

- **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**

description

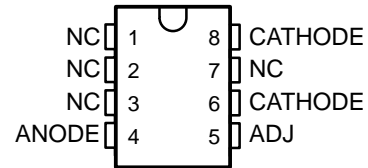
The LT1009 reference circuit is a precision-trimmed 2.5-V shunt regulator featuring low dynamic impedance and a wide operating current range. The maximum initial tolerance is ± 5 mV in the LP package and ± 10 mV in the D package. The reference tolerance is achieved by on-chip trimming, which minimizes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

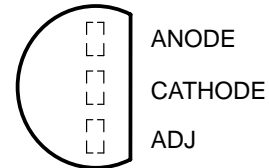
The LT1009C is characterized for operation from 0°C to 70°C. The LT1009I is characterized for operation from –40°C to 85°C.

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



NC—No internal connection

**LP PACKAGE
(TOP VIEW)**

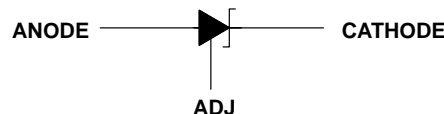


AVAILABLE OPTIONS

T _A	PACKAGE		
	SMALL OUTLINE (D)	PLASTIC CYLINDRICAL (LP)	PLASTIC THIN SHRINK SMALL OUTLINE (PW)
0°C to 70°C	LT1009CD	LT1009CLP	LT1009CPW
–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). The PW package is only available taped and reeled.

symbol



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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**

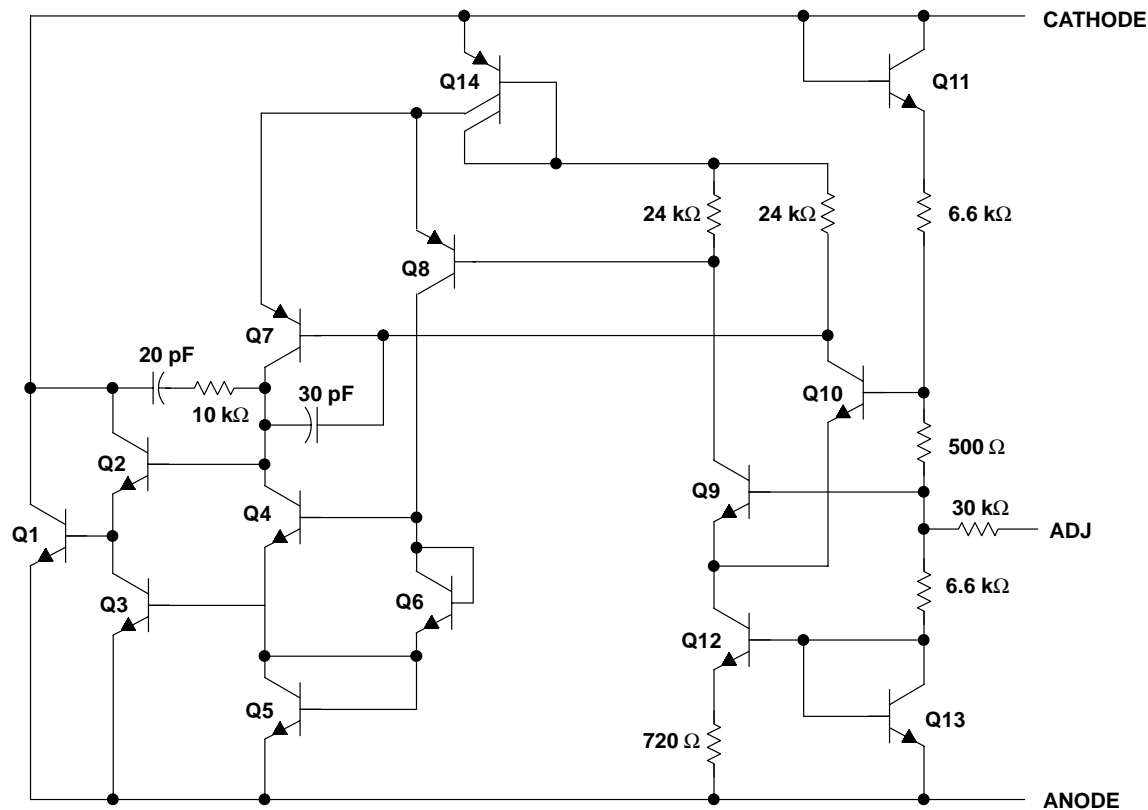
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LT1009
2.5-V INTEGRATED REFERENCE CIRCUIT

SLVS013H – MAY 1987 – REVISED MARCH 2002

schematic



All component values shown are nominal.

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

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
PW package	149°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 51-7

recommended operating conditions

		MIN	MAX	UNIT
T_A Operating free-air temperature range	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	$I_Z = 1\text{ mA}$	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	
α_{VZ} 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	$I_Z = 400\text{ }\mu\text{A to } 10\text{ mA}$		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	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.

LT1009

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TYPICAL CHARACTERISTICS†

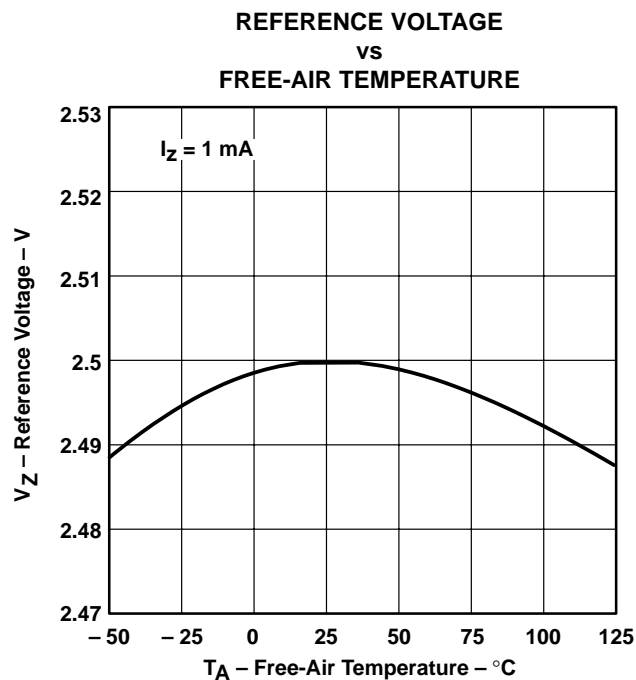


Figure 1

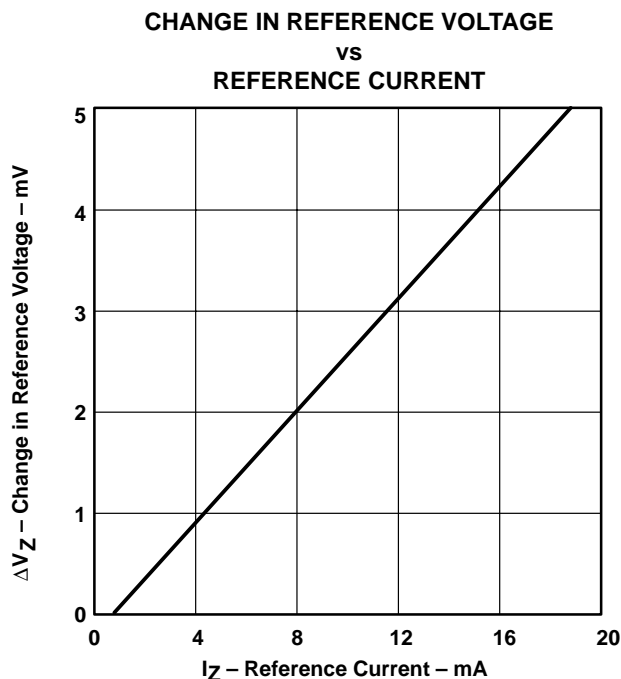


Figure 2

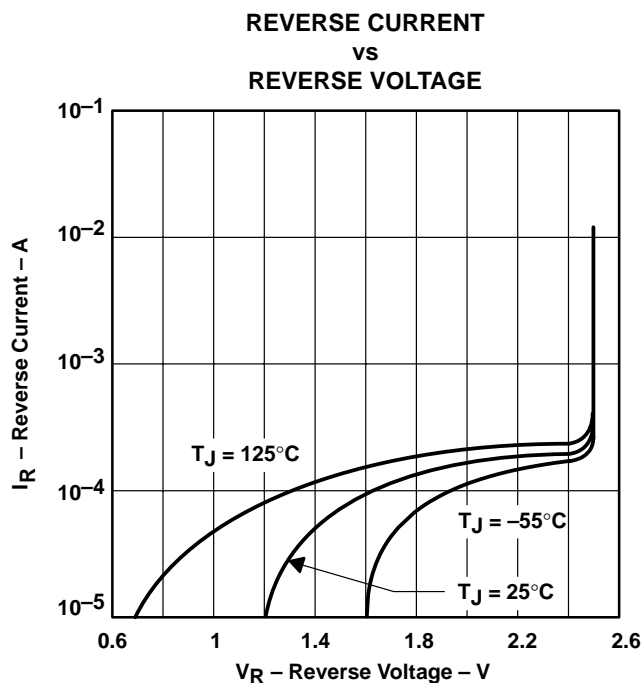


Figure 3

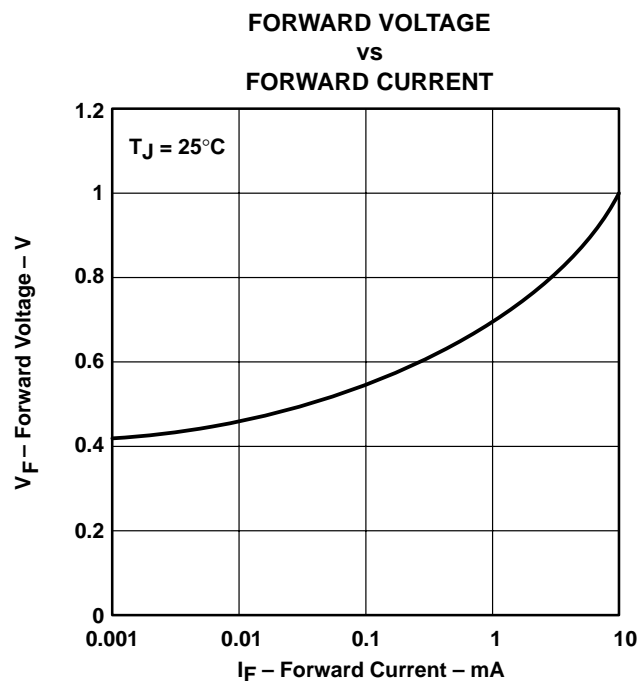


Figure 4

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

TYPICAL CHARACTERISTICS

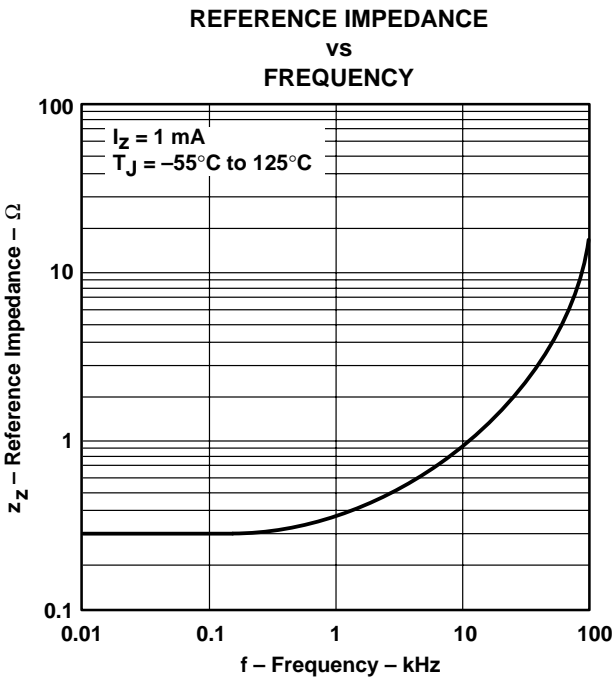


Figure 5

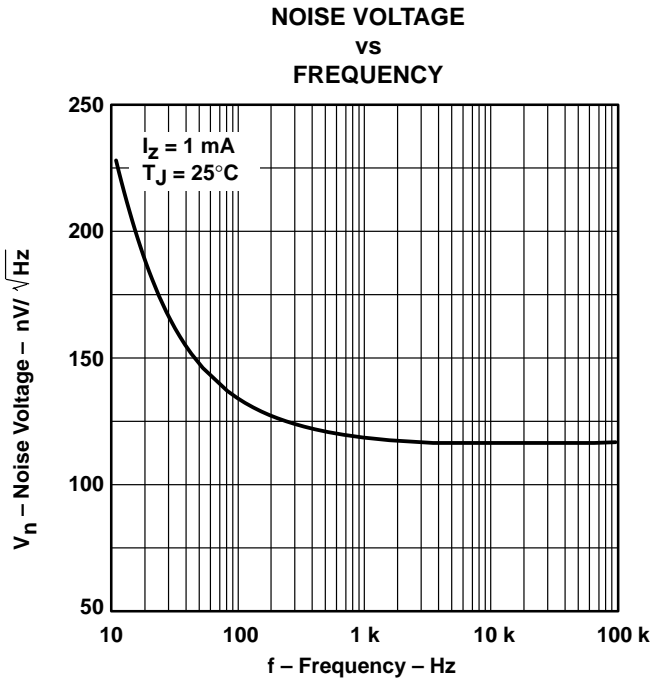


Figure 6

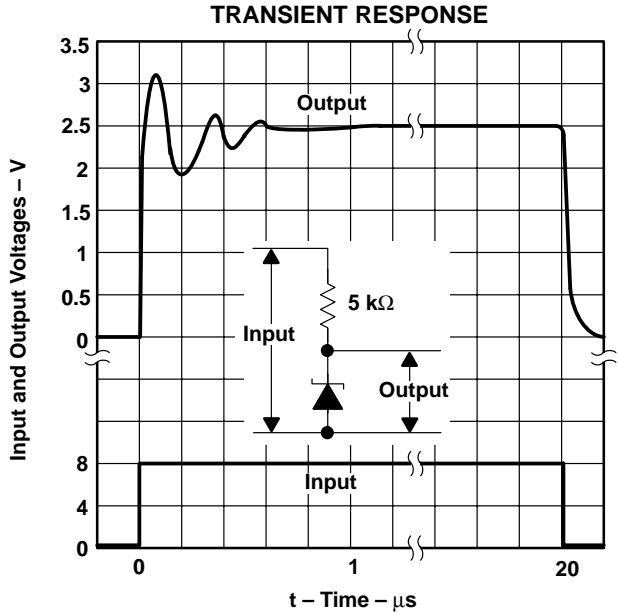


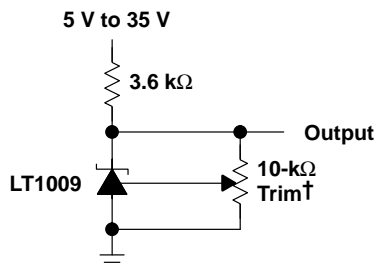
Figure 7

LT1009

2.5-V INTEGRATED REFERENCE CIRCUIT

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APPLICATION INFORMATION



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

Figure 8. 2.5-V Reference

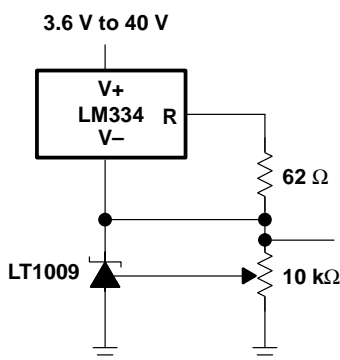


Figure 9. Adjustable Reference With Wide Supply Range

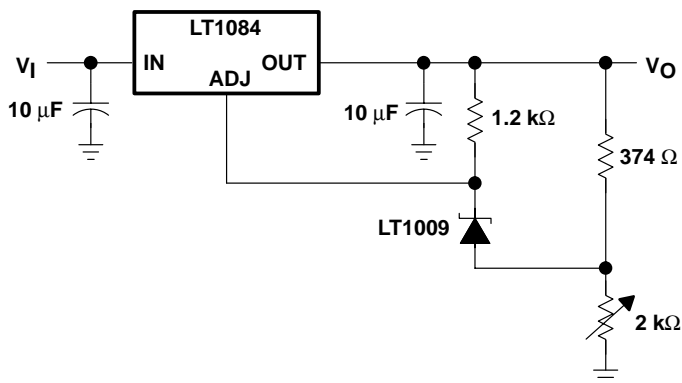


Figure 10. Power Regulator With Low Temperature Coefficient

APPLICATION INFORMATION

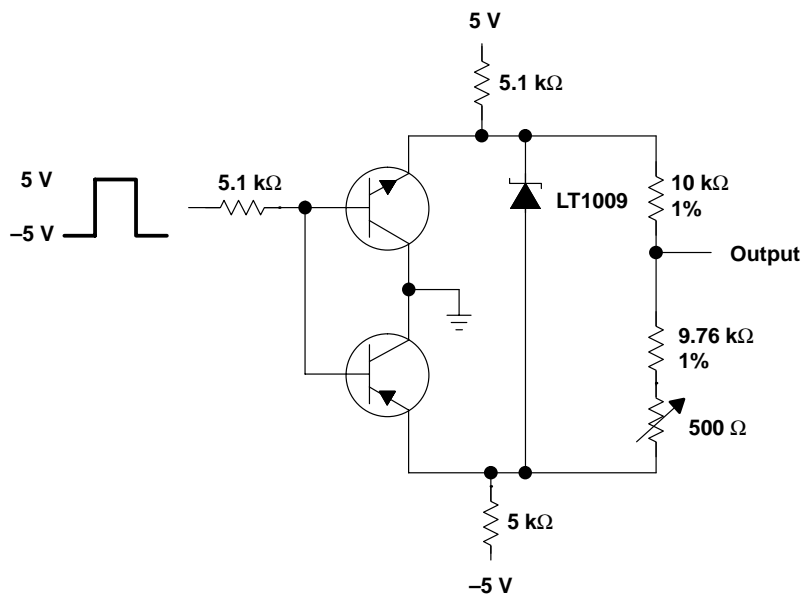


Figure 11. Switchable ± 1.25 -V Bipolar Reference

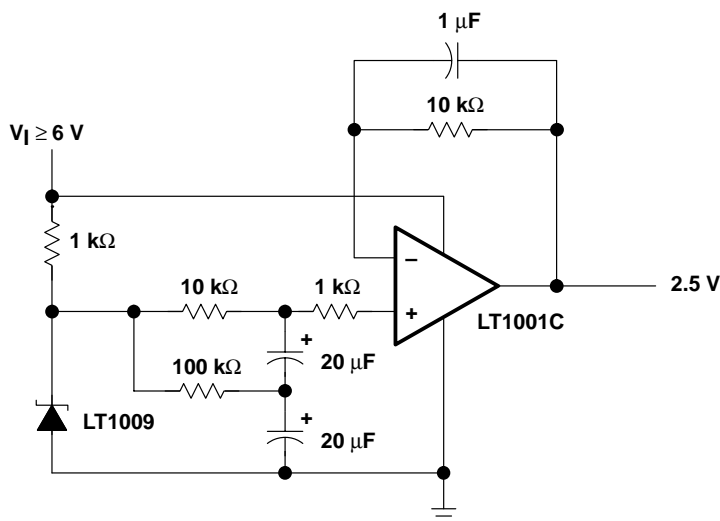


Figure 12. Low-Noise 2.5-V Buffered Reference

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