LM385 Adjustable Micropower Voltage References

FEATURES

- Adjustable from 1.24V to 5.30V
- Operating Current of 10μA to 20mA
- 1% and 2% Initial Tolerance
- 1Ω Dynamic Impedance
- Low Temperature Coefficient

SOP-8

TO-92

DFN-8 3*3

DFN-8 2*2

ORDERING INFORMATION

DEVICE	Package Type	MARKING	Packing	Packing Qty
LM385Z-ADJ/HG	TO-92	LM385-ADJ,385-ADJ	BAG	1000pcs/box
LM385M-ADJ/TR-HG	SOP-8	385-ADJ	REEL	2500pcs/reel
LM385DQ3-ADJ/TR-HG	DFN-8 3*3	385-ADJ	REEL	5000pcs/reel
LM385DQ2-ADJ/TR-HG	DFN-8 2*2	385-ADJ	REEL	5000pcs/reel*

* old：4000pcs/reel,New packaging quantity of 5000 pcs/reel after December 2025.

DESCRIPTION

The LM385-ADJ are micro power 3-terminal adjustable band-gap voltage reference diodes. Operating from 1.24 to 5.3V and over a 10μA to 20mA current range, they feature exceptionally low dynamic impedance and good temperature stability. On-chip trimming is used to provide tight voltage tolerance. Since the LM385-ADJ band-gap reference uses only transistors and resistors, low noise and good long-term stability result. The wide dynamic operating range allows its use with widely varying supplies with excellent regulation.

The extremely low power drain of the LM385-ADJ makes it useful for micro power circuitry. This voltage reference can be used to make portable meters, regulators or general purpose analog circuitry with battery life approaching shelf life. Further, the wide operating current allows it to replace older references with a tighter tolerance part.

CONNECTION DIAGRAM

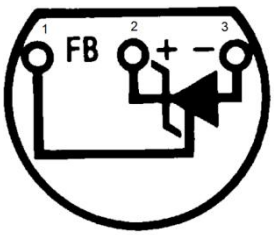


Figure 1. TO-92 Package Bottom View

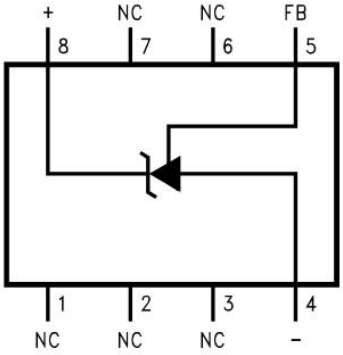


Figure 2. SOP Package Top View

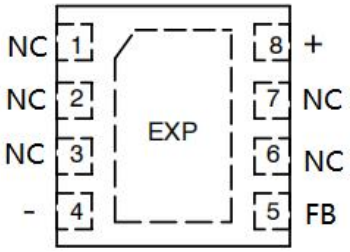
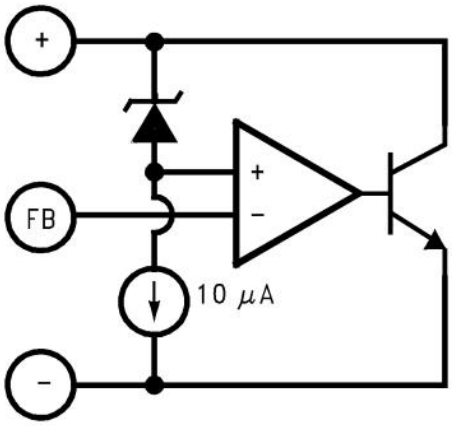


Figure 3. DFN Package Top View

BLOCK DIAGRAM



Typical Applications

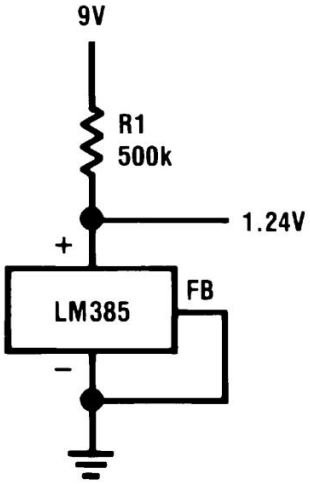


Figure 3. 1.2V Reference

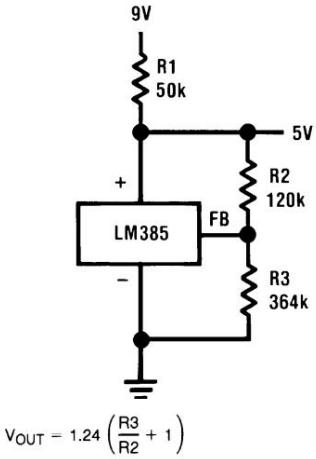


Figure 4. 5.0V Reference

ABSOLUTE MAXIMUM RATINGS (1)

CONDITION		MIN	MAX
Reverse Current		-	300mA
Forward Current		-	10mA
Operating Temperature Range (2)		0°C	70°C
ESD Susceptibility (3)		-	2kV
Storage Temperature		-55°C	150°C
Soldering Information	TO-92 Package (10 sec.)	-	245°C
	SOP Package(10 sec.)	-	260°C
T_J(max) for Elevated Temperature Operation		-	100°C

Note：(1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional. For specifications and test conditions, see the Electrical Characteristics. The specifications apply only for the test conditions listed.

(2) For elevated temperature operation, see Table 1 and Thermal Characteristics.

(3) The human body model is a 100pF capacitor discharged through a 1.5 kΩ resistor into each pin.

THERMAL CHARACTERISTICS

Over operating free-air temperature range (unless otherwise noted)

Thermal Resistance	TO-92	SOP
θ_{JA} (Junction to Ambient)	180°C/W (0.4″ leads)	165°C/W
	170°C/W (0.125″ leads)	
θ_{JC} (Junction to Case)	N/A	N/A

ELECTRICAL CHARACTERISTICS(1)

Parameter	Conditions		Typ	LM385		Unlts (Limit)
				Tested Limit (2)	Design Limit (3)	
Reference Voltage	I_R=100μA		1.240	1.265 1.215	**1.270** **1.205**	V(max) V(min)
Reference Voltage Change with Current	I_{MIN}<I_R<1mA 1mA<I_R<20mA		0.2 5	1 15	**1.5** **25**	mV (max)
Dynamic Output Impedance	I_R=100μA I_{AC}=0.1I_R	f=100Hz V_{OUT}=V_{REF} V_{OUT}=5.3V	0.4 1			Ω
Reference Voltage Change with Output Voltage	I_R=100μA		2	5	**10**	mV (max)
Feedback Current			16	30	**35**	nA(max)
Minimum Operating Current (see curve)	V_{OUT}=V_{REF} V_{OUT}=5.3V		7 35	11 55	**13** **60**	μA (max)
Output Wideband Noise	I_R=100μA, 10Hz<f<10KHz V_{OUT}=V_{REF} V_{OUT}=5.3V		50 170			μVrms
Average Temperature Coefficient(4)	I_R=100μA				**150**	ppm/°C (max)
Long Tem Stability	I_R=100μA,T=1000Hr, TA=25°C ±0.1°C		20			ppm

(1) Parameters identified with **boldface type** apply at temperature extremes. All other numbers apply at TA = TJ = 25°C. Unless otherwise specified, all parameters apply for V_{REF} < V_{OUT} < 5.3V.

(2) Production tested.

(3) Not production tested. These limits are not to be used to calculate average outgoing quality levels.

(4) The average temperature coefficient is defined as the maximum deviation of reference voltage at all measured temperatures from T_{MIN} to T_{MAX}, divided by T_{MAX} − T_{MIN}. The measured temperatures are 0-70°C.

TYPICAL PERFORMANCE CHARACTERISTICS

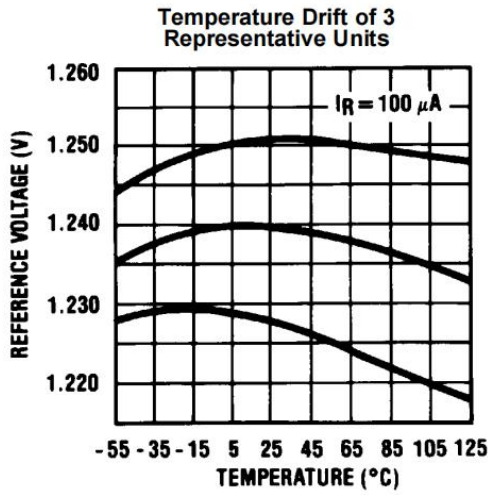


Figure 5.

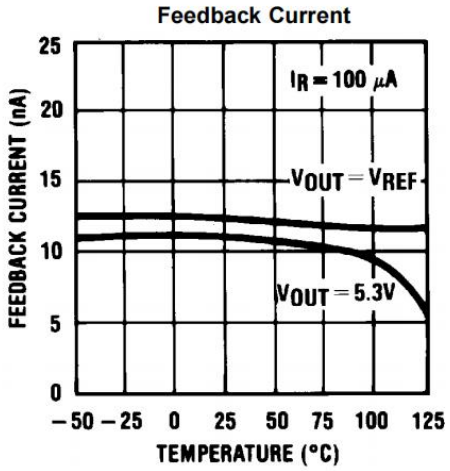


Figure 6.

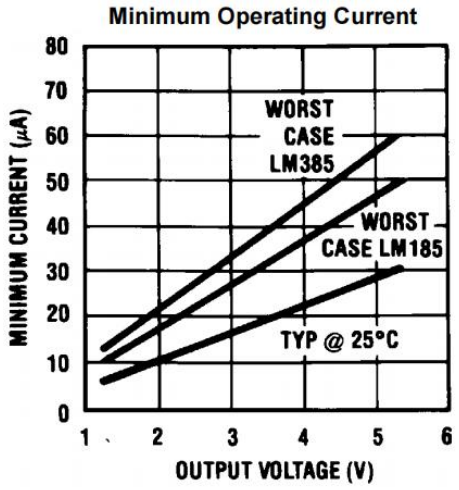


Figure 7.

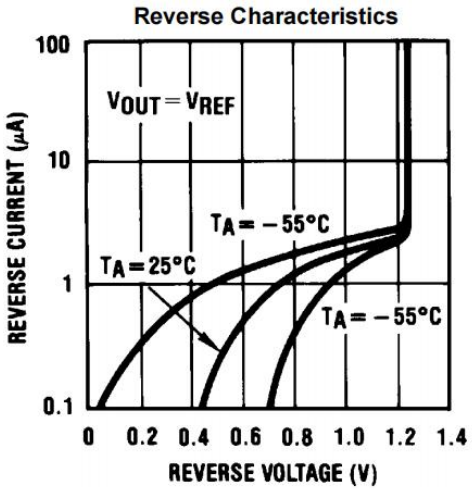


Figure 8.

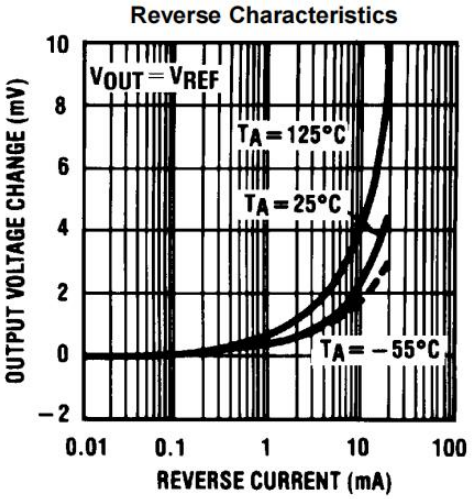


Figure 9.

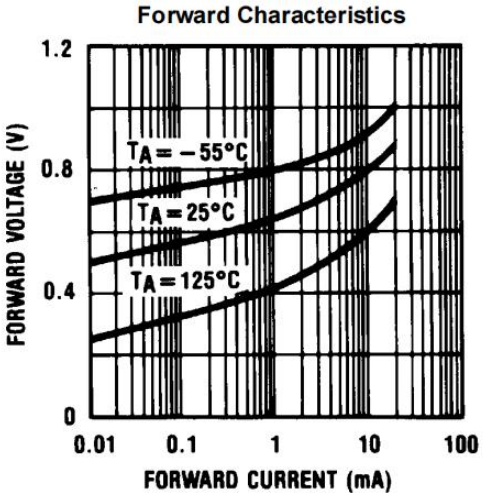


Figure 10.

TYPICAL PERFORMANCE CHARACTERISTICS (CONTINUED)

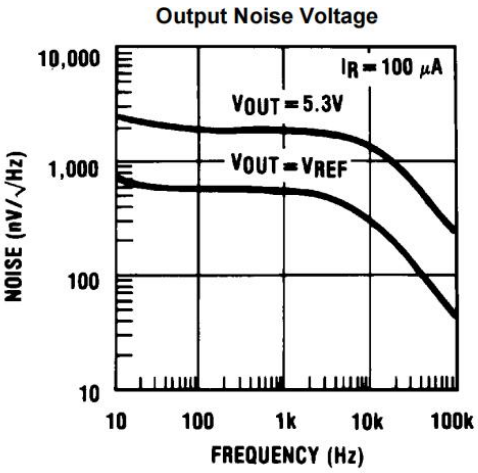


Figure 11.

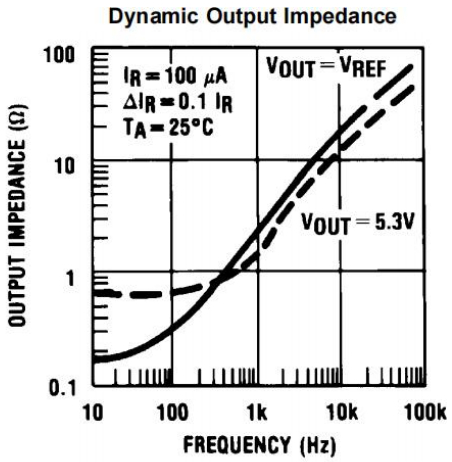


Figure 12.

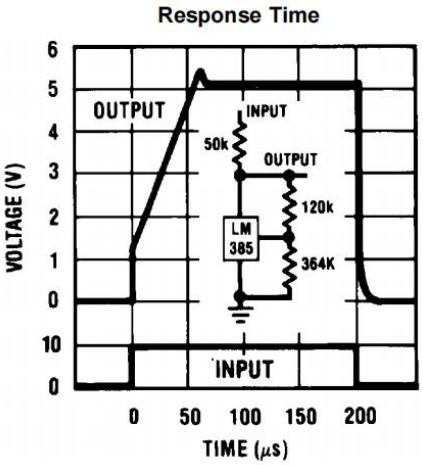


Figure 13.

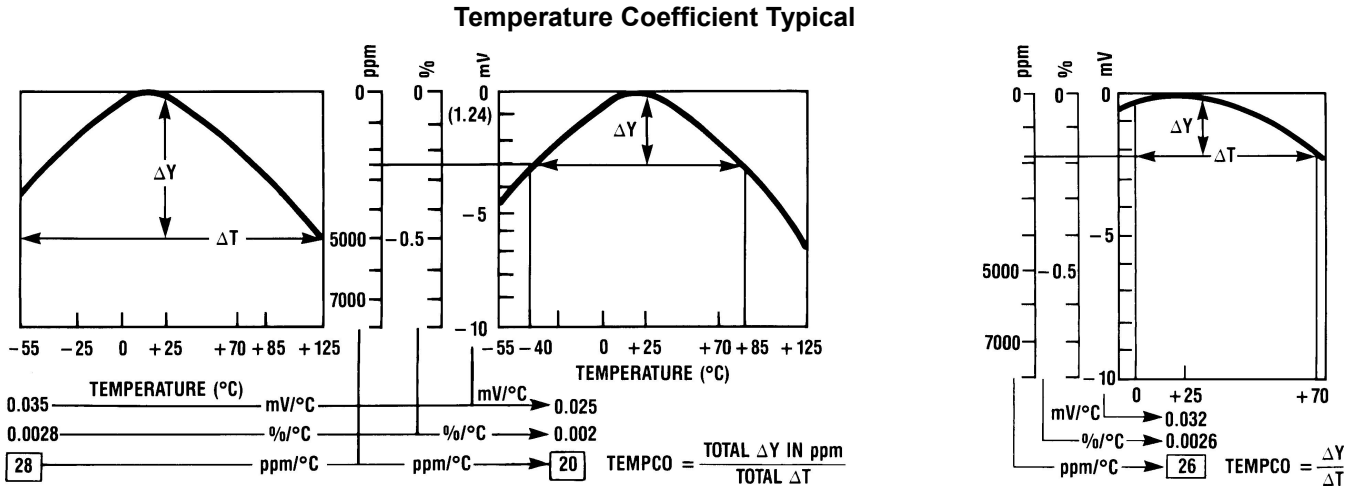


Figure 14.

TYPICAL APPLICATIONS

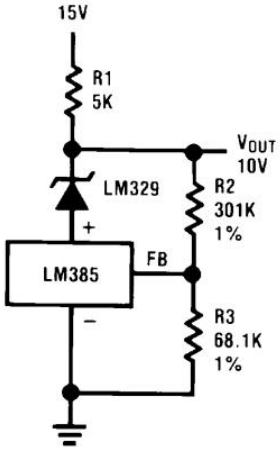


Figure 15.Precision 10V Reference

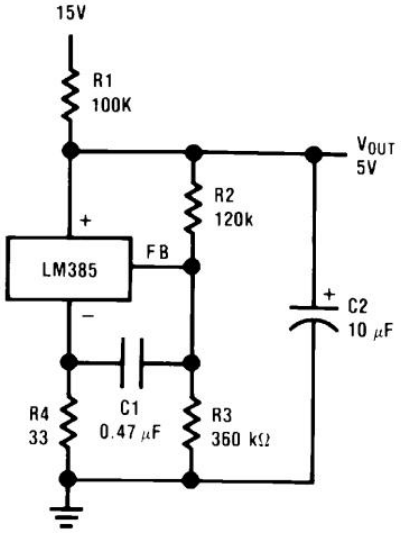


Figure 16.Low AC Noise Reference

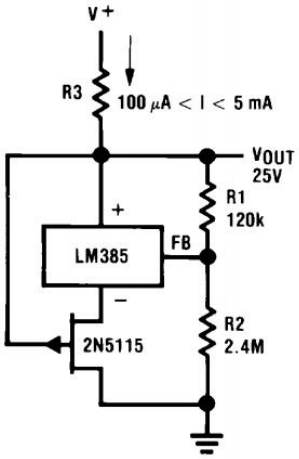


Figure 17.25V Low Current Shunt Regulator

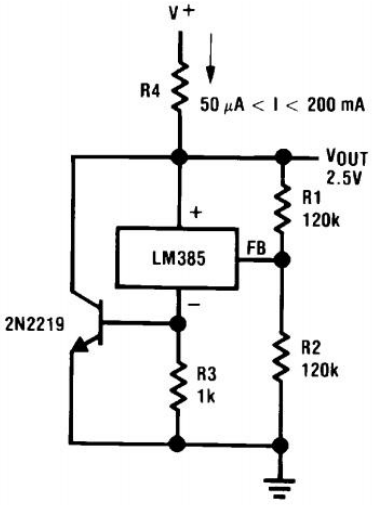


Figure 18. 200mA Shunt Regulator

TYPICAL APPLICATIONS(continued)

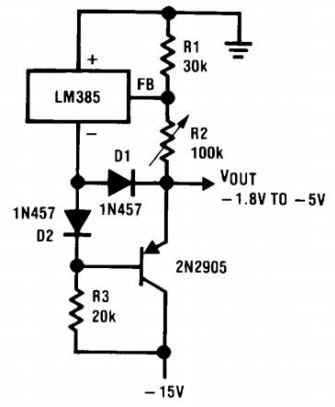


Figure 19. Series-Shunt 20mA Regulator

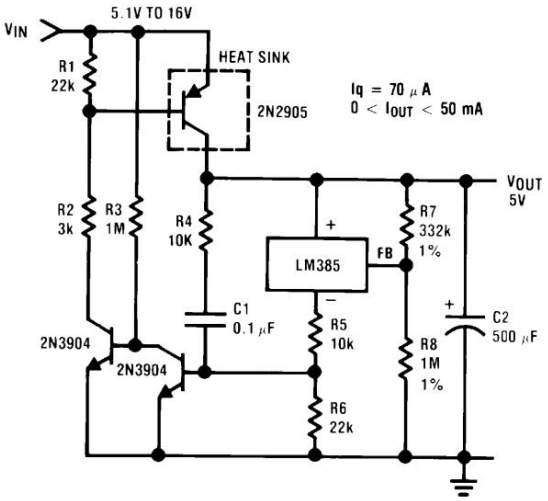


Figure 20. High Efficiency Low Power Regulator

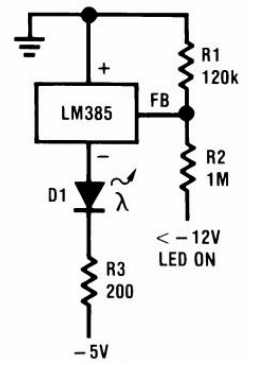


Figure 21. Voltage Level Detector

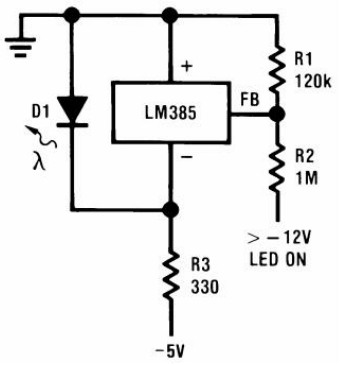


Figure 22. Voltage Level Detector

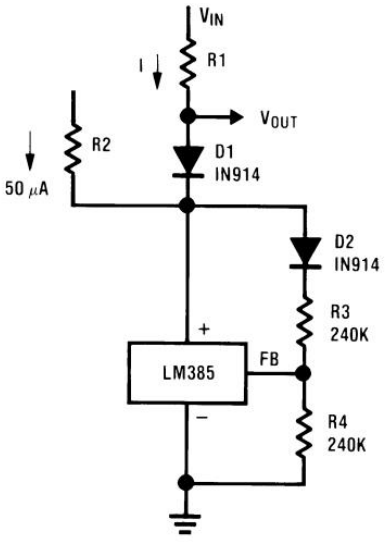


Figure 23. Fast Positive Clamp 2.4V + ΔVD1

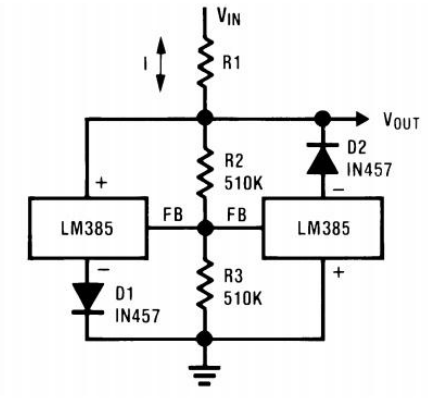


Figure 24. Bidirectional Clamp±2.4V

TYPICAL APPLICATIONS(continued)

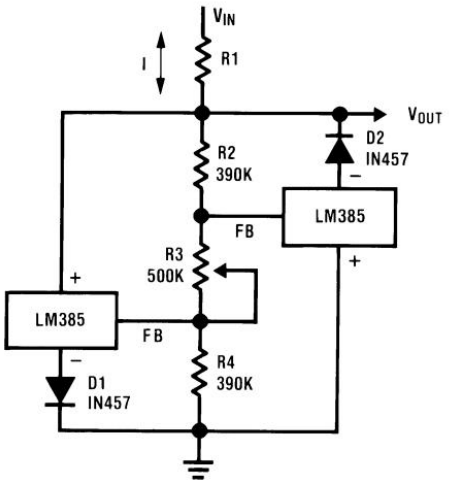


Figure 25. Bidirectional Adjustable Clamp±1.8V to ±2.4V

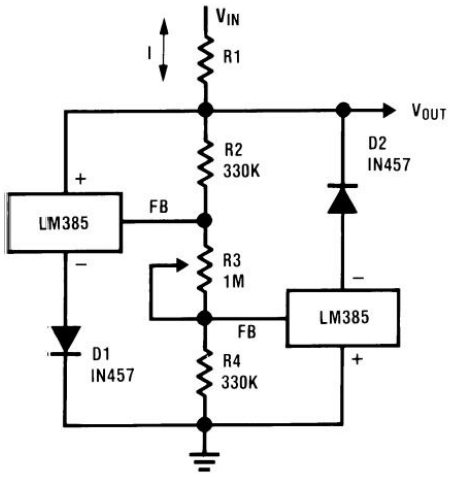


Figure 26. Bidirectional Adjustable Clamp±2.4V to ±6V

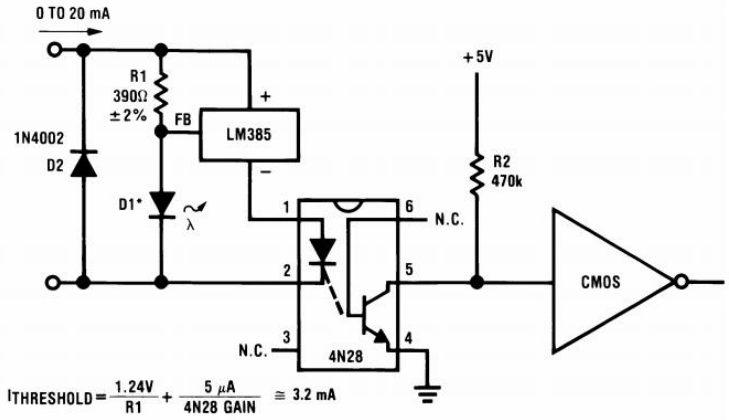


Figure 27. Simple Floating Current Detector

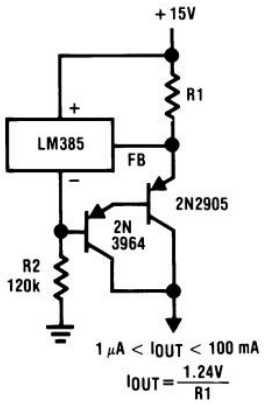
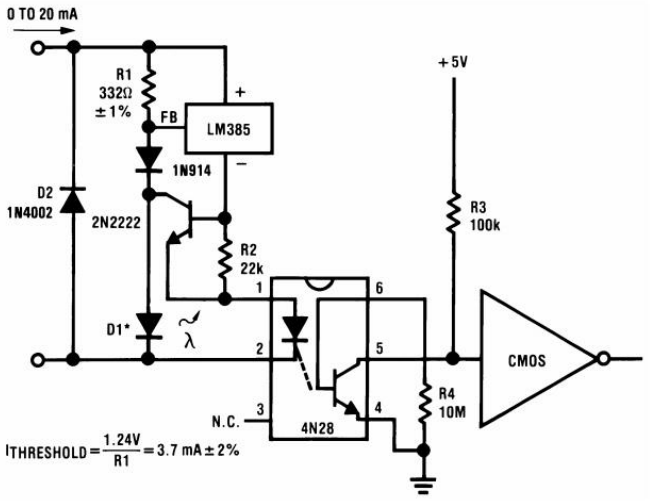


Figure 28. Current Source

TYPICAL APPLICATIONS(continued)



*D1 can be any LED, V_F=1.5V to 2.2V at 3 mA. D1 may act as an indicator. D1 will be on if $I_{THRESHOLD}$ falls below the threshold current, except with I=O.

Figure 29. Precision Floating Current Detector

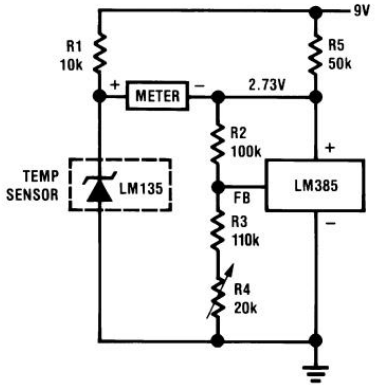


Figure 30. Centigrade Thermometer, 10mV/°C

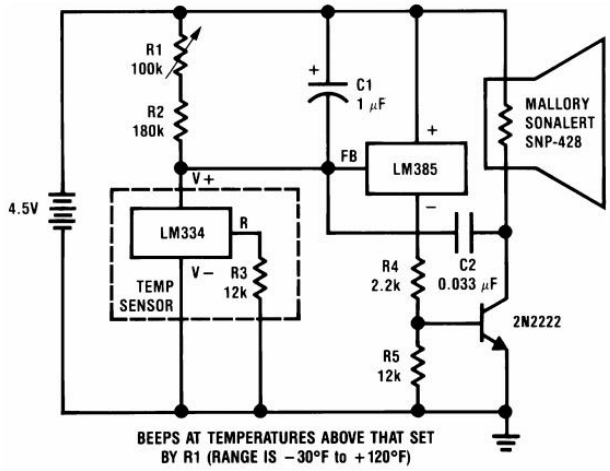
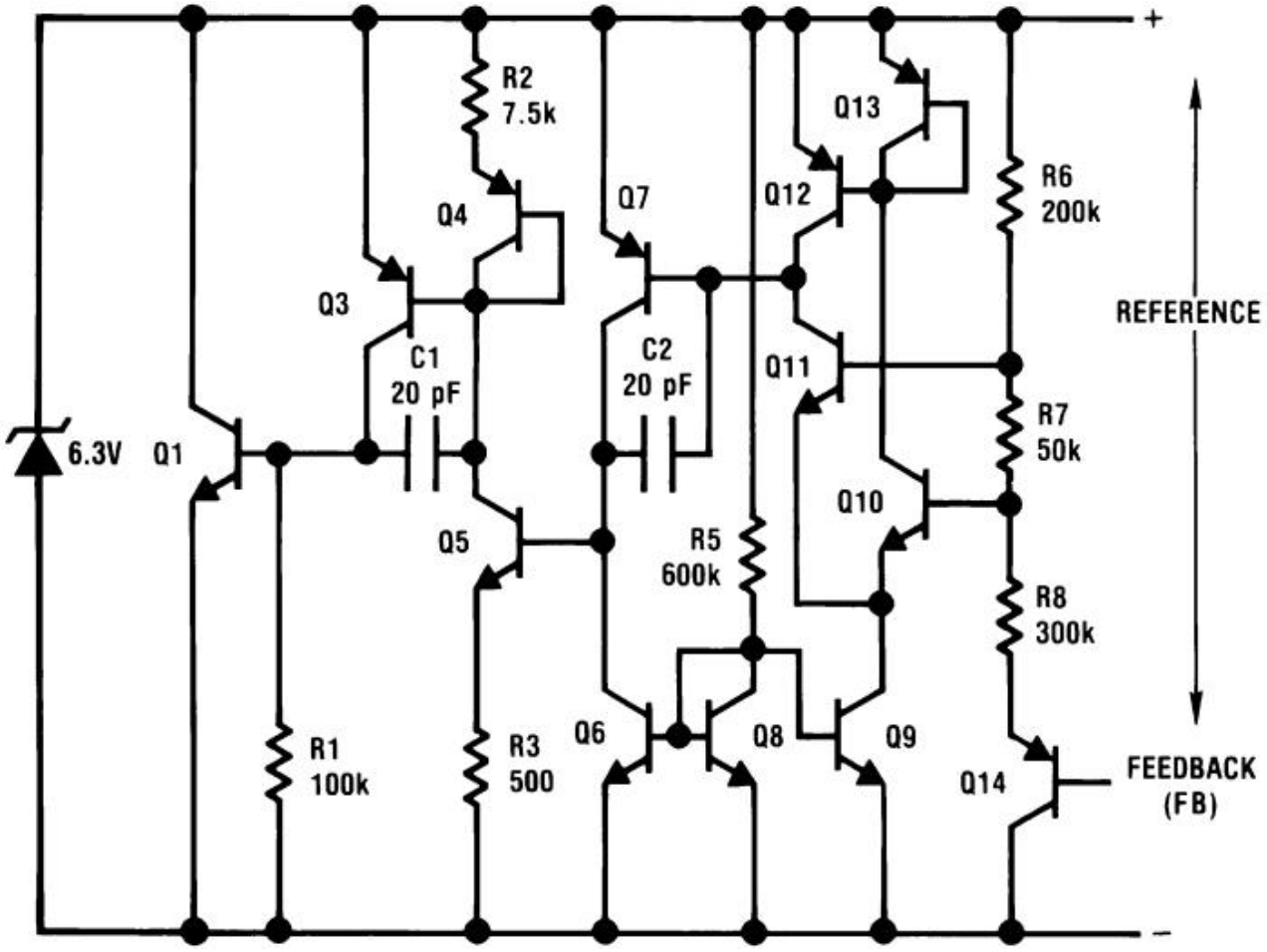


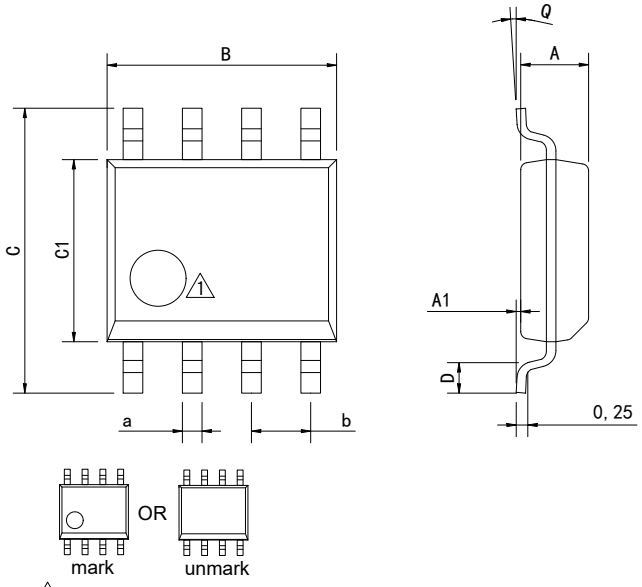
Figure 31. Freezer Alarm

Schematic Diagram



PHYSICAL DIMENSIONS

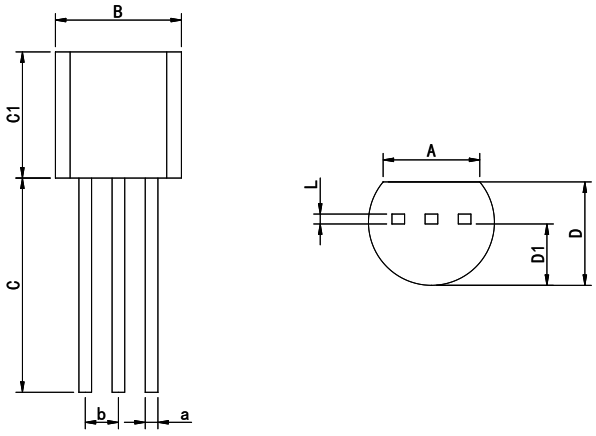
SOP-8 (150mil)



1 Package top mark may be in lower left corner or unmark

Dimensions In Millimeters(SOP-8)									
Symbol:	A	A1	B	C	C1	D	Q	a	b
Min:	1.35	0.05	4.90	5.80	3.80	0.40	0°	0.35	1.27 BSC
Max:	1.55	0.20	5.10	6.20	4.00	0.80	8°	0.45	

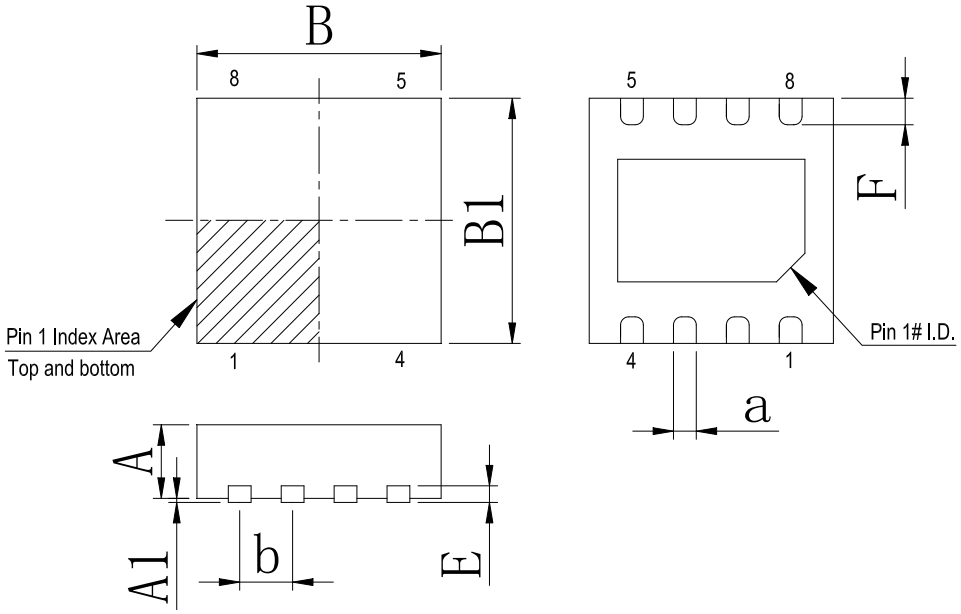
TO-92



Dimensions In Millimeters(TO-92)									
Symbol:	**A**	**B**	**C**	**C1**	**D**	**D1**	**L**	**a**	**b**
Min:	3.43	4.44	13.5	4.32	3.17	2.03	0.33	0.40	1.27BSC
Max:	4.13	5.21	15.3	5.34	4.19	2.67	0.42	0.52	

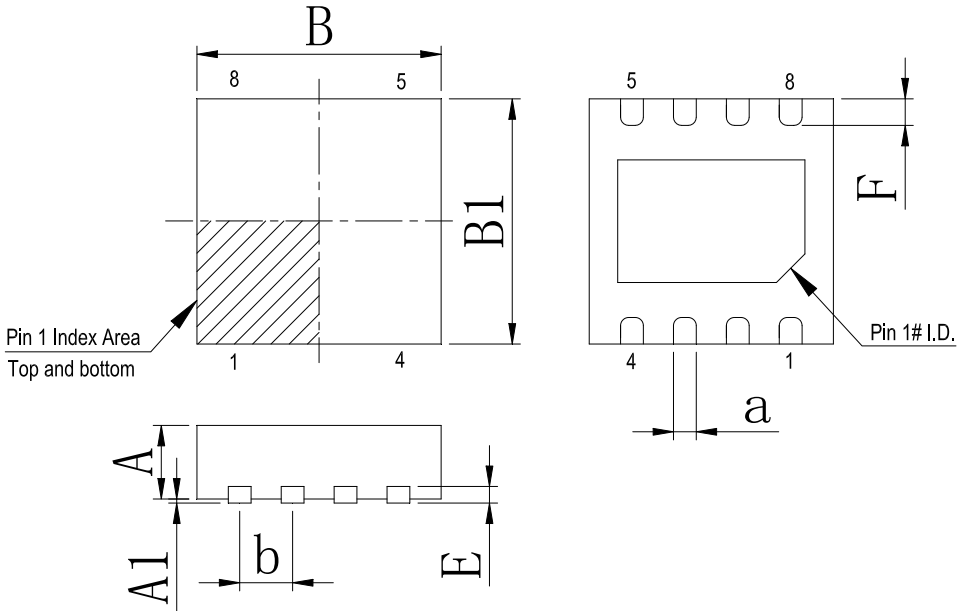
PHYSICAL DIMENSIONS

DFN-8 3*3



Dimensions In Millimeters(DFN-8 3*3)								
Symbol:	A	A1	B	B1	E	F	a	b
Min:	0.85	0.00	2.90	2.90	0.20	0.30	0.20	0.65 BSC
Max:	0.95	0.05	3.10	3.10	0.25	0.50	0.34	

DFN-8 2*2



Dimensions In Millimeters(DFN-8 2*2)								
Symbol:	A	A1	B	B1	E	F	a	b
Min:	0.85	0	1.90	1.90	0.15	0.25	0.18	0.50TYP
Max:	0.95	0.05	2.10	2.10	0.25	0.45	0.30	

REVISION HISTORY

REVISION NUMBER	DATE	REVISION	PAGE
V1.0	2012-6	New	1-15
V1.1	2016-9	Update encapsulation type、Add annotation for Maximum Ratings.	1、3
V1.2	2021-1	Update TO-92 Physical Dimensions	12
V1.3	2024-11	Update Lead Temperature	3
V1.4	2025-3	Add DFN-8 package model	1
V1.5	2025-12	Update important statements、Update sop-8 Dimension drawing	12、15

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