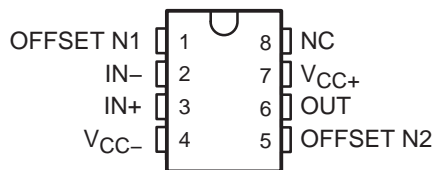


# TL061, TL061A, TL061B, TL062, TL062A TL062B, TL064, TL064A, TL064B LOW-POWER JFET-INPUT OPERATIONAL AMPLIFIERS

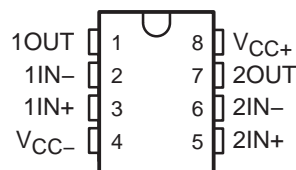
SLOS078J – NOVEMBER 1978 – REVISED SEPTEMBER 2004

- 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

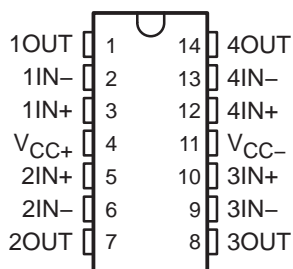
TL061, TL061A . . . D, P, OR PS PACKAGE  
TL061B . . . P PACKAGE  
(TOP VIEW)



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

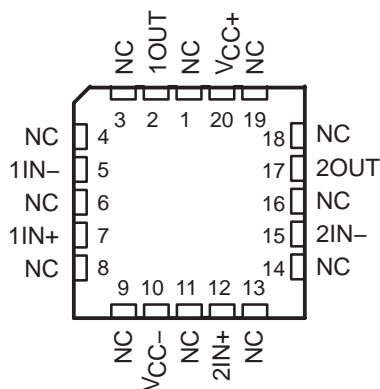


TL064 . . . D, J, N, NS, PW, OR W PACKAGE  
TL064A, TL064B . . . D OR N PACKAGE  
(TOP VIEW)

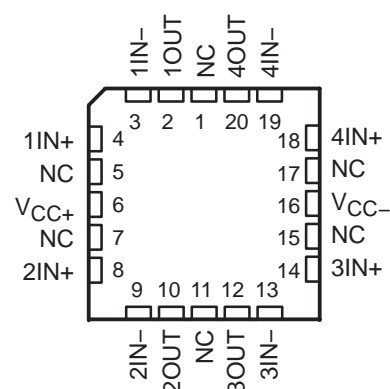


NC – No internal connection

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	061AC	
				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)**

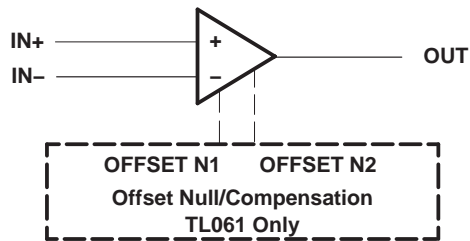
TA	V <sub>IO</sub> MAX AT 25°C	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
-40°C to 85°C	6 mV	PDIP (P)	Tube of 50	TL061IP	TL061IP
				TL062IP	TL062IP
		PDIP (N)	Tube of 25	TL064IN	TL064IN
		SOIC (D)	Tube of 75	TL061ID	TL061I
				TL061IDR	
			Tube of 75	TL062ID	TL062I
				TL062IDR	
			Tube of 50	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).

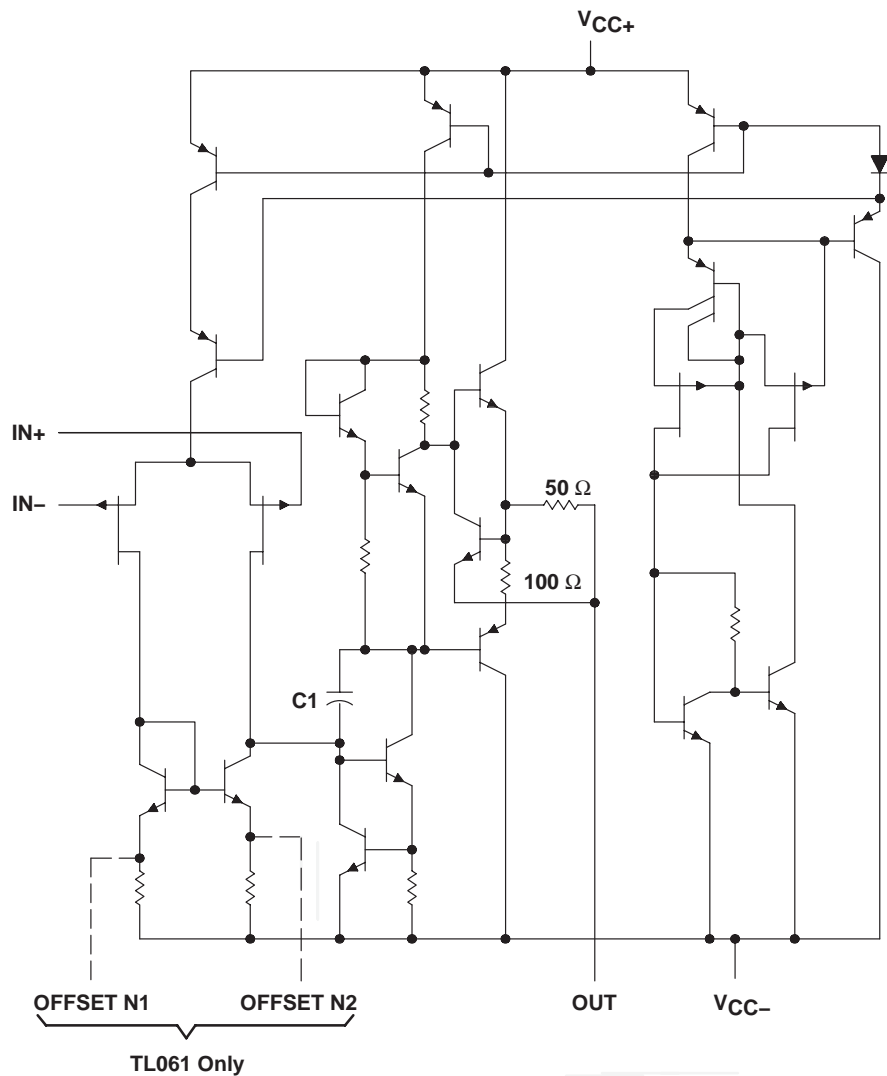
**TL061, TL061A, TL061B, TL062, TL062A  
 TL062B, TL064, TL064A, TL064B  
 LOW-POWER JFET-INPUT OPERATIONAL AMPLIFIERS**

SLOS078J – NOVEMBER 1978 – REVISED SEPTEMBER 2004

symbol (each amplifier)



schematic (each amplifier)



**TL061 Only**  
 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	$T_A = 25^\circ\text{C}$	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	$T_A = 25^\circ\text{C}$	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	$T_A = 25^\circ\text{C}$	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	$R_L = 10\ \text{k}\Omega,$		$T_A = 25^\circ\text{C}$	$\pm 10$	$\pm 13.5$	$T_A = 25^\circ\text{C}$	$\pm 10$	$\pm 13.5$	V
		$R_L \geq 10\ \text{k}\Omega,$		$T_A = \text{Full range}$	$\pm 10$		$T_A = \text{Full range}$		$\pm 10$	
$A_{VD}$	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	$T_A = 25^\circ\text{C}$	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		$T_A = 25^\circ\text{C}$		1	MHz
$r_i$	Input resistance	$T_A = 25^\circ\text{C}$			$10^{12}$		$T_A = 25^\circ\text{C}$		$10^{12}$	$\Omega$
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	$T_A = 25^\circ\text{C},$	6	7.5	mW
$I_{CC}$	Supply current (each amplifier)	$V_O = 0,$ No load		$T_A = 25^\circ\text{C},$	200	250	$T_A = 25^\circ\text{C},$	200	250	$\mu\text{A}$
$V_{O1}/V_{O2}$	Crosstalk attenuation	$A_{VD} = 100,$		$T_A = 25^\circ\text{C}$	120		$T_A = 25^\circ\text{C}$		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,  $V_{CC\pm} = \pm 15\text{ V}$  (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,  $V_{CC\pm} = \pm 15\ \text{V}, T_A = 25^\circ\text{C}$**

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			$\text{nV}/\sqrt{\text{Hz}}$

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





PARAMETER MEASUREMENT INFORMATION

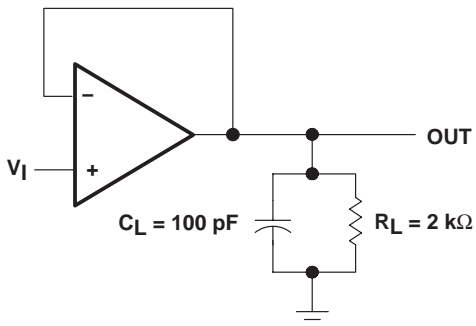


Figure 1. Unity-Gain Amplifier

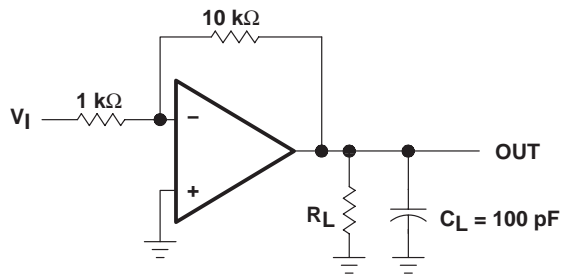


Figure 2. Gain-of-10 Inverting Amplifier

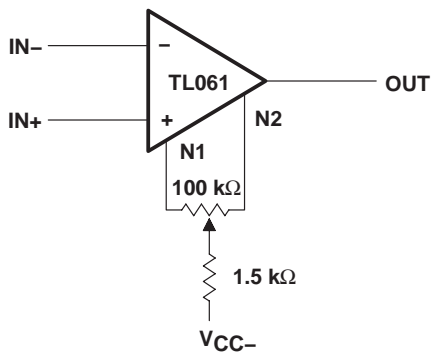


Figure 3. Input Offset-Voltage Null Circuit

**TYPICAL CHARACTERISTICS**

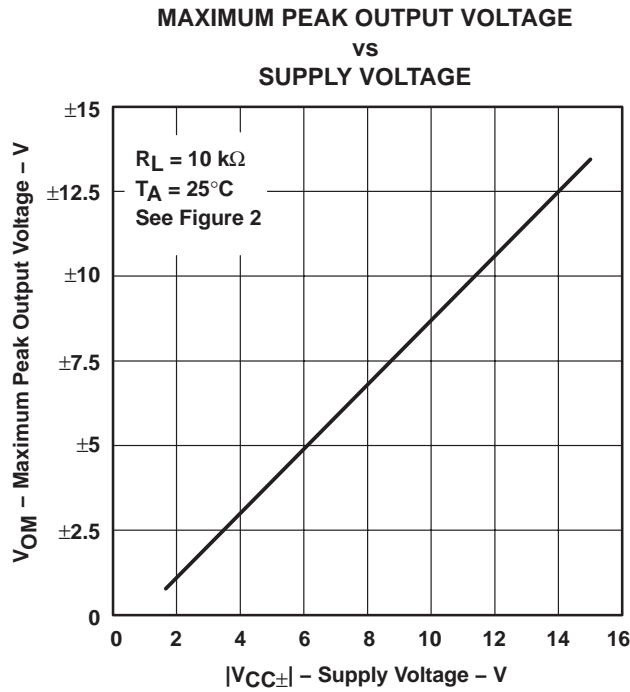
**Table of Graphs**

	<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

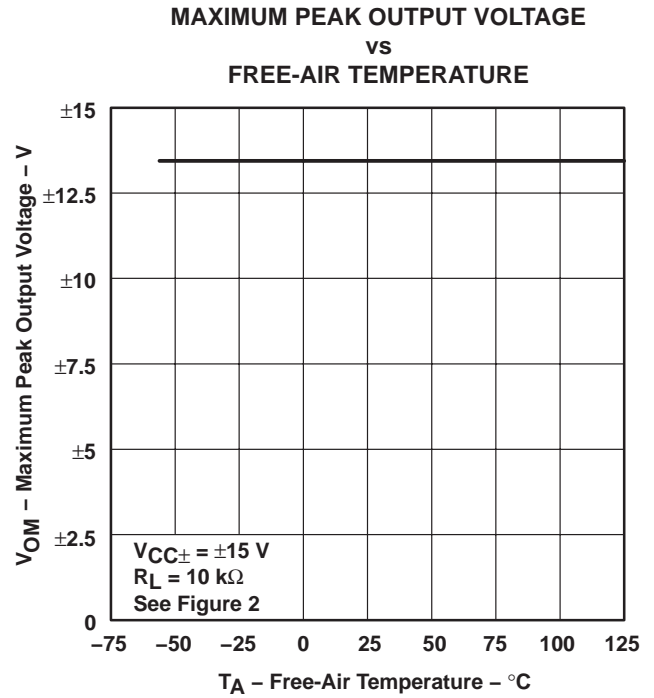
**TL061, TL061A, TL061B, TL062, TL062A  
TL062B, TL064, TL064A, TL064B  
LOW-POWER JFET-INPUT OPERATIONAL AMPLIFIERS**

SLOS078J – NOVEMBER 1978 – REVISED SEPTEMBER 2004

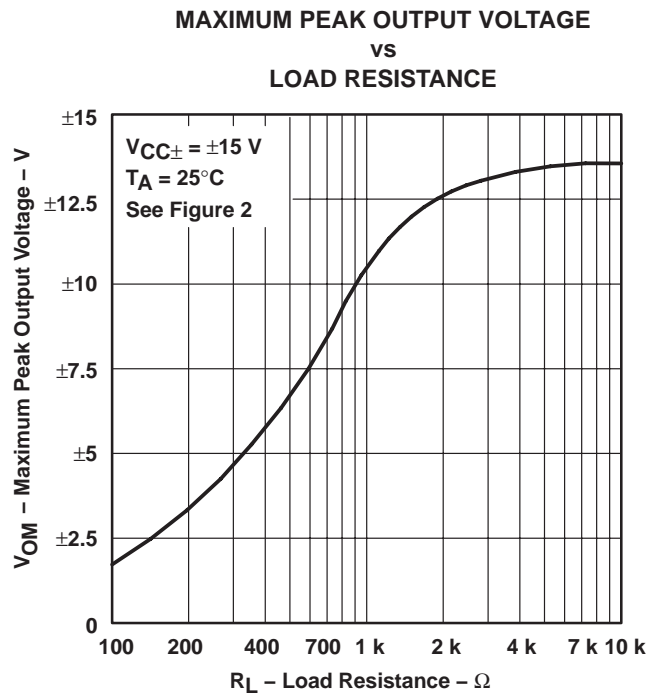
**TYPICAL CHARACTERISTICS†**



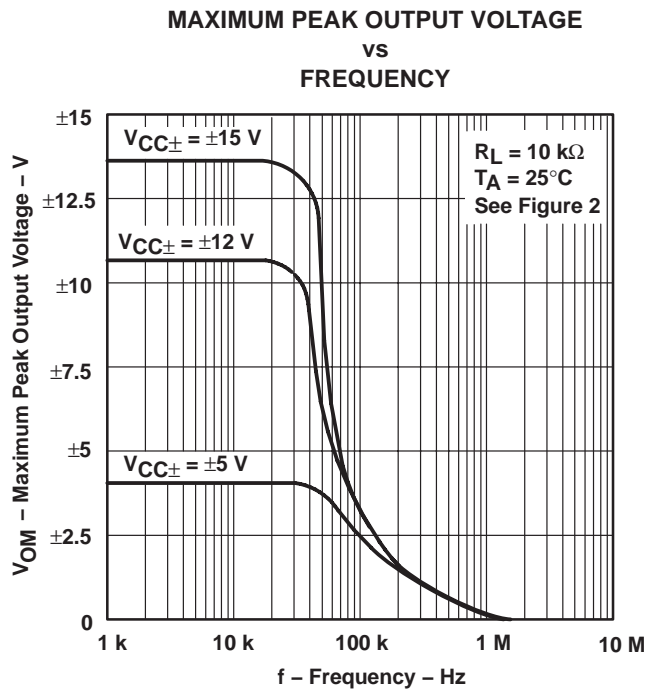
**Figure 4**



**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**

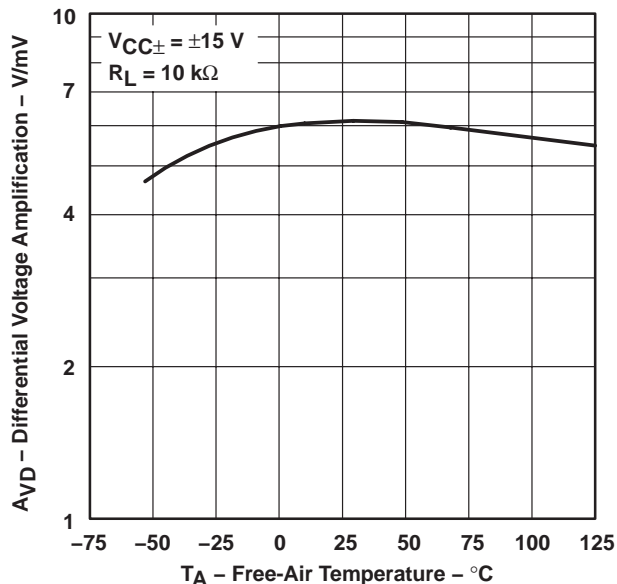


Figure 8

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

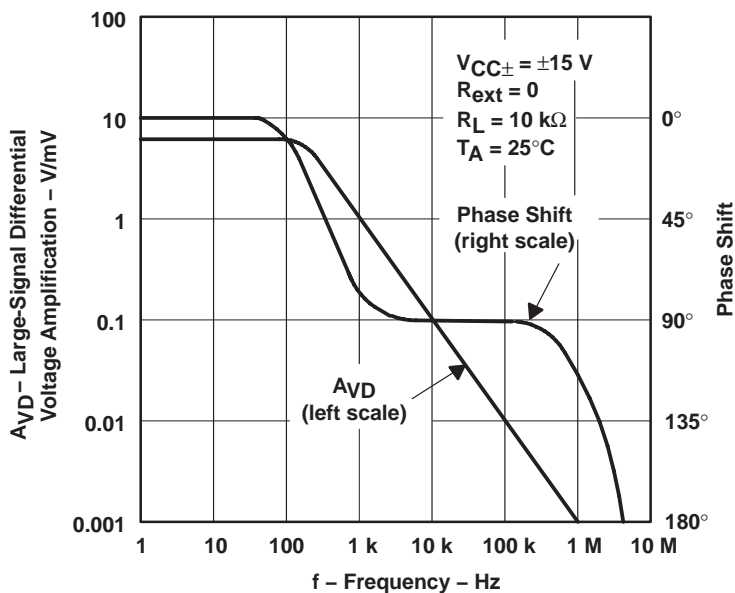


Figure 9

† 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**

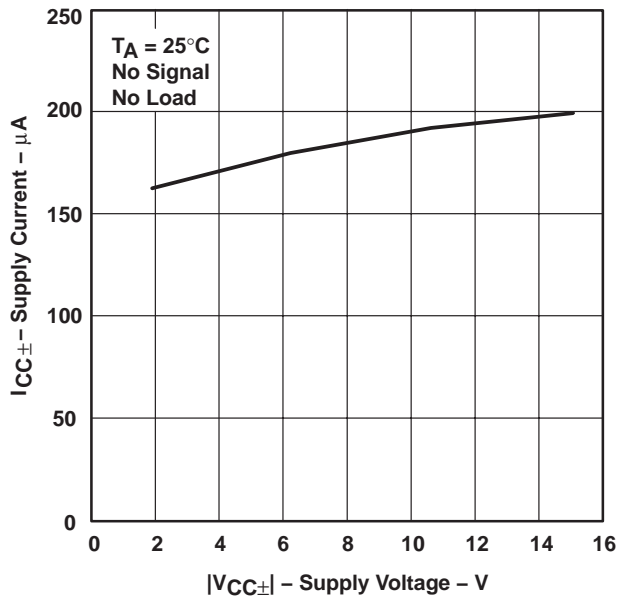


Figure 10

**SUPPLY CURRENT  
vs  
FREE-AIR TEMPERATURE**

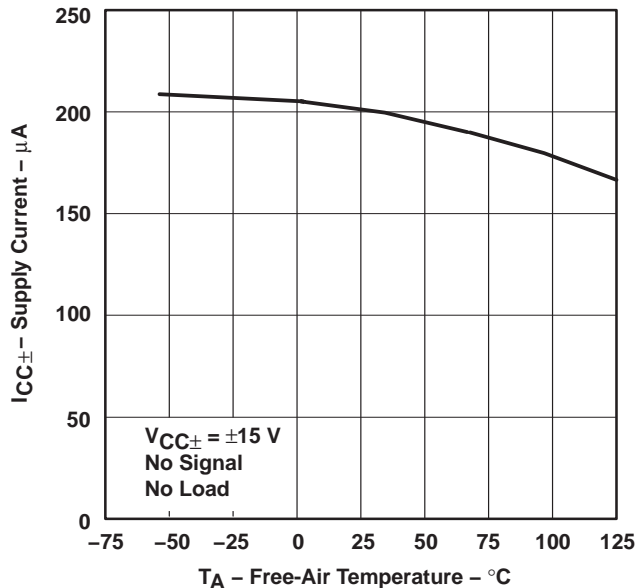


Figure 11

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

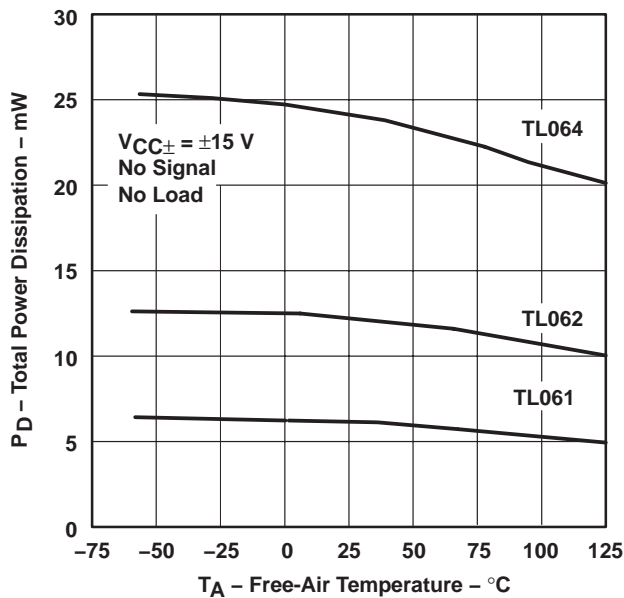


Figure 12

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

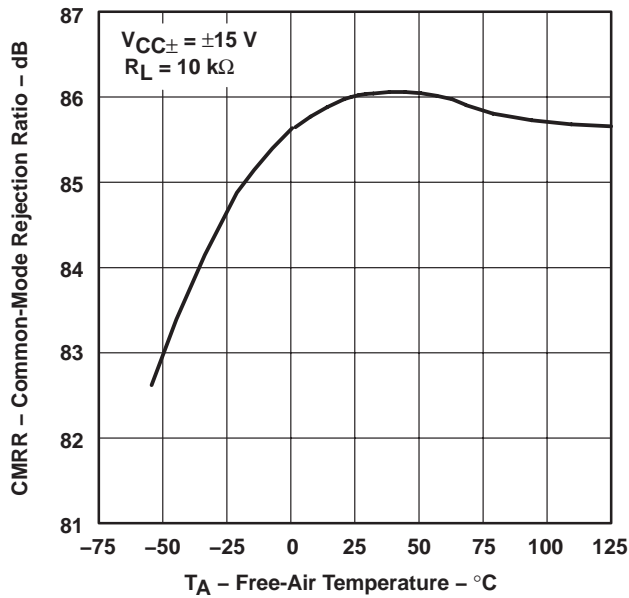


Figure 13

† 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

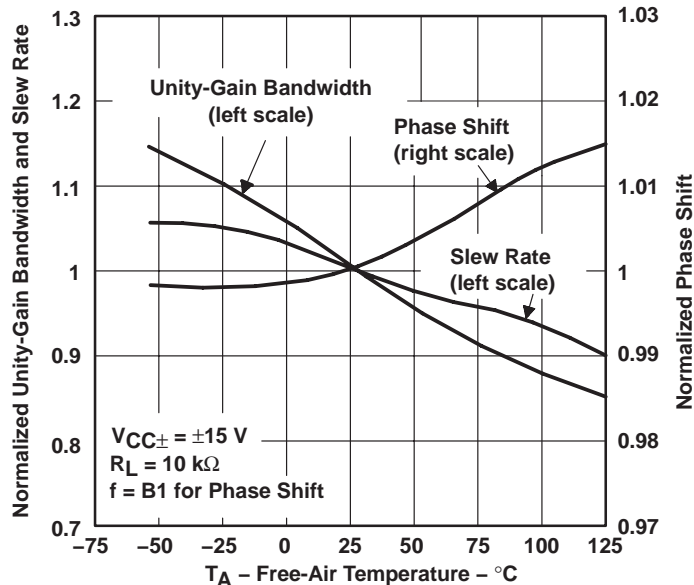


Figure 14

INPUT BIAS CURRENT  
 vs  
 FREE-AIR TEMPERATURE

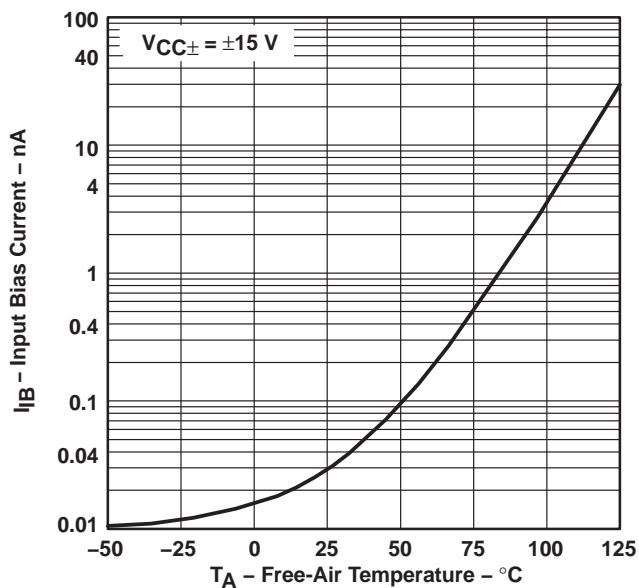


Figure 15

VOLTAGE-FOLLOWER  
 LARGE-SIGNAL PULSE RESPONSE  
 vs  
 TIME

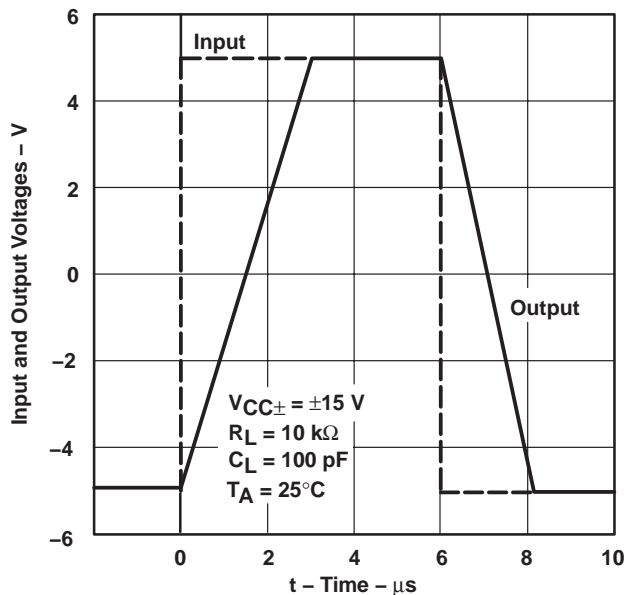
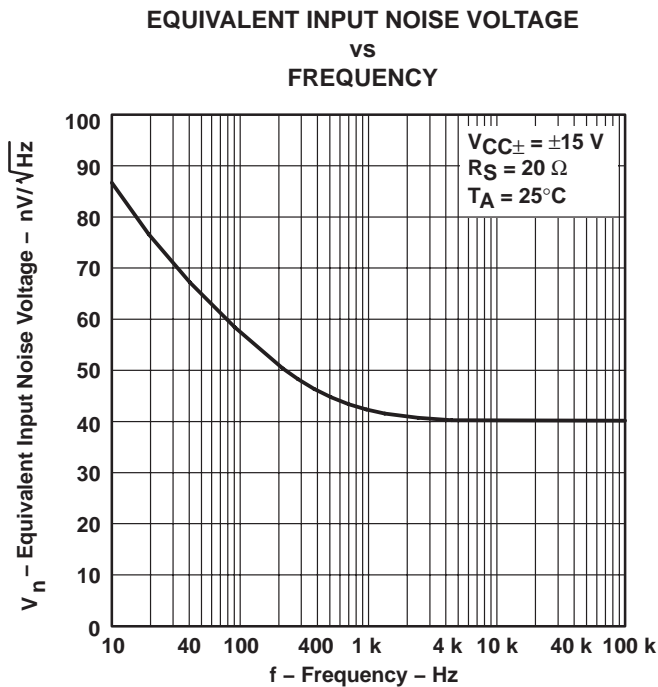
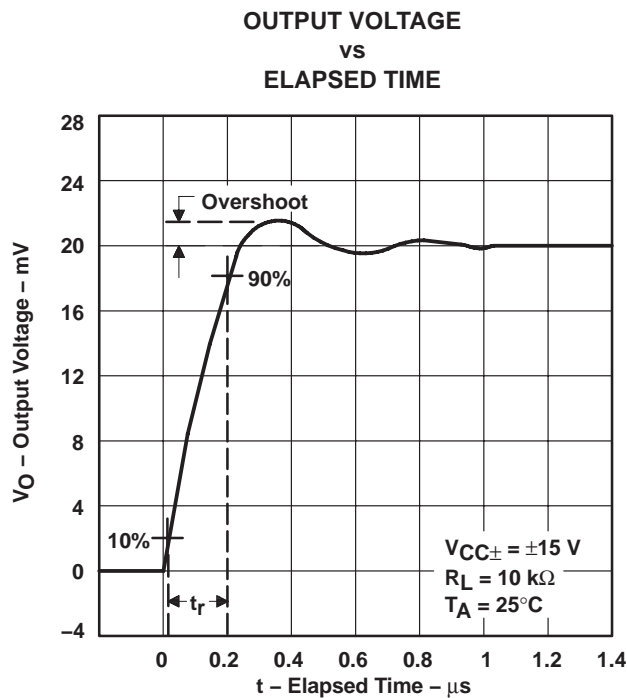


Figure 16

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

SLOS078J – NOVEMBER 1978 – REVISED SEPTEMBER 2004

**TYPICAL CHARACTERISTICS**



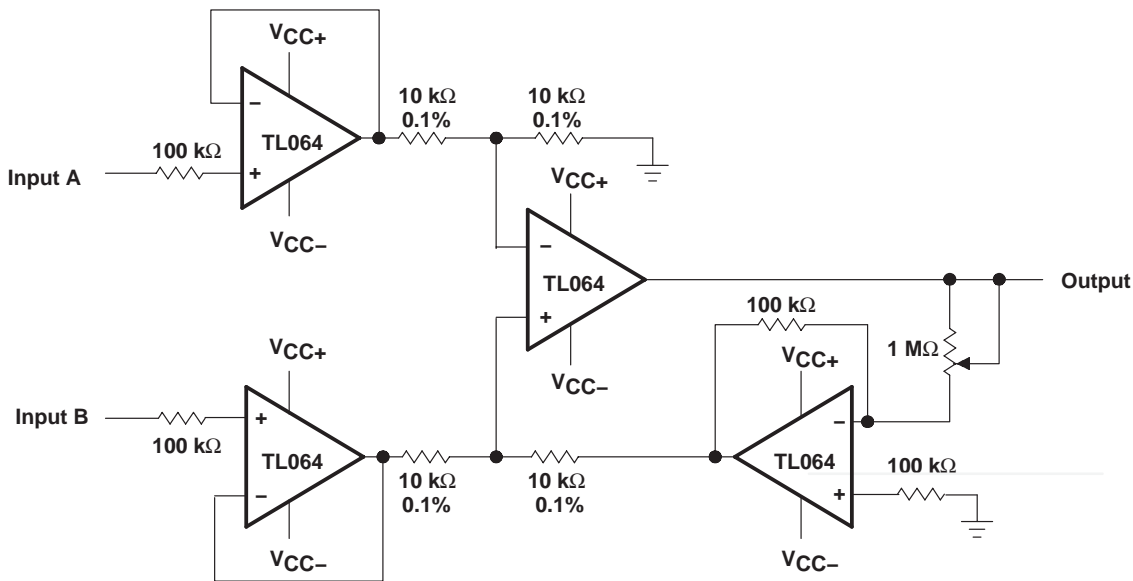
**TL061, TL061A, TL061B, TL062, TL062A  
TL062B, TL064, TL064A, TL064B  
LOW-POWER JFET-INPUT OPERATIONAL AMPLIFIERS**

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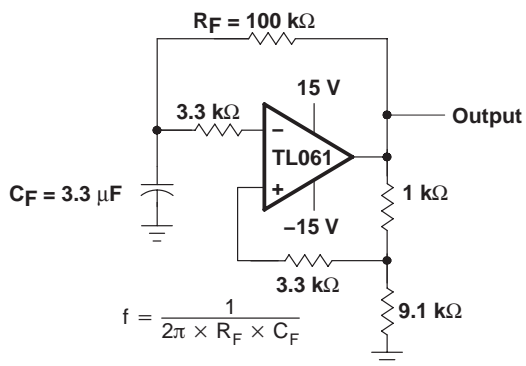
**APPLICATION INFORMATION**

**Table of Application Diagrams**

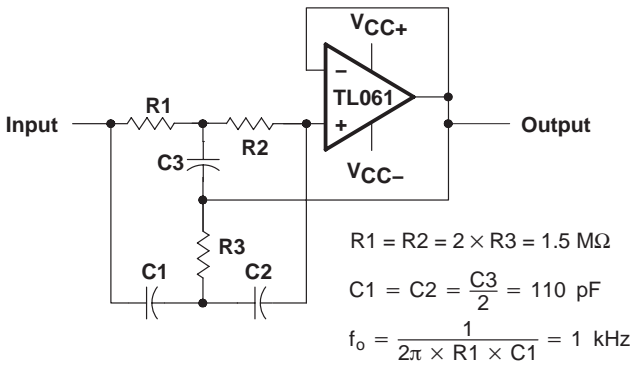
APPLICATION DIAGRAM	PART NUMBER	FIGURE
Instrumentation amplifier	TL064	19
0.5-Hz square-wave oscillator	TL061	20
High-Q notch filter	TL061	21
Audio-distribution amplifier	TL064	22
Low-level light detector preamplifier	TL061	23
AC amplifier	TL061	24
Microphone preamplifier with tone control	TL061	25
Instrumentation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

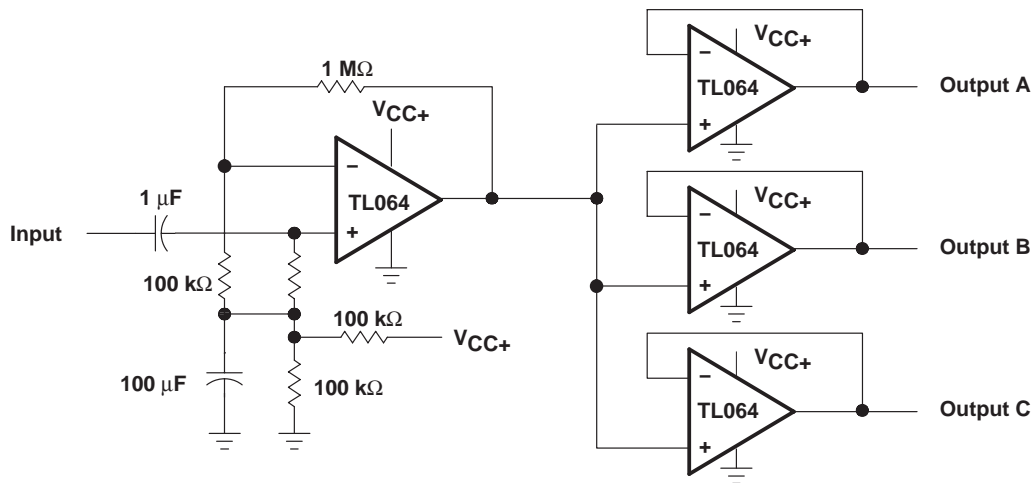


Figure 22. Audio-Distribution Amplifier

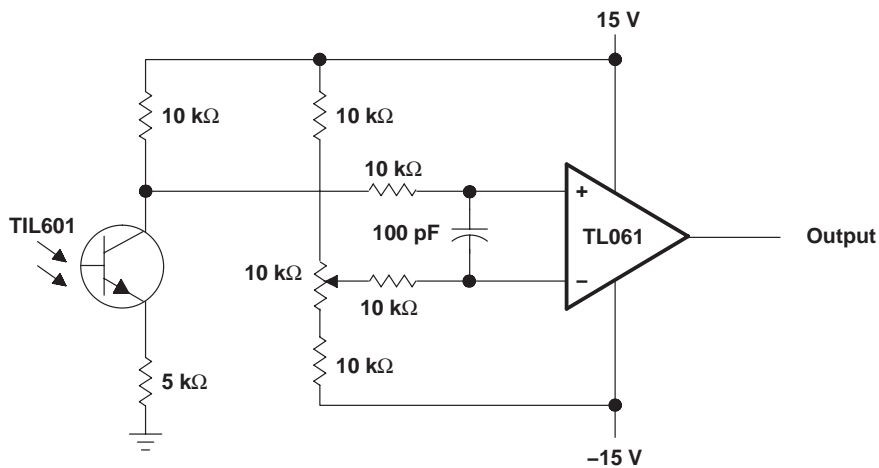
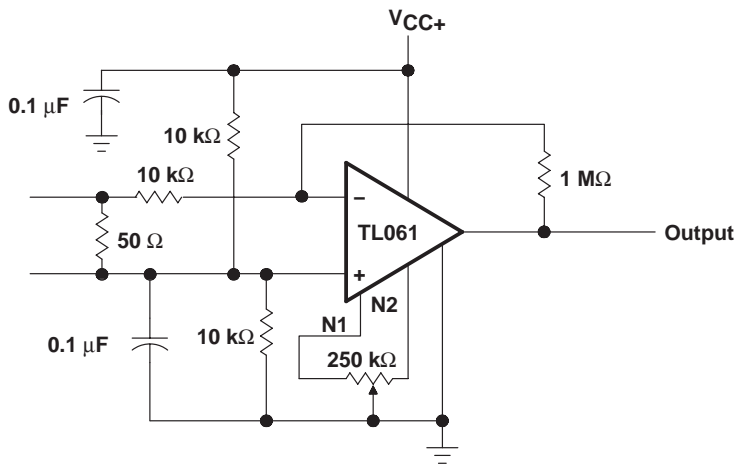
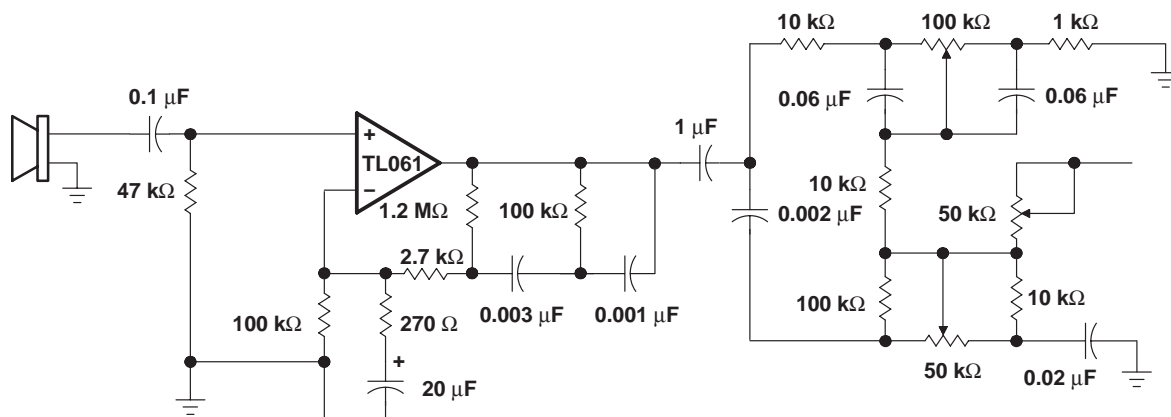


Figure 23. Low-Level Light Detector Preamplifier

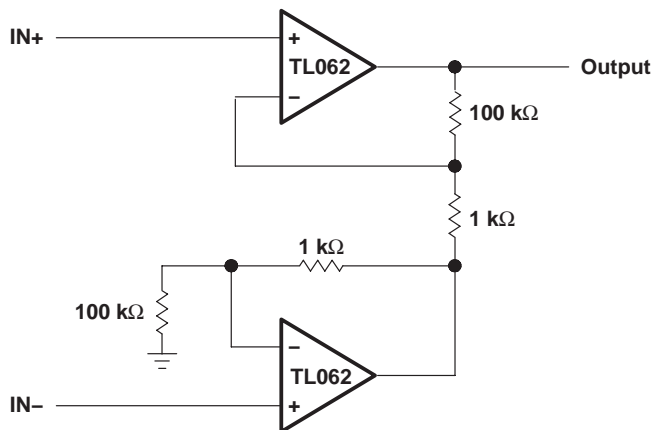
**APPLICATION INFORMATION**



**Figure 24. AC Amplifier**



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



**Figure 26. Instrumentation Amplifier**

APPLICATION INFORMATION

IC PREAMPLIFIER RESPONSE CHARACTERISTICS

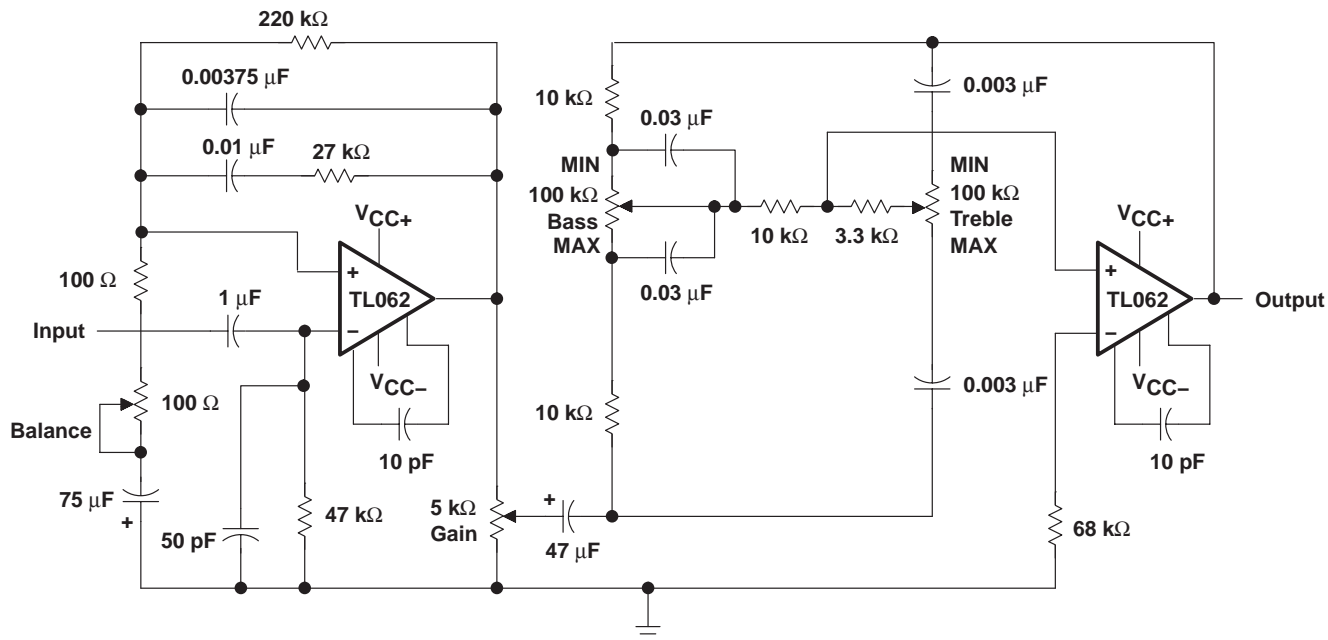
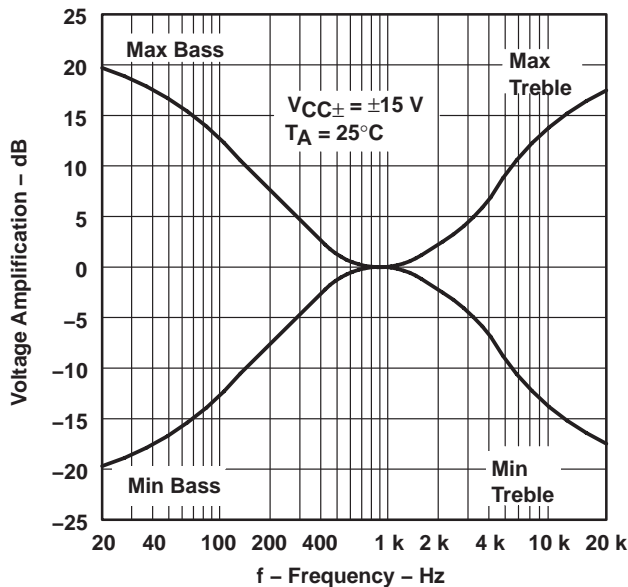


Figure 27. IC Preamplifier

**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
81023012A	OBSOLETE	LCCC	FK	20		TBD	Call TI	Call TI
81023022A	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type
8102302HA	ACTIVE	CFP	U	10	1	TBD	A42 SNPB	N / A for Pkg Type
8102302PA	ACTIVE	CDIP	JG	8	1	TBD	A42 SNPB	N / A for Pkg Type
81023032A	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type
8102303CA	ACTIVE	CDIP	J	14	1	TBD	A42 SNPB	N / A for Pkg Type
8102303DA	ACTIVE	CFP	W	14	1	TBD	A42 SNPB	N / A for Pkg Type
TL061ACD	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL061ACDE4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL061ACDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL061ACDRE4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL061ACP	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
TL061ACPE4	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
TL061ACPSR	ACTIVE	SO	PS	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL061ACPSRE4	ACTIVE	SO	PS	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL061BCD	OBSOLETE	SOIC	D	8		TBD	Call TI	Call TI
TL061BCP	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
TL061BCPE4	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
TL061CD	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL061CDE4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL061CDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL061CDRE4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL061CP	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
TL061CPE4	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
TL061CPSR	ACTIVE	SO	PS	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL061CPSRE4	ACTIVE	SO	PS	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL061CPWLE	OBSOLETE	TSSOP	PW	8		TBD	Call TI	Call TI
TL061ID	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL061IDE4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
						no Sb/Br)		
TL061IDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL061IDRE4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL061IP	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
TL061IPE4	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
TL061MJG	OBSOLETE	CDIP	JG	8		TBD	Call TI	Call TI
TL061MJGB	OBSOLETE	CDIP	JG	8		TBD	Call TI	Call TI
TL062ACD	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL062ACDE4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL062ACDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL062ACDRE4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL062ACJG	OBSOLETE	CDIP	JG	8		TBD	Call TI	Call TI
TL062ACP	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
TL062ACPE4	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
TL062ACPSR	ACTIVE	SO	PS	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL062ACPSRE4	ACTIVE	SO	PS	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL062BCD	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL062BCDE4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL062BCDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL062BCDRE4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL062BCP	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
TL062BCPE4	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
TL062CD	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL062CDE4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL062CDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL062CDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL062CDRE4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL062CDRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
						no Sb/Br)		
TL062CJG	OBSOLETE	CDIP	JG	8		TBD	Call TI	Call TI
TL062CP	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
TL062CPE4	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
TL062CPSLE	OBSOLETE	SO	PS	8		TBD	Call TI	Call TI
TL062CPSR	ACTIVE	SO	PS	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL062CPSRE4	ACTIVE	SO	PS	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL062CPW	ACTIVE	TSSOP	PW	8	150	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL062CPWE4	ACTIVE	TSSOP	PW	8	150	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL062CPWLE	OBSOLETE	TSSOP	PW	8		TBD	Call TI	Call TI
TL062CPWR	ACTIVE	TSSOP	PW	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL062CPWRE4	ACTIVE	TSSOP	PW	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL062CPWRG4	ACTIVE	TSSOP	PW	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL062ID	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL062IDE4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL062IDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL062IDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL062IDRE4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL062IDRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL062IJG	OBSOLETE	CDIP	JG	8		TBD	Call TI	Call TI
TL062IP	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
TL062IPE4	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
TL062IPWR	ACTIVE	TSSOP	PW	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL062IPWRE4	ACTIVE	TSSOP	PW	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL062MFKB	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type
TL062MJG	ACTIVE	CDIP	JG	8	1	TBD	A42 SNPB	N / A for Pkg Type
TL062MJGB	ACTIVE	CDIP	JG	8	1	TBD	A42 SNPB	N / A for Pkg Type
TL064ACD	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL064ACDE4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
TL064ACDR	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL064ACDRE4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL064ACN	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
TL064ACNE4	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
TL064BCD	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL064BCDE4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL064BCDR	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL064BCDRE4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL064BCN	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
TL064BCNE4	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
TL064CD	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL064CDBR	ACTIVE	SSOP	DB	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL064CDBRE4	ACTIVE	SSOP	DB	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL064CDE4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL064CDR	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL064CDRE4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL064CN	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
TL064CNE4	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
TL064CNSR	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL064CNSRE4	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL064CPW	ACTIVE	TSSOP	PW	14	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL064CPWE4	ACTIVE	TSSOP	PW	14	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL064CPWLE	OBSOLETE	TSSOP	PW	14		TBD	Call TI	Call TI
TL064CPWR	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL064CPWRE4	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL064ID	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
TL064IDE4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL064IDG4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL064IDR	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL064IDRE4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL064IDRG4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL064IN	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
TL064INE4	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
TL064INS	ACTIVE	SO	NS	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL064INSG4	ACTIVE	SO	NS	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL064INSR	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL064INSRG4	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL064MFK	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type
TL064MFKB	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type
TL064MJ	ACTIVE	CDIP	J	14	1	TBD	A42 SNPB	N / A for Pkg Type
TL064MJB	ACTIVE	CDIP	J	14	1	TBD	A42 SNPB	N / A for Pkg Type
TL064MWB	ACTIVE	CFP	W	14	1	TBD	A42 SNPB	N / A for Pkg Type

<sup>(1)</sup> 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.

**OBSELETE:** TI has discontinued the production of the device.

<sup>(2)</sup> 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)

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

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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.



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 length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 (0,15) per end.
  - D. Body width does not include interlead flash. Interlead flash shall not exceed .017 (0,43) per side.
  - E. Reference 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 length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 (0,15) per end.
  - D. Body width does not include interlead flash. Interlead flash shall not exceed .017 (0,43) per side.
  - E. Reference 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.

DB (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE

28 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-150

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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