

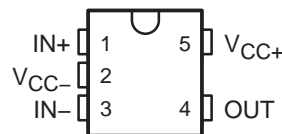
# TLV2361, TLV2362

## HIGH-PERFORMANCE LOW-VOLTAGE OPERATIONAL AMPLIFIERS

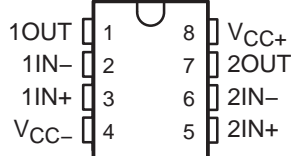
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- **Low Supply-Voltage Operation . . .  $V_{CC} = \pm 1$  V Min**
- **Wide Bandwidth . . . 7 MHz Typ at  $V_{CC\pm} = \pm 2.5$  V**
- **High Slew Rate . . . 3 V/ $\mu$ s Typ at  $V_{CC\pm} = \pm 2.5$  V**
- **Wide Output Voltage Swing . . .  $\pm 2.4$  V Typ at  $V_{CC\pm} = \pm 2.5$  V,  $R_L = 10$  k $\Omega$**
- **Low Noise . . . 8 nV/ $\sqrt{\text{Hz}}$  Typ at  $f = 1$  kHz**

**TLV2361 . . . DBV PACKAGE (TOP VIEW)**



**TLV2362 . . . D, DGK, P, PS, OR PW PACKAGE (TOP VIEW)**



### description/ordering information

The TLV236x devices are high-performance dual operational amplifiers built using an original Texas Instruments bipolar process. These devices can be operated at a very low supply voltage ( $\pm 1$  V), while maintaining a wide output swing. The TLV236x devices offer a dramatically improved dynamic range of signal conditioning in low-voltage systems. The TLV236x devices also provide higher performance than other general-purpose operational amplifiers by combining higher unity-gain bandwidth and faster slew rate. With their low distortion and low-noise performance, these devices are well suited for audio applications.

### ORDERING INFORMATION

$T_A$	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
-0°C to 70°C	SOT-23-5 (DBV)	Reel of 3000	TLV2361CDBVR	VAAC
		Reel of 250	TLV2361CDBVT	
-40°C to 85°C	SOT-23-5 (DBV)	Reel of 3000	TLV2361IDBVR	VAAI
		Reel of 250	TLV2361IDBVT	
	MSOP/VSSOP (DGK)	Reel of 2500	TLV2362IDGKR	YBS
	PDIP (P)	Tube of 50	TLV2362IP	TLV2362IP
	SOIC (D)	Tube of 75	TLV2362ID	2362I
		Reel of 2500	TLV2362IDR	
	SOP (PS)	Reel of 2000	TLV2362IPSR	TY2362
	TSSOP (PW)	Tube of 150	TLV2362IPW	TY2362
Reel of 2000		TLV2362IPWR		

† 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).



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**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.



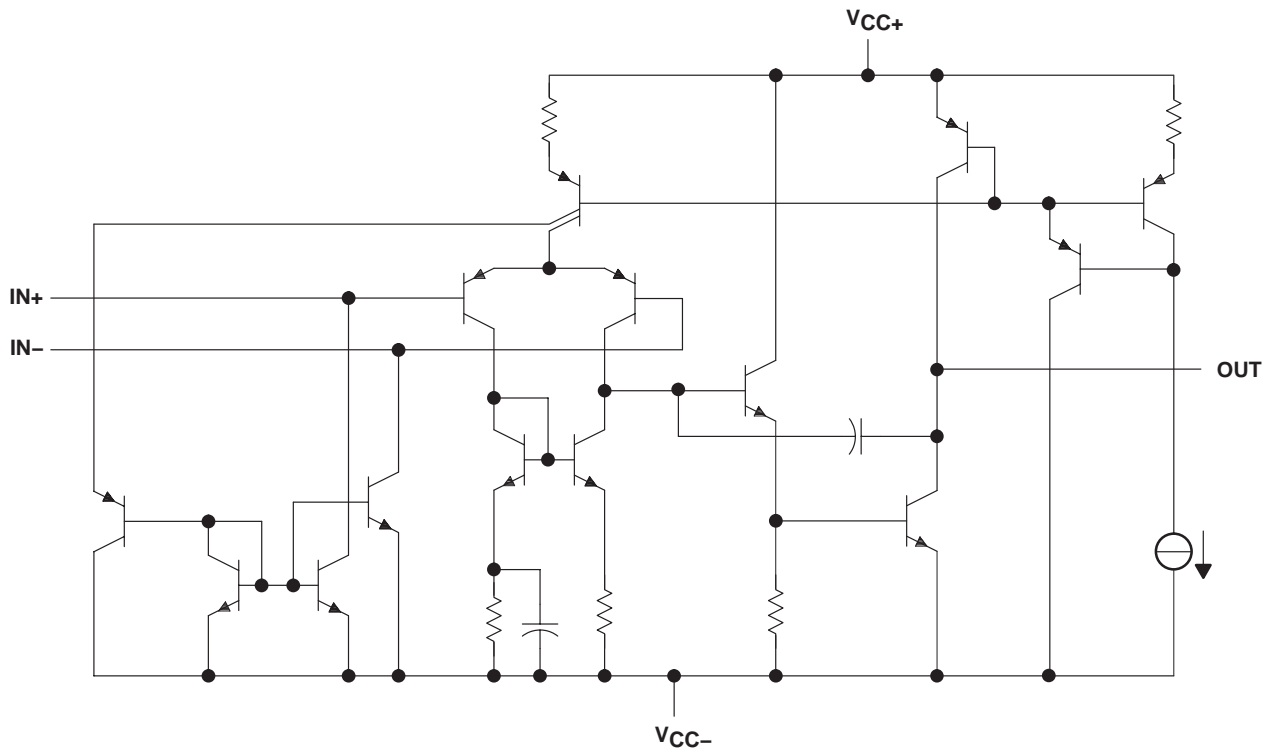
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# TLV2361, TLV2362 HIGH-PERFORMANCE LOW-VOLTAGE OPERATIONAL AMPLIFIERS

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equivalent schematic (each amplifier)



ACTUAL DEVICE COMPONENT COUNT		
COMPONENT	TLV2361	TLV2362
Transistors	30	46
Resistors	6	11
Diodes	1	1
Capacitors	2	4
JFET	1	1

# TLV2361, TLV2362

## HIGH-PERFORMANCE LOW-VOLTAGE OPERATIONAL AMPLIFIERS

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

Supply voltage, $V_{CC+}$ (see Note 1) .....	3.5 V
Supply voltage, $V_{CC-}$ (see Note 1) .....	–3.5 V
Differential input voltage, $V_{ID}$ (see Note 2) .....	±3.5 V
Input voltage, $V_I$ (any input) (see Notes 1 and 3) .....	$V_{CC\pm}$
Output voltage, $V_O$ .....	±3.5 V
Output current, $I_O$ .....	20 mA
Duration of short-circuit current at (or below) 25°C (output shorted to GND) .....	Unlimited
Package thermal impedance, $\theta_{JA}$ (see Notes 4 and 5): D package .....	97°C/W
DBV package .....	206°C/W
DGK package .....	172°C/W
P package .....	85°C/W
PS package .....	95°C/W
PW package .....	149°C/W
Operating virtual junction temperature, $T_J$ .....	150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds .....	260°C
Storage temperature range, $T_{Stg}$ .....	–65°C to 150°C

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

- NOTES:
1. All voltage values, except differential voltages, are with respect to the midpoint between  $V_{CC+}$  and  $V_{CC-}$ .
  2. Differential voltages are at  $IN+$  with respect to  $IN-$ .
  3. All input voltage values must not exceed  $V_{CC}$ .
  4. 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  $P_D = (T_J(\max) - T_A)/\theta_{JA}$ . Selecting the maximum of 150°C can affect reliability.
  5. The package thermal impedance is calculated in accordance with JESD 51-7.

### recommended operating conditions

		MIN	MAX	UNIT
$V_{CC}$	Supply voltage	±1	±2.5	V
$T_A$	Operating free-air temperature	TLV2361C		°C
		TLV2361I, TLV2362I		



# TLV2361, TLV2362 HIGH-PERFORMANCE LOW-VOLTAGE OPERATIONAL AMPLIFIERS

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## TLV2361 and TLV2362 electrical characteristics, $V_{CC\pm} = \pm 1.5\text{ V}$ (unless otherwise noted)

PARAMETER		TEST CONDITIONS		$T_A$	MIN	TYP	MAX	UNIT
$V_{IO}$	Input offset voltage	$V_O = 0,$	$V_{IC} = 0$	25°C	1	6		mV
				Full range		7.5		
$I_{IO}$	Input offset current	$V_O = 0,$	$V_{IC} = 0$	25°C	5	100		nA
				Full range		150		
$I_{IB}$	Input bias current	$V_O = 0,$	$V_{IC} = 0$	25°C	20	150		nA
				Full range		250		
$V_{IC}$	Common-mode input voltage	$ V_{IO}  \leq 7.5\text{ mV}$		25°C	$\pm 0.5$			V
				Full range	$\pm 0.5$			
$V_{OM+}$	Maximum positive-peak output voltage	$R_L = 10\text{ k}\Omega$		25°C	1.2	1.4		V
		$R_L \geq 10\text{ k}\Omega$		Full range	1.2			
$V_{OM-}$	Maximum negative-peak output voltage	$R_L = 10\text{ k}\Omega$		25°C	-1.2	-1.4		V
		$R_L \geq 10\text{ k}\Omega$		Full range	-1.2			
$I_{CC}$	Supply current (per amplifier)	$V_O = 0,$	No load	25°C	1.4	2.25		mA
				Full range		2.75		mA
$A_{VD}$	Large-signal differential voltage amplification	$V_O = \pm 1\text{ V},$	$R_L = 10\text{ k}\Omega$	TLV2361	25°C	60	80	dB
				TLV2362		55		
CMRR	Common-mode rejection ratio	$V_{IC} = \pm 0.5\text{ V}$		25°C	75		dB	
$k_{SVR}$	Supply-voltage rejection ratio	$V_{CC\pm} = \pm 1.5\text{ V to } \pm 2.5\text{ V}$		25°C	80		dB	

## TLV2361 and TLV2362 operating characteristics, $V_{CC\pm} = \pm 1.5\text{ V}, T_A = 25^\circ\text{C}$

PARAMETER		TEST CONDITIONS			TYP	UNIT
SR	Slew rate	$A_V = 1,$	$V_I = \pm 0.5\text{ V}$		2.5	V/ $\mu\text{s}$
$B_1$	Unity-gain bandwidth	$A_V = 40,$	$R_L = 10\text{ k}\Omega,$	$C_L = 100\text{ pF}$	6	MHz
$V_n$	Equivalent input noise voltage	$R_S = 100\ \Omega,$	$R_F = 10\text{ k}\Omega,$	$f = 1\text{ kHz}$	9	nV/ $\sqrt{\text{Hz}}$



# TLV2361, TLV2362

## HIGH-PERFORMANCE LOW-VOLTAGE OPERATIONAL AMPLIFIERS

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### TLV2361 and TLV2362 electrical characteristics, $V_{CC\pm} = \pm 2.5\text{ V}$ (unless otherwise noted)

PARAMETER		TEST CONDITIONS		$T_A$	MIN	TYP	MAX	UNIT
$V_{IO}$	Input offset voltage	$V_O = 0,$	$V_{IC} = 0$	25°C	1	6		mV
				Full range			7.5	
$I_{IO}$	Input offset current	$V_O = 0,$	$V_{IC} = 0$	25°C	5	100		nA
				Full range			150	
$I_{IB}$	Input bias current	$V_O = 0,$	$V_{IC} = 0$	25°C	20	150		nA
				Full range			250	
$V_{IC}$	Common-mode input voltage	$ V_{IO}  \leq 7.5\text{ mV}$		25°C	$\pm 1.5$			V
				Full range	$\pm 1.4$			
$V_{OM+}$	Maximum positive-peak output voltage	$R_L = 10\text{ k}\Omega$		25°C	2	2.4		V
		$R_L \geq 10\text{ k}\Omega$		Full range	2			
$V_{OM-}$	Maximum negative-peak output voltage	$R_L = 10\text{ k}\Omega$		25°C	-2	-2.4		V
		$R_L \geq 10\text{ k}\Omega$		Full range	-2			
$I_{CC}$	Supply current (per amplifier)	$V_O = 0,$	No load	25°C	1.75	2.5		mA
				Full range	3			
AVD	Large-signal differential voltage amplification	$V_O = \pm 1\text{ V},$	$R_L = 10\text{ k}\Omega$	TLV2361	25°C	60	80	dB
				TLV2362		60		
CMRR	Common-mode rejection ratio	$V_{IC} = \pm 0.5\text{ V}$		25°C	85		dB	
kSVR	Supply-voltage rejection ratio	$V_{CC\pm} = \pm 1.5\text{ V to } \pm 2.5\text{ V}$		25°C	80		dB	

### TLV2361 and TLV2362 operating characteristics, $V_{CC\pm} = \pm 2.5\text{ V}, T_A = 25^\circ\text{C}$

PARAMETER		TEST CONDITIONS		TYP	UNIT
SR	Slew rate	$A_V = 1,$	$V_I = \pm 0.5\text{ V}$	3	V/ $\mu\text{s}$
$B_1$	Unity-gain bandwidth	$A_V = 40,$	$R_L = 10\text{ k}\Omega, C_L = 100\text{ pF}$	7	MHz
$V_n$	Equivalent input noise voltage	$R_S = 100\ \Omega,$	$R_F = 10\text{ k}\Omega, f = 1\text{ kHz}$	8	nV/ $\sqrt{\text{Hz}}$
THD + N	Total harmonic distortion, plus noise	$A_V = 1,$	$V_O = \pm 1.2\text{ V}, R_L = 10\text{ k}\Omega, f = 3\text{ kHz}$	0.004	%



# TLV2361, TLV2362 HIGH-PERFORMANCE LOW-VOLTAGE OPERATIONAL AMPLIFIERS

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## TYPICAL CHARACTERISTICS

Table of Graphs

GRAPH TITLE	FIGURE
Supply current vs Free-air temperature	1
Supply current vs Supply voltage	2
Maximum positive output voltage vs Output current	3
Maximum negative output voltage vs Output current	4
Maximum peak-to-peak output voltage vs Frequency	5
Equivalent input noise voltage vs Frequency	6
Total harmonic distortion vs Frequency	7
Total harmonic distortion vs Output voltage	8

### TYPICAL CHARACTERISTICS

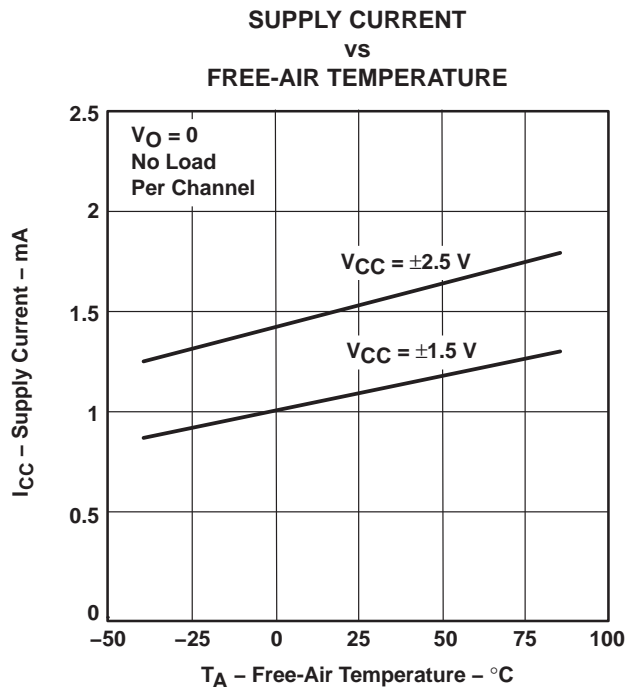


Figure 1

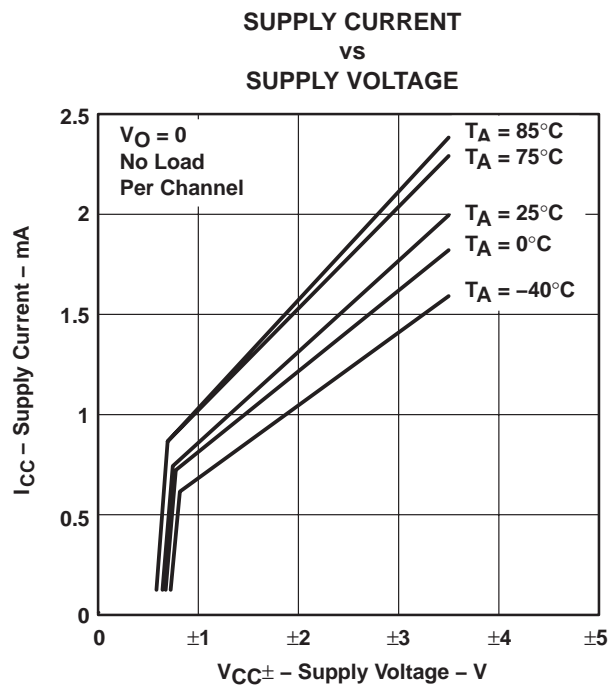


Figure 2

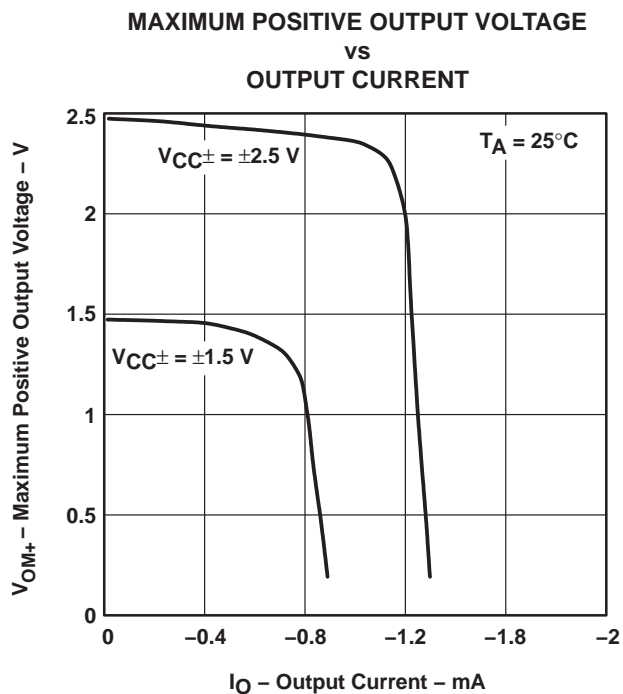


Figure 3

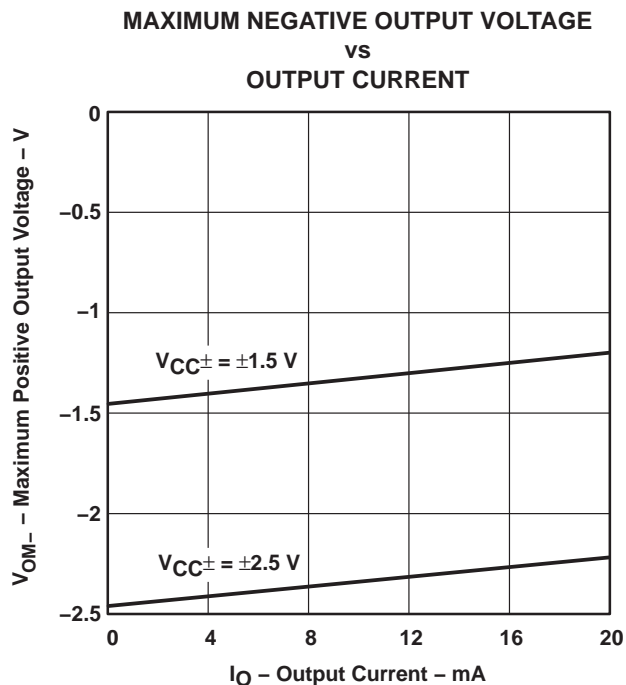


Figure 4

# TLV2361, TLV2362 HIGH-PERFORMANCE LOW-VOLTAGE OPERATIONAL AMPLIFIERS

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## TYPICAL CHARACTERISTICS

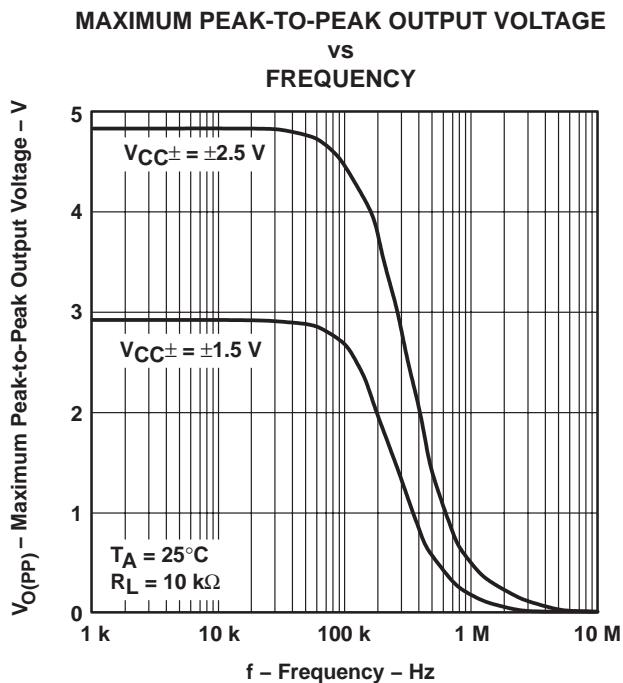


Figure 5

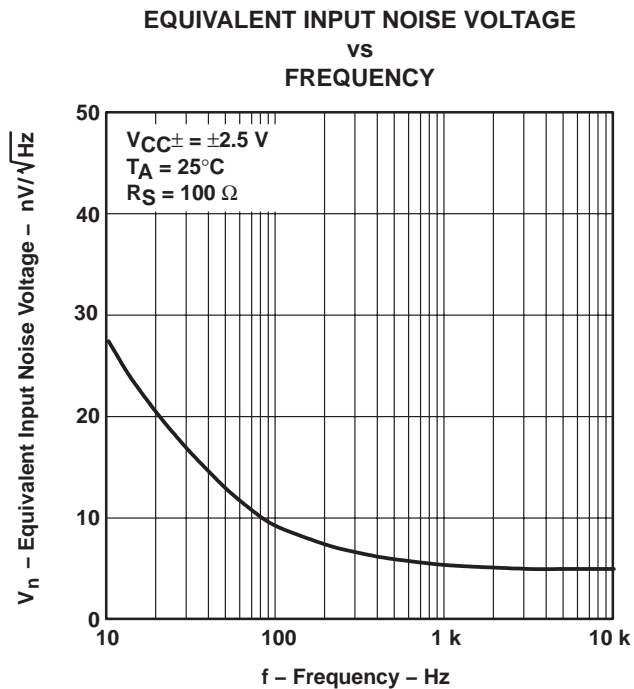


Figure 6

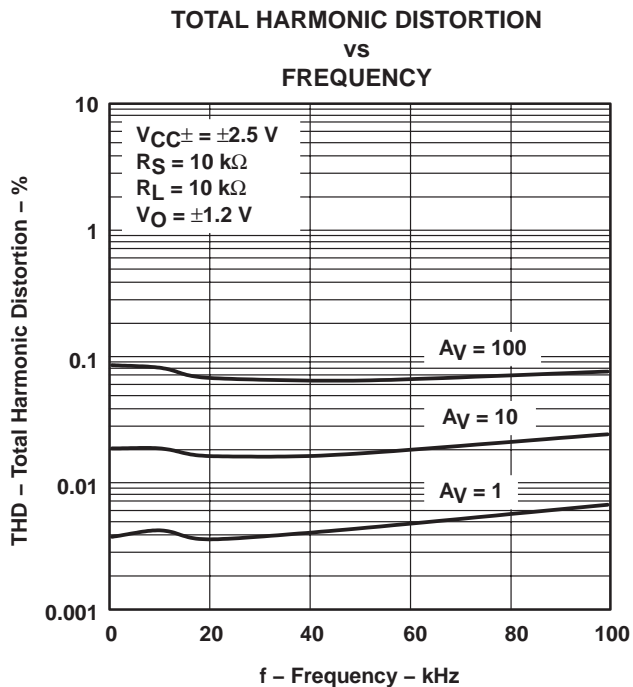


Figure 7

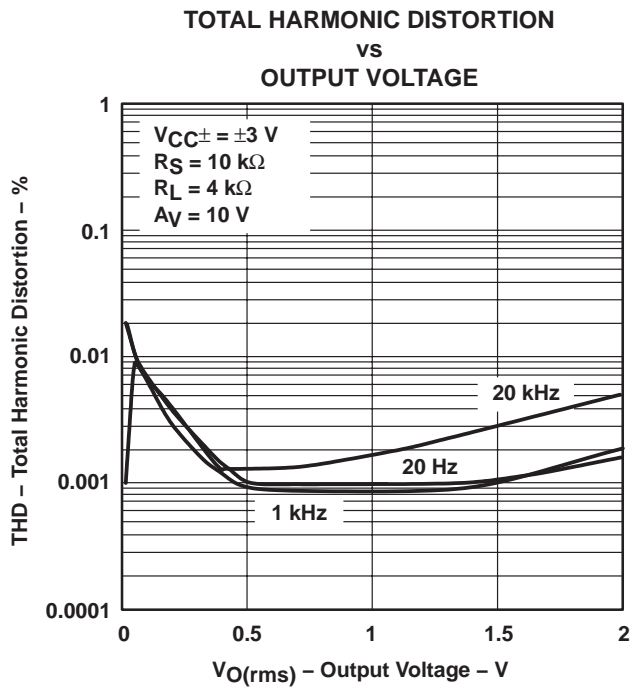


Figure 8

**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>
TLV2361CDBV	OBSOLETE	SOT-23	DBV	5		None	Call TI	Call TI
TLV2361CDBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2361CDBVT	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2361IDBV	OBSOLETE	SOT-23	DBV	5		None	Call TI	Call TI
TLV2361IDBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2361IDBVT	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2362ID	ACTIVE	SOIC	D	8	75	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
TLV2362IDGKR	ACTIVE	MSOP	DGK	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1YEAR
TLV2362IDR	ACTIVE	SOIC	D	8	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
TLV2362IP	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
TLV2362IPSR	ACTIVE	SO	PS	8	2000	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
TLV2362IPW	ACTIVE	TSSOP	PW	8	150	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM
TLV2362IPWLE	OBSOLETE	TSSOP	PW	8		None	Call TI	Call TI
TLV2362IPWR	ACTIVE	TSSOP	PW	8	2000	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM

<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.

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

<sup>(2)</sup> Eco Plan - May not be currently available - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

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

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

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

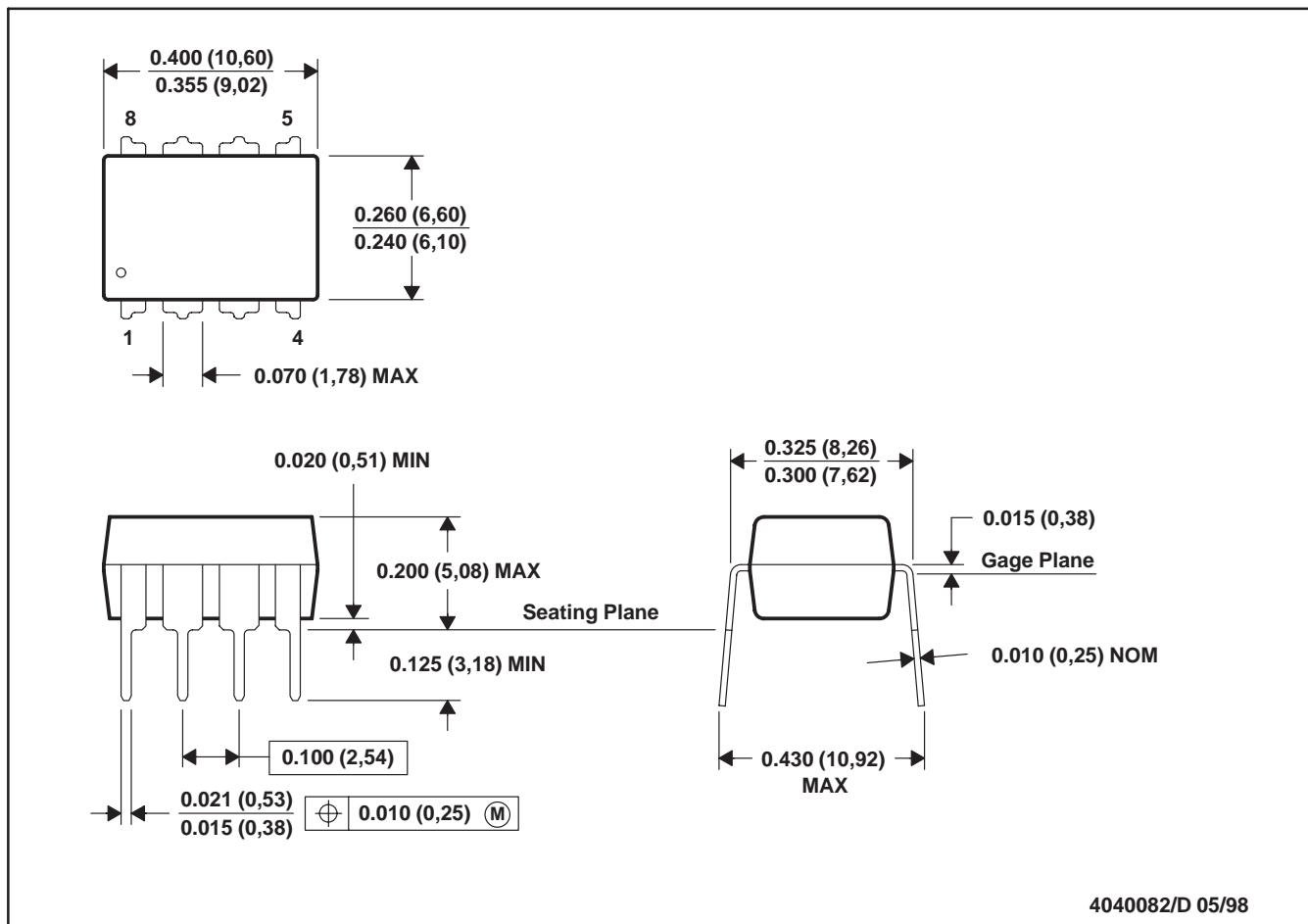
<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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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

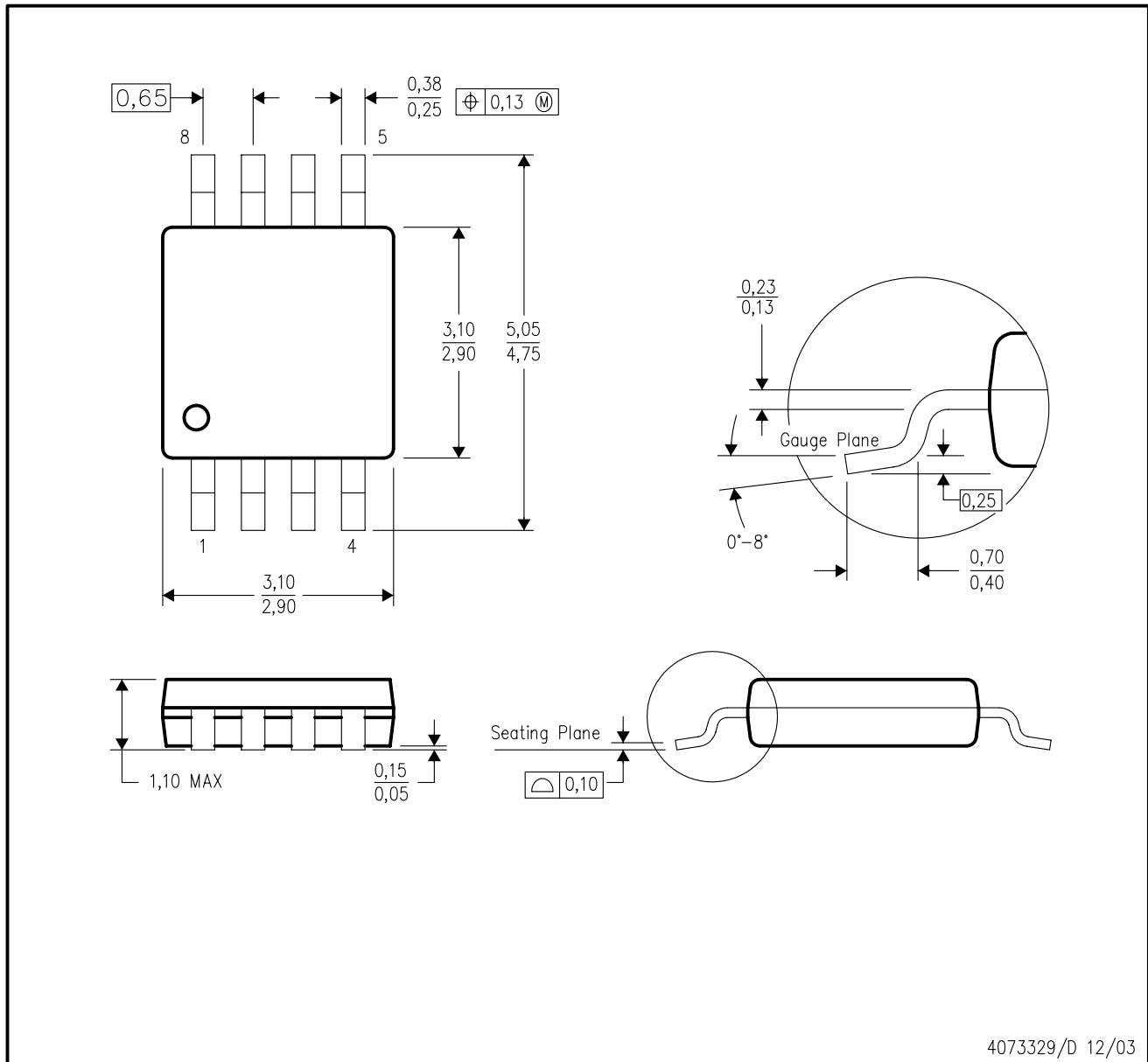
For the latest package information, go to [http://www.ti.com/sc/docs/package/pkg\\_info.htm](http://www.ti.com/sc/docs/package/pkg_info.htm)





DGK (S-PDSO-G8)

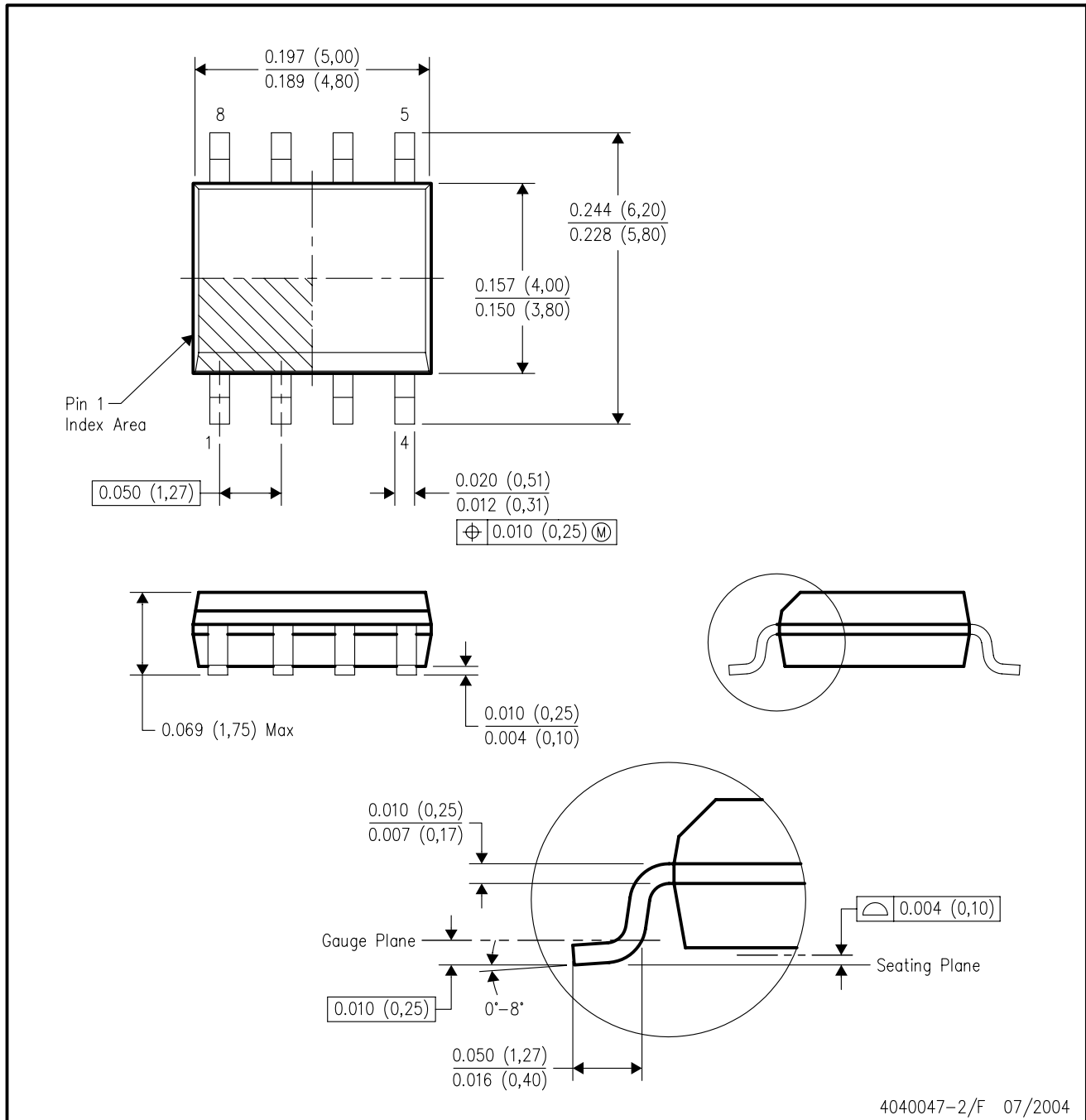
PLASTIC SMALL-OUTLINE PACKAGE



- 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.
  - D. Falls within JEDEC MO-187 variation AA.

D (R-PDSO-G8)

PLASTIC SMALL-OUTLINE PACKAGE

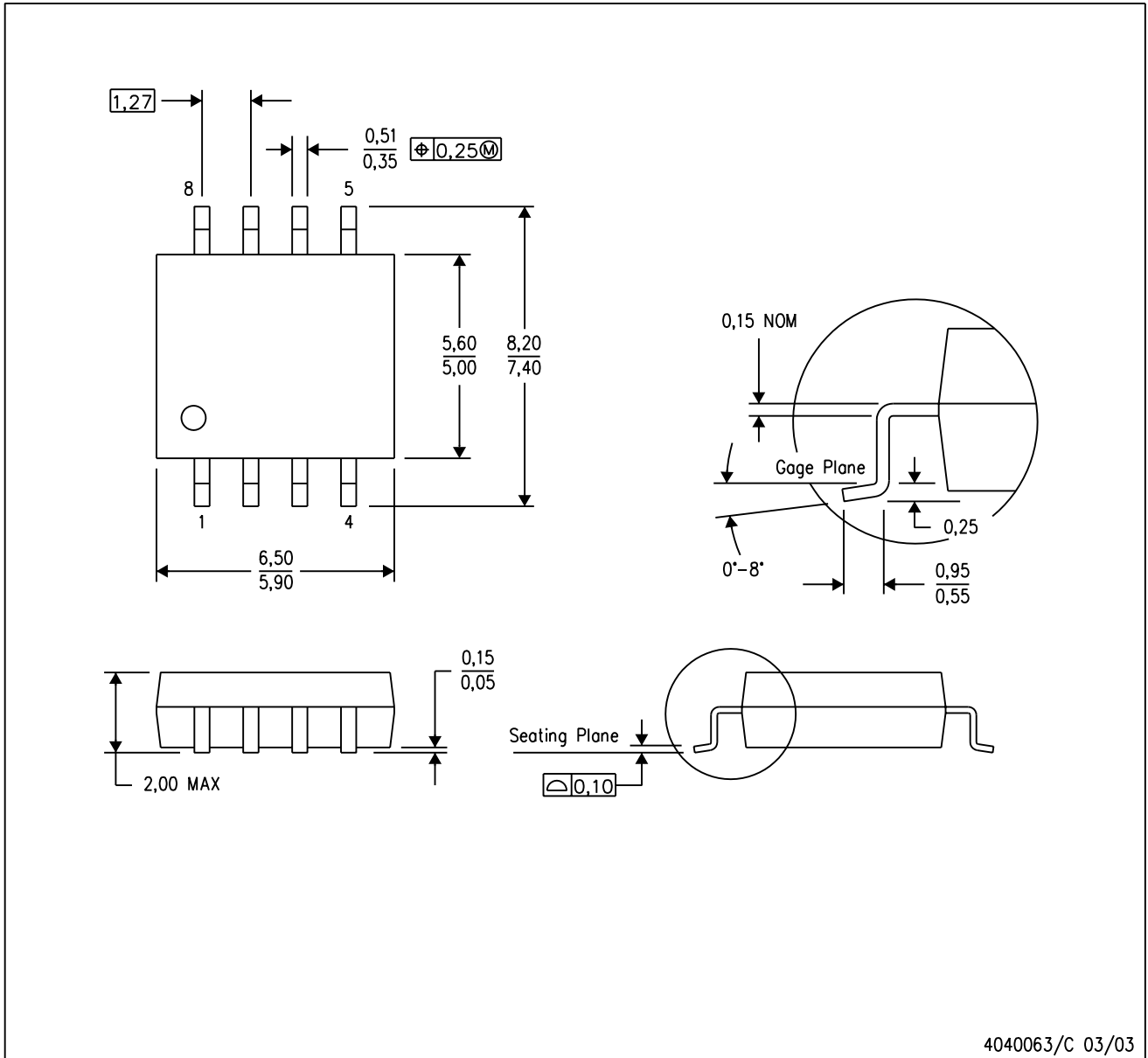


- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
  - D. Falls within JEDEC MS-012 variation AA.

## 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.

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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