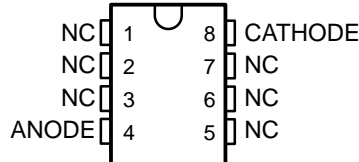


# LM285-1.2, LM385-1.2, LM385B-1.2 MICROPOWER VOLTAGE REFERENCES

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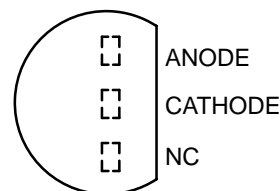
- **Operating Current Range**
  - LM285 . . . 10  $\mu$ A to 20 mA
  - LM385 . . . 15  $\mu$ A to 20 mA
  - LM385B . . . 15  $\mu$ A to 20 mA
- **1% and 2% Initial Voltage Tolerance**
- **Reference Impedance**
  - LM385 . . . 1  $\Omega$  Max at 25°C
  - All Devices . . . 1.5  $\Omega$  Max Over Full Temperature Range
- **Very Low Power Consumption**
- **Applications**
  - Portable Meter References
  - Portable Test Instruments
  - Battery-Operated Systems
  - Current-Loop Instrumentation
  - Panel Meters
- **Interchangeable With Industry Standard LM285-1.2 and LM385-1.2**

LM285-1.2 . . . D PACKAGE  
LM385-1.2 . . . D, PS, OR PW PACKAGE  
LM385B-1.2 . . . D OR PW PACKAGE  
(TOP VIEW)



NC – No internal connection

LM285-1.2, LM385-1.2, LM385B-1.2 . . . LP PACKAGE  
(TOP VIEW)



NC – No internal connection

## description/ordering information

These micropower, two-terminal, band-gap voltage references operate over a 10- $\mu$ A to 20-mA current range and feature exceptionally low dynamic impedance and good temperature stability. On-chip trimming provides tight voltage tolerance. The band-gap reference for these devices has low noise and long-term stability.

## ORDERING INFORMATION

TA	VZ TOLERANCE	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
0°C to 70°C	2%	SOIC (D)	Tube of 75	LM385D-1-2	385-12
			Reel of 2000	LM385DR-1-2	
		SOP (PS)	Reel of 2000	LM385PSR-1-2	L385-12
		TO-92 (LP)	Tube of 1000	LM385LP-1-2	385-12
			Reel of 2000	LM385LPR-1-2	
		TSSOP (PW)	Tube of 150	LM385PW-1-2	385-12
	Reel of 2000		LM385PWR-1-2		
	1%	SOIC (D)	Tube of 75	LM385BD-1-2	385B12
			Reel of 2000	LM385BDR-1-2	
		TO-92 (LP)	Tube of 1000	LM385BLP-1-2	385-12
			Reel of 2000	LM385BLPR-1-2	
		TSSOP (PW)	Tube of 150	LM385BPW-1-2	385B12
Reel of 2000			LM385BPWR-1-2		
–40°C to 85°C	1%	SOIC (D)	Tube of 75	LM285D-1-2	285-12
			Reel of 2000	LM285DR-1-2	
		TO-92 (LP)	Tube of 1000	LM285LP-1-2	285-12

† 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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# LM285-1.2, LM385-1.2, LM385B-1.2 MICROPOWER VOLTAGE REFERENCES

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## description/ordering information (continued)

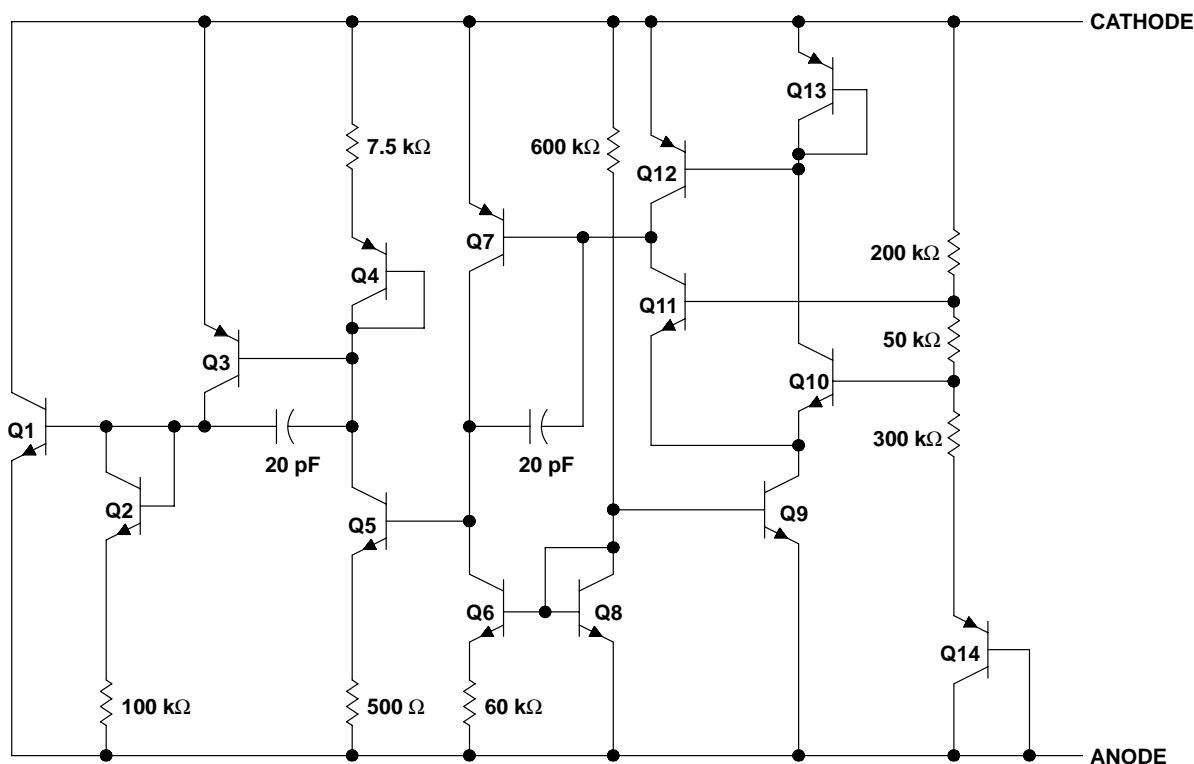
The design makes these devices exceptionally tolerant of capacitive loading and, thus, easier to use in most reference applications. The wide dynamic operating temperature range accommodates varying current supplies, with excellent regulation.

The extremely low power drain of this series makes them useful for micropower circuitry. These voltage references can be used to make portable meters, regulators, or general-purpose analog circuitry, with battery life approaching shelf life. The wide operating current range allows them to replace older references with tighter-tolerance parts.

## symbol



## schematic



NOTE A: Component values shown are nominal.



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# LM285-1.2, LM385-1.2, LM385B-1.2 MICROPOWER VOLTAGE REFERENCES

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

Reverse current, $I_R$ .....	30 mA
Forward current, $I_F$ .....	10 mA
Package thermal impedance, $\theta_{JA}$ (see Notes 1 and 2): D package .....	97°C/W
LP package .....	156°C/W
PS package .....	95°C/W
PW package .....	149°C/W
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. 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 affect reliability.
2. The package thermal impedance is calculated in accordance with JESD 51-7.

## recommended operating conditions

		MIN	MAX	UNIT
$I_z$	Reference current	0.01	20	mA
$T_A$	Operating free-air temperature range	LM285-1.2	–40	85
		LM385-1.2, LM385B-1.2	0	70



# LM285-1.2, LM385-1.2, LM385B-1.2 MICROPOWER VOLTAGE REFERENCES

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## electrical characteristics at specified free-air temperature

PARAMETER	TEST CONDITIONS	T <sub>A</sub> <sup>†</sup>	LM285-1.2			LM385-1.2			LM385B-1.2			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX		
V <sub>Z</sub>	Reference voltage	I <sub>Z</sub> = I(min) to 20 mA <sup>‡</sup>	25°C	1.223	1.235	1.247	1.21	1.235	1.26	1.223	1.235	1.247	V
α <sub>VZ</sub>	Average temperature coefficient of reference voltage <sup>§</sup>	I <sub>Z</sub> = I(min) to 20 mA <sup>‡</sup>	25°C	±20			±20			±20			ppm/°C
ΔV <sub>Z</sub>	Change in reference voltage with current	I <sub>Z</sub> = I(min) to 1 mA <sup>‡</sup>	25°C	1			1			1			mV
			Full range	1.5			1.5			1.5			
		I <sub>Z</sub> = 1 mA to 20 mA	25°C	12			20			20			
			Full range	30			30			30			
ΔV <sub>Z</sub> /Δt	Long-term change in reference voltage	I <sub>Z</sub> = 100 μA	25°C	±20			±20			±20			ppm/khr
I <sub>Z</sub> (min)	Minimum reference current		Full range	8 10		8 15		8 15				μA	
z <sub>Z</sub>	Reference impedance	I <sub>Z</sub> = 100 μA, f = 25 Hz	25°C	0.2 0.6		0.4 1		0.4 1				Ω	
			Full range	1.5		1.5		1.5					
V <sub>n</sub>	Broadband noise voltage	I <sub>Z</sub> = 100 μA, f = 10 Hz to 10 kHz	25°C	60			60			60			μV

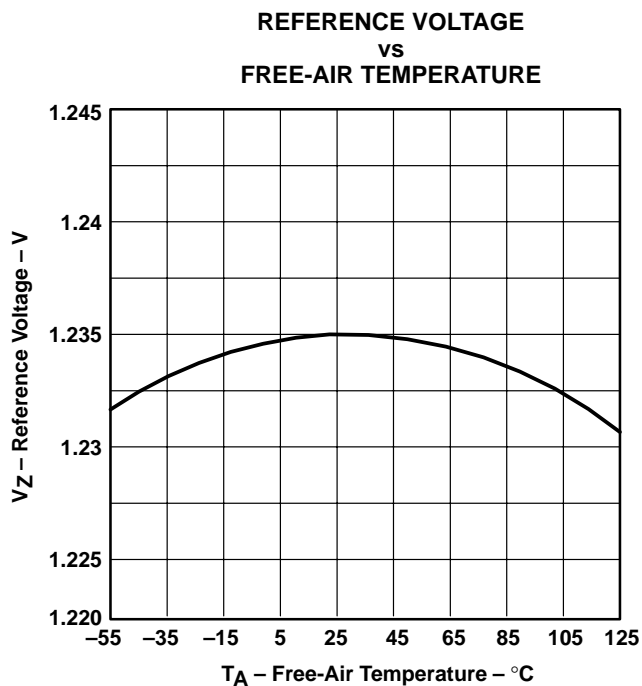
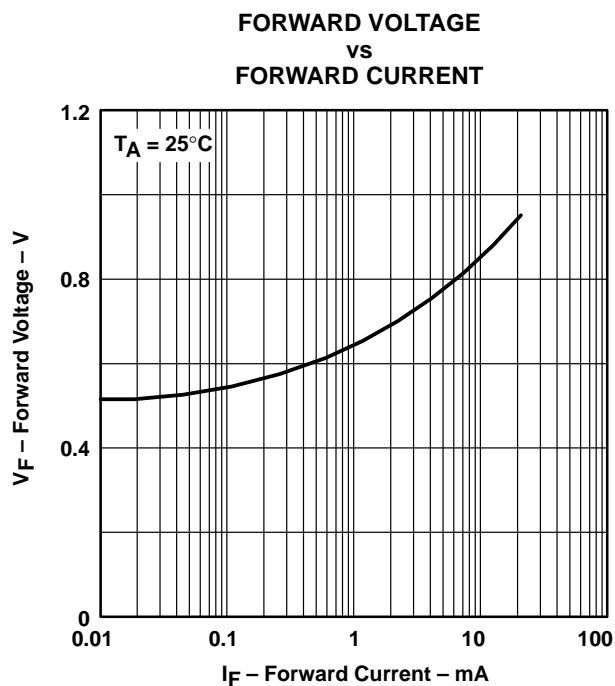
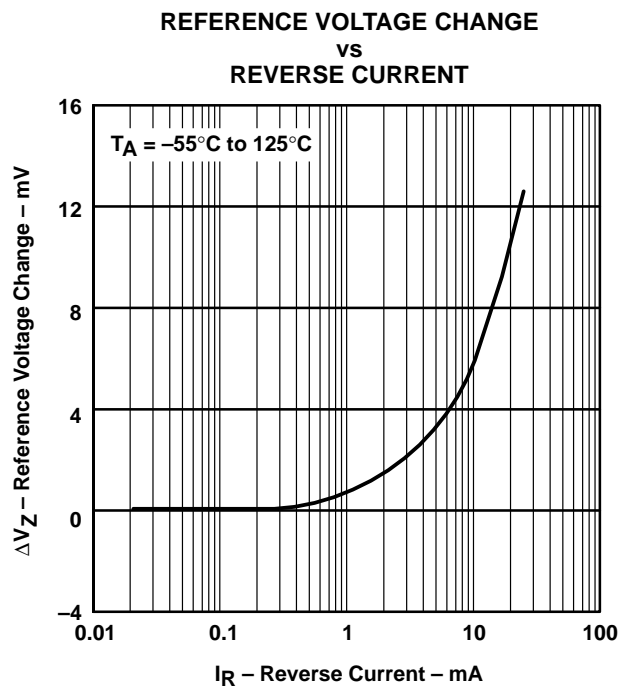
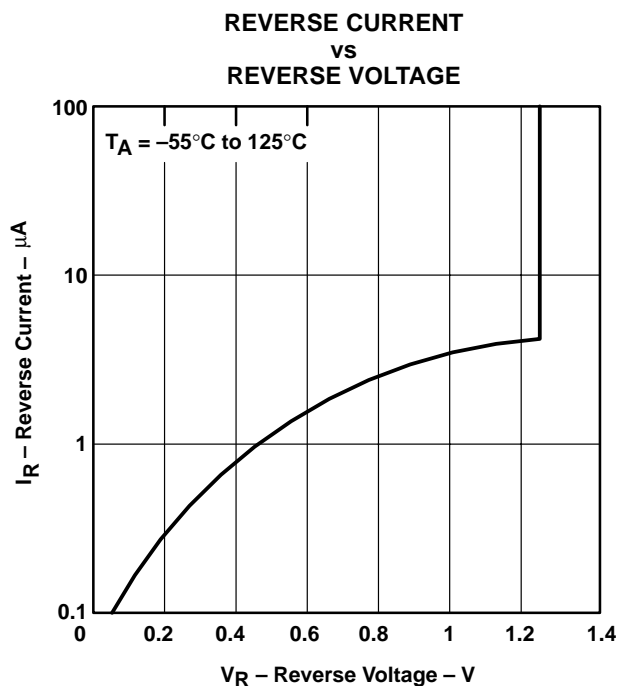
<sup>†</sup> Full range is -40°C to 85°C for the LM285-1.2 and 0°C to 70°C for the LM385-1.2 and LM385B-1.2.

<sup>‡</sup> I(min) = 10 μA for the LM285-1.2 and 15 μA for the LM385-1.2 and LM385B-1.2

<sup>§</sup> The average temperature coefficient of reference voltage is defined as the total change in reference voltage divided by the specified temperature range.



TYPICAL CHARACTERISTICS†



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

# LM285-1.2, LM385-1.2, LM385B-1.2 MICROPOWER VOLTAGE REFERENCES

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## TYPICAL CHARACTERISTICS†

REFERENCE IMPEDANCE  
VS  
REFERENCE CURRENT

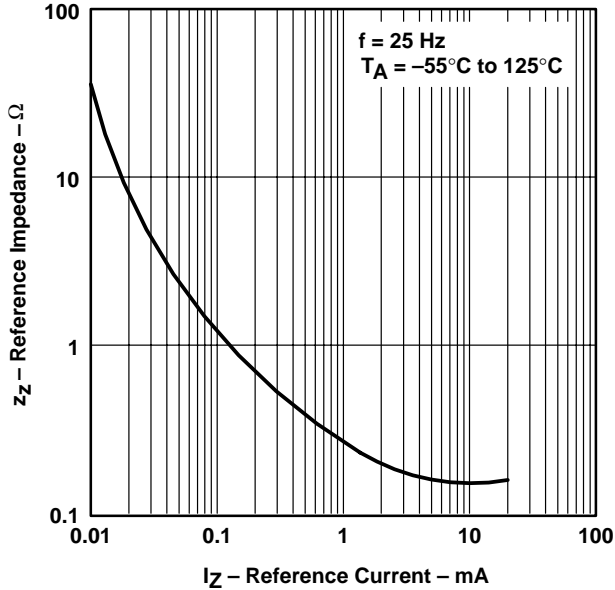


Figure 5

NOISE VOLTAGE  
VS  
FREQUENCY

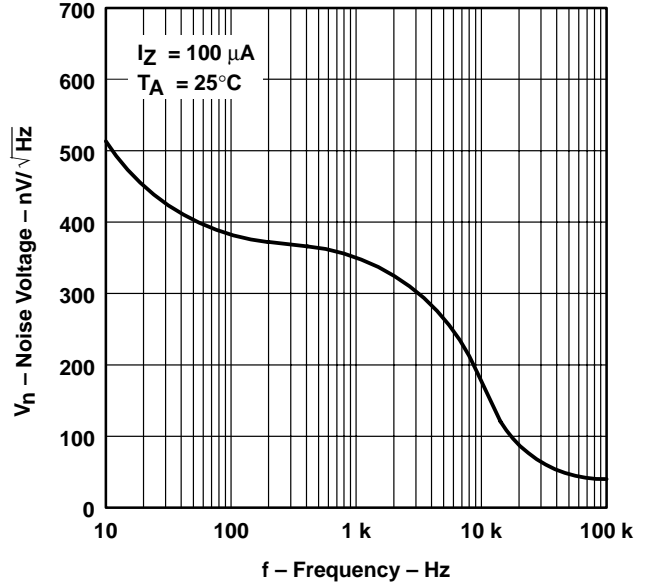


Figure 6

OUTPUT NOISE VOLTAGE  
VS  
CUTOFF FREQUENCY

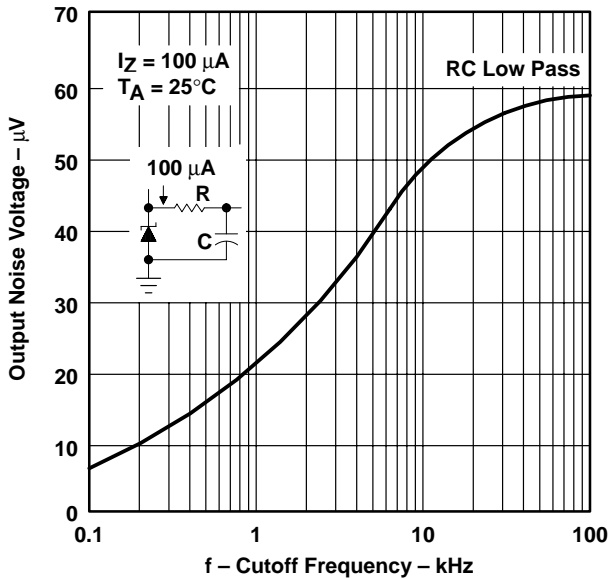


Figure 7

TRANSIENT RESPONSE

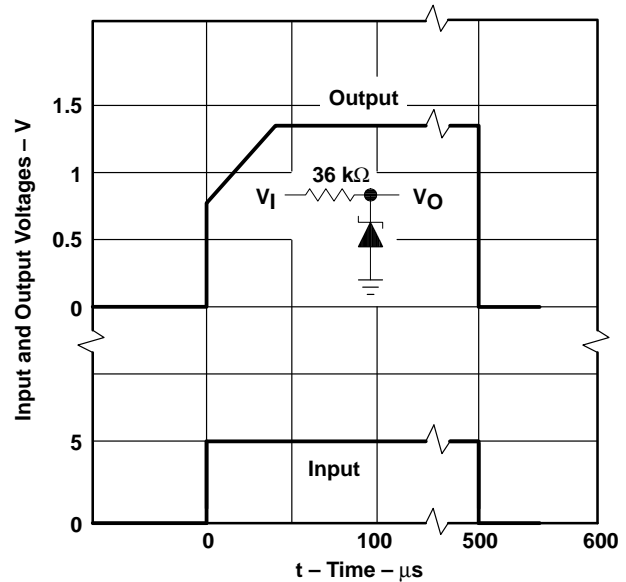


Figure 8

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

APPLICATION INFORMATION

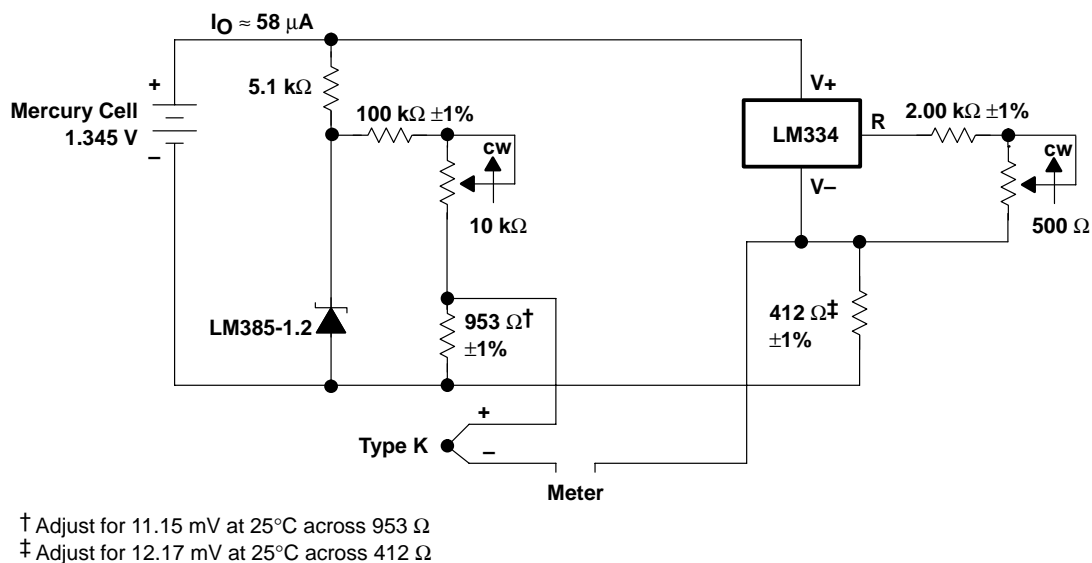


Figure 9. Thermocouple Cold-Junction Compensator

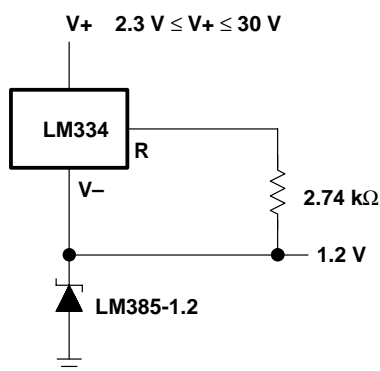


Figure 10. Operation Over a Wide Supply Range

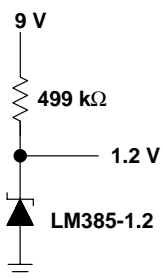
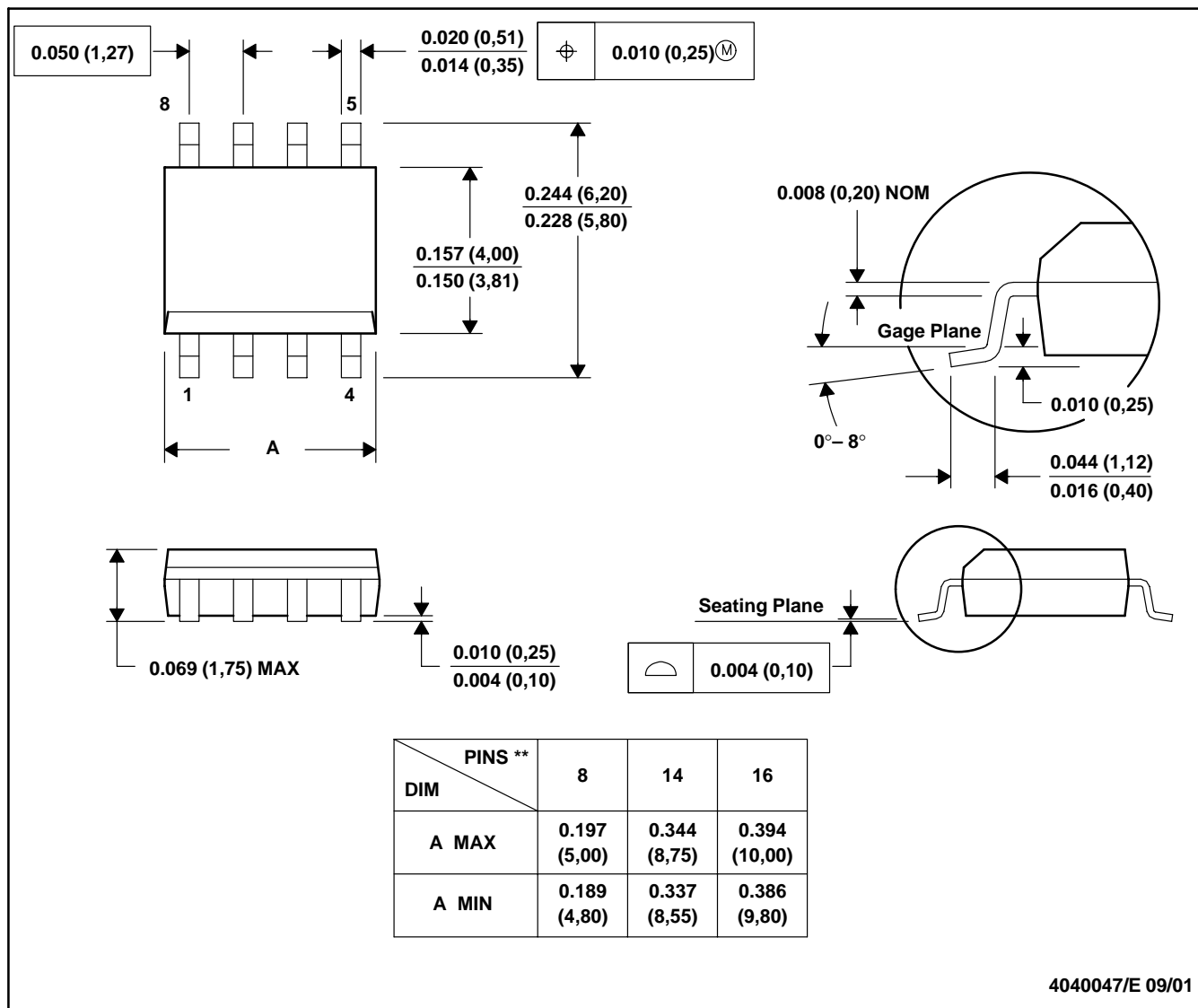


Figure 11. Reference From a 9-V Battery

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

PLASTIC SMALL-OUTLINE PACKAGE

8 PINS SHOWN

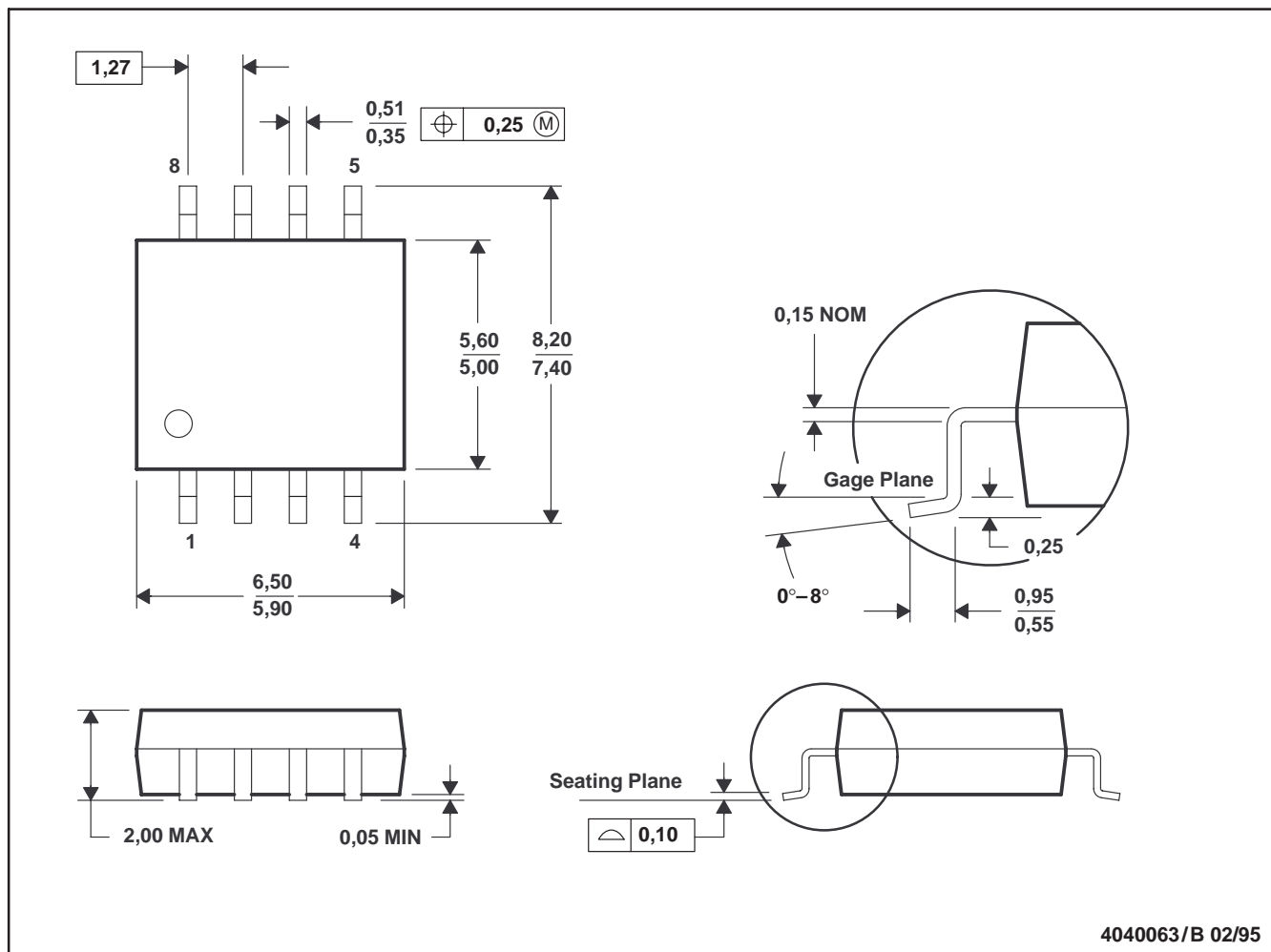


4040047/E 09/01

- 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

PS (R-PDSO-G8)

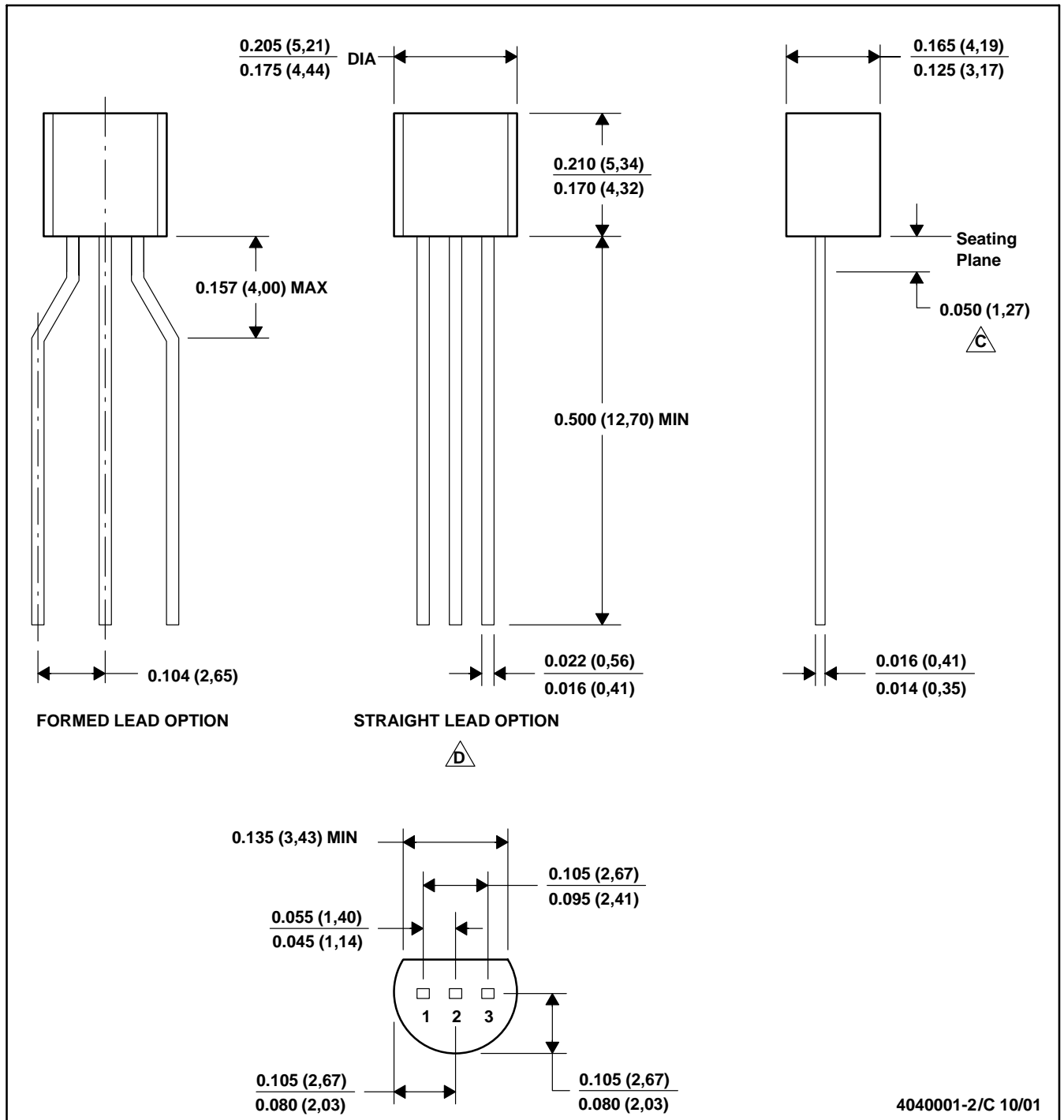
PLASTIC SMALL-OUTLINE PACKAGE



- 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.

LP (O-PBCY-W3)

PLASTIC CYLINDRICAL PACKAGE



4040001-2/C 10/01

- NOTES: A. All linear dimensions are in inches (millimeters).  
 B. This drawing is subject to change without notice.  
 C. Lead dimensions are not controlled within this area  
 D. Falls within JEDEC TO -226 Variation AA (TO-226 replaces TO-92)  
 E. Shipping Method:  
 Straight lead option available in bulk pack only.  
 Formed lead option available in tape & reel or ammo pack.

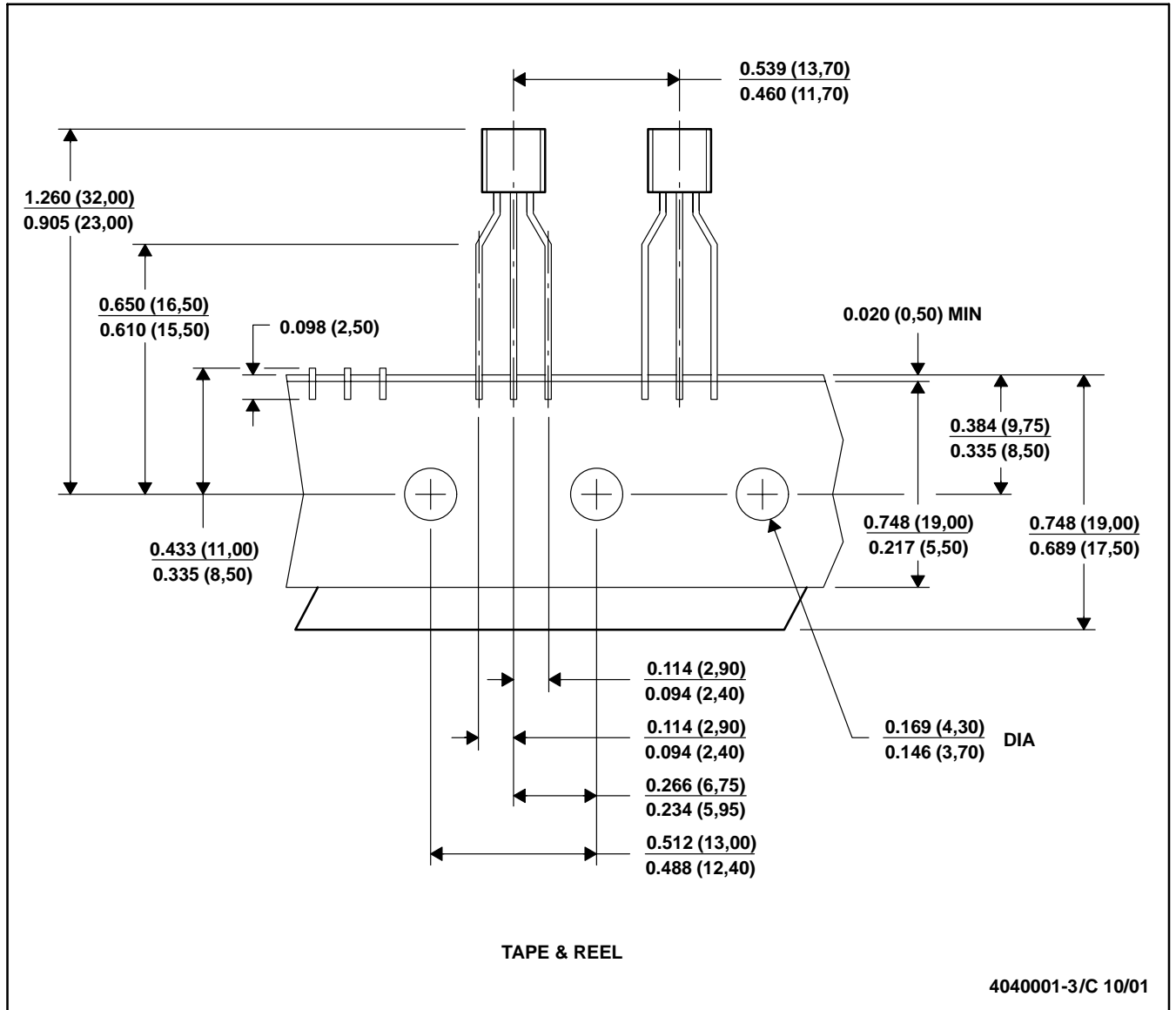


# MECHANICAL DATA

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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