nA
$V_{ICR}$	Common-mode input voltage range	$T_A = 25^\circ\text{C}$		$\pm 11$	-12 to 15	$\pm 11$	-12 to 15	V
$V_{OM}$	Maximum peak output voltage swing	$R_L = 10 \text{ k}\Omega, T_A = 25^\circ\text{C}$		$\pm 10$	$\pm 13.5$	$\pm 10$	$\pm 13.5$	V
		$R_L \geq 10 \text{ k}\Omega, T_A = \text{Full range}$		$\pm 10$		$\pm 10$		
$A_{VD}$	Large-signal differential voltage amplification	$V_O = \pm 10 \text{ V},$ $R_L \geq 10 \text{ k}\Omega$	$T_A = 25^\circ\text{C}$		4		6	V/mV
			$T_A = \text{Full range}$		4		4	
$B_1$	Unity-gain bandwidth	$R_L = 10 \text{ k}\Omega, T_A = 25^\circ\text{C}$		1		1		MHz
$r_i$	Input resistance	$T_A = 25^\circ\text{C}$		$10^{12}$		$10^{12}$		$\Omega$
CMRR	Common-mode rejection ratio	$V_{IC} = V_{ICRmin}, V_O = 0,$ $R_S = 50 \Omega, T_A = 25^\circ\text{C}$		80		86		dB
$k_{SVR}$	Supply-voltage rejection ratio ( $\Delta V_{CC\pm}/\Delta V_{IO}$ )	$V_{CC} = \pm 9 \text{ V to } \pm 15 \text{ V},$ $V_O = 0, R_S = 50 \Omega,$ $T_A = 25^\circ\text{C}$		80		95		dB
$P_D$	Total power dissipation (each amplifier)	$V_O = 0,$ No load	$T_A = 25^\circ\text{C},$		6		7.5	mW
$I_{CC}$	Supply current (each amplifier)	$V_O = 0,$ No load	$T_A = 25^\circ\text{C},$		200		250	$\mu\text{A}$
$VO_1/VO_2$	Crosstalk attenuation	$A_{VD} = 100, T_A = 25^\circ\text{C}$		120		120		dB

<sup>†</sup> All characteristics are measured under open-loop conditions with zero common-mode input voltage, unless otherwise specified. Full range for  $T_A$  is  $0^\circ\text{C}$  to  $70^\circ\text{C}$  for TL06\_C, TL06\_AC, and TL06\_BC and  $-40^\circ\text{C}$  to  $85^\circ\text{C}$  for TL06\_I.

<sup>‡</sup> Input bias currents of an FET-input operational amplifier are normal junction reverse currents, which are temperature sensitive, as shown in Figure 15. Pulse techniques are used to maintain the junction temperature as close to the ambient temperature as possible.

**TL061, TL061A, TL061B, TL062, TL062A  
TL062B, TL064, TL064A, TL064B  
LOW-POWER JFET-INPUT OPERATIONAL AMPLIFIERS**

SLOS078J – NOVEMBER 1978 – REVISED SEPTEMBER 2004

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

PARAMETER	TEST CONDITIONS†	TL061M TL062M			TL064M			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	
$V_{IO}$ Input offset voltage	$V_O = 0$ , $R_S = 50 \Omega$	$T_A = 25^\circ\text{C}$		3	6	$T_A = 25^\circ\text{C}$		mV
		$T_A = -55^\circ\text{C to } 125^\circ\text{C}$		9		15		
$\alpha_{V_{IO}}$ Temperature coefficient of input offset voltage	$V_O = 0$ , $R_S = 50 \Omega$ , $T_A = -55^\circ\text{C to } 125^\circ\text{C}$	10			10			$\mu\text{V}/^\circ\text{C}$
$I_{IO}$ Input offset current	$V_O = 0$	$T_A = 25^\circ\text{C}$		5	100	$T_A = 25^\circ\text{C}$		pA
		$T_A = -55^\circ\text{C}$		20*		20*		nA
		$T_A = 125^\circ\text{C}$		20		20		
$I_{IB}$ Input bias current‡	$V_O = 0$	$T_A = 25^\circ\text{C}$		30	200	$T_A = 25^\circ\text{C}$		pA
		$T_A = -55^\circ\text{C}$		50*		50*		nA
		$T_A = 125^\circ\text{C}$		50		50		
$V_{ICR}$ Common-mode input voltage range	$T_A = 25^\circ\text{C}$	$\pm 11.5$	-12 to 15	$\pm 11.5$	-12 to 15			V
$V_{OM}$ Maximum peak output voltage swing	$R_L = 10 \text{ k}\Omega$ , $T_A = 25^\circ\text{C}$	$\pm 10$	$\pm 13.5$	$\pm 10$	$\pm 13.5$			V
	$R_L \geq 10 \text{ k}\Omega$ , $T_A = -55^\circ\text{C to } 125^\circ\text{C}$	$\pm 10$		$\pm 10$				
$A_{VD}$ Large-signal differential voltage amplification	$V_O = \pm 10 \text{ V}$ , $R_L \geq 10 \text{ k}\Omega$	$T_A = 25^\circ\text{C}$		4	6	$T_A = 25^\circ\text{C}$		V/mV
		$T_A = -55^\circ\text{C to } 125^\circ\text{C}$		4		4		
$B_1$ Unity-gain bandwidth	$R_L = 10 \text{ k}\Omega$ , $T_A = 25^\circ\text{C}$							MHz
$r_i$ Input resistance	$T_A = 25^\circ\text{C}$	$10^{12}$			$10^{12}$			$\Omega$
CMRR Common-mode rejection ratio	$V_{IC} = V_{ICRmin}$ , $V_O = 0$ , $R_S = 50 \Omega$ , $T_A = 25^\circ\text{C}$	80	86	80	86			dB
$k_{SVR}$ Supply-voltage rejection ratio ( $\Delta V_{CC\pm}/\Delta V_{IO}$ )	$V_{CC} = \pm 9 \text{ V to } \pm 15 \text{ V}$ , $V_O = 0$ , $R_S = 50 \Omega$ , $T_A = 25^\circ\text{C}$	80	95	80	95			dB
$P_D$ Total power dissipation (each amplifier)	$V_O = 0$ , No load	$T_A = 25^\circ\text{C}$		6	7.5	$T_A = 25^\circ\text{C}$		mW
$I_{CC}$ Supply current (each amplifier)	$V_O = 0$ , No load	$T_A = 25^\circ\text{C}$		200	250	$T_A = 25^\circ\text{C}$		$\mu\text{A}$
$V_{O1}/V_{O2}$ Crosstalk attenuation	$A_{VD} = 100$ , $T_A = 25^\circ\text{C}$	120			120			dB

\* This parameter is not production tested.

† All characteristics are measured under open-loop conditions, with zero common-mode voltage, unless otherwise specified.

‡ Input bias currents of an FET-input operational amplifier are normal junction reverse currents, which are temperature sensitive, as shown in Figure 15. Pulse techniques are used to maintain the junction temperature as close to the ambient temperature as possible.

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

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
SR Slew rate at unity gain (see Note 5)	$V_I = 10 \text{ V}$ , $R_L = 10 \text{ k}\Omega$ , $C_L = 100 \text{ pF}$ , See Figure 1	1.5	3.5		V/ $\mu\text{s}$
$t_r$ Rise time	$V_I = 20 \text{ mV}$ , $C_L = 100 \text{ pF}$ , See Figure 1	0.2			$\mu\text{s}$
Overshoot factor		10%			
$V_n$ Equivalent input noise voltage	$R_S = 20 \Omega$ , $f = 1 \text{ kHz}$	42			nV/ $\sqrt{\text{Hz}}$

NOTE 5: Slew rate at  $-55^\circ\text{C to } 125^\circ\text{C}$  is 0.7 V/ $\mu\text{s}$  min.





PARAMETER MEASUREMENT INFORMATION

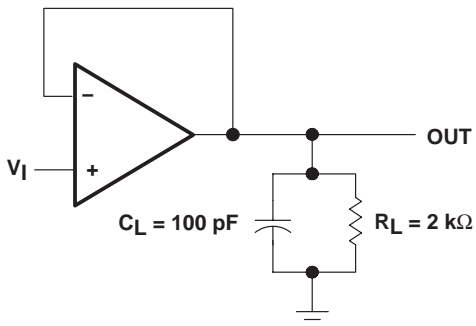


Figure 1. Unity-Gain Amplifier

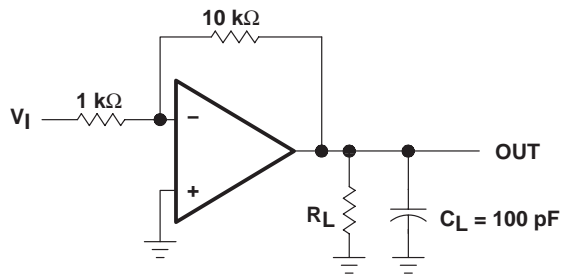


Figure 2. Gain-of-10 Inverting Amplifier

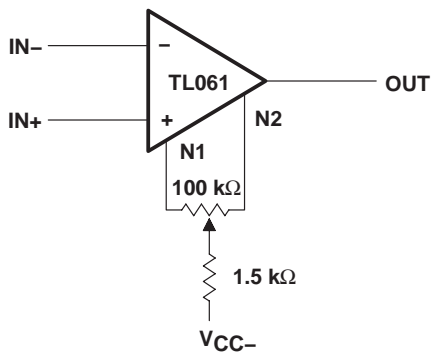


Figure 3. Input Offset-Voltage Null Circuit

**TYPICAL CHARACTERISTICS**

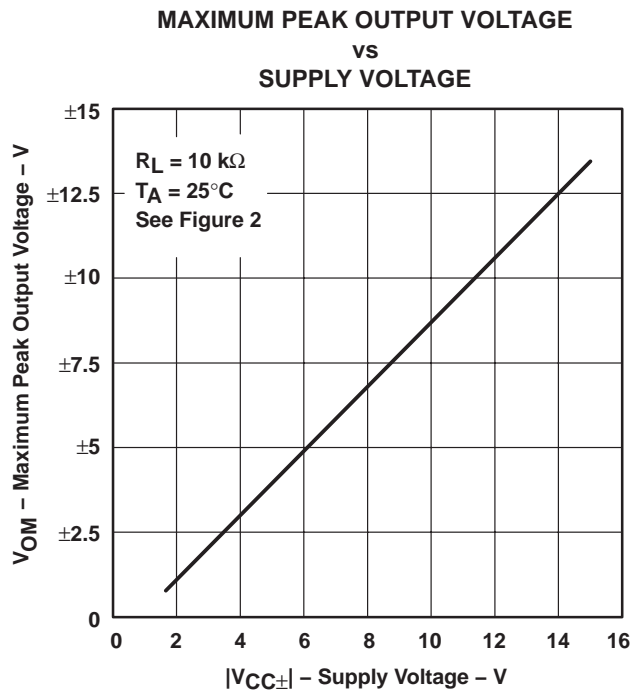
**Table of Graphs**

	<b>FIGURE</b>
Maximum peak output voltage vs Supply voltage	4
Maximum peak output voltage vs Free-air temperature	5
Maximum peak output voltage vs Load resistance	6
Maximum peak output voltage vs Frequency	7
Differential voltage amplification vs Free-air temperature	8
Large-signal differential voltage amplification vs Frequency	9
Phase shift vs Frequency	9
Supply current vs Supply voltage	10
Supply current vs Free-air temperature	11
Total power dissipation vs Free-air temperature	12
Common-mode rejection ratio vs Free-air temperature	13
Normalized unity-gain bandwidth vs Free-air temperature	14
Normalized slew rate vs Free-air temperature	14
Normalized phase shift vs Free-air temperature	14
Input bias current vs Free-air temperature	15
Voltage-follower large-signal pulse response vs Time	16
Output voltage vs Elapsed time	17
Equivalent input noise voltage vs Frequency	18

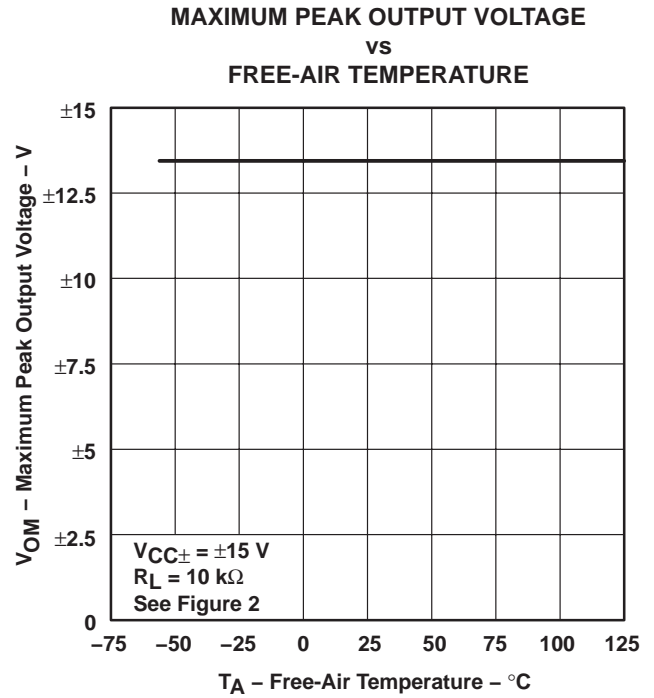
**TL061, TL061A, TL061B, TL062, TL062A  
TL062B, TL064, TL064A, TL064B  
LOW-POWER JFET-INPUT OPERATIONAL AMPLIFIERS**

SLOS078J – NOVEMBER 1978 – REVISED SEPTEMBER 2004

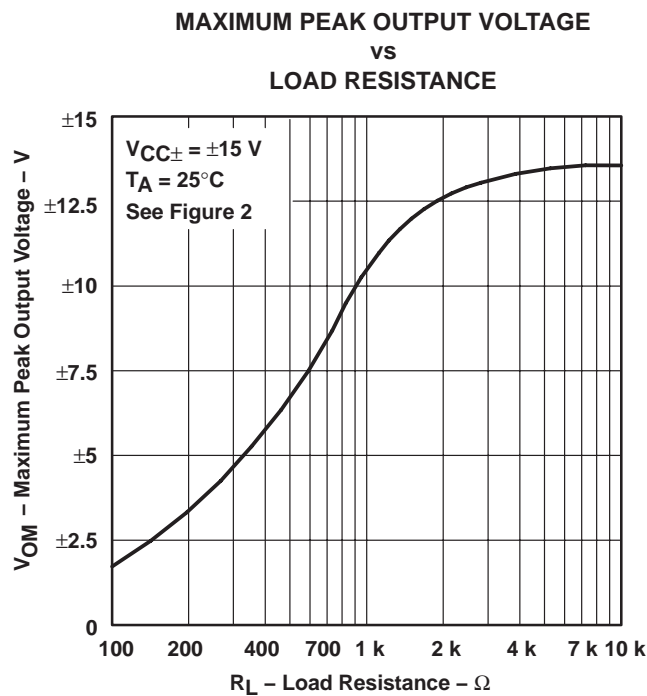
**TYPICAL CHARACTERISTICS†**



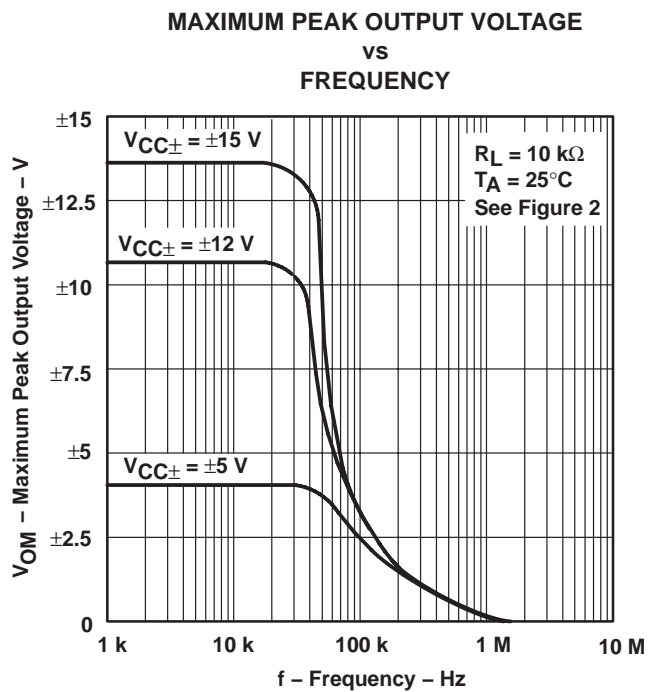
**Figure 4**



**Figure 5**



**Figure 6**



**Figure 7**

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

**TYPICAL CHARACTERISTICS†**

**DIFFERENTIAL VOLTAGE AMPLIFICATION  
 vs  
 FREE-AIR TEMPERATURE**

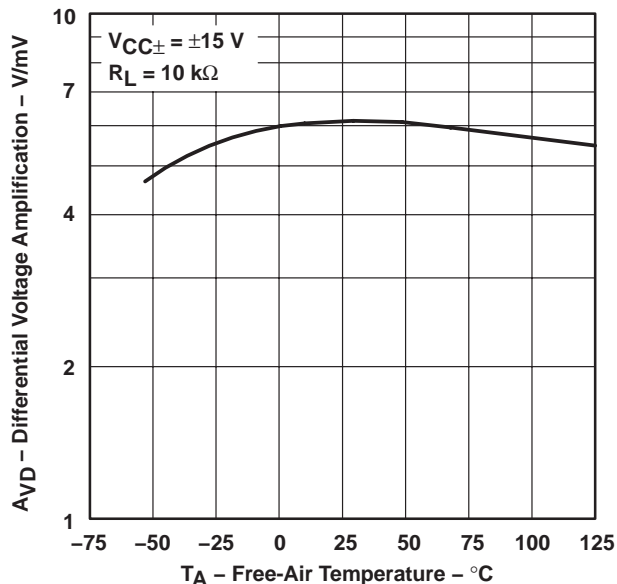


Figure 8

**LARGE-SIGNAL  
 DIFFERENTIAL VOLTAGE  
 AMPLIFICATION AND PHASE SHIFT  
 vs  
 FREQUENCY**

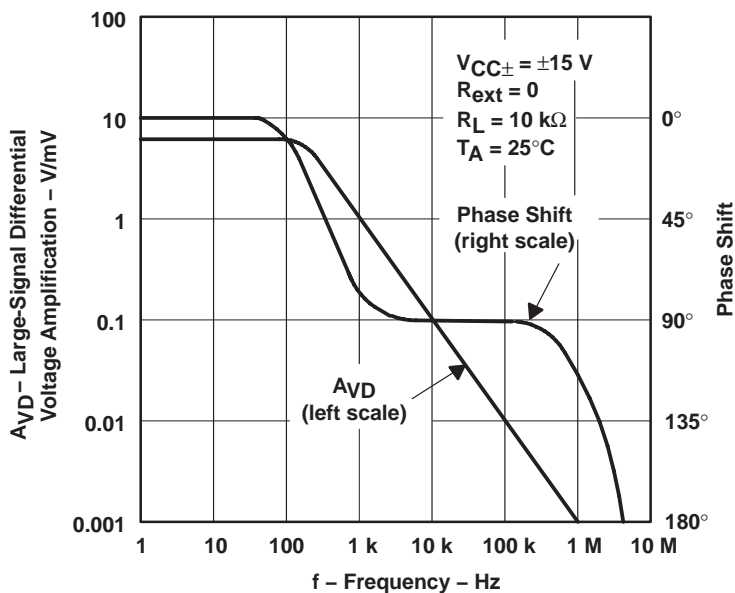


Figure 9

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

**TL061, TL061A, TL061B, TL062, TL062A  
TL062B, TL064, TL064A, TL064B**  
**LOW-POWER JFET-INPUT OPERATIONAL AMPLIFIERS**

SLOS078J – NOVEMBER 1978 – REVISED SEPTEMBER 2004

**TYPICAL CHARACTERISTICS†**

**SUPPLY CURRENT  
vs  
SUPPLY VOLTAGE**

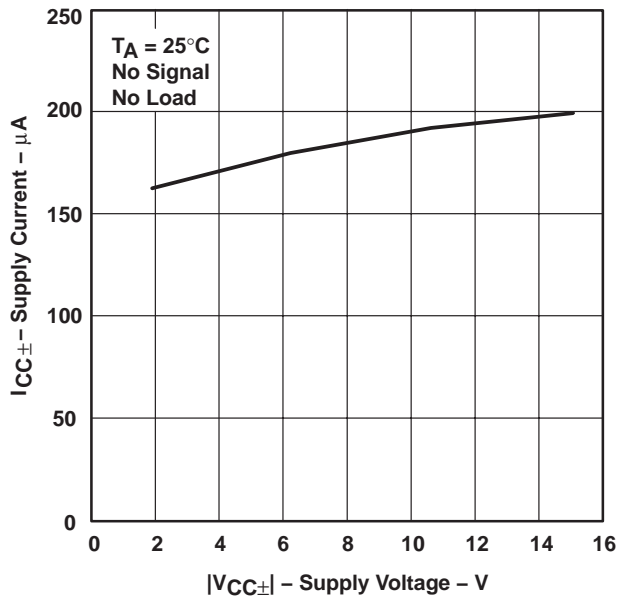


Figure 10

**SUPPLY CURRENT  
vs  
FREE-AIR TEMPERATURE**

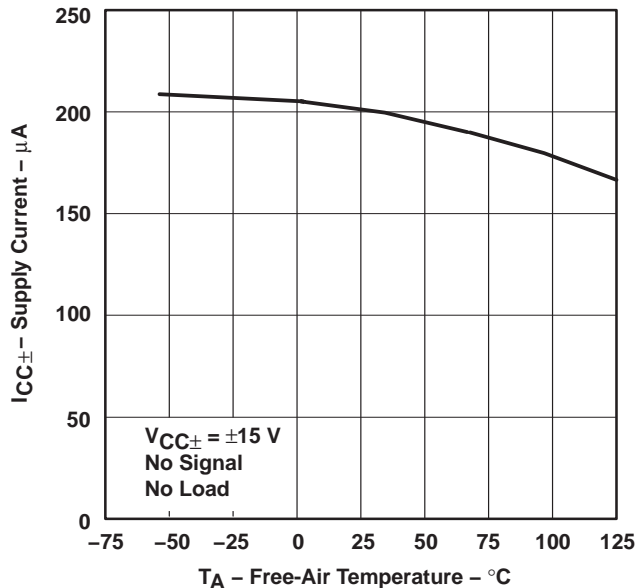


Figure 11

**TOTAL POWER DISSIPATION  
vs  
FREE-AIR TEMPERATURE**

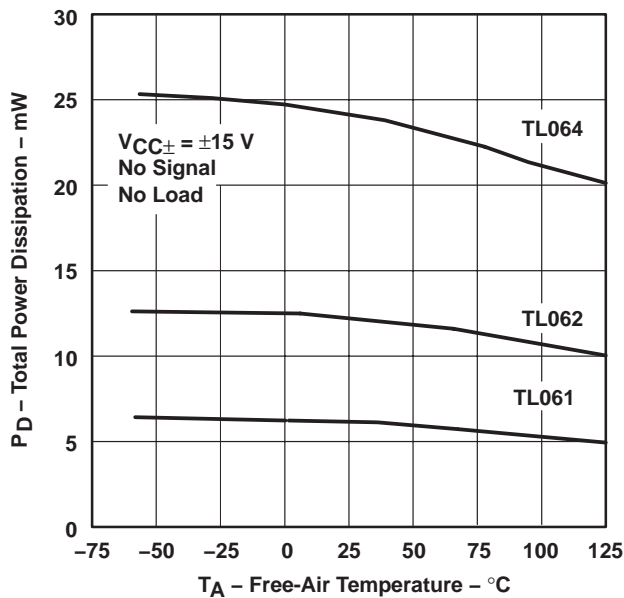


Figure 12

**ALL EXCEPT TL06\_C  
COMMON-MODE REJECTION RATIO  
vs  
FREE-AIR TEMPERATURE**

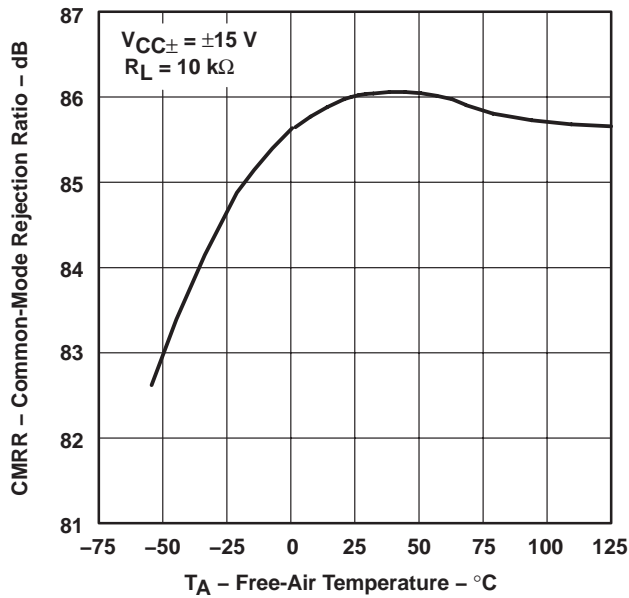


Figure 13

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

TYPICAL CHARACTERISTICS

NORMALIZED UNITY-GAIN BANDWIDTH,  
 SLEW RATE, AND PHASE SHIFT

vs

FREE-AIR TEMPERATURE

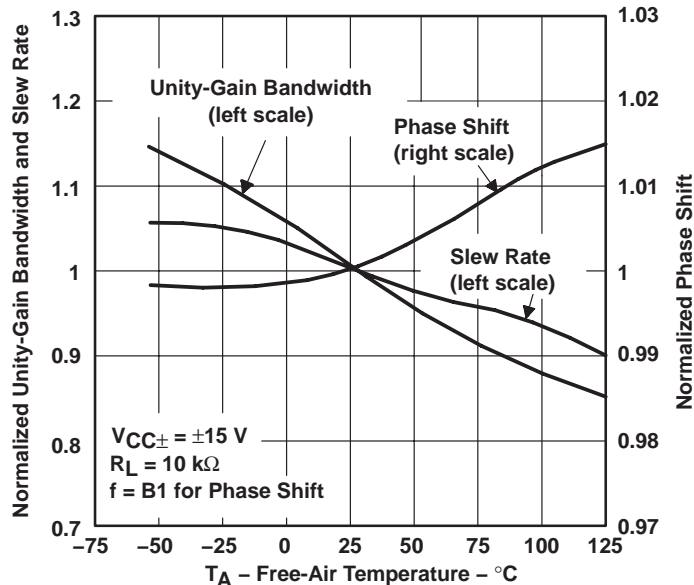


Figure 14

INPUT BIAS CURRENT  
 vs  
 FREE-AIR TEMPERATURE

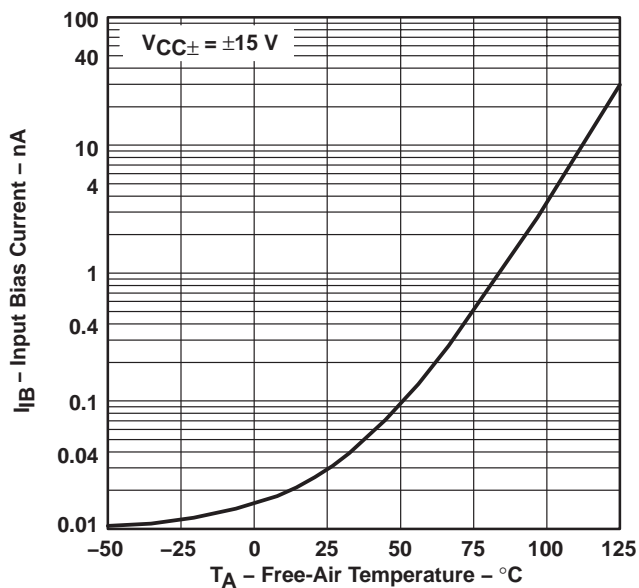


Figure 15

VOLTAGE-FOLLOWER  
 LARGE-SIGNAL PULSE RESPONSE  
 vs  
 TIME

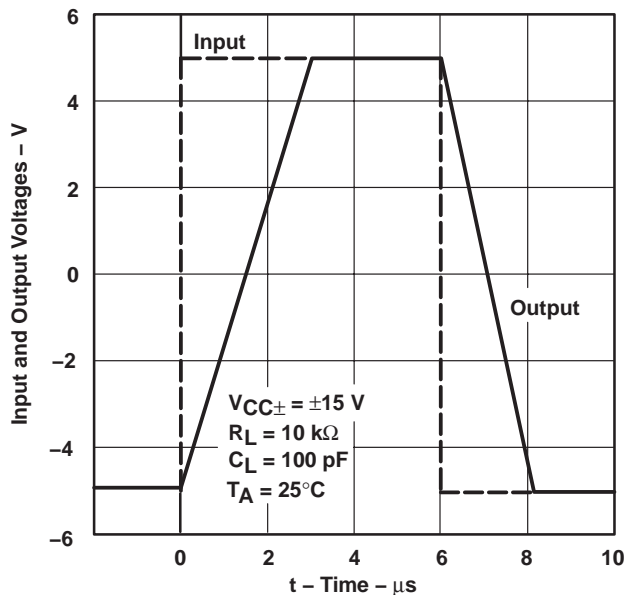
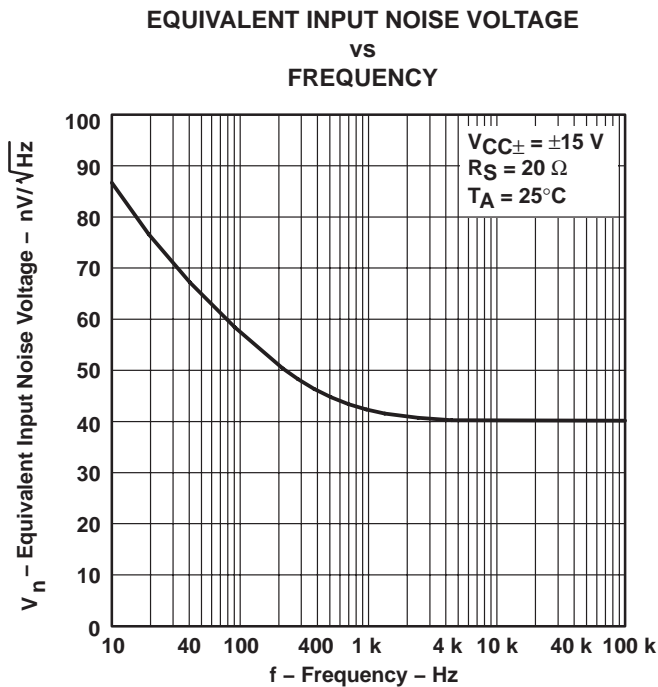
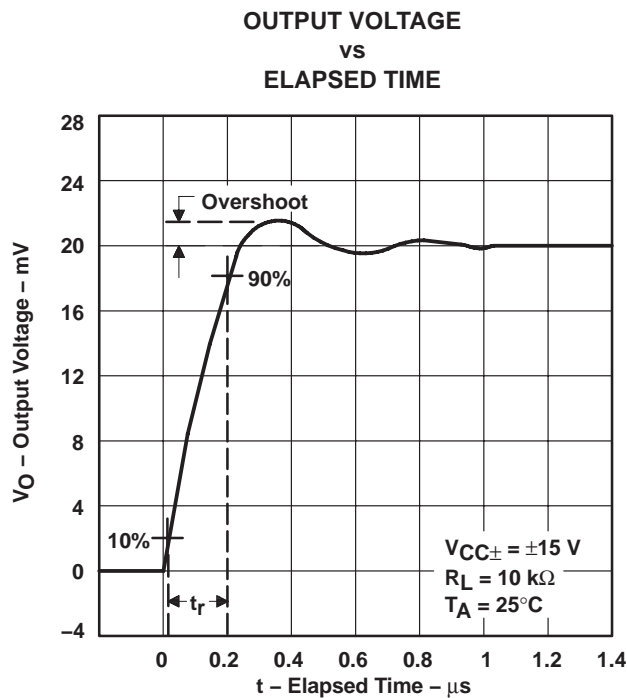


Figure 16

TL061, TL061A, TL061B, TL062, TL062A  
 TL062B, TL064, TL064A, TL064B  
 LOW-POWER JFET-INPUT OPERATIONAL AMPLIFIERS

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TYPICAL CHARACTERISTICS



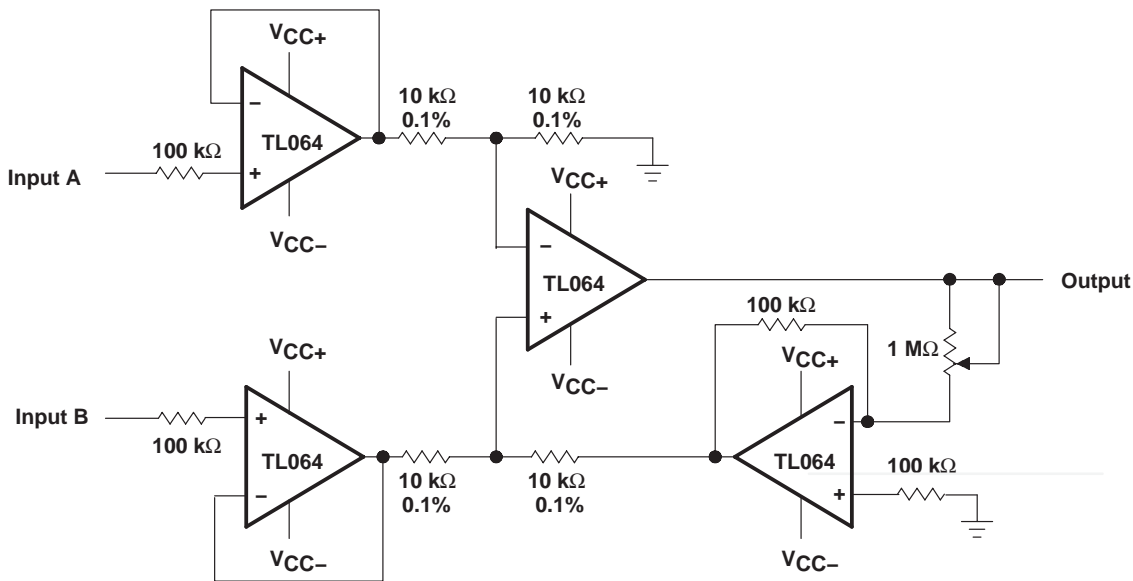
**TL061, TL061A, TL061B, TL062, TL062A  
TL062B, TL064, TL064A, TL064B  
LOW-POWER JFET-INPUT OPERATIONAL AMPLIFIERS**

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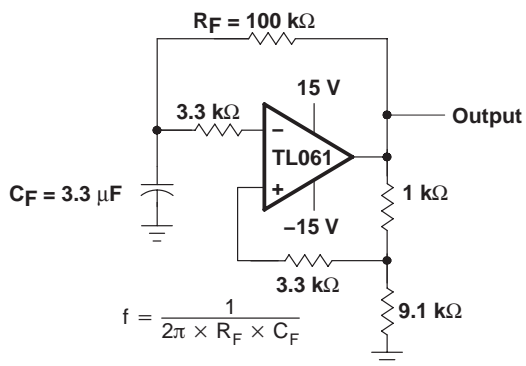
**APPLICATION INFORMATION**

**Table of Application Diagrams**

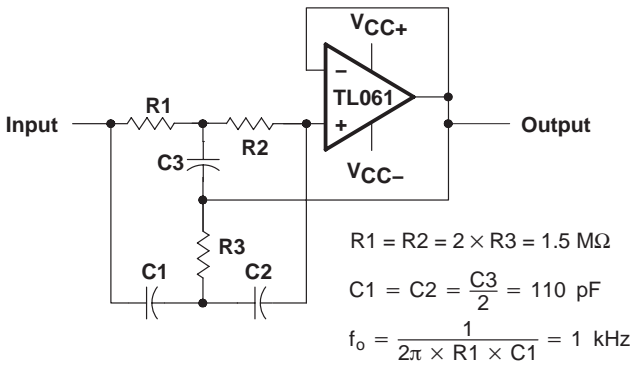
APPLICATION DIAGRAM	PART NUMBER	FIGURE
Instrumentation amplifier	TL064	19
0.5-Hz square-wave oscillator	TL061	20
High-Q notch filter	TL061	21
Audio-distribution amplifier	TL064	22
Low-level light detector preamplifier	TL061	23
AC amplifier	TL061	24
Microphone preamplifier with tone control	TL061	25
Instrumentation amplifier	TL062	26
IC preamplifier	TL062	27



**Figure 19. Instrumentation Amplifier**



**Figure 20. 0.5-Hz Square-Wave Oscillator**



**Figure 21. High-Q Notch Filter**



APPLICATION INFORMATION

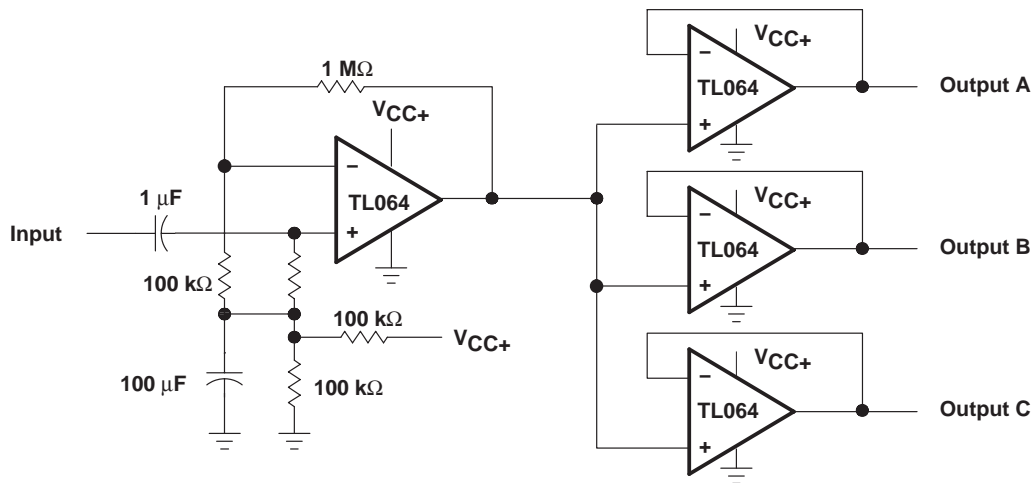


Figure 22. Audio-Distribution Amplifier

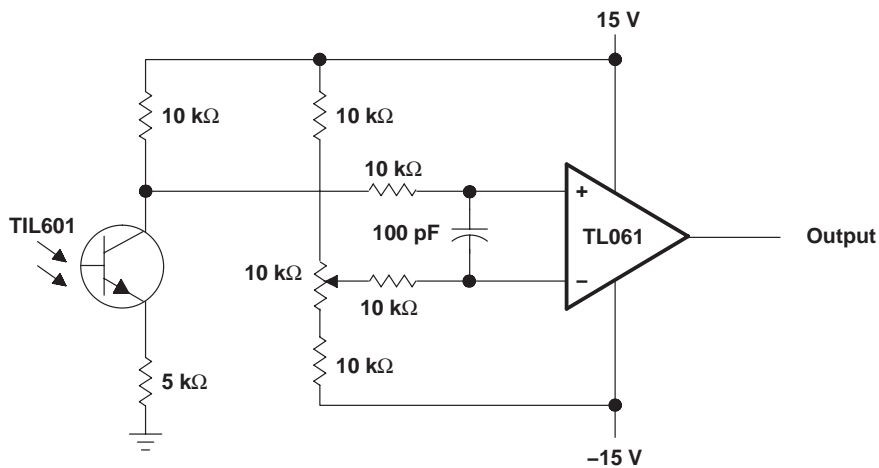
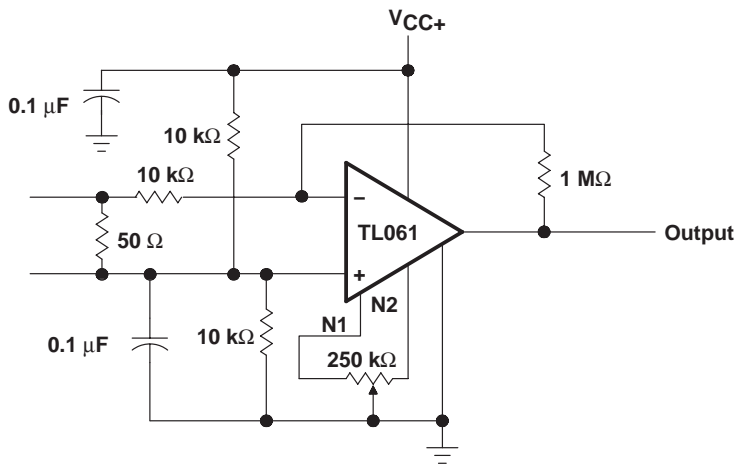
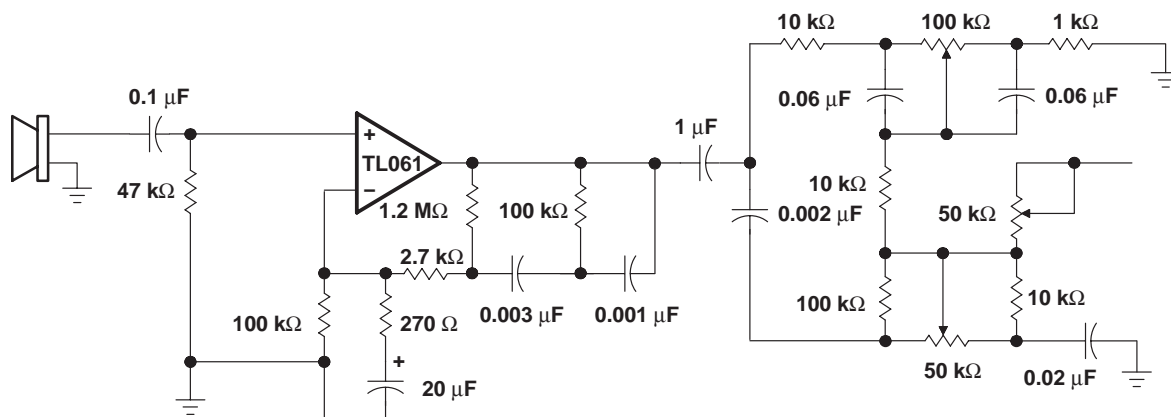


Figure 23. Low-Level Light Detector Preamplifier

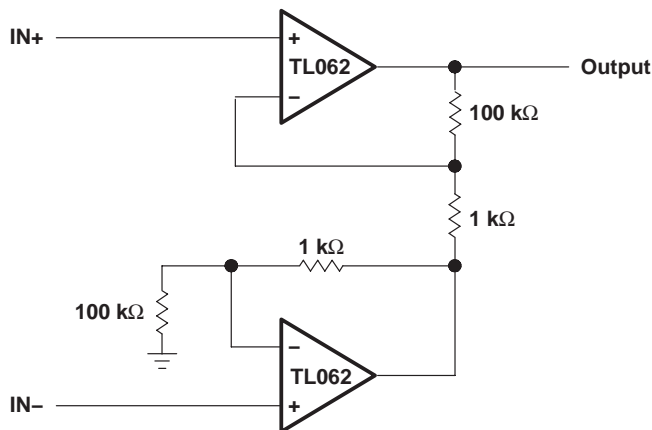
**APPLICATION INFORMATION**



**Figure 24. AC Amplifier**



**Figure 25. Microphone Preamp with Tone Control**



**Figure 26. Instrumentation Amplifier**

APPLICATION INFORMATION

IC PREAMPLIFIER RESPONSE CHARACTERISTICS

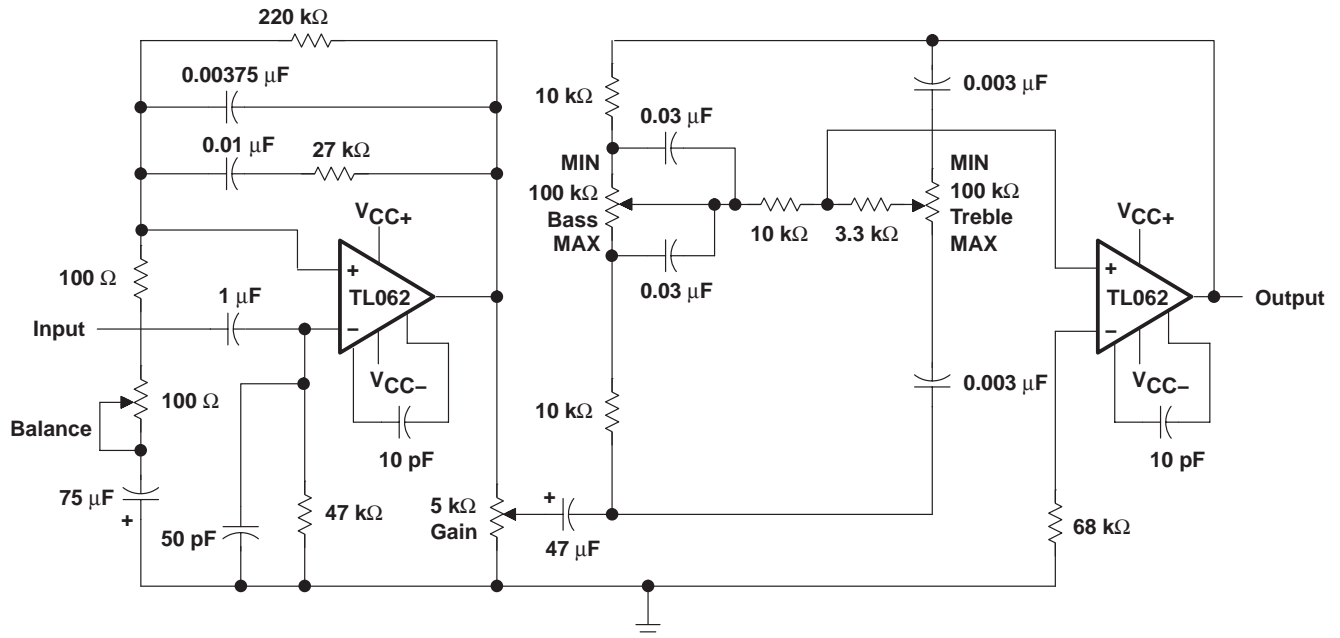
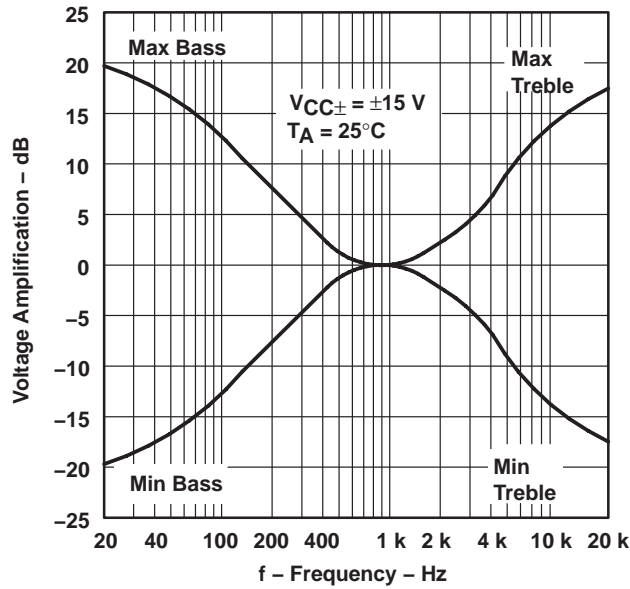


Figure 27. IC Preamplifier

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



DIM \ PINS **	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)

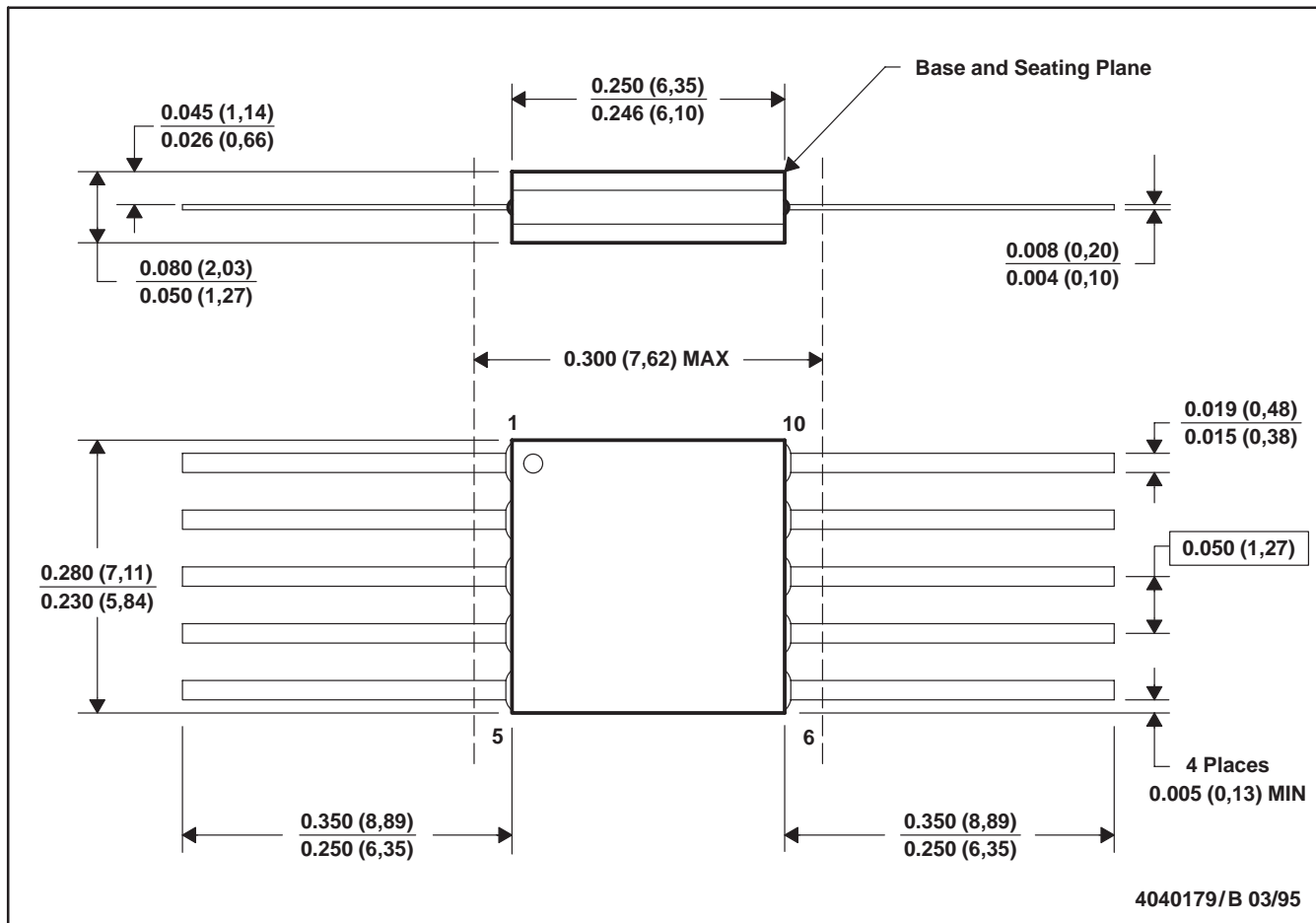


4040083/F 03/03

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

U (S-GDFP-F10)

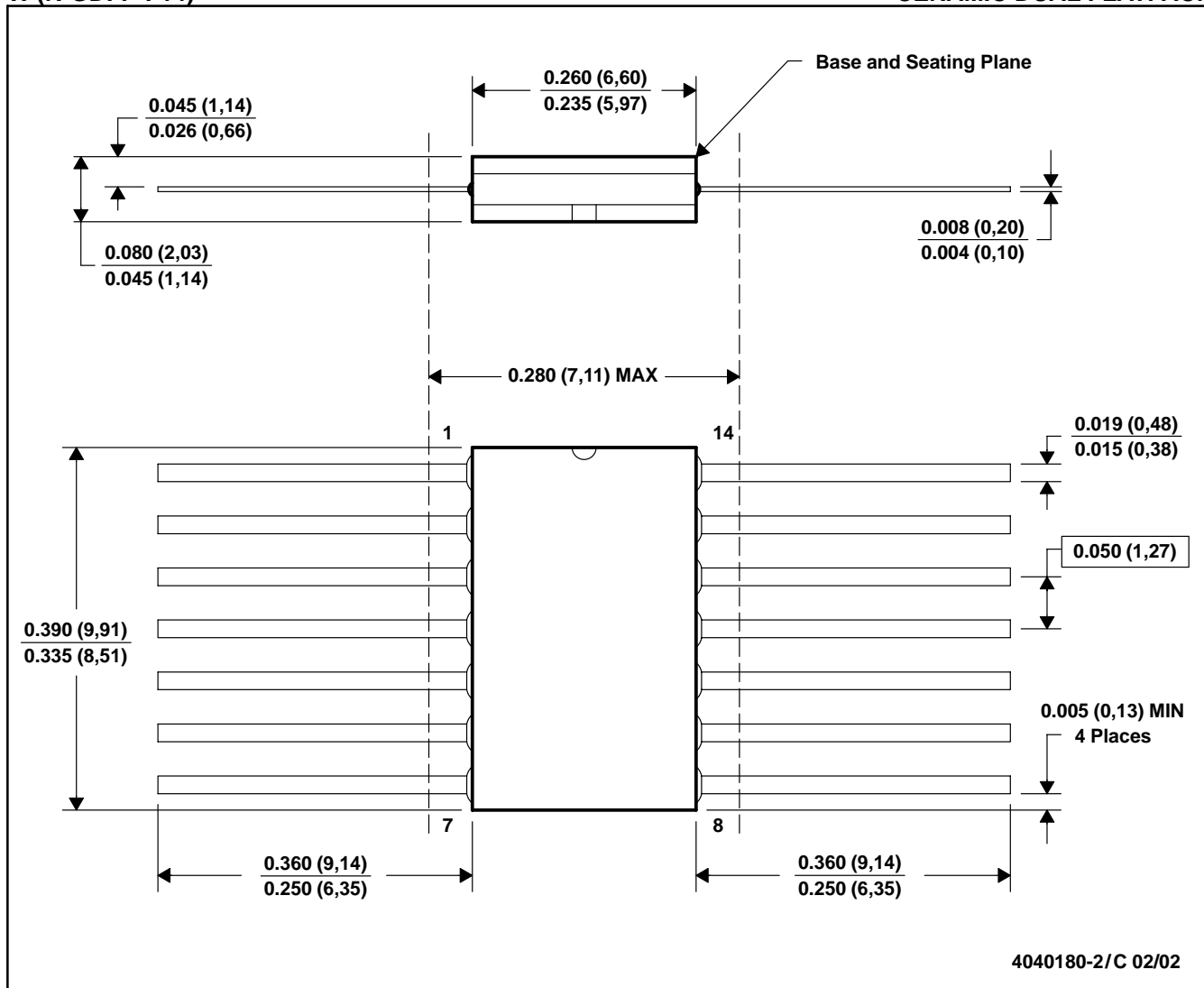
CERAMIC DUAL FLATPACK



- 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 only.  
 E. Falls within MIL STD 1835 GDFP1-F10 and JEDEC MO-092AA

W (R-GDFP-F14)

CERAMIC DUAL FLATPACK



- 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 only.  
 E. 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](http://www.ti.com/sc/docs/package/pkg_info.htm)

N (R-PDIP-T\*\*)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



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

D (R-PDSO-G14)

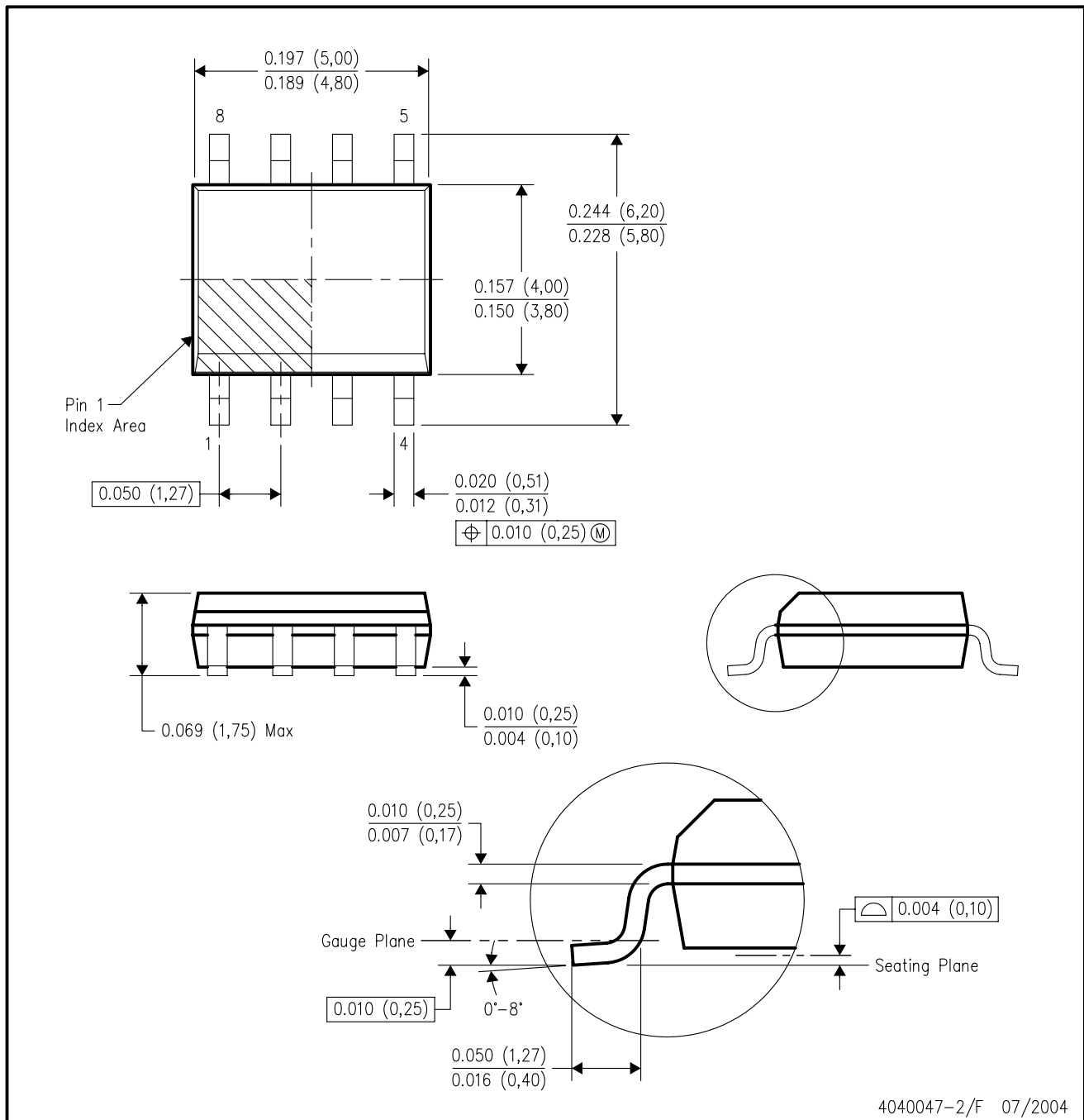
PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- 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 AB.

D (R-PDSO-G8)

PLASTIC SMALL-OUTLINE PACKAGE



- 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



- 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



- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - 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



4040064/F 01/97

- 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

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