

FEATURES

- *Guaranteed* $\pm 4\text{mV}$ initial accuracy LT1004-1.2
- *Guaranteed* $\pm 20\text{mV}$ accuracy LT1004-2.5
- *Guaranteed* $10\mu\text{A}$ operating current
- *Guaranteed* temperature performance
- Operates up to 20mA
- Very low dynamic impedance

APPLICATIONS

- Portable meter references
- Portable test instruments
- Battery operated systems
- Current loop instrumentation

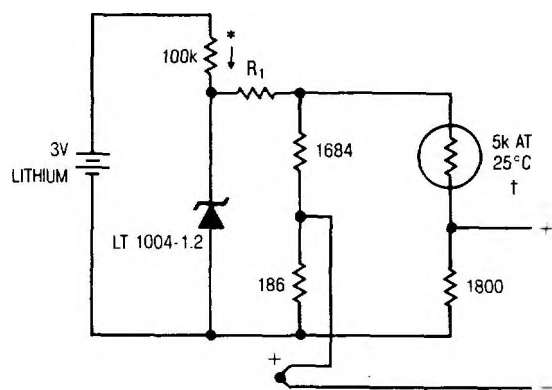
DESCRIPTION

The LT1004 Micropower Voltage References are two terminal bandgap reference diodes designed to provide high accuracy and excellent temperature characteristics at very low operating currents. Optimization of the key parameters in the design, processing and testing of the device results in accuracy specifications previously attainable only with selected units. Below is a distribution plot of reference voltage for a typical lot of LT1004-1.2. Virtually all of the units fall well within the prescribed limits of $\pm 4\text{mV}$.

The LT1004 is a pin for pin replacement for the LM185/385 series of references with improved accuracy specifications. More important, the LT1004 is an attractive device for use in systems where accuracy was previously obtained at the expense of power consumption and trimming.

For a low drift micropower reference with guaranteed temperature coefficient, see the LT1034 data sheet.

Micropower Cold Junction Compensation For Thermocouples



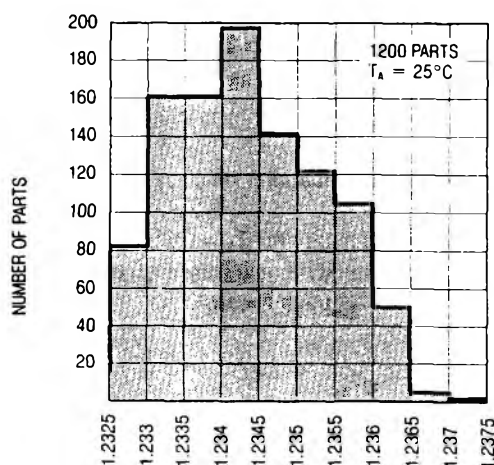
TC	TYPE	R_1
J		233k
K		299k
T		300k
S		2.1M

• QUIESCENT CURRENT $\approx 15\mu\text{A}$

† YELLOW SPRINGS INST. CO.
PART #44007

COMPENSATES WITHIN
 $\pm 1^\circ\text{C}$ FROM 0°C TO 60°C

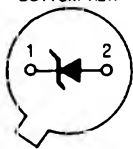
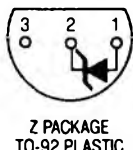
**Typical Distribution of
Reference Voltage (LT1004-1.2)**



ABSOLUTE MAXIMUM RATINGS

Reverse Breakdown Current	30mA
Forward Current	10mA
Operating Temperature Range	
LT1004M	−55°C to 125°C
LT1004C	0°C to 70°C
Storage Temperature Range	
LT1004M	−65°C to 150°C
LT1004C	−65°C to 150°C
Lead Temperature (Soldering, 10 sec.)	300°C

PACKAGE/ORDER INFORMATION

BOTTOM VIEW  H PACKAGE TO-46 METAL CAN	LT1004MH LT1004CH
BOTTOM VIEW  Z PACKAGE TO-92 PLASTIC	LT1004CZ

ELECTRICAL CHARACTERISTICS (See Note 1)

SYMBOL	PARAMETER	CONDITIONS	LT1004-1.2			LT1004-2.5			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
V_Z	Reverse Breakdown Voltage	$I_R = 100\mu A$ LT1004M $-55^\circ C \leq T_A \leq 125^\circ C$ ● LT1004M/C $0^\circ C \leq T_A \leq 70^\circ C$ ●	1.231	1.235	1.239	2.480	2.500	2.520	V
			1.220	1.230	1.245	2.460	2.500	2.535	V
			1.225	1.235	1.245	2.470	2.500	2.530	V
$\frac{\Delta V_Z}{\Delta \text{Temp}}$	Average Temperature Coefficient	$I_{min} \leq I_R \leq 20mA$ (Note 2)	20			20			ppm/°C
I_{min}	Minimum Operating Current		8 10			12 20			μA
$\frac{\Delta V_Z}{\Delta I_R}$	Reverse Breakdown Voltage Change with Current	$I_{min} \leq I_R \leq 1mA$ ● $1mA \leq I_R \leq 20mA$ ●	1 1.5 10 20			1 1.5 10 20			mV mV mV mV
r_Z	Reverse Dynamic Impedance	$I_R = 100\mu A$ ●	0.2 0.6 1.5			0.2 0.6 1.5			Ω Ω
e_n	Wide Band Noise (RMS)	$I_R = 100\mu A$ $10Hz \leq f \leq 10kHz$	60			120			μV
$\frac{\Delta V_Z}{\Delta \text{Time}}$	Long Term Stability	$I_R = 100\mu A$ $T_A = 25^\circ C \pm 0.1^\circ C$	20			20			ppm/kHr

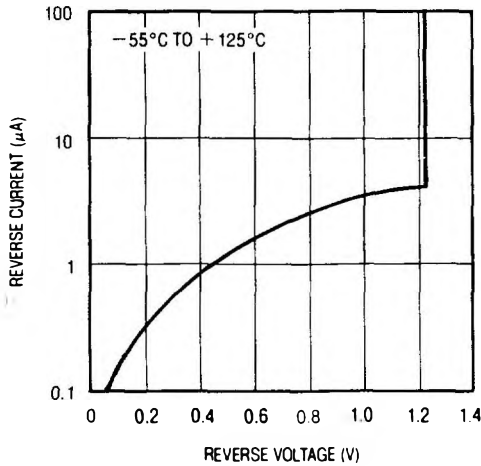
The ● denotes the specifications which apply over the full operating temperature range.

Note 1: All specifications are for $T_A = 25^\circ C$ unless otherwise noted.

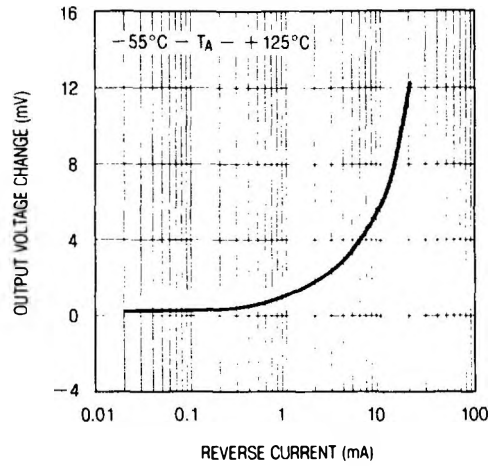
Note 2: Selected devices with guaranteed maximum temperature coefficient are available upon request.

TYPICAL PERFORMANCE CHARACTERISTICS 1.2 VOLT

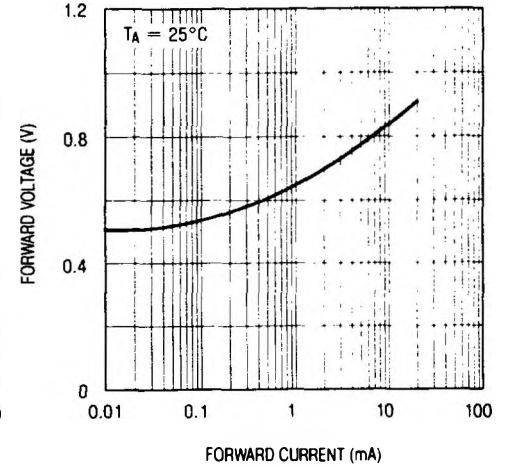
Reverse Characteristics



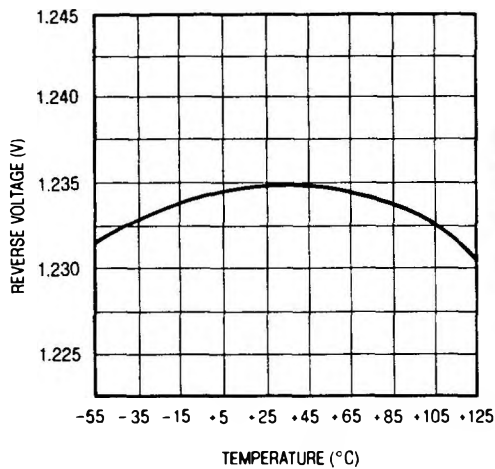
Reverse Voltage Change



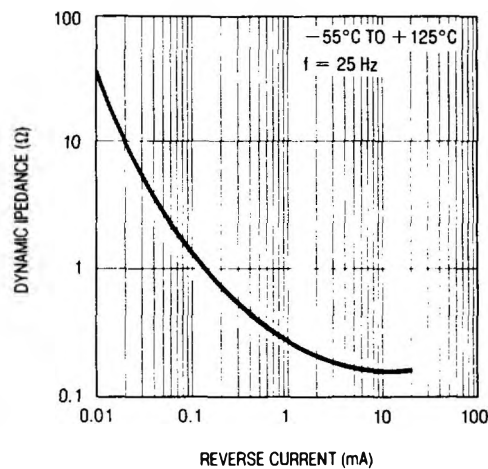
Forward Characteristics



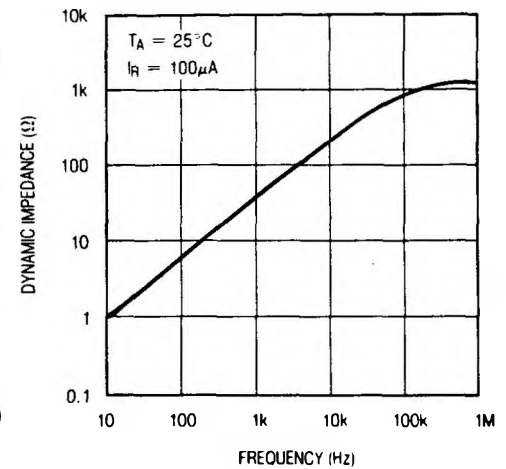
Temperature Drift



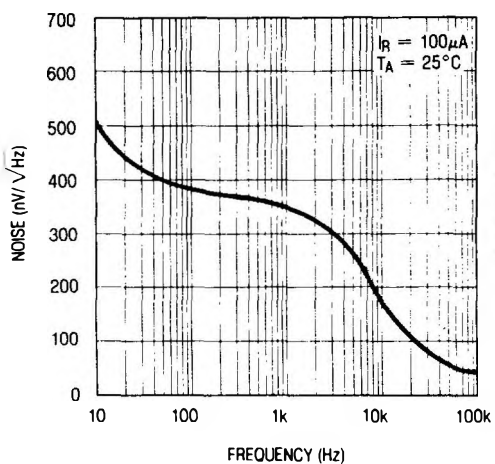
Reverse Dynamic Impedance



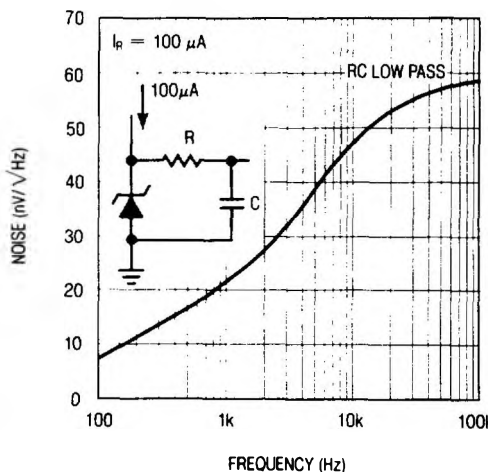
Reverse Dynamic Impedance



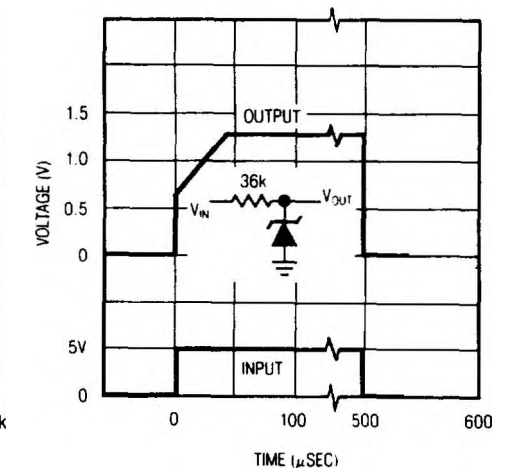
Noise Voltage



Filtered Output Noise

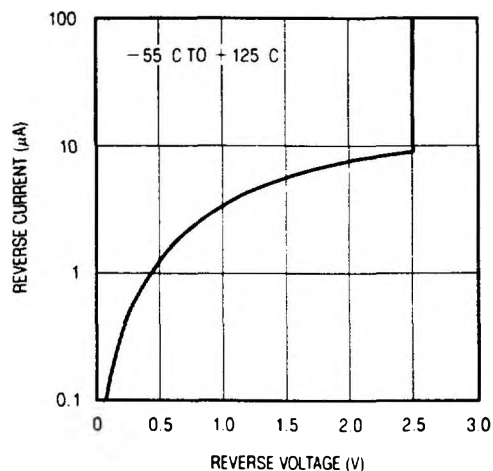


Response Time

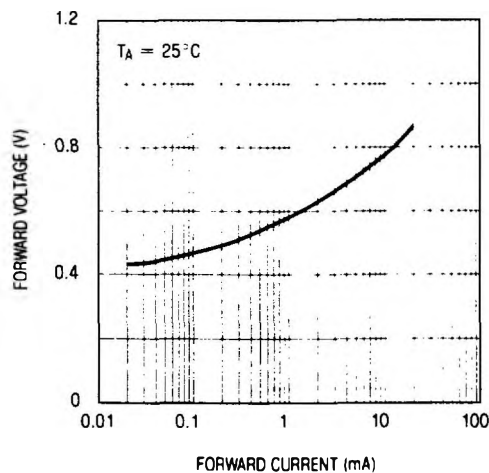


TYPICAL PERFORMANCE CHARACTERISTICS 2.5 VOLT

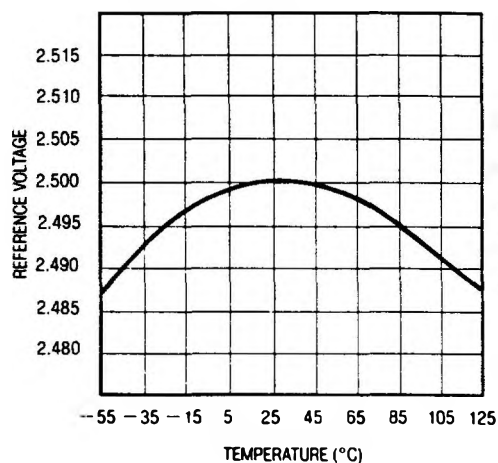
Reverse Characteristics



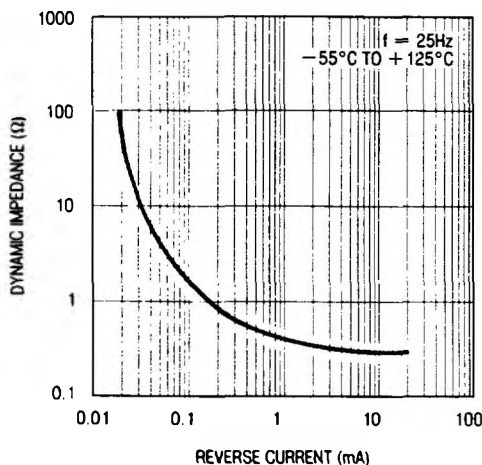
Forward Characteristics



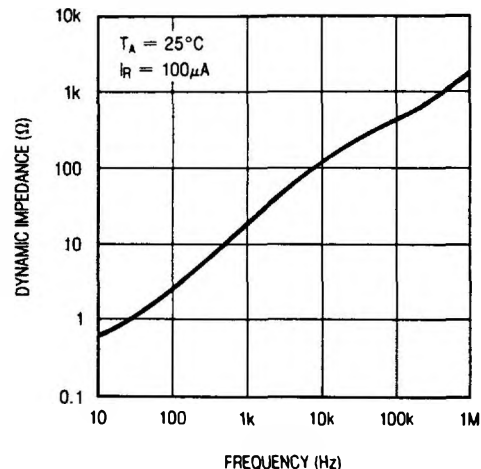
Temperature Drift



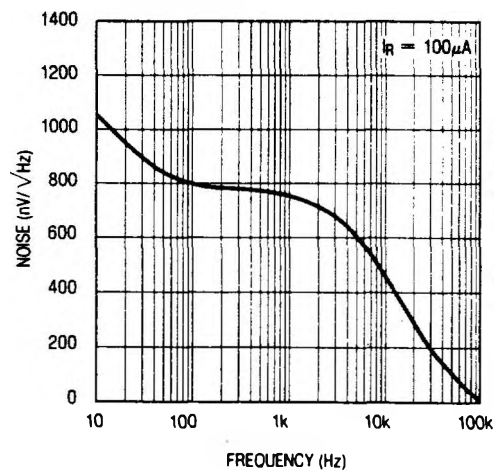
Reverse Dynamic Impedance



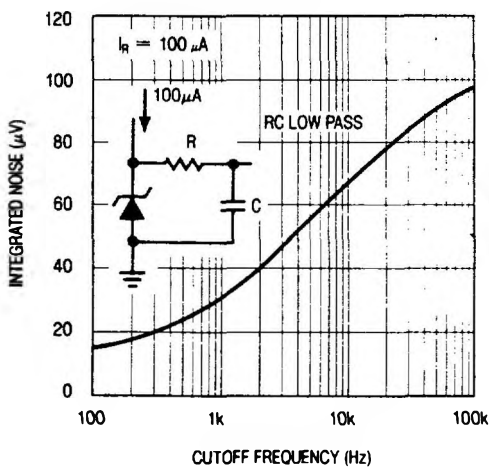
Reverse Dynamic Impedance



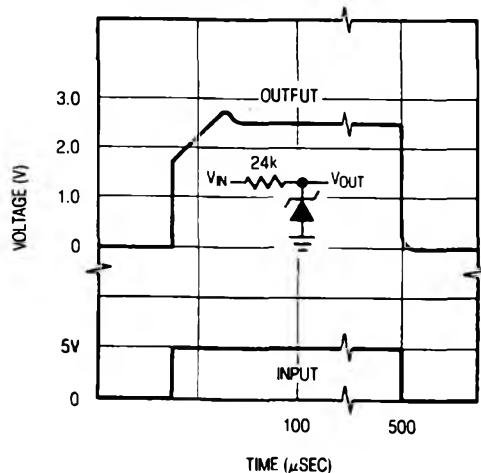
Noise Voltage



Filtered Output Noise

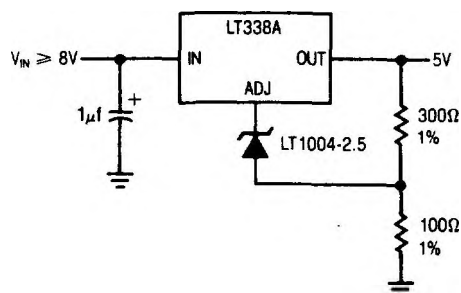


Response Time

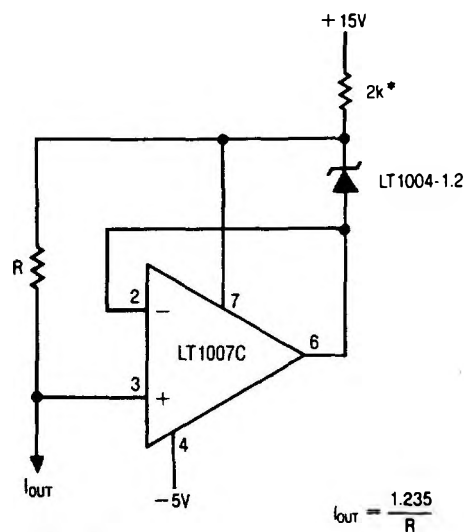


TYPICAL APPLICATIONS

High Stability 5V Regulator



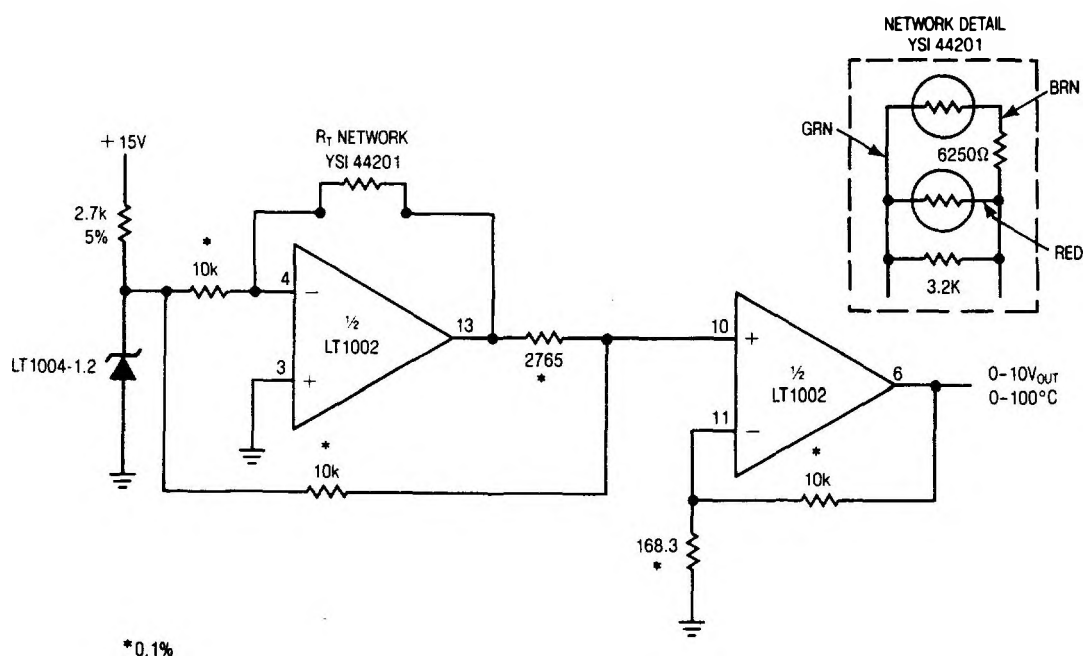
Ground Referenced Current Source



* MAY BE INCREASED FOR SMALL OUTPUT CURRENTS

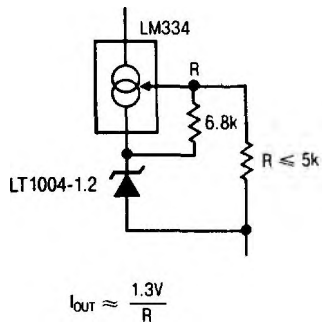
$$R \approx \frac{2V}{I_{OUT} + 10\mu A}$$

0-100°C Linear Output Thermometer

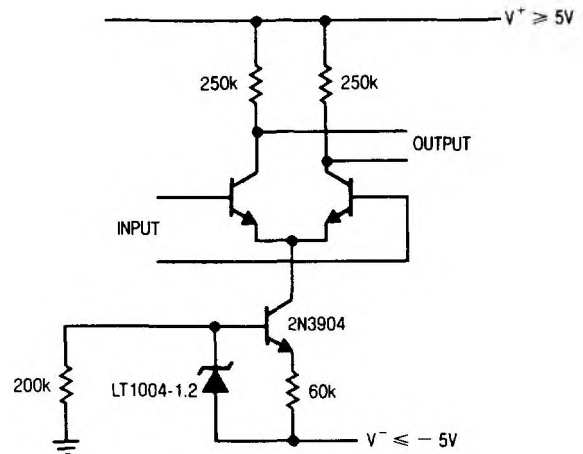


TYPICAL APPLICATIONS

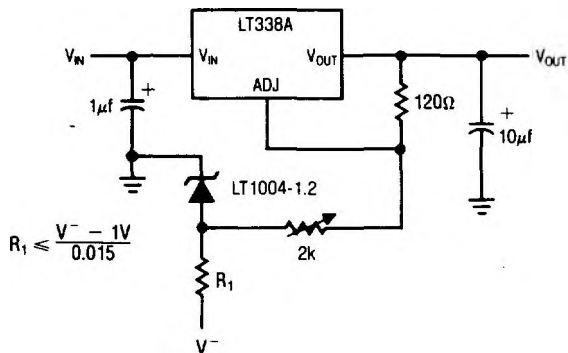
**Low Temperature Coefficient
2 Terminal Current Source**



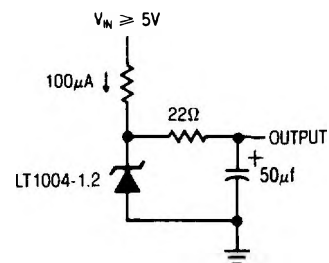
**Constant Gain Amplifier
Over Temperature**



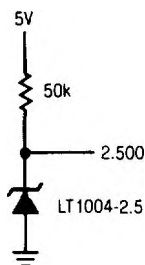
Variable Output Supply



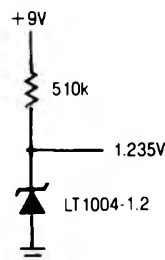
Low Noise Reference



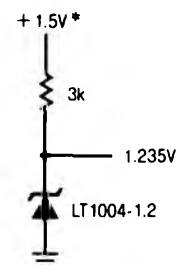
2.5V Reference



**Micropower Reference
from 9V Battery**



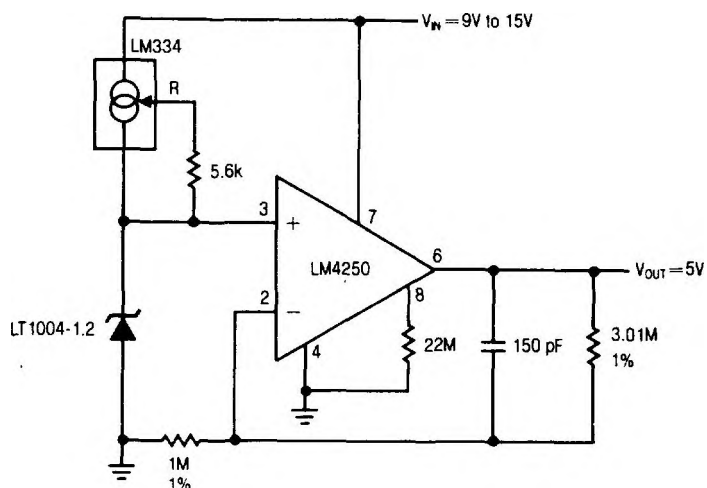
1.2V Reference from 1.5V Battery



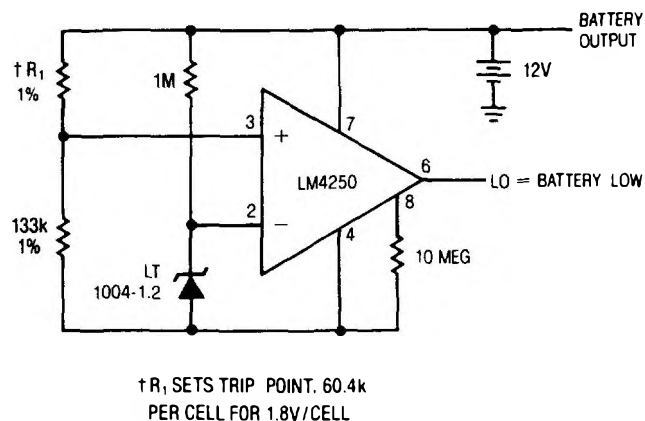
* OUTPUT REGULATES
DOWN TO 1.285V
FOR $I_{OUT} = 0$

TYPICAL APPLICATIONS

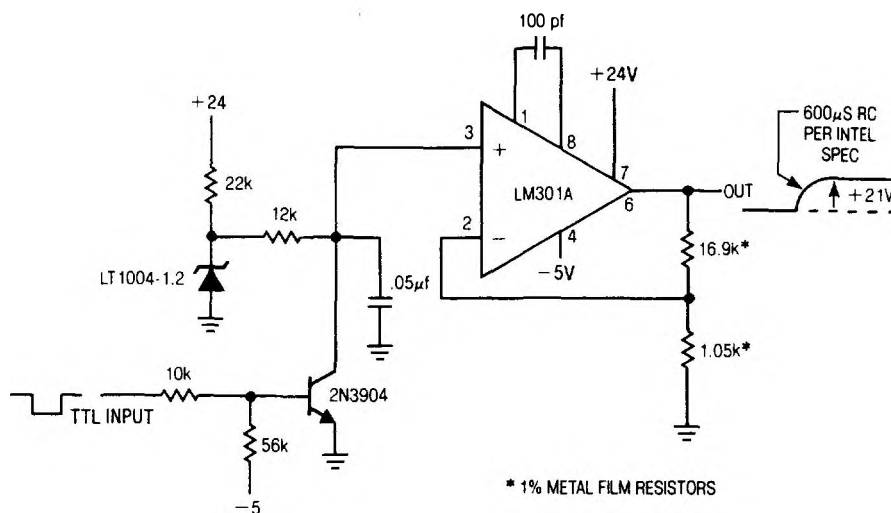
Micropower 5V Reference



Lead Acid Low Battery Detector

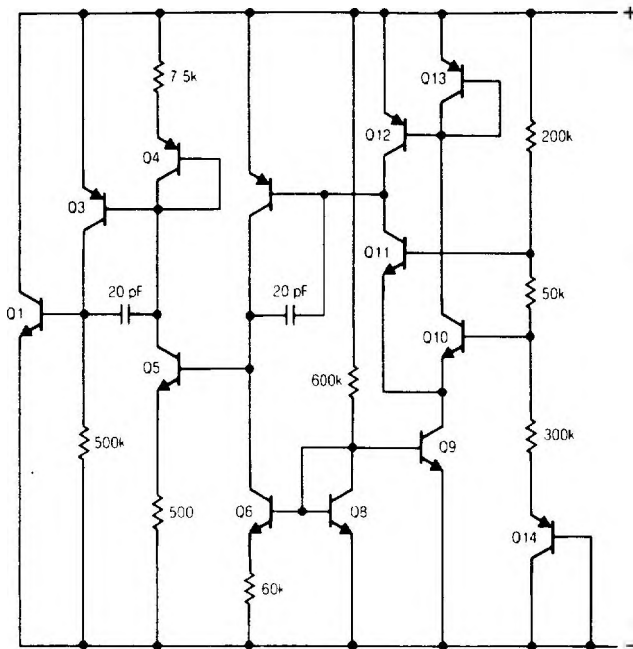


V_{pp} Generator for Eeproms — No Trim Required

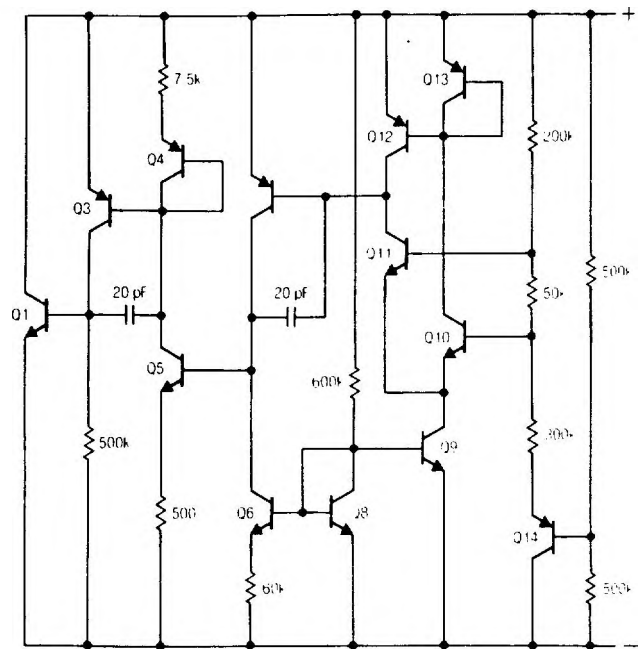


SCHEMATIC DIAGRAM

LT1004-1.2

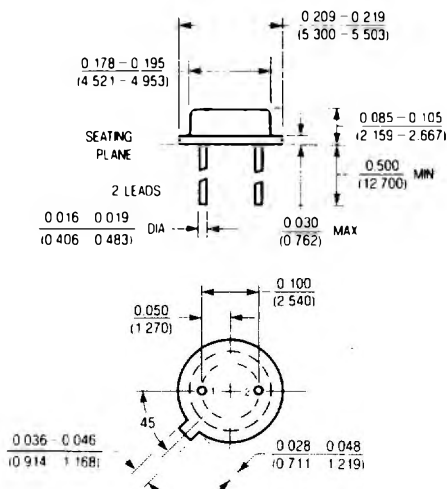


LT1004-2.5



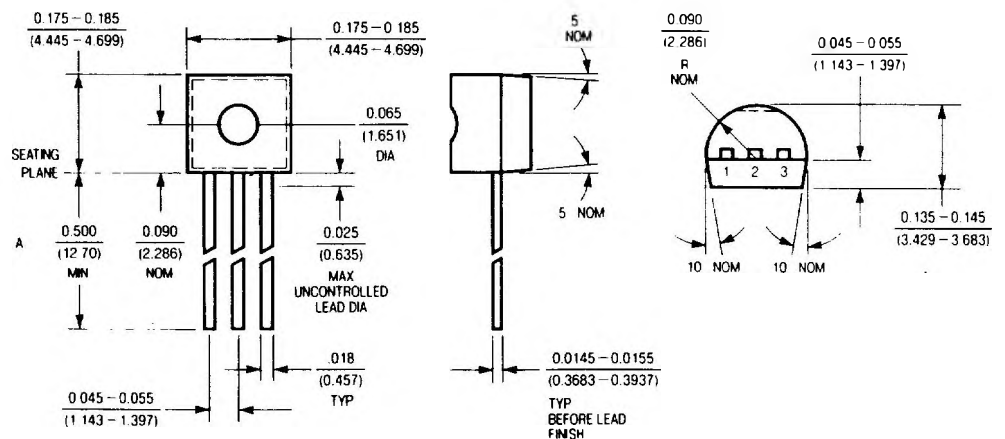
PACKAGE DESCRIPTION Dimensions in inches (millimeters) unless otherwise noted.

H Package, 2 Lead TO-46 Metal Can



T_{jmax}	θ_{ja}	θ_{jc}
150°C	440°C/W	80°C/C/W

Z Package, 3 Lead TO-92 Plastic



T_{jmax}	θ_{ja}
100°C	160°C/W