MOTOROLA Semiconductors

MC1403,A
MC1503,A

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 Motorola MC1506, MC1508, and MC3510 D/A converters, and MC14433 A/D systems. Low temperature drift is a prime design consideration.

- Output Voltage = 2.5 V ±25 mV
- Input Voltage Range = 4.5 V to 40 V
- Quiescent Current = 1.2 mA typ
- Output Current = 10 mA
- Temperature Coefficient = 10 ppm/°C typ
- Guaranteed Temperature Drift Specification
- Equivalent to AD580
- Standard 8-Pin DIP Package

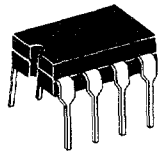
Typical Applications

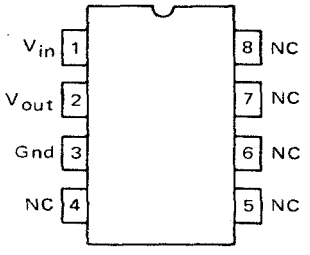
- Voltage Reference for 8-12 Bit D/A Converters
- Low T_C Zener Replacement
- High Stability Current Reference
- Voltmeter System Reference

PRECISION LOW-VOLTAGE REFERENCE

LASER TRIMMED SILICON MONOLITHIC INTEGRATED CIRCUIT

U SUFFIX
CERAMIC PACKAGE
CASE 693





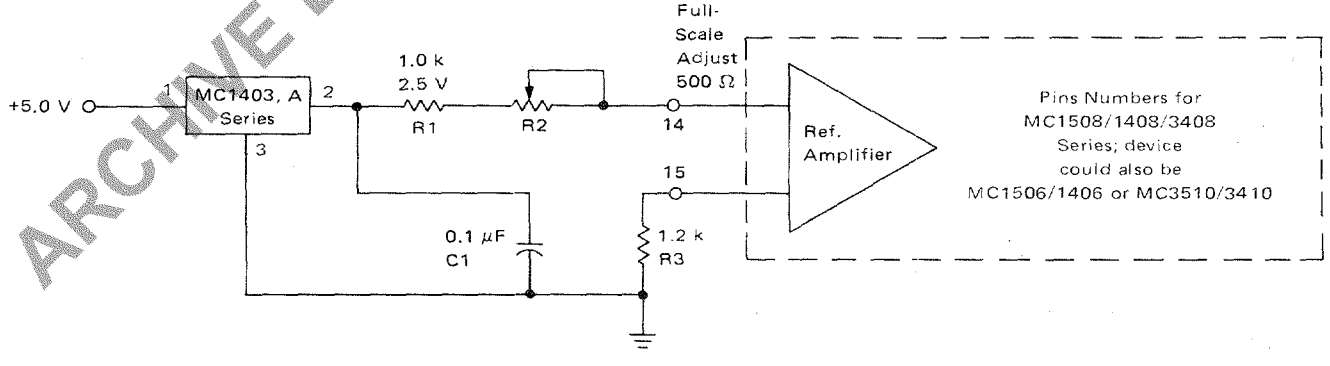
MAXIMUM RATINGS (T_A = 25°C unless otherwise noted.)

Rating	Symbol	Value	Unit
Input Voltage	V_I	40	V
Storage Temperature	T_{stg}	-65 to 150	°C
Junction Temperature	T_J	+175	°C
Operating Ambient Temeprature Range	T_A		
MC1503,A		-55 to +125	°C
MC1403,A		0 to +70	°C

ORDERING INFORMATION

Device	Temperature Range	Package
MC1503U	-55 to +125°C	Ceramic DIP
MC1503AU	-55 to +125°C	Ceramic DIP
MC1403U	0 to +70°C	Ceramic DIP
MC1403AU	0 to +70°C	Ceramic DIP

FIGURE 1 – A REFERENCE FOR MOTOROLA MONOLITHIC D/A CONVERTERS



PROVIDING THE REFERENCE CURRENT FOR MOTOROLA MONOLITHIC D/A CONVERTERS

The MC1403/1503 makes an ideal reference for the Motorola monolithic D/A converters. The MC1406/1506, MC1408/1508, MC3410/3510 and MC3408 D/A converters all require a stable current reference of nominally 2.0 mA. This can be easily obtained from the MC1403/1503 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 MC1403/1503 reference can provide the required current input for up to five of the monolithic D/A converters.

DS 9468
(Replaces NP-64)

ELECTRICAL CHARACTERISTICS (V_I = 15 V, T_A = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
Output Voltage (I_O = 0 mA)	V_O	2.475	2.50	2.525	V
Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$				ppm/°C
MC1503		–	–	55	
MC1503A		–	–	25	
MC1403		–	10	40	
MC1403A		–	10	25	
Output Voltage Change (over specified temperature range)	ΔV_O				mV
MC1503, MC1503A } -55°C to +125°C		–	–	25	
		–	–	11	
MC1403, MC1403A } 0°C to +70°C		–	–	7.0	
		–	–	4.4	
Line Regulation	Reg_{in}				mV
(15 V ≤ V_I ≤ 40 V)		–	1.2	4.5	
(4.5 V ≤ V_I ≤ 15 V)		–	0.6	3.0	
Load Regulation ($0 mA < I_O < 10 mA$)	Reg_{load}	–	–	10	mV
Quiescent Current (I_O = 0 mA)	I_I	–	1.2	1.5	mA

FIGURE 2 – MC1403/1503 SCHEMATIC

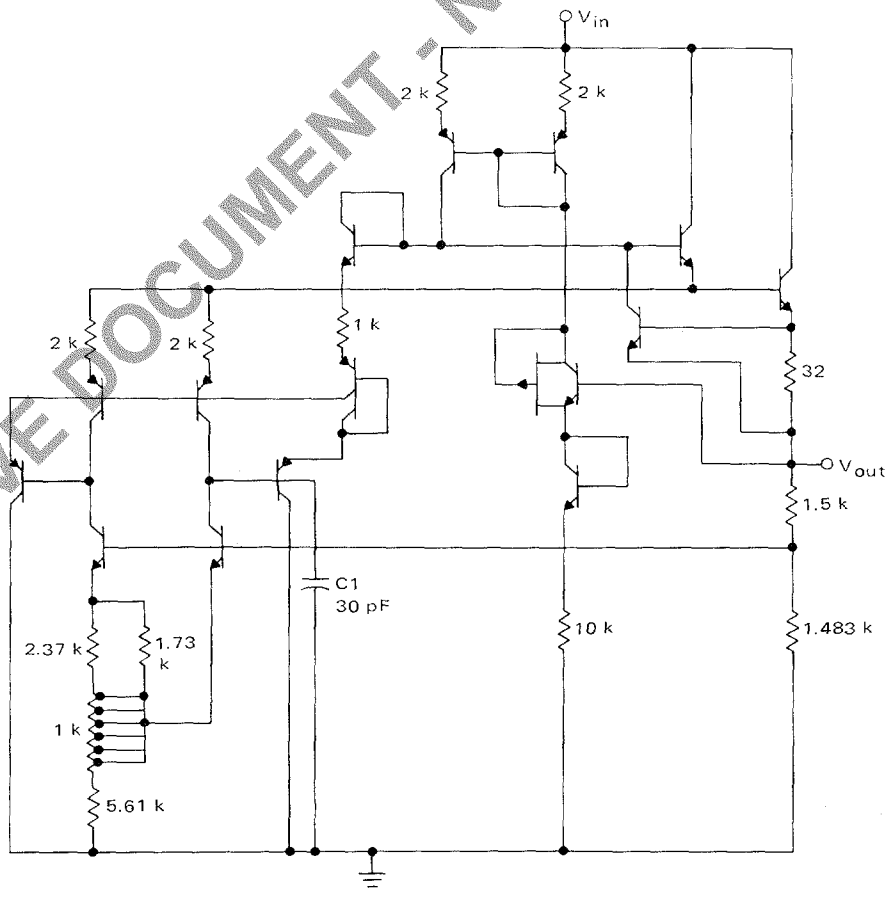


FIGURE 3 – TYPICAL CHANGE IN V_{out} versus V_{in}
(NORMALIZED TO V_{in} = 15 V @ T_C = 25°C)

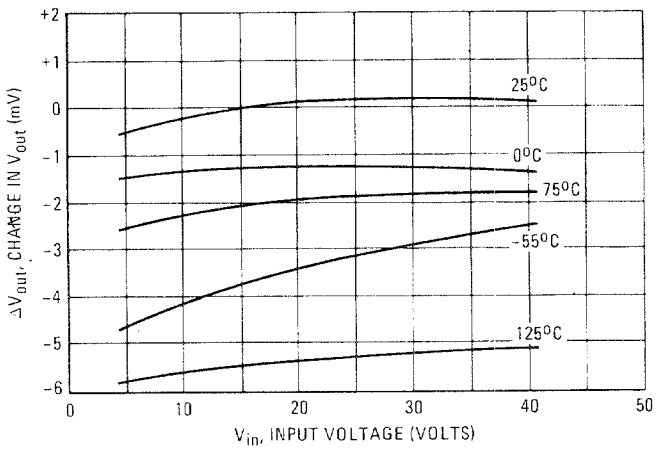


FIGURE 4 – CHANGE IN OUTPUT VOLTAGE
versus LOAD CURRENT
(NORMALIZED TO V_{out} @ V_{in} = 15 V, I_{out} = 0 mA)

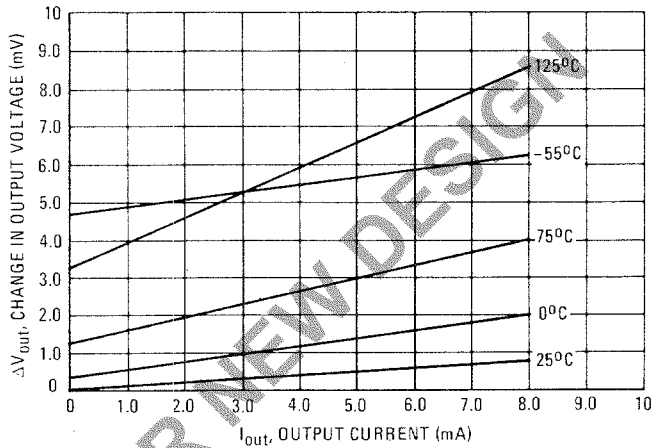


FIGURE 5 – QUIESCENT CURRENT versus TEMPERATURE
(V_{in} = 15 V, I_{out} = 0 mA)

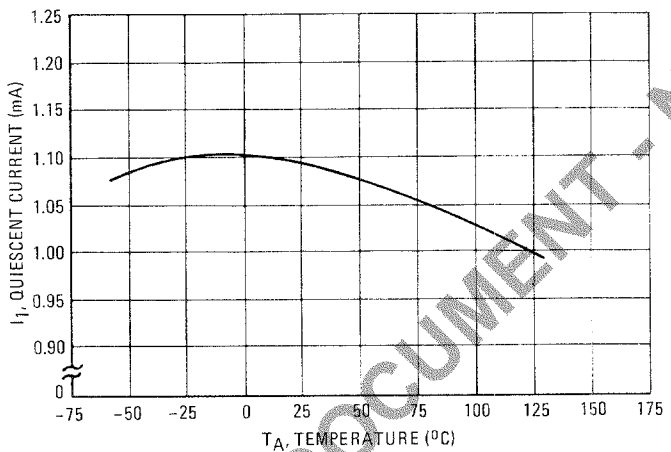


FIGURE 6 – CHANGE IN V_{out} versus TEMPERATURE
(NORMALIZED TO V_{out} @ V_{in} = 15 V)

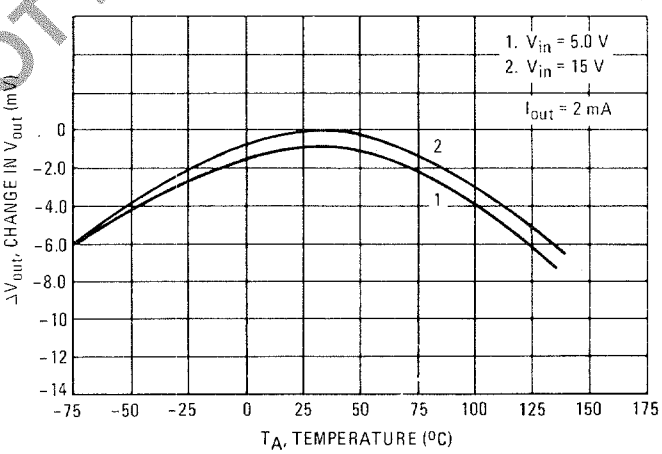
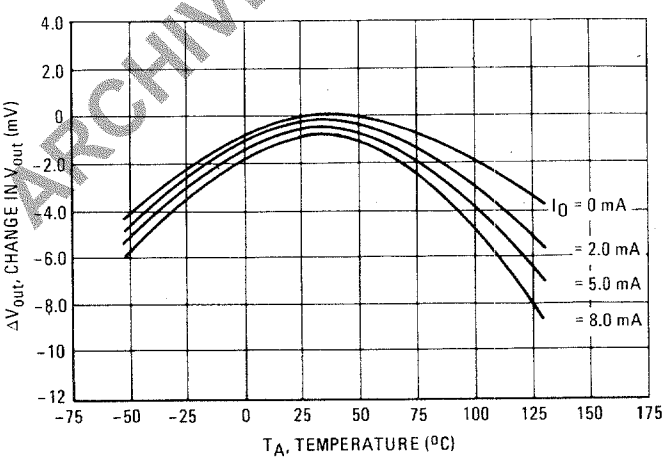
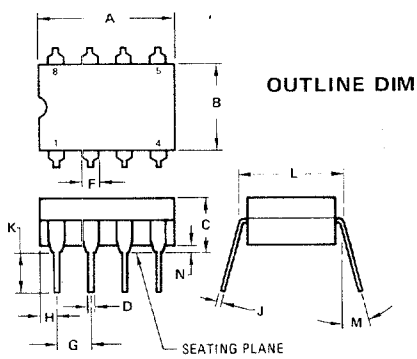


FIGURE 7 – CHANGE IN V_{out} versus TEMPERATURE
(NORMALIZED TO T_A @ V_{in} = 15 V, I_{out} = 0 mA)



OUTLINE DIMENSIONS



DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	9.91	10.92	0.390	0.430
B	6.22	6.99	0.245	0.275
C	4.32	5.08	0.170	0.200
D	0.41	0.51	0.016	0.020
F	1.40	1.65	0.055	0.065
G	2.54 BSC		0.100 BSC	
H	1.14	1.65	0.045	0.065
J	0.20	0.30	0.008	0.012
K	3.18	4.06	0.125	0.160
L	7.37	7.87	0.290	0.310
M	–	15°	–	15°
N	0.51	1.02	0.020	0.040

NOTES:
1. LEADS WITHIN 0.13 mm (0.005) RAD OF TRUE POSITION AT SEATING PLANE AT MAXIMUM MATERIAL CONDITION.
2. DIMENSION "L" TO CENTER OF LEADS WHEN FORMED PARALLEL.

CASE 693

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 V to 200 mV operation, R_I is also changed, as shown on the diagram.

When using R_C equal to 300 kΩ, 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 ohms in Figure 8.

FIGURE 8 – 3-1/2-DIGIT VOLTMETER