

LM199/LM399

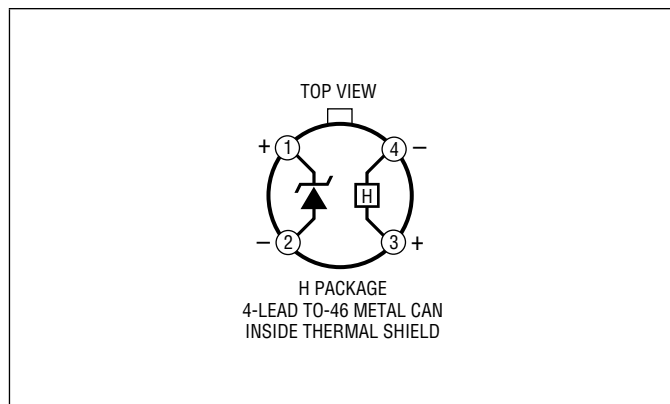
LM199A/LM399A

ABSOLUTE MAXIMUM RATINGS

(Note 1)

Temperature Stabilizer	40V
Reverse Breakdown Current.....	20mA
Forward Current.....	1mA
Reference to Substrate Voltage, V_{RS} (Note 2)	-0.1V
Operating Temperature Range	
LM199/LM199A (OBSOLETE)	-55°C to 125°C
LM399/LM399A	0°C to 70°C
Storage Temperature Range	
LM199/LM199A (OBSOLETE)	-65°C to 150°C
LM399/LM399A	-65°C to 150°C
Lead Temperature (Soldering, 10 sec).....	300°C

PIN CONFIGURATION



ORDER INFORMATION

LEAD FREE FINISH	TAPE AND REEL	PART MARKING	PACKAGE DESCRIPTION	TEMPERATURE RANGE
LM399H	LM399H#TRPBF	LM399H	4-Lead TO-46 Metal Can	0°C to 70°C
LM399AH	LM399AH#TRPBF	LM399AH	4-Lead TO-46 Metal Can	0°C to 70°C
OBSOLETE PACKAGE				
LM199H	LM199H#TRPBF		4-Lead TO-46 Metal Can	-55°C to 125°C
LM199AH	LM199AH#TRPBF		4-Lead TO-46 Metal Can	-55°C to 125°C
LM199AH-20	LM199AH-20#TRPBF		4-Lead TO-46 Metal Can	-55°C to 125°C
LM399AH-20	LM399AH-20#TRPBF		4-Lead TO-46 Metal Can	0°C to 70°C
LM399AH-50	LM399AH-50#TRPBF		4-Lead TO-46 Metal Can	0°C to 70°C

Consult LTC Marketing for parts specified with wider operating temperature ranges.

Consult LTC Marketing for information on nonstandard lead based finish parts.

For more information on lead free part marking, go to: <http://www.linear.com/leadfree/>

For more information on tape and reel specifications, go to: <http://www.linear.com/tapeandreel/>

ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at $T_A = 25^\circ\text{C}$. (Note 3)

SYMBOL	PARAMETER	CONDITIONS		LM199/LM199A			LM399/LM399A			UNITS
				MIN	TYP	MAX	MIN	TYP	MAX	
V_Z	Reverse Breakdown Voltage	$0.5\text{mA} \leq I_R \leq 10\text{mA}$	●	6.8	6.95	7.1	6.75	6.95	7.3	V
ΔV_Z	Reverse Breakdown Voltage Change with Current	$0.5\text{mA} \leq I_R \leq 10\text{mA}$	●		6	9		6	12	mV
r_Z	Reverse Dynamic Impedance	$I_R = 1\text{mA}$ (Note 6) ($10\text{Hz} \leq f \leq 100\text{Hz}$)	●		0.5	1		0.5	1.5	Ω
$\frac{\Delta V_Z}{\Delta \text{Temp}}$	Temperature Coefficient LM199/LM399	$-55^\circ\text{C} \leq T_A \leq 85^\circ\text{C}$ $85^\circ\text{C} \leq T_A \leq 125^\circ\text{C}$ $0^\circ\text{C} \leq T_A \leq 70^\circ\text{C}$			0.3 5	1 15		0.3	2	ppm/°C ppm/°C ppm/°C
	LM199A/LM399A	$-55^\circ\text{C} \leq T_A \leq 85^\circ\text{C}$ $85^\circ\text{C} \leq T_A \leq 125^\circ\text{C}$ $0^\circ\text{C} \leq T_A \leq 70^\circ\text{C}$			0.2 5	0.5 10		0.3	1	ppm/°C ppm/°C ppm/°C
e_n	RMS Noise	$10\text{Hz} \leq f \leq 10\text{kHz}$	●		7	20		7	50	μV

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ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at $T_A = 25^\circ\text{C}$. (Note 3)

SYMBOL	PARAMETER	CONDITIONS	LM199/LM199A			LM399/LM399A			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
$\frac{\Delta V_Z}{\Delta \text{Time}}$	Long-Term Stability	Stabilized, $22^\circ\text{C} \leq T_A \leq 28^\circ\text{C}$, 1000 Hours, $I_R = 1\text{mA} \pm 0.1\%$		8	(Note 4)		8	(Note 4)	ppm/ $\sqrt{\text{kH}}$
I_H	Temperature Stabilizer Supply Current	$T_A = 25^\circ\text{C}$, Still Air, $V_H = 30\text{V}$ $T_A = -55^\circ\text{C}$ (Note 5)		8.5 22	14 28		8.5	15	mA
V_H	Temperature Stabilizer Supply Voltage	●	9		40	9		40	V
	Warm-Up Time to $\pm 0.05\% V_Z$	$V_H = 30\text{V}$		3			3		Seconds
	Initial Turn-On Current	$9\text{V} \leq V_H \leq 40\text{V}$ (Note 5)		140	200		140	200	mA

Note 1: Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.

Note 2: The substrate is electrically connected to the negative terminal of the temperature stabilizer. The voltage that can be applied to either terminal of the reference is 40V more positive or 0.1V more negative than the substrate.

Note 3: These specifications apply for 30V applied to the temperature stabilizer and $-55^\circ\text{C} \leq T_A \leq 125^\circ\text{C}$ for the LM199; and $0^\circ\text{C} \leq T_A \leq 70^\circ\text{C}$ for the LM399.

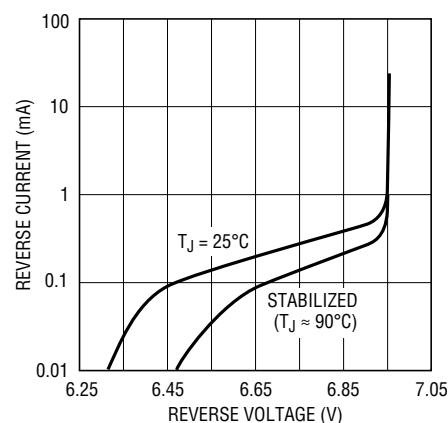
Note 4: Devices with maximum guaranteed long-term stability of 20ppm/ $\sqrt{\text{kH}}$ are available. Drift decreases with time.

Note 5: This initial current can be reduced by adding an appropriate resistor and capacitor to the heater circuit. See the Typical Performance Characteristics graphs to determine values.

Note 6: Guaranteed by "Reverse Breakdown Change with Current."

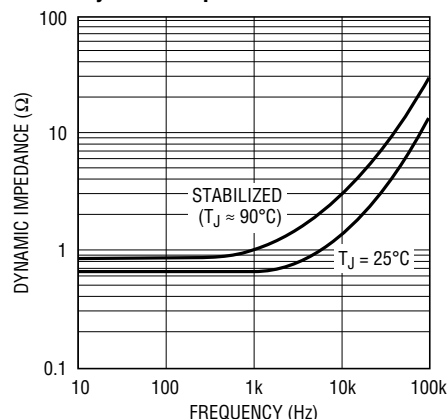
TYPICAL PERFORMANCE CHARACTERISTICS

Reverse Characteristics



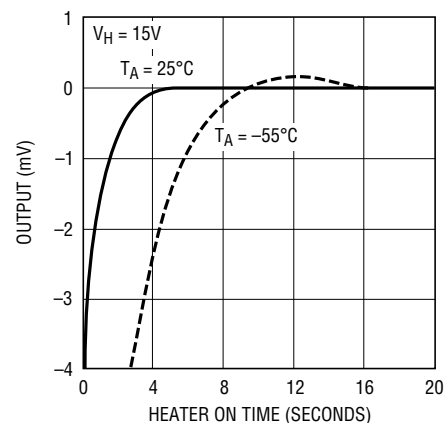
LM199 G01

Dynamic Impedance



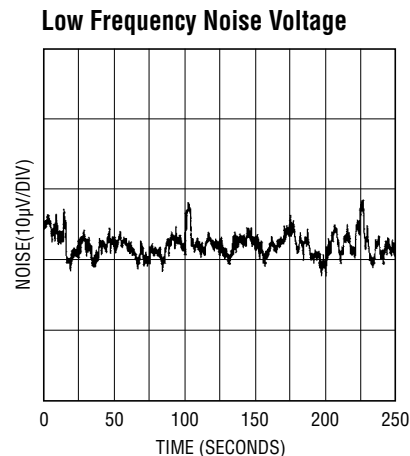
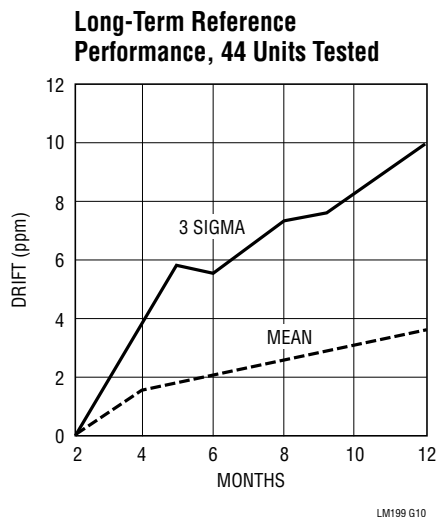
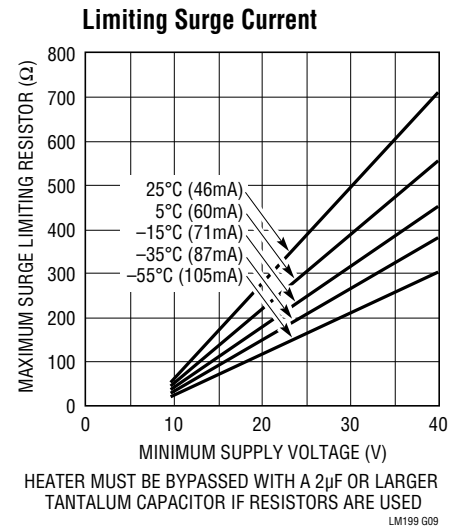
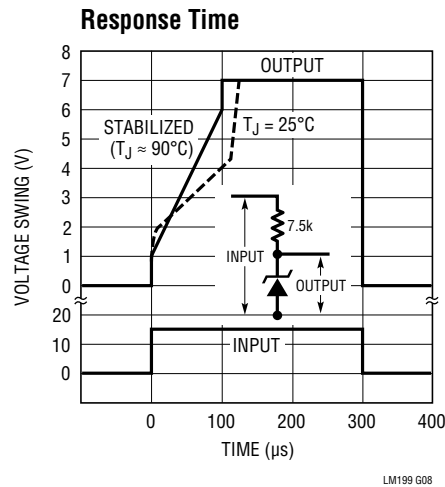
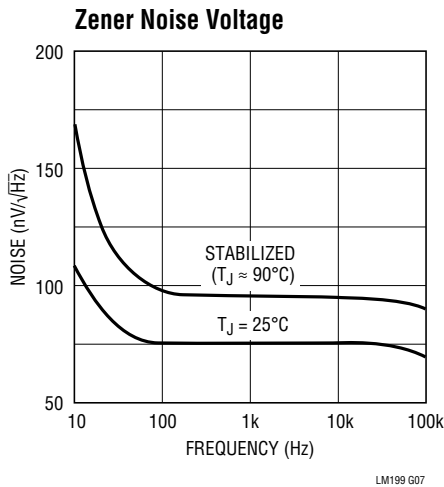
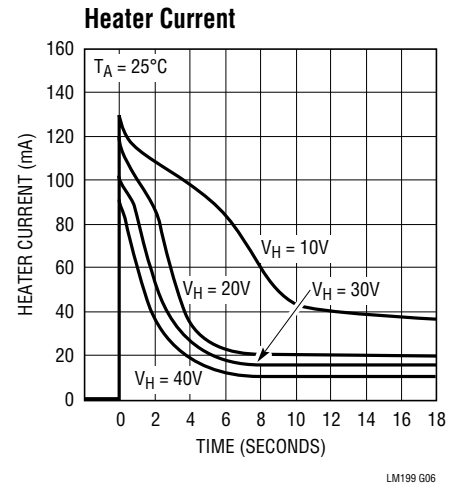
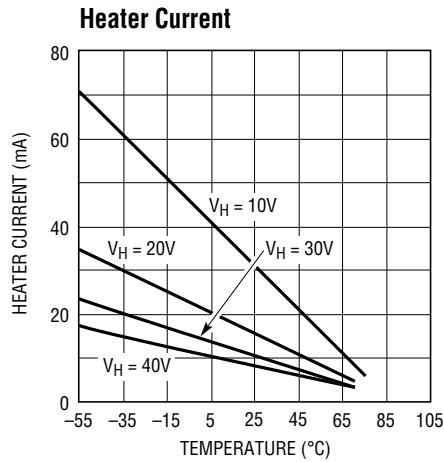
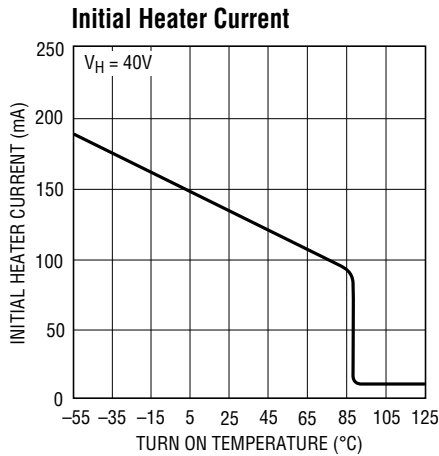
LM199 G02

Stabilization Time

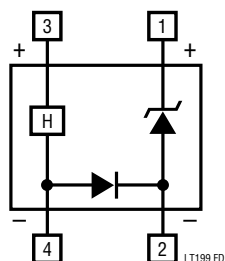


LM199 G03

TYPICAL PERFORMANCE CHARACTERISTICS

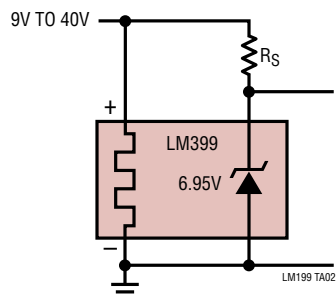


FUNCTIONAL BLOCK DIAGRAM

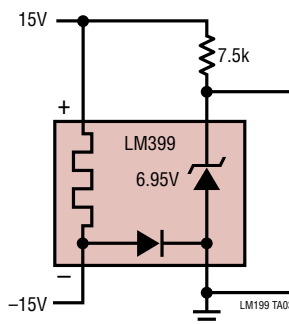


TYPICAL APPLICATIONS

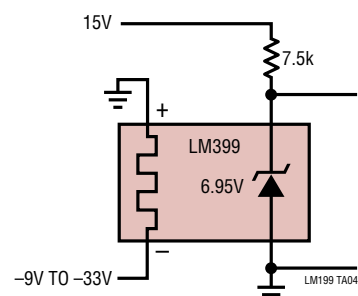
Single Supply Operation



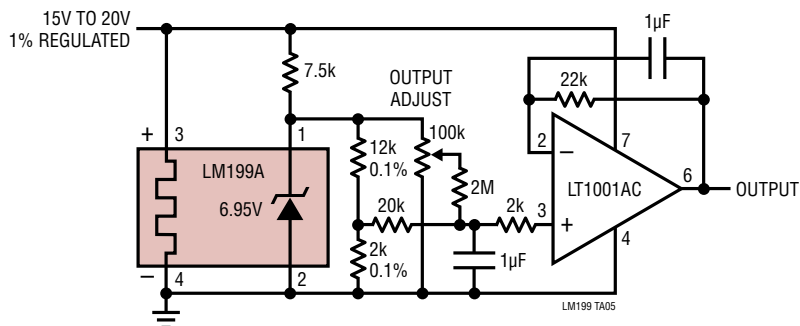
Split Supply Operation



Negative Heater Supply with Positive Reference



Standard Cell Replacement



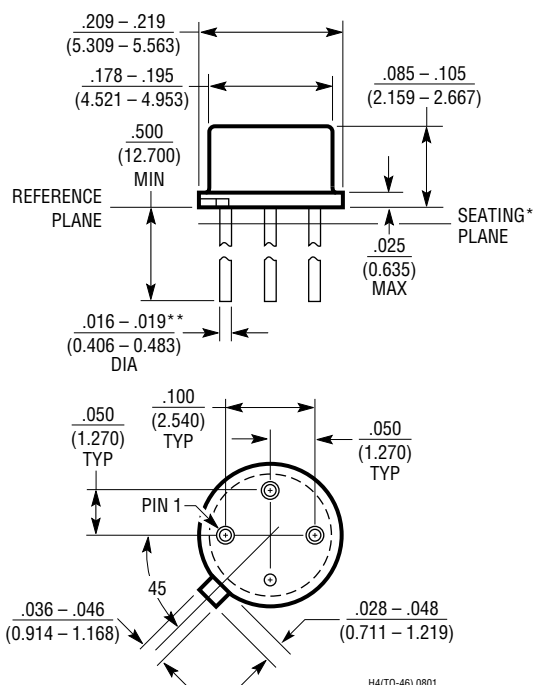
The circuit diagram shows a precision 10V reference. It features an LM399 (10V Zener diode array) connected to a 12V to 18V supply. The LM399 is labeled with a 6.95V Zener voltage. The output of the LM399 is connected to the non-inverting input (pin 3) of an LT1001AC precision centrabuck converter. The LT1001AC is configured with a feedback network consisting of an 8.8k 1% resistor and a 5k resistor. The output of the LT1001AC is labeled 'OUTPUT 10V'. A 200k resistor is connected between the supply and the non-inverting input. A 19k 1% resistor and a 3k TRIM potentiometer are connected between the supply and the inverting input (pin 2) of the LT1001AC. The LM399 is also connected to a 6.95V Zener diode.

The circuit diagram shows the internal components of the LM199 SDO2 oscillator. It includes several transistors (Q10, Q11, Q12, Q13, Q14, Q15, Q16), resistors (50Ω, 2k, 30k, 1k, 2k, 2.6k, 10k), capacitors (15pF, 30pF), and a diode (Q3, 6.3V). The circuit is powered by a 5V supply (pin 1) and ground (pin 2).

PACKAGE DESCRIPTION

Please refer to <http://www.linear.com/designtools/packaging/> for the most recent package drawings.

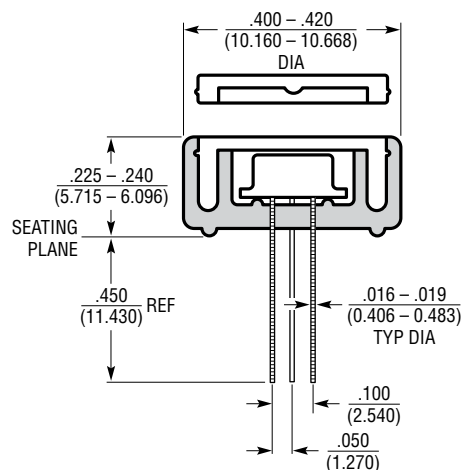
H Package
4-Lead TO-46 Metal Can
(Reference LTC DWG # 05-08-1341)



*LEAD DIAMETER IS UNCONTROLLED BETWEEN THE REFERENCE PLANE AND .050" BELOW THE REFERENCE PLANE

**FOR SOLDER DIP LEAD FINISH, LEAD DIAMETER IS .016 - .024 (0.406 - 0.610)

Thermal Shield* for TO-46, H Package



*THERMAL SHIELD MATERIAL IS VALOX

REVISION HISTORY (Revision history begins at Rev C)

REV	DATE	DESCRIPTION	PAGE NUMBER
C	12/14	Package/Order Information updated	2
		Thermal shield dimensions corrected	7

LM199/LM399

LM199A/LM399A

RELATED PARTS

PART NUMBER	DESCRIPTION	COMMENTS
LT[®]1021	Precision References for Series or Shunt Operation	Industry Standard Pinout, -40°C to 125°C
LT1389	1.25V, 2.5V, 4V and 5V Nanopower Shunt Reference	800nA, 0.05% Accuracy, 10ppm/°C Drift
LT1634	1.25 and 2.5V Micropower Shunt Reference	0.05%, 10ppm/°C, 10μA Current
LTZ1000	7V Ultra Precision, Stable Shunt Reference	0.05ppm/°C, 1.2mV _{P-P} Noise