

## 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.

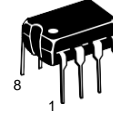
- Output Voltage: 2.5 V  $\pm$  25 mV
- Input Voltage Range: 4.5 V to 40 V
- Quiescent Current: 1.2 mA Typical
- Output Current: 10 mA
- Temperature Coefficient: 10 ppm/ $^{\circ}$ C Typical
- Guaranteed Temperature Drift Specification
- Equivalent to AD580
- Standard 8-Pin DIP, and 8-Pin SOIC Package

### 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 HT1403B HT1403A	$T_A$	- 40 to +85 0 to + 70	$^{\circ}$ C $^{\circ}$ C

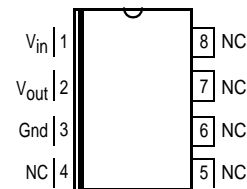


**N SUFFIX**  
PLASTIC PACKAGE  
CASE 626



**R SUFFIX**  
PLASTIC PACKAGE  
CASE 751  
(SO-8)

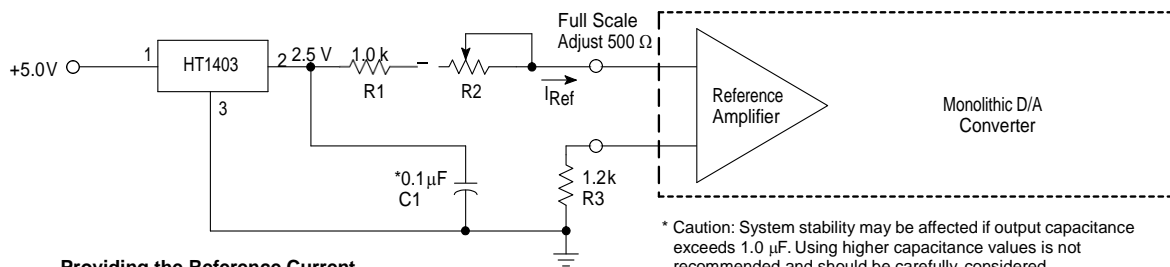
### PIN CONNECTIONS



### ORDERING INFORMATION

Device	Operating Temperature Range	Package
HT1403ARZ	$T_A = 0^{\circ}$ to $+70^{\circ}$ C	SO-8
HT1403ANZ		Plastic DIP
HT1403BRZ	$T_A = - 40^{\circ}$ to $+85^{\circ}$ C	SO-8
HT1403BNZ		Plastic DIP

**Figure 1. A Reference for Monolithic D/A Converters**



### Providing the Reference Current for Motorola Monolithic D/A Converters

The HT1403 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 HT1403 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.

\* Caution: System stability may be affected if output capacitance exceeds 1.0  $\mu$ F. Using higher capacitance values is not recommended and should be carefully considered.

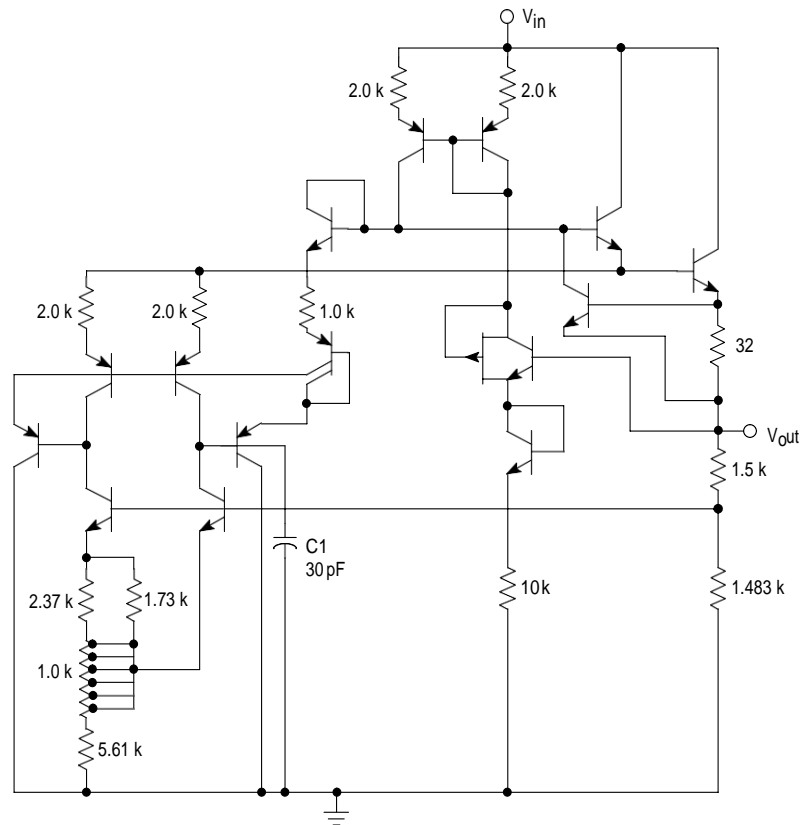
The resistor R3 improves temperature performance by matching the impedance on both inputs of the D/A reference amplifier. The capacitor decouples any noise present on the reference line. It is essential if the D/A converter is located any appreciable distance from the reference.

A single HT1403 reference can provide the required current input for up to five of the monolithic D/A converters.

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

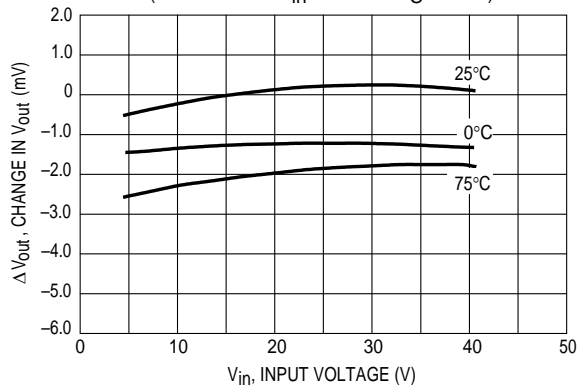
Characteristic	Symbol	Min	Typ	Max	Unit
Output Voltage ( $I_O = 0\text{ mA}$ )	$V_{out}$	2.475	2.5	2.525	V
Temperature Coefficient of Output Voltage* HT1403	$\Delta V_O/\Delta T$	-	10	40	ppm/ $^\circ\text{C}$
Output Voltage Change* (Over specified temperature range) HT1403 0 to $+70^\circ\text{C}$ HT1403B -40 to $+85^\circ\text{C}$	$\Delta V_O$	-	-	7.0 12.5	mV
Line Regulation ( $I_O = 0\text{ mA}$ ) (15 V $\approx$ $V_I \approx$ 40 V) (4.5 V $\approx$ $V_I \approx$ 15V)	Reg <sub>line</sub>	-	1.2 0.6	4.5 3.0	mV
Load Regulation (0 mA < $I_O$ < 10 mA)	Reg <sub>load</sub>	-	-	10	mV
Quiescent Current ( $I_O = 0\text{ mA}$ )	$I_Q$	-	1.2	1.5	mA

\* Guaranteed but not tested.

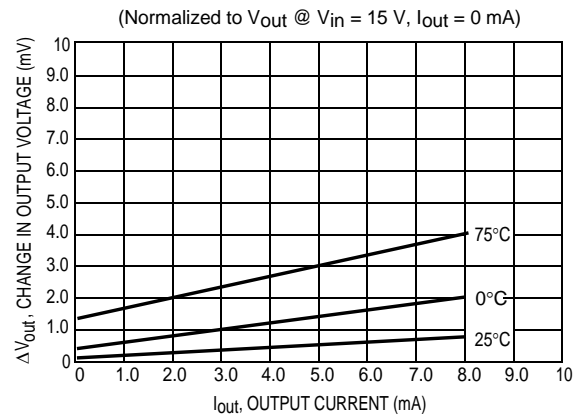
**Figure 2. HT1403, B Schematic**


This device contains 15 active transistors.

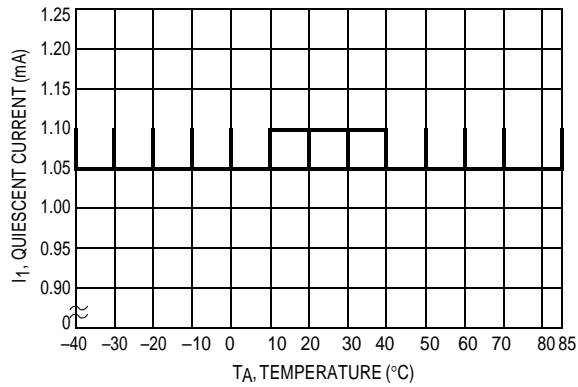
**Figure 3. Typical Change in  $V_{out}$  versus  $V_{in}$**   
 (Normalized to  $V_{in} = 15\text{ V}$  @  $T_C = 25^\circ\text{C}$ )



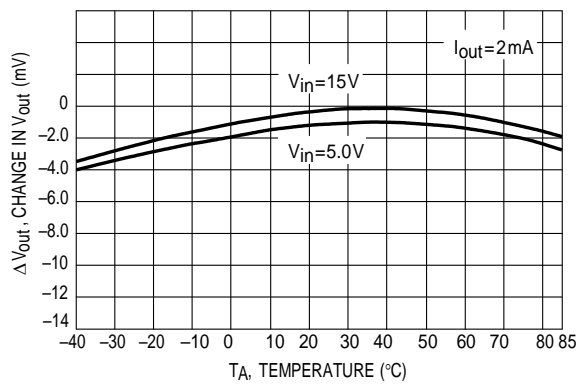
**Figure 4. Change in Output Voltage versus Load Current**



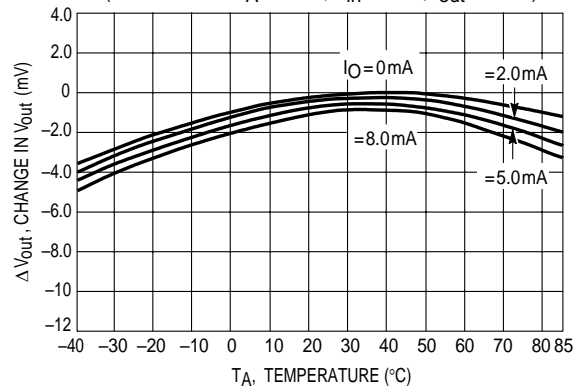
**Figure 5. Quiescent Current versus Temperature**  
 ( $V_{in} = 15\text{ V}$ ,  $I_{out} = 0\text{ mA}$ )



**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  $T_A = 25^\circ\text{C}$ ,  $V_{in} = 15\text{ V}$ ,  $I_{out} = 0\text{ mA}$ )



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

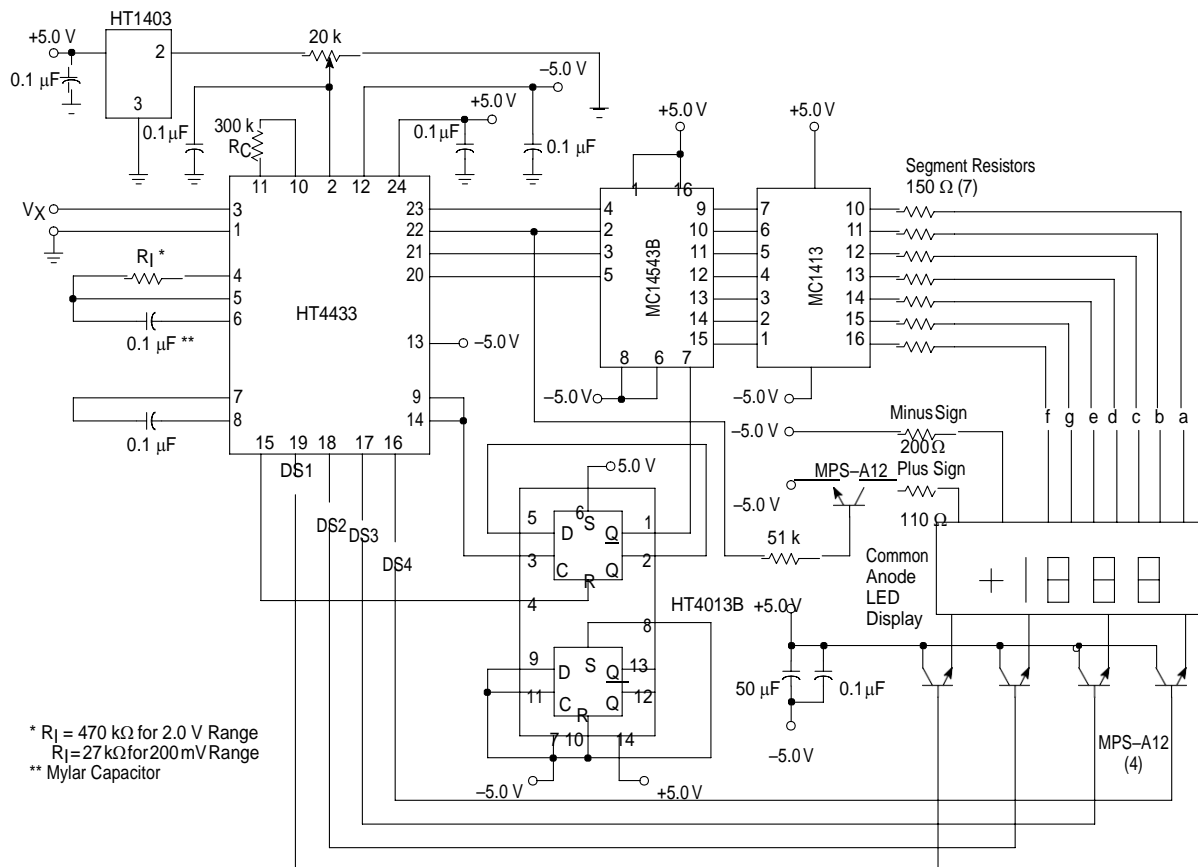
An example of a 3-1/2-digit voltmeter using the HT4433 is shown in the circuit diagram of Figure 8. The reference voltage for the system uses an HT1403 2.5 V reference IC. The full scale potentiometer can calibrate for a full scale of 199.9 mV or 1.999 V. When switching from 2.0 V to 200 mV operation,  $R_1$  is also changed, as shown on the diagram.

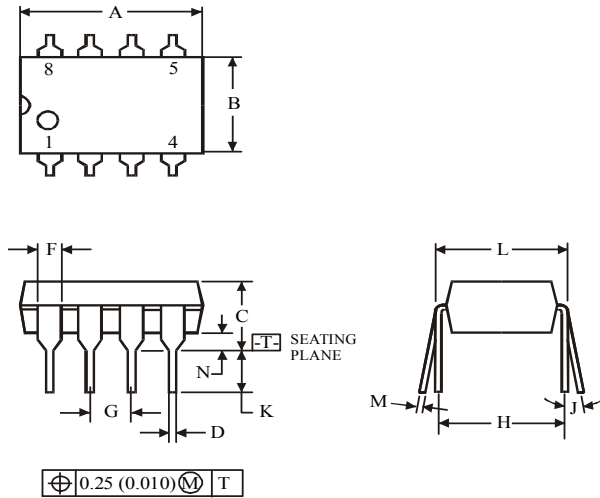
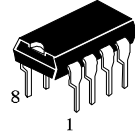
When using  $R_C$  equal to 300 k $\Omega$ , the clock frequency for the system is about 66 kHz. The resulting conversion time is approximately 250 ms.

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 HT4013B flip-flop and blanking the display using the blanking input of the HT4543B.

The display uses an LED display with common anode digit lines driven with an HT4543B decoder and an HT1413 LED driver. The HT1413 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 HT4543B, HT4013B and LED displays are referenced to  $V_{EE}$  via Pin 13 of the HT4433. 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  $\Omega$  in Figure 8.

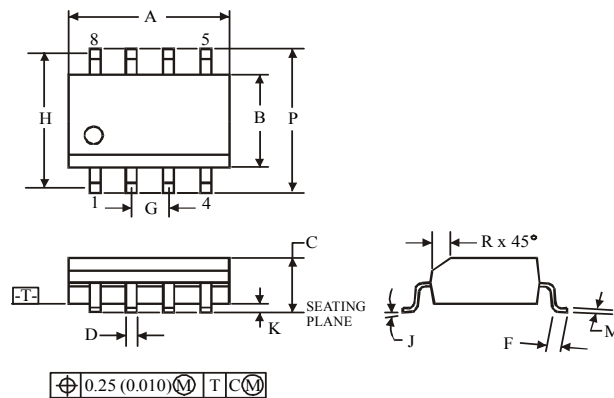
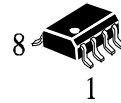
**Figure 8. 3-1/2-Digit Voltmeter**


**(DIP8)**


Symbol	Dimension, mm	
	MIN	MAX
A	8.51	10.16
B	6.1	7.11
C		5.33
D	0.36	0.56
F	1.14	1.78
G	2.54	
H	7.62	
J	0°	10°
K	2.92	3.81
L	7.62	8.26
M	0.2	0.36
N	0.38	

**NOTES:**

- Dimensions "A", "B" do not include mold flash or protrusions.  
Maximum mold flash or protrusions 0.25 mm (0.010) per side.

**(SOP8)**


Symbol	Dimension, mm	
	MIN	MAX
A	4.8	5
B	3.8	4
C	1.35	1.75
D	0.33	0.51
F	0.4	1.27
G	1.27	
H	5.72	
J	0°	8°
K	0.1	0.25
M	0.19	0.25
P	5.8	6.2
R	0.25	0.5

**NOTES:**

- Dimensions A and B do not include mold flash or protrusion.
- Maximum mold flash or protrusion 0.15 mm (0.006) per side for A; for B - 0.25 mm (0.010) per side.