LM285, LM385B

Micropower Voltage Reference Diodes

The LM285/LM385 series are micropower two−terminal bandgap voltage regulator diodes. Designed to operate over a wide current range of 10 μA to 20 mA, these devices feature exceptionally low dynamic impedance, low noise and stable operation over time and temperature. Tight voltage tolerances are achieved by on−chip trimming. The large dynamic operating range enables these devices to be used in applications with widely varying supplies with excellent regulation. Extremely low operating current make these devices ideal for micropower circuitry like portable instrumentation, regulators and other analog circuitry where extended battery life is required.

The LM285/LM385 series are packaged in a low cost TO−226 plastic case and are available in two voltage versions of 1.235 V and 2.500 V as denoted by the device suffix (see Ordering Information table). The LM285 is specified over a −40°C to +85°C temperature range while the LM385 is rated from 0°C to +70°C.

The LM385 is also available in a surface mount plastic package in voltages of 1.235 V and 2.500 V.

Features

- Operating Current from 10 μA to 20 mA
- 1.0%, 1.5%, 2.0% and 3.0% Initial Tolerance Grades
- Low Temperature Coefficient
- 1.0 Ω Dynamic Impedance
- Surface Mount Package Available
- Pb−Free Packages are Available

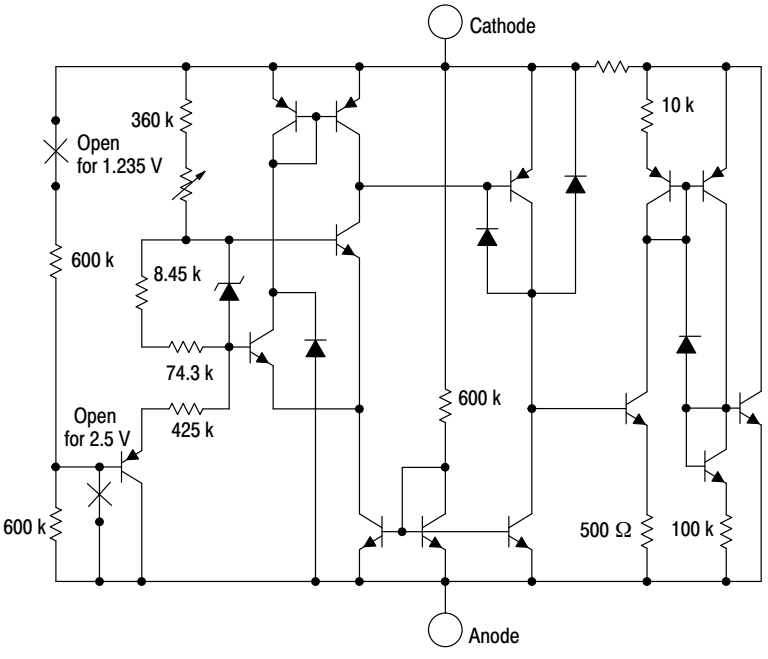


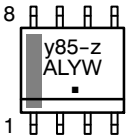
Figure 1. Representative Schematic Diagram

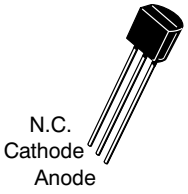
ON Semiconductor®

http://onsemi.com

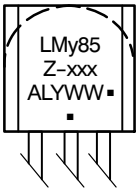
MARKING DIAGRAMS

SOIC−8
D SUFFIX
CASE 751



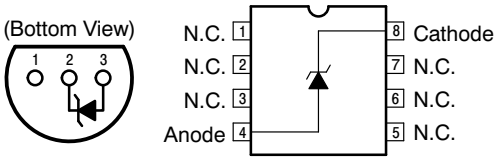


TO−92
(TO−226)
Z SUFFIX
CASE 29

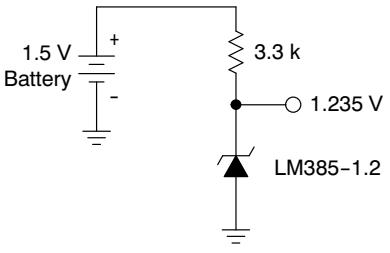


xxx	= 1.2 or 2.5
y	= 2 or 3
z	= 1 or 2
A	= Assembly Location
L	= Wafer Lot
Y	= Year
W, WW	= Work Week
▪	= Pb−Free Package

(Note: Microdot may be in either location)



Standard Application



ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 6 of this data sheet.

MAXIMUM RATINGS (T_A = 25°C, unless otherwise noted)

Rating	Symbol	Value	Unit
Reverse Current	I_R	30	mA
Forward Current	I_F	10	mA
Operating Ambient Temperature Range LM285 LM385	T_A	 −40 to +85 0 to +70	°C
Operating Junction Temperature	T_J	+150	°C
Storage Temperature Range	T_{stg}	−65 to + 150	°C
Electrostatic Discharge Sensitivity (ESD) Human Body Model (HBM) Machine Model (MM) Charged Device Model (CDM)	ESD	 4000 400 2000	V

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

ELECTRICAL CHARACTERISTICS (T_A = 25°C, unless otherwise noted)

Characteristic	Symbol	LM285−1.2			LM385−1.2/LM385B−1.2			Unit
		Min	Typ	Max	Min	Typ	Max	
Reverse Breakdown Voltage ($I_{Rmin} \le I_R \le$ 20 mA) LM285−1.2/LM385B−1.2 $T_A = T_{low}$ to T_{high} (Note 1) LM385−1.2 $T_A = T_{low}$ to T_{high} (Note 1)	$V_{(BR)R}$	 1.223 1.200 − −	 1.235 − − −	 1.247 1.270 − −	 1.223 1.210 1.205 1.192	 1.235 − 1.235 −	 1.247 1.260 1.260 1.273	V
Minimum Operating Current T_A = 25°C $T_A = T_{low}$ to T_{high} (Note 1)	I_{Rmin}	 − −	 8.0 −	 10 20	 −	 8.0 −	 15 20	μA
Reverse Breakdown Voltage Change with Current $I_{Rmin} \le I_R \le$ 1.0 mA, T_A = +25°C $T_A = T_{low}$ to T_{high} (Note 1) 1.0 mA $\le I_R \le$ 20 mA, T_A = +25°C $T_A = T_{low}$ to T_{high} (Note 1)	$\Delta V_{(BR)R}$	 − − − −	 − − − −	 1.0 1.5 10 20	 − − − −	 − − − −	 1.0 1.5 20 25	mV
Reverse Dynamic Impedance I_R = 100 μA, T_A = +25°C	Z	 −	 0.6	 −	 −	 0.6	 −	Ω
Average Temperature Coefficient 10 μA $\le I_R \le$ 20 mA, $T_A = T_{low}$ to T_{high} (Note 1)	$\Delta V_{(BR)}/\Delta T$	 −	 80	 −	 −	 80	 −	ppm/°C
Wideband Noise (RMS) I_R = 100 μA, 10 Hz $\le$ f $\le$ 10 kHz	n	 −	 60	 −	 −	 60	 −	μV
Long Term Stability I_R = 100 μA, T_A = +25°C ± 0.1°C	S	 −	 20	 −	 −	 20	 −	ppm/kHR
Reverse Breakdown Voltage ($I_{Rmin} \le I_R \le$ 20 mA) LM285−2.5/LM385B−2.5 $T_A = T_{low}$ to T_{high} (Note 1) LM385−2.5 $T_A = T_{low}$ to T_{high} (Note 1)	$V_{(BR)R}$	 2.462 2.415 − −	 2.5 − − −	 2.538 2.585 − −	 2.462 2.436 2.425 2.400	 2.5 − 2.5 −	 2.538 2.564 2.575 2.600	V
Minimum Operating Current T_A = 25°C $T_A = T_{low}$ to T_{high} (Note 1)	I_{Rmin}	 − −	 13 −	 20 30	 − −	 13 −	 20 30	μA

1. T_{low} = −40°C for LM285−1.2, LM285−2.5
   T_{high} = +85°C for LM285−1.2, LM285−2.5
   T_{low} = 0°C for LM385−1.2, LM385B−1.2, LM385−2.5, LM385B−2.5
   T_{high} = +70°C for LM385−1.2, LM385B−1.2, LM385−2.5, LM385B−2.5

ELECTRICAL CHARACTERISTICS (T_A = 25°C, unless otherwise noted)

Characteristic	Symbol	LM285−1.2			LM385−1.2/LM385B−1.2			Unit
		Min	Typ	Max	Min	Typ	Max	
Reverse Breakdown Voltage Change with Current	$\Delta V_{(BR)R}$							mV
$I_{Rmin} \le I_R \le 1.0$ mA, T_A = +25°C		–	–	1.0	–	–	2.0	
$T_A = T_{low}$ to T_{high} (Note 2)		–	–	1.5	–	–	2.5	
1.0 mA $\le I_R \le$ 20 mA, T_A = +25°C		–	–	10	–	–	20	
$T_A = T_{low}$ to T_{high} (Note 2)		–	–	20	–	–	25	
Reverse Dynamic Impedance	Z							Ω
I_R = 100 μA, T_A = +25°C		–	0.6	–	–	0.6	–	
Average Temperature Coefficient	$\Delta V_{(BR)}/\Delta T$							ppm/°C
20 μA $\le I_R \le$ 20 mA, $T_A = T_{low}$ to T_{high} (Note 2)		–	80	–	–	80	–	
Wideband Noise (RMS)	n							μV
I_R = 100 μA, 10 Hz ≤ f ≤ 10 kHz		–	120	–	–	120	–	
Long Term Stability	S							ppm/kHR
I_R = 100 μA, T_A = +25°C ± 0.1°C		–	20	–	–	20	–	

2. T_{low} = −40°C for LM285−1.2, LM285−2.5
   T_{high} = +85°C for LM285−1.2, LM285−2.5
   T_{low} = 0°C for LM385−1.2, LM385B−1.2, LM385−2.5, LM385B−2.5
   T_{high} = +70°C for LM385−1.2, LM385B−1.2, LM385−2.5, LM385B−2.5

TYPICAL PERFORMANCE CURVES FOR LM285−1.2/385−1.2/385B−1.2

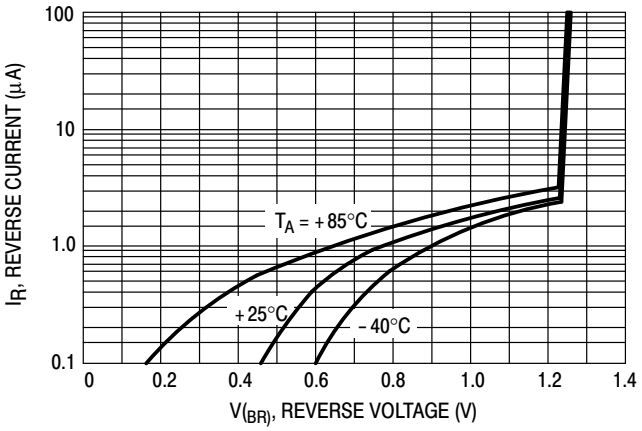


Figure 2. Reverse Characteristics

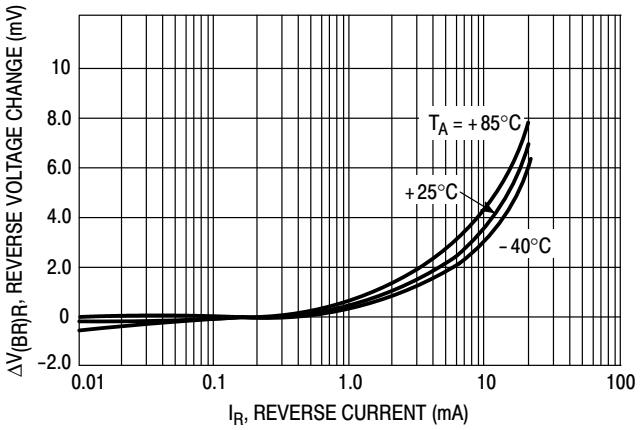


Figure 3. Reverse Characteristics

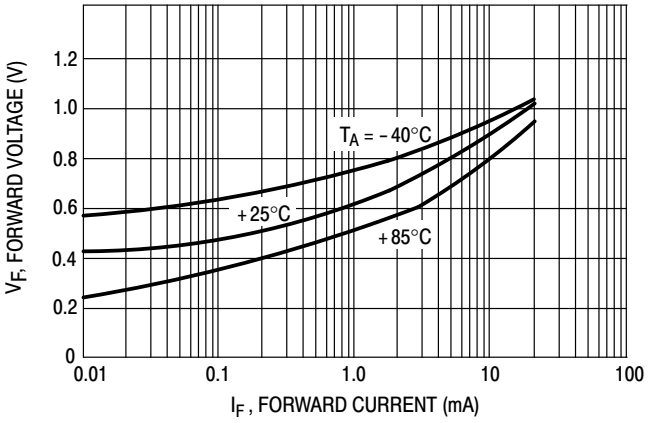


Figure 4. Forward Characteristics

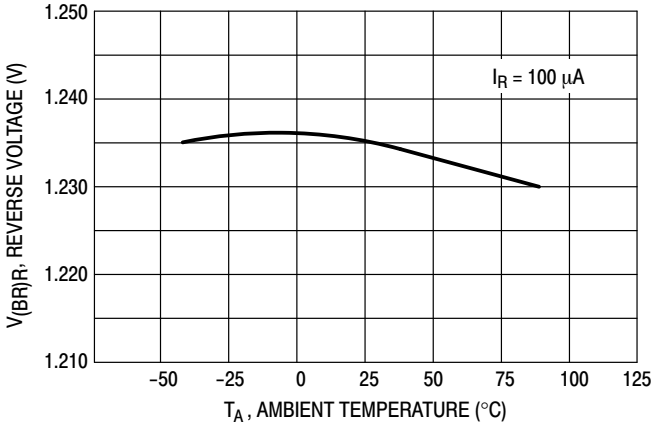


Figure 5. Temperature Drift

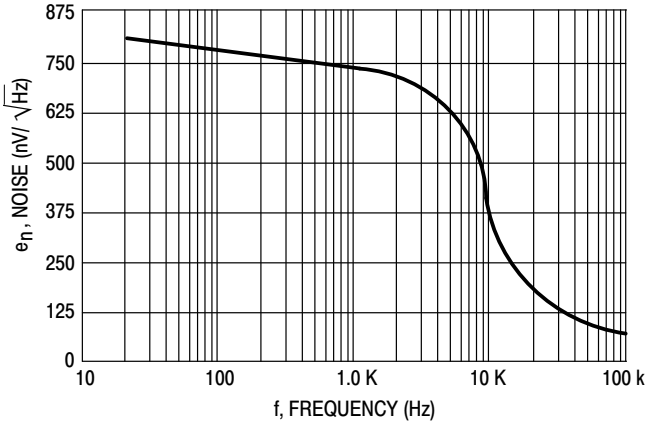


Figure 6. Noise Voltage

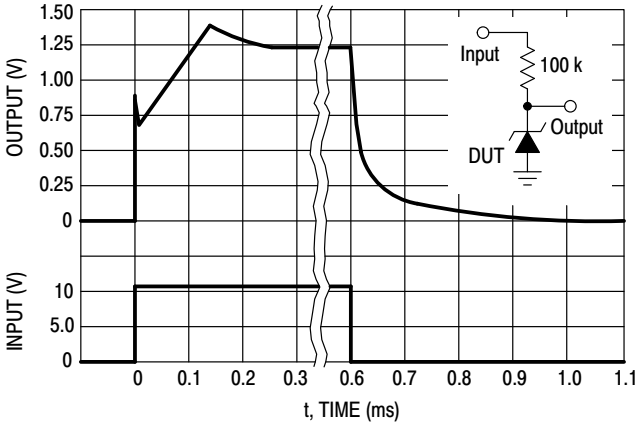


Figure 7. Response Time

TYPICAL PERFORMANCE CURVES FOR LM285−2.5/385−2.5/385B−2.5

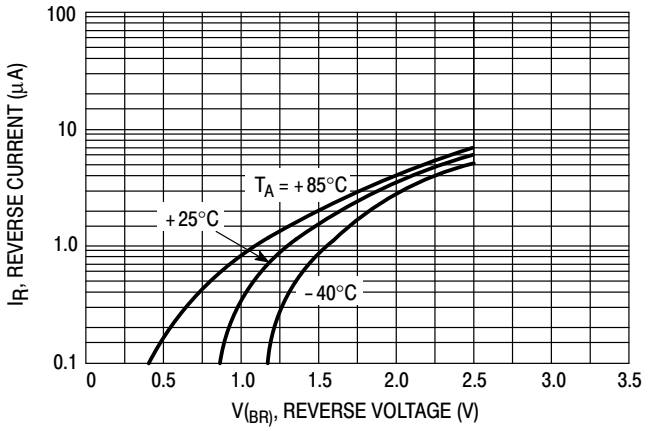


Figure 8. Reverse Characteristics

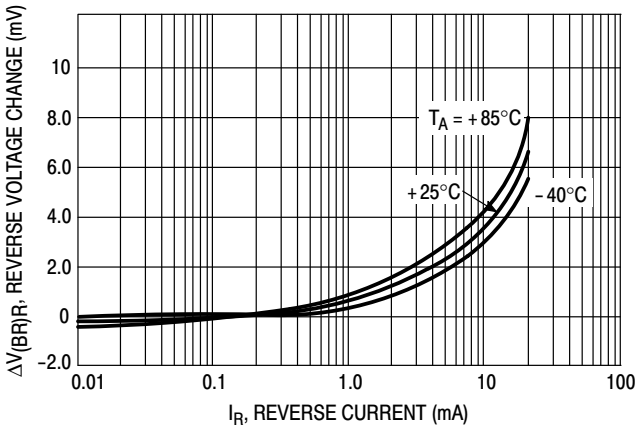


Figure 9. Reverse Characteristics

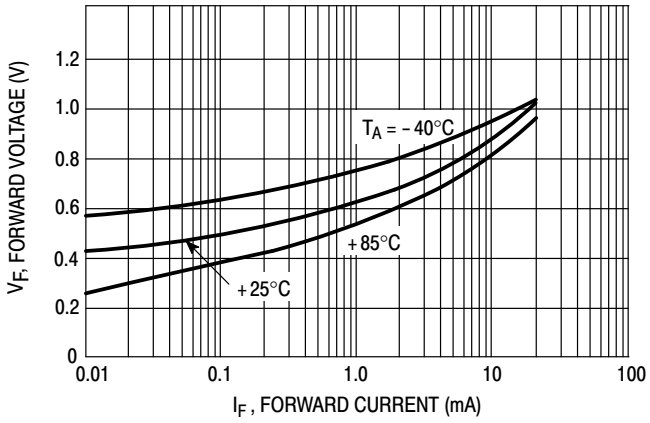


Figure 10. Forward Characteristics

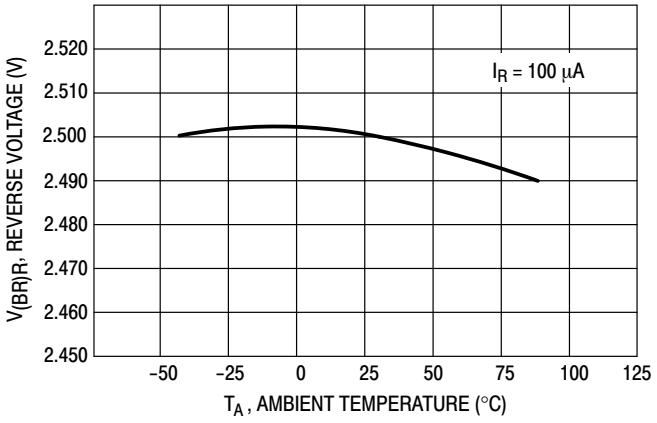


Figure 11. Temperature Drift

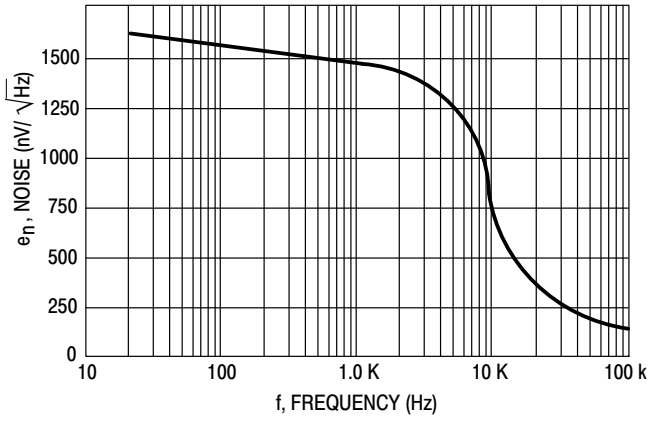


Figure 12. Noise Voltage

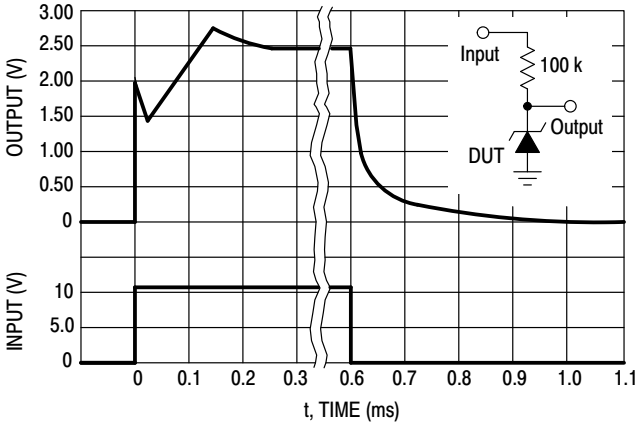


Figure 13. Response Time

ORDERING INFORMATION

Device	Operating Temperature Range	Reverse Break−Down Voltage	Package	Shipping†
LM285D−1.2	T_A = −40°C to +85°C	1.235 V	SOIC−8	98 Units / Rail
LM285D−1.2G			SOIC−8 (Pb−Free)	98 Units / Rail
LM285D−1.2R2			SOIC−8	2500 / Tape & Reel
LM285D−1.2R2G			SOIC−8 (Pb−Free)	2500 / Tape & Reel
LM285D−2.5		2.500 V	SOIC−8	98 Units / Rail
LM285D−2.5G			SOIC−8 (Pb−Free)	98 Units / Rail
LM285D−2.5R2			SOIC−8	2500 / Tape & Reel
LM285D−2.5R2G			SOIC−8 (Pb−Free)	2500 / Tape & Reel
LM285Z−1.2		1.235 V	TO−92	2000 Units / Bag
LM285Z−1.2G			TO−92 (Pb−Free)	2000 Units / Bag
LM285Z−2.5		2.500 V	TO−92	2000 Units / Bag
LM285Z−2.5G			TO−92 (Pb−Free)	2000 Units / Bag
LM285Z−1.2RA		1.235 V	TO−92	2000 / Tape & Reel
LM285Z−1.2RAG			TO−92 (Pb−Free)	2000 / Tape & Reel
LM285Z−2.5RA		2.500 V	TO−92	2000 / Tape & Reel
LM285Z−2.5RAG			TO−92 (Pb−Free)	2000 / Tape & Reel
LM285Z−2.5RP			TO−92	2000 Units / Fan−Fold
LM285Z−2.5RPG			TO−92 (Pb−Free)	2000 Units / Fan−Fold
LM385BD−1.2	T_A = 0°C to +70°C	1.235 V	SOIC−8	98 Units / Rail
LM385BD−1.2G			SOIC−8 (Pb−Free)	98 Units / Rail
LM385BD−1.2R2			SOIC−8	2500 / Tape & Reel
LM385BD−1.2R2G			SOIC−8 (Pb−Free)	2500 / Tape & Reel
LM385BD−2.5		2.500 V	SOIC−8	98 Units / Rail
LM385BD−2.5G			SOIC−8 (Pb−Free)	98 Units / Rail
LM385BD−2.5R2			SOIC−8	2500 / Tape & Reel
LM385BD−2.5R2G			SOIC−8 (Pb−Free)	2500 / Tape & Reel
LM385BZ−1.2		1.235 V	TO−92	2000 Units / Bag
LM385BZ−1.2G			TO−92 (Pb−Free)	2000 Units / Bag
LM385BZ−1.2RA			TO−92	2000 / Tape & Reel
LM385BZ−1.2RAG			TO−92 (Pb−Free)	2000 / Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

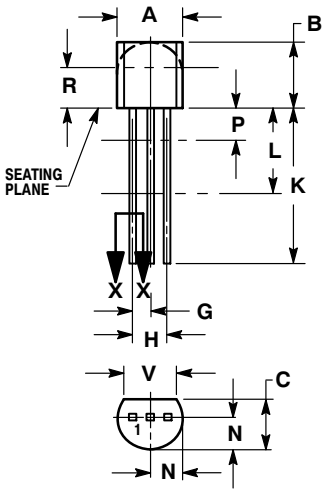
ORDERING INFORMATION

Device	Operating Temperature Range	Reverse Break−Down Voltage	Package	Shipping†
LM385BZ−2.5	T_A = 0°C to +70°C	2.500 V	TO−92	2000 Units / Bag
LM385BZ−2.5G			TO−92 (Pb−Free)	2000 Units / Bag
LM385BZ−2.5RA			TO−92	2000 / Tape & Reel
LM385BZ−2.5RAG			TO−92 (Pb−Free)	2000 / Tape & Reel
LM385D−1.2		1.235 V	SOIC−8	98 Units / Rail
LM385D−1.2G			SOIC−8 (Pb−Free)	98 Units / Rail
LM385D−1.2R2			SOIC−8	2500 / Tape & Reel
LM385D−1.2R2G			SOIC−8 (Pb−Free)	2500 / Tape & Reel
LM385D−2.5		2.500 V	SOIC−8	98 Units / Rail
LM385D−2.5G			SOIC−8 (Pb−Free)	98 Units / Rail
LM385D−2.5R2			SOIC−8	2500 / Tape & Reel
LM385D−2.5R2G			SOIC−8 (Pb−Free)	2500 / Tape & Reel
LM385Z−1.2		1.235 V	TO−92	2000 Units / Bag
LM385Z−1.2G			TO−92 (Pb−Free)	2000 Units / Bag
LM385Z−1.2RA			TO−92	2000 / Tape & Reel
LM385Z−1.2RAG			TO−92 (Pb−Free)	2000 / Tape & Reel
LM385Z−1.2RP			TO−92	2000 / Ammo Box
LM385Z−1.2RPG			TO−92 (Pb−Free)	2000 / Ammo Box
LM385Z−2.5		2.500 V	TO−92	2000 Units / Bag
LM385Z−2.5G			TO−92 (Pb−Free)	2000 Units / Bag
LM385Z−2.5RP			TO−92	2000 / Ammo Box
LM385Z−2.5RPG			TO−92 (Pb−Free)	2000 / Ammo Box

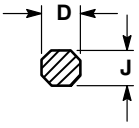
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

PACKAGE DIMENSIONS

TO−92 (TO−226)
CASE 29−11
ISSUE AM



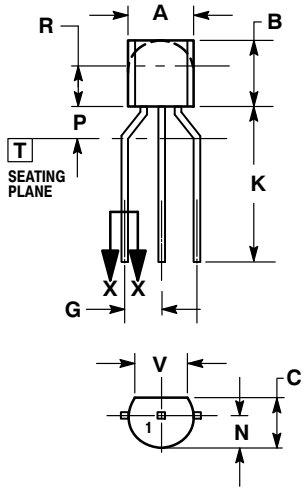
STRAIGHT LEAD
BULK PACK



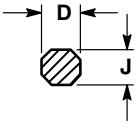
SECTION X−X

NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. CONTOUR OF PACKAGE BEYOND DIMENSION R IS UNCONTROLLED.
4. LEAD DIMENSION IS UNCONTROLLED IN P AND BEYOND DIMENSION K MINIMUM.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.175	0.205	4.45	5.20
B	0.170	0.210	4.32	5.33
C	0.125	0.165	3.18	4.19
D	0.016	0.021	0.407	0.533
G	0.045	0.055	1.15	1.39
H	0.095	0.105	2.42	2.66
J	0.015	0.020	0.39	0.50
K	0.500	---	12.70	---
L	0.250	---	6.35	---
N	0.080	0.105	2.04	2.66
P	---	0.100	---	2.54
R	0.115	---	2.93	---
V	0.135	---	3.43	---



BENT LEAD
TAPE & REEL
AMMO PACK



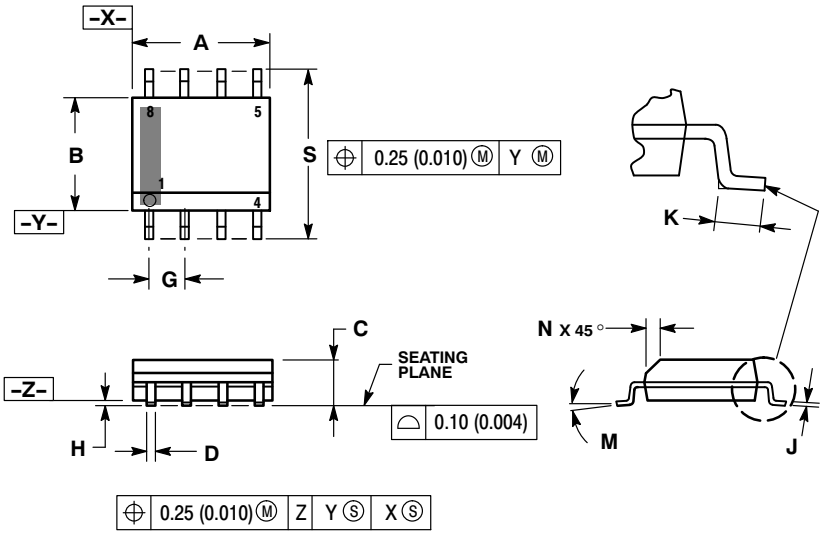
SECTION X−X

NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. CONTOUR OF PACKAGE BEYOND DIMENSION R IS UNCONTROLLED.
4. LEAD DIMENSION IS UNCONTROLLED IN P AND BEYOND DIMENSION K MINIMUM.

	MILLIMETERS	
DIM	MIN	MAX
A	4.45	5.20
B	4.32	5.33
C	3.18	4.19
D	0.40	0.54
G	2.40	2.80
J	0.39	0.50
K	12.70	---
N	2.04	2.66
P	1.50	4.00
R	2.93	---
V	3.43	---

PACKAGE DIMENSIONS

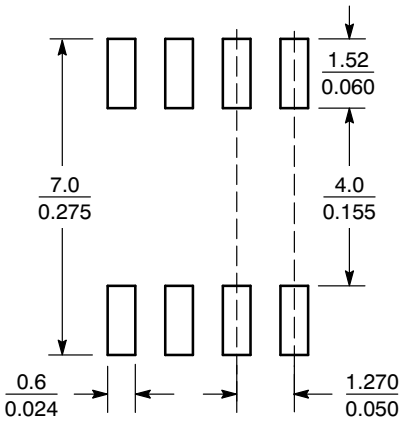
SOIC−8 NB
CASE 751−07
ISSUE AJ



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. 751−01 THRU 751−06 ARE OBSOLETE. NEW STANDARD IS 751−07.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	4.80	5.00	0.189	0.197
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.053	0.069
D	0.33	0.51	0.013	0.020
G	1.27 BSC		0.050 BSC	
H	0.10	0.25	0.004	0.010
J	0.19	0.25	0.007	0.010
K	0.40	1.27	0.016	0.050
M	0 °	8 °	0 °	8 °
N	0.25	0.50	0.010	0.020
S	5.80	6.20	0.228	0.244

SOLDERING FOOTPRINT*



SCALE 6:1 (mm / inches)

*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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