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MOTOROLA

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: > ± 6%
- Wide Input Voltage Range: V_{ref} + 2.5 V to 40 V
- Low Quiescent Current: 1.25 mA Typical
- Temperature Coefficient: 10 ppm/°C Typical
- Low Output Noise: 12 μV p–p Typical
- Excellent Ripple Rejection: > 80 dB Typical

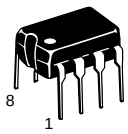
Typical Applications

- 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

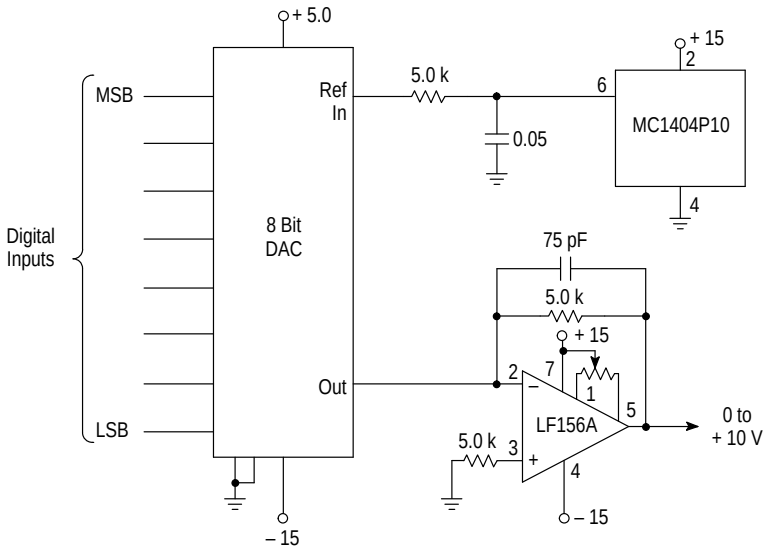
5.0, 6.25, and 10–VOLT OUTPUT VOLTAGES

SEMICONDUCTOR TECHNICAL DATA

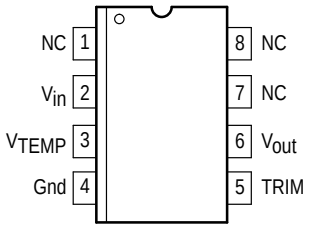


P SUFFIX
PLASTIC PACKAGE
CASE 626

Figure 1. Voltage Output 8–Bit DAC Using MC1404P10



PIN CONNECTIONS



ORDERING INFORMATION

Device	Operating Temperature Range	Package
MC1404P5	T_A = 0° to +70°C	Plastic DIP
MC1404P6		Plastic DIP
MC1404P10		Plastic DIP

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 V, T_A = 25°C, and Trim Terminal not connected, unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
Output Voltage (I_O = 0 mA)	V_O				V
MC1404P5		4.95	5.0	5.05	
MC1404P6		6.19	6.25	6.31	
MC1404P10		9.9	10	10.1	
Output Voltage Tolerance	–	–	± 0.1	± 1.0	%
Output Trim Range (Figure 10) (R_P = 100 kΩ)	ΔV_{TRIM}	± 6.0	–	–	%
Output Voltage Temperature Coefficient, Over Full Temperature Range	$\Delta V_O/\Delta T$	–	10	40	ppm/°C
Maximum Output Voltage Change Over Temperature Range	ΔV_O				mV
MC1404P5		–	–	14	
MC1404P6		–	–	17.5	
MC1404P10		–	–	28	
Line Regulation (Note 1) (V_{in} = V_{out} + 2.5 V to 40 V, I_{out} = 0 mA)	Reg_{line}	–	2.0	6.0	mV
Load Regulation (Note 1) (0 ≤ I_O ≤ 10 mA)	Reg_{load}	–	–	10	mV
Quiescent Current (I_O = 0 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 V, T_A = 25°C, all voltage ranges, unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
Turn–On Settling Time (to ± 0.01%)	t_S	–	50	–	μs
Output Noise Voltage – P to P (Bandwidth 0.1 to 10 Hz)	V_n	–	12	–	μV
Small–Signal Output Impedance	r_o				Ω
120 Hz		–	0.15	–	
500 Hz		–	0.2	–	
Power Supply Rejection Ratio	PSRR	70	80	–	dB

TYPICAL CHARACTERISTICS

Figure 2. Simplified Device Diagram

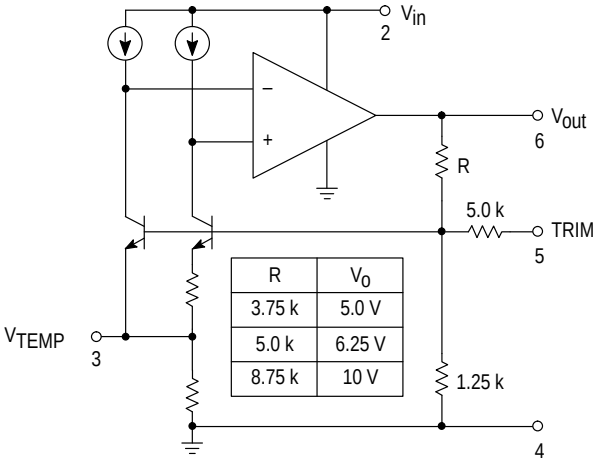


Figure 3. Line Regulation versus Temperature

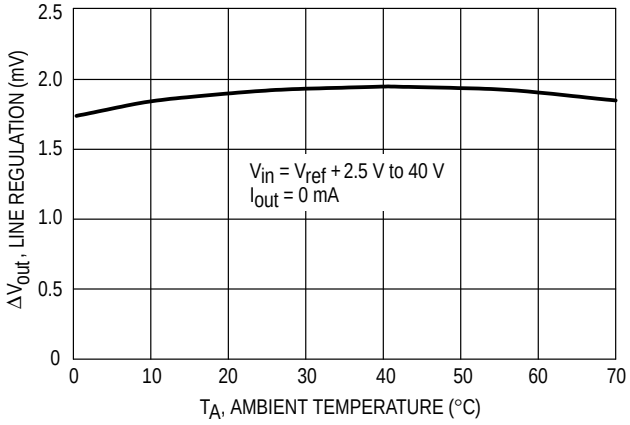


Figure 4. Output Voltage versus Temperature MC1404P10

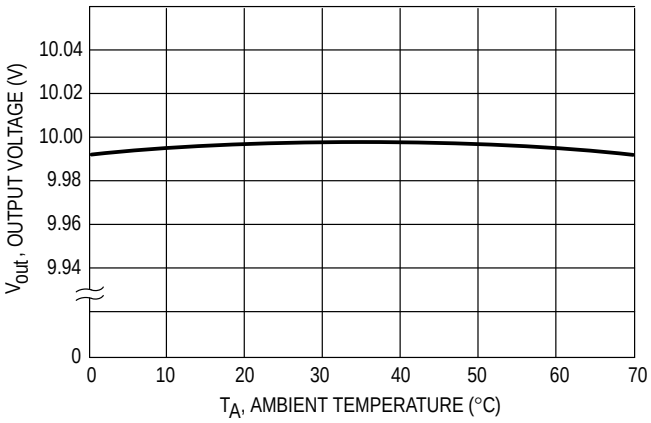


Figure 5. Load Regulation versus Temperature

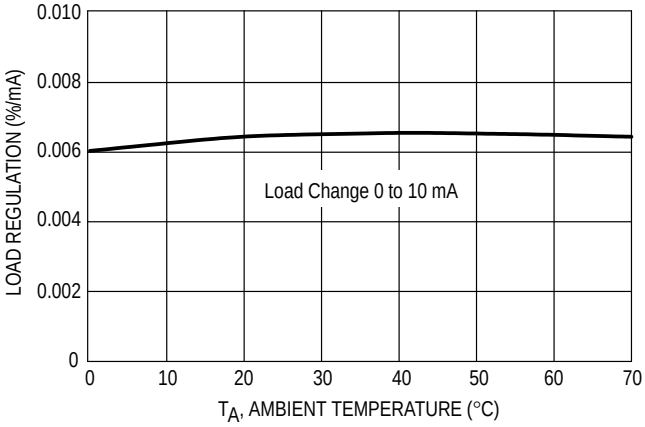


Figure 6. Power Supply Rejection Ratio versus Frequency

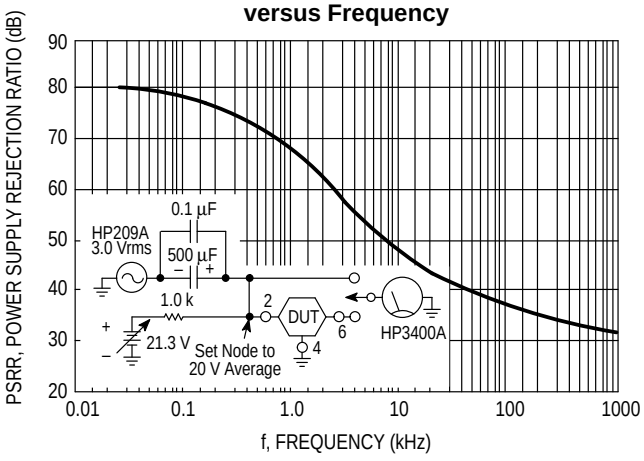


Figure 7. Quiescent Current versus Temperature

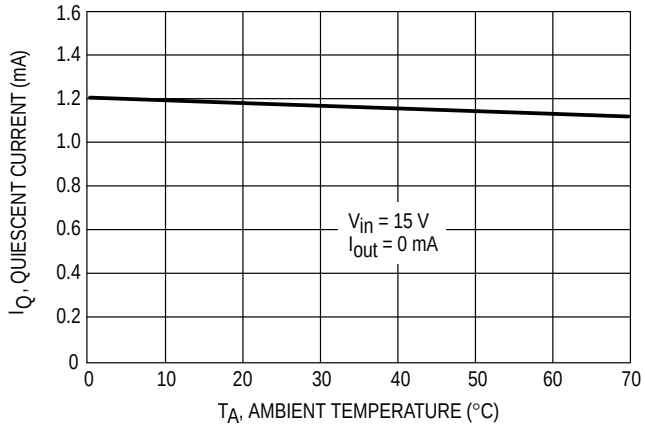


Figure 8. Short Circuit Current versus Temperature

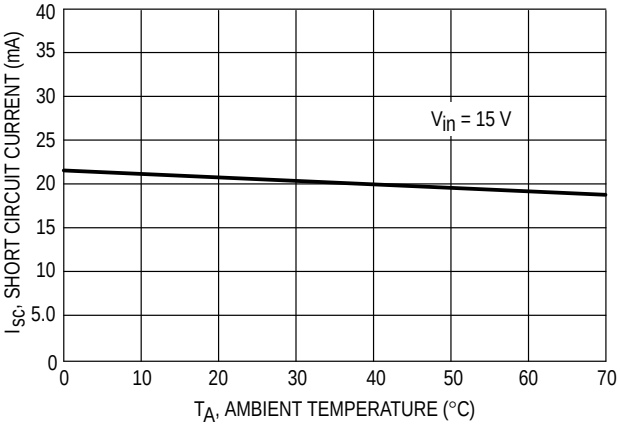


Figure 9. V_{TEMP} Output versus Temperature

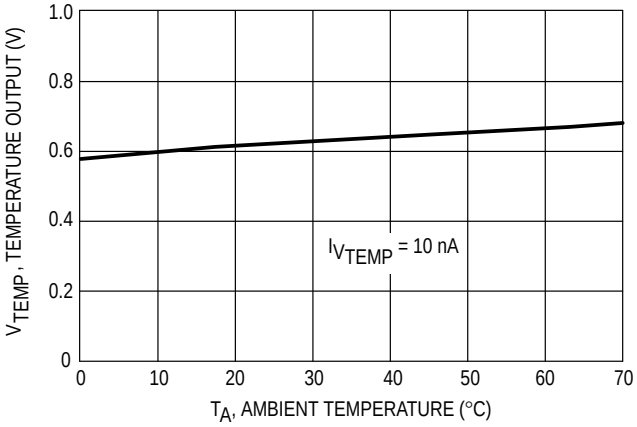
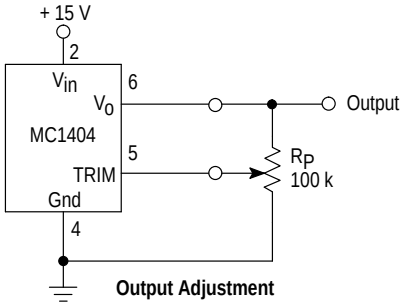


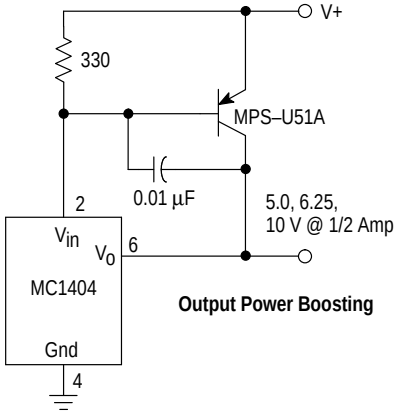
Figure 10. Output Trim Configuration



The MC1404 trim terminal can be used to adjust the output voltage over a ± 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 kΩ or 200 kΩ trimpot is recommended.

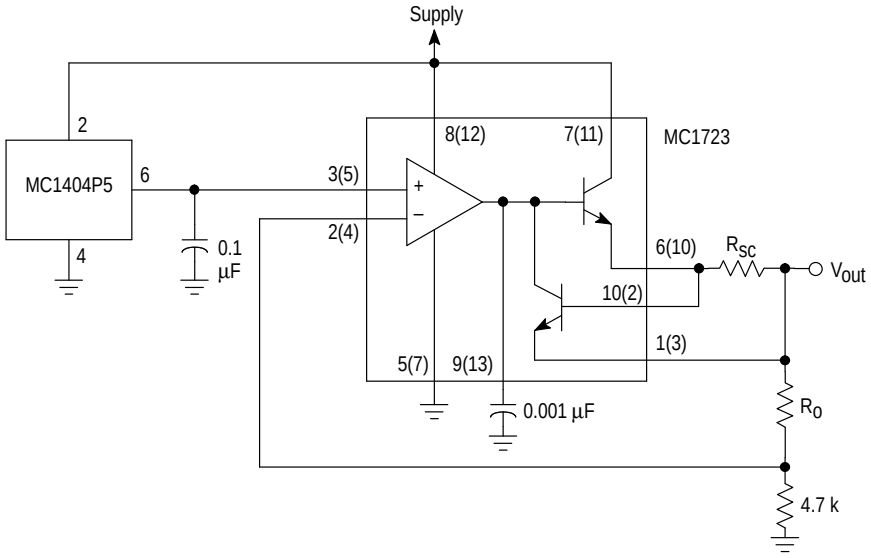
Although Figure 10 illustrates a wide trim range, temperature coefficients may become unpredictable for trim > ± 6.0%.

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



$$V_{out} = 5.0\ V \left(\frac{R_O + 4.7\ k}{4.7\ k} \right)$$

$$I_{omax} \approx \frac{0.6\ V}{R_{SC}}$$

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

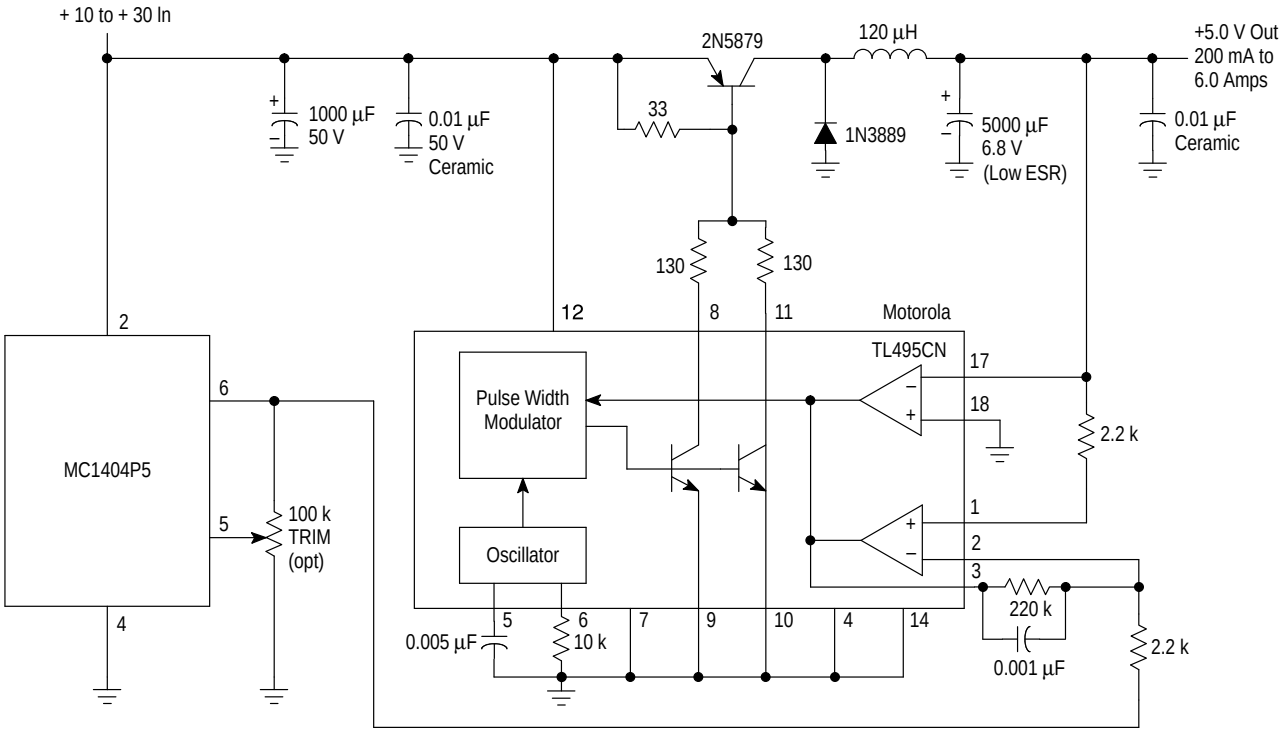
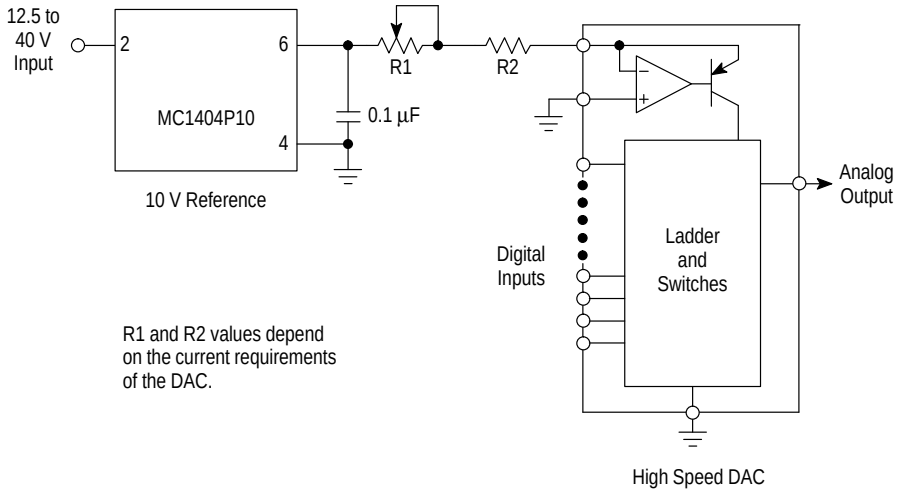
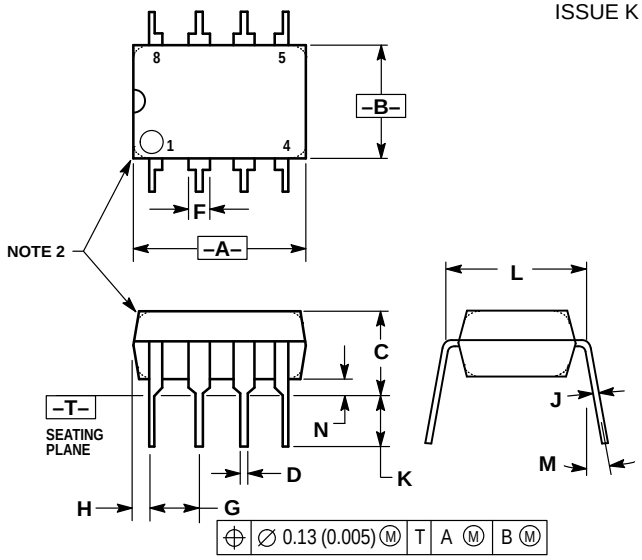


Figure 14. Reference for a High Speed DAC



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.

	MILLIMETERS		INCHES	
DIM	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

NOTES

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