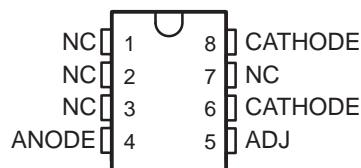


- Excellent Temperature Stability
- Initial Tolerance . . . 0.2% Max
- Dynamic Impedance . . . 0.6  $\Omega$  Max
- Wide Operating Current Range
- Directly Interchangeable With LM136
- Needs No Adjustment for Minimum Temperature Coefficient

**D OR PW PACKAGE  
(TOP VIEW)**



NC – No internal connection

## description/ordering information

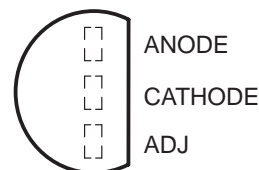
The LT1009 reference circuit is a precision-trimmed 2.5-V shunt regulator featuring low dynamic impedance and a wide operating current range. The maximum initial tolerance is  $\pm 5$  mV in the LP package and  $\pm 10$  mV in the D package. The reference tolerance is achieved by on-chip trimming, which minimizes the initial voltage tolerance and the temperature coefficient  $\alpha_V$ .

Although the LT1009 needs no adjustments, a third terminal (ADJ) allows the reference voltage to be adjusted  $\pm 5\%$  to eliminate system errors. In many applications, the LT1009 can be used as a terminal-for-terminal replacement for the LM136-2.5, which eliminates the external trim network.

The LT1009 uses include 5-V system references, 8-bit analog-to-digital converter (ADC) and digital-to-analog converter (DAC) references, and power-supply monitors. The device also can be used in applications such as digital voltmeters and current-loop measurement and control systems.

The LT1009C is characterized for operation from 0°C to 70°C. The LT1009I is characterized for operation from –40°C to 85°C.

**LP PACKAGE  
(TOP VIEW)**



## ORDERING INFORMATION

$T_A$	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
0°C to 70°C	SOIC (D)	Tube of 75	LT1009CD	1009C
		Reel of 2500	LT1009CDR	
	TO-226 / TO-92 (LP)	Bulk of 1000	LT1009CLP	LT1009C
		Ammo of 2000	LT1009CLPM	
		Reel of 2000	LT1009CLPR	
	TSSOP (PW)	Tube of 150	LT1009CPW	1009C
		Reel of 2000	LT1009CPWR	
–40°C to 85°C	SOIC (D)	Tube of 75	LT1009ID	1009I
		Reel of 2500	LT1009IDR	
	TO-226 / TO-92 (LP)	Bulk of 1000	LT1009ILP	LT1009I
		Reel of 2000	LT1009ILPR	
	TSSOP (PW)	Tube of 150	LT1009IPW	1009I
		Reel of 2000	LT1009IPWR	

† 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.

 **TEXAS  
INSTRUMENTS**

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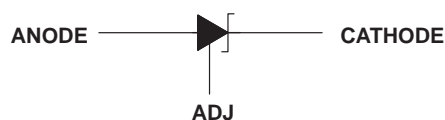
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# LT1009

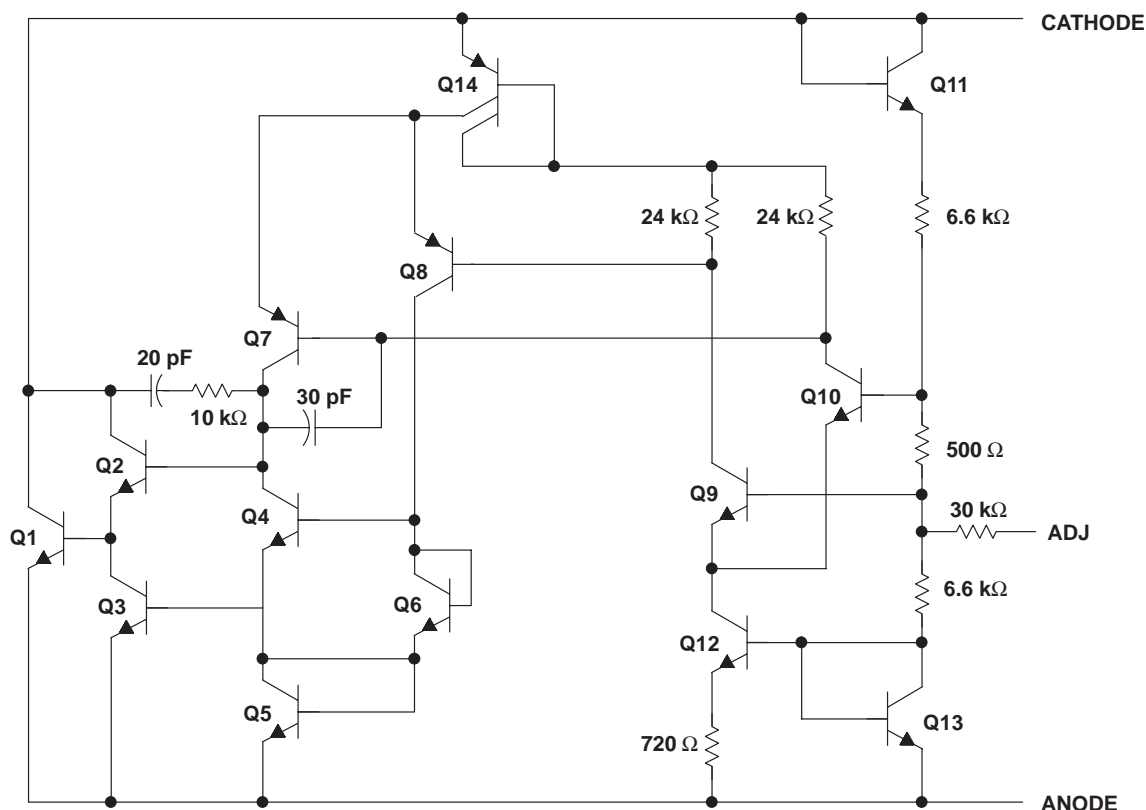
## 2.5-V INTEGRATED REFERENCE CIRCUIT

SLVS013J – MAY 1987 – REVISED SEPTEMBER 2003

### symbol



### schematic



All component values shown are nominal.

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

Reverse current, $I_R$	20 mA
Forward current, $I_F$	10 mA
Package thermal impedance, $\theta_{JA}$ , (see Notes 1 and 2): D package	97°C/W
LP package	140°C/W
PW package	149°C/W
Operating virtual junction temperature, $T_J$	150°C
Storage temperature range, $T_{stg}$	–65°C to 150°C

<sup>†</sup> 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. 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  $P_D = (T_{J(max)} - T_A)/\theta_{JA}$ . Operation at the absolute maximum  $T_J$  of 150°C can impact reliability.
2. The package thermal impedance is calculated in accordance with JESD 51-7.



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# LT1009

## 2.5-V INTEGRATED REFERENCE CIRCUIT

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### recommended operating conditions

		MIN	MAX	UNIT	
T <sub>A</sub>	Operating free-air temperature range	LT1009C	0	70	°C
		LT1009I	−40	85	

### electrical characteristics at specified free-air temperature

PARAMETER	TEST CONDITIONS		$T_A$ †	LT1009C			LT1009I			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
$V_Z$ Reference voltage	$I_Z = 1\text{ mA}$	D package	25°C	2.49	2.5	2.51	2.49	2.5	2.51	V
		LP package		2.495	2.5	2.505	2.495	2.5	2.505	
		D package	Full range	2.485		2.515	2.475		2.525	
		LP package		2.491		2.509	2.48		2.52	
$V_F$ Forward voltage	$I_F = 2\text{ mA}$		25°C	0.4		1	0.4		1	V
Adjustment range	$I_Z = 1\text{ mA}$ , $V_{ADJ} = \text{GND to } V_Z$		25°C	125			125			mV
	$I_Z = 1\text{ mA}$ , $V_{ADJ} = 0.6\text{ V to } V_Z - 0.6\text{ V}$			45			45			
$\Delta V_Z(\text{temp})$ Change in reference voltage with temperature		D package	Full range			5			15	mV
		LP package				4			15	
$\alpha_{V_Z}$ Average temperature coefficient of reference voltage‡			0°C to 70°C		15	25			30	ppm/°C
			–40°C to 85°C					20		
$\Delta V_Z$ Change in reference voltage with current	$I_Z = 400\text{ }\mu\text{A to } 10\text{ mA}$		25°C		2.6	10		2.6	6	mV
			Full range			12			10	
$\Delta V_Z/\Delta t$ Long-term change in reference voltage	$I_Z = 1\text{ mA}$		25°C		20			20		ppm/khr
$z_z$ Reference impedance	$I_Z = 1\text{ mA}$		25°C		0.3	1		0.3	1	$\Omega$
			Full range			1.4			1.4	

† Full range is 0°C to 70°C for the LT1009C and –40°C to 85°C for the LT1009I.

‡ The average temperature coefficient of reference voltage is defined as the total change in reference voltage divided by the specified temperature range.

# LT1009

## 2.5-V INTEGRATED REFERENCE CIRCUIT

SLVS013J – MAY 1987 – REVISED SEPTEMBER 2003

### TYPICAL CHARACTERISTICS†

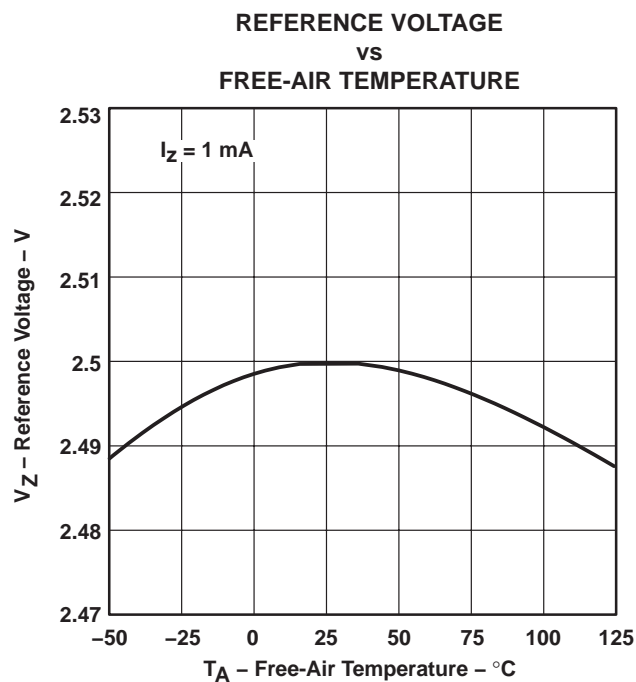


Figure 1

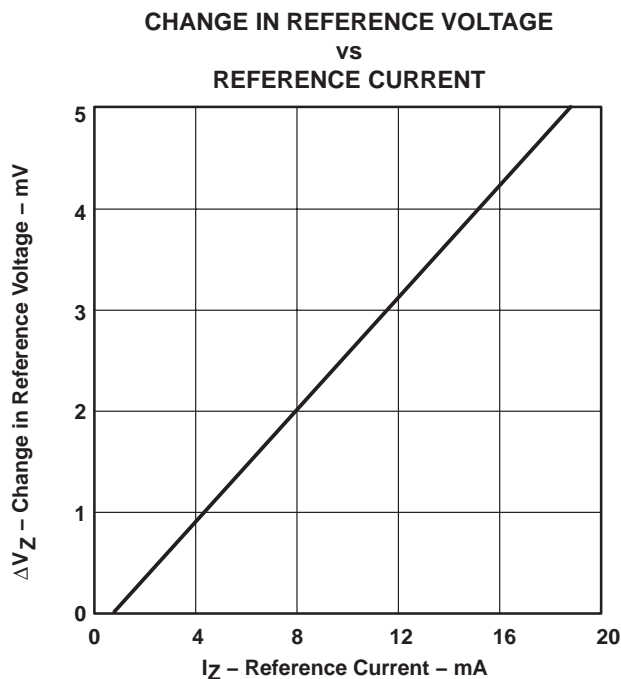


Figure 2

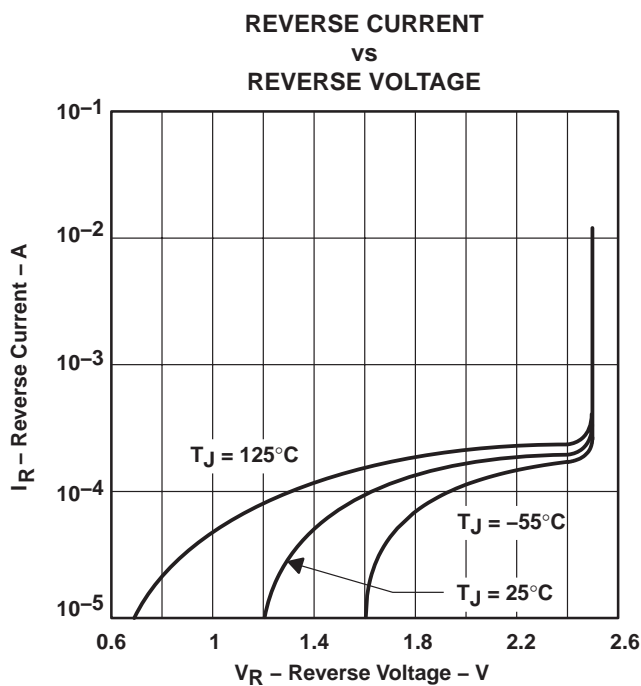


Figure 3

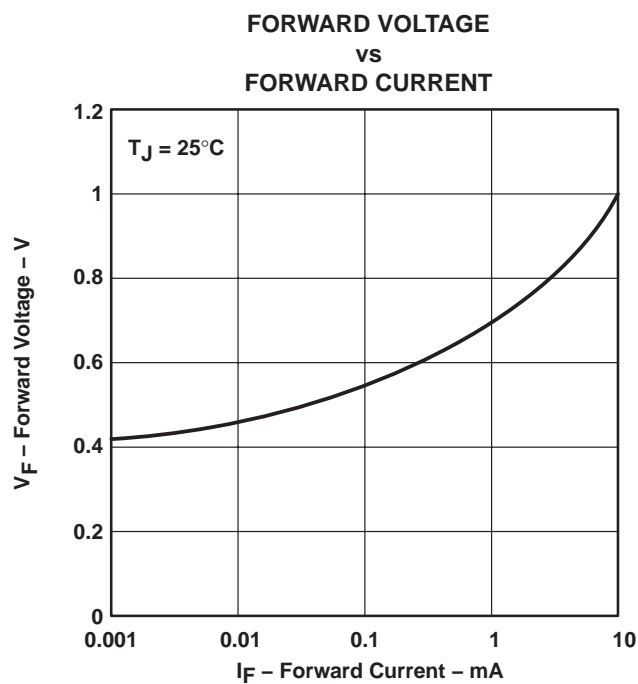


Figure 4

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

TYPICAL CHARACTERISTICS

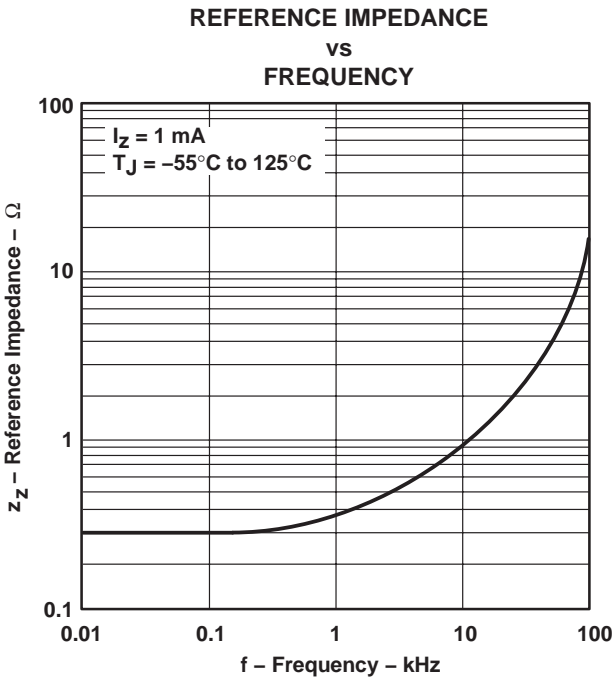


Figure 5

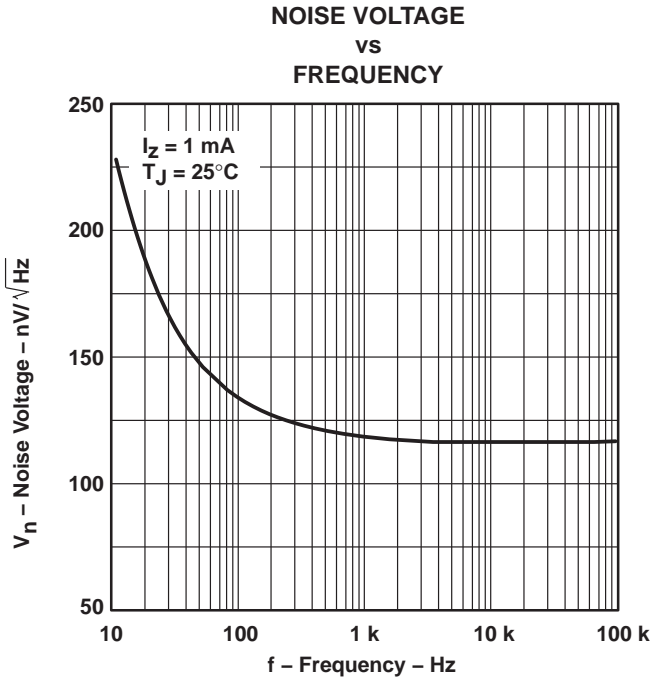


Figure 6

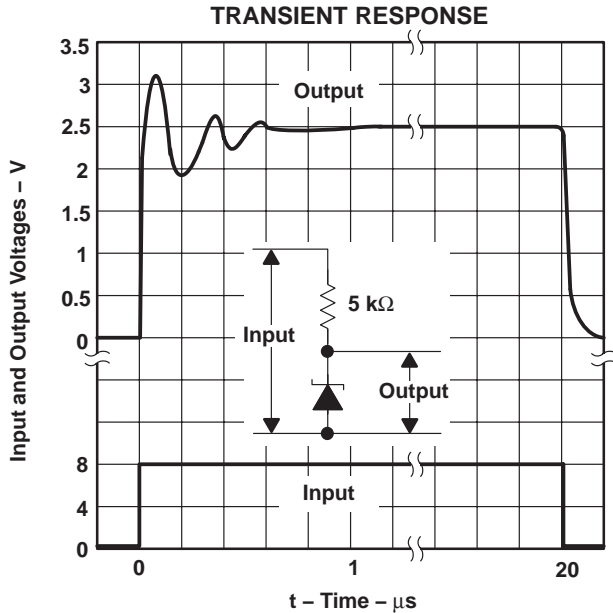


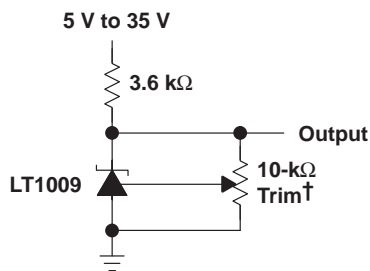
Figure 7

# LT1009

## 2.5-V INTEGRATED REFERENCE CIRCUIT

SLVS013J – MAY 1987 – REVISED SEPTEMBER 2003

### APPLICATION INFORMATION



†This does not affect temperature coefficient. It provides  $\pm 5\%$  trim range.

Figure 8. 2.5-V Reference

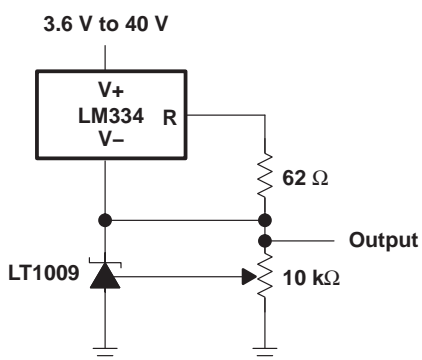


Figure 9. Adjustable Reference With Wide Supply Range

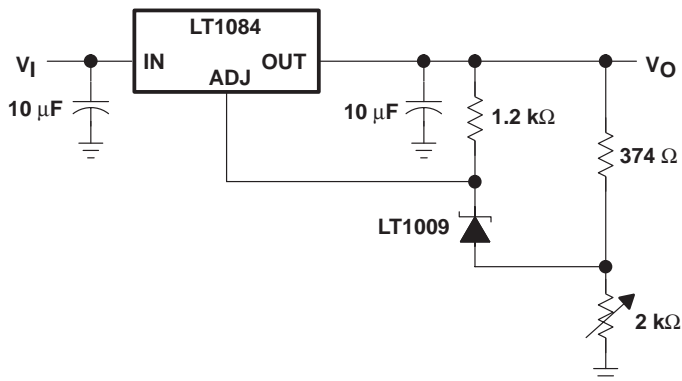


Figure 10. Power Regulator With Low Temperature Coefficient

APPLICATION INFORMATION

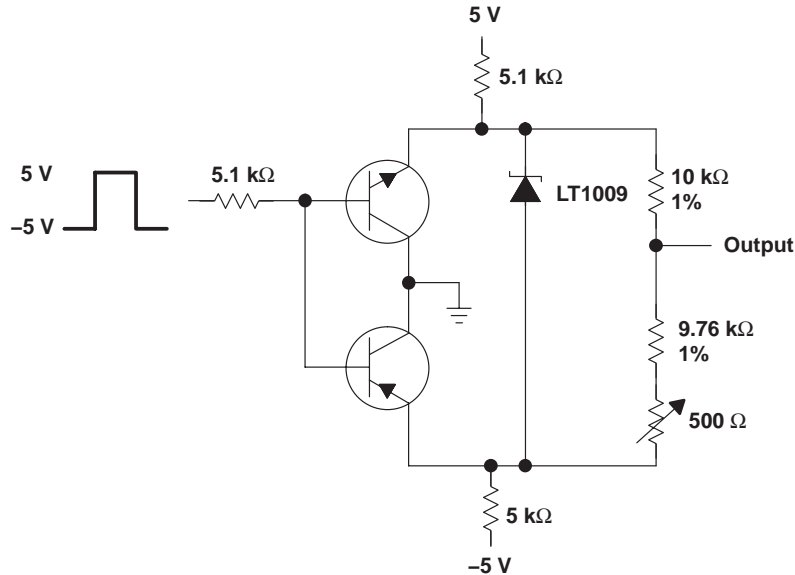


Figure 11. Switchable  $\pm 1.25$ -V Bipolar Reference

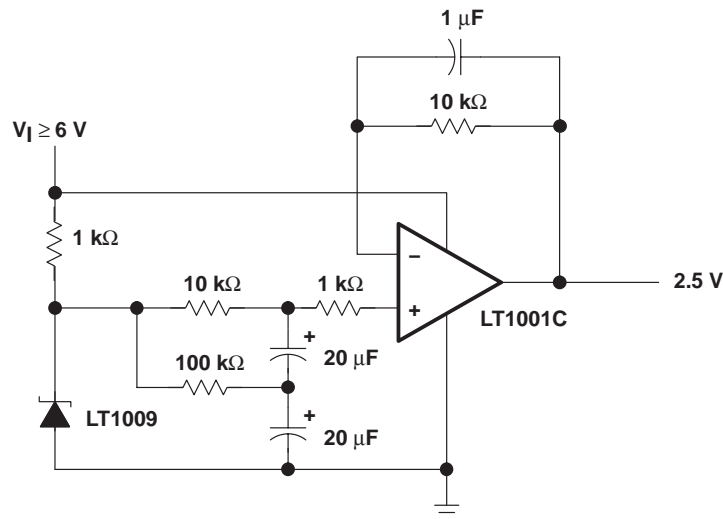
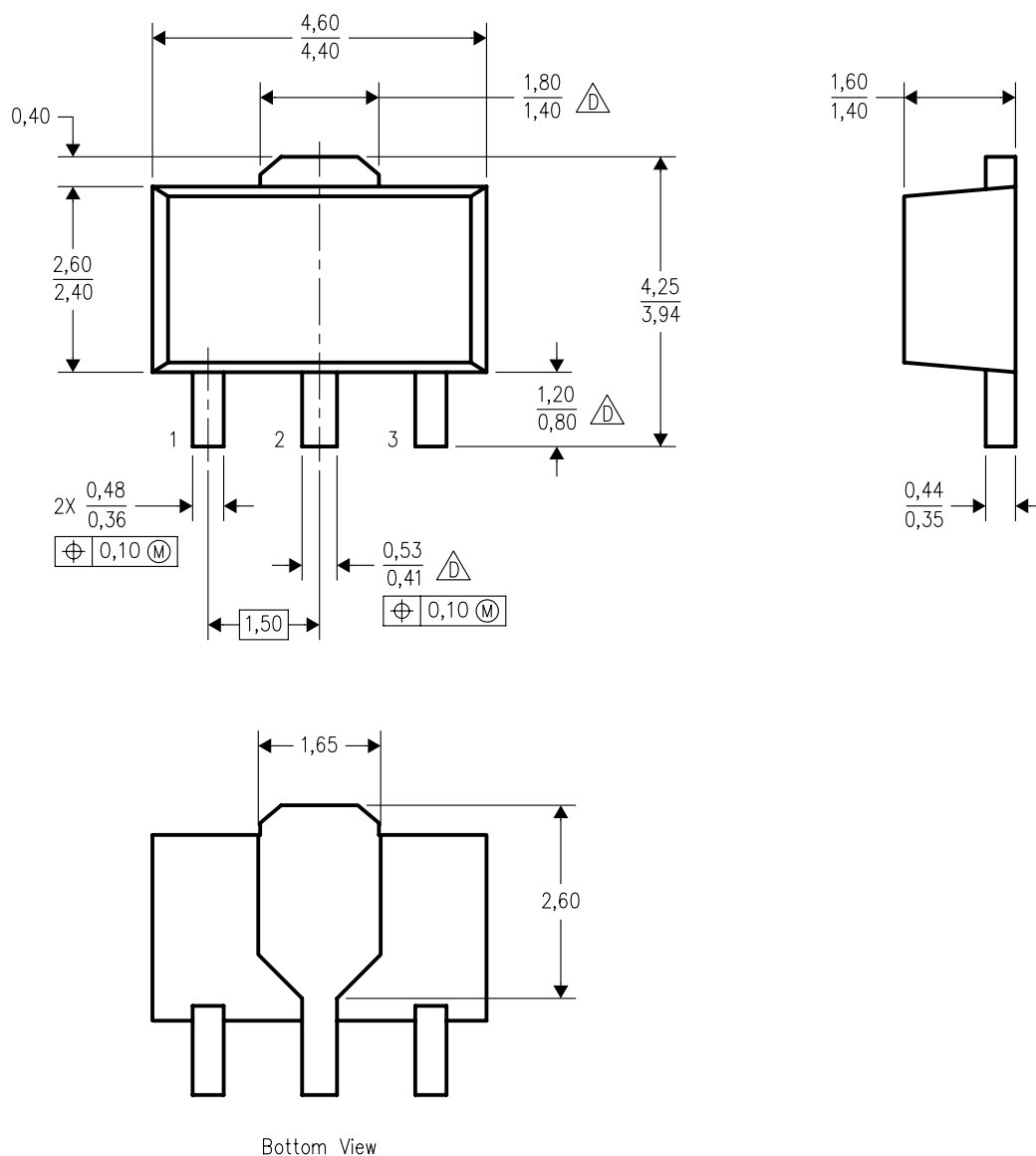


Figure 12. Low-Noise 2.5-V Buffered Reference

PK (R-PSSO-F3)

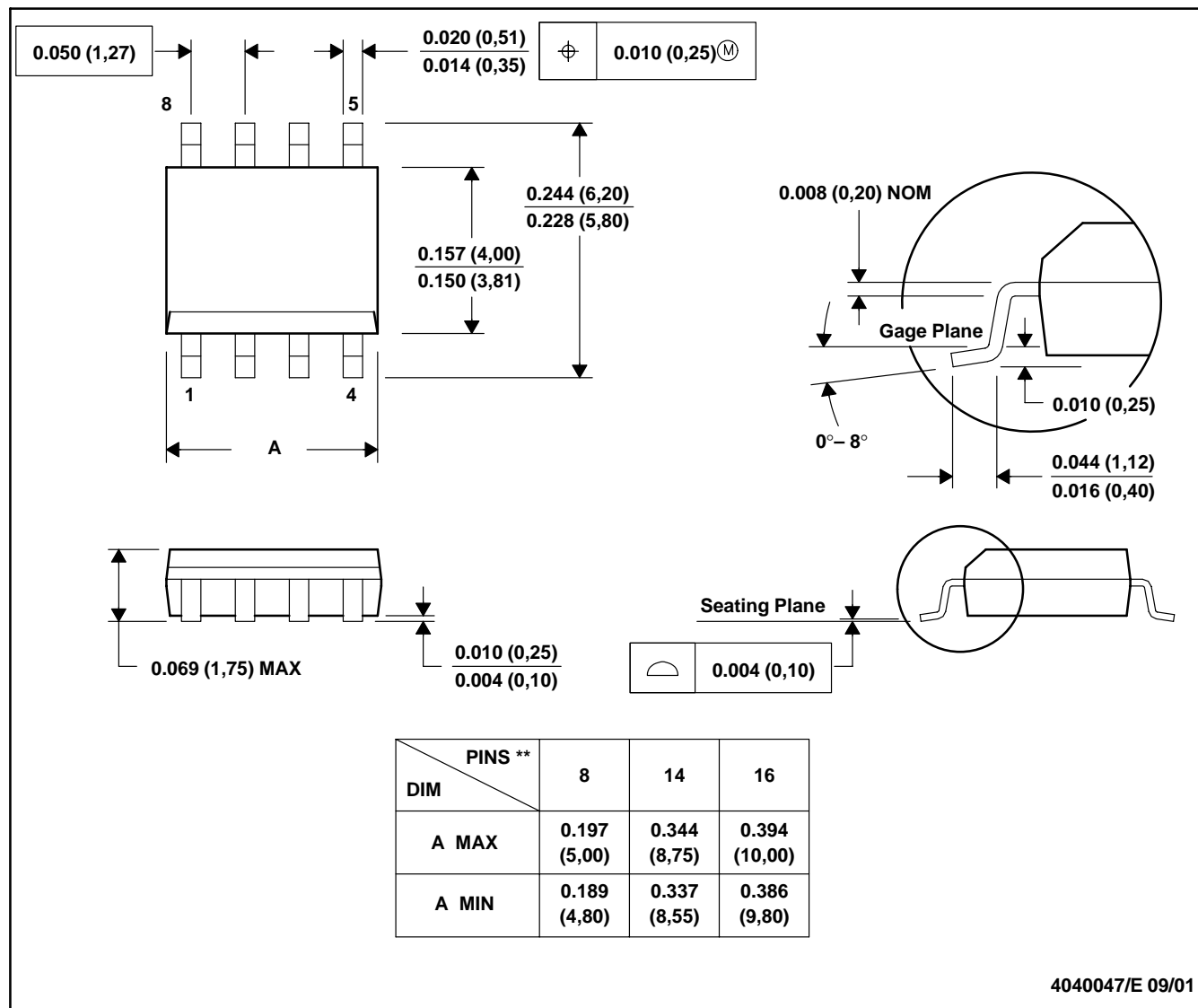
PLASTIC SINGLE-IN-LINE PACKAGE



4040234/C 07/2004

- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5-1994.
  - B. This drawing is subject to change without notice.
  - C. The center lead is in electrical contact with the tab.
- $\triangle D$  Falls within JEDEC TO-243 variation AA, except minimum lead length, pin 2 minimum lead width, and minimum tab width.

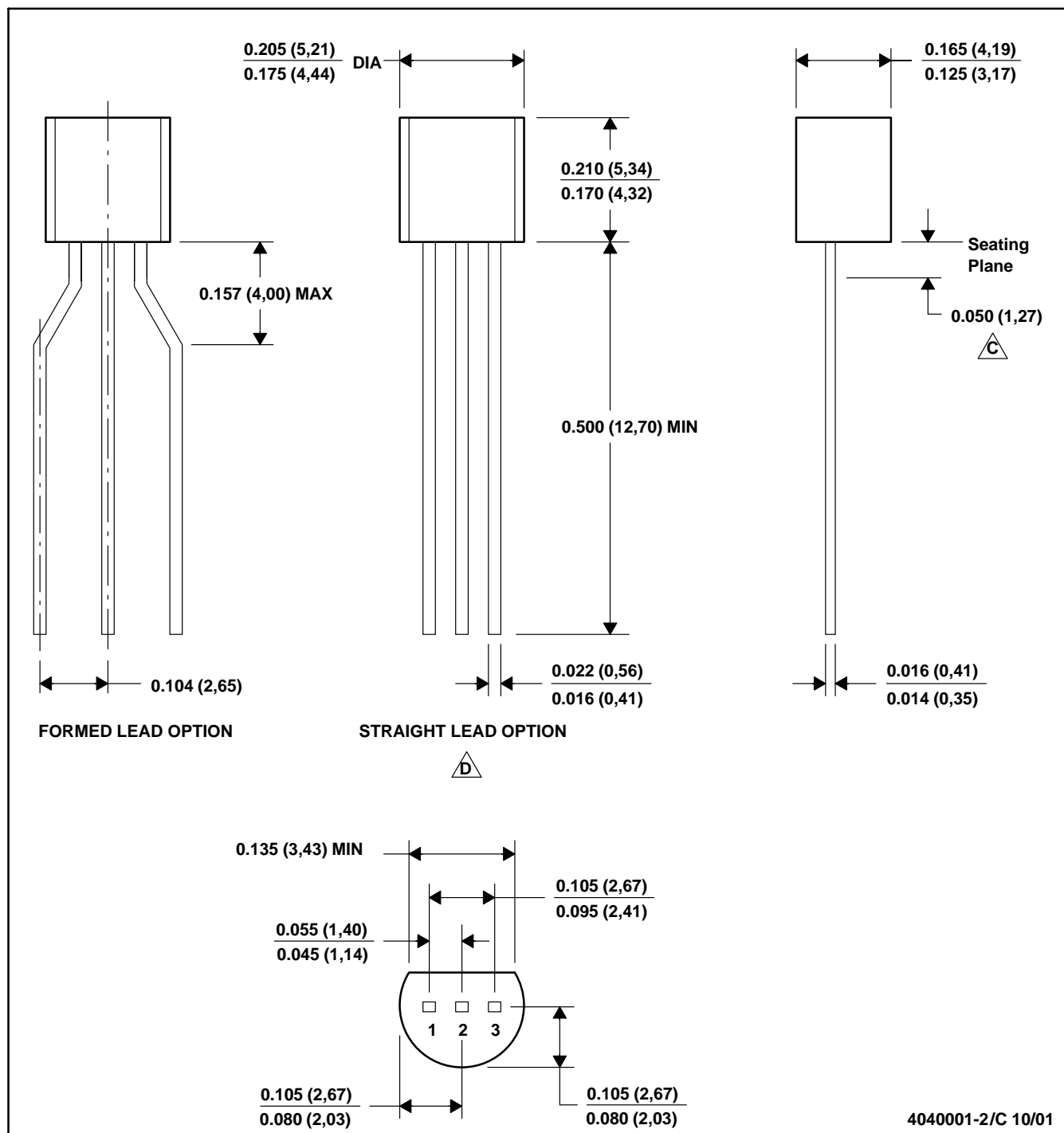


**D (R-PDSO-G\*\*)****PLASTIC SMALL-OUTLINE PACKAGE****8 PINS SHOWN**

- 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

## LP (O-PBCY-W3)

## PLASTIC CYLINDRICAL PACKAGE



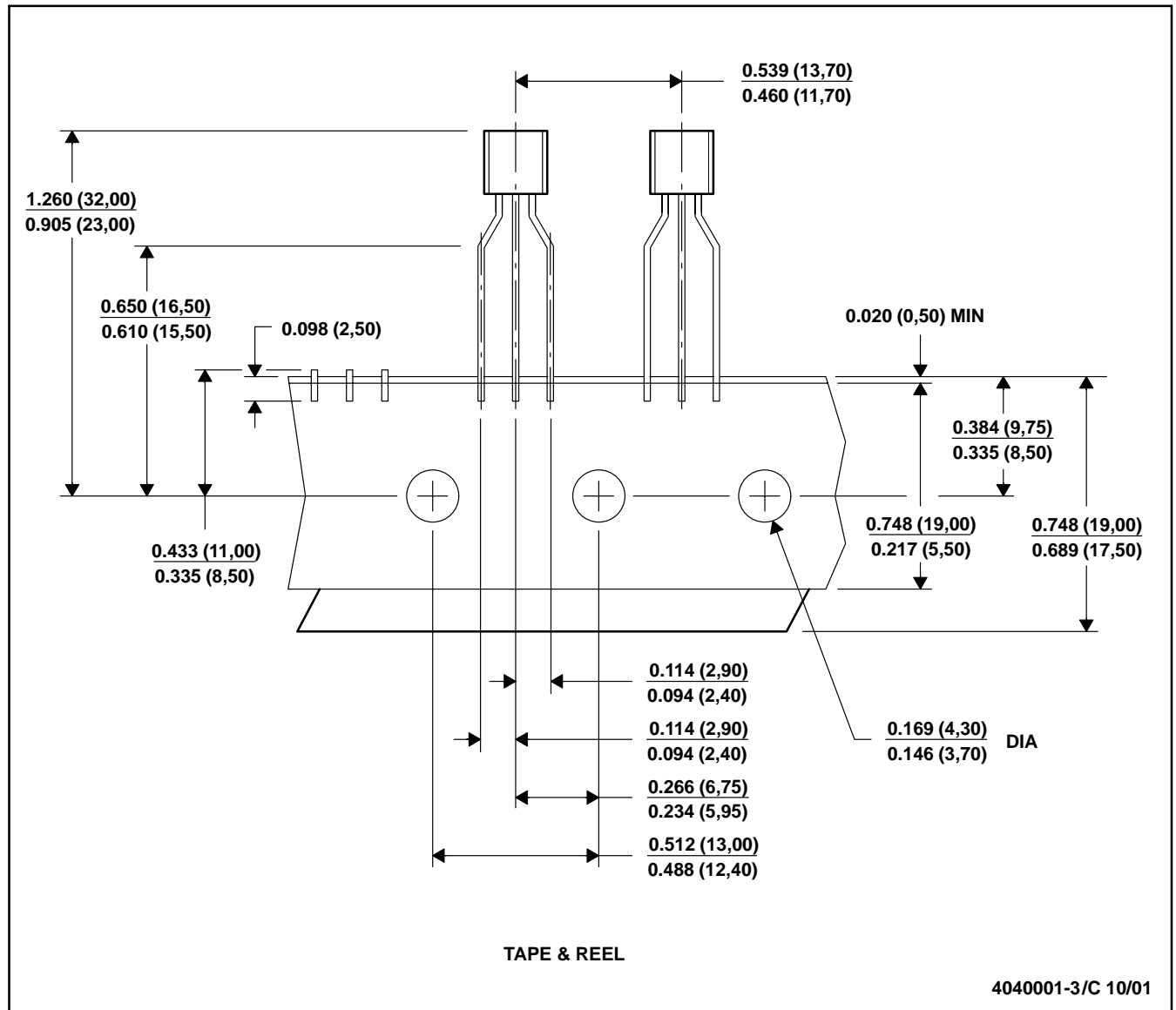
4040001-2/C 10/01

# MECHANICAL DATA

MSOT002A – OCTOBER 1994 – REVISED NOVEMBER 2001

LP (O-PBCY-W3)

PLASTIC CYLINDRICAL PACKAGE

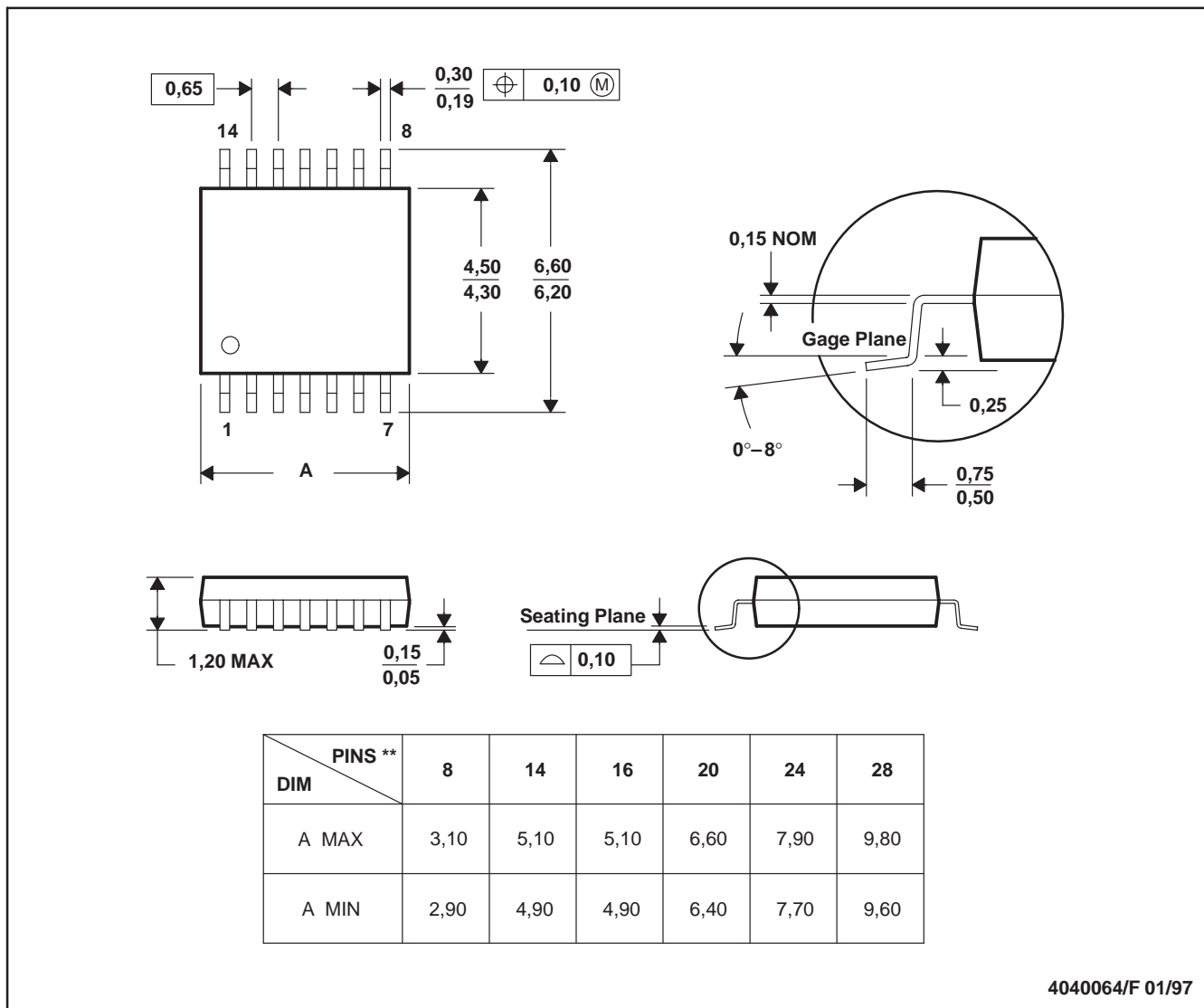


- NOTES: A. All linear dimensions are in inches (millimeters).  
B. This drawing is subject to change without notice.  
C. Tape and Reel information for the Format Lead Option package.

## PW (R-PDSO-G\*\*)

## PLASTIC SMALL-OUTLINE PACKAGE

14 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-153

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