National Semiconductor

June 1988

LM1403/LM1403A Precision 2.50V Reference

General Description

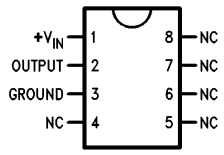
The LM1403 is a precision, monolithic, temperature-compensated voltage reference. The LM1403 makes use of thin-film technology enhanced by the discrete laser trimming of resistors to achieve excellent Temperature coefficient (Tempco) of V_{OUT} (as low as 11 ppm/°C), along with tight initial tolerance, (as low as 0.02%). The trim scheme is such that individual resistors are cut open rather than being trimmed (partially cut), to avoid resistor drift caused by electromigration in the trimmed area. The LM1403 also provides excellent stability vs. changes in input voltage and output current. The output is current-limited and is short circuit proof.

Features

- Low cost
- Low 400 μA operating current
- Low output impedance (0.15Ω)
- Excellent line regulation (0.0001%/V typical)
- Single-supply operation
- Low temperature coefficient
- Excellent initial accuracy (0.05% typical)
- Excellent for low-voltage operation (V_S = 5V, V_{REF} = 2.500V)
- For tighter specs, refer to LM368-2.5

Connection Diagram

Dual-In-Line Package



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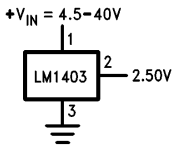
Top View

Order Number LM1403N or LM1403AN
See NS Package Number N08E

Typical Applications

Low Voltage Reference



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Absolute Maximum Ratings (Note 7)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Input Voltage	40V
Power Dissipation	600 mW
Output Short-Circuit Duration	Continuous
Storage Temperature Range	−60°C to +150°C
Operating Temperature Range	0°C to +70°C
Lead Temperature (Soldering, 10 sec.)	260°C

ESD rating to be determined.

Electrical Characteristics (Note 1)

Parameter	Conditions	LM1403, LM1403A			
		Typical	Tested Limit (Note 2)	Design Limit (Note 3)	Units (Max. Unless Noted)
V_{OUT}		+2.500			V
V_{OUT} Error: LM1403 LM1403A		±0.05 ±0.04	±1.0 ±0.4		% %
Line Regulation	$4.5V \le V_{IN} \le 40V$	0.2	3		mV
Load Regulation (Note 8)	$0\ mA \le I_{SOURCE} \le 10\ mA$	1.5	10		mV
Thermal Regulation	T = 20 ms (Note 4)	±0.005	±0.02		%/100 mW
Quiescent Current	$I_L = 0$ mA	0.350	1.50		mA
Change of Quiescent Current vs. V_{IN}	$5.0V \le V_{IN} \le 30V$	3			μA/V
Temperature Coefficient of V_{OUT} (see graph): LM1403A (Note 5) LM1403	$0°C \le T_A \le 70°C$ $0°C \le T_A \le 70°C$	±11 ±15	±25	 ±40	ppm/°C ppm/°C
Short Circuit Current	$V_{OUT} = 0$	30	70	100	mA
Noise: 0.1 Hz–10 Hz 100 Hz–10 kHz		12 420			μVp-p nV/√Hz

Note 1: Unless otherwise noted, these specifications apply: $T_A = 25°C$, $4.9V \le V_{IN} \le 15.5V$, $0 \le I_{LOAD} \le 0.5$ mA, $0 \le C_L \le 200$ pF.

Note 2: Tested Limits are guaranteed and 100% tested in production.

Note 3: Design Limits are guaranteed (but not 100% production tested) over the indicated temperature and supply voltage ranges. These limits are used to calculate outgoing quality levels.

Note 4: Thermal Regulation is defined as the change in the output Voltage at a time T after a step change in power dissipation of 100 mW.

Note 5: Temperature Coefficient of V_{OUT} is defined as the worst case delta-V_{OUT} measured at Specified Temperatures divided by the total span of the Specified Temperature Range (See graphs). There is no guarantee that the Specified Temperatures are exactly at the minimum or maximum deviation.

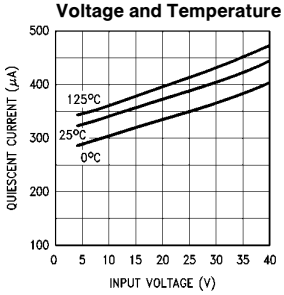
Note 6: Thermal Resistance is 160°C/W, junction to ambient, soldered into a PC board.

Note 7: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. DC and AC electrical specifications do not apply when operating the device beyond its Rated Operating Conditions (see Note 1 and Conditions).

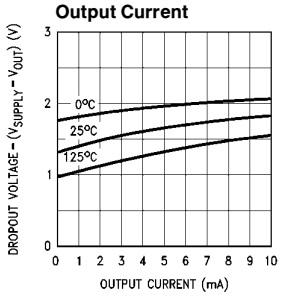
Note 8: Load regulation is measured on the output pin at a point 1/8" below the base of the package. Regulation is measured at constant junction temperature, using pulse testing with a low duty cycle. Changes in output voltage due to heating effects are covered under the specification for thermal regulation.

Typical Performance Characteristics (Note 1)

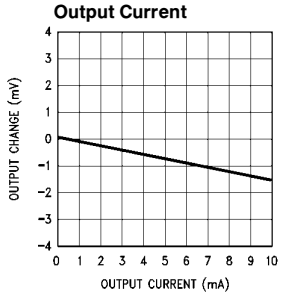
Quiescent Current vs Input Voltage and Temperature



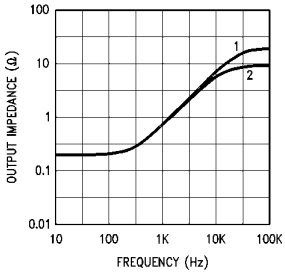
Dropout Voltage vs Output Current



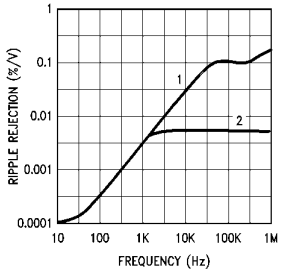
Output Change vs Output Current



Output Impedance vs Frequency



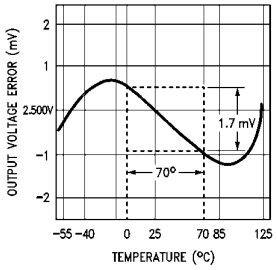
Ripple Rejection vs Frequency



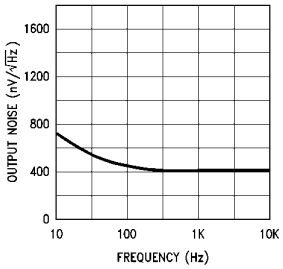
(1) LM1403 as is.

(2) With 10Ω in series with 10 μF, V_{OUT} to GND.

Temperature Coefficient



Output Noise vs. Frequency



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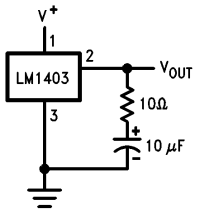
Typical Temperature Coefficient Calculations:

T.C. = 1.7 mV/(70° × 2.5V)

= 9.7 ppm/°C

Typical Applications

Improved Noise Performance



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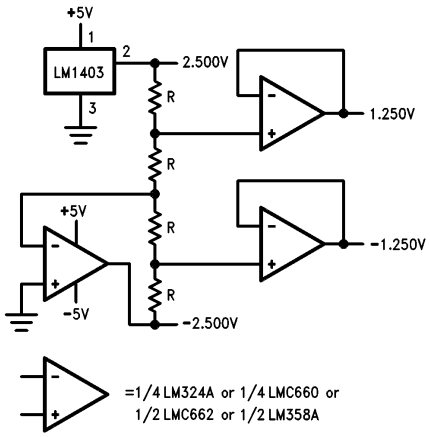
±2.5V, ±1.25V References



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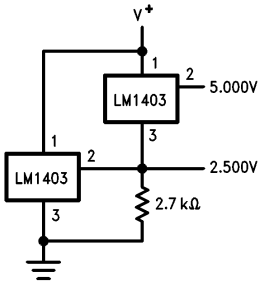
R= Thin Film Resistor Network,
±0.05% Matching and 5 ppm Tracking
(Beckman 694-3-R-10K-A),
(Caddock T-914-10K-100-05)
or similar.

Multiple Output Voltages



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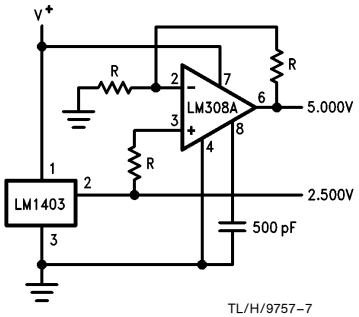
R = Thin Film Resistor Network
0.05% Matching and 5 ppm Tracking
(Beckman 694-3-R-10K-A),
(Caddock T-914-10K-100-05)
or similar.



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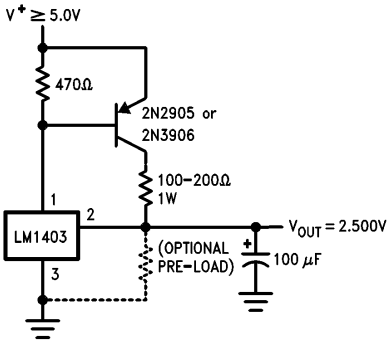
Reference with Booster



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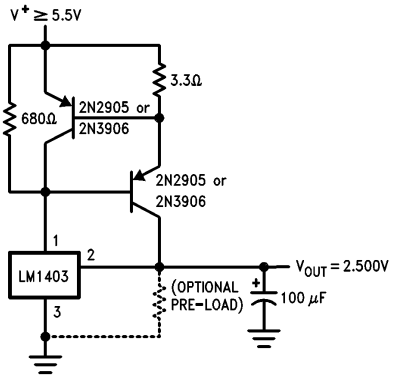
100 mA Boosted Reference



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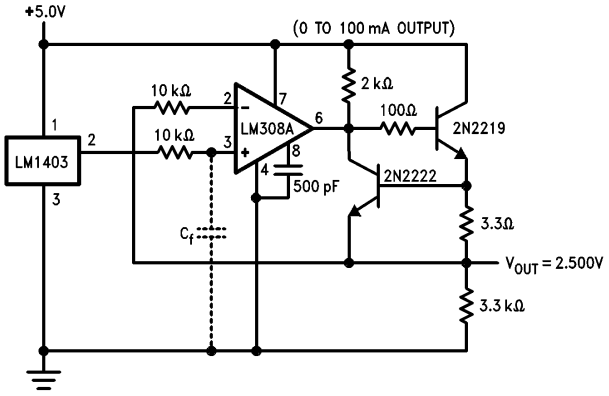
Typical Applications (Continued)

Buffered High-Current Reference with Filter



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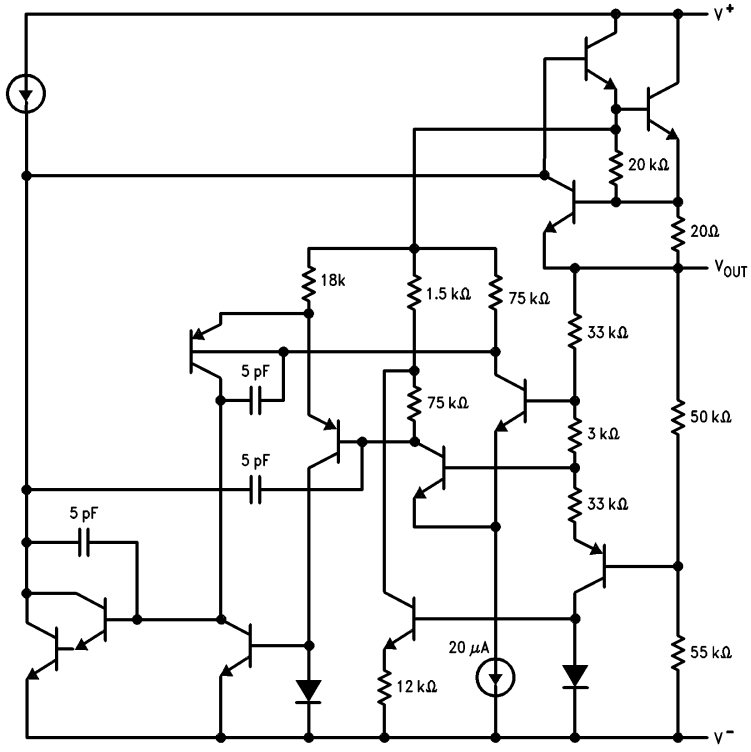
Simplified Schematic Diagram



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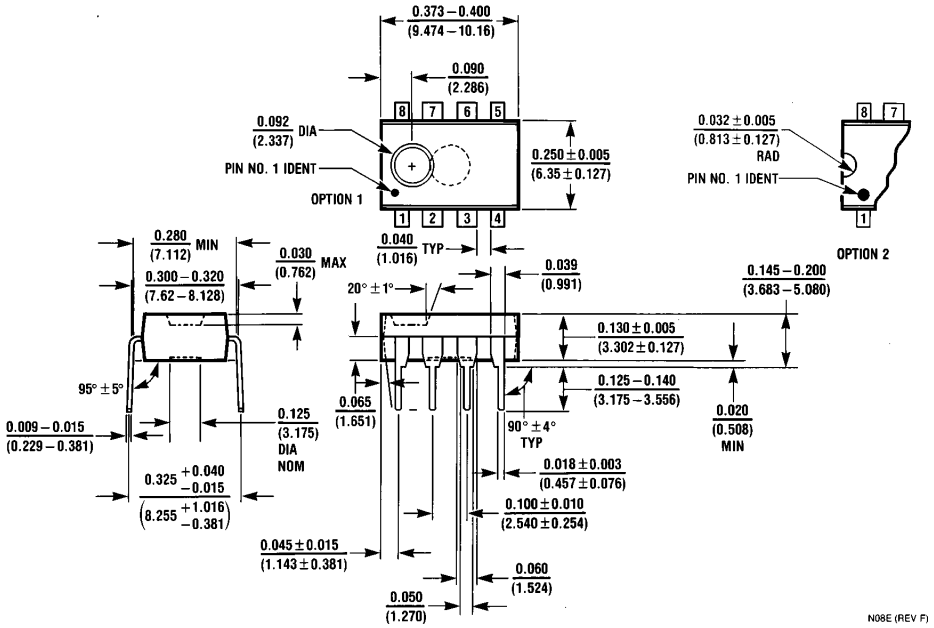
*Reg. U.S. Pat. Off.

Physical Dimensions inches (millimeters)

Lit. # 106560



Plastic Dual-In-Line Package (N)
Order Number LM1403N or LM1403AN
NS Package Number N08E

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