

PROBLEMAS PROPUESTOS TEMA 2: SENsoRES RESISTIVOS

Problema P.2.10

En una aplicación de medida de temperatura se desea utilizar una RTD de platino. Como la temperatura a medir se encuentra en el entorno de los 100°C, se prefiere utilizar la relación $R(T) = R_{100} (1 + \alpha_{100} * \Delta T)$, con $\Delta T = T - 100^\circ\text{C}$. ¿Cuál será el valor de α_{100} ?

Datos: $R_0 = 100 \Omega$; $\alpha_0 = 0,00385 \Omega/\Omega/\text{K}$.

Problema P.2.11 (Ejercicio de examen, febrero 2007)

Un sensor resistivo de temperatura (RTD) de platino tipo PT1000 tiene un coeficiente de temperatura $\alpha = 0,00385^\circ\text{C}^{-1}$. Si se une al circuito de acondicionamiento mediante dos hilos de cobre de 20 metros cada uno, que presentan una resistencia de 45 mΩ/m, calcular el error en la medida que se produce si el sensor se encuentra a 40 °C.

Indique alguna forma para evitar dicho error.

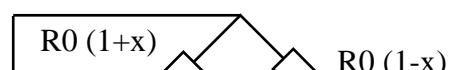
Problema P.2.12 (Ejercicio de examen, junio 2006)

Si colocamos una resistencia fija en paralelo con un sensor NTC, logramos una variación más lineal de la resistencia del conjunto a costa de una menor sensibilidad. A este proceso lo denominamos "linealización de una NTC". Sin embargo, la respuesta no es totalmente lineal. En la siguiente tabla tenemos los valores de resistencia para distintas temperaturas de un conjunto formado por un sensor NTC Philips de temperatura característica 3528 °K y resistencia de reposo de 1kΩ y un resistor fijo de valor 403Ω. Calcule el error de linealidad, entendido como la máxima discrepancia en la magnitud de entrada entre la respuesta real y la recta que pasa por los puntos extremos de dicha respuesta que producen la misma salida, expresada como porcentaje del fondo de escala de la magnitud de entrada. Indique la sensibilidad del conjunto, tomando como base para el cálculo la recta hallada.

Temperatura [°C]	20	25	30	35	40	45	50	55	60
Resistencia total [Ω]	303,2	287,2	270,5	253,2	235,6	218,0	200,7	184,0	168

Problema P.2.13

Una célula de carga tiene 4 galgas montadas sobre un soporte de acero. conectadas tal y como se muestran en la



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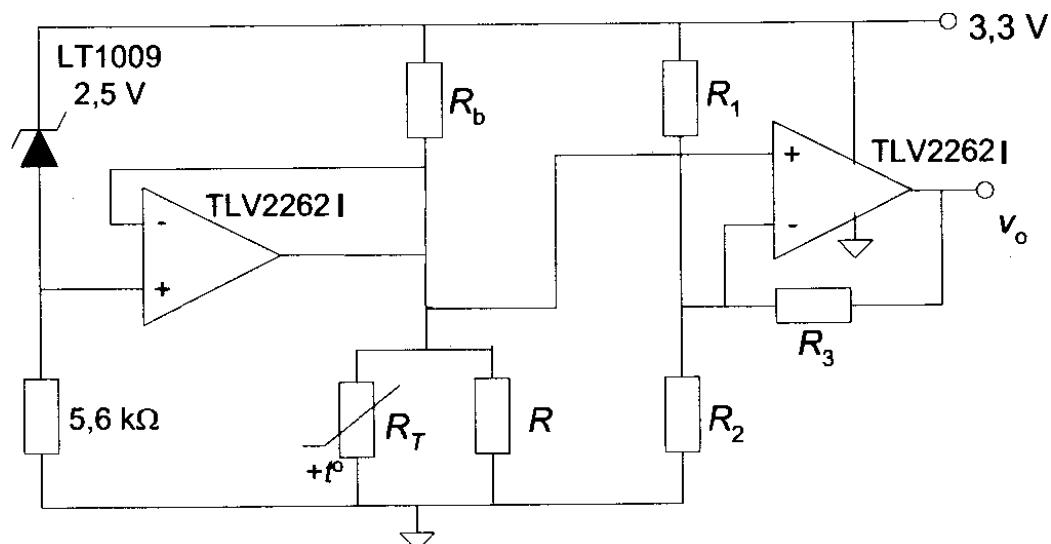
Problema P.2.14

El circuito de la figura representa un termómetro. Utiliza como sensor una PTC de silicio, que se linealiza mediante una resistencia R en paralelo y alimentando el conjunto a corriente constante con la ayuda de una referencia de tensión LT1009. Para que el autocalentamiento provoque un error despreciable, se limita la corriente a través del sensor a $400\mu\text{A}$. Calcule:

- El valor de R para linealizar el sensor entre 0°C y 50°C .
- El valor de R_B para no sobre pasar el autocalentamiento máximo previsto.
- Los valores R_1 , R_2 y R_3 para que la salida sea $0,1\text{V}$ a 0°C y $3,1\text{V}$ a 50°C .
- Si la temperatura ambiente puede llegar hasta los 40°C , calcule el error absoluto debido a la tensión de offset del operacional.

Datos de la PTC: $813,5\Omega$ a 0°C ; 1000Ω a 25°C y 1211Ω a 50°C .

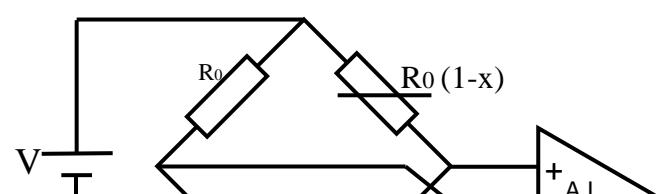
Datos de los integrados: Consultar las hojas de características.



Problema P.2.15

En la figura tenemos un puente con dos sensores en un brazo, cuya salida se amplifica con un amplificador de instrumentación. Calcule:

- La ganancia del amplificador para que la máxima salida sea de 1V .
- El CMRR del amplificador si no se desea



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Problema P.2.16 (Ejercicio de examen, septiembre 2004)

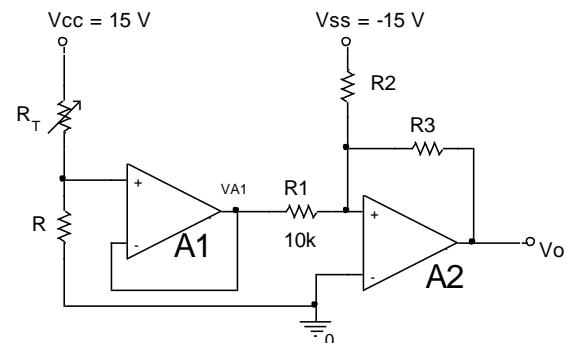
La figura representa un circuito de medida de temperatura. En él se utiliza como sensor una RTD de platino (R_T) tipo PT-100. Su coeficiente de temperatura vale $0'004 \text{ [} (\Omega/\Omega)/\text{ } ^\circ\text{C} \text{]}$, y la potencia máxima que puede disipar es de 30 mW.

Con el diseño pretendemos medir temperaturas entre $0 \text{ } ^\circ\text{C}$ y $100 \text{ } ^\circ\text{C}$, de forma que la tensión de salida V_0 en milivoltios represente directamente el valor de la temperatura medida.

Se pide:

- Hallar la expresión teórica de la tensión de salida del operacional A1 (V_{A1}) en función de la temperatura. ¿Es dicha relación lineal? ¿Por qué?
- Calcular R , atendiendo a las limitaciones de la RTD.
- Calcular los valores de R_2 y R_3 para que la salida del operacional A2 (V_0) cumpla lo indicado en el enunciado.
- A la vista de los resultados de los apartados anteriores, indique la función que realiza cada bloque operacional.
- Realizar una tabla con los valores de R_T , V_{A1} y V_0 en el margen de medida y con un paso de $20 \text{ } ^\circ\text{C}$. Incluir también el valor de tensión idealmente esperado en la salida en cada caso. Calcular para cada temperatura el error absoluto cometido en mV.
- Dibujar la curva que relaciona la temperatura de entrada y la tensión de salida (tanto la real como la idealmente esperada). Obtener el error de no-linealidad del sistema.

NOTA: El error de no linealidad es la máxima desviación de la tensión de salida del circuito respecto a la recta que une los puntos extremos de dicha tensión, expresada en porcentaje del fondo de escala (tensión máxima).



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- Low Noise . . . 12 nV/ $\sqrt{\text{Hz}}$ Typ at $f = 1 \text{ kHz}$
- Low Input Bias Current . . . 1 pA Typ
- Fully Specified for Both Single-Supply and Split-Supply Operation
- Low Power . . . 500 μA Max
- Common-Mode Input Voltage Range Includes Negative Rail

- Low Input Offset Voltage 950 μV Max at $T_A = 25^\circ\text{C}$ (TLV226xA)
- Wide Supply Voltage Range 2.7 V to 8 V
- Macromodel Included
- Available in Q-Temp Automotive HighRel Automotive Applications Configuration Control / Print Support Qualification to Automotive Standards

description

The TLV2262 and TLV2264 are dual and quad low voltage operational amplifiers from Texas Instruments. Both devices exhibit rail-to-rail output performance for increased dynamic range in single or split supply applications. The TLV226x family offers a compromise between the micro-power TLV225x and the ac performance of the TLC227x. It has low supply current for battery-powered applications, while still having adequate ac performance for applications that demand it. This family is fully characterized at 3 V and 5 V and is optimized for low-voltage applications. The noise performance has been dramatically improved over previous generations of CMOS amplifiers. Figure 1 depicts the low level of noise voltage for this CMOS amplifier, which has only 200 μA (typ) of supply current per amplifier.

The TLV226x, exhibiting high input impedance and low noise, are excellent for small-signal conditioning for high-impedance sources, such as piezoelectric transducers. Because of the micro-power dissipation levels combined with 3-V operation, these devices work well in hand-held monitoring and remote-sensing applications. In addition, the rail-to-rail output feature with single or split supplies makes this family a great choice when interfacing with analog-to-digital converters (ADCs). For precision applications, the TLV226xA family is available and has a maximum input offset voltage of 950 μV .

The TLV2262/4 also makes great upgrades to the TLV2332/4 in standard designs. They offer increased output dynamic range, lower noise voltage and lower input offset voltage. This enhanced feature set allows them to be used in a wider range of applications. For applications that require higher output drive and wider input voltage range, see the TLV2432 and TLV2442 devices. If your design requires single amplifiers, please see the TLV2211/21/31 family. These devices are single rail-to-rail operational amplifiers in the SOT-23 package. Their small size and low power consumption make them ideal for high density, battery-powered equipment.

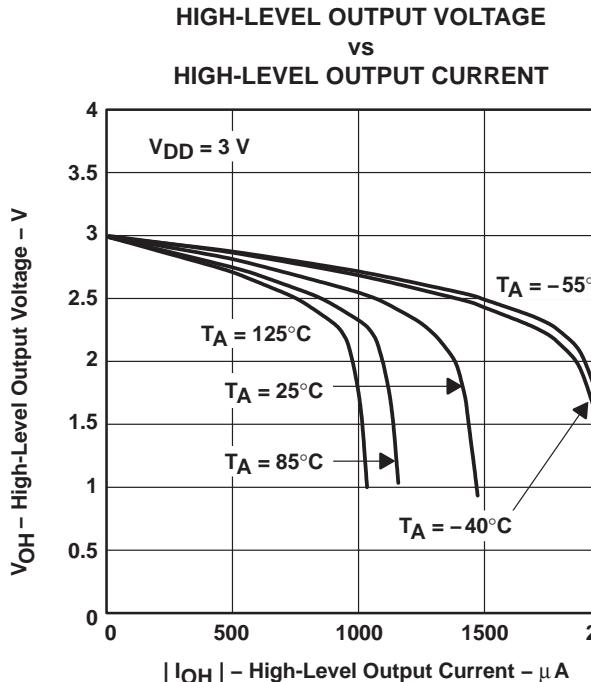


Figure 1

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standard warranty. Production processing does not necessarily include testing of all parameters.

On products compliant to MIL-PRF-38535, all parameters are tested unless otherwise noted. On all other products, production processing does not necessarily include testing of all parameters.



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TLV2262 AVAILABLE OPTIONS

TA	VI _O max AT 25°C	PACKAGED DEVICES					
		SMALL OUTLINE (D)	CHIP CARRIER (FK)	CERAMIC DIP (JG)	PLASTIC DIP (P)	TSSOP (PW)	CERAMIC FLATPACK (U)
0°C to 70°C	2.5 mV	TLV2262CD	—	—	TLV2262CP	TLV2262CPWLE	—
-40°C to 125°C	950 µV 2.5 mV	TLV2262AID TLV2262ID	— —	— —	TLV2262AIP TLV2262IP	TLV2262AIPWLE —	— —
-40°C to 125°C	950 µV 2.5 mV	TLV2262AQD TLV2262QD	— —	— —	— —	— —	— —
-55°C to 125°C	950 µV 2.5 mV	— —	TLV2262AMFK TLV2262MFK	TLV2262AMJG TLV2262MJG	— —	— —	TLV2262AMU TLV2262MU

† The D packages are available taped and reeled. Add R suffix to device type (e.g., TLV2262CDR).

‡ The PW package is available only left-end taped and reeled.

§ Chips are tested at 25°C.

¶ For the most current package and ordering information see the Package Option Addendum at the end of this document, or see the TI web site at www.ti.com.

TLV2264 AVAILABLE OPTIONS

TA	VI _O max AT 25°C	PACKAGED DEVICES					
		SMALL OUTLINE (D)	CHIP CARRIER (FK)	CERAMIC DIP (J)	PLASTIC DIP (N)	TSSOP (PW)	CERAMIC FLATPACK (W)
-40°C to 125°C	950 µV 2.5 mV	TLV2264AID TLV2264ID	— —	— —	TLV2264AIN TLV2264IN	TLV2264AIPWLE —	— —
-40°C to 125°C	950 µV 2.5 mV	TLV2264AQD TLV2264QD	— —	— —	— —	— —	— —
-55°C to 125°C	950 µV 2.5 mV	— —	TLV2264AMFK TLV2264MFK	TLV2264AMJ TLV2264MJ	— —	— —	TLV2264AMW TLV2264MW

† The D packages are available taped and reeled. Add R suffix to device type (e.g., TLV2262IDR).

‡ The PW package is available only left-end taped and reeled.

§ Chips are tested at 25°C.

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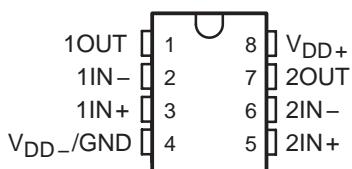


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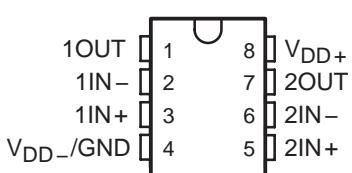
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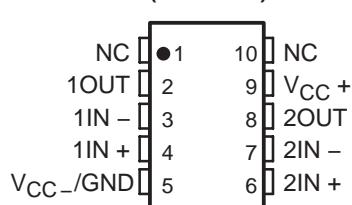
TLV2262C, TLV2262AC
 TLV2262I, TLV2262AI
 TLV2262Q, TLV2262AQ
 D, P, OR PW PACKAGE
 (TOP VIEW)



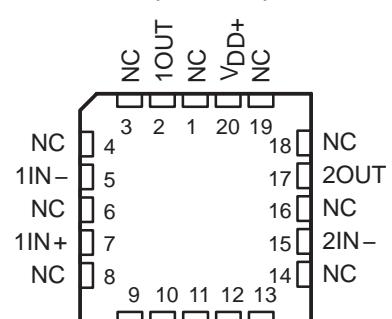
TLV2262M, TLV2262AM
 JG PACKAGE
 (TOP VIEW)



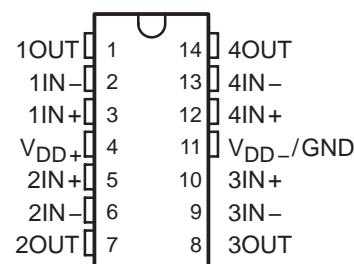
TLV2662M, TLV2262AM
 U PACKAGE
 (TOP VIEW)



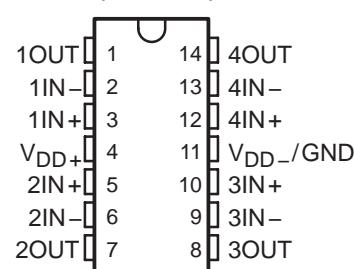
TLV2262M, TLV2262AM
 FK PACKAGE
 (TOP VIEW)



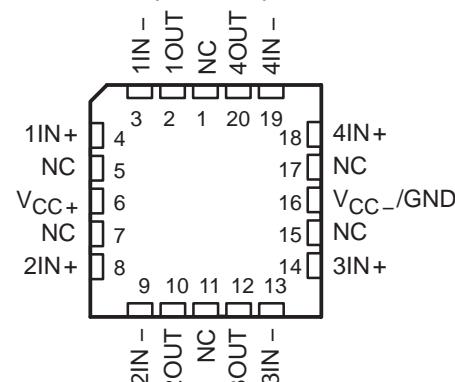
TLV2264I, TLV2264AI
 TLV2264Q, TLV2264AQ
 D, N, OR PW PACKAGE
 (TOP VIEW)



TLV2264M, TLV2264AM
 J OR W PACKAGE
 (TOP VIEW)



TLV2264M, TLV2264AM
 FK PACKAGE
 (TOP VIEW)



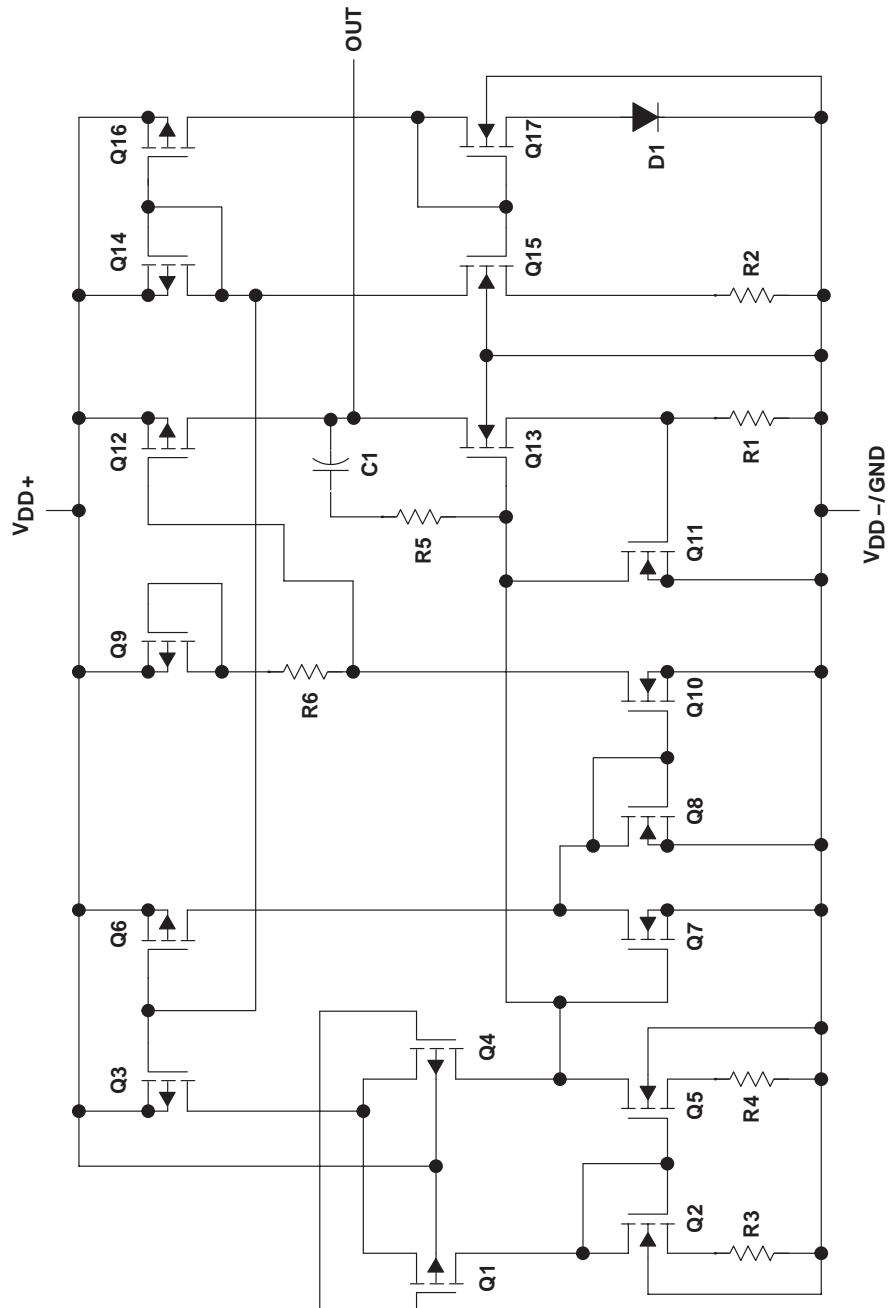
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ACTUAL DEVICE COMPONENT COUNT†		
COMPONENT	TLV2252	TLV2254
Transistors	38	76
Resistors	28	54
Diodes	9	18
Capacitors	3	6

† Includes both amplifiers and all ESD, bias, and trim circuitry

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

Supply voltage, V_{DD} (see Note 1)	.....	16 V
Differential input voltage, V_{ID} (see Note 2)	.....	$\pm V_{DD}$
Input voltage range, V_I (any input, see Note 1)	.....	$V_{DD} - 0.3$ V to $V_{DD} +$
Input current, I_I (each input)	± 5 mA
Output current, I_O	± 50 mA
Total current into V_{DD+}	± 50 mA
Total current out of V_{DD-}	± 50 mA
Duration of short-circuit current (at or below) 25°C (see Note 3)	.....	unlimited
Continuous total power dissipation	.....	See Dissipation Rating Table
Operating free-air temperature range, T_A :	I suffix	-40°C to 125°C
	Q suffix	-40°C to 125°C
	M suffix	-55°C to 125°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. All voltage values, except differential voltages, are with respect to V_{DD-} .
 2. Differential voltages are at the noninverting input with respect to the inverting input. Excessive current flows when input is brought below $V_{DD-} - 0.3$ V.
 3. The output may be shorted to either supply. Temperature and/or supply voltages must be limited to ensure that the maximum dissipation rating is not exceeded.

DISSIPATION RATING TABLE

PACKAGE	$T_A \leq 25^\circ\text{C}$ POWER RATING	DERATING FACTOR ABOVE $T_A = 25^\circ\text{C}$	$T_A = 85^\circ\text{C}$ POWER RATING	$T_A = 125^\circ\text{C}$ POWER RATING
D-8	725 mW	5.8 mW/°C	377 mW	145 mW
D-14	950 mW	7.6 mW/°C	494 mW	190 mW
FK	1375 mW	11.0 mW/°C	715 mW	275 mW
J	1375 mW	11.0 mW/°C	715 mW	275 mW
JG	1050 mW	8.4 mW/°C	—	210 mW
N	1150 mW	9.2 mW/°C	598 mW	—
P	1000 mW	8.0 mW/°C	520 mW	200 mW
PW-8	525 mW	4.2 mW/°C	273 mW	105 mW
PW-14	700 mW	5.6 mW/°C	364 mW	—
U	700 mW	5.5 mW/°C	—	150 mW
W	700 mW	5.5 mW/°C	370 mW	150 mW

recommended operating conditions

	I SUFFIX		Q SUFFIX		M SUFFIX		UNIT
	MIN	MAX	MIN	MAX	MIN	MAX	
Supply voltage, $V_{DD\pm}$ (see Note 1)	2.7	8	2.7	8	2.7	8	V
Input voltage range, V_I	V_{DD-}	$V_{DD+} - 1.3$	V_{DD-}	$V_{DD+} - 1.3$	V_{DD-}	$V_{DD+} - 1.3$	V

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TLV2262I electrical characteristics at specified free-air temperature, $V_{DD} = 3\text{ V}$ (unless otherwise noted)

PARAMETER	TEST CONDITIONS	T_A^\dagger	TLV2262I			TLV2262AI			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX		
V_{IO} Input offset voltage	$V_{DD} \pm 1.5\text{ V}, V_{IC} = 0, V_O = 0, R_S = 50\Omega$	25°C	300	2500		300	950		μV	
		Full range		3000			1500			
		25°C to 85°C		2		2			$\mu\text{V}/^\circ\text{C}$	
		25°C		0.003		0.003			$\mu\text{V}/\text{mo}$	
		25°C	0.5	60		0.5	60		pA	
		85°C		150		150				
		Full range		800		800				
		25°C	1	60		1	60		pA	
		85°C		150		150				
I_{IO} Input offset current		Full range		800		800				
I_{IB} Input bias current		25°C	0	-0.3		0	-0.3		V	
		to	to			to	to			
		2	2.2			2	2.2		V	
		Full range	0			0				
			to			to				
			1.7			1.7				
		25°C		2.99		2.99			V	
		25°C		2.85		2.85				
V_{OH} High-level output voltage		Full range		2.825		2.825				
		25°C		2.7		2.7				
		Full range		2.65		2.65				
V_{OL} Low-level output voltage		$V_{IC} = 1.5\text{ V}, I_{OL} = 50\mu\text{A}$	25°C		10		10		mV	
		$V_{IC} = 1.5\text{ V}, I_{OL} = 500\mu\text{A}$	25°C		100		100			
		Full range			150		150			
		$V_{IC} = 1.5\text{ V}, I_{OL} = 1\text{ mA}$	25°C		200		200			
		Full range			300		300		mV	
		$V_{IC} = 1.5\text{ V}, V_O = 1\text{ V to }2\text{ V}$	25°C	60	100		60	100		
		$R_L = 50\text{ k}\Omega^\ddagger$	Full range	30			30			
		$R_L = 1\text{ M}\Omega^\ddagger$	25°C		100		100			
$r_{i(d)}$ Differential input resistance			25°C		10 ¹²		10 ¹²		Ω	
			25°C		10 ¹²		10 ¹²		Ω	
$r_{i(c)}$ Common-mode input resistance			25°C		10 ¹²		10 ¹²		Ω	
			25°C		10 ¹²		10 ¹²		Ω	
$C_{i(c)}$ Common-mode input capacitance	$f = 10\text{ kHz}, \text{P package}$		25°C		8		8		pF	
			25°C		270		270		Ω	
Z_O Closed-loop output impedance	$f = 100\text{ kHz}, A_V = 10$		25°C	65	75		65	77	Ω	
			25°C						Ω	
V_{DDP} Common-mode	$V_{IC} = 0\text{ to }1.7\text{ V},$		25°C						Ω	
			25°C						Ω	

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TLV2262I electrical characteristics at specified free-air temperature, $V_{DD} = 3\text{ V}$ (unless otherwise noted) (continued)

PARAMETER	TEST CONDITIONS	T_A^\dagger	TLV2262I			TLV2262AI			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
I_{DD} Supply current	$V_O = 1.5\text{ V}$, No load	25°C	400	500	400	500	400	500	μA
		Full range			500			500	

[†] Full range is –40°C to 125°C.

TLV2262I operating characteristics at specified free-air temperature, $V_{DD} = 3\text{ V}$

PARAMETER	TEST CONDITIONS	T_A^\dagger	TLV2262I			TLV2262AI			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
SR Slew rate at unity gain	$V_O = 1.1\text{ V}$ to 1.9 V , $R_L = 50\text{ k}\Omega^\ddagger$, $C_L = 100\text{ pF}^\ddagger$	25°C	0.35	0.55	0.35	0.55			$\text{V}/\mu\text{s}$
		Full range	0.3			0.3			
V_n Equivalent input noise voltage	$f = 10\text{ Hz}$	25°C	43		43				$\text{nV}/\sqrt{\text{Hz}}$
	$f = 1\text{ kHz}$	25°C	12		12				
$V_{N(PP)}$ Peak-to-peak equivalent input noise voltage	$f = 0.1\text{ Hz}$ to 1 Hz	25°C	0.6		0.6				μV
	$f = 0.1\text{ Hz}$ to 10 Hz	25°C	1		1				
I_n Equivalent input noise current		25°C	0.6		0.6				$\text{fA}/\sqrt{\text{Hz}}$
THD + N Total harmonic distortion plus noise	$V_O = 0.5\text{ V}$ to 2.5 V , $f = 20\text{ kHz}$, $R_L = 50\text{ k}\Omega^\ddagger$	$A_V = 1$	0.03%	0.03%		0.05%	0.05%		
Gain-bandwidth product	$f = 1\text{ kHz}$, $C_L = 100\text{ pF}^\ddagger$	$R_L = 50\text{ k}\Omega^\ddagger$	25°C	0.67		0.67			MHz
BOM Maximum output-swing bandwidth	$V_O(\text{PP}) = 1\text{ V}$, $R_L = 50\text{ k}\Omega^\ddagger$,	$A_V = 1$, $C_L = 100\text{ pF}^\ddagger$	25°C	395		395			kHz
t_s Settling time	$A_V = -1$, Step = 1 V to 2 V, $R_L = 50\text{ k}\Omega^\ddagger$, $C_L = 100\text{ pF}^\ddagger$	To 0.1%	25°C	5.6		5.6			μs
		To 0.01%		12.5		12.5			
ϕ_m Phase margin at unity gain	$R_L = 50\text{ k}\Omega^\ddagger$,	$C_L = 100\text{ pF}^\ddagger$	25°C	55°		55°			
			25°C	11		11			
									dB

[†] Full range is –40°C to 125°C.

[‡] Referenced to 1.5 V

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8917-REF004X-055000-DAL00-TEXAS INSTRUMENTS

FEATURES

- Maximum Initial Tolerance: 0.2%
- Guaranteed Temperature Stability
- Maximum 0.6Ω Dynamic Impedance
- Wide Operating Current Range
- Directly Interchangeable with LM136 for Improved Performance
- No Adjustments Needed for Minimum Temperature Coefficient
- Available in 8-Lead SO and MSOP Packages and 3-Lead TO-92 Package

APPLICATIONS

- Reference for 5V Systems
- 8-Bit A/D and D/A Reference
- Digital Voltmeters
- Current Loop Measurement and Control Systems
- Power Supply Monitor

DESCRIPTION

The LT®1009 is a precision trimmed 2.5V shunt regulator diode featuring a maximum initial tolerance of only $\pm 5\text{mV}$. The low dynamic impedance and wide operating current range enhances its versatility. The 0.2% reference tolerance is achieved by on-chip trimming which not only minimizes the initial voltage tolerance but also minimizes the temperature drift.

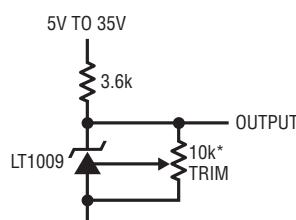
Even though no adjustments are needed with the LT1009, a third terminal allows the reference voltage to be adjusted $\pm 5\%$ to calibrate out system errors. In many applications, the LT1009 can be used as a pin-to-pin replacement of the LM136 and the external trim network eliminated.

For a lower drift 2.5V reference, see the LT1019 data sheet.

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All other trademarks are the property of their respective owners.

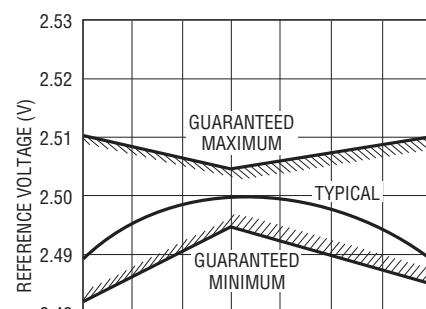
TYPICAL APPLICATION

2.5V Reference



*DOES NOT AFFECT
TEMPERATURE COEFFICIENT.
 $\pm 5\%$ TRIM RANGE

Output Voltage



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LT1009 Series

ABSOLUTE MAXIMUM RATINGS (Note 1)

Reverse Current 20mA
Forward Current 10mA
Storage Temperature Range -65°C to 150°C
Lead Temperature (Soldering, 10 sec) 300°C

Operating Temperature Range
LT1009/LT1009C 0°C to 70°C
LT1009I -40°C to 85°C
LT1009M (OBSOLETE) -55°C to 125°C

PIN CONFIGURATION

<p>BOTTOM VIEW</p> <p>H PACKAGE 3-LEAD TO-46 METAL CAN</p> <p>T_{JMAX} = 150°C, θ_{JA} = 440°C/W, θ_{JG} = 80°C/W</p> <p>OBSOLETE PACKAGE</p> <p>Consider the MS8, S8 or Z Packages for Alternate Source</p>	<p>TOP VIEW</p> <p>MS8 PACKAGE 8-LEAD PLASTIC MSOP</p> <p>T_{JMAX} = 150°C, θ_{JA} = 250°C/W</p>
<p>TOP VIEW</p> <p>S8 PACKAGE 8-LEAD PLASTIC SO</p> <p>T_{JMAX} = 150°C, θ_{JA} = 190°C/W</p>	<p>BOTTOM VIEW</p> <p>Z PACKAGE 3-LEAD PLASTIC TO-92</p> <p>T_{JMAX} = 100°C, θ_{JA} = 160°C/W</p>

ORDER INFORMATION

LEAD FREE FINISH	TAPE AND REEL	PART MARKING	PACKAGE DESCRIPTION	TEMPERATURE RANGE
LT1009MH#PBF	LT1009MH#TRPBF		3-Lead TO-46 Metal Can	-55°C to 125°C
LT1009CH#PBF	LT1009CH#TRPBF		3-Lead TO-46 Metal Can	0°C to 70°C
LT1009CMS8#PBF	LT1009CMS8#TRPBF	LTQZ	8-Lead Plastic MSOP	0°C to 70°C
LT1009S8#PBF	LT1009S8#TRPBF	1009	8-Lead Plastic SO	0°C to 70°C

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ORDER INFORMATION

LEAD BASED FINISH	TAPE AND REEL	PART MARKING	PACKAGE DESCRIPTION	TEMPERATURE RANGE
LT1009MH	LT1009MH#TR		3-Lead TO-46 Metal Can	-55°C to 125°C
LT1009CH	LT1009CH#TR		3-Lead TO-46 Metal Can	0°C to 70°C
LT1009CMS8	LT1009CMS8#TR	LTQZ	8-Lead Plastic MSOP	0°C to 70°C
LT1009S8	LT1009S8#TR	1009	8-Lead Plastic SO	0°C to 70°C
LT1009IS8	LT1009IS8#TR	1009I	8-Lead Plastic SO	-40°C to 85°C
LT1009CZ	LT1009CZ#TR		3-Lead Plastic TO-92	0°C to 70°C
LT1009IZ	LT1009IZ#TR		3-Lead Plastic TO-92	-40°C to 85°C

Consult LTC Marketing for parts specified with wider operating temperature ranges.

For more information on lead free part marking, go to: <http://www.linear.com/leadfree/>

For more information on tape and reel specifications, go to: <http://www.linear.com/tapeandreel/>

AVAILABLE OPTIONS

TEMPERATURE	ACCURACY (%)	TEMPERATURE COEFFICIENT (ppm/°C)	PACKAGE STYLE			
			TO-46 (H) OBSOLETE	MSOP-8 (MS8)	SO-8 (S8)	TO-92 (Z)
0°C to 70°C	0.20 0.40	25 25	LT1009CH	LT1009CMS8	LT1009S8	LT1009CZ
-40°C to 85°C	0.20 0.40	35 35			LT1009IS8	LT1009IZ
-55°C to 125°C	0.20	35	LT1009MH			

ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at $T_A = 25^\circ\text{C}$.

SYMBOL	PARAMETER	CONDITIONS	LT100M			LT1009I			LT1009/LT1009C			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
V_Z	Reverse Breakdown Voltage	$T_A = 25^\circ\text{C}$, $I_R = 1\text{mA}$ H, Z Pkg MS, S Pkg	2.495 2.49	2.500 2.50	2.505 2.51	2.495 2.49	2.500 2.50	2.505 2.51	2.495 2.49	2.500 2.50	2.505 2.51	V
$\frac{\Delta V_Z}{\Delta I_R}$	Reverse Breakdown Change with Current	$400\mu\text{A} \leq I_R \leq 10\text{mA}$	●	2.6 3.0	6 10	2.6 3.0	10 12	2.6 3.0	10 12	2.6 3.0	10 12	mV
r_Z	Reverse Dynamic Impedance	$I_R = 1\text{mA}$	●	0.2 0.4	0.6 1.0	0.2 0.4	1.0 1.4	0.2 0.4	1.0 1.4	0.2 0.4	1.0 1.4	Ω
	Temperature Stability	$T_{\text{MIN}} \leq T_A \leq T_{\text{MAX}}$	●		15		15		15	1.8	4	mV
ΔV_T	Average Temperature	$0^\circ\text{C} \leq T_A \leq 70^\circ\text{C}$		15	25	15	25	15	25	15	25	ppm/°C

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