LMx85-1.2, LM385B-1.2 Micropower Voltage References

Features

- Operating Current Range
  - LM285-1.2: 10 μA to 20 mA
  - LM385-1.2: 15 μA to 20 mA
  - LM385B-1.2: 15 μA to 20 mA
- 1% and 2% Initial Voltage Tolerance
- Reference Impedance
  - LM385-1.2: 1 Ω MAX at 25°C
  - All devices: 1.5 Ω MAX over Full Temperature Range
- Very Low Power Consumption
- Interchangeable with Industry Standard LM285-1.2 and LM385-1.2

Applications

- Portable Meter References
- Portable Test Instruments
- Battery-Operated Systems
- Current-Loop Instrumentation
- Panel Meters

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.

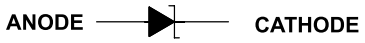
The design makes these devices exceptionally tolerant of capacitive loading and, thus, easier to use in most reference applications. The wide dynamic operating temperature range accommodates varying current supplies, with excellent regulation.

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.

Device Information(1)

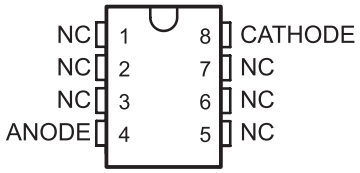
PART NUMBER	PACKAGE (PIN)	BODY SIZE (NOM)
LMx85-1.2	SOIC (8)	4.90 mm × 3.91 mm
	SOP (8)	6.20 mm × 5.30 mm
	TSSOP (8)	3.00 mm × 4.40 mm
	TO-226 (3)	4.30 mm × 4.30 mm

Simplified Schematic



Pin Configuration and Functions

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



NC – No internal connection

LM285-1.2, LM385-1.2, LM385B-1.2 . . . LP PACKAGE
(TOP VIEW)

NC – No internal connection

Pin Functions

PIN			TYPE	DESCRIPTION
NAME	LP	D, PS or PW		
ANODE	1	4	I	Shunt Current/Voltage input
CATHODE	2	8	O	Common pin, normally connected to ground
NC	3	1, 2, 3, 5, 6, 7	—	No internal connection

Specifications

Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)(1)

		MIN	MAX	UNIT
I_R	Reverse Current		30	mA
I_F	Forward Current		10	mA
T_J	Operating virtual junction temperature		150	°C
T_{stg}	Storage temeprature	–65	150	°C

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins(1)	±2000	V
		Charged device model (CDM), per JEDEC specification JESD22-C101, all pins(2)	±1000	

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

Recommended Operating Conditions

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

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

Thermal Information

THERMAL METRIC		LMx85-1.2				UNIT
		D	LP	PS	PW	
		8 PINS	3 PINS	8 PINS	8 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	97	140	95	149	°C/W

Electrical Characteristics

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

PARAMETER		TEST CONDITIONS	T_A(1)	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(2)	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(3)	I_Z = I(min) to 20 mA(2)	Full Range		±20			±20			±20		ppm/°C
Δ_{VZ}	Change in reference voltage with current	I_Z = I(min) to 1 mA(2)	25°C			1			1			1	mV
			Full Range			1.5			1.5			1.5	
		I_Z = I(min) 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

(1) 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.
(2) I(min) = 10 µA for the LM285-1.2 and 15 µA for the LM385-1.2 and LM385B-1.2
(3) The average temperature coefficient of reference voltage is defined as the total change in reference voltage divided by the specified temperature range.

Typical Characteristics

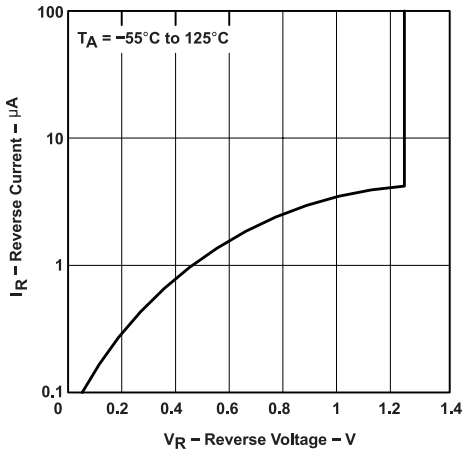


Figure 1. Reverse Current vs Reverse Voltage

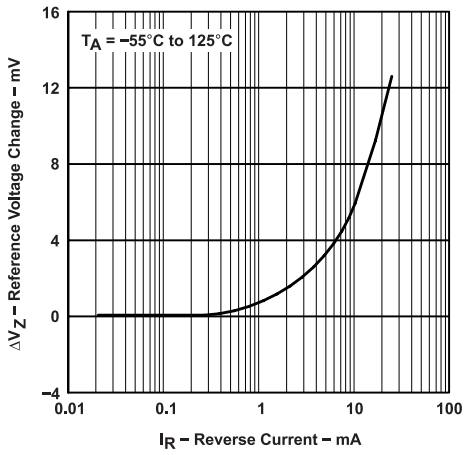


Figure 2. Reference Voltage Change vs Reverse Current

Typical Characteristics (continued)

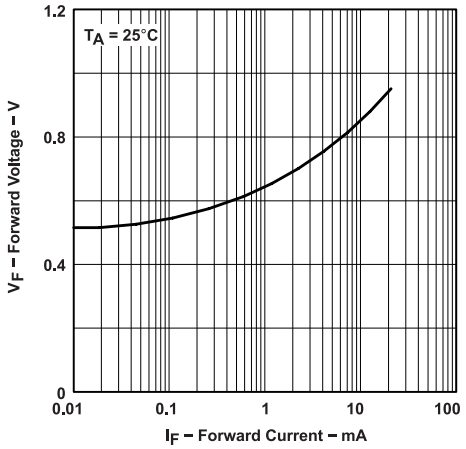


Figure 3. Forward Voltage vs Forward Current

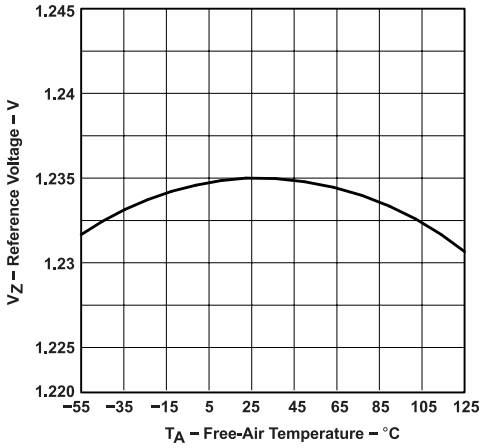


Figure 4. Reference Voltage vs Free-Air Temperature

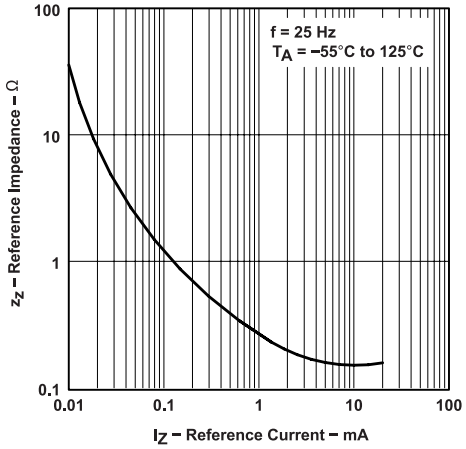


Figure 5. Reference Impedance vs Reference Current

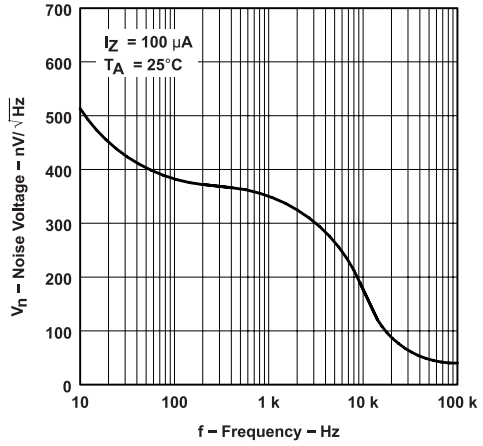


Figure 6. Noise Voltage vs Frequency

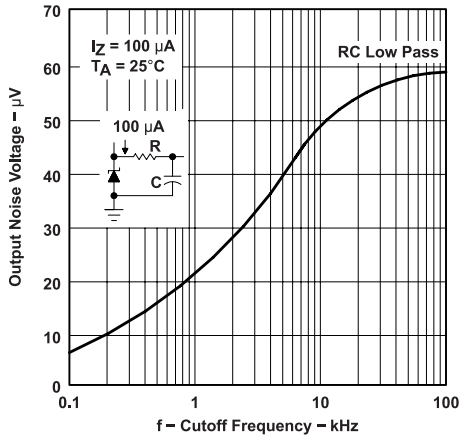


Figure 7. Output Noise Voltage vs Cutoff Frequency

Detailed Description

Overview

The LM285-1.2, LM385-1.2, and LM385-1.2 devices are micropower, two-terminal, band-gap voltage references which operate over a 10-μA to 20-mA current range. 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.

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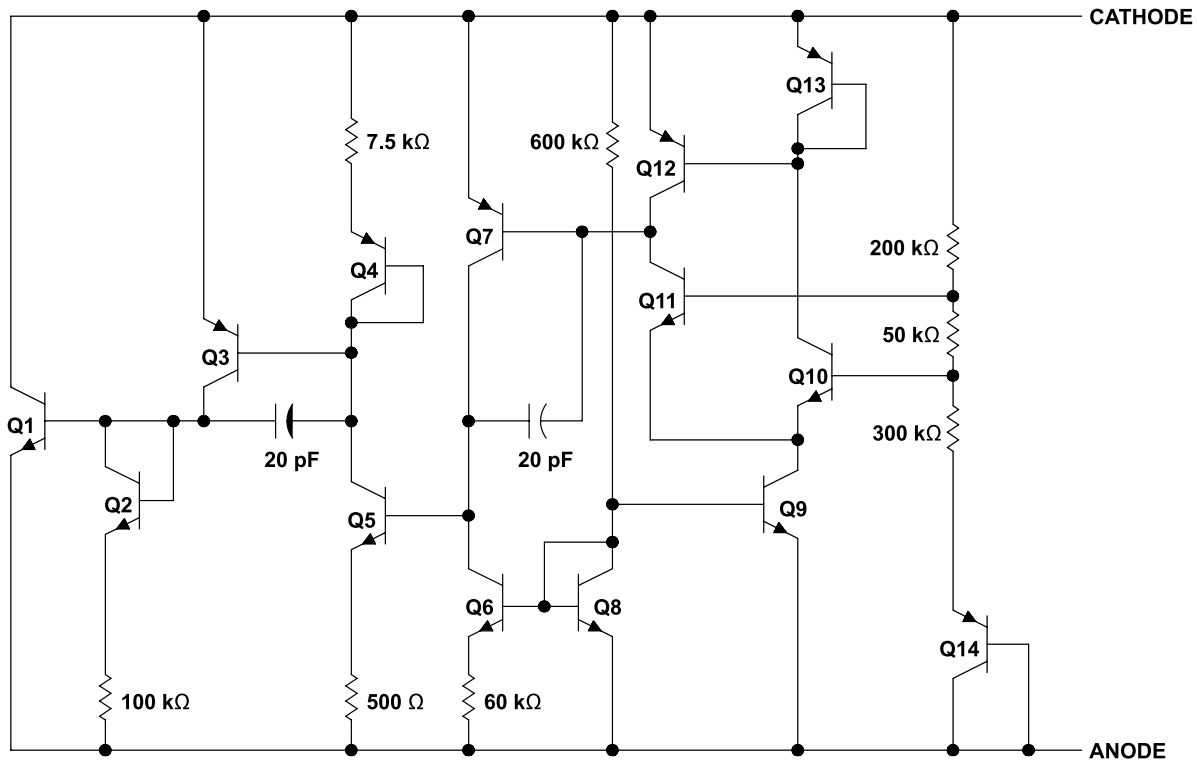
Functional Block Diagram



A. Component values shown are nominal.

Feature Description

A band gap voltage reference controls high gain amplifier and shunt pass element to maintain a nearly constant voltage between cathode and anode. Regulation occurs after a minimum current is provided to power the voltage divider and amplifier. Internal frequency compensation provides a stable loop for all capacitor loads. Floating shunt design is useful for both positive and negative regulation applications.

Device Functional Modes

LM285-1.2, LM385-1.2, and LM385-1.2 devices will operate in one mode, which is as a fixed voltage reference that cannot be adjusted.

In order for a proper Reverse Voltage to be developed, current must be sourced into the cathode of LM285. The minimum current needed for proper regulation is denoted in *Electrical Characteristics* as $I_{Z,min}$.

Important statement:

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