LM199A/LM299A/LM399A Precision Reference

General Description

The LM199A/LM299A/LM399A are precision, temperature-stabilized monolithic zeners offering temperature coefficients a factor of ten better than high quality reference zeners. Constructed on a single monolithic chip is a temperature stabilizer circuit and an active reference zener. The active circuitry reduces the dynamic impedance of the zener to about 0.5Ω and allows the zener to operate over 0.5 mA to 10 mA current range with essentially no change in voltage or temperature coefficient. Further, a new subsurface zener structure gives low noise and excellent long term stability compared to ordinary monolithic zeners. The package is supplied with a thermal shield to minimize heater power and improve temperature regulation.

The LM199A series references are exceptionally easy to use and free of the problems that are often experienced with ordinary zeners. There is virtually no hysteresis in reference voltage with temperature cycling. Also, the LM199A is free of voltage shifts due to stress on the leads. Finally, since the unit is temperature stabilized, warm up time is fast.

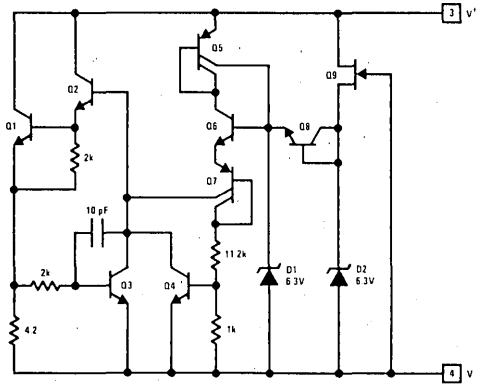
The LM199A can be used in almost any application in place of ordinary zeners with improved performance. Some ideal applications are analog to digital converters, calibration standards, precision voltage or current sources or precision power supplies. Further in many cases the LM199A can replace references in existing equipment with a minimum of wiring changes.

The LM199A series devices are packaged in a standard hermetic TO-46 package inside a thermal shield. The LM199 is rated for operation from −55°C to +125°C while the LM299A is rated for operation from −25°C to +85°C and the LM399A is rated from 0°C to +70°C.

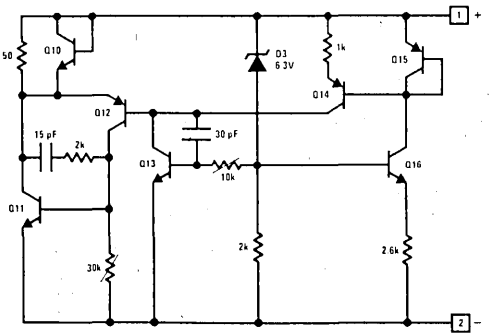
Features

- Guaranteed 0.00005%/°C temperature coefficient
- Low dynamic impedance – 0.5Ω
- Initial tolerance on breakdown voltage – 2%
- Sharp breakdown at 400μA
- Wide operating current – 500μA to 10 mA
- Wide supply range for temperature stabilizer
- Guaranteed low noise
- Low power for stabilization – 300 mW at 25°C
- Long term stability – 20 ppm

Schematic Diagrams



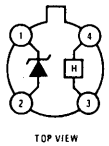
Temperature Stabilizer



Reference

Connection Diagram

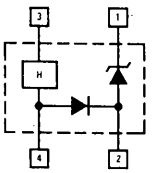
Metal Can Package



TOP VIEW

Order Number
LM199AH
LM299AH
LM399AH
See Package H04D

Functional Block Diagram



Absolute Maximum Ratings

Temperature Stabilizer Voltage	40V
Reverse Breakdown Current	20 mA
Forward Current	1 mA
Reference to Substrate Voltage $V_{(RS)}$ (Note 1)	+40V −0.1V
Operating Temperature Range	
LM199A	−55°C to +125°C
LM299A	−25°C to +85°C
LM399A	0°C to +70°C
Storage Temperature Range	−55°C to +150°C
Lead Temperature (Soldering, 10 seconds)	300°C

Electrical Characteristics (Note 2)

PARAMETER	CONDITIONS	LM199A, LM299A			LM399A			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	
Reverse Breakdown Voltage	$0.5\ mA \leq I_R \leq 10\ mA$	6.8	6.95	7.1	6.6	6.95	7.3	V
Reverse Breakdown Voltage Change With Current	$0.5\ mA \leq I_R \leq 10\ mA$		6	9		6	12	mV
Reverse Dynamic Impedance	$I_R = 1\ mA$		0.5	1		0.5	1.5	Ω
Reverse Breakdown Temperature Coefficient	$-55°C \leq T_A \leq 85°C$ } LM199A		0.00002	0.00005				%/°C
	$85°C \leq T_A \leq 125°C$ } LM199A		0.0005	0.0010				%/°C
	$-25°C \leq T_A \leq 85°C$ LM299A		0.00002	0.00005				%/°C
	$0°C \leq T_A \leq 70°C$ LM399A					0.00003	0.0001	%/°C
RMS Noise	$10\ Hz \leq f \leq 10\ kHz$		7	20		7	50	μV
Long Term Stability	Stabilized, $22°C \leq T_A \leq 28°C$, 1000 Hours, $I_R = 1\ mA \pm 0.1\%$		20			20		ppm
Temperature Stabilizer Supply Current	$T_A = 25°C$, Still Air, $V_S = 30V$		8.5	14		8.5	15	mA
	$T_A = -55°C$		22	28				
Temperature Stabilizer Supply Voltage (Note 3)		9		40	9		40	V
Warm-Up Time to 0.05%	$V_S = 30V$, $T_A = 25°C$		3			3		Seconds
Initial Turn-on Current	$9 \leq V_S \leq 40$, $T_A = 25°C$		140	200		140	200	mA

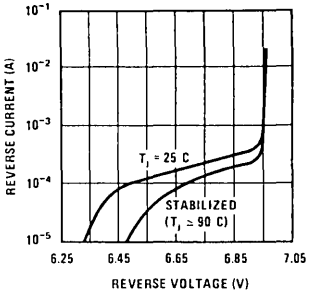
Note 1: The substrate is electrically connected to the negative terminal of the temperature stabilizer. The voltage that can be applied to either terminal of the reference is 40V more positive or 0.1V more negative than the substrate.

Note 2: These specifications apply for 30V applied to the temperature stabilizer and $-55°C \leq T_A \leq +125°C$ for the LM199A; $-25°C \leq T_A \leq +85°C$ for the LM299A and $0°C \leq T_A \leq +70°C$ for the LM399A.

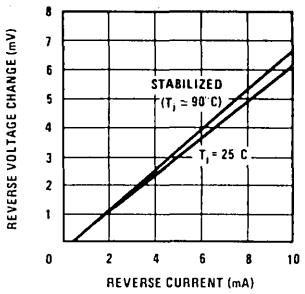
Note 3: CAUTION. If the device is operated for more than 60 seconds with heater supply voltage between 2V and 9V the heater temperature control circuitry is not properly biased and the device can rise to approximately +150°C.

Typical Performance Characteristics

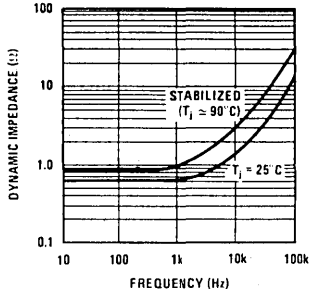
Reverse Characteristics



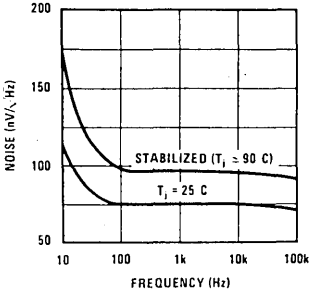
Reverse Voltage Change



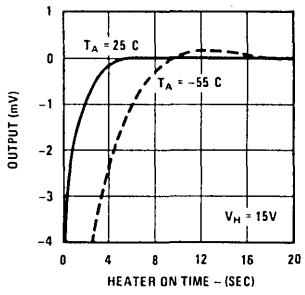
Dynamic Impedance



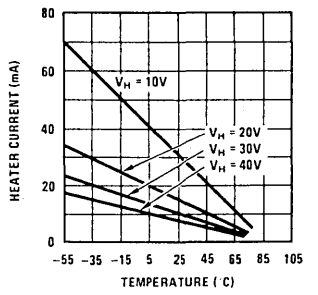
Zener Noise Voltage



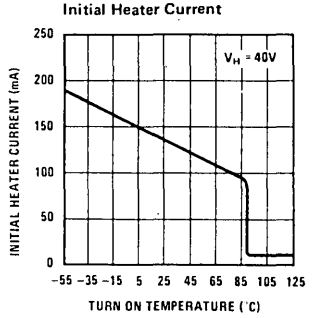
Stabilization Time



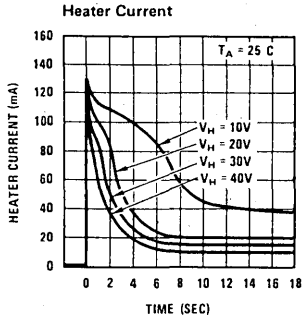
Heater Current



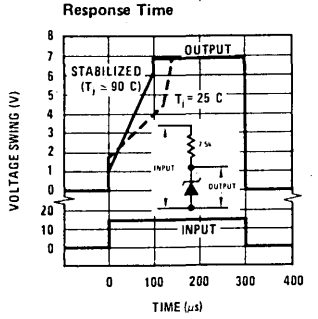
Initial Heater Current



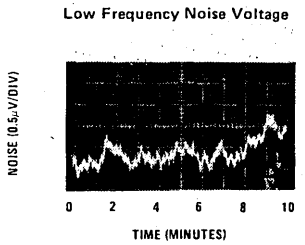
Heater Current



Response Time

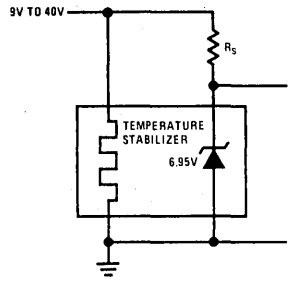


Low Frequency Noise Voltage

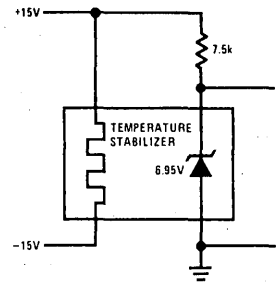


Typical Applications

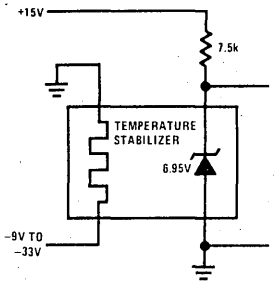
Single Supply Operation



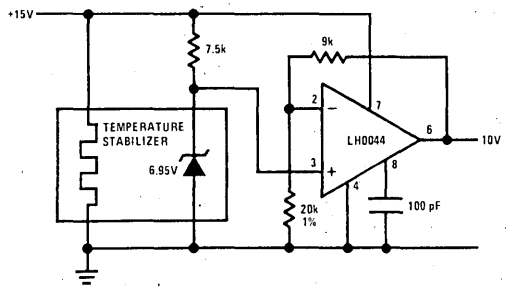
Split Supply Operation



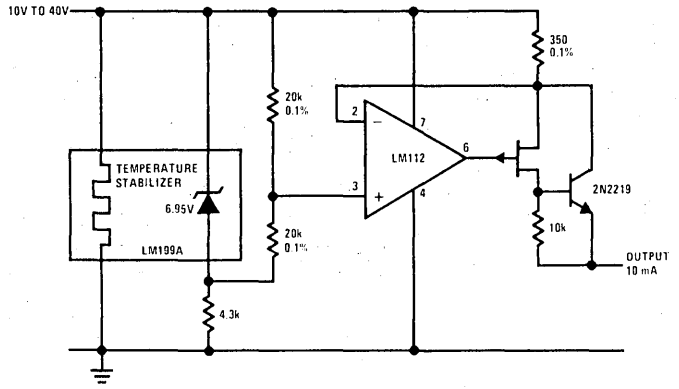
Negative Heater Supply with Positive Reference



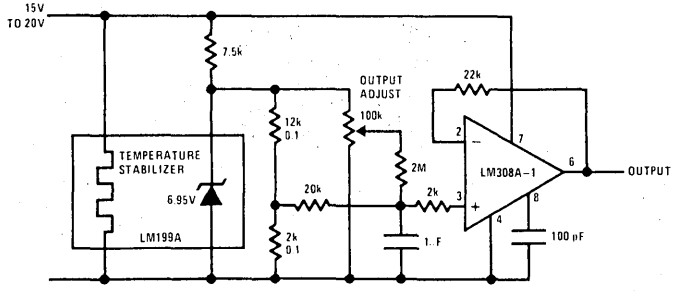
Buffered Reference With Single Supply



Positive Current Source

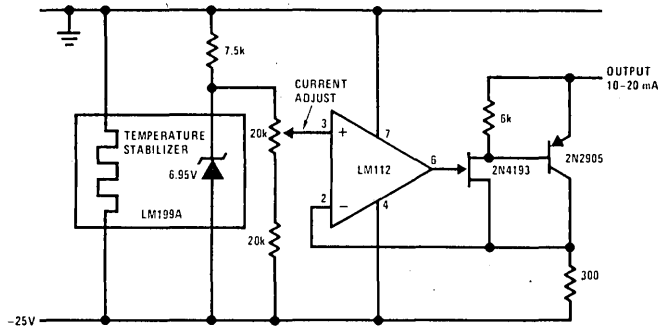


Standard Cell Replacement

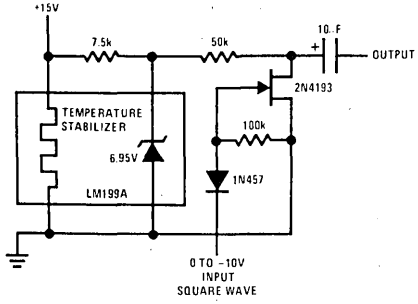


Typical Applications (Cont'd)

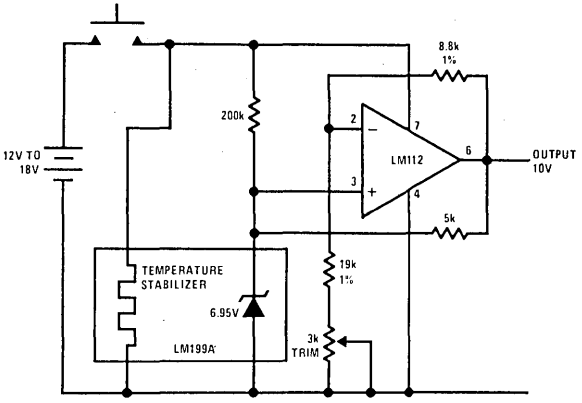
Negative Current Source



Square Wave Voltage Reference

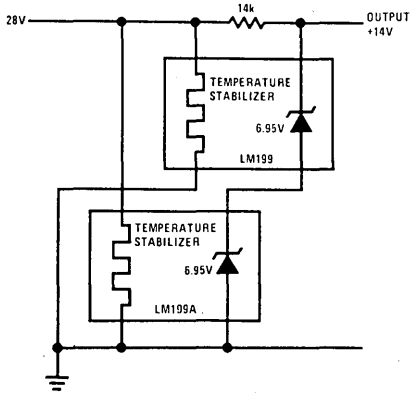


Portable Calibrator*

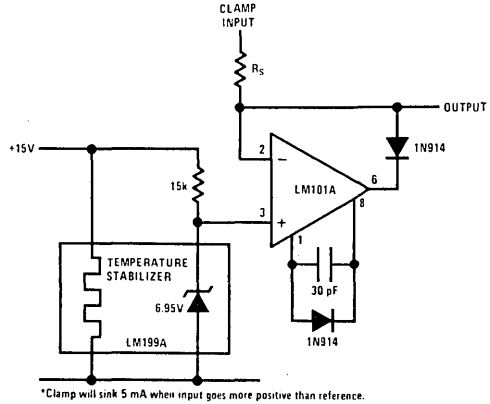


*Warm-up time 10 seconds; intermittant operation does not degrade long term stability.

14V Reference



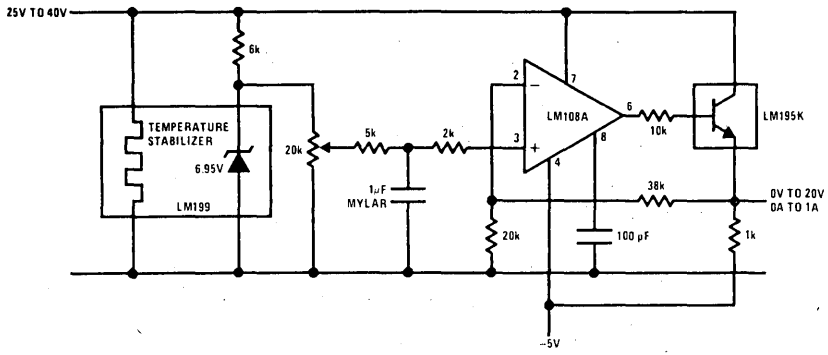
Precision Clamp*



*Clamp will sink 5 mA when input goes more positive than reference.

Typical Applications (Cont'd)

0V to 20V Power Reference



Bipolar Output Reference