



钲地半导体  
Tudi Semiconductor

## Product Specification

TUDI-LM385

Micropower Voltage Reference Diode

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- Design
- research and development
- production
- and sales



## Features

- $\pm 3\%$  Initial Tolerance
- Operating Current of 100 $\mu$ A to 20mA
- 0.8 Dynamic Impedance
- Low Temperature Coefficient
- Low Voltage Reference—1.235V
- 2.5V Device Also Available

## Description

The LM385 is a micro-power-bandgap reference voltage source fabricated using bipolar process technology. It delivers stable voltage reference across an operating current range of 100 $\mu$ A to 20mA, featuring low dynamic resistance and excellent temperature stability. The integrated reference adjustment mechanism ensures minimal output voltage tolerance. With its bandgap reference architecture consisting solely of transistors and resistors, the circuit exhibits low noise levels and superior long-term stability.

The LM385 design has been meticulously engineered to address potential challenges under diverse load conditions, ensuring exceptional adaptability to external loads and reliable performance across most reference voltage source applications. Its wide dynamic operating range enables the chip to maintain outstanding adjustment capabilities even when power supply fluctuations occur significantly.

The LM385 delivers precise reference voltage with minimal load current, making it ideal for low-power circuits as a reference voltage source in battery-powered portable devices, regulated power supplies, and general analog circuits.

The LM385 series products are available in two fixed voltage specifications: 1.2V (LM385-1.2) and 2.5V (LM385-2.5). Standard package types for the LM385 include TO-92, SOT-23 and SOP-8.

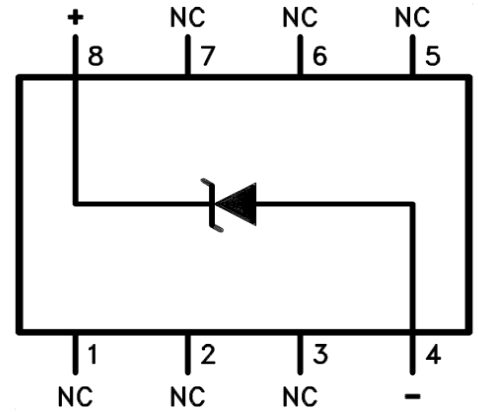


Figure 1. SOP8 Pin Diagram

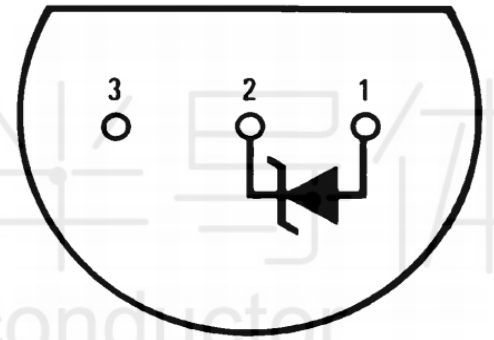


Figure 2. TO92 Pin Diagram

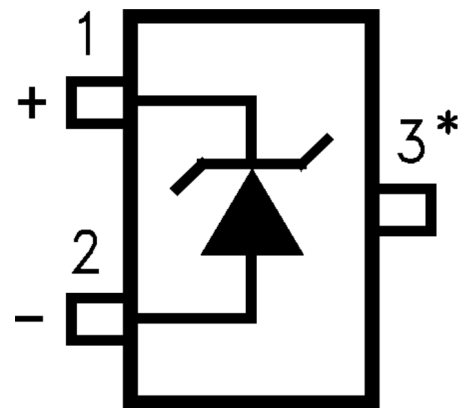


Figure 3. SOT23 Pin Diagram



## Pin Description

Pin number			Name	Function
TO92	SOT23	SOP8		
2	1	8	Anode	Positive pole
1	2	4	Cathode	Negative pole
3	3	1,2,3,5,6,7	NC	No internal connections

## Absolute Rating

Project	Parameter values	Unit
Back current	30	mA
Forward current	10	mA
Operating temperature range	-0~70	°C
Storage temperature	-55~150	°C
Welding temperature (spot welding, 10 seconds)	260	°C

**Note:** Limit parameters refer to the maximum values that must not be exceeded under any conditions. Exceeding these limits may cause physical damage such as product degradation. Additionally, normal chip operation cannot be guaranteed when approaching limit parameters.



## Electrical parameters (1) LM385-1.2V (Ta=25 , unless otherwise specified)

Parameter	Test condition	Representative value	LM385B-1.2		LM385-1.2		Unit
			Least	Crest	Least	Crest	
Breakdown reverse voltage	Ta=25°C, 100μA ≤ IR ≤ 20mA	1.235	1.223	1.247	1.205	1.260	V
Minimum working current		100		120		120	μA
Rate of change of reverse breakdown voltage with current	100μA ≤ IR ≤ 1mA			1.5		1.5	mV
	1mA ≤ IR ≤ 20mA			25		25	
Reverse dynamic impedance	IR=100μA, f=20Hz	1					Ω
Multi-frequency noise(rms)	IR=100μA, 10 Hz ≤ f ≤ 10kHz	60					μV
Long term stability	IR=100μA, T=1000Hr, TA=25°C ± 0.1°C	20					ppm
Mean temperature coefficient	IR=100 μA	80		150		150	ppm/°C

## Electrical parameters (2) LM385-2.5V (Ta=25 , unless otherwise specified)

Parameter	Test condition	Representative value	LM385A-2.5		LM385B-2.5		LM385-2.5		Unit
			Least	Crest	Least	Crest	Least	Crest	
Breakdown reverse voltage	Ta=25°C, 100μA ≤ IR ≤ 20mA	2.5	2.480	2.520	2.462	2.538	2.425	2.575	V
Minimum working current		100		120		130		130	μA
Rate of change of reverse breakdown voltage with current	100μA ≤ IR ≤ 1mA			1.5		2.5		2.5	mV
	1mA ≤ IR ≤ 20mA			20		25		25	
Reverse dynamic impedance	IR=100μA, f=20Hz	1							Ω
Multi-frequency noise(rms)	IR=100μA, 10Hz ≤ f ≤ 10kHz	120							μV
Long term stability	IR=100μA, T=1000Hr, TA=25°C ± 0.1°C	20							ppm
Mean temperature coefficient	IR=100 μA	80		150		150		150	ppm/°C



## Application circuit diagram and working principle explanation for wide

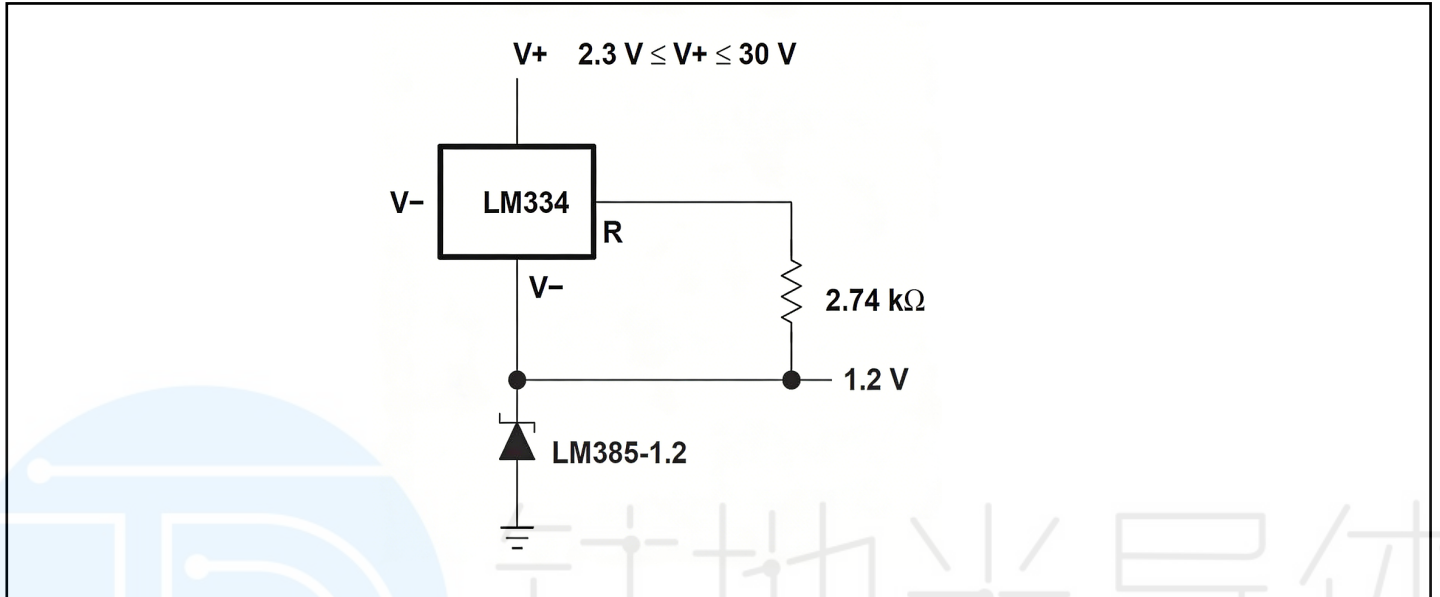


Figure 4 Input range reference

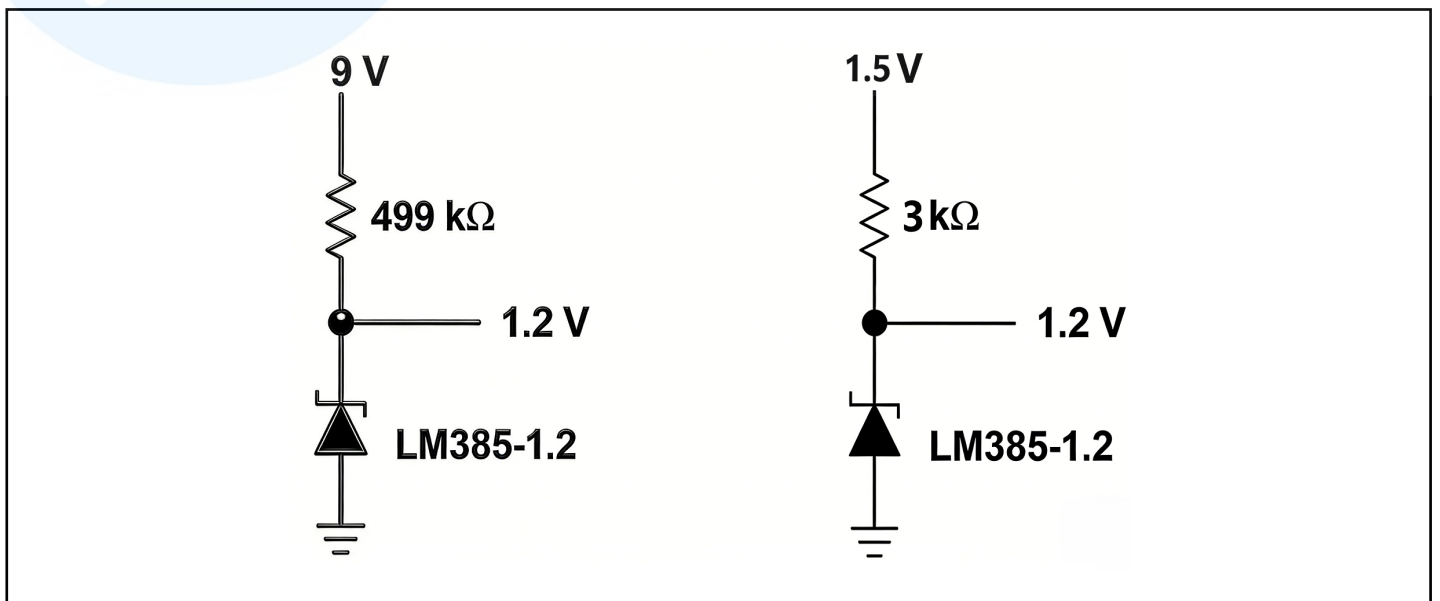


Figure 5 Micro Power Supply Reference (9V and 1.5V)

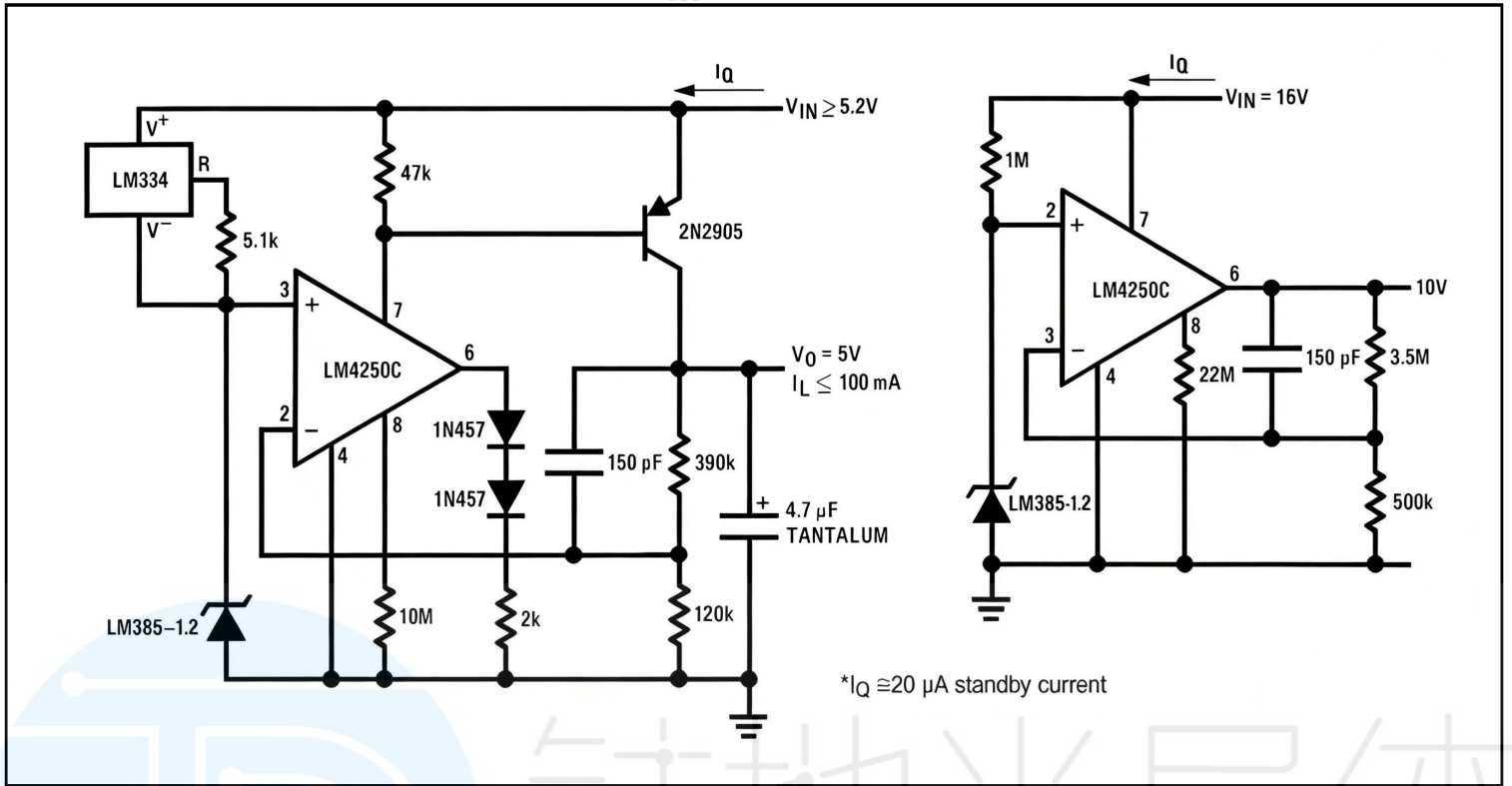


Figure 6 5V Regulator and 10V Reference Voltage Source

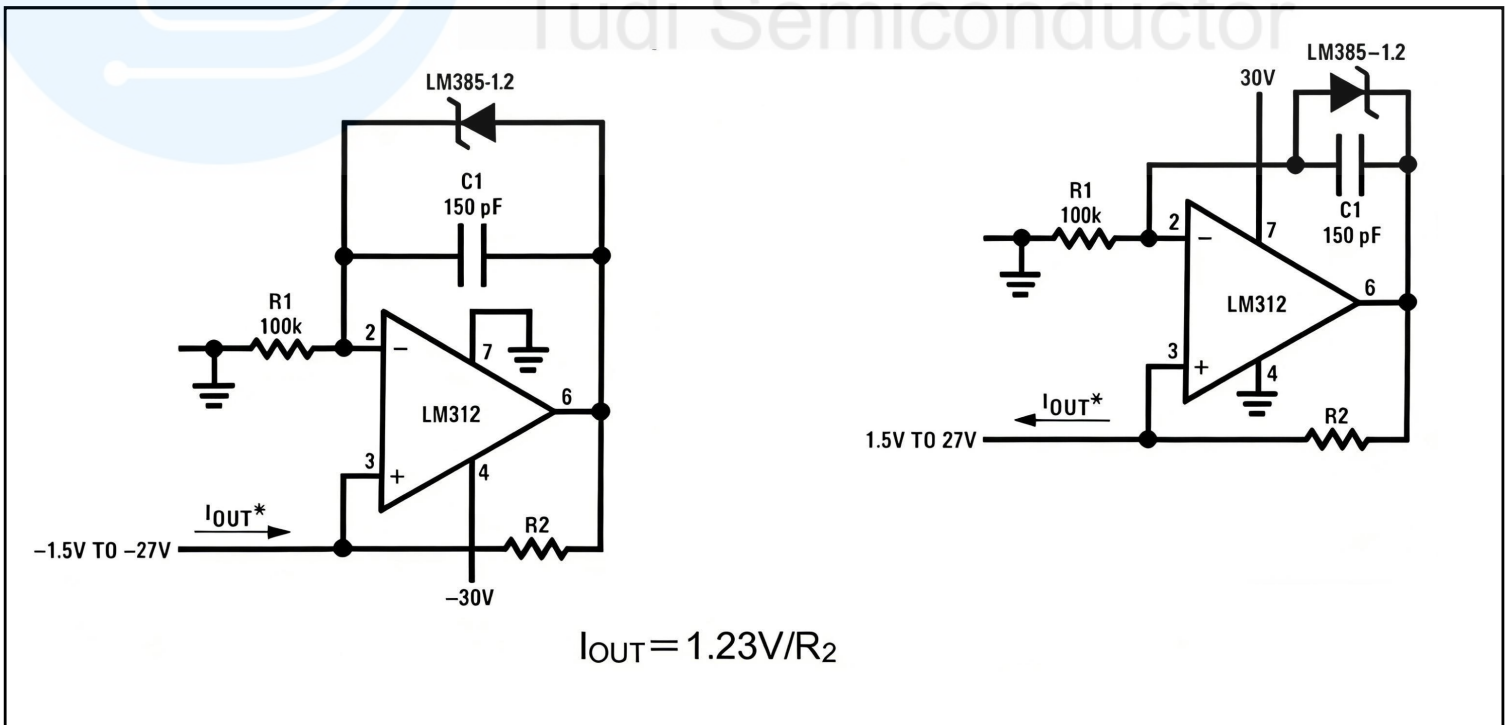


Figure 7 1μA to 1mA Precision Current Source

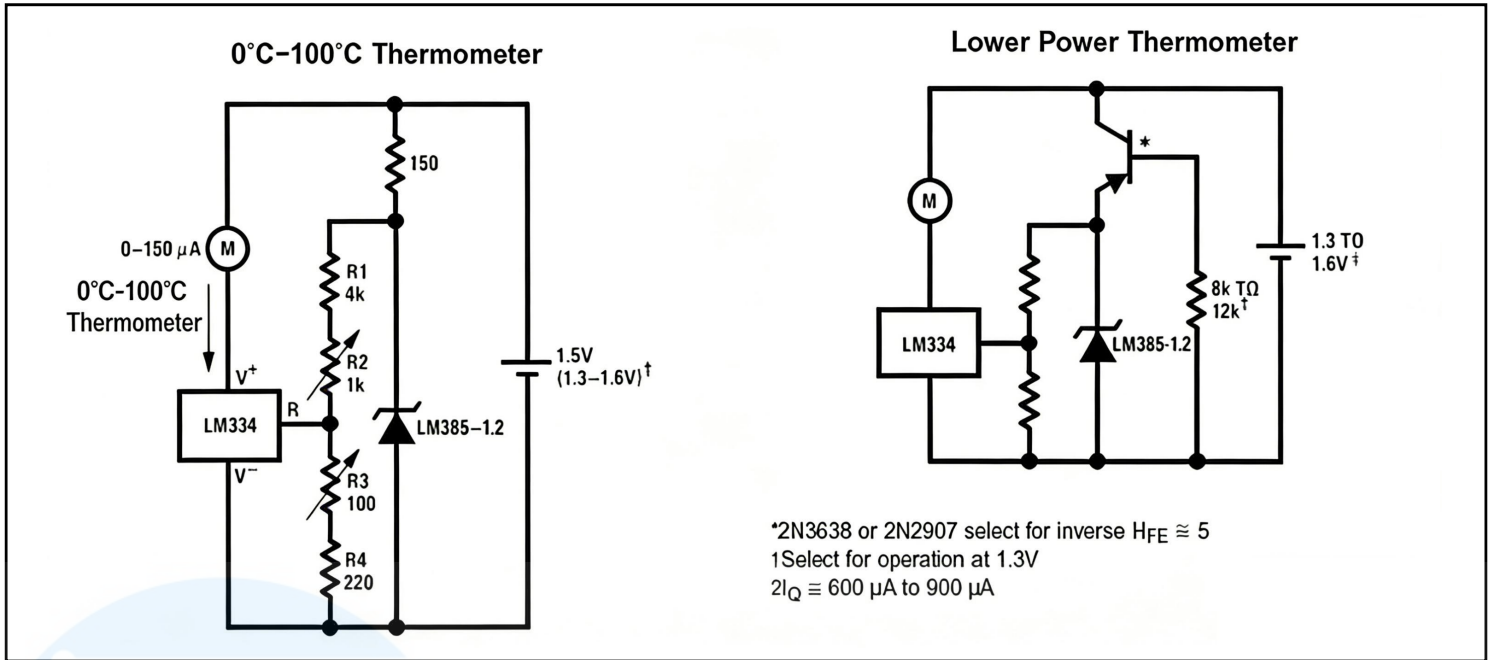


Figure 8 Thermometer

Reverse  $H_{FE} \approx 5$ , select device as 2N3638 or 2N2907.

Select to operate at 1.3V;  $I_Q = 600 \mu A \sim 900 \mu A$

Short-circuit LM385, adjust R3 to make  $I_{OUT} = \text{temp} @ 1 \mu A / ^\circ K$ ; remove short-circuit, adjust R2, read out appropriate percentage temperature value:  $I_Q$  at 1.3V @ 500  $\mu A$ ;  $I_Q$  at 1.6V @ 2.4 mA

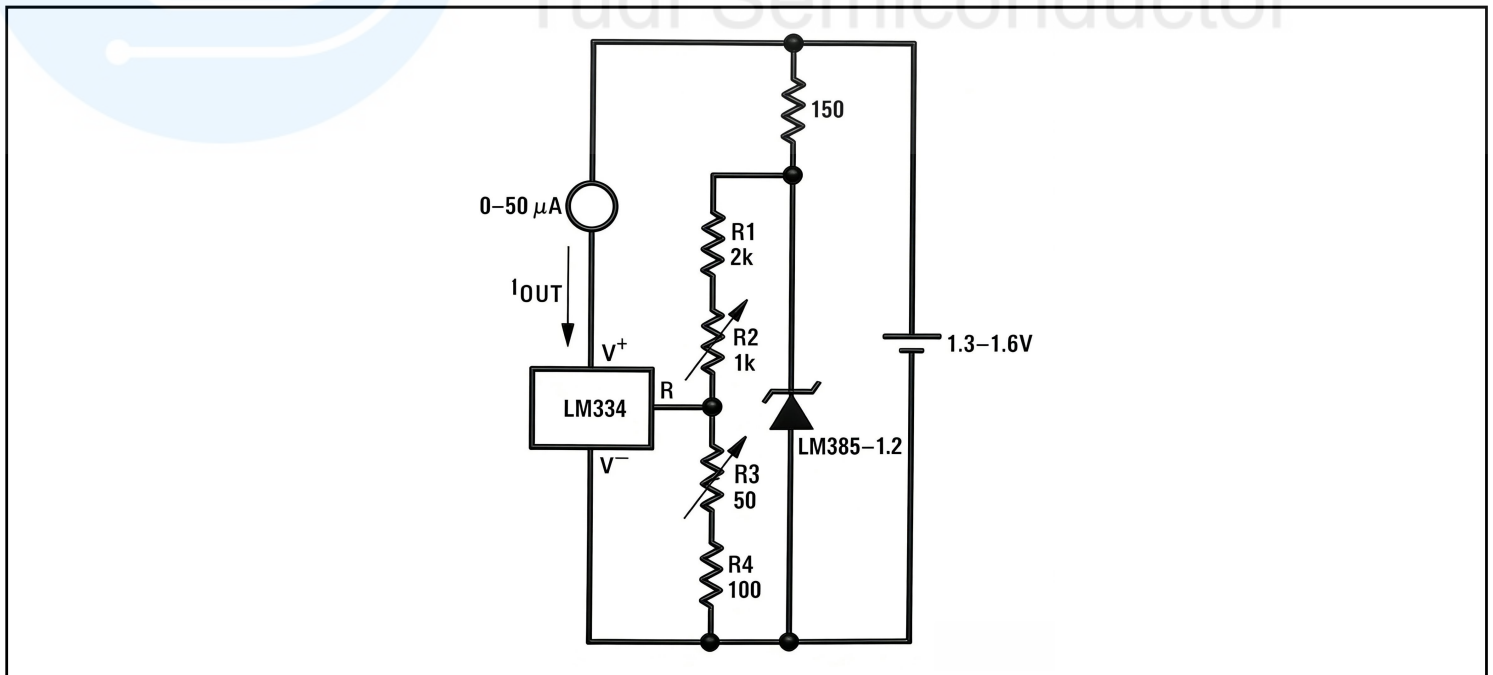


Figure 9 0-50°C Thermometer

Short-Circuit the LM385 and Adjust R3 to Set  $I_{OUT} = \text{temp} @ 1.8 \mu A / ^\circ K$ ; Remove the Short Circuit, Adjust R2, and Read the Correct Value in Units of T.

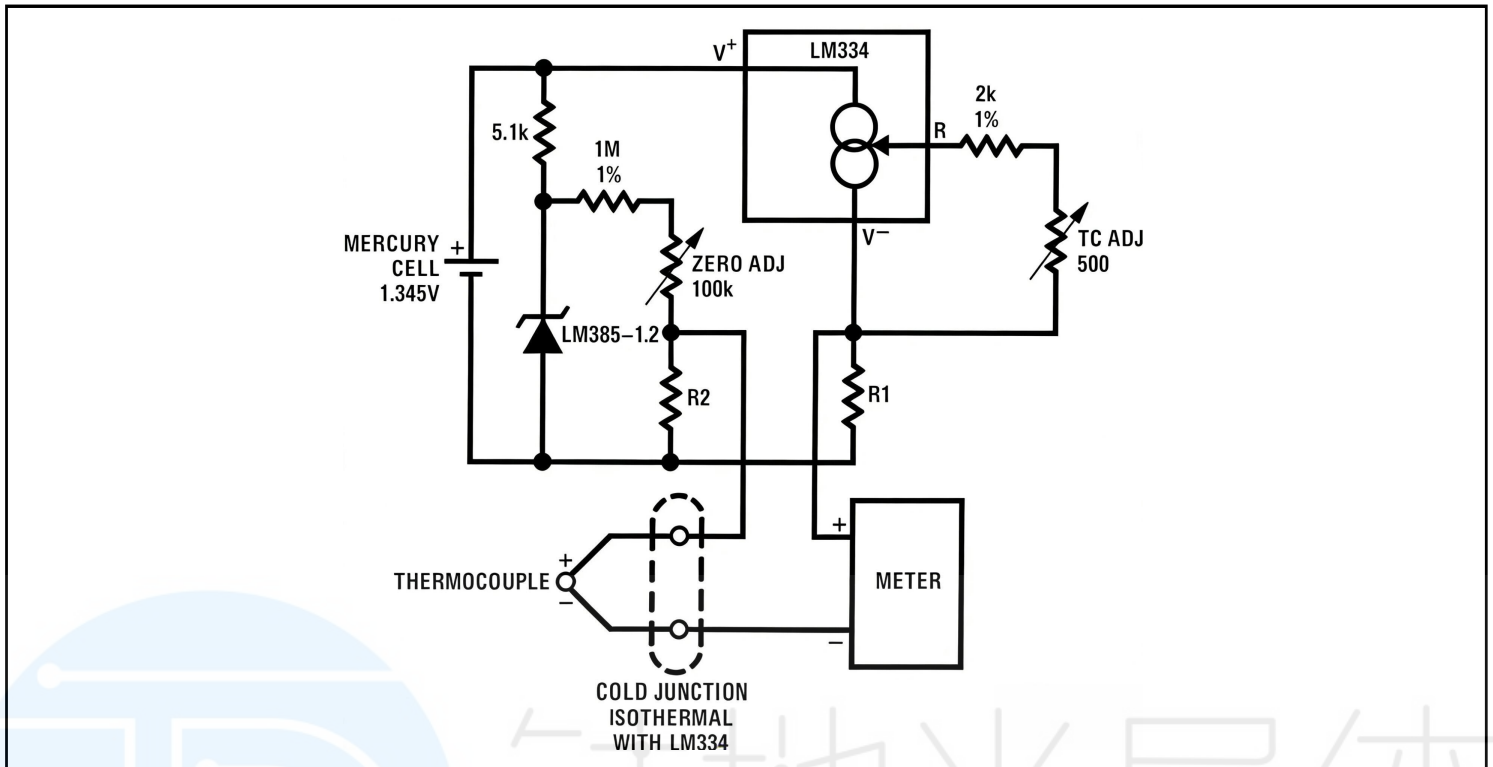


Figure 10 Low-Power Thermal Corner Room Temperature Connection Compensator

- Adjust TC ADJ until the voltage across R1 and the thermoelectric figure of merit corresponding to absolute temperature are in proportional relationship.
- Adjust ZERO ADJ until the voltage across R2 becomes proportional to the thermoelectric figure of merit corresponding to the relative temperature (273.2K).

Thermoelectric corner type	Proportionality coefficient ( $\mu\text{V}/1^\circ\text{C}$ )	R1 ( $\Omega$ )	R2 ( $\Omega$ )	Voltage across the R1 terminals@25°C	Voltage across the R2 terminals@25°C
J	52.3	523	1.24K	15.60	14.32
T	42.8	432	1K	12.77	11.78
K	40.8	412	953	12.17	11.17
S	6.4	63.4	150	1.908	1.766

The typical power supply current is 50 $\mu\text{A}$ .

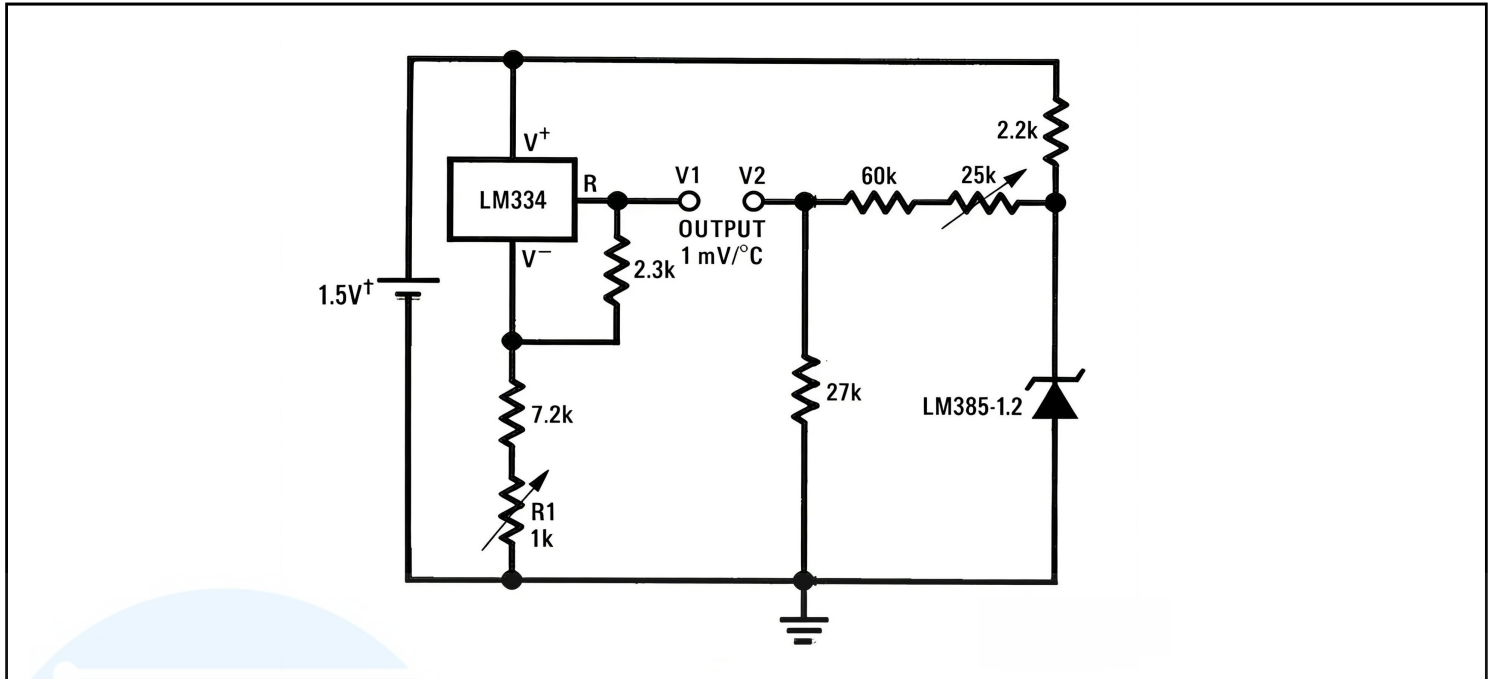


Figure 11 Percentage Thermometer

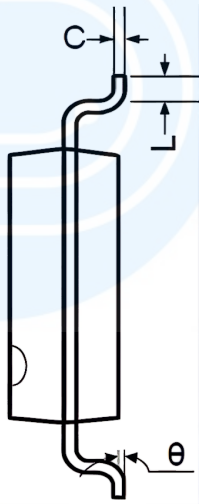
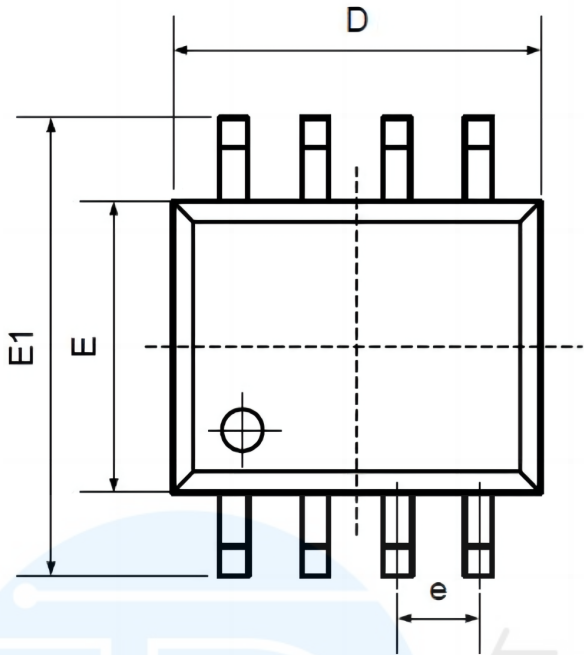
Adjust R1 to set  $V1 = \text{temp} @ 1\text{mV}/^\circ\text{K}$ ; adjust V2 to 273.2mV. IQ ranges from 1.3V to 1.6V power supply voltage; age = 50~150  $\mu\text{A}$

## Order information

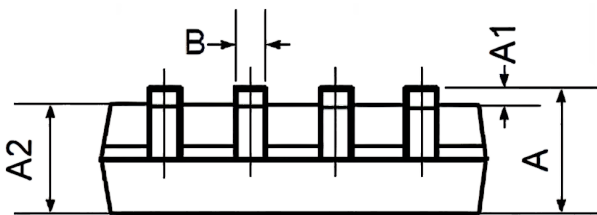
Order Number	Package	Package Quantity	Marking On The park	Temperature	Data Rate
LM385DR-1-2-TUDI	SOP8	Tape,Reel,2500	385-12	0°C to 70°C	1.235V
LM385BDR-1-2-TUDI	SOP8	Tape,Reel,2500	385B12		
LM385BLPR-1-2-TUDI	TO92-3	A box of 1800	385B12		
LM385DR-2-5-TUDI	SOP8	Tape,Reel,2500	385-25		2.5V
LM385BDR-2-5-TUDI	SOP8	Tape,Reel,2500	385B25		
LM385BLPR-2-5-TUDI	TO92-3	A box of 1800	385B25		



Package SOP8

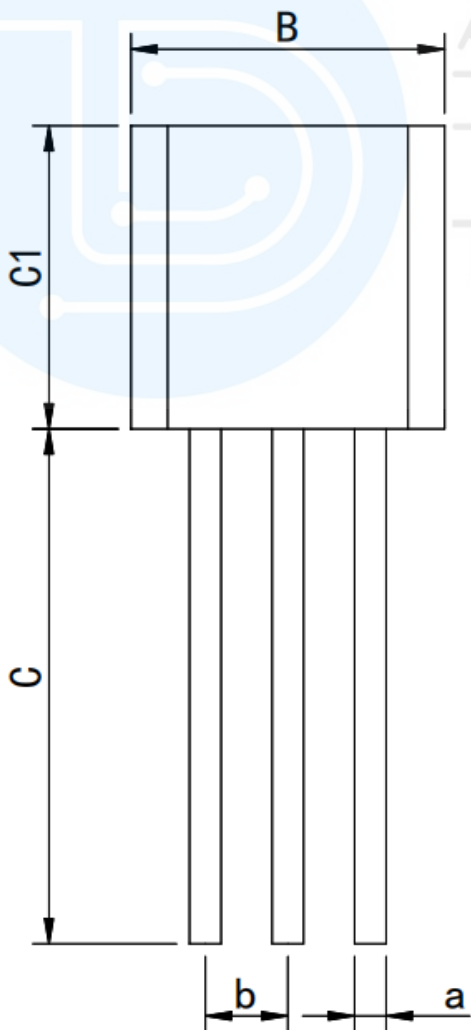
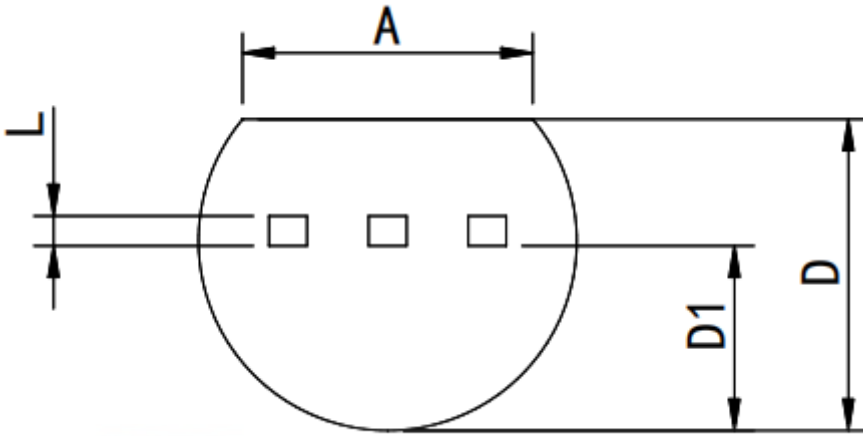


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
B	0.330	0.510	0.013	0.020
C	0.190	0.250	0.007	0.010
D	4.780	5.000	0.188	0.197
E	3.800	4.000	0.150	0.157
E1	5.800	6.300	0.228	0.248
e	1.270TYP		0.050TYP	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°





Package TO92



Symbol	Min	Max
A	3.43	4.13
B	4.44	5.21
C	13.5	15.3
C1	4.32	5.34
D	3.17	4.19
D1	2.03	2.67
L	0.33	0.42
a	0.40	0.52
b	1.27BSC	



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