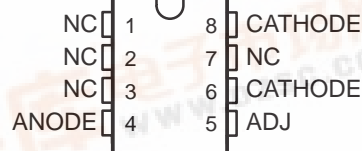


2.5-V INTEGRATED REFERENCE CIRCUITS

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- **Excellent Temperature Stability**
- **Initial Tolerance . . . 0.2% Max**
- **Dynamic Impedance . . . 0.6 Ω Max**
- **Wide Operating Current Range**
- **Directly Interchangeable With LM136**
- **Needs No Adjustment for Minimum Temperature Coefficient**
- **Surface-Mount Three-Lead Package**

**D PACKAGE
(TOP VIEW)**



NC—No internal connection

description

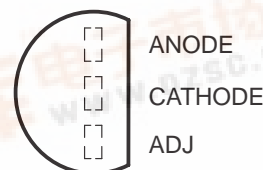
The LT1009 reference circuit is a precision-trimmed 2.5-V shunt regulator featuring low dynamic impedance and a wide operating current range. The maximum initial tolerance is ± 5 mV in the LP package and ± 10 mV in the D package. The reference tolerance is achieved by on-chip trimming, which minimizes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

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 ADC and 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)**



logic symbol



AVAILABLE OPTIONS

T _A	PACKAGED DEVICES		CHIP FORM (Y)
	SMALL OUTLINE (D)	PLASTIC CYLINDRICAL (LP)	
0°C to 70°C	LT1009CD	LT1009CLP	LT1009Y
-40°C to 85°C	LT1009ID	LT1009ILP	

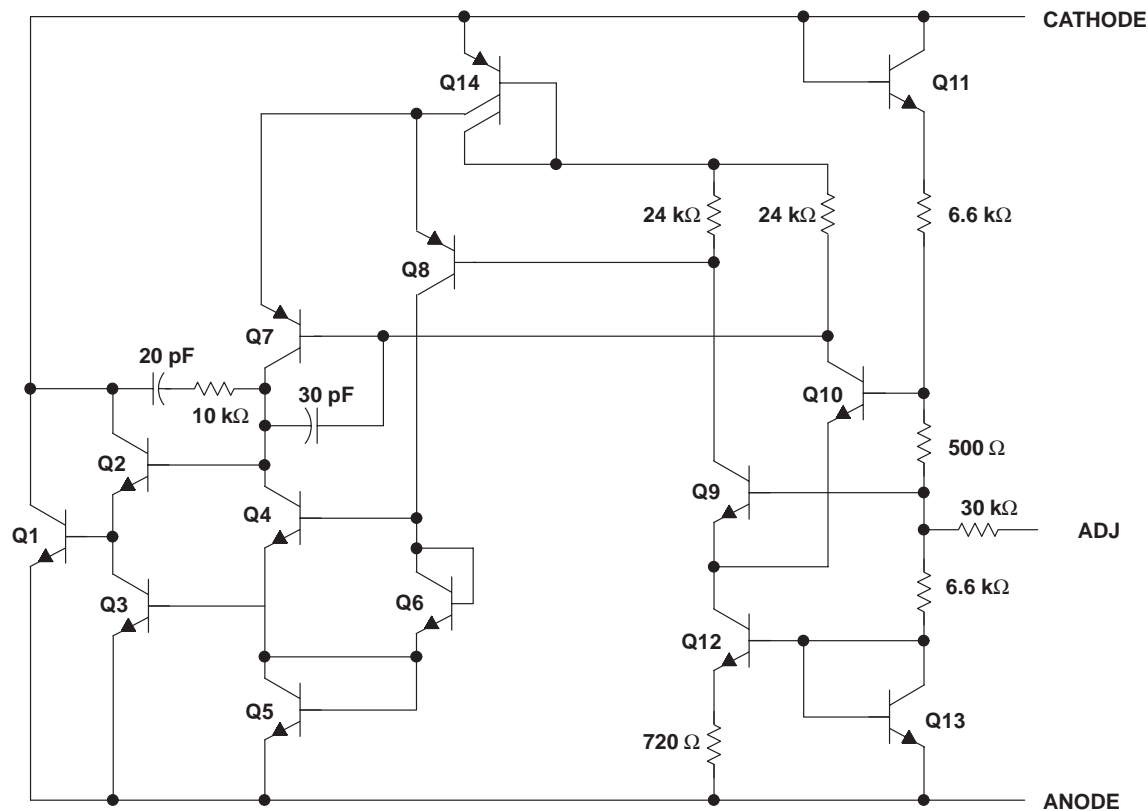
The D and LP packages are available taped and reeled. Add the suffix R to device type (e.g., LT1009CDR). Chip forms are tested at 25°C.

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.

LT1009
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schematic



All component values shown are nominal.

absolute maximum ratings over operating free-air temperature range†

Reverse current, I_R	20 mA
Forward current, I_F	10 mA
Package thermal impedance, θ_{JA} , (see Notes 1 and 2): D package	97°C/W
LP package	156°C/W
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds: D and LP packages	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 $T_{J(max)}$, θ_{JA} , and T_A . The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_{J(max)} - T_A) / \theta_{JA}$. 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.

recommended operating conditions

		MIN	MAX	UNIT
Operating free-air temperature range, T_A	LT1009C	0	70	°C
	LT1009I	–40	85	

LT1009

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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 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 mA		25°C	0.4		1	0.4		1	V
Adjustment range		I _Z = 1 mA, V _{ADJ} = GND to V _Z		25°C	125			125			mV
		I _Z = 1 mA, V _{ADJ} = 0.6 V to V _Z – 0.6 V			45			45			
ΔV _Z (temp)	Change in reference voltage with temperature		D package	Full range	5			15			mV
			LP package		4			15			
αV _Z	Average temperature coefficient of reference voltage‡			0°C to 70°C	15		25	30			ppm/°C
				–40°C to 85°C			20				
ΔV _Z	Change in reference voltage with current	I _Z = 400 μA to 10 mA		25°C	2.6		10	2.6		6	mV
				Full range	12		10				
ΔV _Z /Δt	Long-term change in reference voltage	I _Z = 1 mA		25°C	20			20			ppm/khr
z _Z	Reference impedance	I _Z = 1 mA		25°C	0.3		1	0.3		1	Ω
				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.

electrical characteristics at $T_A = 25^\circ\text{C}$

PARAMETER		TEST CONDITIONS	LT1009Y			UNIT
			MIN	TYP	MAX	
V _Z	Reference voltage	I _Z = 1 mA	2.49	2.5	2.51	V
V _F	Forward voltage	I _F = 2 mA	0.4		1	V
Adjustment range		I _Z = 1 mA, V _{ADJ} = GND to V _Z	125			mV
		I _Z = 1 mA, V _{ADJ} = 0.6 V to V _Z − 0.6 V	45			
ΔV _Z (temp)	Change in reference voltage with temperature		2.5			mV
α _{VZ}	Average temperature coefficient of reference voltage [‡]		15			ppm/°C
ΔV _Z	Change in reference voltage with current	I _Z = 400 μA to 10 mA	2.6			mV
ΔV _Z /Δt	Long-term change in reference voltage	I _Z = 1 mA	20			ppm/khr
z _Z	Reference impedance	I _Z = 1 mA	0.3		1	W

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

LT1009

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TYPICAL CHARACTERISTICS†

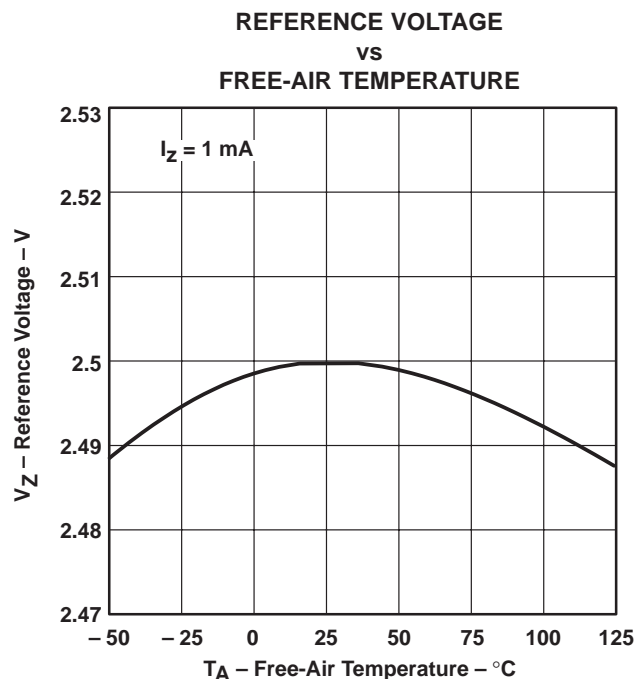


Figure 1

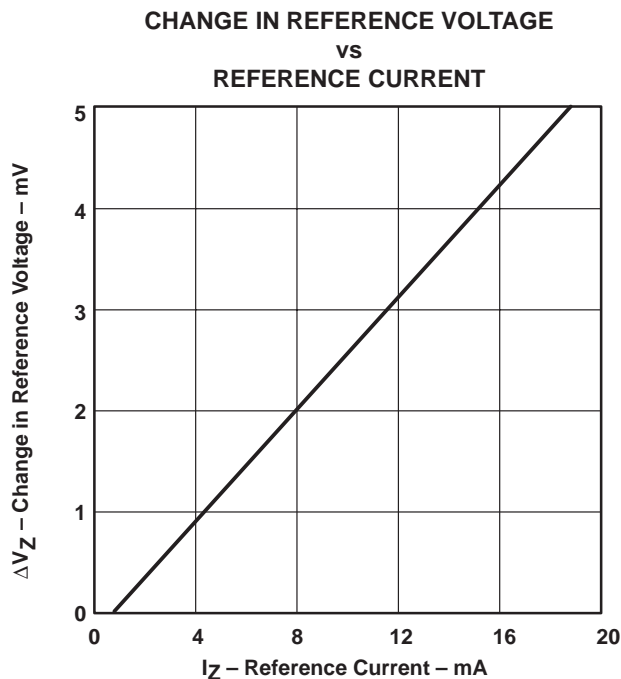


Figure 2

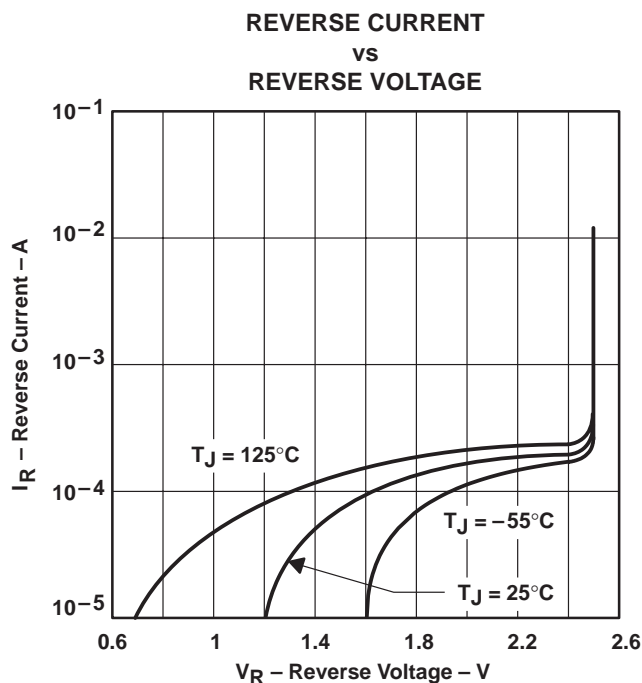


Figure 3

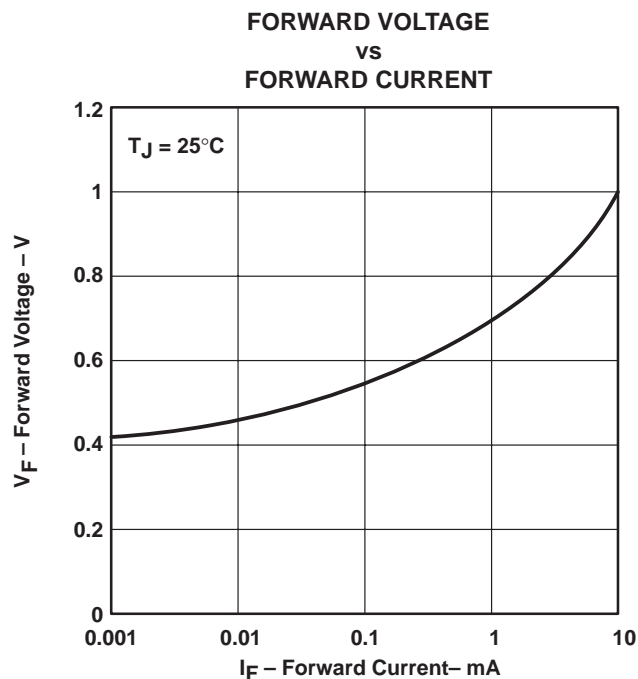


Figure 4

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

TYPICAL CHARACTERISTICS

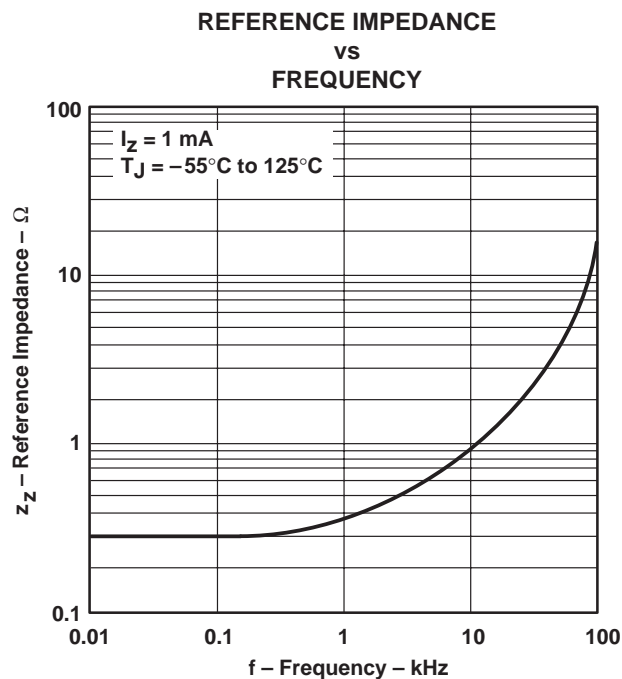


Figure 5

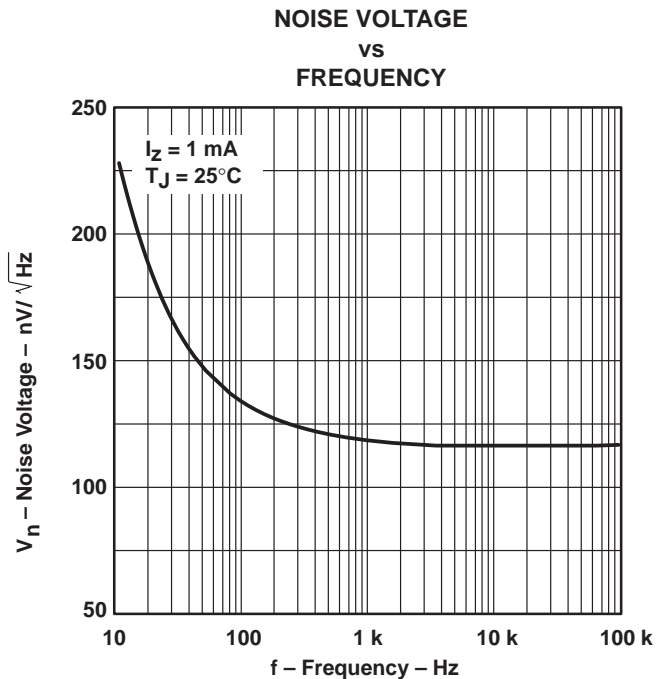


Figure 6

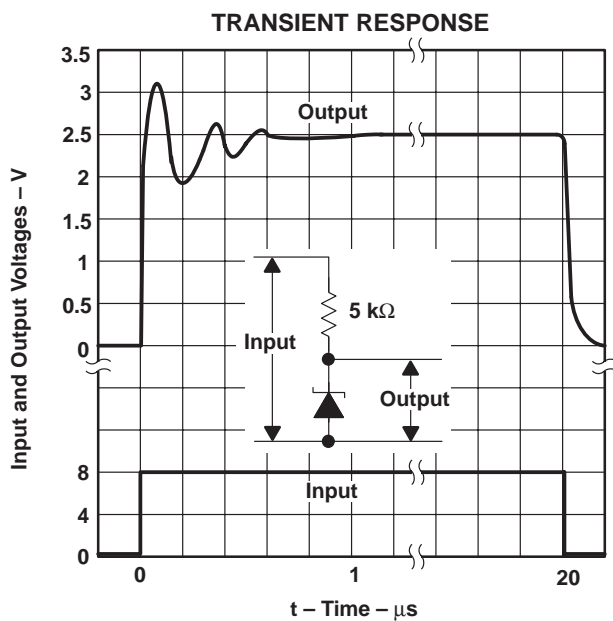


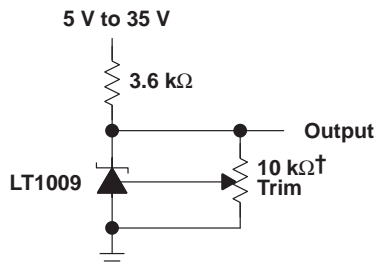
Figure 7

LT1009

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APPLICATION INFORMATION



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

Figure 8. 2.5-V Reference

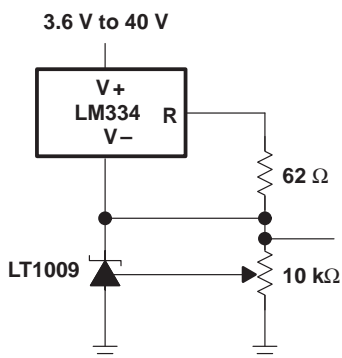


Figure 9. Adjustable Reference With Wide Supply Range

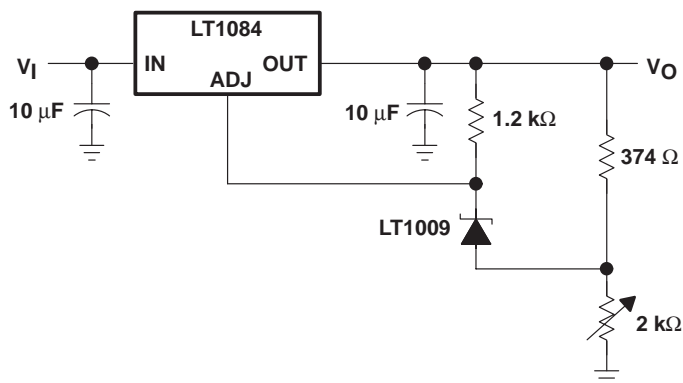


Figure 10. Power Regulator With Low Temperature Coefficient

APPLICATION INFORMATION

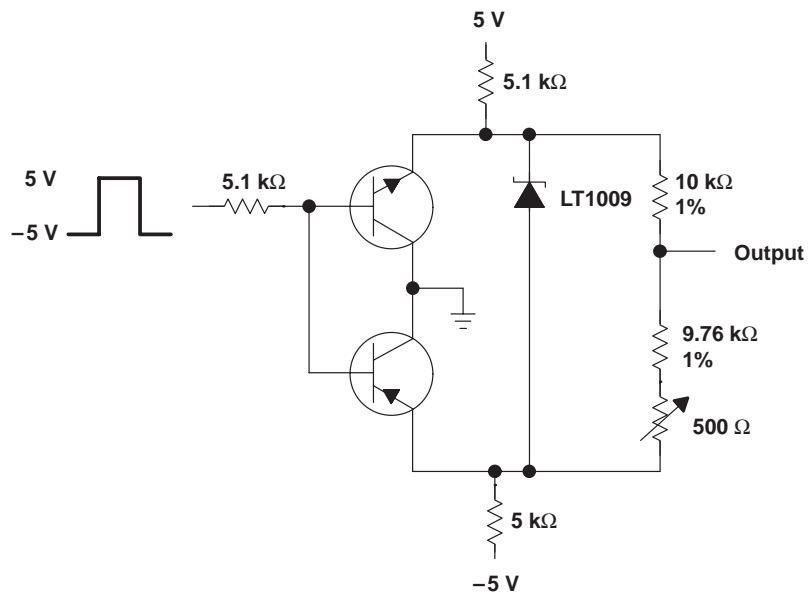


Figure 11. Switchable ± 1.25 -V Bipolar Reference

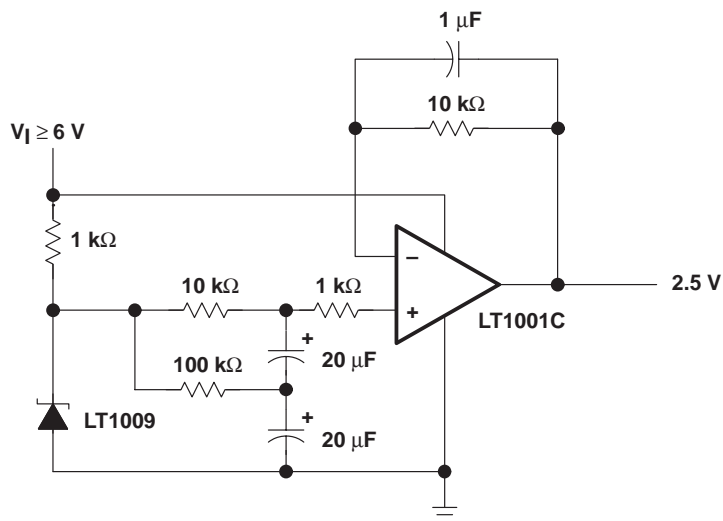


Figure 12. Low-Noise 2.5-V Buffered Reference

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