

# MC1404

## Voltage Reference Family

The MC1404 of ICs is a family of temperature-compensated voltage references for precision data conversion applications, such as A/D, D/A, V/F, and F/V. Advances in laser-trimming and ion-implanted devices, as well as monolithic fabrication techniques, make these devices stable and accurate to 12 bits over both military and commercial temperature ranges. In addition to excellent temperature stability, these parts offer excellent long-term stability and low noise.

- Output Voltages: Standard, 5.0 V, 6.25 V, 10 V
- Trimmable Output:  $> \pm 6\%$
- Wide Input Voltage Range:  $V_{ref} + 2.5 V$  to 40 V
- Low Quiescent Current: 1.25 mA Typical
- Temperature Coefficient: 10 ppm/ $^{\circ}C$  Typical
- Low Output Noise: 12  $\mu V$  p-p Typical
- Excellent Ripple Rejection:  $> 80$  dB Typical

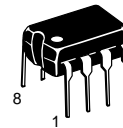
### Typical Applications

- Voltage Reference for 8 to 12 Bit D/A Converters
- Low  $T_C$  Zener Replacement
- High Stability Current Reference
- MPU D/A and A/D Applications

## PRECISION LOW DRIFT VOLTAGE REFERENCES

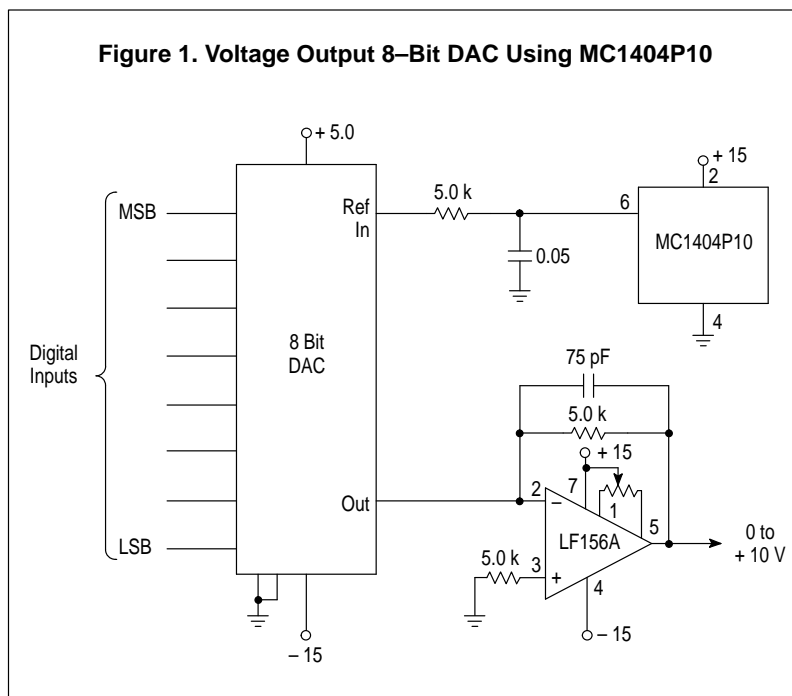
5.0, 6.25, and 10-VOLT OUTPUT VOLTAGES

### SEMICONDUCTOR TECHNICAL DATA

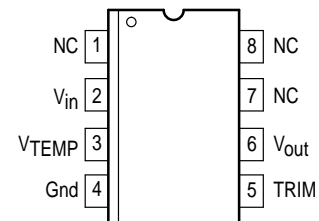


**P SUFFIX**  
PLASTIC PACKAGE  
CASE 626

**Figure 1. Voltage Output 8-Bit DAC Using MC1404P10**



### PIN CONNECTIONS



### ORDERING INFORMATION

| Device    | Operating Temperature Range         | Package     |
|-----------|-------------------------------------|-------------|
| MC1404P5  | $T_A = 0^{\circ}$ to $+70^{\circ}C$ | Plastic DIP |
| MC1404P6  |                                     | Plastic DIP |
| MC1404P10 |                                     | Plastic DIP |

# MC1404

## MAXIMUM RATINGS

| Rating                              | Symbol    | Value         | Unit |
|-------------------------------------|-----------|---------------|------|
| Input Voltage                       | $V_{in}$  | 40            | V    |
| Storage Temperature                 | $T_{stg}$ | - 65 to + 150 | °C   |
| Junction Temperature                | $T_J$     | + 175         | °C   |
| Operating Ambient Temperature Range | $T_A$     | 0 to + 70     | °C   |

## ELECTRICAL CHARACTERISTICS ( $V_{in} = 15\text{ V}$ , $T_A = 25^\circ\text{C}$ , and Trim Terminal not connected, unless otherwise noted.)

| Characteristic   | Symbol                | Min                 | Typ               | Max                  | Unit         |
|--|-----------------------|---------------------|-------------------|----------------------|--------------|
| Output Voltage<br>( $I_O = 0\text{ mA}$ )  | $V_O$                 | 4.95<br>6.19<br>9.9 | 5.0<br>6.25<br>10 | 5.05<br>6.31<br>10.1 | V            |
| Output Voltage Tolerance   | -                     | -                   | $\pm 0.1$         | $\pm 1.0$            | %            |
| Output Trim Range (Figure 10)<br>( $R_P = 100\text{ k}\Omega$ )                                    | $\Delta V_{TRIM}$     | $\pm 6.0$           | -                 | -                    | %            |
| Output Voltage Temperature Coefficient,<br>Over Full Temperature Range                             | $\Delta V_O/\Delta T$ | -                   | 10                | 40                   | ppm/°C       |
| Maximum Output Voltage Change<br>Over Temperature Range  | $\Delta V_O$          | -                   | -                 | 14<br>17.5<br>28     | mV           |
| Line Regulation (Note 1)<br>( $V_{in} = V_{out} + 2.5\text{ V}$ to 40 V, $I_{out} = 0\text{ mA}$ ) | Reg <sub>line</sub>   | -                   | 2.0               | 6.0                  | mV           |
| Load Regulation (Note 1)<br>( $0 \leq I_O \leq 10\text{ mA}$ )                                     | Reg <sub>load</sub>   | -                   | -                 | 10                   | mV           |
| Quiescent Current<br>( $I_O = 0\text{ mA}$ )   | $I_Q$                 | -                   | 1.2               | 1.5                  | mA           |
| Short Circuit Current  | $I_{SC}$              | -                   | 20                | 45                   | mA           |
| Long Term Stability  | -                     | -                   | 25                | -                    | ppm/1000 hrs |

NOTE: 1. Includes thermal effects.

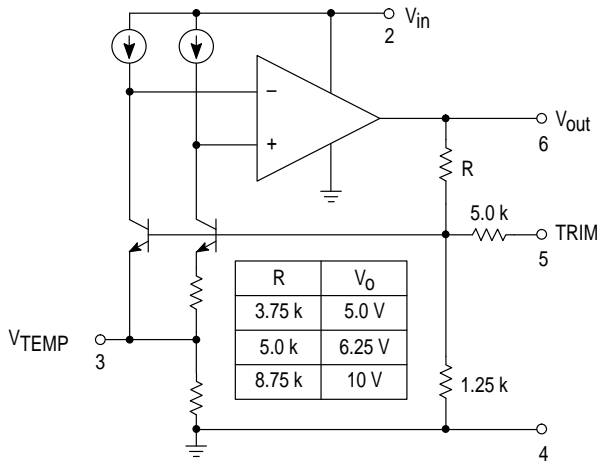
## DYNAMIC CHARACTERISTICS ( $V_{in} = 15\text{ V}$ , $T_A = 25^\circ\text{C}$ , all voltage ranges, unless otherwise noted.)

| Characteristic  | Symbol | Min | Typ         | Max | Unit          |
|---|--------|-----|-------------|-----|---------------|
| Turn-On Settling Time<br>(to $\pm 0.01\%$ )               | $t_S$  | -   | 50          | -   | $\mu\text{s}$ |
| Output Noise Voltage - P to P<br>(Bandwidth 0.1 to 10 Hz) | $V_n$  | -   | 12          | -   | $\mu\text{V}$ |
| Small-Signal Output Impedance<br>120 Hz<br>500 Hz         | $r_o$  | -   | 0.15<br>0.2 | -   | $\Omega$      |
| Power Supply Rejection Ratio                              | PSRR   | 70  | 80          | -   | dB            |

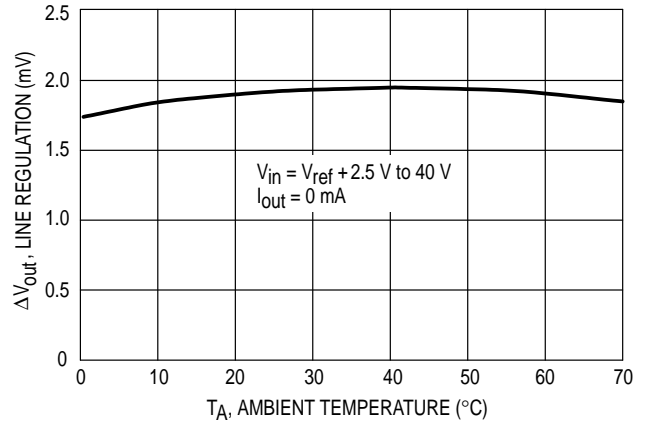
# MC1404

## TYPICAL CHARACTERISTICS

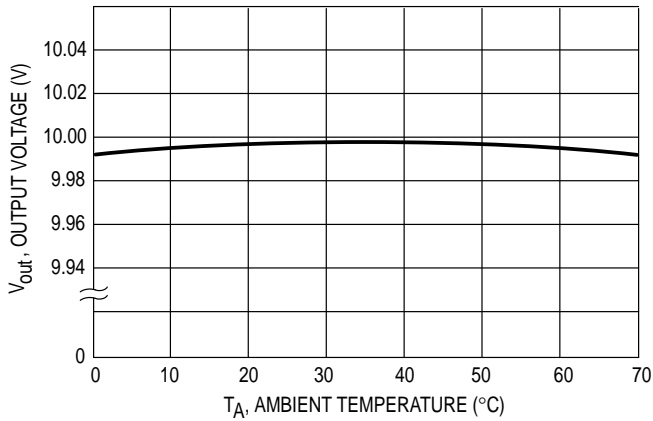
**Figure 2. Simplified Device Diagram**



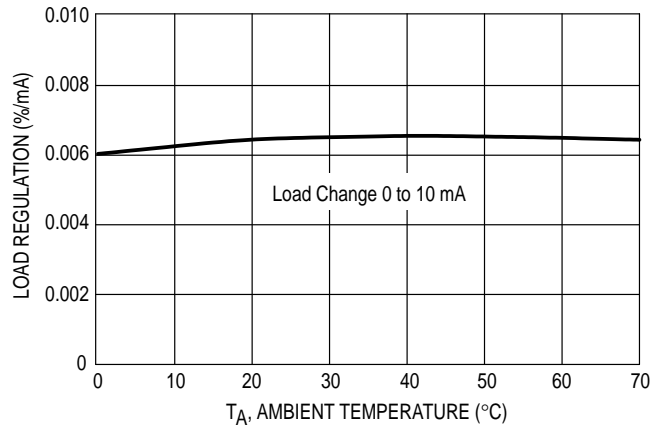
**Figure 3. Line Regulation versus Temperature**



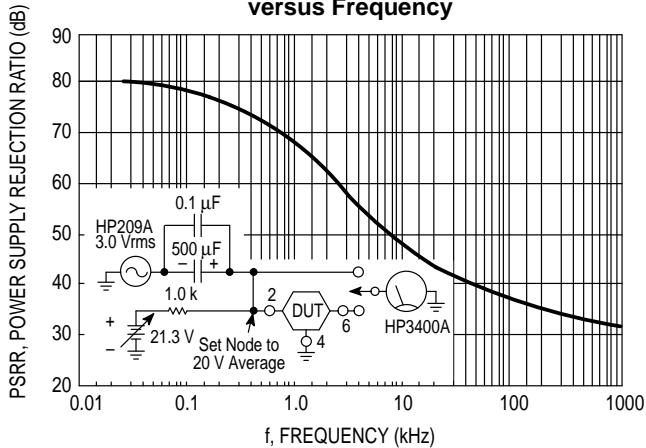
**Figure 4. Output Voltage versus Temperature  
MC1404P10**



**Figure 5. Load Regulation versus Temperature**



**Figure 6. Power Supply Rejection Ratio  
versus Frequency**



**Figure 7. Quiescent Current versus Temperature**

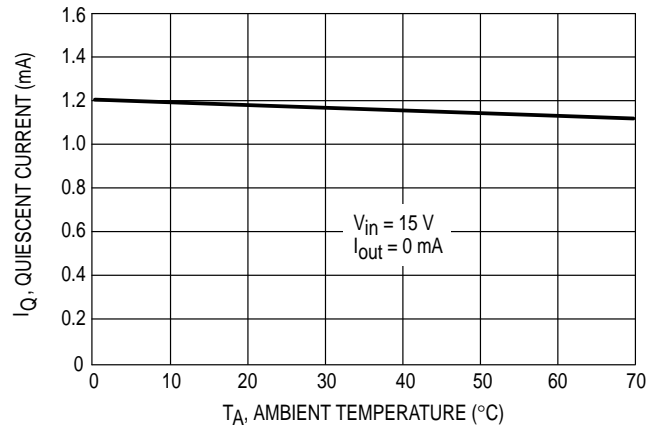


Figure 8. Short Circuit Current versus Temperature

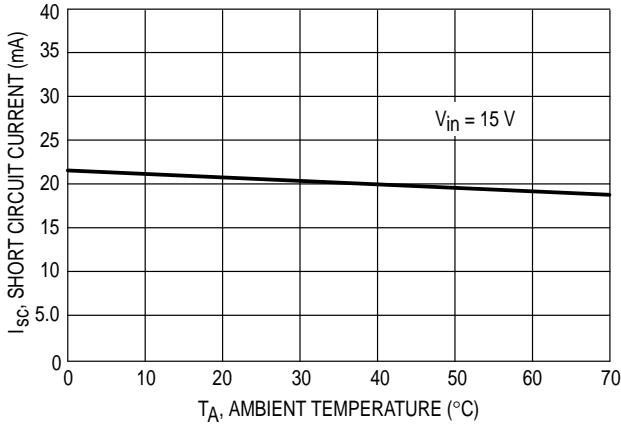


Figure 9. V\_TEMP Output versus Temperature

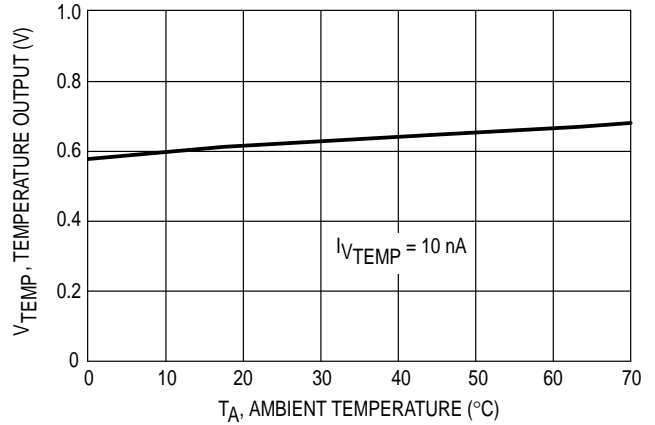
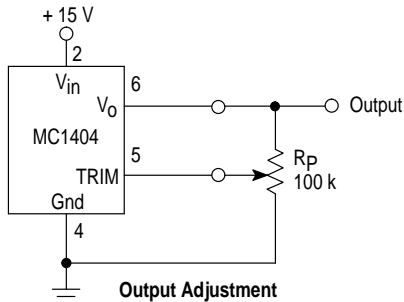


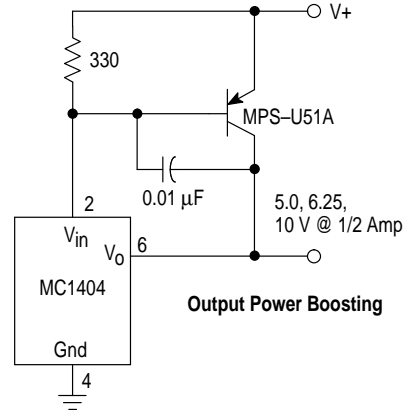
Figure 10. Output Trim Configuration



The MC1404 trim terminal can be used to adjust the output voltage over a  $\pm 6.0\%$  range. For example, the output can be set to 10.000 V or to 10.240 V for binary applications. For trimming, Bourns type 3059, 100 k $\Omega$  or 200 k $\Omega$  trimpot is recommended.

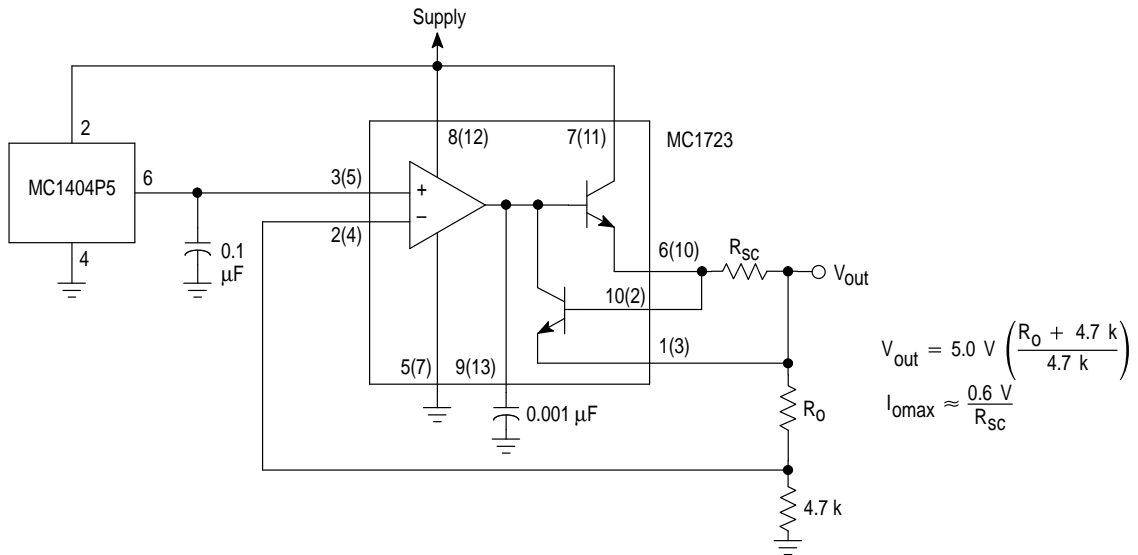
Although Figure 10 illustrates a wide trim range, temperature coefficients may become unpredictable for trim  $> \pm 6.0\%$ .

Figure 11. Precision Supply Using MC1404



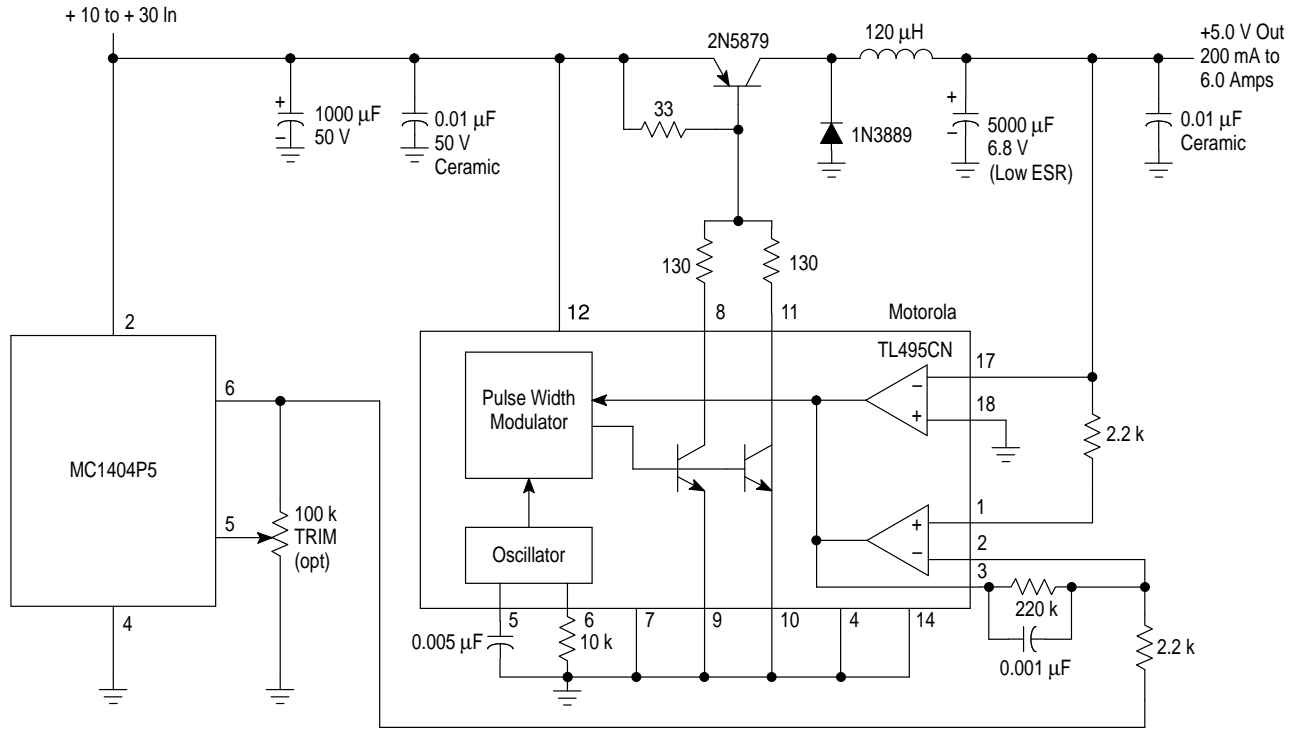
The addition of a power transistor, a resistor, and a capacitor converts the MC1404 into a precision supply with one ampere current capability. At  $V_+ = 15$  V, the MC1404 can carry in excess of 14 mA of load current with good regulation. If the power transistor current gain exceeds 75, a one ampere supply can be realized.

Figure 12. Ultra Stable Reference for MC1723 Voltage Regulator

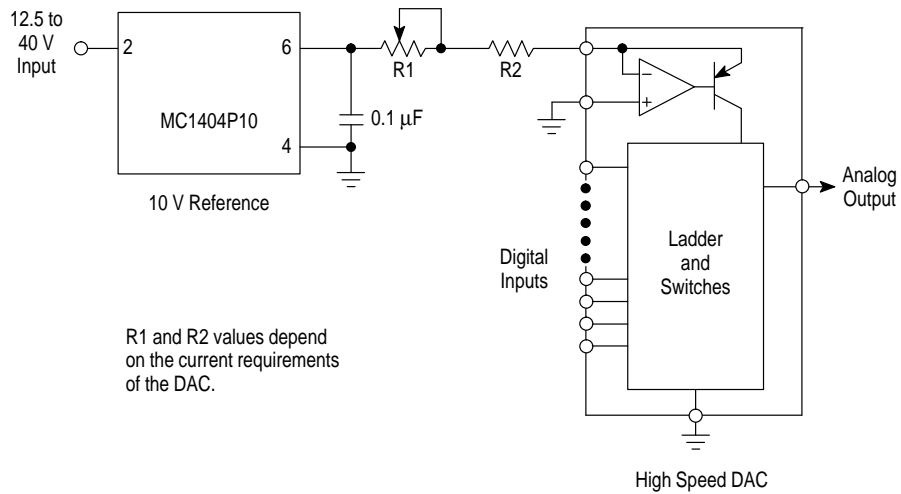


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**Figure 13. 5.0 V, 6.0 Amp, 25 kHz Switching Regulator with Separate Ultra-Stable Reference**



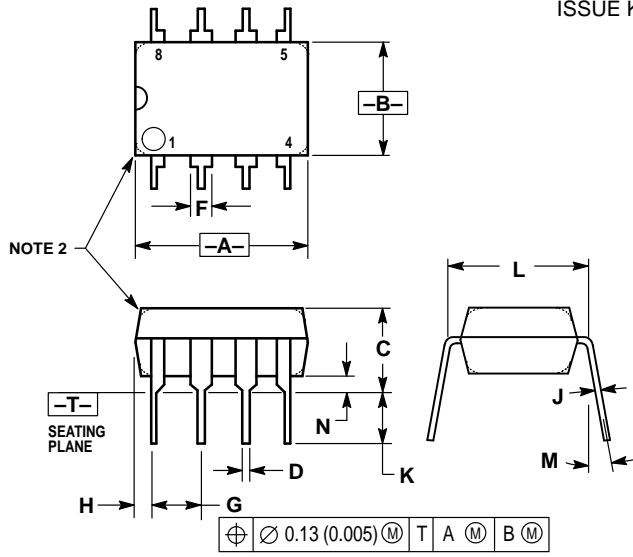
**Figure 14. Reference for a High Speed DAC**



# MC1404

## OUTLINE DIMENSIONS

P1 SUFFIX  
PLASTIC PACKAGE  
CASE 626-05  
ISSUE K



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        | 1.01  | 0.030     | 0.040 |

**MC1404**  
**NOTES**

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MC1404/D

