

LM134/LM234/LM334

3-Terminal Adjustable Current Sources

General Description

The LM134/LM234/LM334 are 3-terminal adjustable current sources featuring 10,000:1 range in operating current, excellent current regulation and a wide dynamic voltage range of 1V to 40V. Current is established with one external resistor and no other parts are required. Initial current accuracy is $\pm 3\%$. The LM134/LM234/LM334 are true floating current sources with no separate power supply connections. In addition, reverse applied voltages of up to 20V will draw only a few dozen microamperes of current, allowing the devices to act as both a rectifier and current source in AC applications.

The sense voltage used to establish operating current in the LM134 is 64mV at 25°C and is directly proportional to absolute temperature ($^{\circ}\text{K}$). The simplest one external resistor connection, then, generates a current with $\approx +0.33\%/^{\circ}\text{C}$ temperature dependence. Zero drift operation can be obtained by adding one extra resistor and a diode.

Applications for the current sources include bias networks, surge protection, low power reference, ramp generation,

LED driver, and temperature sensing. The LM234-3 and LM234-6 are specified as true temperature sensors with guaranteed initial accuracy of $\pm 3^{\circ}\text{C}$ and $\pm 6^{\circ}\text{C}$, respectively. These devices are ideal in remote sense applications because series resistance in long wire runs does not affect accuracy. In addition, only 2 wires are required.

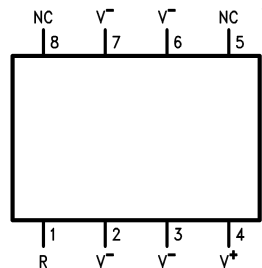
The LM134 is guaranteed over a temperature range of -55°C to $+125^{\circ}\text{C}$, the LM234 from -25°C to $+100^{\circ}\text{C}$ and the LM334 from 0°C to $+70^{\circ}\text{C}$. These devices are available in TO-46 hermetic, TO-92 and SO-8 plastic packages.

Features

- Operates from 1V to 40V
- 0.02%/V current regulation
- Programmable from 1 μA to 10mA
- True 2-terminal operation
- Available as fully specified temperature sensor
- $\pm 3\%$ initial accuracy

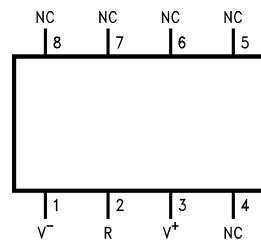
Connection Diagrams

SO-8
Surface Mount Package



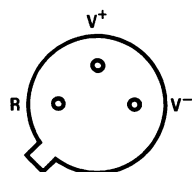
00569724
Order Number LM334M or LM334MX
See NS Package Number M08A

SO-8 Alternative Pinout
Surface Mount Package



00569725
Order Number LM334SM or LM334SMX
See NS Package Number M08A

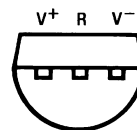
TO-46
Metal Can Package



V⁻ Pin is electrically connected to case.

00569712
Bottom View
Order Number LM134H,
LM234H or LM334H
See NS Package
Number H03H

TO-92 Plastic Package



00569710
Bottom View
Order Number LM334Z, LM234Z-3 or LM234Z-6
See NS Package Number Z03A

Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

V ⁺ to V ⁻ Forward Voltage	
LM134/LM234/LM334	40V
LM234-3/LM234-6	30V
V ⁺ to V ⁻ Reverse Voltage	20V
R Pin to V ⁻ Voltage	5V
Set Current	10 mA
Power Dissipation	400 mW
ESD Susceptibility (Note 6)	2000V
Operating Temperature Range (Note 5)	
LM134	-55°C to +125°C

LM234/LM234-3/LM234-6

-25°C to +100°C

LM334

0°C to +70°C

Soldering Information

TO-92 Package (10 sec.)	260°C
TO-46 Package (10 sec.)	300°C
SO Package	
Vapor Phase (60 sec.)	215°C
Infrared (15 sec.)	220°C

See AN-450 "Surface Mounting Methods and Their Effect on Product Reliability" (Appendix D) for other methods of soldering surface mount devices.

Electrical Characteristics (Note 2)

Parameter	Conditions	LM134/LM234			LM334			Units
		Min	Typ	Max	Min	Typ	Max	
Set Current Error, V ⁺ =2.5V, (Note 3)	10μA ≤ I _{SET} ≤ 1mA			3			6	%
	1mA < I _{SET} ≤ 5mA			5			8	%
	2μA ≤ I _{SET} < 10μA			8			12	%
Ratio of Set Current to Bias Current	100μA ≤ I _{SET} ≤ 1mA	14	18	23	14	18	26	
	1mA ≤ I _{SET} ≤ 5mA		14			14		
	2 μA ≤ I _{SET} ≤ 100 μA		18	23		18	26	
Minimum Operating Voltage	2μA ≤ I _{SET} ≤ 100μA		0.8			0.8		V
	100μA < I _{SET} ≤ 1mA		0.9			0.9		V
	1mA < I _{SET} ≤ 5mA		1.0			1.0		V
Average Change in Set Current with Input Voltage	2μA ≤ I _{SET} ≤ 1mA							
	1.5 ≤ V ⁺ ≤ 5V		0.02	0.05		0.02	0.1	%/V
	5V ≤ V ⁺ ≤ 40V		0.01	0.03		0.01	0.05	%/V
	1mA < I _{SET} ≤ 5mA							
	1.5V ≤ V ≤ 5V		0.03			0.03		%/V
5V ≤ V ≤ 40V		0.02			0.02		%/V	
Temperature Dependence of Set Current (Note 4)	25μA ≤ I _{SET} ≤ 1mA	0.96T	T	1.04T	0.96T	T	1.04T	
Effective Shunt Capacitance			15			15		pF

Note 1: "Absolute Maximum Ratings" indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is functional, but do not guarantee specific performance limits.

Note 2: Unless otherwise specified, tests are performed at T_j = 25°C with pulse testing so that junction temperature does not change during test

Note 3: Set current is the current flowing into the V⁺ pin. For the Basic 2-Terminal Current Source circuit shown on the first page of this data sheet. I_{SET} is determined by the following formula: I_{SET} = 67.7 mV/R_{SET} (@ 25°C). Set current error is expressed as a percent deviation from this amount. I_{SET} increases at 0.336%/°C @ T_j = 25°C (227 μV/°C).

Electrical Characteristics (Note 2) (Continued)

Note 4: I_{SET} is directly proportional to absolute temperature ($^{\circ}K$). I_{SET} at any temperature can be calculated from: $I_{SET} = I_o (T/T_o)$ where I_o is I_{SET} measured at T_o ($^{\circ}K$).

Note 5: For elevated temperature operation, T_J max is:

LM134	150 $^{\circ}C$
LM234	125 $^{\circ}C$
LM334	100 $^{\circ}C$

Thermal Resistance	TO-92	TO-46	SO-8
θ_{ja} (Junction to Ambient)	180 $^{\circ}C/W$ (0.4" leads) 160 $^{\circ}C/W$ (0.125" leads)	440 $^{\circ}C/W$	165 $^{\circ}C/W$
θ_{jc} (Junction to Case)	N/A	32 $^{\circ}C/W$	80 $^{\circ}C/W$

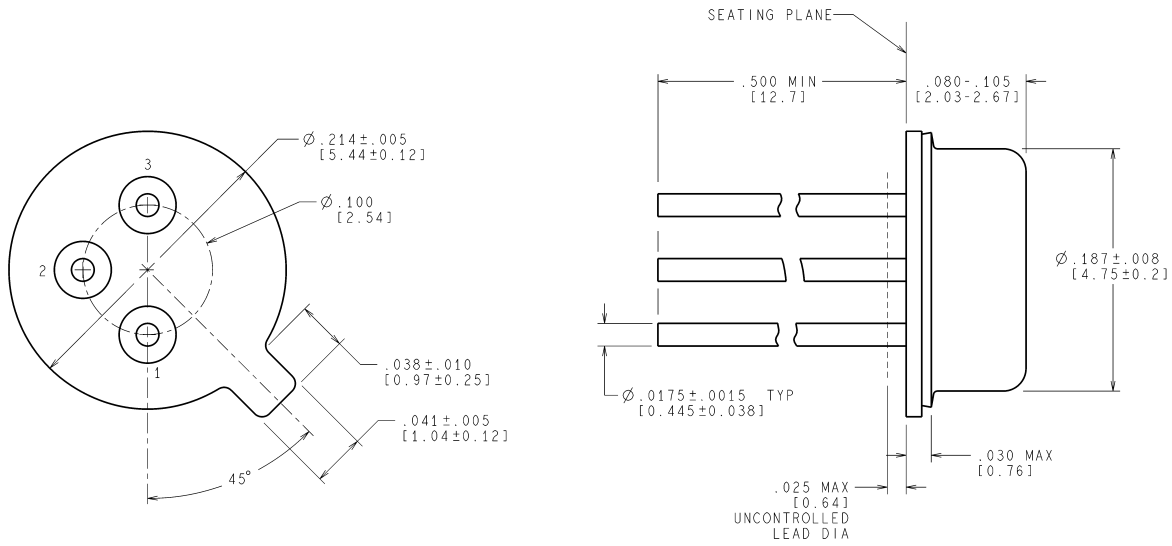
Note 6: Human body model, 100pF discharged through a 1.5k Ω resistor.

Electrical Characteristics (Note 2)

Parameter	Conditions	LM234-3			LM234-6			Units
		Min	Typ	Max	Min	Typ	Max	
Set Current Error, $V^+=2.5V$, (Note 3)	$100\mu A \leq I_{SET} \leq 1mA$ $T_J = 25^{\circ}$			± 1			± 2	%
Equivalent Temperature Error				± 3			± 6	$^{\circ}C$
Ratio of Set Current to Bias Current	$100\mu A \leq I_{SET} \leq 1mA$	14	18	26	14	18	26	
Minimum Operating Voltage	$100\mu A I_{SET} \leq 1mA$		0.9			0.9		V
Average Change in Set Current with Input Voltage	$100\mu A \leq I_{SET} \leq 1mA$ $1.5 \leq V^+ \leq 5V$ $5V \leq V^+ \leq 30V$		0.02	0.05		0.02	0.01	%/V
			0.01	0.03		0.01	0.05	%/V
Temperature Dependence of Set Current (Note 4) and	$100\mu A \leq I_{SET} \leq 1mA$	0.98T	T	1.02T	0.97T	T	1.03T	
Equivalent Slope Error				± 2			± 3	%
Effective Shunt Capacitance			15			15		pF

Physical Dimensions inches (millimeters)

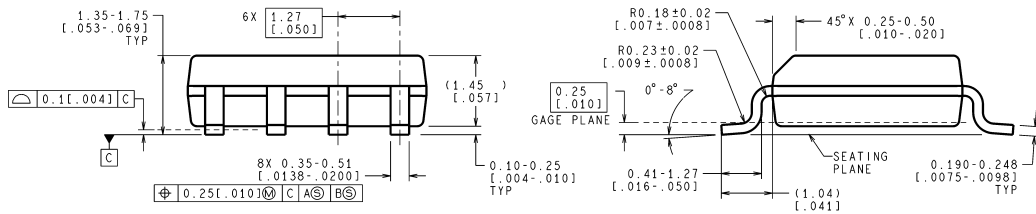
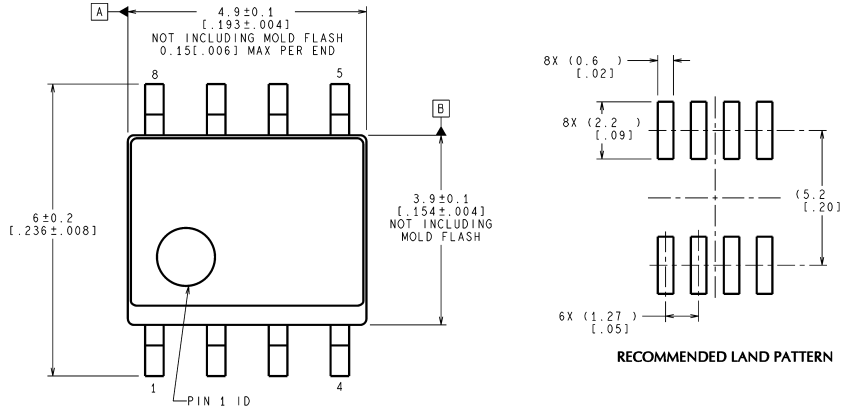
unless otherwise noted



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H03H (Rev F)

**Order Number LM134H, LM234H or LM334H
NS Package Number H03H**



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VALUES IN [] ARE INCHES
DIMENSIONS IN () FOR REFERENCE ONLY

M08A (Rev K)

**SO Package (M)
Order Number LM334M, LM334MX,
LM334SM or LM334SMX
NS Package Number M08A**