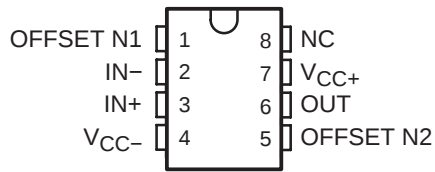


TL061, TL061A, TL061B, TL062, TL062A TL062B, TL064, TL064A, TL064B LOW-POWER JFET-INPUT OPERATIONAL AMPLIFIERS

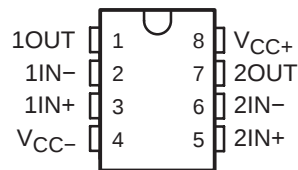
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- Very Low Power Consumption
- Typical Supply Current . . . 200 μ A (Per Amplifier)
- Wide Common-Mode and Differential Voltage Ranges
- Low Input Bias and Offset Currents
- Common-Mode Input Voltage Range Includes V_{CC+}
- Output Short-Circuit Protection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

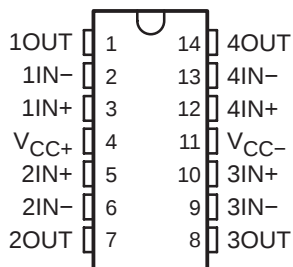
TL061, TL061A . . . D, P, OR PS PACKAGE
TL061B . . . P PACKAGE
(TOP VIEW)



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

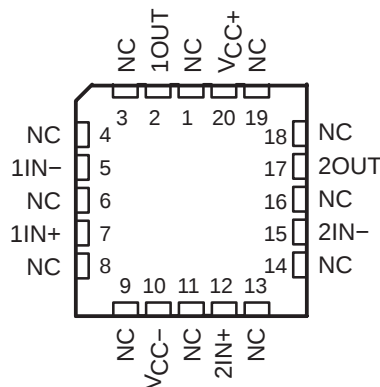


TL064 . . . D, J, N, NS, PW, OR W PACKAGE
TL064A, TL064B . . . D OR N PACKAGE
(TOP VIEW)

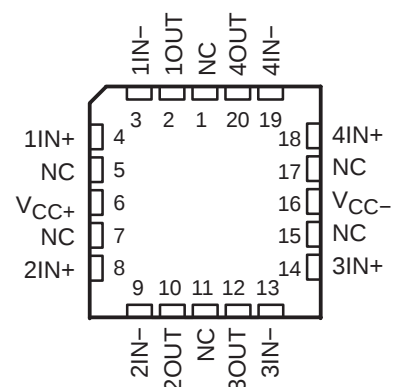


NC – No internal connection

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**

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description/ordering information (continued)

ORDERING INFORMATION

T _A	V _{IO} 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
			Reel of 2500	TL061CDR	
			Tube of 75	TL062CD	TL062C
			Reel of 2500	TL062CDR	
			Tube of 50	TL064CD	TL064C
			Reel of 2500	TL064CDR	
		SOP (PS)	Reel of 2000	TL061CPSR	T061
				TL062CPSR	T062
		SOP (NS)	Reel of 2000	TL064CNSR	TL064
		TSSOP (PW)	Tube of 150	TL062CPW	T062
			Reel of 2000	TL062CPWR	
			Tube of 90	TL064CPW	T064
			Reel of 2000	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
			Reel of 2500	TL061ACDR	
			Tube of 75	TL062ACD	062AC
			Reel of 2500	TL062ACDR	
			Tube of 50	TL064ACD	TL064AC
			Reel of 2500	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
			Reel of 2500	TL062BCDR	
			Tube of 50	TL064BCD	TL064BC
			Reel of 2500	TL064BCDR	

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

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

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description/ordering information (continued)

ORDERING INFORMATION (continued)

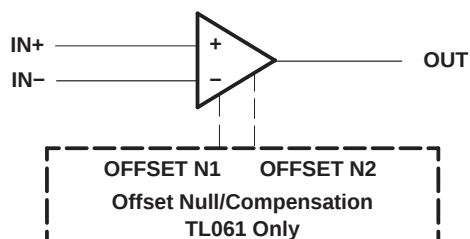
T_A	$V_{IO\text{MAX}}$ AT 25°C	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	6 mV	PDIP (P)	Tube of 50	TL061IP	TL061IP
				TL062IP	TL062IP
		PDIP (N)	Tube of 25	TL064IN	TL064IN
		SOIC (D)	Tube of 75	TL061ID	TL061I
			Reel of 2000	TL061IDR	
			Tube of 75	TL062ID	TL062I
			Reel of 2000	TL062IDR	
			Tube of 50	TL064ID	TL064I
			Reel of 2500	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.

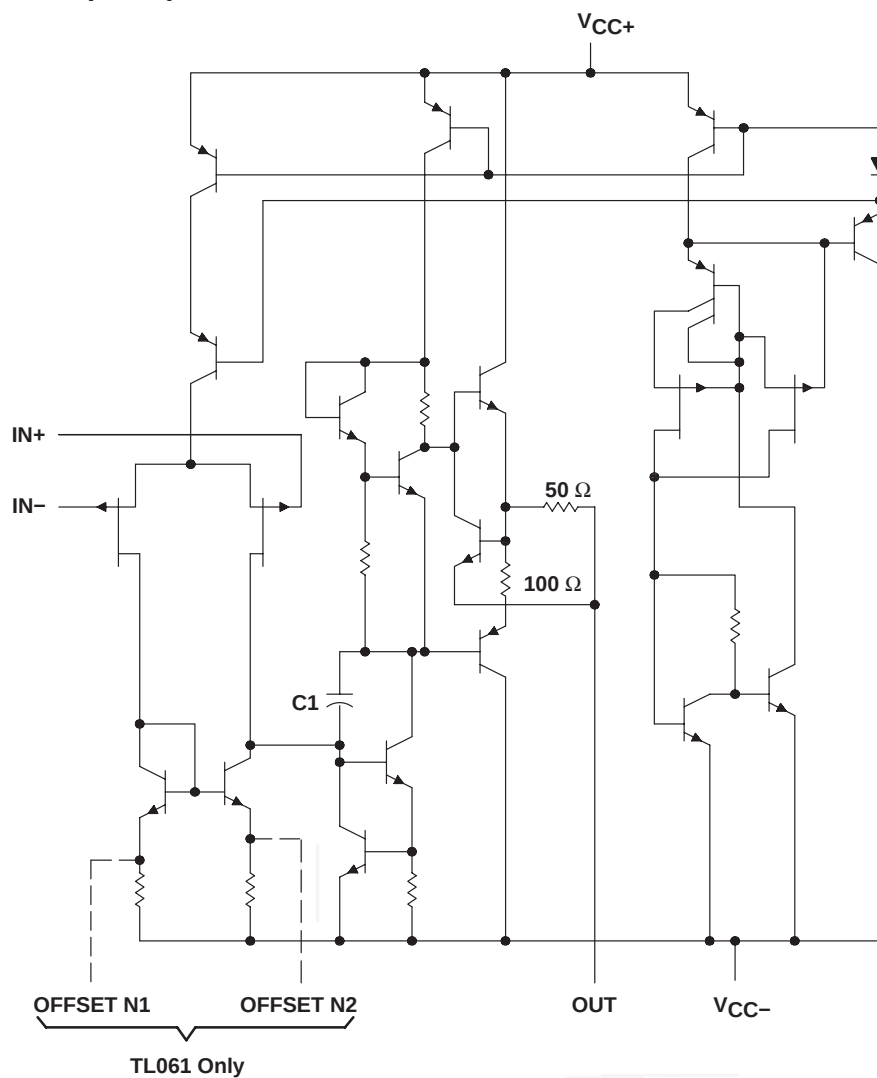
TL061, TL061A, TL061B, TL062, TL062A TL062B, TL064, TL064A, TL064B LOW-POWER JFET-INPUT OPERATIONAL AMPLIFIERS

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symbol (each amplifier)



schematic (each amplifier)



$C1 = 10 \text{ pF}$ 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

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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)		±30	±30	±30	V
Input voltage, V_I (see Notes 1 and 3)		±15	±15	±15	V
Duration of output short circuit (see Note 4)		Unlimited	Unlimited	Unlimited	
Package thermal impedance, θ_{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		
	PW (14-pin) package	113	113		
Package thermal impedance, θ_{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:
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 should 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.



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

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electrical characteristics, $V_{CC\pm} = \pm 15$ 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 Ω	T _A = 25°C T _A = Full range	3	15		3	6	mV	
					20			7.5		
α _{V_{IO}}	Temperature coefficient of input offset voltage	V _O = 0, R _S = 50 Ω, T _A = Full range		10			10		μV/°C	
I _{IO}	Input offset current	V _O = 0	T _A = 25°C	5	200		5	100	pA	
			T _A = Full range		5			3	nA	
I _{IB}	Input bias current‡	V _O = 0	T _A = 25°C	30	400		30	200	pA	
			T _A = Full range		10			7	nA	
V _{ICR}	Common-mode input voltage range	T _A = 25°C		±11	−12 to 15		±11	−12 to 15	V	
V _{OM}	Maximum peak output voltage swing	R _L = 10 kΩ,	T _A = 25°C	±10	±13.5		±10	±13.5	V	
		R _L ≥ 10 kΩ,	T _A = Full range	±10			±10			
A _{VD}	Large-signal differential voltage amplification	V _O = ± 10 V, R _L ≥ 10 kΩ	T _A = 25°C	3	6		4	6	V/mV	
			T _A = Full range	3			4			
B ₁	Unity-gain bandwidth	R _L = 10 kΩ,	T _A = 25°C	1			1		MHz	
r _i	Input resistance	T _A = 25°C		10 ¹²			10 ¹²		Ω	
CMRR	Common-mode rejection ratio	V _{IC} = V _{ICRmin} , V _O = 0, R _S = 50 Ω, T _A = 25°C		70	86		80	86	dB	
k _{SVR}	Supply-voltage rejection ratio (ΔV _{CC±} /ΔV _{IO})	V _{CC} = ± 9 V to ± 15 V, V _O = 0, R _S = 50 Ω, T _A = 25°C		70	95		80	95	dB	
P _D	Total power dissipation (each amplifier)	V _O = 0, No load	T _A = 25°C,	6	7.5		6	7.5	mW	
I _{CC}	Supply current (each amplifier)	V _O = 0, No load	T _A = 25°C,	200	250		200	250	μA	
V _{O1} /V _{O2}	Crosstalk attenuation	A _{VD} = 100,	T _A = 25°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°C to 70°C for TL06_C, TL06_AC, and TL06_BC and -40°C to 85°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

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

PARAMETER	TEST CONDITIONS†	TL061BC TL062BC TL064BC			TL061I TL062I TL064I			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO} Input offset voltage	$V_O = 0$, $R_S = 50\ \Omega$ $T_A = 25^\circ\text{C}$ $T_A = \text{Full range}$		2	3		3	6	mV
$\alpha_{V_{IO}}$ 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	$V_O = 0$ $T_A = 25^\circ\text{C}$ $T_A = \text{Full range}$		5	100		5	100	pA
				3			10	nA
I_{IB} Input bias current‡	$V_O = 0$ $T_A = 25^\circ\text{C}$ $T_A = \text{Full range}$		30	200		30	200	pA
				7			20	nA
V_{ICR} Common-mode input voltage range	$T_A = 25^\circ\text{C}$	± 11	-12 to 15		± 11	-12 to 15		V
V_{OM} Maximum peak output voltage swing	$R_L = 10\ \text{k}\Omega$, $T_A = 25^\circ\text{C}$ $R_L \geq 10\ \text{k}\Omega$, $T_A = \text{Full range}$	± 10	± 13.5		± 10	± 13.5		V
A_{VD} Large-signal differential voltage amplification	$V_O = \pm 10\ \text{V}$, $T_A = 25^\circ\text{C}$ $R_L \geq 10\ \text{k}\Omega$, $T_A = \text{Full range}$	4	6		4	6		V/mV
		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}		Ω
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)	$V_O = 0$, $T_A = 25^\circ\text{C}$, No load		6	7.5		6	7.5	mW
I_{CC} Supply current (each amplifier)	$V_O = 0$, $T_A = 25^\circ\text{C}$, No load		200	250		200	250	μA
$VO1/VO2$ 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°C to 70°C for TL06_C, TL06_AC, and TL06_BC and -40°C to 85°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**

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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	$V_O = 0$, $R_S = 50\ \Omega$	$T_A = 25^\circ\text{C}$ $T_A = -55^\circ\text{C to } 125^\circ\text{C}$	3	6	9	3	9	15	mV
$\alpha_{V_{IO}}$ 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		5	100		pA
		$T_A = -55^\circ\text{C}$		20*			20*		nA
		$T_A = 125^\circ\text{C}$		20			20		nA
I_{IB} Input bias current‡	$V_O = 0$	$T_A = 25^\circ\text{C}$	30	200		30	200		pA
		$T_A = -55^\circ\text{C}$		50*			50*		nA
		$T_A = 125^\circ\text{C}$		50			50		nA
V_{ICR} Common-mode input voltage range	$T_A = 25^\circ\text{C}$		± 11.5	-12 to 15		± 11.5	-12 to 15		V
V_{OM} Maximum peak output voltage swing	$R_L = 10\ \text{k}\Omega$, $T_A = 25^\circ\text{C}$		± 10	± 13.5		± 10	± 13.5		V
	$R_L \geq 10\ \text{k}\Omega$, $T_A = -55^\circ\text{C to } 125^\circ\text{C}$		± 10			± 10			V
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		4	6		V/mV
		$T_A = -55^\circ\text{C to } 125^\circ\text{C}$	4			4			V/mV
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}		Ω
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		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		μA
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/ μs
t_r	Rise time	$V_I = 20\ \text{mV}$, $C_L = 100\ \text{pF}$, See Figure 1	$R_L = 10\ \text{k}\Omega$, See Figure 1		0.2		μs
	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/ μs min.



PARAMETER MEASUREMENT INFORMATION

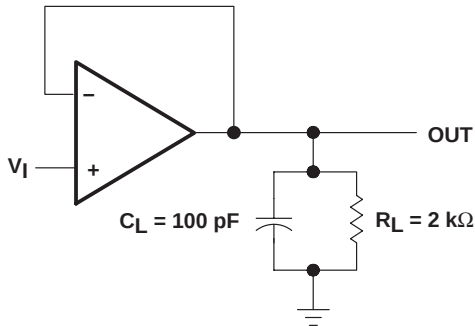


Figure 1. Unity-Gain Amplifier

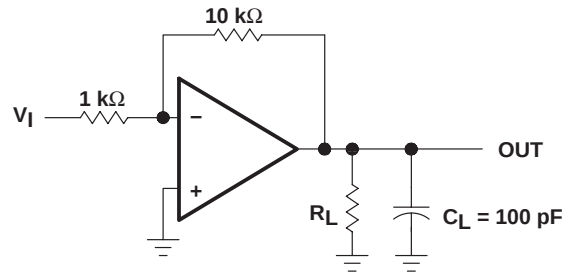


Figure 2. Gain-of-10 Inverting Amplifier

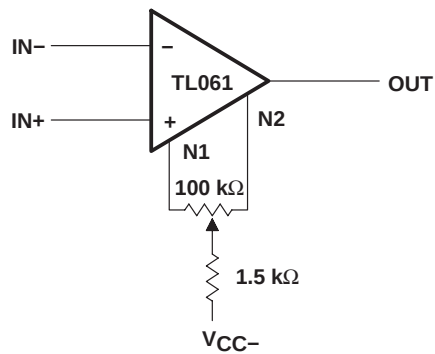


Figure 3. Input Offset-Voltage Null Circuit

TYPICAL CHARACTERISTICS

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TYPICAL CHARACTERISTICS†

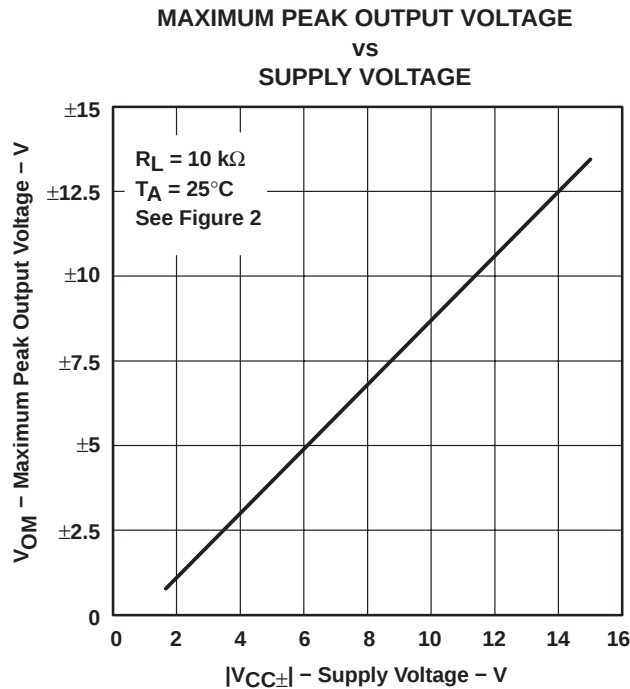


Figure 4

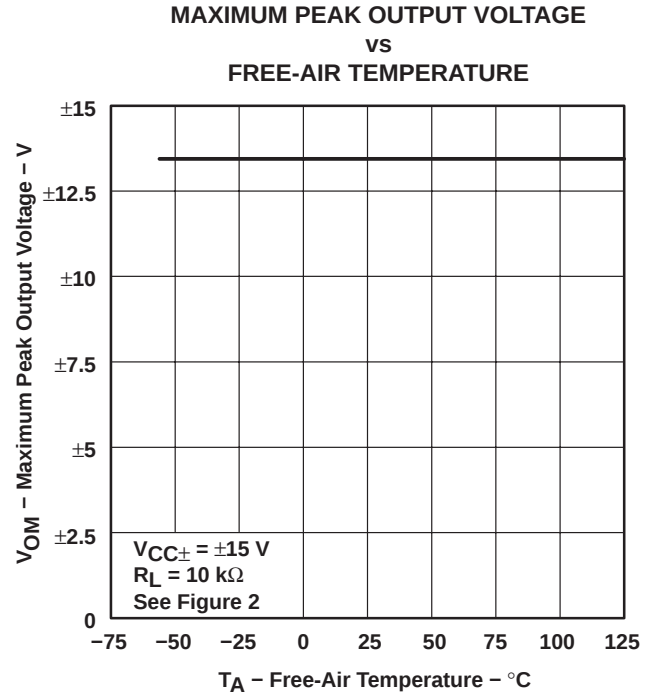


Figure 5

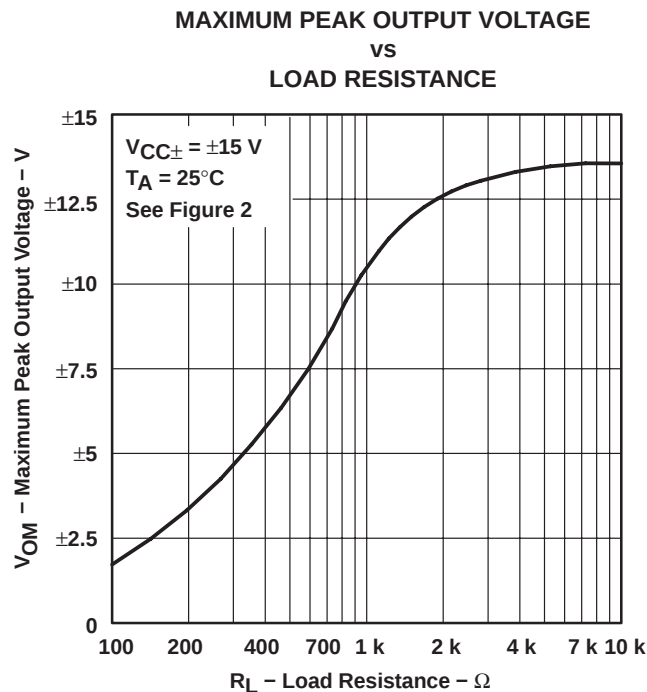


Figure 6

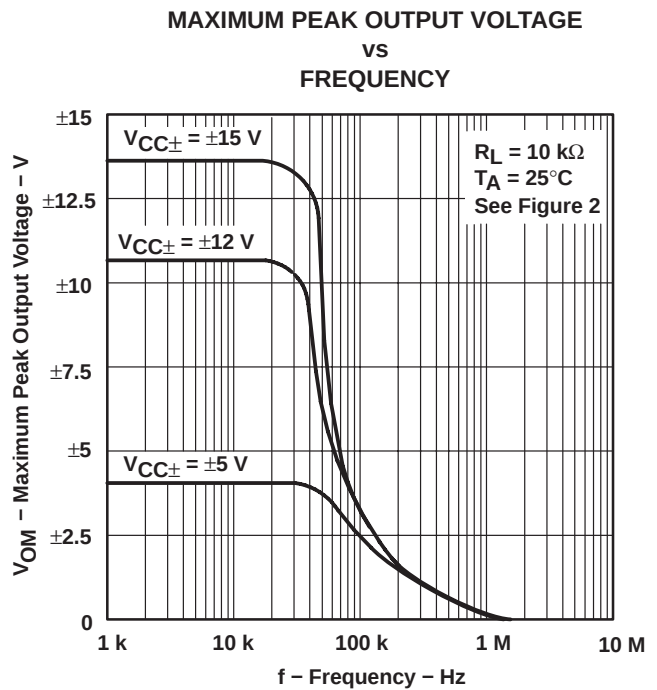


Figure 7

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

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

SLOS078J – NOVEMBER 1978 – REVISED SEPTEMBER 2004

TYPICAL CHARACTERISTICS†

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

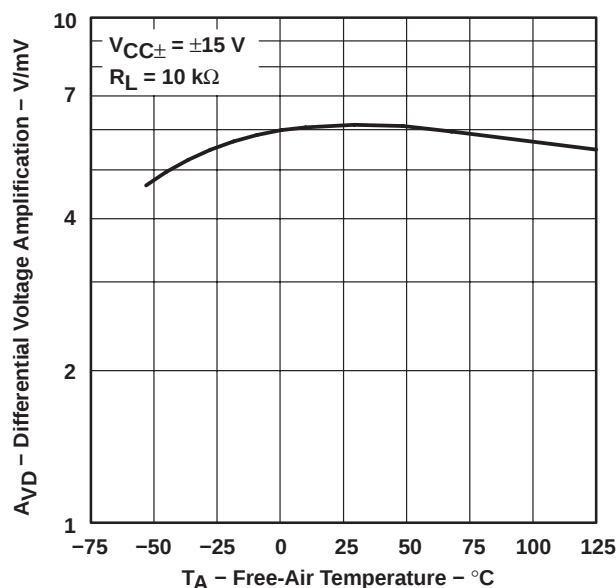


Figure 8

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

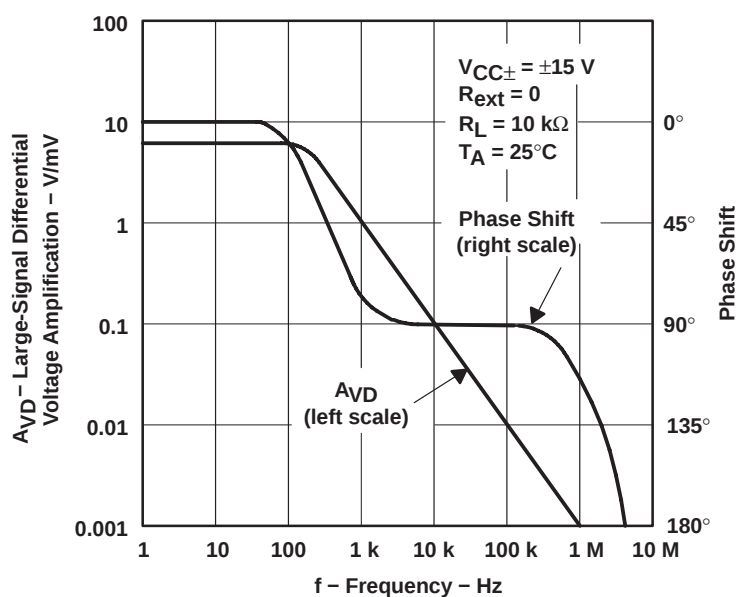


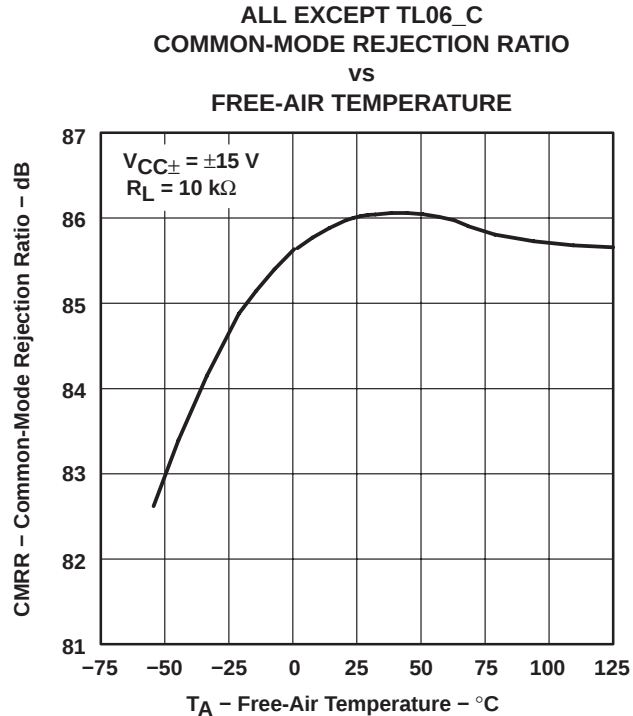
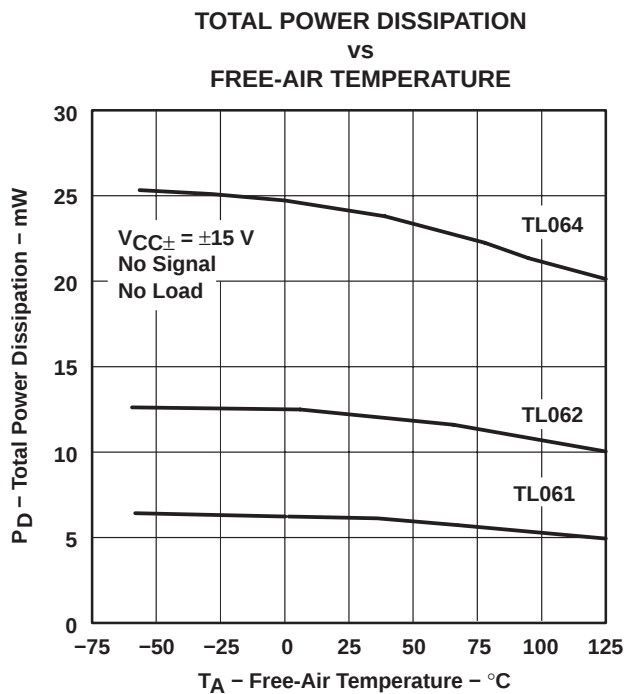
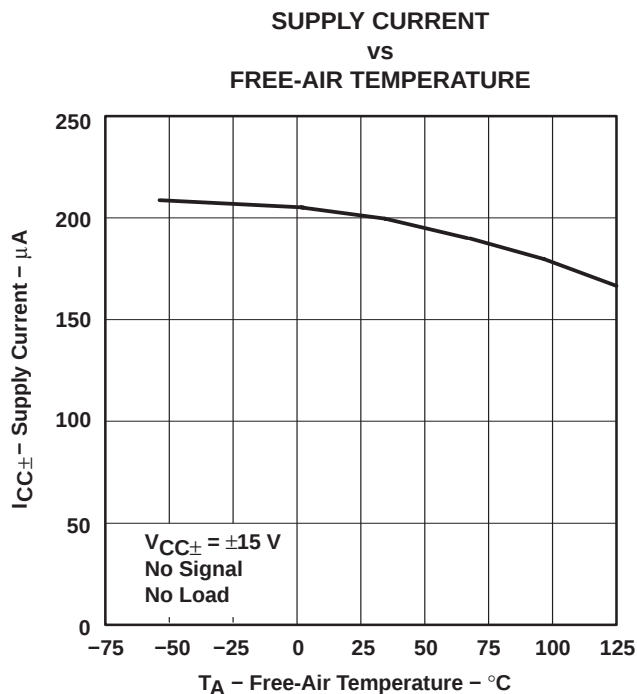
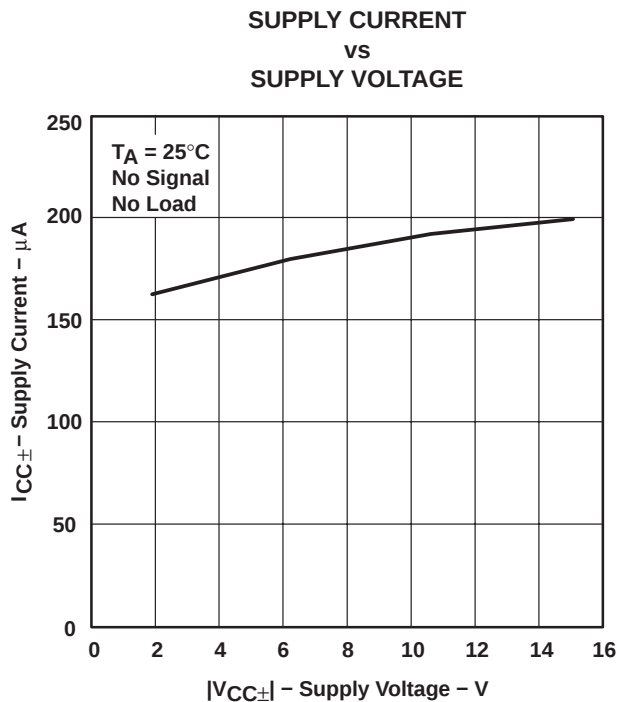
Figure 9

† 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†



† 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

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

VS

FREE-AIR TEMPERATURE

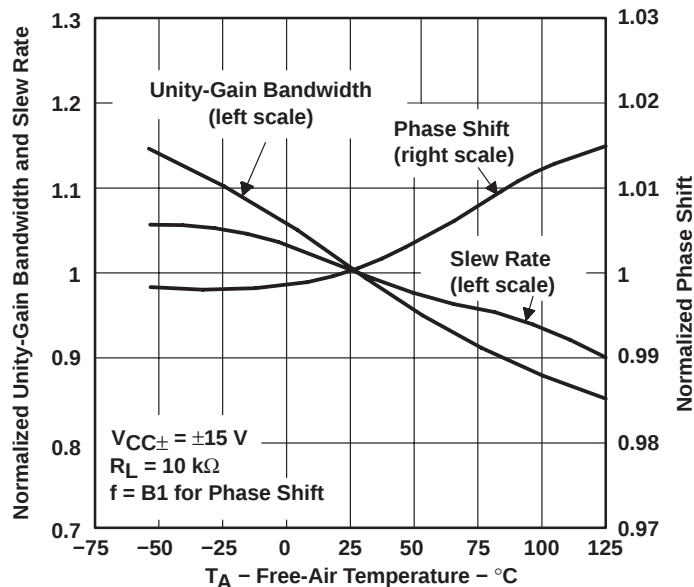


Figure 14

INPUT BIAS CURRENT
 VS
 FREE-AIR TEMPERATURE

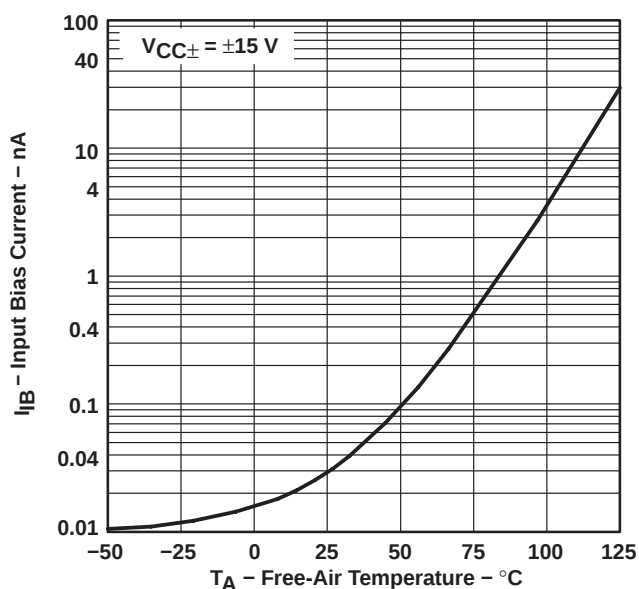


Figure 15

VOLTAGE-FOLLOWER
 LARGE-SIGNAL PULSE RESPONSE
 VS
 TIME

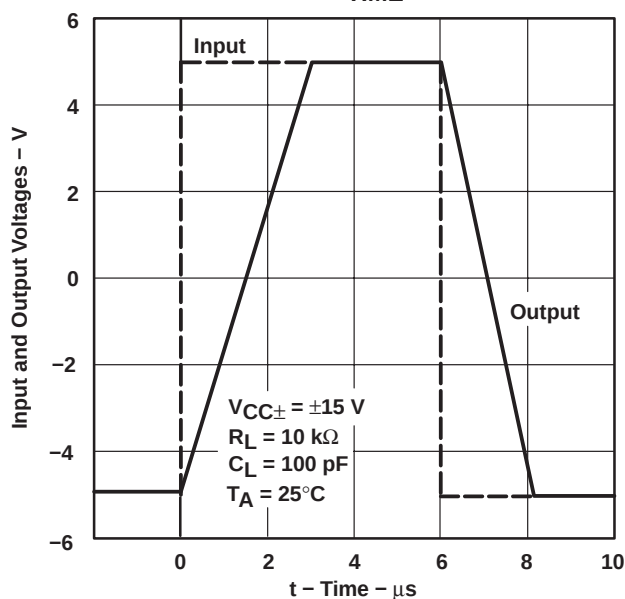


Figure 16

TYPICAL CHARACTERISTICS

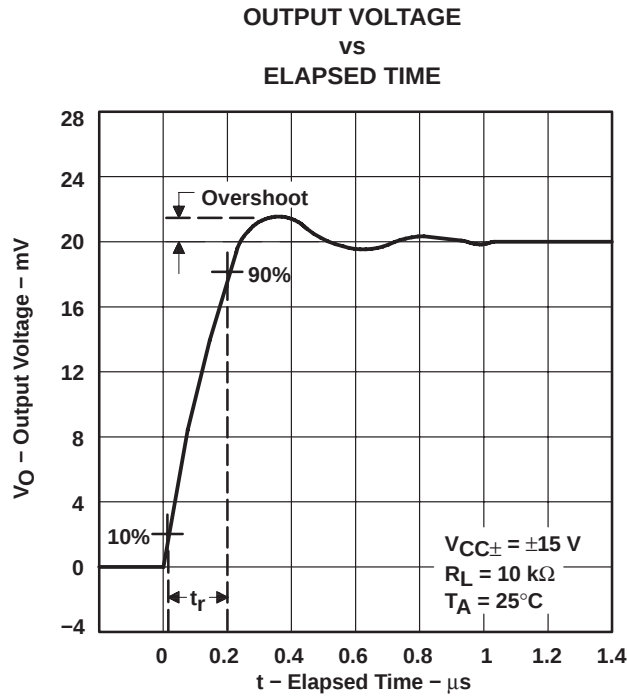


Figure 17

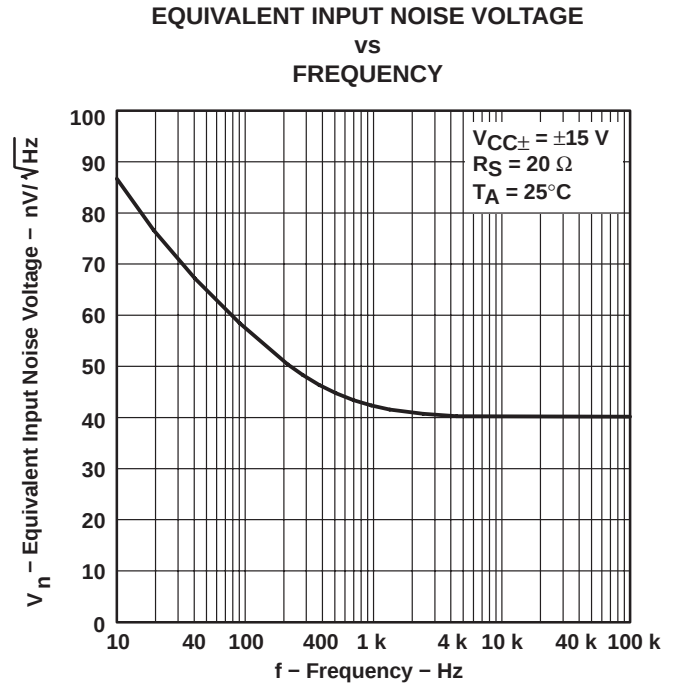


Figure 18

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

SLOS078J – NOVEMBER 1978 – REVISED SEPTEMBER 2004

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

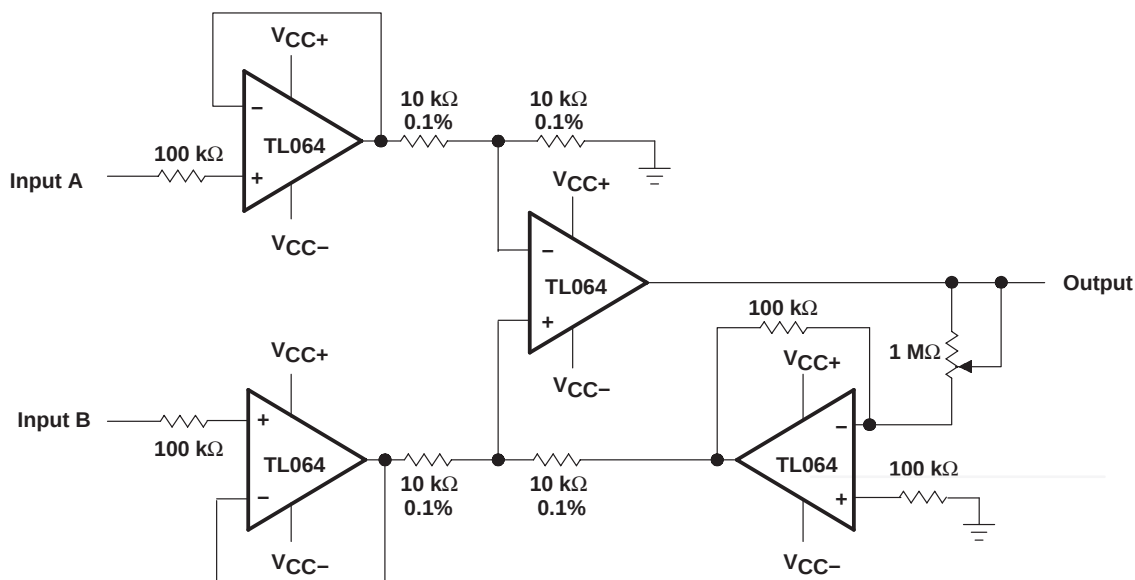


Figure 19. Instrumentation Amplifier

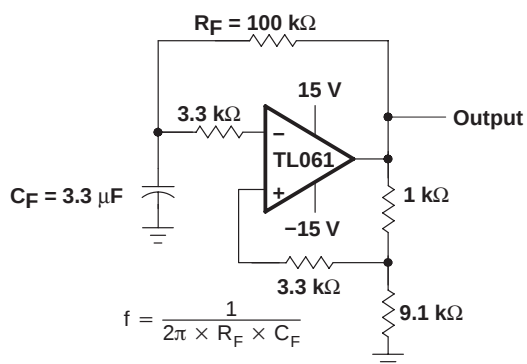


Figure 20. 0.5-Hz Square-Wave Oscillator

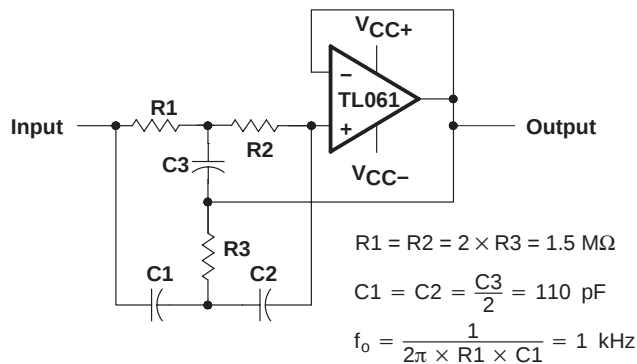


Figure 21. High-Q Notch Filter

APPLICATION INFORMATION

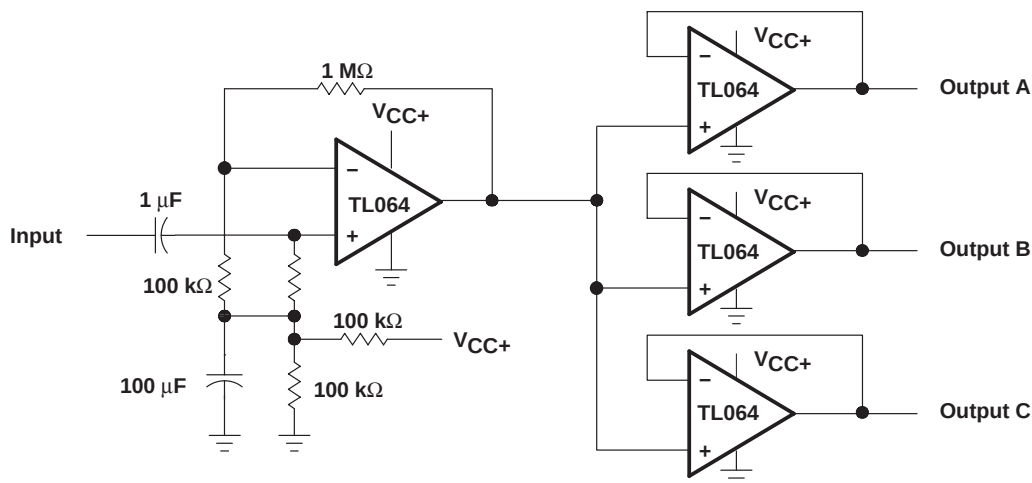


Figure 22. Audio-Distribution Amplifier

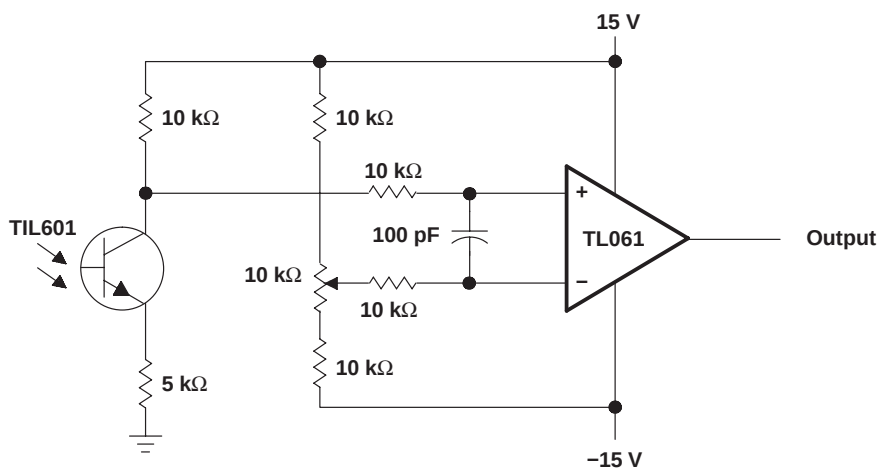


Figure 23. Low-Level Light Detector Preamplifier

APPLICATION INFORMATION

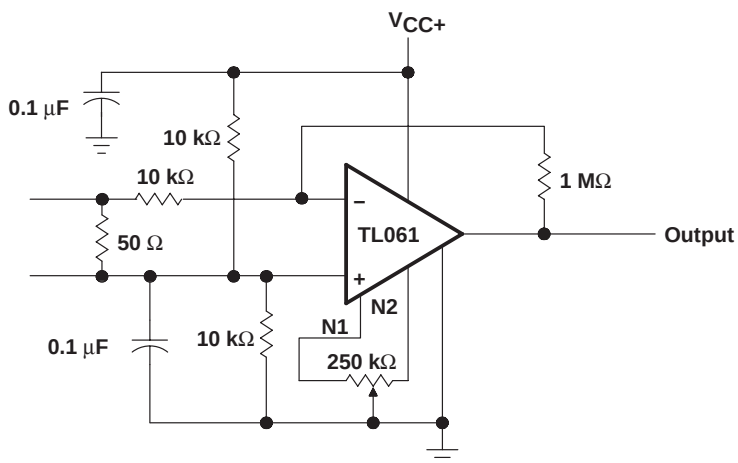


Figure 24. AC Amplifier

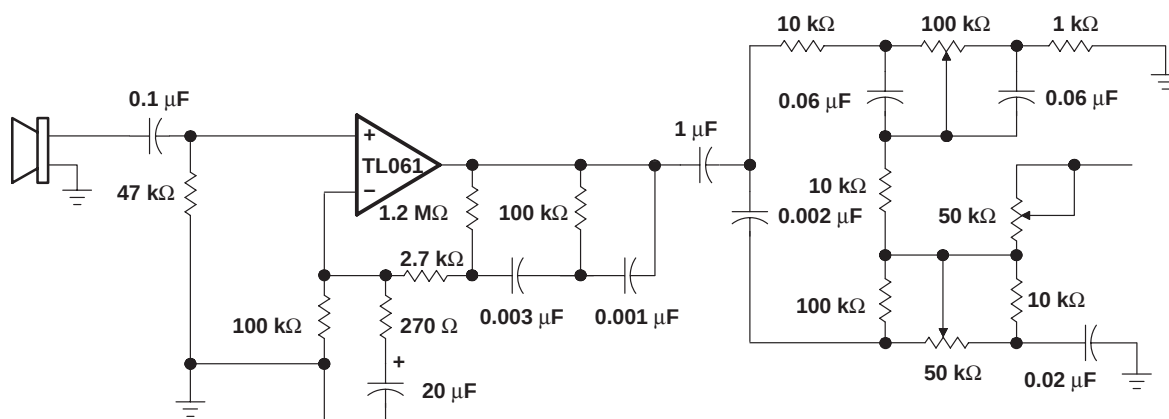


Figure 25. Microphone Preamplifier With Tone Control

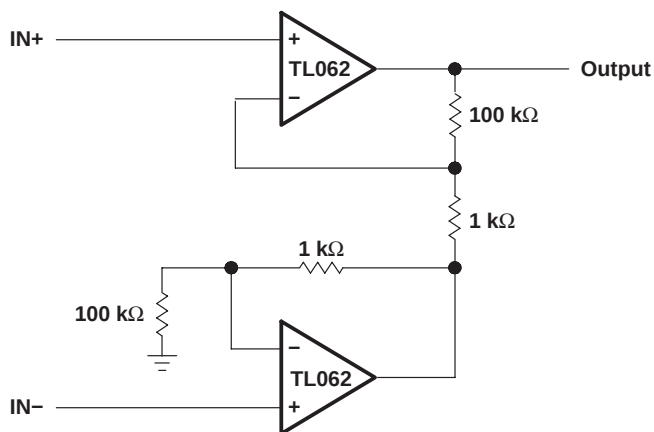
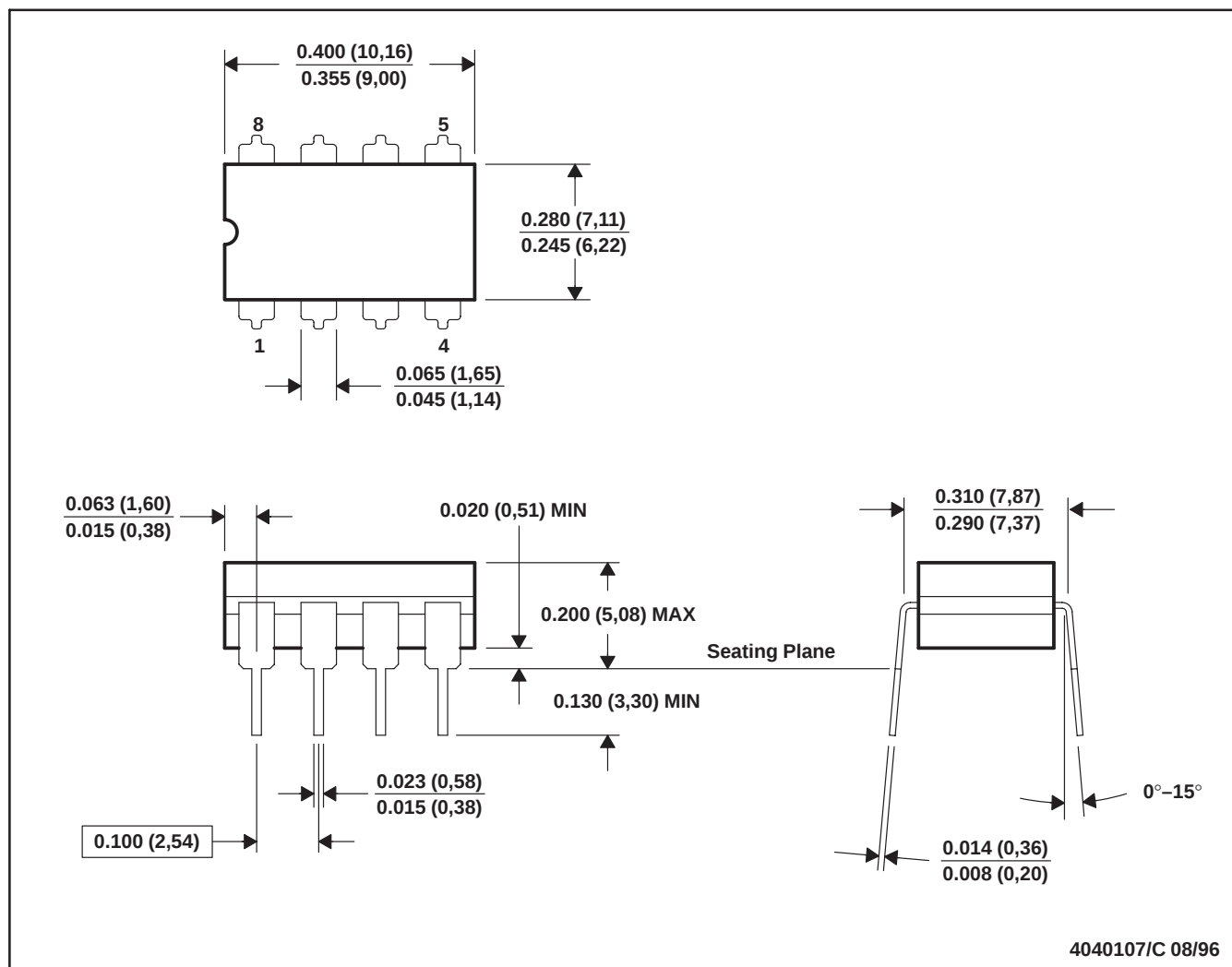


Figure 26. Instrumentation Amplifier

JG (R-GDIP-T8)

CERAMIC DUAL-IN-LINE

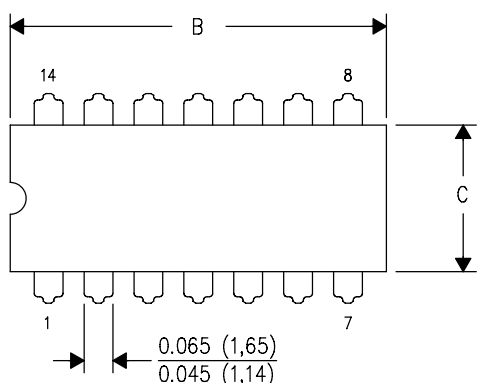


- NOTES: A. All linear dimensions are in inches (millimeters).
 B. This drawing is subject to change without notice.
 C. This package can be hermetically sealed with a ceramic lid using glass frit.
 D. Index point is provided on cap for terminal identification.
 E. Falls within MIL STD 1835 GDIP1-T8

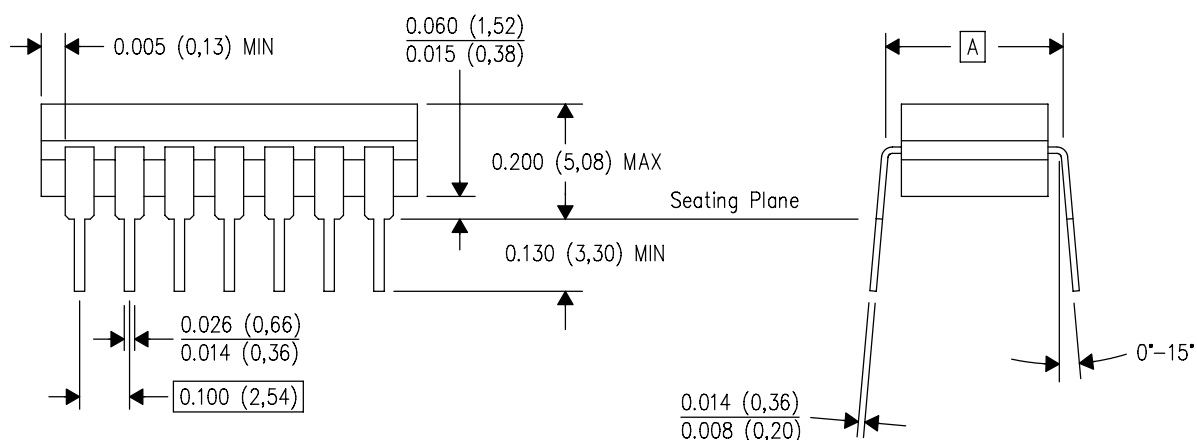
J (R-GDIP-T**)

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)

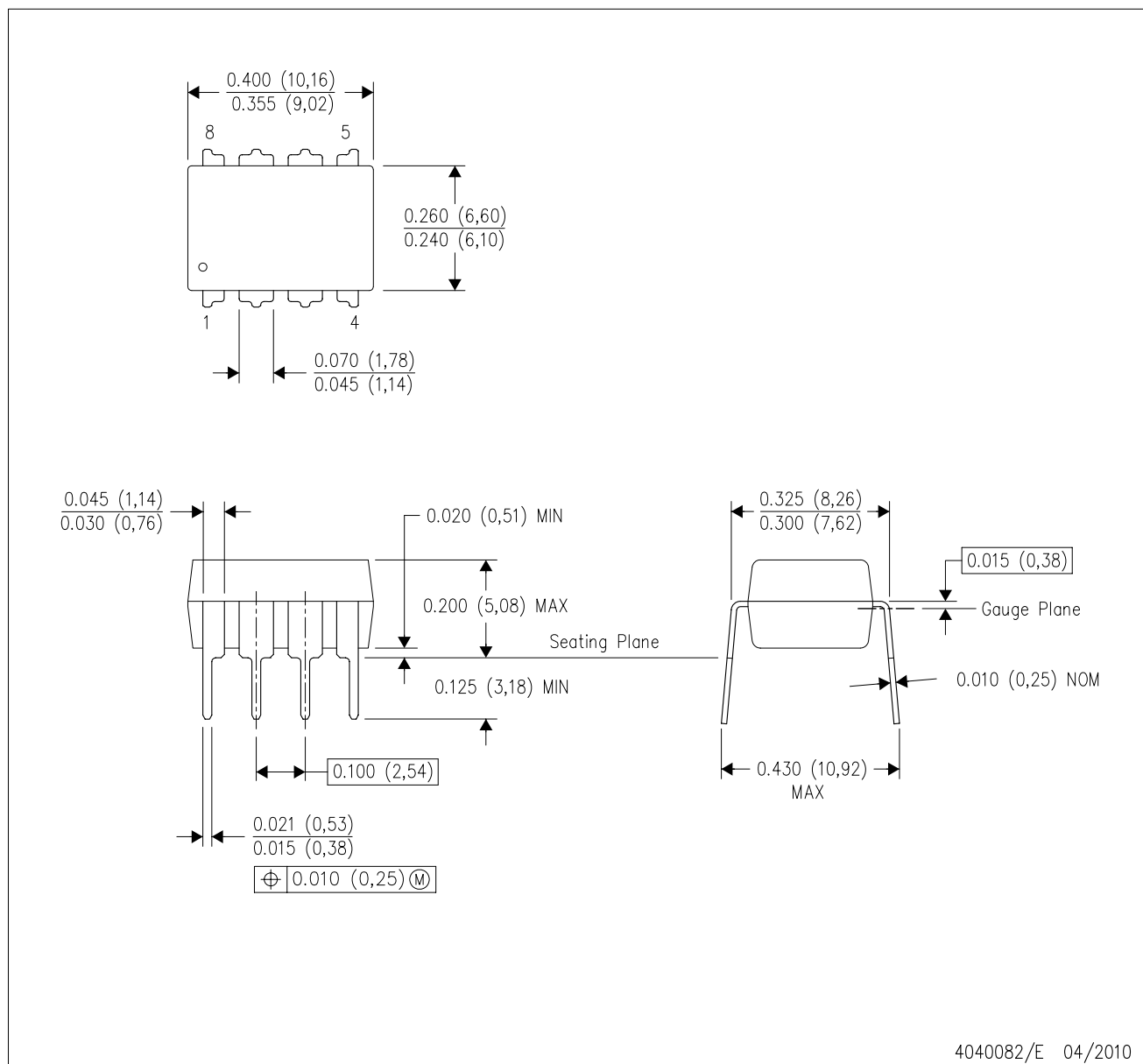


4040083/F 03/03

- 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.

P (R-PDIP-T8)

PLASTIC DUAL-IN-LINE PACKAGE

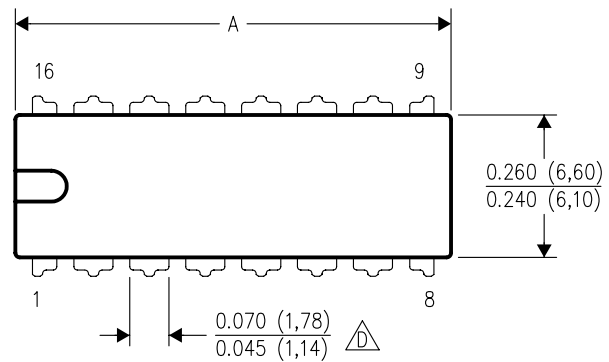


- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. Falls within JEDEC MS-001 variation BA.

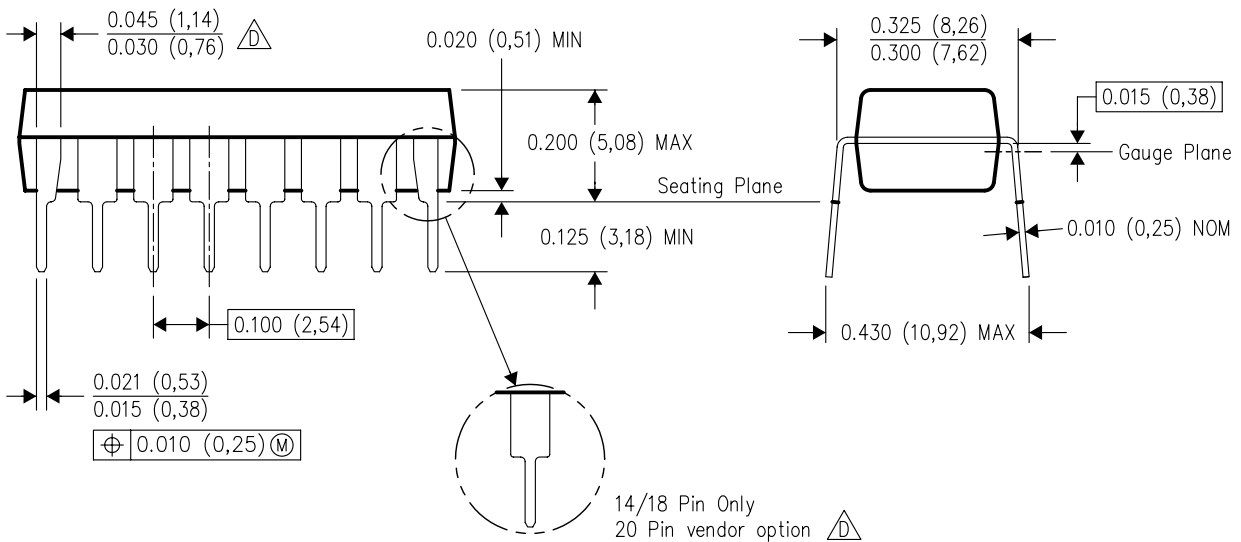
N (R-PDIP-T**)

16 PINS SHOWN

PLASTIC DUAL-IN-LINE PACKAGE



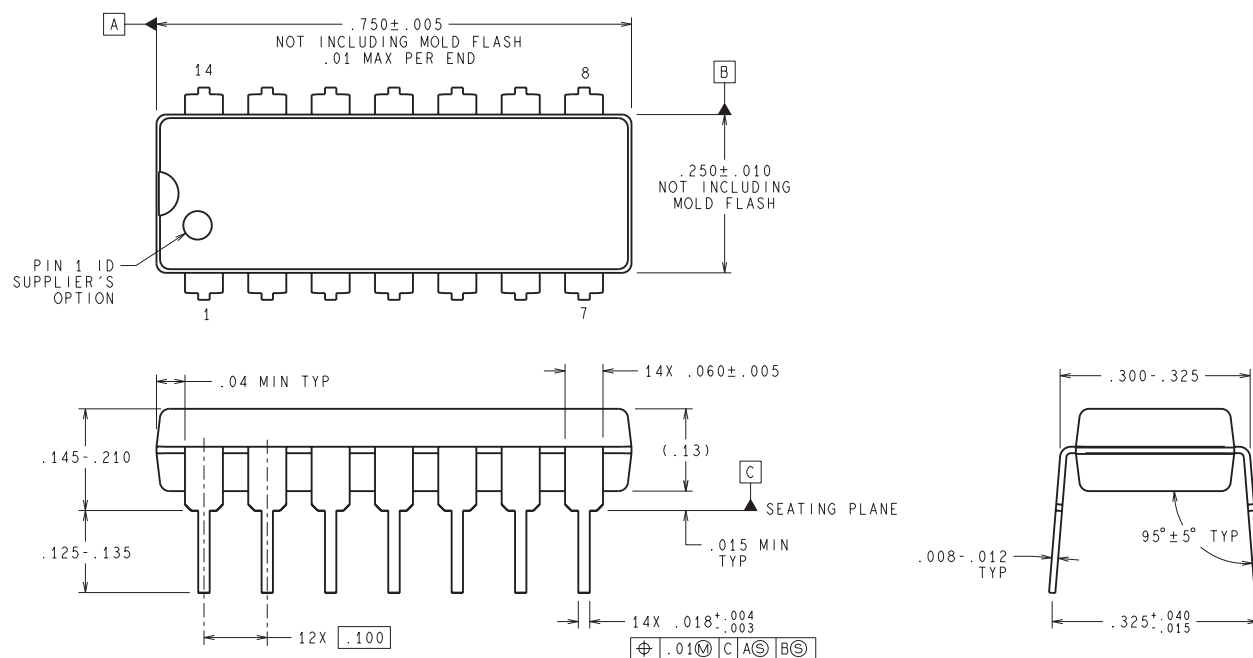
PINS **	14	16	18	20
DIM				
A MAX	0.775 (19,69)	0.775 (19,69)	0.920 (23,37)	1.060 (26,92)
A MIN	0.745 (18,92)	0.745 (18,92)	0.850 (21,59)	0.940 (23,88)
MS-001 VARIATION	AA	BB	AC	AD



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.

NFF0014A

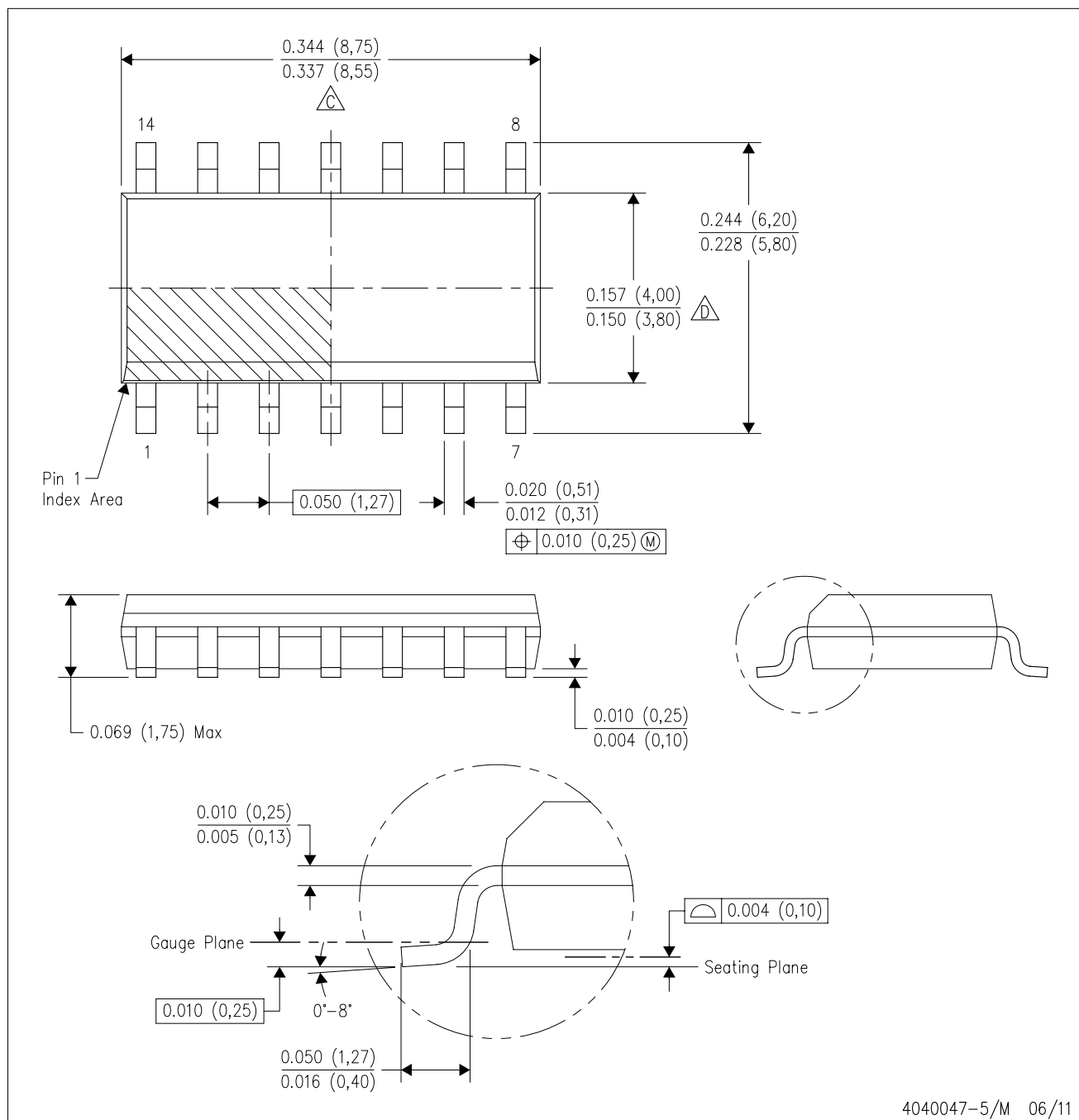


DIMENSIONS ARE IN INCHES
DIMENSIONS IN () FOR REFERENCE ONLY

N14A (Rev G)

D (R-PDSO-G14)

PLASTIC SMALL OUTLINE



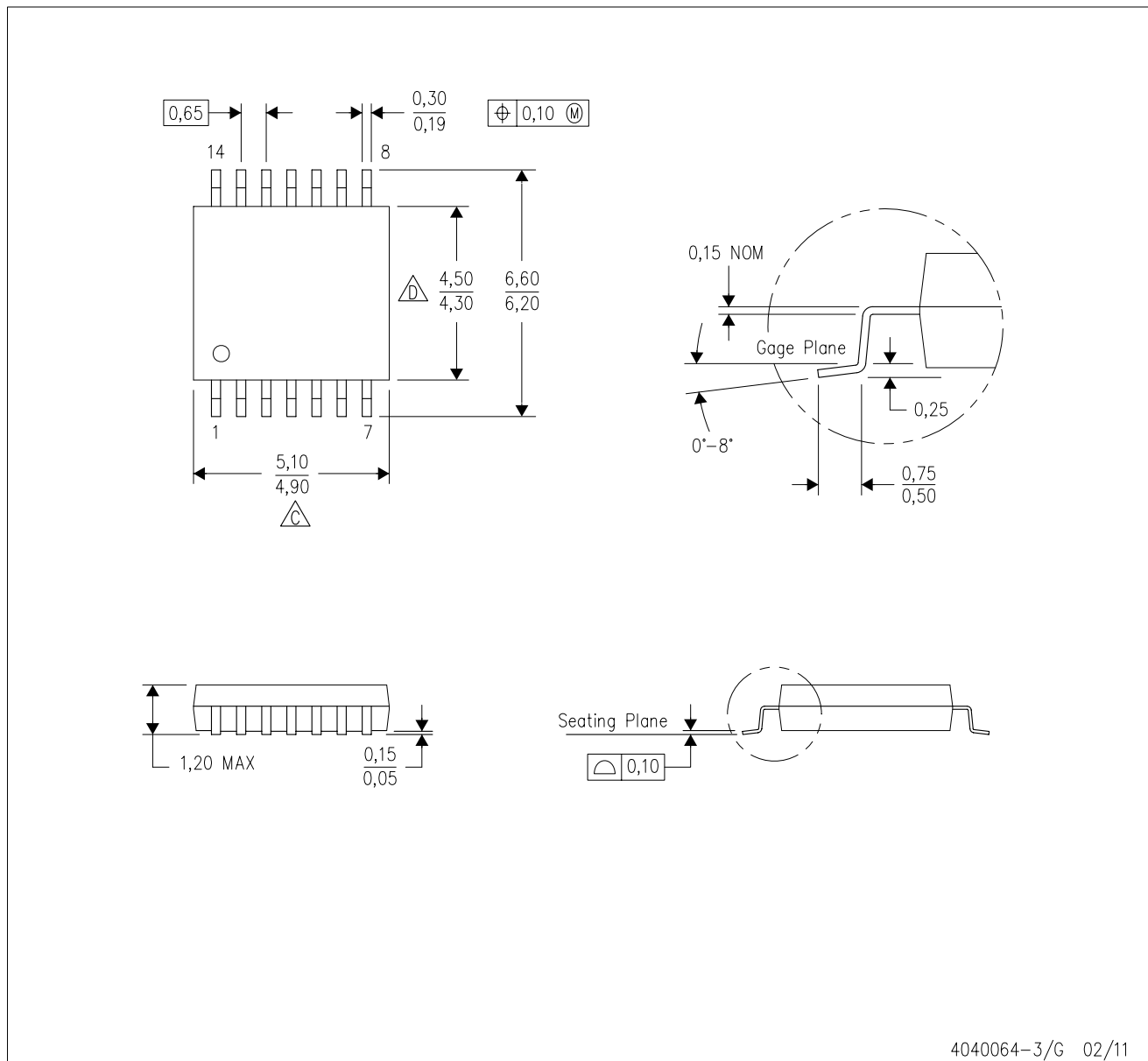
4040047-5/M 06/11

NOTES:

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

PW (R-PDSO-G14)

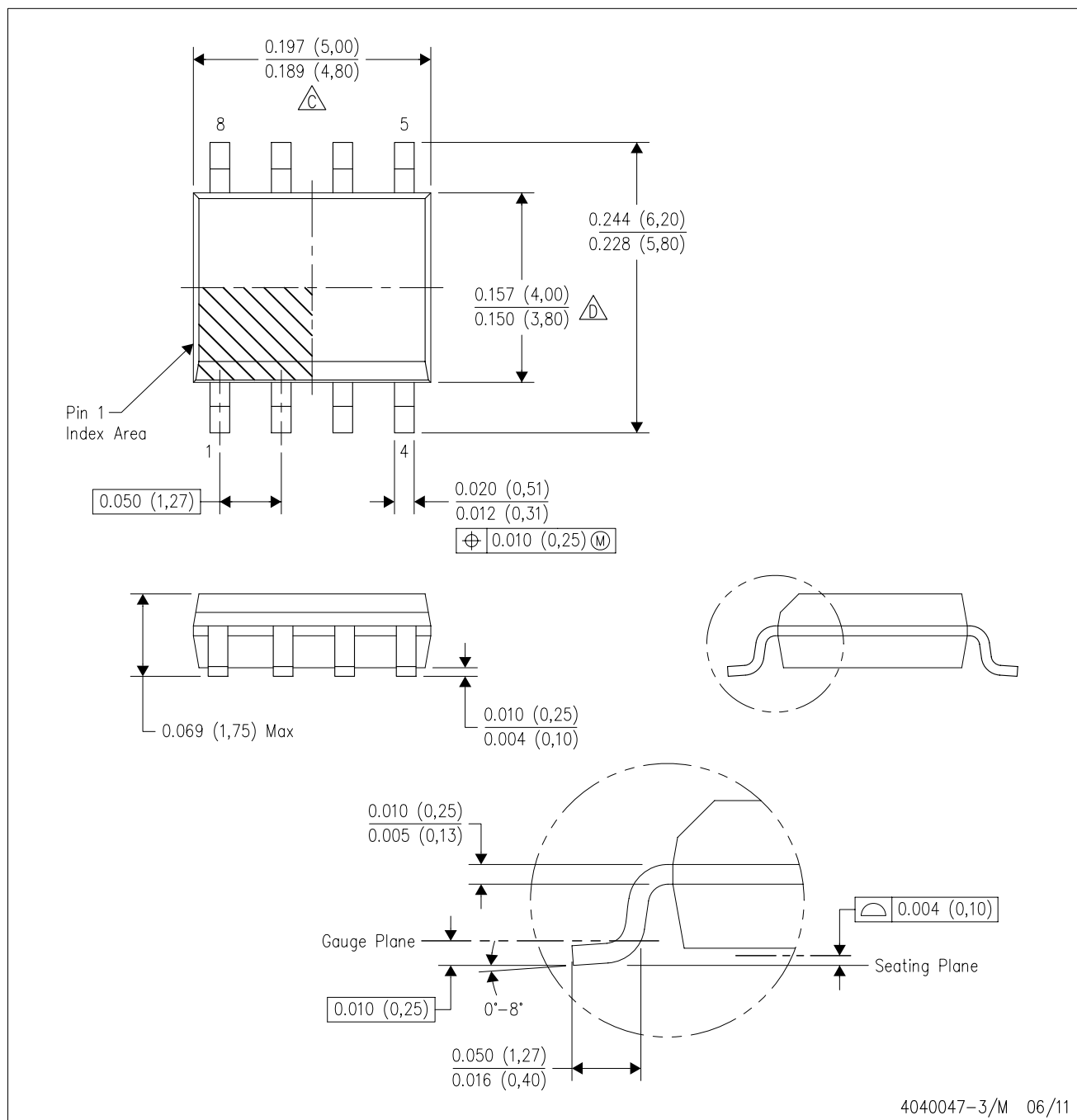
PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - B. This drawing is subject to change without notice.
 - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
 - D. Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
 - E. Falls within JEDEC MO-153

D (R-PDSO-G8)

PLASTIC SMALL OUTLINE

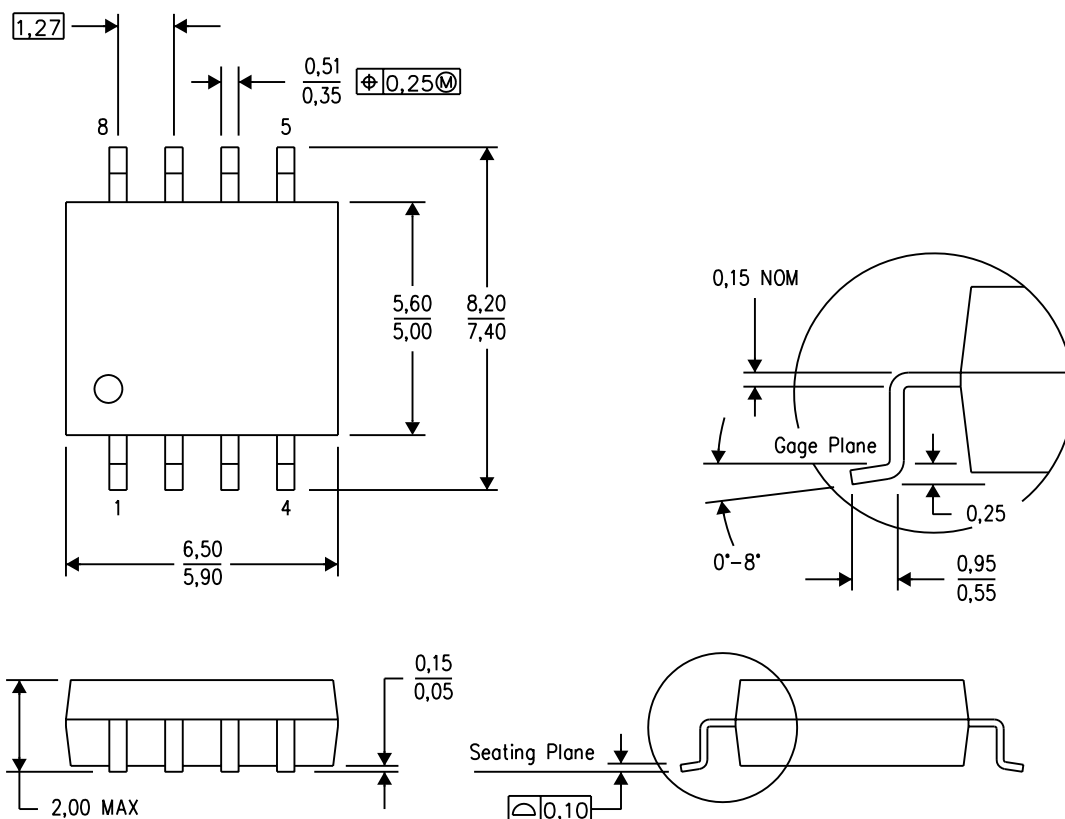


- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
 - D. Body width does not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

MECHANICAL DATA

PS (R-PDSO-G8)

PLASTIC SMALL-OUTLINE PACKAGE



4040063/C 03/03

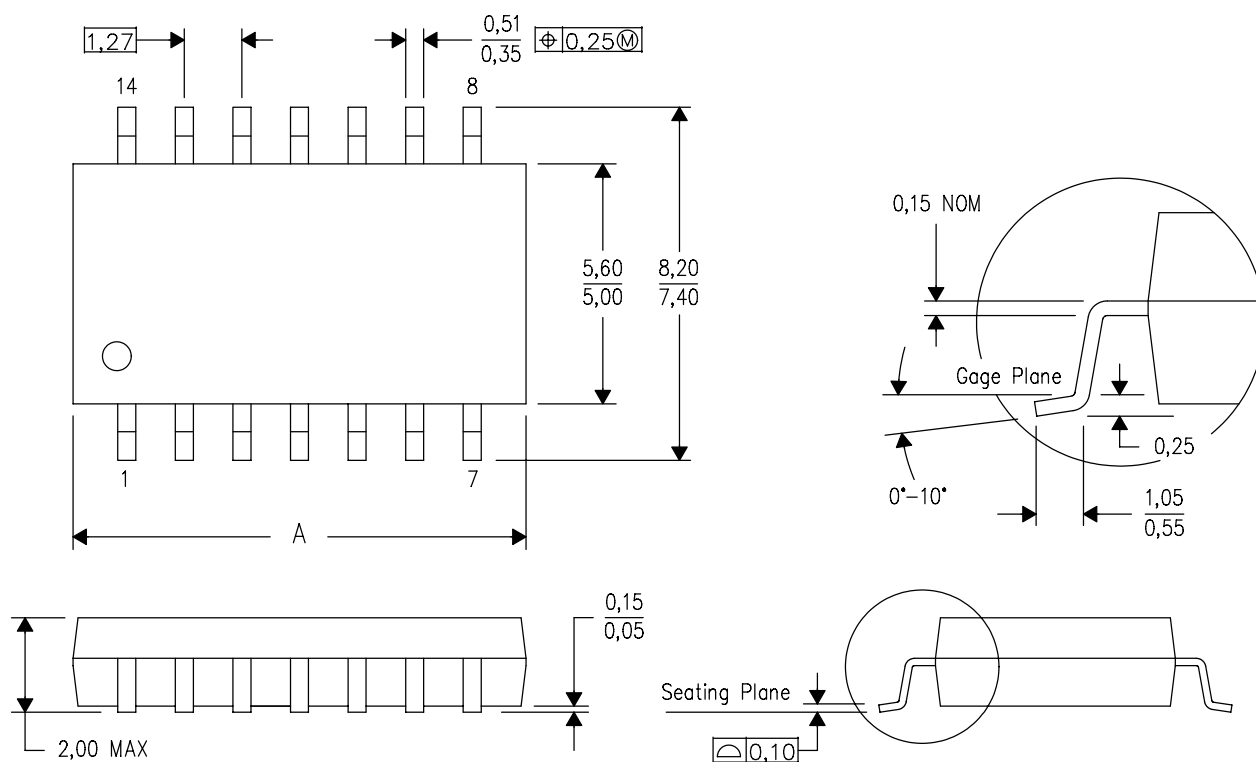
- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

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.