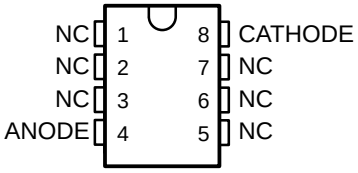
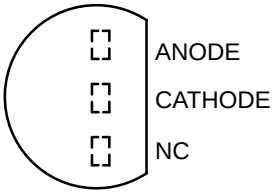
- **Operating Current Range**
  - **LM285 . . . 10 μA to 20 mA**
  - **LM385 . . . 15 μA to 20 mA**
  - **LM385B . . . 15 μA to 20 mA**
- **1% and 2% Initial Voltage Tolerance**
- **Reference Impedance**
  - **LM385 . . . 1 Ω Max at 25°C**
  - **All Devices . . . 1.5 Ω Max Over Full Temperature Range**
- **Very Low Power Consumption**
- **Applications**
  - **Portable Meter References**
  - **Portable Test Instruments**
  - **Battery-Operated Systems**
  - **Current-Loop Instrumentation**
  - **Panel Meters**
- **Designed to be Interchangeable With National LM285-1.2 and LM385-1.2**

LM285-1.2, LM385B-1.2 . . . D PACKAGE
LM385-1.2 . . . D OR PS PACKAGE
(TOP VIEW)



NC – No internal connection

LP PACKAGE
(TOP VIEW)



NC – No internal connection

description

These micropower, two-terminal, band-gap voltage references operate over a 10-μA to 20-mA current range and feature exceptionally low dynamic impedance and good temperature stability. On-chip trimming provides tight voltage tolerance. The band-gap reference for these devices has low noise and long-term stability.

The design makes these devices exceptionally tolerant of capacitive loading and, thus, easier to use in most reference applications. The wide dynamic operating temperature range accommodates varying current supplies, with excellent regulation.

The extremely low power drain of this series makes them useful for micropower circuitry. These voltage references can be used to make portable meters, regulators, or general-purpose analog circuitry, with battery life approaching shelf life. The wide operating current range allows them to replace older references with tighter-tolerance parts.

The LM285-1.2 is characterized for operation from –40°C to 85°C. The LM385-1.2 and LM385B-1.2 are characterized for operation from 0°C to 70°C.

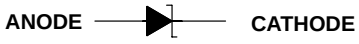
AVAILABLE OPTIONS

T_A	V_Z TOLERANCE	PACKAGED DEVICES	
		SMALL OUTLINE (D, PS)	PLASTIC (LP)
0°C to 70°C	2%	LM385D-1.2 LM385PS-1.2	LM385LP-1.2
	1%	LM385BD-1.2	LM385BLP-1.2
–40°C to 85°C	1%	LM285D-1.2	LM285LP-1.2

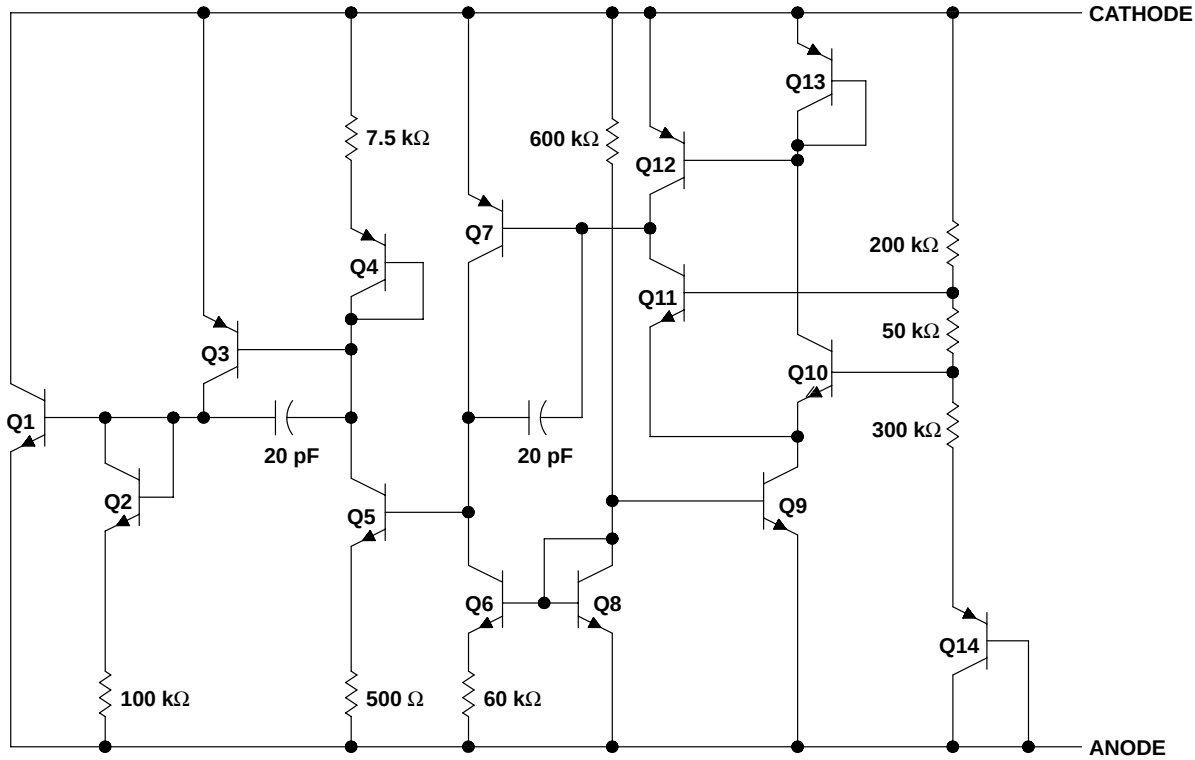
The D and LP packages are available taped and reeled. Add the suffix R to the device type (e.g., LM385DR-1-2). The PS package is only available taped and reeled.
For ordering purposes, the decimal point in the part number must be replaced with a hyphen (i.e., show the -1.2 suffix as “-1-2”).

Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

symbol



schematic



NOTE A: Component values shown are nominal.

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Reverse current, I_R . . . . . 30 mA
Forward current, I_F . . . . . 10 mA
Package thermal impedance, θ_{JA} (see Notes 1 and 2): D package . . . . . 97°C/W
LP package . . . . . 156°C/W
PS package . . . . . 95°C/W
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds . . . . . 260°C
Storage temperature range, T_{stg} . . . . . –65°C to 150°C

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTES: 1. Maximum power dissipation is a function of $T_{J(max)}$, θ_{JA}, and T_A. The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_{J(max)} – T_A)/\theta_{JA}$. Operation at the absolute maximum T_J of 150°C can affect reliability.
2. The package thermal impedance is calculated in accordance with JESD 51-7.

recommended operating conditions

			MIN	MAX	UNIT
I_Z	Reference current		0.01	20	mA
T_A	Operating free-air temperature range	LM285-1.2	–40	85	°C
		LM385-1.2, LM385B-1.2	0	70	

electrical characteristics at specified free-air temperature

PARAMETER		TEST CONDITIONS	T_A†	LM285-1.2			LM385-1.2			LM385B-1.2			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
V_Z	Reference voltage	I_Z = I(min) to 20 mA‡	25°C	1.223	1.235	1.247	1.21	1.235	1.26	1.223	1.235	1.247	V
α_{VZ}	Average temperature coefficient of reference voltage§	I_Z = I(min) to 20 mA‡	25°C		±20			±20			±20		ppm/°C
ΔV_Z	Change in reference voltage with current	I_Z = I(min) to 1 mA‡	25°C			1			1			1	mV
			Full range			1.5			1.5			1.5	
		I_Z = 1 mA to 20 mA	25°C			12			20			20	
			Full range			30			30			30	
$\Delta V_Z/\Delta t$	Long-term change in reference voltage	I_Z = 100 μA	25°C		±20			±20			±20		ppm/khr
I_Z(min)	Minimum reference current		Full range		8	10		8	15		8	15	μA
z_z	Reference impedance	I_Z = 100 μA, f = 25 Hz	25°C		0.2	0.6		0.4	1		0.4	1	Ω
			Full range			1.5			1.5			1.5	
V_n	Broadband noise voltage	I_Z = 100 μA, f = 10 Hz to 10 kHz	25°C		60			60			60		μV

† Full range is –40°C to 85°C for the LM285-1.2 and 0°C to 70°C for the LM385-1.2 and LM385B-1.2.
‡ I(min) = 10 μA for the LM285-1.2 and 15 μA for the LM385-1.2 and LM385B-1.2
§ The average temperature coefficient of reference voltage is defined as the total change in reference voltage divided by the specified temperature range.

TYPICAL CHARACTERISTICS†

REVERSE CURRENT
vs
REVERSE VOLTAGE

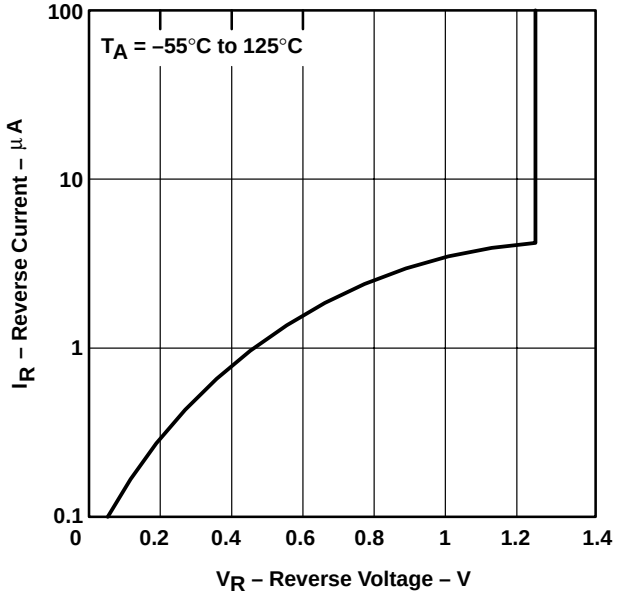


Figure 1

REFERENCE VOLTAGE CHANGE
vs
REVERSE CURRENT

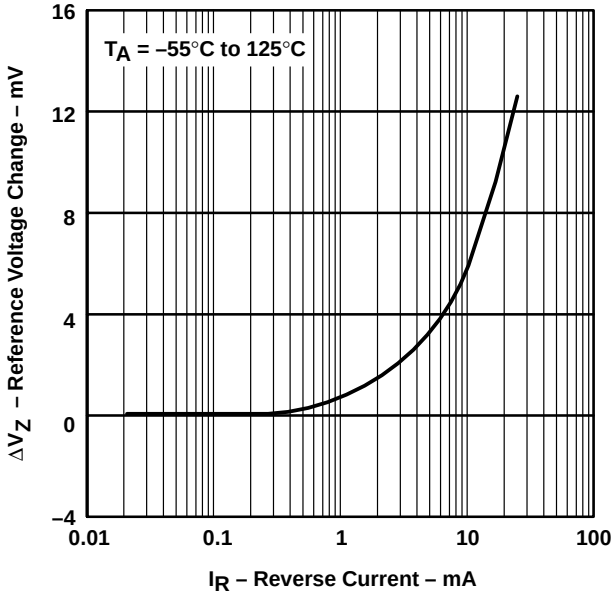


Figure 2

FORWARD VOLTAGE
vs
FORWARD CURRENT

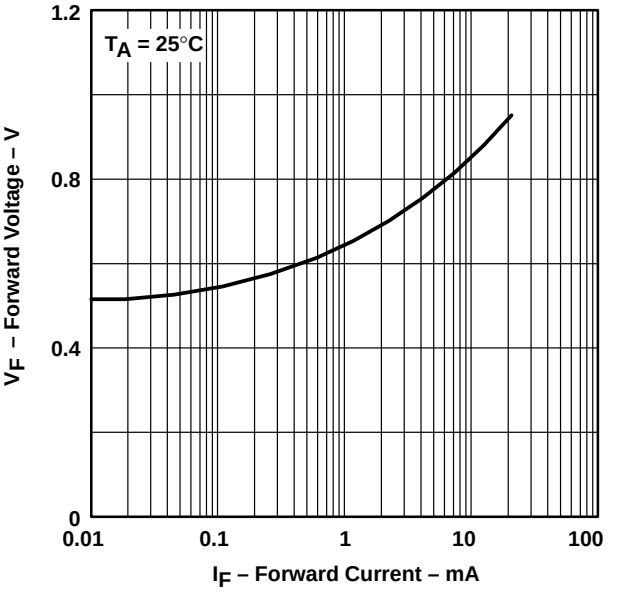


Figure 3

REFERENCE VOLTAGE
vs
FREE-AIR TEMPERATURE

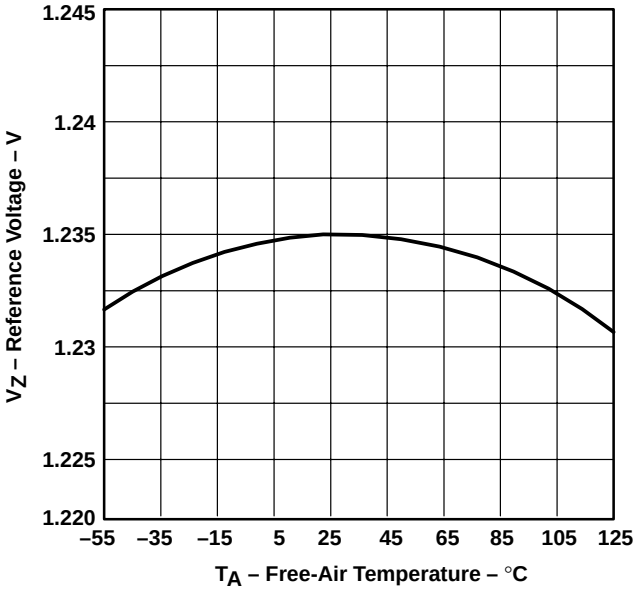


Figure 4

† Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

TYPICAL CHARACTERISTICS†

REFERENCE IMPEDANCE vs REFERENCE CURRENT

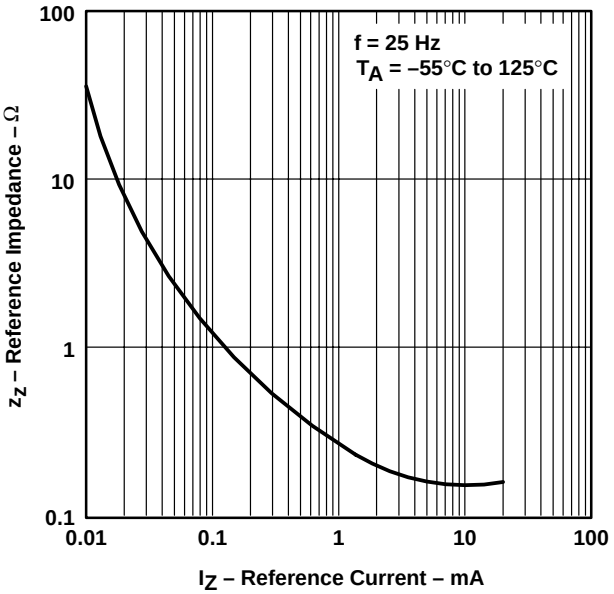


Figure 5

NOISE VOLTAGE vs FREQUENCY

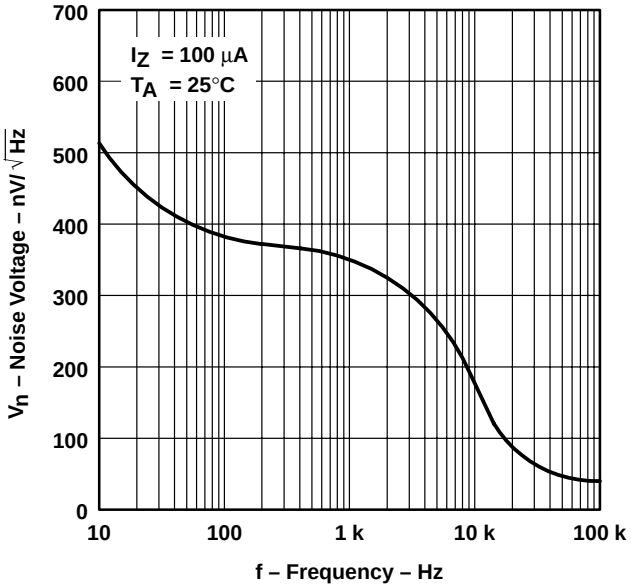


Figure 6

OUTPUT NOISE VOLTAGE vs CUTOFF FREQUENCY

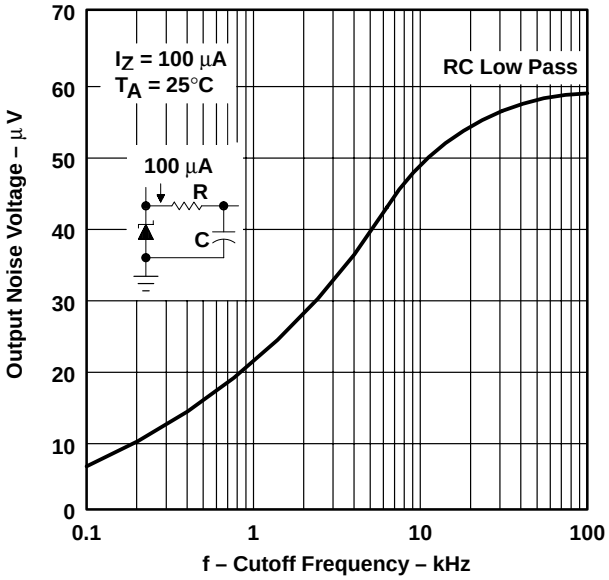


Figure 7

TRANSIENT RESPONSE

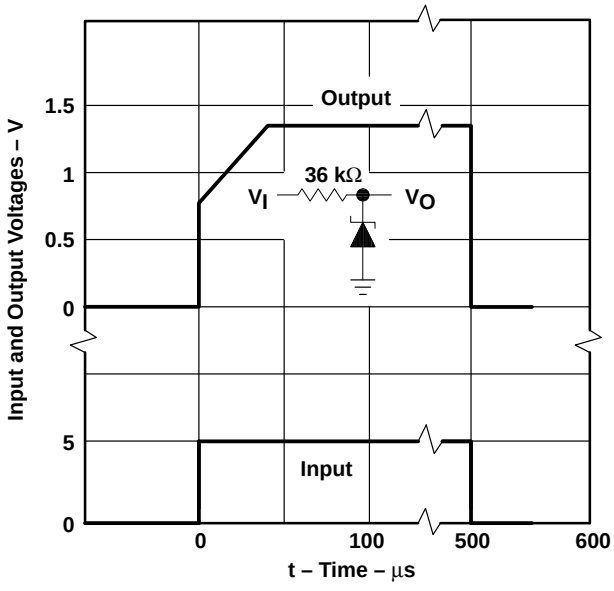
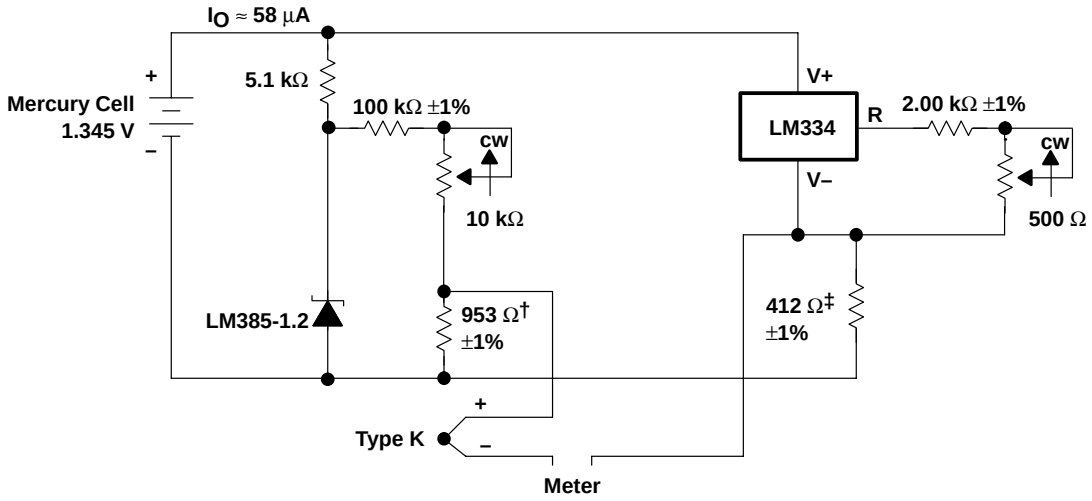


Figure 8

† Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

APPLICATION INFORMATION



† Adjust for 11.15 mV at 25°C across 953 Ω
‡ Adjust for 12.17 mV at 25°C across 412 Ω

Figure 9. Thermocouple Cold-Junction Compensator

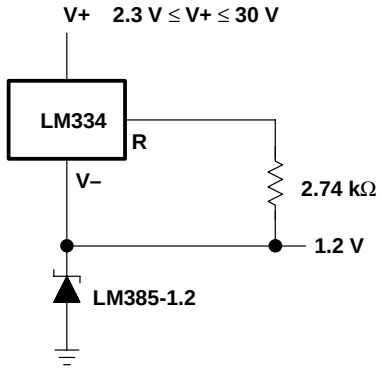


Figure 10. Operation Over a Wide Supply Range

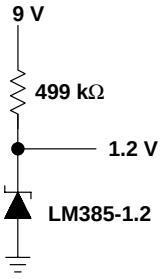


Figure 11. Reference From a 9-V Battery

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Mailing Address:

Texas Instruments
Post Office Box 655303
Dallas, Texas 75265

LM385-1.2, Micropower Voltage Reference

DEVICE STATUS: **ACTIVE**

PARAMETER NAME	LM385-1.2
VO (V)	1.235
Vout/Vref Initial Tol (%)	2
Min Iz for Regulation (uA)	10
Iout/Iz (max) (mA)	20
Temp Coeff (typ) (ppm/ degree C)	20
Output Topology	Shunt

FEATURES

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- Operating Current Range
  - LM285 . . . 10 uA to 20 mA
  - LM385 . . . 15 uA to 20 mA
  - LM385B ...15 uA to 20 mA
- 1% and 2% Initial Voltage Tolerance
- Reference Impedance
  - LM385...1 Ω Max at 25°C
  - All Devices . . . 1.5 Ω Max Over Full Temperature Range
- Very Low Power Consumption
- Applications
  - Portable Meter References
  - Portable Test Instruments
  - Battery-Operated Systems
  - Current-Loop Instrumentation
  - Panel Meters
- Designed to be Interchangeable With National LM285-1.2 and LM385-1.2

DESCRIPTION

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These micropower, two-terminal, band-gap voltage references operate over a 10-uA to 20-mA current range and feature exceptionally low dynamic impedance and good temperature stability. On-chip trimming provides tight voltage tolerance. The band-gap reference for these devices has low noise and long-term stability.

The design makes these devices exceptionally tolerant of capacitive loading and, thus, easier to use in most reference applications. The wide dynamic operating temperature range accommodates varying current supplies, with excellent regulation.

The extremely low power drain of this series makes them useful for micropower circuitry. These voltage references can be used to make portable meters, regulators, or general-purpose analog circuitry, with battery life approaching shelf life. The wide operating current range allows them to replace older references with tighter-tolerance parts.

The LM285-1.2 is characterized for operation from –40°C to 85°C. The LM385-1.2 and LM385B-1.2 are characterized for operation from 0°C to 70°C.

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DATASHEET

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Full datasheet in Acrobat PDF: lm385-1.2.pdf (106 KB,Rev.E) (Updated: 02/12/2002)

APPLICATION NOTES

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- PowerFLEX (TM) -- Surface-Mount Alternative for Through-Hole Power Packages (SZZA015 - Updated: 04/08/1999)

RELATED DOCUMENTS

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- Enhanced Plastic Portfolio Brochure (SGZB004, 385 KB - Updated: 08/19/2002)
- Military Analog Selection Guide (SGLB002, 318 KB - Updated: 11/09/2000)
- Military Semiconductors Selection Guide 2002 (Rev. B) (SGYC003B, 1648 KB - Updated: 04/22/2002)
- Standard Linear Products Cross Reference (SLYT017, 586 KB - Updated: 05/03/2000)

SAMPLES

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ORDERABLE DEVICE	PACKAGE INDUSTRY (TI)	PINS	TEMP (°C)	STATUS	PRODUCT CONTENT	SAMPLES
LM385D-1-2	SOP (D)	8	0 TO 70	ACTIVE	View Product Content	Request Samples
LM385LP-1-2	TO/SOT (LP)	3	0 TO 70	ACTIVE	View Product Content	Request Samples
LM385PWR-1-2	TSSOP (PW)	8	0 TO 70	ACTIVE	View Product Content	Request Samples

PRICING/AVAILABILITY/PKG

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DEVICE INFORMATION | **TI INVENTORY STATUS AS OF 3:00 PM GMT, 26 Sep 2002** | **REPORTED DISTRIBUTOR INVENTORY AS OF 3:00 PM GMT, 26 Sep 2002**

ORDERABLE DEVICE	STATUS	PACKAGE TYPE|PINS	TEMP (°C)	PRODUCT CONTENT	BUDGETARY PRICING QTY | $US	STD PACK QTY	IN STOCK	IN PROGRESS QTY|DATE	LEAD TIME	DISTRIBUTOR COMPANY|REGION	IN STOCK	PURCHASE
LM385D-1-2	ACTIVE	SOP (D) | 8	0 TO 70	View Contents	1KU | 0.42	75	N/A*	>10k | 02 Oct	8 WKS	Avnet | AMERICA	28	BUY NOW
								5550 | 03 Oct				
								>10k | 06 Nov				
								>10k | 14 Nov				
LM385DR-1-2	ACTIVE	SOP (D) | 8	0 TO 70	View Contents	1KU | 0.42	2500	N/A*	1294 | 23 Sep	8 WKS			
								1206 | 27 Sep				
								>10k | 02 Oct				
								2500 | 03 Oct				
								2500 | 14 Oct				

LM385LP-1-2	ACTIVE	TO/SOT (LP) | 3	0 TO 70	View Contents	1KU | 0.42	1000	N/A*	377 | 23 Sep	10 WKS	DigiKey | AMERICA	525	BUY NOW
								>10k | 07 Oct				
								>10k | 13 Nov				
								>10k | 21 Nov				
								>10k | 02 Dec				
LM385LPR-1-2	ACTIVE	TO/SOT (LP) | 3	0 TO 70	View Contents	1KU | 0.42	2000	N/A*	>10k | 07 Oct	10 WKS			
								>10k | 13 Nov				
								>10k | 21 Nov				
								>10k | 02 Dec				
LM385PS-1.2	OBSOLETE	SOP (PS) | 8	0 TO 70	View Contents	1KU |		N/A*		Not Available			
LM385PWR-1-2	ACTIVE	TSSOP (PW) | 8	0 TO 70	View Contents	1KU | 0.42	2000	2000	230 | 25 Sep	16 WKS			
								>10k | 07 Oct				
								>10k | 14 Oct				
								>10k | 11 Nov				

Table Data Updated on: 9/26/2002

LM385B-1.2, Micropower Voltage Reference

DEVICE STATUS: **ACTIVE**

PARAMETER NAME	LM385B-1.2
VO (V)	1.235
Vout/Vref Initial Tol (%)	1
Min Iz for Regulation (uA)	10
Iout/Iz (max) (mA)	20
Temp Coeff (typ) (ppm/ degree C)	20
Output Topology	Shunt

FEATURES

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- Operating Current Range
  - LM285 . . . 10 uA to 20 mA
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  - LM385B ...15 uA to 20 mA
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  - Portable Test Instruments
  - Battery-Operated Systems
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  - Panel Meters
- Designed to be Interchangeable With National LM285-1.2 and LM385-1.2

DESCRIPTION

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These micropower, two-terminal, band-gap voltage references operate over a 10-uA to 20-mA current range and feature exceptionally low dynamic impedance and good temperature stability. On-chip trimming provides tight voltage tolerance. The band-gap reference for these devices has low noise and long-term stability.

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The LM285-1.2 is characterized for operation from –40°C to 85°C. The LM385-1.2 and LM385B-1.2 are characterized for operation from 0°C to 70°C.

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SAMPLES

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LM385BD-1-2	SOP (D)	8	0 TO 70	ACTIVE	View Product Content	Request Samples
LM385BLP-1-2	TO/SOT (LP)	3	0 TO 70	ACTIVE	View Product Content	Request Samples
LM385BPWR-1-2	TSSOP (PW)	8	0 TO 70	ACTIVE	View Product Content	Request Samples

PRICING/AVAILABILITY/PKG

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DEVICE INFORMATION							TI INVENTORY STATUS AS OF 3:00 PM GMT, 26 Sep 2002			REPORTED DISTRIBUTOR INVENTORY AS OF 3:00 PM GMT, 26 Sep 2002		
ORDERABLE DEVICE	STATUS	PACKAGE TYPE|PINS	TEMP (°C)	PRODUCT CONTENT	BUDGETARY PRICING QTY | $US	STD PACK QTY	IN STOCK	IN PROGRESS QTY|DATE	LEAD TIME	DISTRIBUTOR COMPANY|REGION	IN STOCK	PURCHASE
LM385BD-1-2	ACTIVE	SOP (D) | 8	0 TO 70	View Contents	1KU | 0.56	75	N/A*	>10k | 01 Oct	8 WKS	Avnet | AMERICA	20	BUY NOW
								1575 | 03 Oct				
								>10k | 05 Nov				
								2925 | 06 Nov				
								>10k | 13 Nov				
LM385BDR-1-2	ACTIVE	SOP (D) | 8	0 TO 70	View Contents	1KU | 0.56	2500	N/A*	927 | 23 Sep	8 WKS			
								6630 | 24 Sep				
								>10k | 01 Oct				
								>10k | 03 Oct				
								>10k | 05 Nov				

LM385BLP-1-2	ACTIVE	TO/SOT (LP) | 3	0 TO 70	View Contents	1KU | 0.56	1000	N/A*	>10k | 07 Oct	10 WKS	Avnet | AMERICA	>1k	BUY NOW
								>10k | 13 Nov				
								>10k | 21 Nov				
								>10k | 02 Dec				
LM385BLPR-1-2	ACTIVE	TO/SOT (LP) | 3	0 TO 70	View Contents	1KU | 0.56	2000	N/A*	>10k | 07 Oct	10 WKS			
								>10k | 13 Nov				
								>10k | 21 Nov				
								>10k | 02 Dec				
LM385BPWR-1-2	ACTIVE	TSSOP (PW) | 8	0 TO 70	View Contents	1KU | 0.56	2000	N/A*	1971 | 25 Sep	16 WKS			
								>10k | 07 Oct				
								>10k | 14 Oct				
								>10k | 11 Nov				

Table Data Updated on: 9/26/2002