

Micropower Voltage Reference Diodes

LM285, LM385B

The LM285/LM385 series are micropower two-terminal bandgap voltage regulator diodes. Designed to operate over a wide current range of 10 μ A 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 $+85^{\circ}\text{C}$ temperature range while the LM385 is rated from 0°C to $+70^{\circ}\text{C}$.

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 μ A 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
- These Devices are Pb-Free and are RoHS Compliant

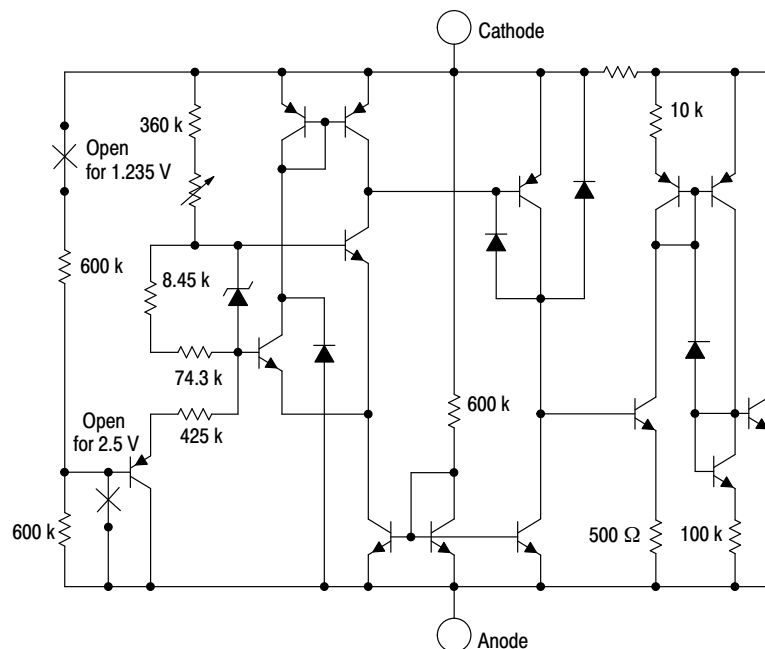
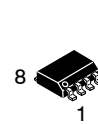
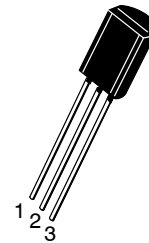
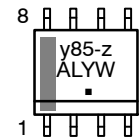


Figure 1. Representative Schematic Diagram

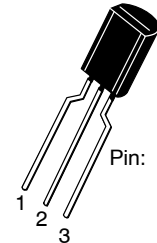
MARKING DIAGRAMS



SOIC-8
D SUFFIX
CASE 751



TO-92
CASE 29-10



Pin: 1. N.C.
2. Cathode
3. Anode

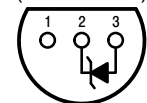
STRAIGHT LEAD

BENT LEAD

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

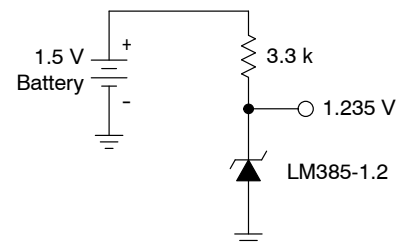
(Note: Microdot may be in either location)

(Bottom View)



N.C. 1
N.C. 2
N.C. 3
Anode 4
Cathode 8
N.C. 7
N.C. 6
N.C. 5

Standard Application



ORDERING INFORMATION

See detailed ordering and shipping information on page 6 of this data sheet.

NOTE: Some of the devices on this data sheet have been **DISCONTINUED**. Please refer to the table on page 6.

LM285, LM385B

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 those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

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} ≤ I _R ≤ 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} ≤ I _R ≤ 1.0 mA, T _A = +25 °C T _A = T _{low} to T _{high} (Note 1) 1.0 mA ≤ I _R ≤ 20 mA, T _A = +25 °C T _A = T _{low} to T _{high} (Note 1)	ΔV _{(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 ≤ I _R ≤ 20 mA, T _A = T _{low} to T _{high} (Note 1)	ΔV _{(BR)R} /ΔT	–	80	–	–	80	–	ppm/°C
Wideband Noise (RMS) I _R = 100 μA, 10 Hz ≤ f ≤ 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} ≤ I _R ≤ 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

LM285, LM385B

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 I _{Rmin} ≤ I _R ≤ 1.0 mA, T _A = +25 °C T _A = T _{low} to T _{high} (Note 2) 1.0 mA ≤ I _R ≤ 20 mA, T _A = +25 °C T _A = T _{low} to T _{high} (Note 2)	ΔV _{(BR)R}	–	–	1.0 1.5 10 20	–	–	2.0 2.5 20 25	mV
Reverse Dynamic Impedance I _R = 100 μA, T _A = +25 °C	Z	–	0.6	–	–	0.6	–	Ω
Average Temperature Coefficient 20 μA ≤ I _R ≤ 20 mA, T _A = T _{low} to T _{high} (Note 2)	ΔV _{(BR)R} /ΔT	–	80	–	–	80	–	ppm/°C
Wideband Noise (RMS) I _R = 100 μA, 10 Hz ≤ f ≤ 10 kHz	n	–	120	–	–	120	–	μV
Long Term Stability I _R = 100 μA, T _A = +25 °C ± 0.1 °C	S	–	20	–	–	20	–	ppm/kHR

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

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

LM285, LM385B

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

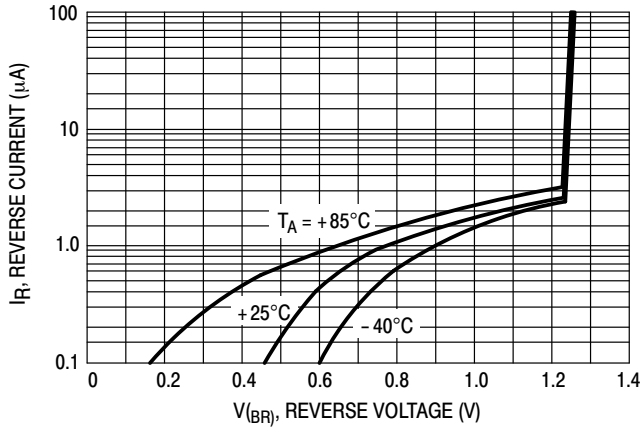


Figure 2. Reverse Characteristics

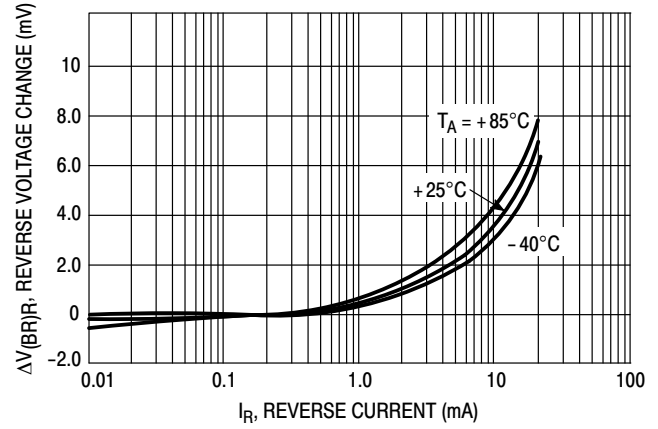


Figure 3. Reverse Characteristics

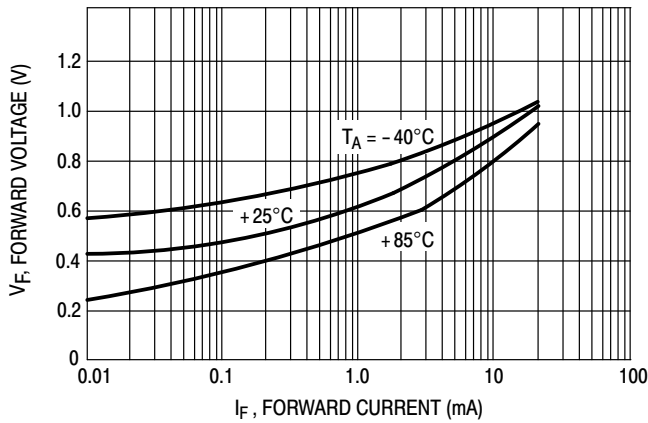


Figure 4. Forward Characteristics

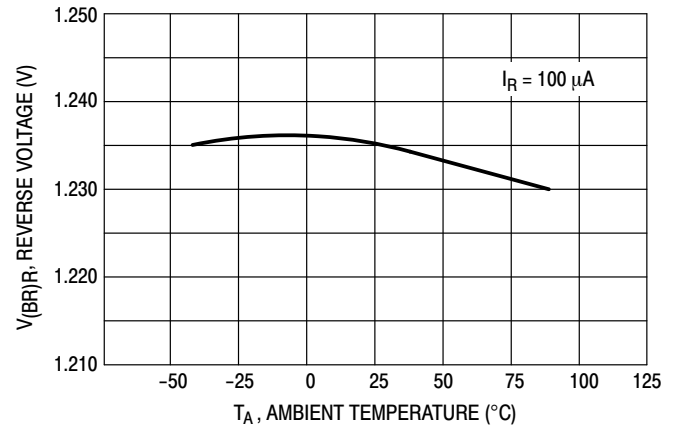


Figure 5. Temperature Drift

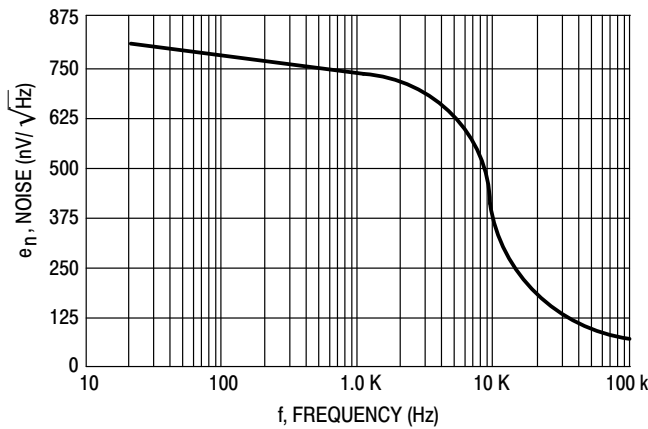


Figure 6. Noise Voltage

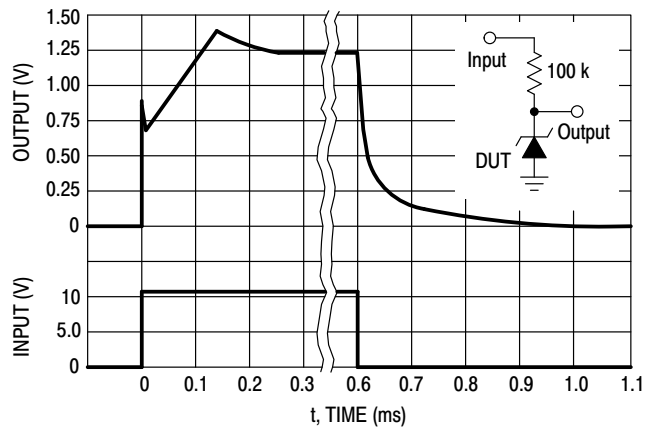


Figure 7. Response Time

LM285, LM385B

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

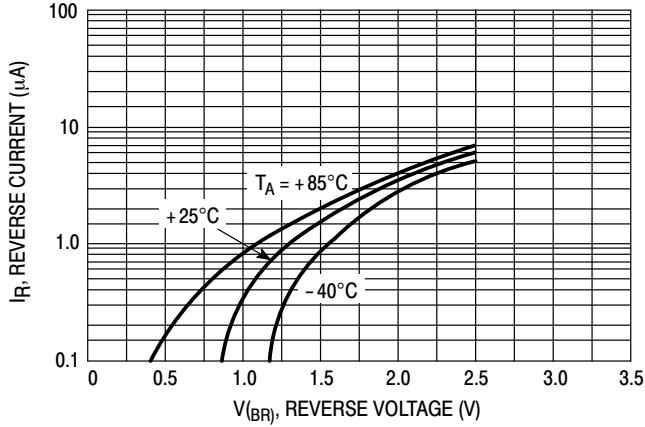


Figure 8. Reverse Characteristics

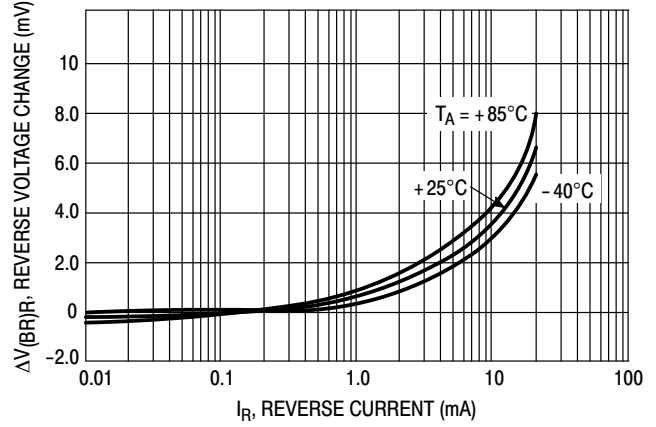


Figure 9. Reverse Characteristics

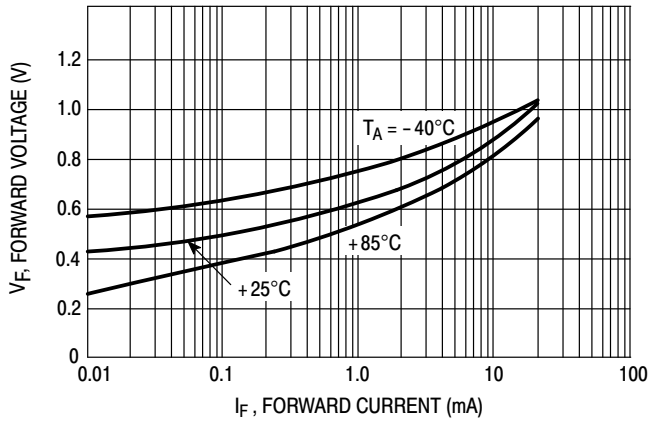


Figure 10. Forward Characteristics

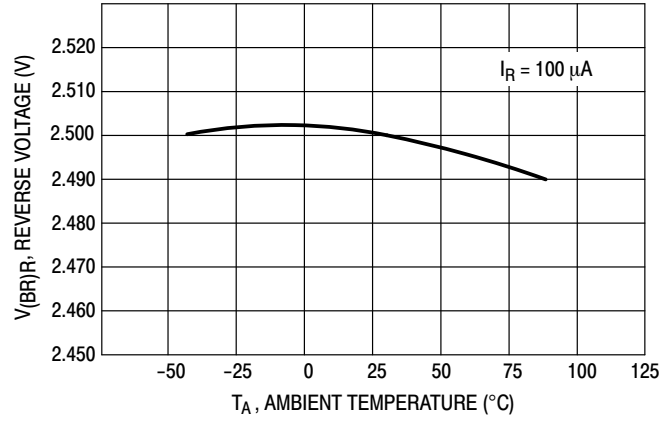


Figure 11. Temperature Drift

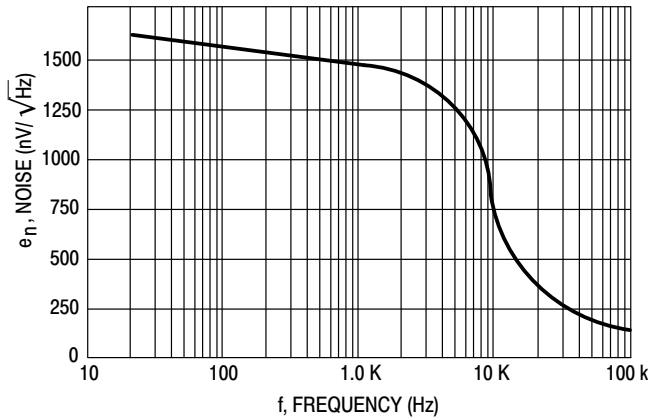


Figure 12. Noise Voltage

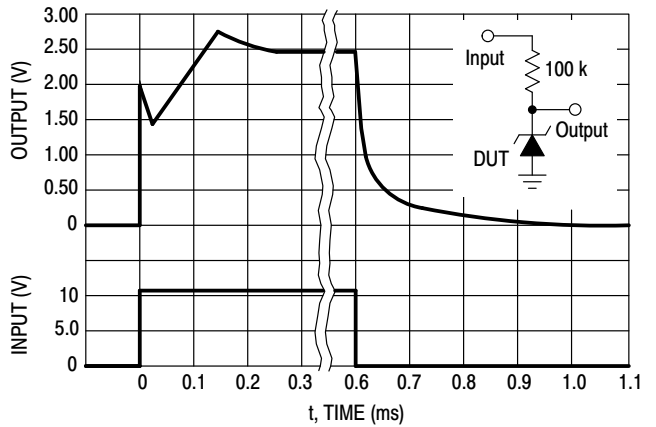


Figure 13. Response Time

LM285, LM385B

ORDERING INFORMATION

Device	Operating Temperature Range	Reverse Break-Down Voltage	Package	Shipping [†]
LM285D-1.2G	$T_A = -40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$	1.235 V	SOIC-8 (Pb-Free)	98 Units / Rail
LM285D-1.2R2G			SOIC-8 (Pb-Free)	2500 / Tape & Reel
LM285D-2.5G		2.500 V	SOIC-8 (Pb-Free)	98 Units / Rail
LM285D-2.5R2G			SOIC-8 (Pb-Free)	2500 / Tape & Reel
LM385BD-1.2R2G	$T_A = 0\text{ }^{\circ}\text{C}$ to $+70\text{ }^{\circ}\text{C}$	1.235 V	SOIC-8 (Pb-Free)	2500 / Tape & Reel
LM385BD-2.5G		2.500 V	SOIC-8 (Pb-Free)	98 Units / Rail
LM385BD-2.5R2G			SOIC-8 (Pb-Free)	2500 / Tape & Reel
LM385D-1.2G		1.235 V	SOIC-8 (Pb-Free)	98 Units / Rail
LM385D-1.2R2G			SOIC-8 (Pb-Free)	2500 / Tape & Reel
LM385D-2.5G		2.500 V	SOIC-8 (Pb-Free)	98 Units / Rail
LM385D-2.5R2G			SOIC-8 (Pb-Free)	2500 / Tape & Reel

DISCONTINUED (Note 3)

LM285D-1.2	$T_A = -40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$	1.235 V	SOIC-8	98 Units / Rail
LM285D-1.2R2			SOIC-8	2500 / Tape & Reel
LM285D-2.5		2.500 V	SOIC-8	98 Units / Rail
LM285D-2.5R2			SOIC-8	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-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
LM285Z-2.5G		2.500 V	TO-92 (Pb-Free)	2000 Units / Bag

LM285, LM385B

ORDERING INFORMATION (continued)

Device	Operating Temperature Range	Reverse Break-Down Voltage	Package	Shipping [†]
--------	-----------------------------	----------------------------	---------	-----------------------

DISCONTINUED (Note 3)

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-2.5		2.500 V	SOIC-8	98 Units / Rail
LM385BD-2.5R2			SOIC-8	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
LM385BZ-2.5		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-1.2R2			SOIC-8	2500 / Tape & Reel
LM385D-2.5		2.500 V	SOIC-8	98 Units / Rail
LM385D-2.5R2			SOIC-8	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-2.5RP			TO-92	2000 / Ammo Box
LM385Z-2.5RPG			TO-92 (Pb-Free)	2000 / Ammo Box
LM385Z-2.5G		2.500 V	TO-92 (Pb-Free)	2000 Units / Bag

[†] 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](#).

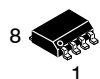
3. **DISCONTINUED:** These devices are not available. Please contact your **onsemi** representative for information. The most current information on these devices may be available on www.onsemi.com.

LM285, LM385B

REVISION HISTORY

Revision	Description of Changes	Date
13	LM385Z-2.5G, LM285Z-2.5G OPNs Marked as Discontinued.	07/15/2025

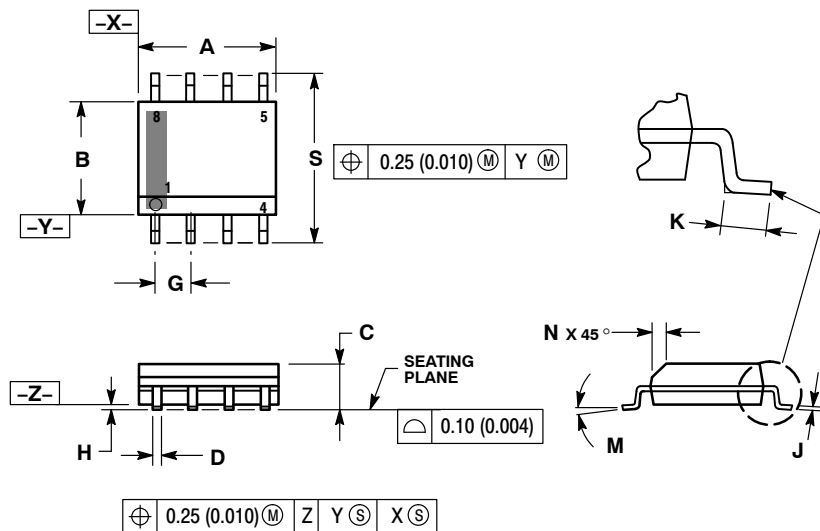
This document has undergone updates prior to the inclusion of this revision history table. The changes tracked here only reflect updates made on the noted approval dates.



SCALE 1:1

SOIC-8 NB
CASE 751-07
ISSUE AK

DATE 16 FEB 2011

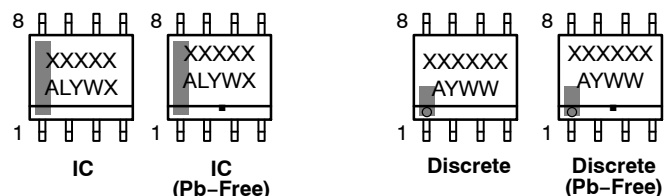
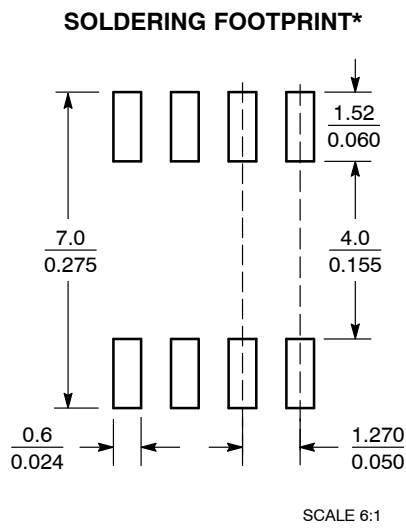


NOTES:

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.

DIM	MILLIMETERS		INCHES	
	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

GENERIC
MARKING DIAGRAM*



XXXXXX = Specific Device Code
A = Assembly Location
L = Wafer Lot
Y = Year
W = Work Week
▪ = Pb-Free Package

XXXXXX = Specific Device Code
A = Assembly Location
Y = Year
WW = Work Week
▪ = Pb-Free Package

*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

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

STYLES ON PAGE 2

DOCUMENT NUMBER:	98ASB42564B	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	SOIC-8 NB	PAGE 1 OF 2

onsemi and onsemi are trademarks of Semiconductor Components Industries, LLC dba onsemi or its subsidiaries in the United States and/or other countries. onsemi reserves the right to make changes without further notice to any products herein. onsemi makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does onsemi assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. onsemi does not convey any license under its patent rights nor the rights of others.

SOIC-8 NB
CASE 751-07
ISSUE AK

DATE 16 FEB 2011

STYLE 1: PIN 1. EMITTER 2. COLLECTOR 3. COLLECTOR 4. EMITTER 5. EMITTER 6. BASE 7. BASE 8. EMITTER	STYLE 2: PIN 1. COLLECTOR, DIE, #1 2. COLLECTOR, #1 3. COLLECTOR, #2 4. COLLECTOR, #2 5. BASE, #2 6. EMITTER, #2 7. BASE, #1 8. EMITTER, #1	STYLE 3: PIN 1. DRAIN, DIE #1 2. DRAIN, #1 3. DRAIN, #2 4. DRAIN, #2 5. GATE, #2 6. SOURCE, #2 7. GATE, #1 8. SOURCE, #1	STYLE 4: PIN 1. ANODE 2. ANODE 3. ANODE 4. ANODE 5. ANODE 6. ANODE 7. ANODE 8. COMMON CATHODE
STYLE 5: PIN 1. DRAIN 2. DRAIN 3. DRAIN 4. DRAIN 5. GATE 6. GATE 7. SOURCE 8. SOURCE	STYLE 6: PIN 1. SOURCE 2. DRAIN 3. DRAIN 4. SOURCE 5. SOURCE 6. GATE 7. GATE 8. SOURCE	STYLE 7: PIN 1. INPUT 2. EXTERNAL BYPASS 3. THIRD STAGE SOURCE 4. GROUND 5. DRAIN 6. GATE 3 7. SECOND STAGE Vd 8. FIRST STAGE Vd	STYLE 8: PIN 1. COLLECTOR, DIE #1 2. BASE, #1 3. BASE, #2 4. COLLECTOR, #2 5. COLLECTOR, #2 6. EMITTER, #2 7. EMITTER, #1 8. COLLECTOR, #1
STYLE 9: PIN 1. EMITTER, COMMON 2. COLLECTOR, DIE #1 3. COLLECTOR, DIE #2 4. EMITTER, COMMON 5. EMITTER, COMMON 6. BASE, DIE #2 7. BASE, DIE #1 8. EMITTER, COMMON	STYLE 10: PIN 1. GROUND 2. BIAS 1 3. OUTPUT 4. GROUND 5. GROUND 6. BIAS 2 7. INPUT 8. GROUND	STYLE 11: PIN 1. SOURCE 1 2. GATE 1 3. SOURCE 2 4. GATE 2 5. DRAIN 2 6. DRAIN 2 7. DRAIN 1 8. DRAIN 1	STYLE 12: PIN 1. SOURCE 2. SOURCE 3. SOURCE 4. GATE 5. DRAIN 6. DRAIN 7. DRAIN 8. DRAIN
STYLE 13: PIN 1. N.C. 2. SOURCE 3. SOURCE 4. GATE 5. DRAIN 6. DRAIN 7. DRAIN 8. DRAIN	STYLE 14: PIN 1. N-SOURCE 2. N-GATE 3. P-SOURCE 4. P-GATE 5. P-DRAIN 6. P-DRAIN 7. N-DRAIN 8. N-DRAIN	STYLE 15: PIN 1. ANODE 1 2. ANODE 1 3. ANODE 1 4. ANODE 1 5. CATHODE, COMMON 6. CATHODE, COMMON 7. CATHODE, COMMON 8. CATHODE, COMMON	STYLE 16: PIN 1. EMITTER, DIE #1 2. BASE, DIE #1 3. EMITTER, DIE #2 4. BASE, DIE #2 5. COLLECTOR, DIE #2 6. COLLECTOR, DIE #2 7. COLLECTOR, DIE #1 8. COLLECTOR, DIE #1
STYLE 17: PIN 1. VCC 2. V2OUT 3. V1OUT 4. TXE 5. RXE 6. VEE 7. GND 8. ACC	STYLE 18: PIN 1. ANODE 2. ANODE 3. SOURCE 4. GATE 5. DRAIN 6. DRAIN 7. CATHODE 8. CATHODE	STYLE 19: PIN 1. SOURCE 1 2. GATE 1 3. SOURCE 2 4. GATE 2 5. DRAIN 2 6. MIRROR 2 7. DRAIN 1 8. MIRROR 1	STYLE 20: PIN 1. SOURCE (N) 2. GATE (N) 3. SOURCE (P) 4. GATE (P) 5. DRAIN 6. DRAIN 7. DRAIN 8. DRAIN
STYLE 21: PIN 1. CATHODE 1 2. CATHODE 2 3. CATHODE 3 4. CATHODE 4 5. CATHODE 5 6. COMMON ANODE 7. COMMON ANODE 8. CATHODE 6	STYLE 22: PIN 1. I/O LINE 1 2. COMMON CATHODE/VCC 3. COMMON CATHODE/VCC 4. I/O LINE 3 5. COMMON ANODE/GND 6. I/O LINE 4 7. I/O LINE 5 8. COMMON ANODE/GND	STYLE 23: PIN 1. LINE 1 IN 2. COMMON ANODE/GND 3. COMMON ANODE/GND 4. LINE 2 IN 5. LINE 2 OUT 6. COMMON ANODE/GND 7. COMMON ANODE/GND 8. LINE 1 OUT	STYLE 24: PIN 1. BASE 2. EMITTER 3. COLLECTOR/ANODE 4. COLLECTOR/ANODE 5. CATHODE 6. CATHODE 7. COLLECTOR/ANODE 8. COLLECTOR/ANODE
STYLE 25: PIN 1. VIN 2. N/C 3. REXT 4. GND 5. IOUT 6. IOUT 7. IOUT 8. IOUT	STYLE 26: PIN 1. GND 2. dv/dt 3. ENABLE 4. ILIMIT 5. SOURCE 6. SOURCE 7. SOURCE 8. VCC	STYLE 27: PIN 1. ILIMIT 2. OVLO 3. UVLO 4. INPUT+ 5. SOURCE 6. SOURCE 7. SOURCE 8. DRAIN	STYLE 28: PIN 1. SW_TO_GND 2. DASIC_OFF 3. DASIC_SW_DET 4. GND 5. V_MON 6. VBULK 7. VBULK 8. VIN
STYLE 29: PIN 1. BASE, DIE #1 2. EMITTER, #1 3. BASE, #2 4. EMITTER, #2 5. COLLECTOR, #2 6. COLLECTOR, #2 7. COLLECTOR, #1 8. COLLECTOR, #1	STYLE 30: PIN 1. DRAIN 1 2. DRAIN 1 3. GATE 2 4. SOURCE 2 5. SOURCE 1/DRAIN 2 6. SOURCE 1/DRAIN 2 7. SOURCE 1/DRAIN 2 8. GATE 1		

DOCUMENT NUMBER:	98ASB42564B	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	SOIC-8 NB	PAGE 2 OF 2

onsemi and **onsemi** are trademarks of Semiconductor Components Industries, LLC dba **onsemi** or its subsidiaries in the United States and/or other countries. **onsemi** reserves the right to make changes without further notice to any products herein. **onsemi** makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. **onsemi** does not convey any license under its patent rights nor the rights of others.

onsemi, **Onsemi**, and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi**'s product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:

Technical Library: www.onsemi.com/design/resources/technical-documentation
onsemi Website: www.onsemi.com

ONLINE SUPPORT: www.onsemi.com/support

For additional information, please contact your local Sales Representative at
www.onsemi.com/support/sales