

MC1403, B

Low Voltage Reference

A precision band-gap voltage reference designed for critical instrumentation and D/A converter applications. This unit is designed to work with D/A converters, up to 12 bits in accuracy, or as a reference for power supply applications.

- Output Voltage: 2.5 V \pm 25 mV
- Input Voltage Range: 4.5 V to 40 V
- Quiescent Current: 1.2 mA Typical
- Output Current: 10 mA
- Temperature Coefficient: 10 ppm/ $^{\circ}$ C Typical
- Guaranteed Temperature Drift Specification
- Equivalent to AD580
- Standard 8-Pin DIP, and 8-Pin SOIC Package

Typical Applications

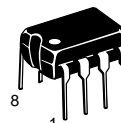
- Voltage Reference for 8 to 12 Bit D/A Converters
- Low T_C Zener Replacement
- High Stability Current Reference
- Voltmeter System Reference

MAXIMUM RATINGS ($T_A = 25^{\circ}$ C, unless otherwise noted.)

Rating	Symbol	Value	Unit
Input Voltage	V_I	40	V
Storage Temperature	T_{stg}	-65 to 150	$^{\circ}$ C
Junction Temperature	T_J	+175	$^{\circ}$ C
Operating Ambient Temperature Range MC1403B MC1403	T_A	-40 to +85 0 to +70	$^{\circ}$ C $^{\circ}$ C

PRECISION LOW VOLTAGE REFERENCE

SEMICONDUCTOR TECHNICAL DATA

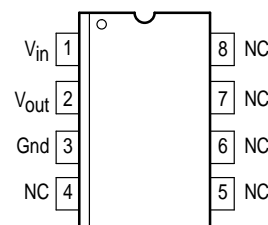


P1 SUFFIX
PLASTIC PACKAGE
CASE 626



D SUFFIX
PLASTIC PACKAGE
CASE 751
(SO-8)

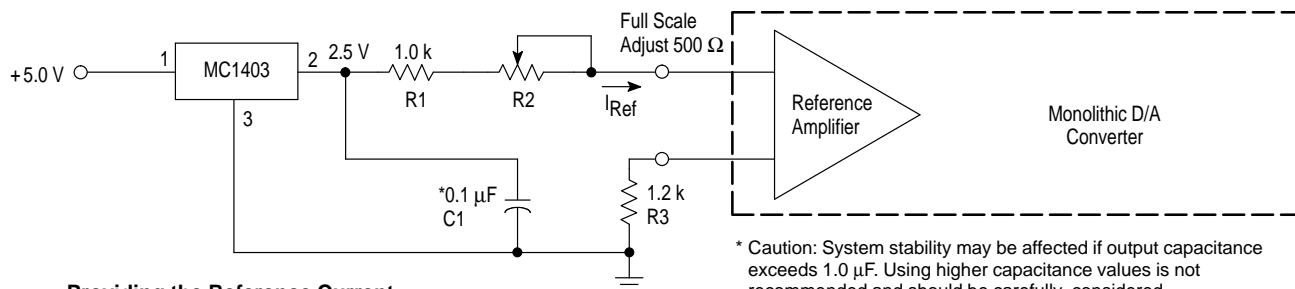
PIN CONNECTIONS



ORDERING INFORMATION

Device	Operating Temperature Range	Package
MC1403D	$T_A = 0^{\circ}$ to $+70^{\circ}$ C	SO-8
MC1403P1		Plastic DIP
MC1403BD	$T_A = -40^{\circ}$ to $+85^{\circ}$ C	SO-8
MC1403BP1		Plastic DIP

Figure 1. A Reference for Monolithic D/A Converters



Providing the Reference Current for Motorola Monolithic D/A Converters

The MC1403 makes an ideal reference for many monolithic D/A converters, requiring a stable current reference of nominally 2.0 mA. This can be easily obtained from the MC1403 with the addition of a series resistor, R1. A variable resistor, R2, is recommended to provide means for full-scale adjust on the D/A converter.

The resistor R3 improves temperature performance by matching the impedance on both inputs of the D/A reference amplifier. The capacitor decouples any noise present on the reference line. It is essential if the D/A converter is located any appreciable distance from the reference.

A single MC1403 reference can provide the required current input for up to five of the monolithic D/A converters.

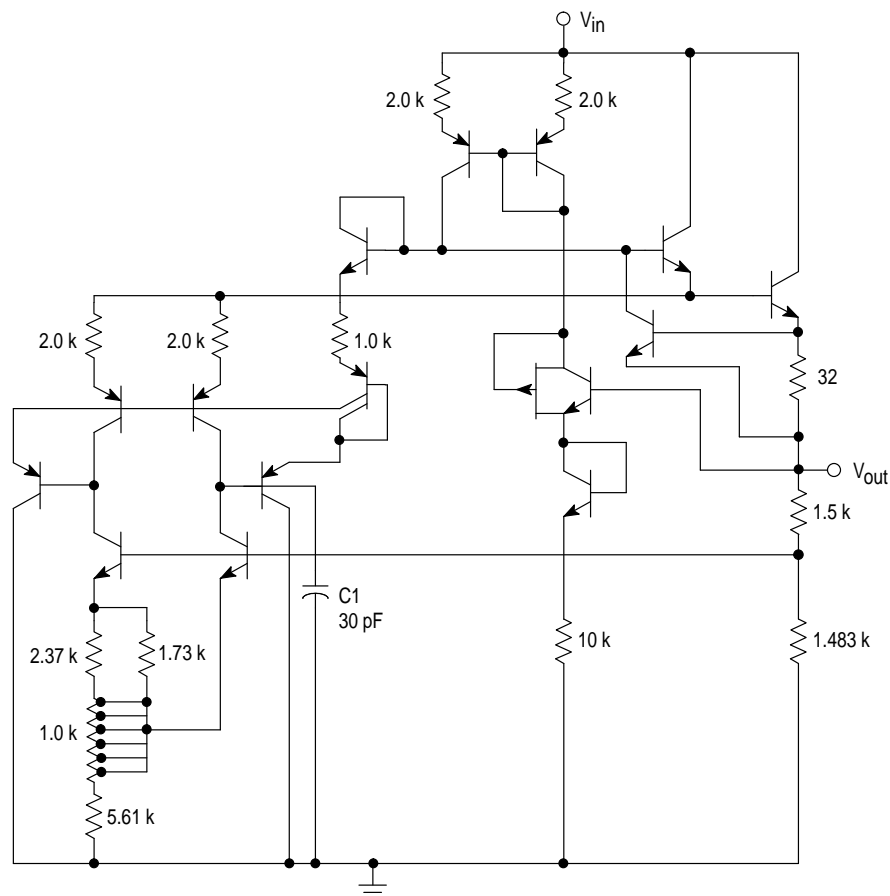
MC1403, B

ELECTRICAL CHARACTERISTICS ($V_{in} = 15\text{ V}$, $T_A = 25^\circ\text{C}$, unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
Output Voltage ($I_O = 0\text{ mA}$)	V_{out}	2.475	2.5	2.525	V
Temperature Coefficient of Output Voltage* MC1403	$\Delta V_O / \Delta T$	—	10	40	ppm/ $^\circ\text{C}$
Output Voltage Change* (Over specified temperature range)	ΔV_O				mV
MC1403 0 to $+70^\circ\text{C}$		—	—	7.0	
MC1403B -40 to $+85^\circ\text{C}$		—	—	12.5	
Line Regulation ($I_O = 0\text{ mA}$) ($15\text{ V} \leq V_I \leq 40\text{ V}$) ($4.5\text{ V} \leq V_I \leq 15\text{ V}$)	Reg_{line}	—	1.2 0.6	4.5 3.0	mV
Load Regulation ($0\text{ mA} < I_O < 10\text{ mA}$)	Reg_{load}	—	—	10	mV
Quiescent Current ($I_O = 0\text{ mA}$)	I_Q	—	1.2	1.5	mA

* Guaranteed but not tested.

Figure 2. MC1403, B Schematic



This device contains 15 active transistors.

Figure 3. Typical Change in V_{out} versus V_{in}
(Normalized to $V_{in} = 15\text{ V}$ @ $T_C = 25^\circ\text{C}$)

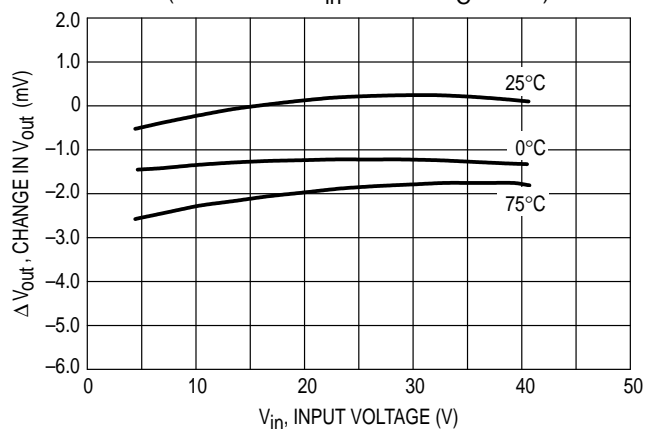


Figure 4. Change in Output Voltage versus Load Current

(Normalized to V_{out} @ $V_{in} = 15\text{ V}$, $I_{out} = 0\text{ mA}$)

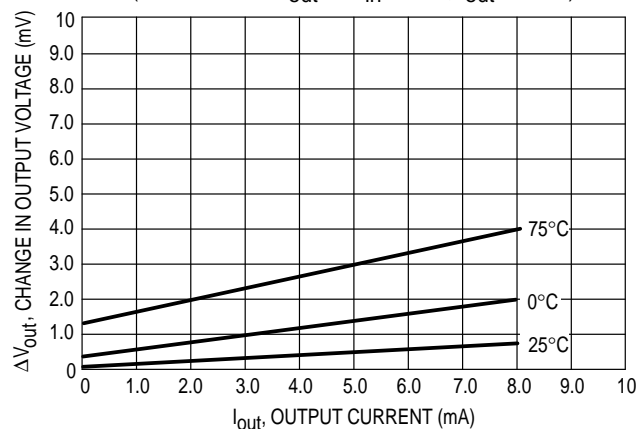


Figure 5. Quiescent Current versus Temperature
($V_{in} = 15\text{ V}$, $I_{out} = 0\text{ mA}$)

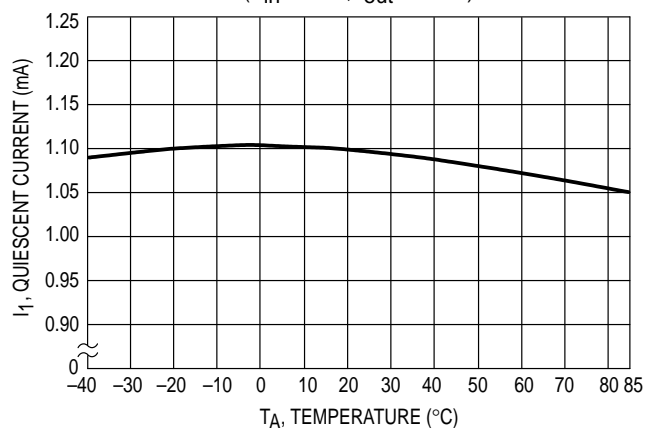


Figure 6. Change in V_{out} versus Temperature
(Normalized to V_{out} @ $V_{in} = 15\text{ V}$)

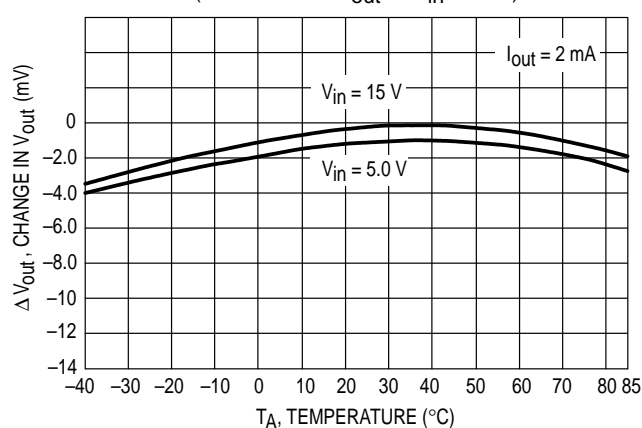
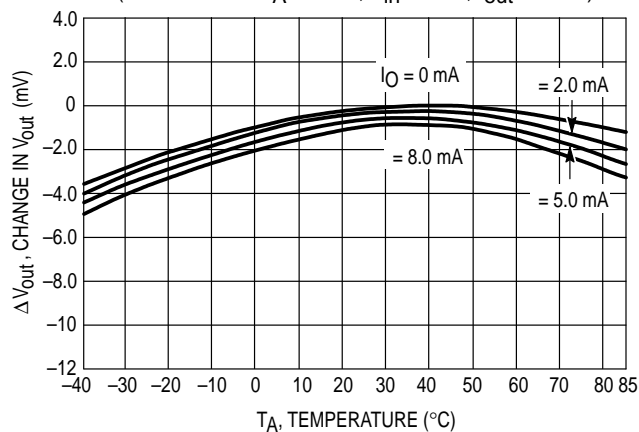


Figure 7. Change in V_{out} versus Temperature
(Normalized to $T_A = 25^\circ\text{C}$, $V_{in} = 15\text{ V}$, $I_{out} = 0\text{ mA}$)



MC1403, B

3-1/2-Digit Voltmeter – Common Anode Displays, Flashing Overrange

An example of a 3-1/2-digit voltmeter using the MC14433 is shown in the circuit diagram of Figure 8. The reference voltage for the system uses an MC1403 2.5 V reference IC. The full scale potentiometer can calibrate for a full scale of 199.9 mV or 1.999 V. When switching from 2.0 V to 200 mV operation, R_I is also changed, as shown on the diagram.

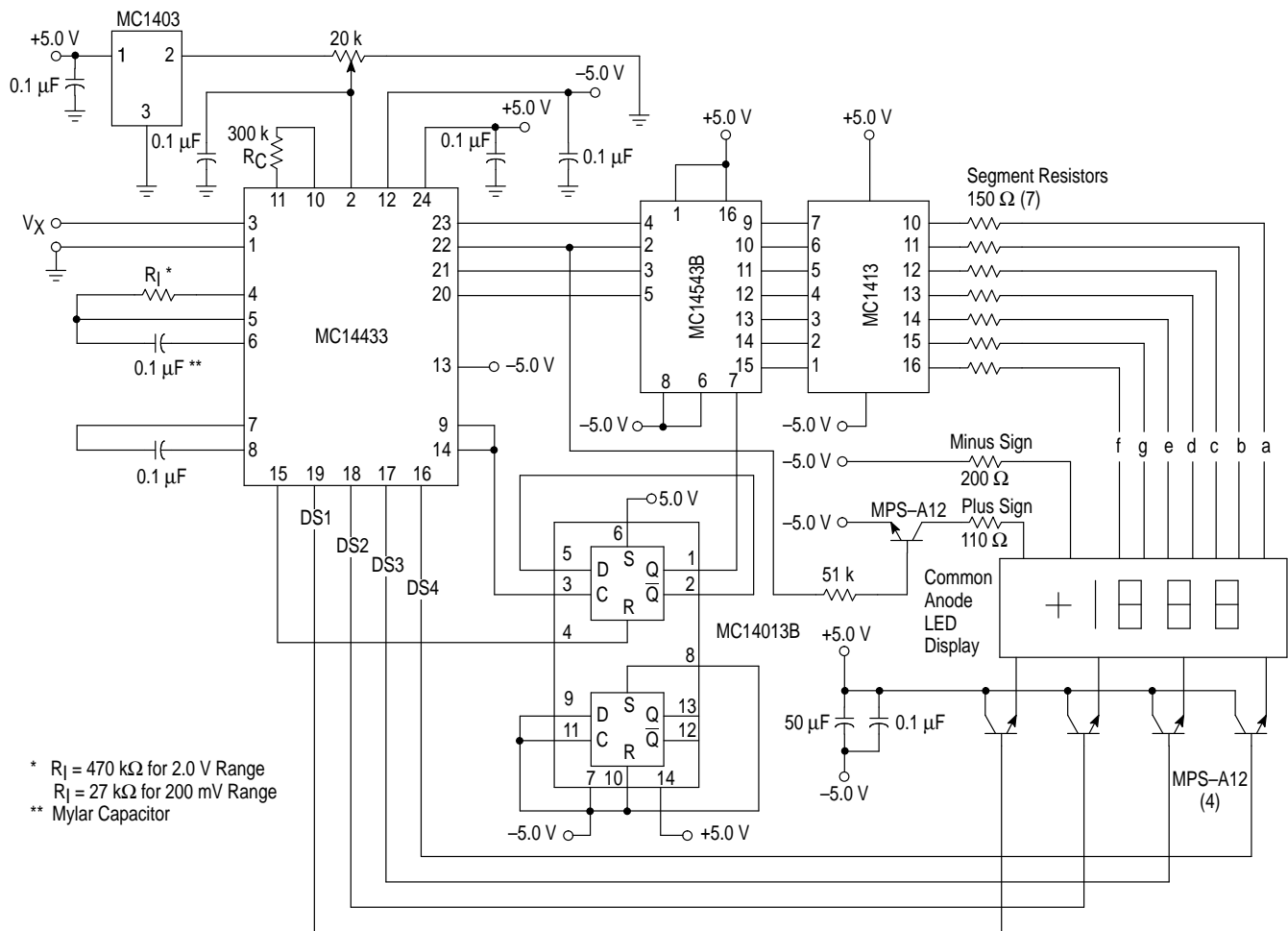
When using R_C equal to 300 k Ω , the clock frequency for the system is about 66 kHz. The resulting conversion time is approximately 250 ms.

When the input is overrange, the display flashes on and off. The flashing rate is one-half the conversion rate. This is

done by dividing the EOC pulse rate by 2 with 1/2 MC14013B flip-flop and blanking the display using the blanking input of the MC14543B.

The display uses an LED display with common anode digit lines driven with an MC14543B decoder and an MC1413 LED driver. The MC1413 contains 7 Darlington transistor drivers and resistors to drive the segments of the display. The digit drive is provided by four MPS-A12 Darlington transistors operating in an emitter-follower configuration. The MC14543B, MC14013B and LED displays are referenced to V_{EE} via Pin 13 of the MC14433. This places the full power supply voltage across the display. The current for the display may be adjusted by the value of the segment resistors shown as 150 Ω in Figure 8.

Figure 8. 3-1/2-Digit Voltmeter



* $R_I = 470 \text{ k}\Omega$ for 2.0 V Range
 $R_I = 27 \text{ k}\Omega$ for 200 mV Range
 ** Mylar Capacitor

OUTLINE DIMENSIONS

Technical drawing of a 4-pin connector. The top view shows a rectangular body with four pins (1, 2, 3, 4) and dimensions A (width), B (height), and F (pin spacing). The side view shows the profile with dimensions C (top thickness), D (pin thickness), G (body thickness), H (total width), J (pin height), K (total height), L (top width), M (pin angle), and N (pin length). A detail view shows the pin profile with dimensions F and G. A note indicates the seating plane is at the base of the pins. The drawing includes a title block with the following information:

⊕	∅ 0.13 (0.005)	Ⓜ	T	A	Ⓜ	B	Ⓜ
---	----------------	---	---	---	---	---	---

NOTES:

1. DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.
2. PACKAGE CONTOUR OPTIONAL (ROUND OR SQUARE CORNERS).
3. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	9.40	10.16	0.370	0.400
B	6.10	6.60	0.240	0.260
C	3.94	4.45	0.155	0.175
D	0.38	0.51	0.015	0.020
F	1.02	1.78	0.040	0.070
G	2.54 BSC		0.100 BSC	
H	0.76	1.27	0.030	0.050
J	0.20	0.30	0.008	0.012
K	2.92	3.43	0.115	0.135
L	7.62 BSC		0.300 BSC	
M	—	10°	—	10°
N	0.76	1.04	0.030	0.040


NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.80	5.00	0.189	0.196
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.054	0.068
D	0.35	0.49	0.014	0.019
F	0.40	1.25	0.016	0.049
G	1.27 BSC		0.050 BSC	
J	0.18	0.25	0.007	0.009
K	0.10	0.25	0.004	0.009
M	0°	7°	0°	7°
P	5.80	6.20	0.229	0.244
R	0.25	0.50	0.010	0.019

MC1403, B
NOTES

MC1403, B
NOTES

Motorola reserves the right to make changes without further notice to any products herein. Motorola makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does Motorola assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation consequential or incidental damages. "Typical" parameters which may be provided in Motorola data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. Motorola does not convey any license under its patent rights nor the rights of others. Motorola products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the Motorola product could create a situation where personal injury or death may occur. Should Buyer purchase or use Motorola products for any such unintended or unauthorized application, Buyer shall indemnify and hold Motorola and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that Motorola was negligent regarding the design or manufacture of the part. Motorola and  are registered trademarks of Motorola, Inc. Motorola, Inc. is an Equal Opportunity/Affirmative Action Employer.

Mfax is a trademark of Motorola, Inc.

How to reach us:

USA/EUROPE/Locations Not Listed: Motorola Literature Distribution;
P.O. Box 5405, Denver, Colorado 80217. 1-303-675-2140 or 1-800-441-2447

JAPAN: Motorola Japan Ltd.; SPD, Strategic Planning Office, 141,
4-32-1 Nishi-Gotanda, Shinagawa-ku, Tokyo, Japan. 81-3-5487-8488

Customer Focus Center: 1-800-521-6274

Mfax™: RMFAX0@email.sps.mot.com – TOUCHTONE 1-602-244-6609
Motorola Fax Back System – US & Canada ONLY 1-800-774-1848
– <http://sps.motorola.com/mfax/>

ASIA/PACIFIC: Motorola Semiconductors H.K. Ltd.; Silicon Harbour Centre,
2, Dai King Street, Tai Po Industrial Estate, Tai Po, N.T., Hong Kong.
852-26629298

HOME PAGE: <http://motorola.com/sps/>



MOTOROLA

