- **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 3-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. A maximum initial tolerance of ±5 mV is available in the FK, JG, or LP package and ±10 mV in the D or PK package. The reference tolerance is achieved by on-chip trimming, which minimizes the initial voltage tolerance and the temperature coefficient α_{VZ}.

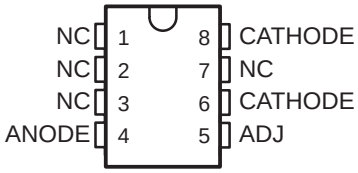
Even though the LT1009 needs no adjustments, a third terminal (ADJ) allows the reference voltage to be adjusted ±5% to eliminate system errors. In many applications, the LT1009 can be used as a terminal-for-terminal replacement for the LM136-2.5, which eliminates the external trim network.

The uses of the LT1009 include a 5-V system reference, an 8-bit ADC and DAC reference, and a power supply monitor. The LT1009 can also be used in applications such as digital voltmeters and current-loop measurement and control systems.

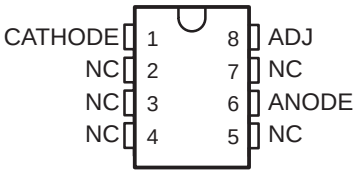
The LT1009C is characterized for operation from 0°C to 70°C. The LT1009I is characterized for operation from –40°C to 85°C. The LT1009M is characterized for operation over the full military temperature range of –55°C to 125°C.

logic symbol

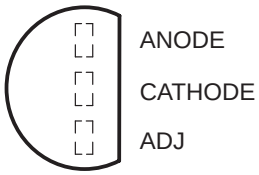
D PACKAGE
(TOP VIEW)



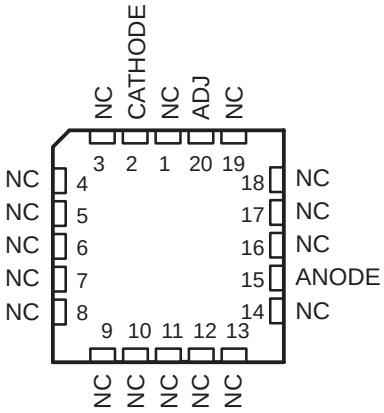
JG PACKAGE
(TOP VIEW)



LP PACKAGE
(TOP VIEW)

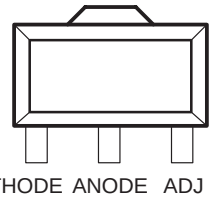


FK PACKAGE
(TOP VIEW)

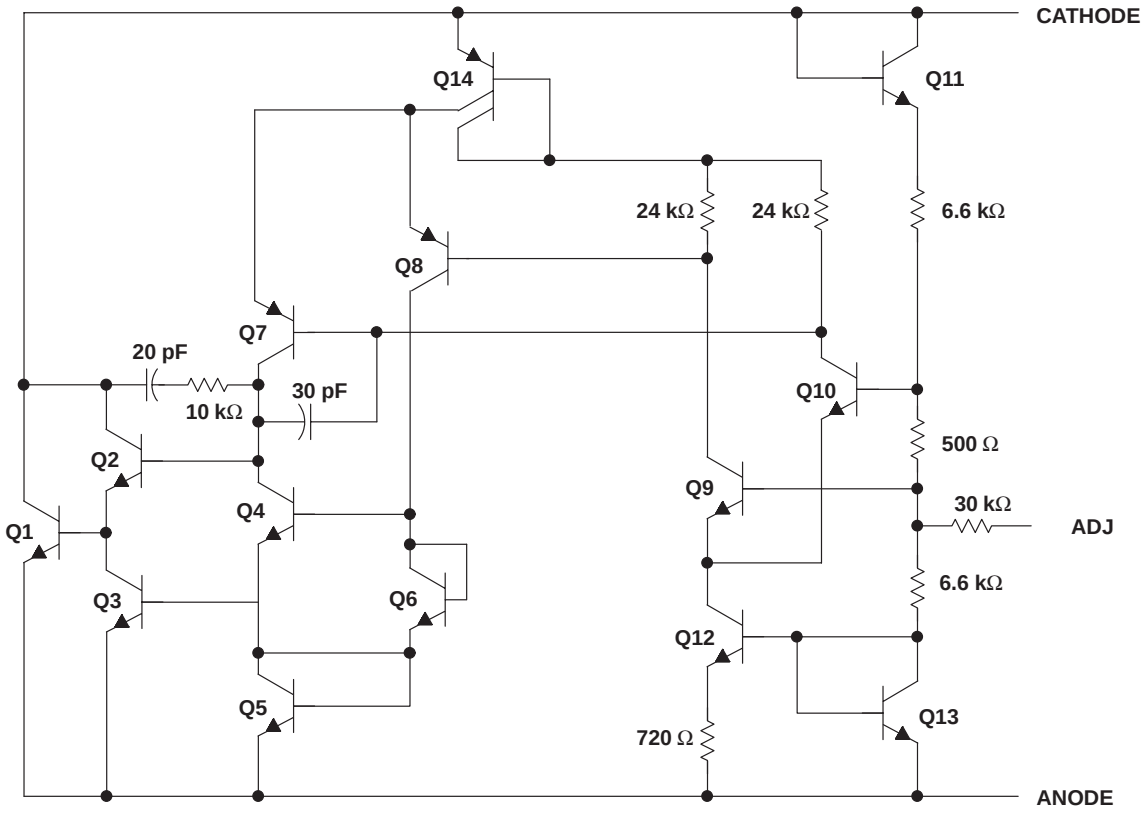


NC – No internal connection

PK PACKAGE
(TOP VIEW)



schematic



All component values shown are nominal.

AVAILABLE OPTIONS

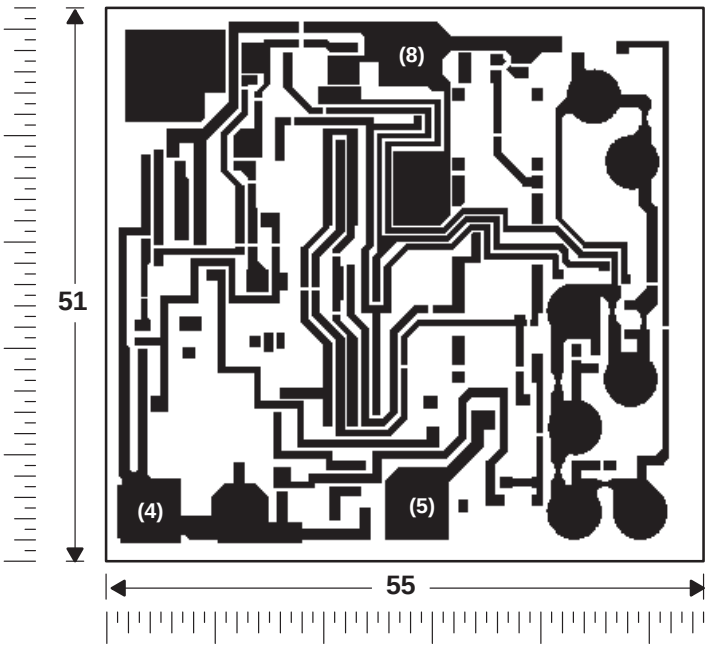
T_A	PACKAGED DEVICES					CHIP FORM (Y)
	SMALL OUTLINE (D)	CHIP CARRIER (FK)	CERAMIC DIP (JG)	PLASTIC CYLINDRICAL (LP)	PLASTIC LEAD-MOUNT (PK)	
0°C to 70°C	LT1009CD	—	—	LT1009CLP	LT1009CPK	LT1009Y
–40°C to 85°C	LT1009ID	—	—	LT1009ILP	—	
–55°C to 125°C	—	LT1009MFK	LT1009MJG	—	—	

The D and LP packages are available taped and reeled. Add R suffix to device type (e.g., LT1009CDR). PK device is only available taped and reeled. No R suffix is required.

LT1009Y chip information

This chip, when properly assembled, displays characteristics similar to the LT1009C (see electrical tables). Thermal compression or ultrasonic bonding may be used on the doped aluminum bonding pads. The chip may be mounted with conductive epoxy or a gold-silicon preform.

BONDING PAD ASSIGNMENTS



CHIP THICKNESS:
15 MILS TYPICAL

BONDING PADS:
4 × 4 MILS MINIMUM

$T_J$max = 150°C

TOLERANCES ARE ±10%.

ALL DIMENSIONS ARE IN MILS.

absolute maximum ratings over operating free-air temperature range†

Reverse current, I_R	20 mA
Forward current, I_F	10 mA
Continuous total power dissipation	See Dissipation Rating Tables 1 and 2
Operating free-air temperature range, T_A: LT1009C	0°C to 70°C
LT1009I	–40°C to 85°C
LT1009M	–55°C to 125°C
Storage temperature range, T_{stg}	–65°C to 150°C
Case temperature for 60 seconds, T_C: FK package	260°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds: D, LP, and PK packages	260°C
Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds: JG package	300°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.

DISSIPATION RATING TABLE 1 – FREE-AIR TEMPERATURE

PACKAGE	$T_A \le 25°C$ POWER RATING	DERATING FACTOR ABOVE $T_A = 25°C$	$T_A = 70°C$ POWER RATING	$T_A = 85°C$ POWER RATING	$T_A = 125°C$ POWER RATING
D	725 mW	5.8 mW/°C	464 mW	377 mW	—
FK	1375 mW	11.0 mW/°C	880 mW	715 mW	275 mW
JG	1050 mW	8.4 mW/°C	672 mW	546 mW	210 mW
LP	775 mW	6.2 mW/°C	496 mW	403 mW	—
PK	500 mW	4.0 mW/°C	320 mW	—	—

DISSIPATION RATING TABLE 2 – CASE TEMPERATURE

PACKAGE	$T_C \le 25°C$ POWER RATING	DERATING FACTOR ABOVE $T_C = 25°C$	$T_C = 70°C$ POWER RATING
PK	3125 mW	25 mW/°C	2000 mW

electrical characteristics at specified free-air temperature

PARAMETER		TEST CONDITIONS		T_A†	LT1009C			LT1009I			LT1009M			UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
V_Z	Reference voltage	I_Z = 1 mA	FK, JG, LP package	25°C	2.495	2.5	2.505	2.495	2.5	2.505	2.495	2.5	2.505	V
			D, PK package		2.49	2.5	2.51	2.49	2.5	2.51				
			FK, JG, LP package	Full range	2.491		2.509	2.48		2.52	2.46		2.535	
			D, PK package		2.485		2.515	2.475		2.525				
V_F	Forward voltage	I_F = 2 mA		25°C	0.4		1	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			15			
$\Delta V_{Z(temp)}$	Change in reference voltage with temperature		FK, JG, LP package	Full range			4			15			15*	mV
			D, PK package				5			15				
α_{VZ}	Average temperature coefficient of reference voltage‡			0°C to 70°C		15	25							ppm/°C
				–40°C to 85°C					20					
				–55°C to 125°C								25	35	
ΔV_Z	Change in reference voltage with current	I_Z = 400 µA to 10 mA		25°C		2.6	10		2.6	6		2.6	6	mV
				Full range			12			10			10	
$\Delta V_Z/\Delta t$	Long-term change in reference voltage	I_Z = 1 mA		25°C		20			20			20		ppm/khr
z_z	Reference impedance	I_Z = 1 mA		25°C		0.3	1		0.3	1		0.3	0.6*	Ω
				Full range			1.4			1.4			1*	

* On products compliant to MIL-STD-883, Class B, this parameter is not production tested.
† Full range is 0°C to 70°C for the LT1009C, –40°C to 85°C for the LT1009I, and –55°C to 125°C for the LT1009M.
‡ The average temperature coefficient of reference voltage is defined as the total change in reference voltage divided by the specified temperature range.

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electrical characteristics at T_A = 25°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			
$\Delta V_{Z(temp)}$	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
$\Delta V_Z/\Delta t$	Long-term change in reference voltage	I_Z = 1 mA		20		ppm/khr
z_z	Reference impedance	I_Z = 1 mA		0.3	1	Ω

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

TYPICAL CHARACTERISTICS†

REFERENCE VOLTAGE vs FREE-AIR TEMPERATURE

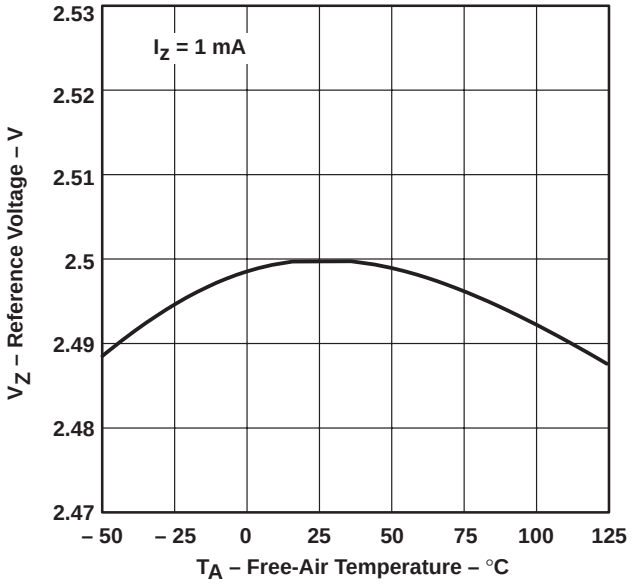


Figure 1

CHANGE IN REFERENCE VOLTAGE vs REFERENCE CURRENT

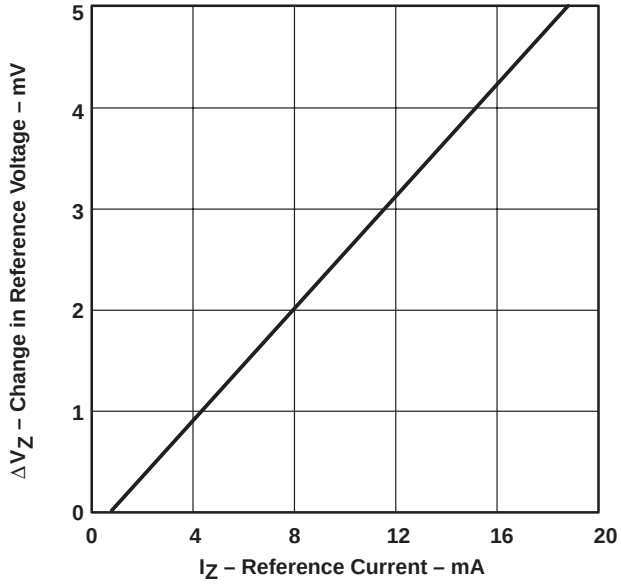


Figure 2

REVERSE CURRENT vs REVERSE VOLTAGE

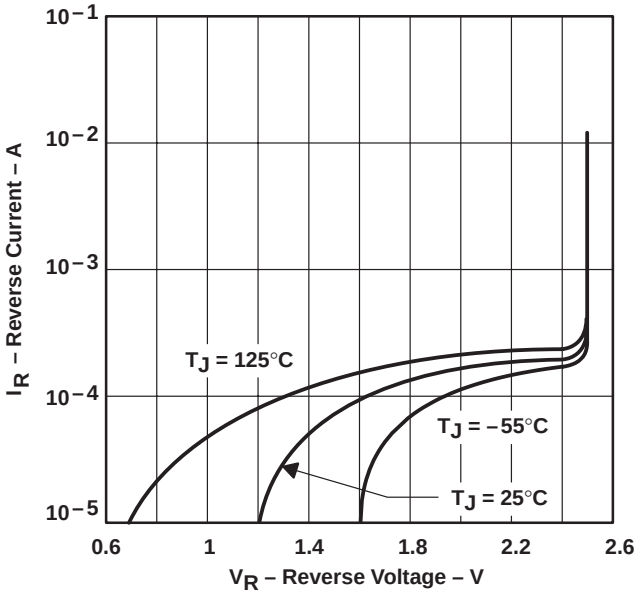


Figure 3

FORWARD VOLTAGE vs FORWARD CURRENT

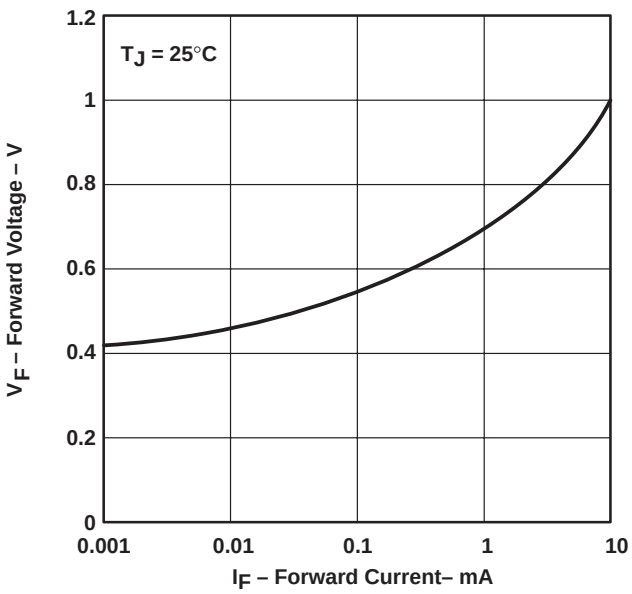


Figure 4

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

TYPICAL CHARACTERISTICS

REFERENCE IMPEDANCE vs FREQUENCY

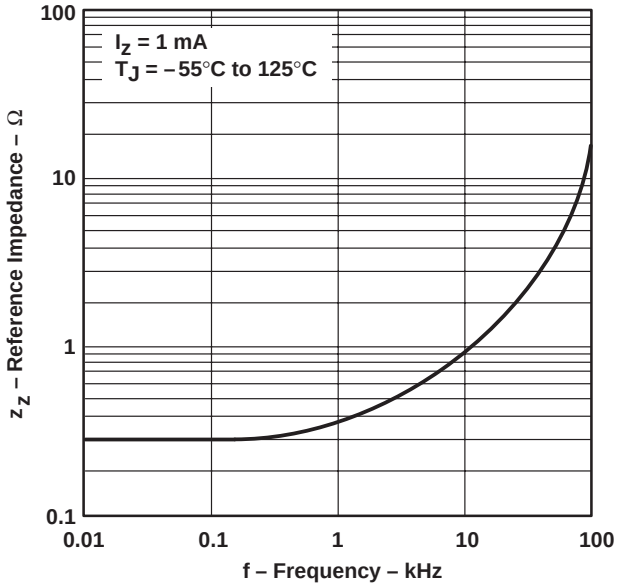


Figure 5

NOISE VOLTAGE vs FREQUENCY

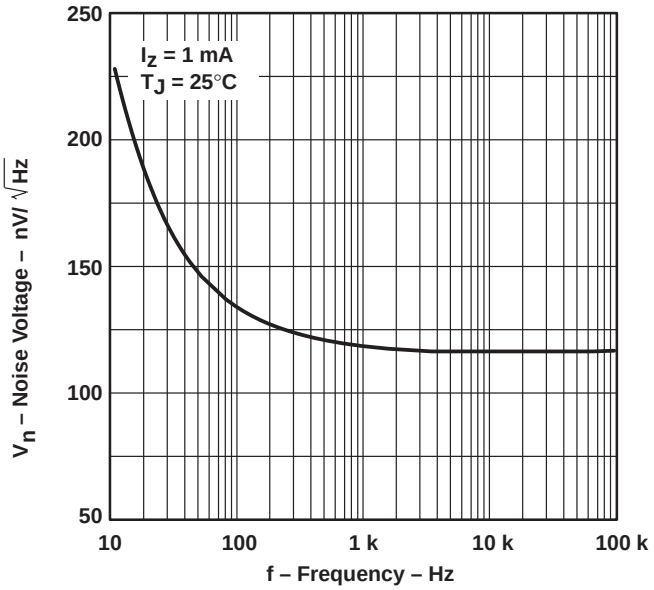


Figure 6

TRANSIENT RESPONSE

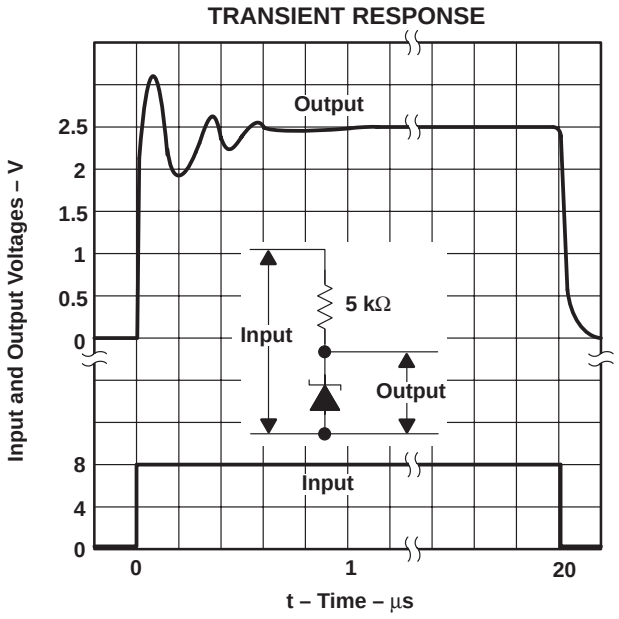
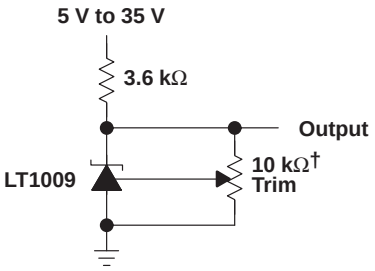


Figure 7

APPLICATION INFORMATION



†This does not affect temperature coefficient. It provides ±5% trim range.

Figure 8. 2.5-V Reference

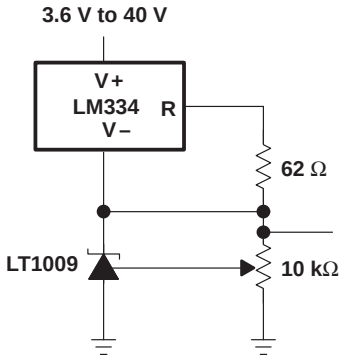


Figure 9. Adjustable Reference With Wide Supply Range

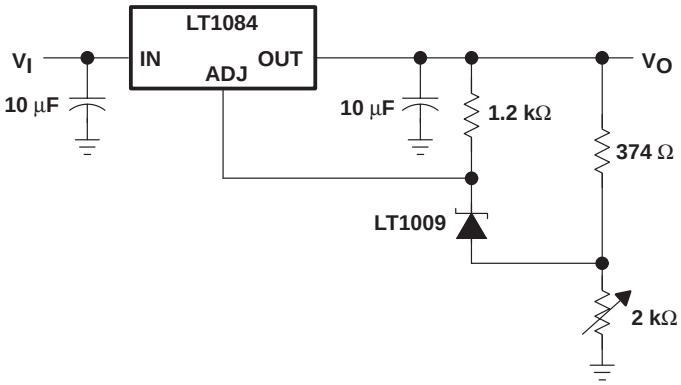


Figure 10. Power Regulator With Low Temperature Coefficient

APPLICATION INFORMATION

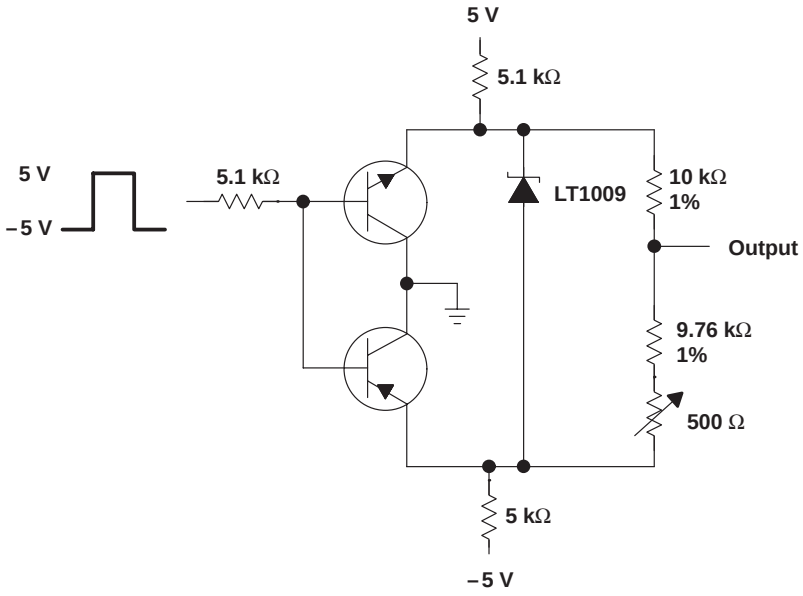


Figure 11. Switchable ±1.25-V Bipolar Reference

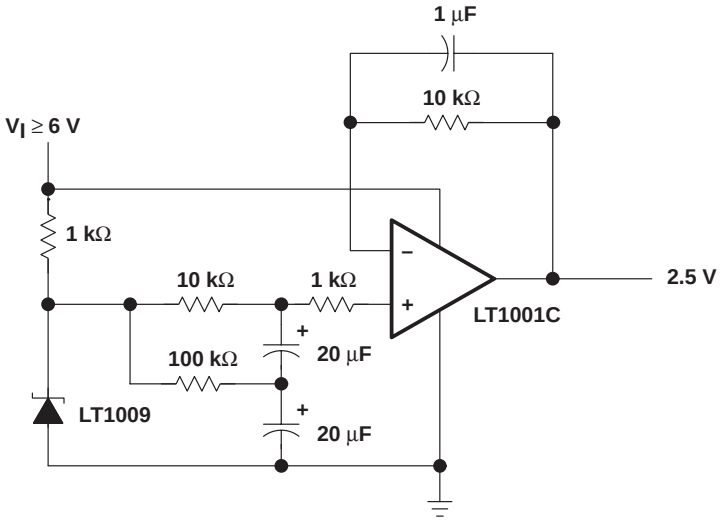


Figure 12. Low-Noise 2.5-V Buffered Reference

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