

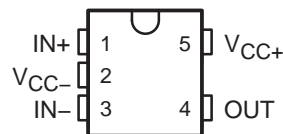
TLV2361, TLV2362

HIGH-PERFORMANCE LOW-VOLTAGE OPERATIONAL AMPLIFIERS

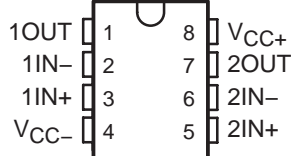
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- **Low Supply-Voltage Operation . . . $V_{CC} = \pm 1$ V Min**
- **Wide Bandwidth . . . 7 MHz Typ at $V_{CC\pm} = \pm 2.5$ V**
- **High Slew Rate . . . 3 V/ μ s Typ at $V_{CC\pm} = \pm 2.5$ V**
- **Wide Output Voltage Swing . . . ± 2.4 V Typ at $V_{CC\pm} = \pm 2.5$ V, $R_L = 10$ k Ω**
- **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 (± 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	YC3_
		Reel of 250	TLV2361CDBVT	
-40°C to 85°C	SOT-23-5 (DBV)	Reel of 3000	TLV2361IDBVR	YC4_
		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.

‡ DBV: The actual top-side marking has one additional character that designates the wafer fab/assembly site.



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.



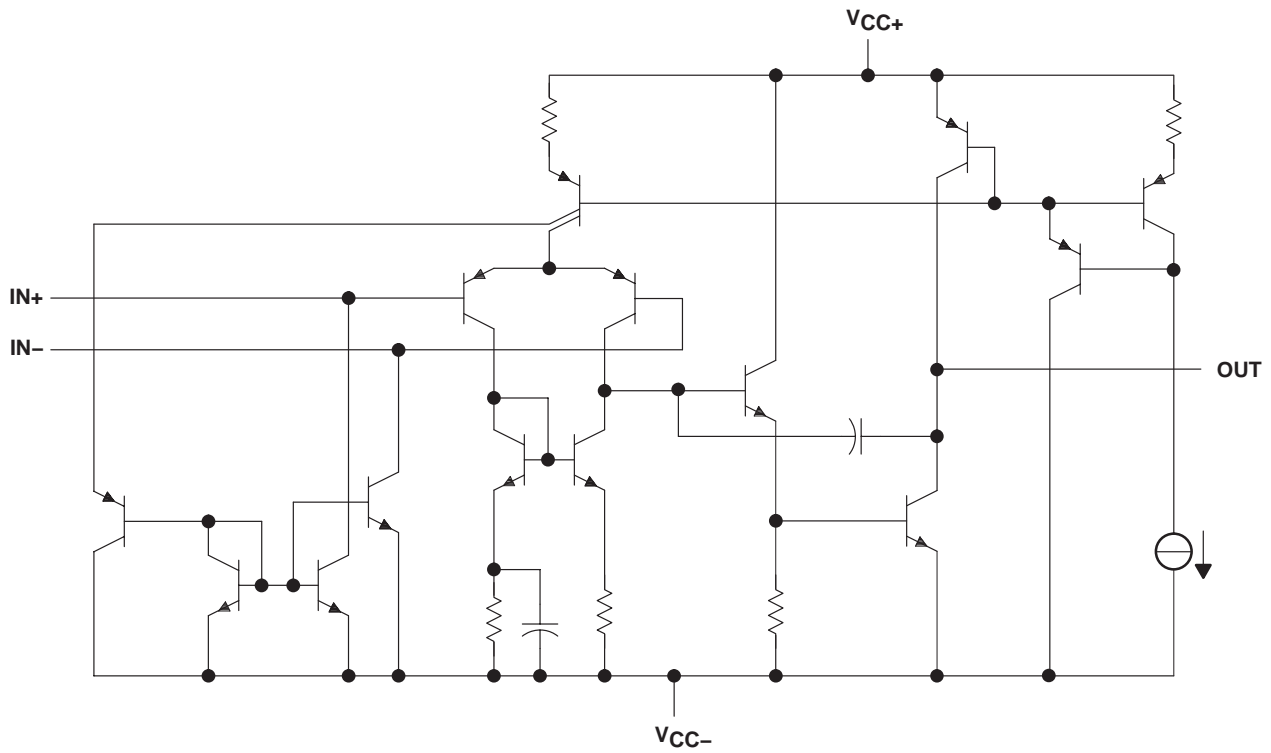
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equivalent schematic (each amplifier)



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, θ_{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 $T_J(\max)$, θ_{JA} , and T_A . The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(\max) - T_A)/\theta_{JA}$. 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		



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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		± 0.5		V
				Full range		± 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				
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/ μs
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

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TLV2361 and TLV2362 electrical characteristics, $V_{CC\pm} = \pm 2.5$ 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$ mV		25°C	± 1.5			V
				Full range	± 1.4			
V_{OM+}	Maximum positive-peak output voltage	$R_L = 10$ k Ω		25°C	2	2.4		V
		$R_L \geq 10$ k Ω		Full range	2			
V_{OM-}	Maximum negative-peak output voltage	$R_L = 10$ k Ω		25°C	-2	-2.4		V
		$R_L \geq 10$ k Ω		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	$V_O = \pm 1$ V,	$R_L = 10$ k Ω	TLV2361	25°C	60	80	dB
				TLV2362		60		
CMRR	Common-mode rejection ratio	$V_{IC} = \pm 0.5$ V		25°C	85		dB	
kSVR	Supply-voltage rejection ratio	$V_{CC\pm} = \pm 1.5$ V to ± 2.5 V		25°C	80		dB	

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

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



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TYPICAL CHARACTERISTICS

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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



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TYPICAL CHARACTERISTICS

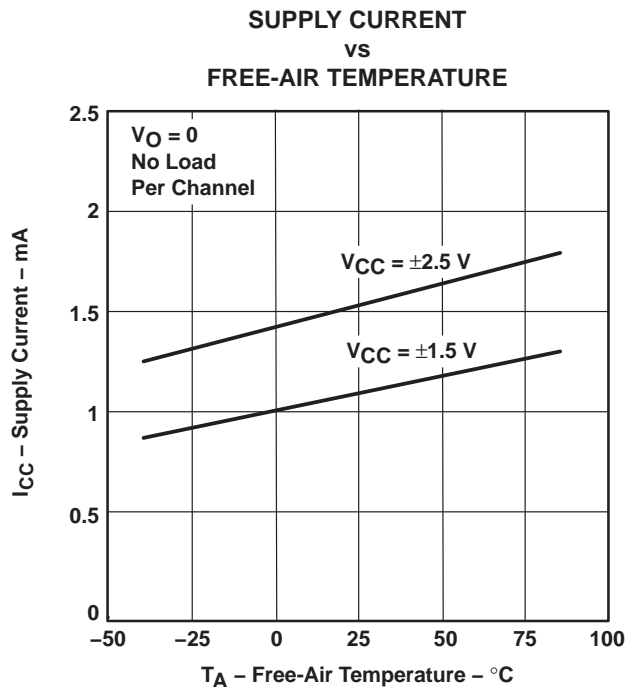


Figure 1

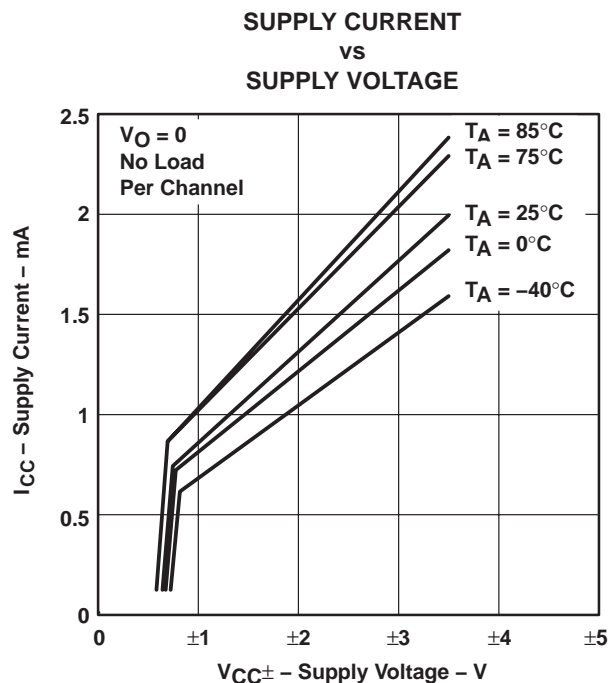


Figure 2

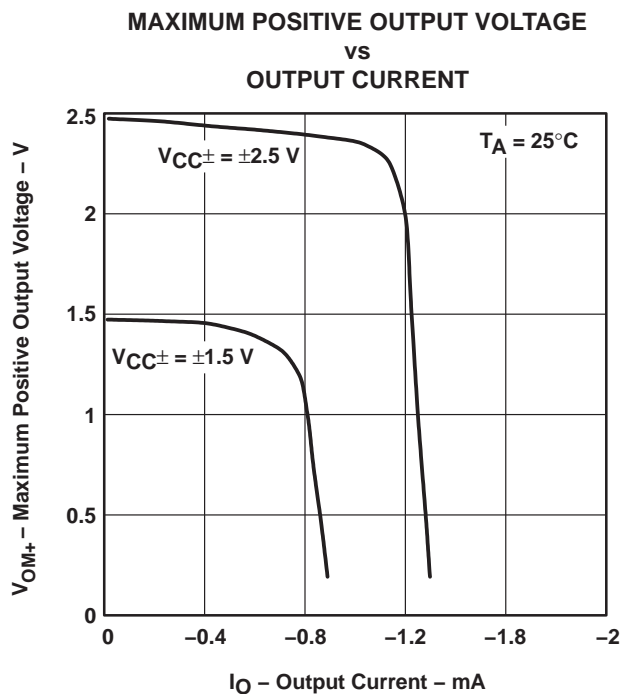


Figure 3

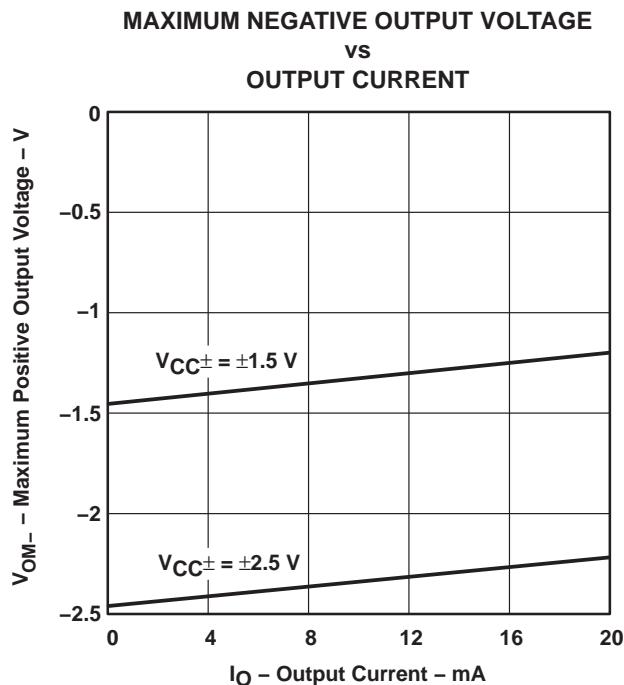


Figure 4

TLV2361, TLV2362 HIGH-PERFORMANCE LOW-VOLTAGE OPERATIONAL AMPLIFIERS

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TYPICAL CHARACTERISTICS

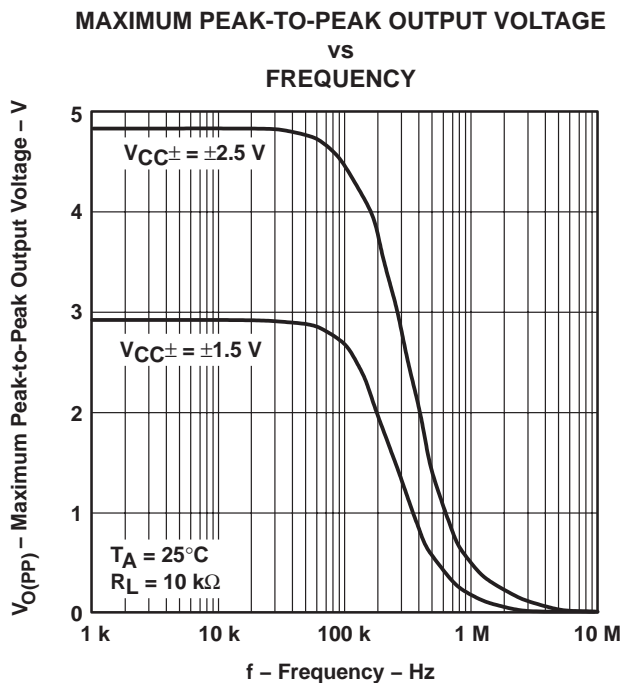


Figure 5

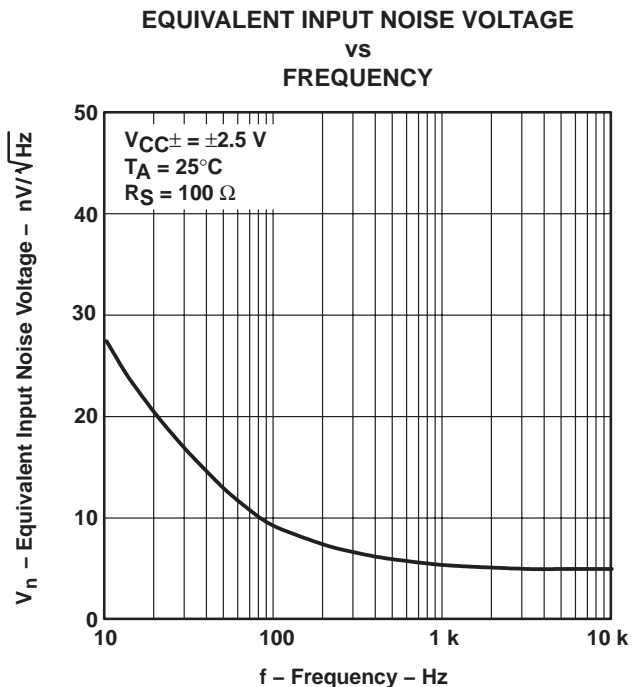


Figure 6

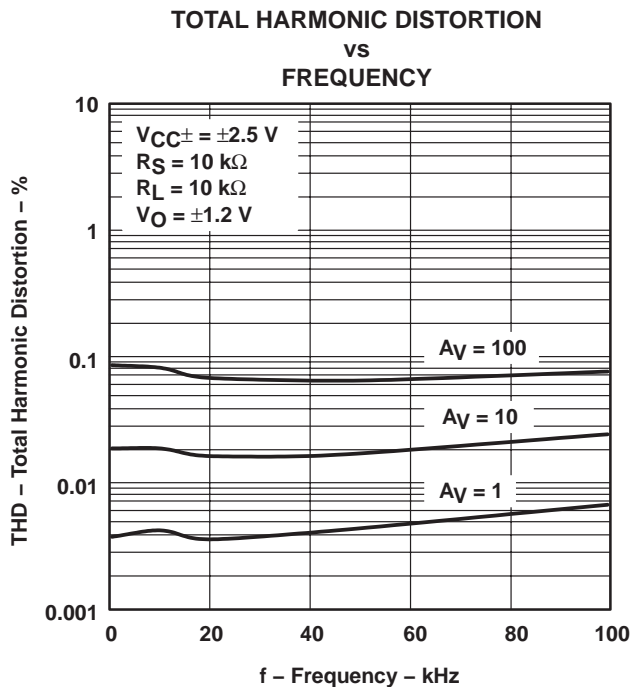


Figure 7

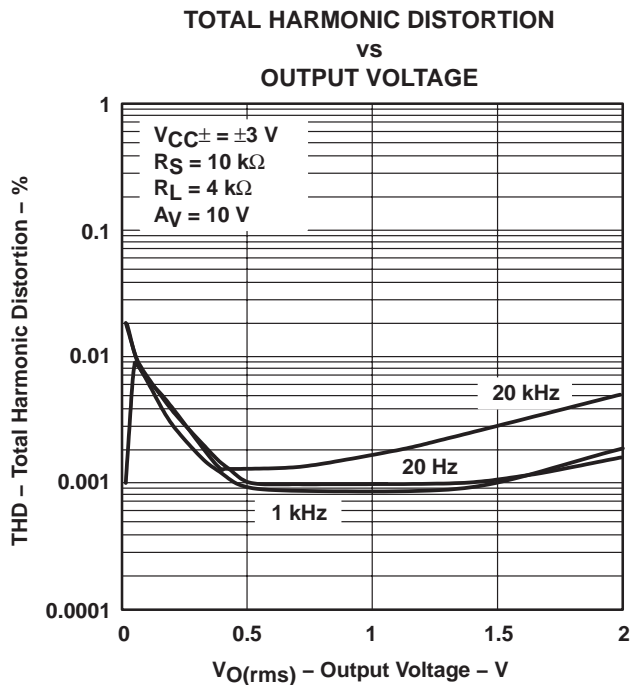


Figure 8



PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
TLV2361CDBV	OBSOLETE	SOT-23	DBV	5		TBD	Call TI	Call TI
TLV2361CDBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2361CDBVRE4	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2361CDBVRG4	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
TLV2361CDBVTE4	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2361CDBVTG4	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2361IDBV	OBSOLETE	SOT-23	DBV	5		TBD	Call TI	Call TI
TLV2361IDBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2361IDBVRE4	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2361IDBVRG4	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
TLV2361IDBVTE4	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2361IDBVTG4	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2362ID	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2362IDE4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2362IDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2362IDGKR	ACTIVE	MSOP	DGK	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2362IDGKRG4	ACTIVE	MSOP	DGK	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2362IDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2362IDRE4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2362IDRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2362IP	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
TLV2362IPE4	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
TLV2362IPSR	ACTIVE	SO	PS	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2362IPSRE4	ACTIVE	SO	PS	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
						no Sb/Br)		
TLV2362IPSRG4	ACTIVE	SO	PS	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2362IPW	ACTIVE	TSSOP	PW	8	150	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2362IPWE4	ACTIVE	TSSOP	PW	8	150	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2362IPWG4	ACTIVE	TSSOP	PW	8	150	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2362IPWLE	OBSOLETE	TSSOP	PW	8		TBD	Call TI	Call TI
TLV2362IPWR	ACTIVE	TSSOP	PW	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2362IPWRE4	ACTIVE	TSSOP	PW	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2362IPWRG4	ACTIVE	TSSOP	PW	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

⁽¹⁾ The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

⁽²⁾ Eco Plan - 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)

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

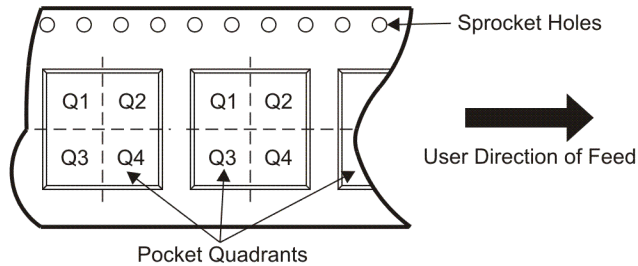
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TAPE AND REEL INFORMATION



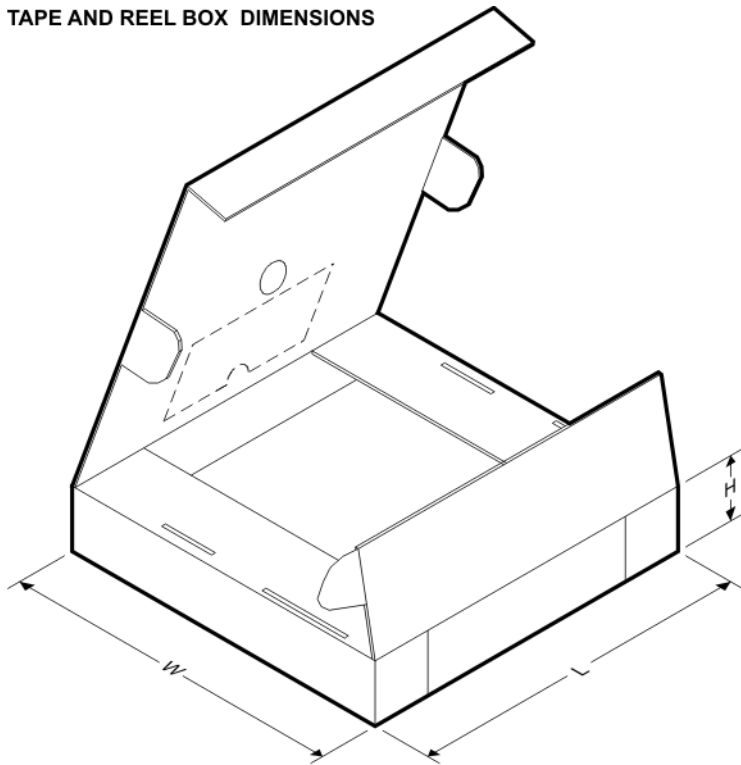
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TLV2361CDBVR	SOT-23	DBV	5	3000	180.0	9.2	3.23	3.17	1.37	4.0	8.0	Q3
TLV2361CDBVT	SOT-23	DBV	5	250	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLV2361CDBVT	SOT-23	DBV	5	250	180.0	9.2	3.23	3.17	1.37	4.0	8.0	Q3
TLV2361IDBVR	SOT-23	DBV	5	3000	180.0	9.2	3.23	3.17	1.37	4.0	8.0	Q3
TLV2361IDBVT	SOT-23	DBV	5	250	180.0	9.2	3.23	3.17	1.37	4.0	8.0	Q3
TLV2362IDGKR	MSOP	DGK	8	2500	330.0	13.0	5.3	3.4	1.4	8.0	12.0	Q1
TLV2362IDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
TLV2362IPSR	SO	PS	8	2000	330.0	16.4	8.2	6.6	2.5	12.0	16.0	Q1
TLV2362IPWR	TSSOP	PW	8	2000	330.0	12.4	7.0	3.6	1.6	8.0	12.0	Q1

TAPE AND REEL BOX DIMENSIONS

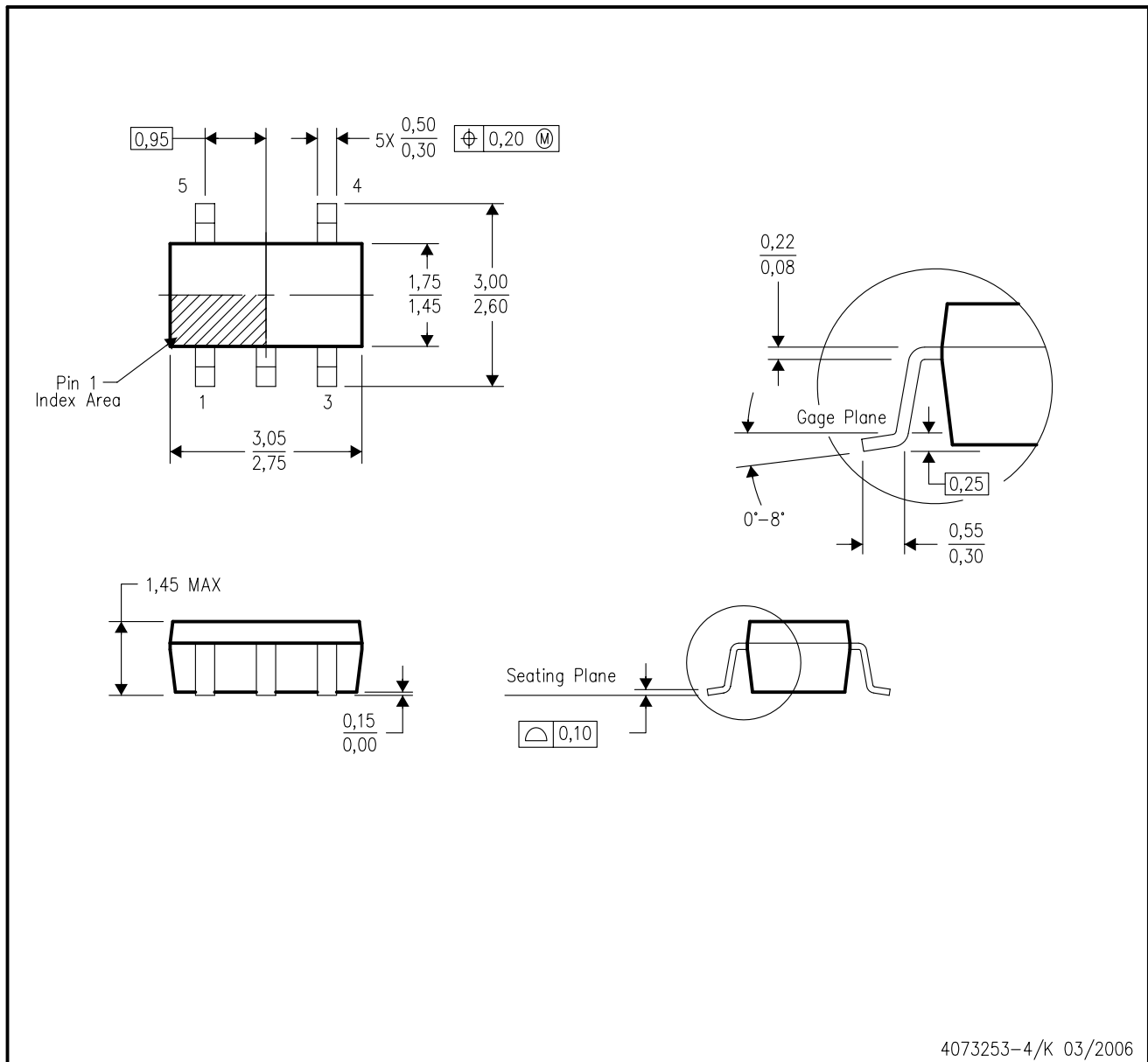


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TLV2361CDBVR	SOT-23	DBV	5	3000	205.0	200.0	33.0
TLV2361CDBVT	SOT-23	DBV	5	250	195.0	200.0	45.0
TLV2361CDBVT	SOT-23	DBV	5	250	201.0	192.0	26.0
TLV2361IDBVR	SOT-23	DBV	5	3000	205.0	200.0	33.0
TLV2361IDBVT	SOT-23	DBV	5	250	201.0	192.0	26.0
TLV2362IDGKR	MSOP	DGK	8	2500	358.0	335.0	35.0
TLV2362IDR	SOIC	D	8	2500	340.5	338.1	20.6
TLV2362IPSR	SO	PS	8	2000	346.0	346.0	33.0
TLV2362IPWR	TSSOP	PW	8	2000	346.0	346.0	29.0

DBV (R-PDSO-G5)

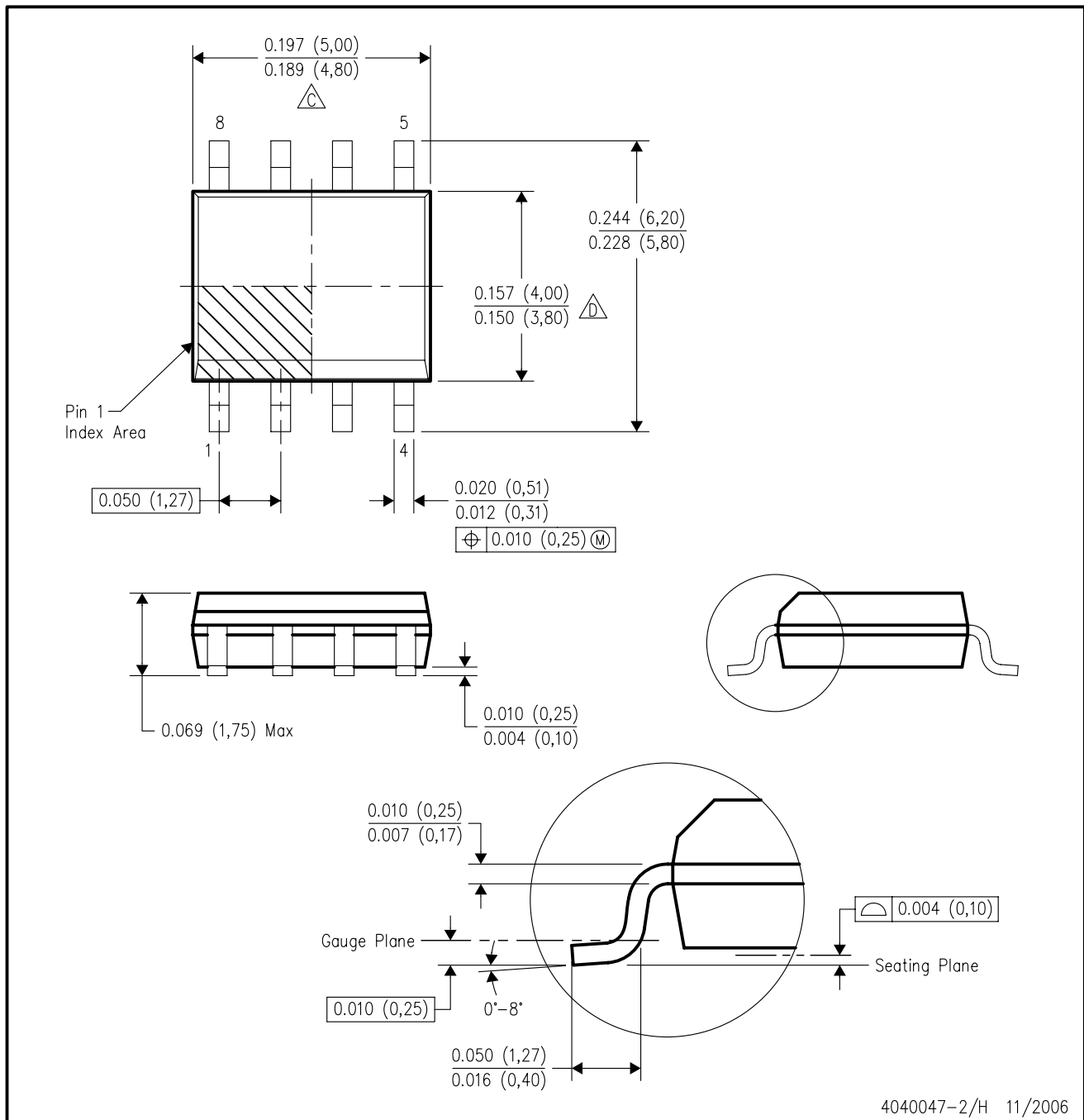
PLASTIC SMALL-OUTLINE PACKAGE



- 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. Mold flash and protrusion shall not exceed 0.15 per side.
 - D. Falls within JEDEC MO-178 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 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.

PW (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

14 PINS SHOWN

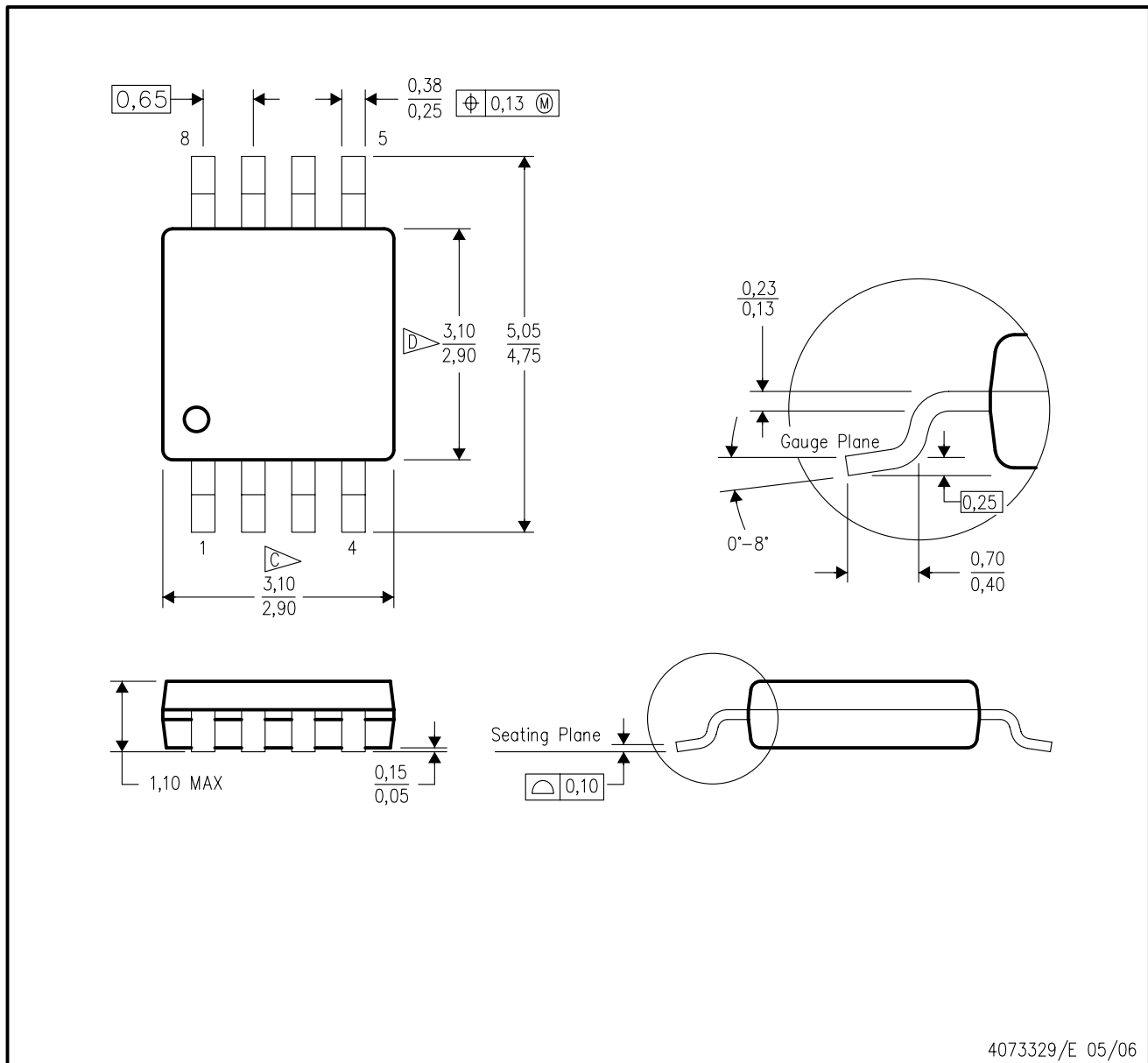


4040064/F 01/97

- 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

DGK (S-PDSO-G8)

PLASTIC SMALL-OUTLINE PACKAGE

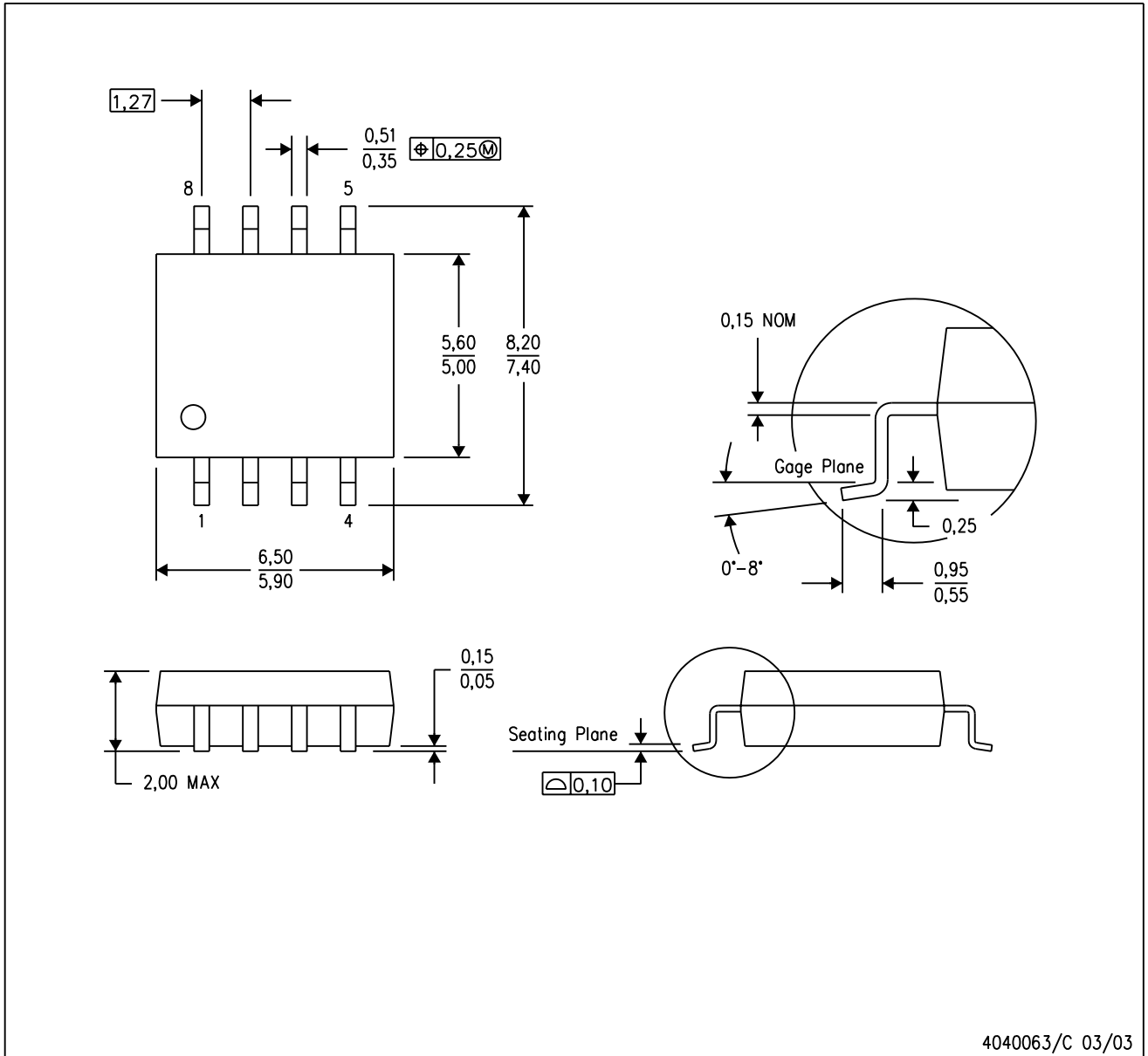


- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 per end.
 - D. Body width does not include interlead flash. Interlead flash shall not exceed 0.50 per side.
 - E. Falls within JEDEC MO-187 variation AA, except interlead flash.

MECHANICAL DATA

PS (R-PDSO-G8)

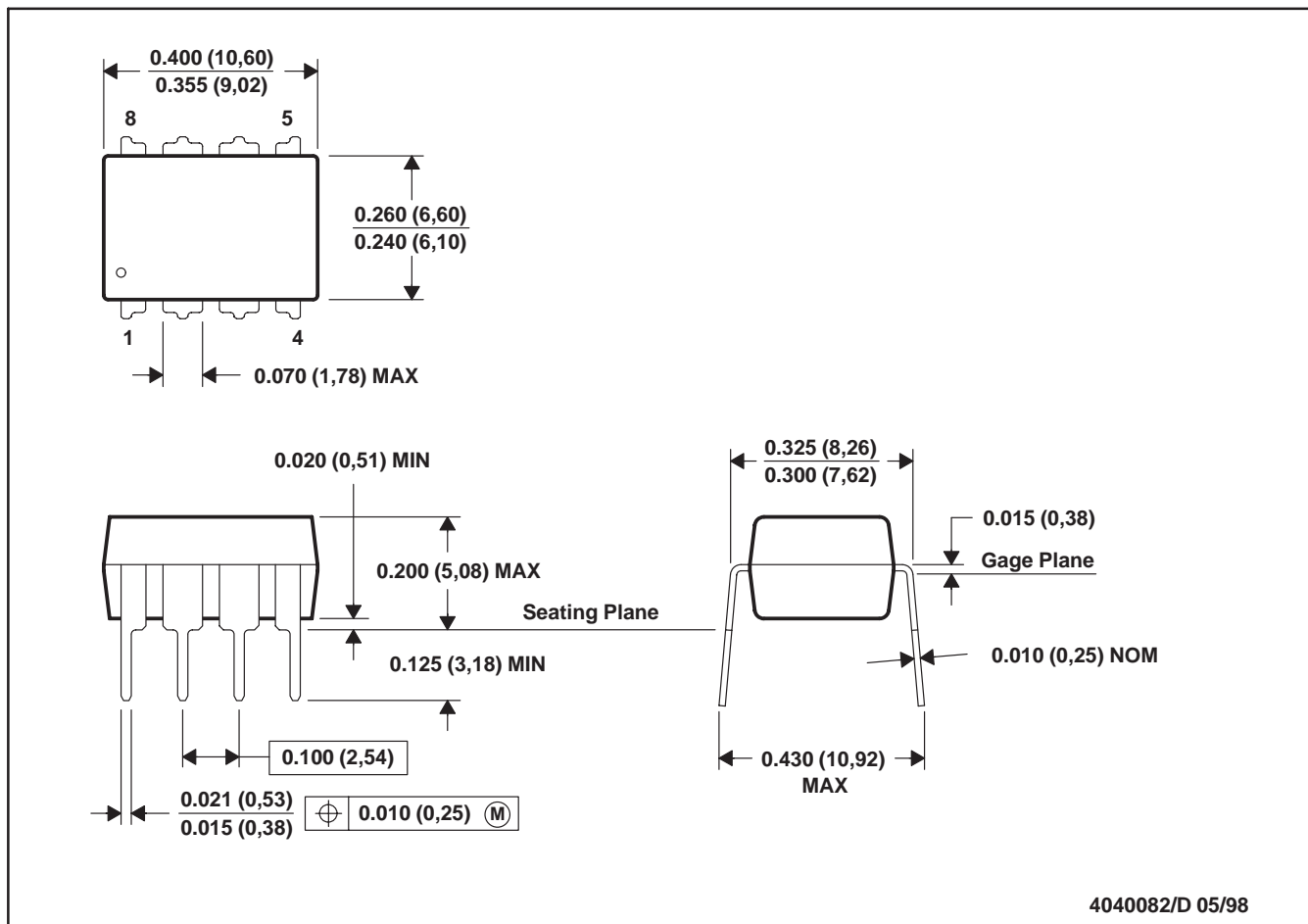
PLASTIC SMALL-OUTLINE PACKAGE



- 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.

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

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