

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: $V_{ref} + 2.5 \text{ V}$ to 40 V
- Low Quiescent Current: 1.25 mA Typical
- Temperature Coefficient: 10 ppm/ $^{\circ}\text{C}$ Typical
- Low Output Noise: 12 μV p-p Typical
- Excellent Ripple Rejection: $> 80 \text{ dB}$ Typical

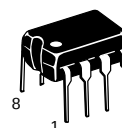
Typical Applications

- 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

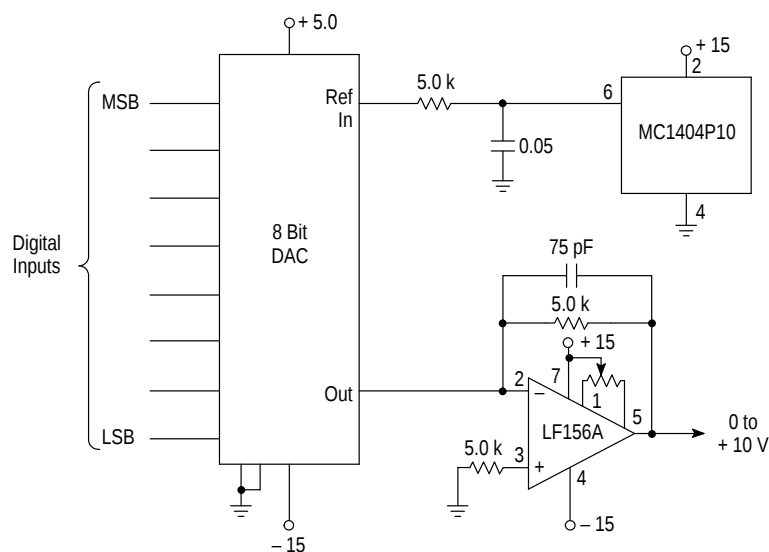
5.0, 6.25, and 10-VOLT OUTPUT VOLTAGES

SEMICONDUCTOR TECHNICAL DATA

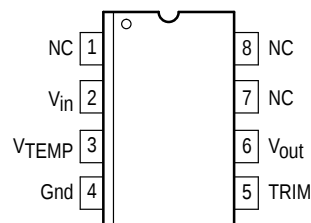


P SUFFIX
PLASTIC PACKAGE
CASE 626

Figure 1. Voltage Output 8-Bit DAC Using MC1404P10



PIN CONNECTIONS



ORDERING INFORMATION

Device	Operating Temperature Range	Package
MC1404P5	$T_A = 0^{\circ} \text{ to } +70^{\circ}\text{C}$	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 ($V_{in} = 15$ V, $T_A = 25^\circ\text{C}$, and Trim Terminal not connected, unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
Output Voltage ($I_O = 0$ mA)	V_O	4.95 6.19 9.9	5.0 6.25 10	5.05 6.31 10.1	V
Output Voltage Tolerance	–	–	± 0.1	± 1.0	%
Output Trim Range (Figure 10) ($R_P = 100$ k Ω)	ΔV_{TRIM}	± 6.0	–	–	%
Output Voltage Temperature Coefficient, Over Full Temperature Range (Note 1)	$\Delta V_O/\Delta T$	–	10	40	ppm/°C
Maximum Output Voltage Change Over Temperature Range (Note 1)	ΔV_O	– – –	– – –	14 17.5 28	mV
Line Regulation (Note 2) ($V_{in} = V_{out} + 2.5$ V to 40 V, $I_{out} = 0$ mA)	Reg_{line}	–	2.0	6.0	mV
Load Regulation (Note 2) ($0 \leq I_O \leq 10$ 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. Guaranteed but not tested.

NOTE: 2. Includes thermal effects.

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

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

MC1404

TYPICAL CHARACTERISTICS

Figure 2. Simplified Device Diagram

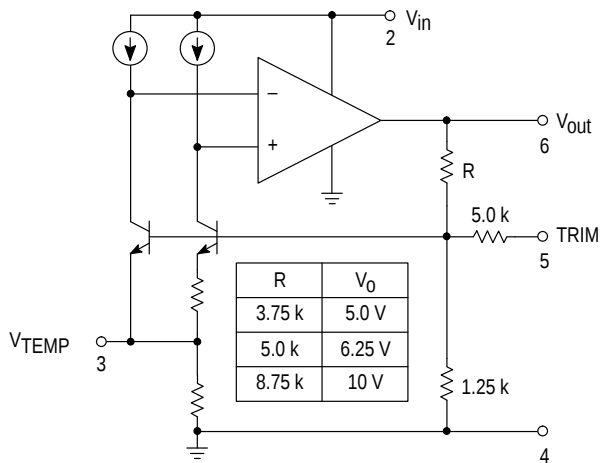


Figure 3. Line Regulation versus Temperature

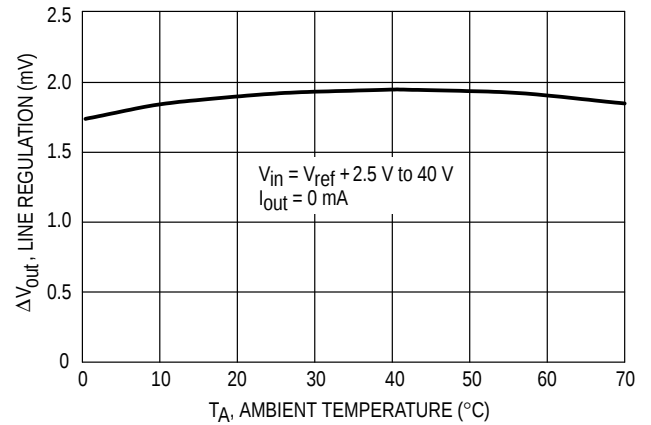


Figure 4. Output Voltage versus Temperature
MC1404P10

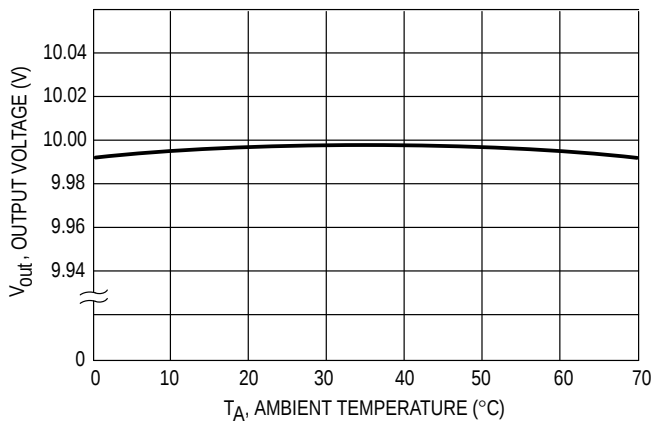


Figure 5. Load Regulation versus Temperature

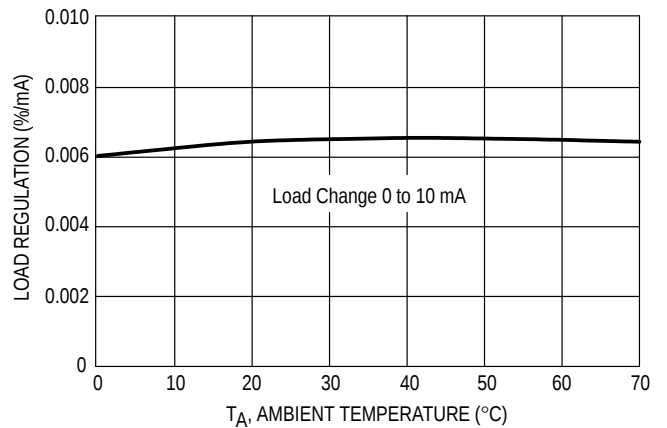


Figure 6. Power Supply Rejection Ratio
versus Frequency

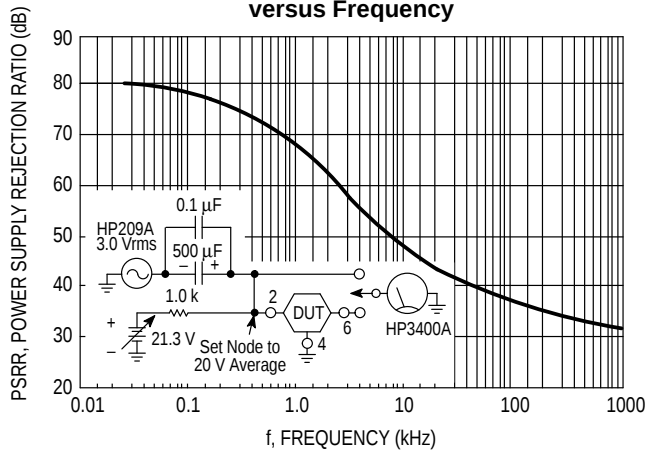


Figure 7. Quiescent Current versus Temperature

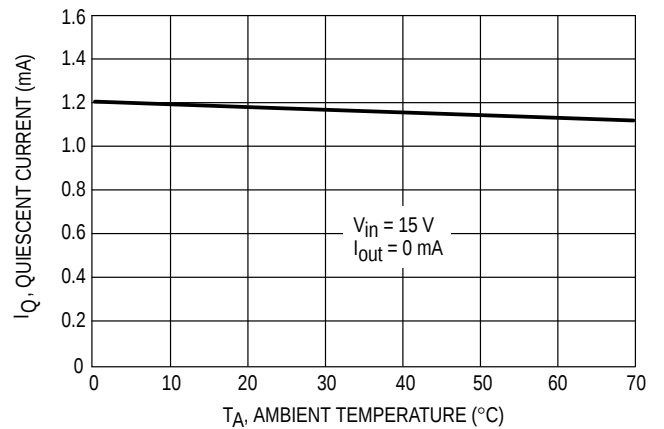


Figure 8. Short Circuit Current versus Temperature

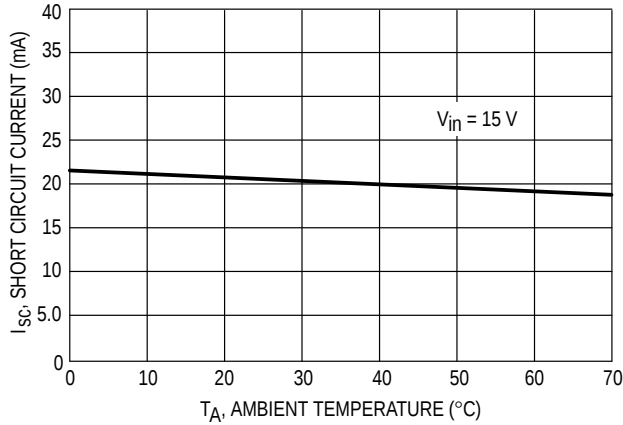


Figure 9. VTEMP Output versus Temperature

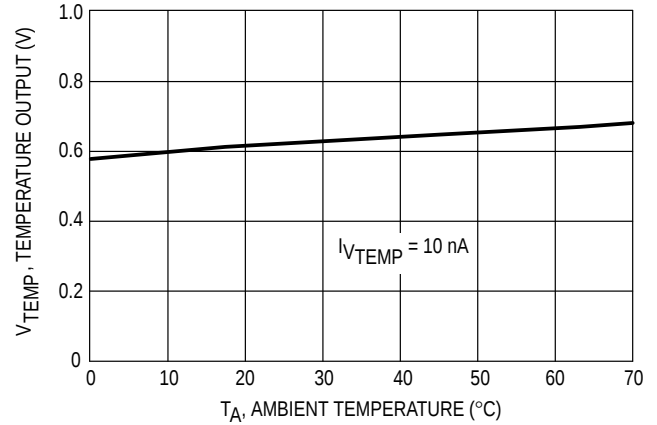
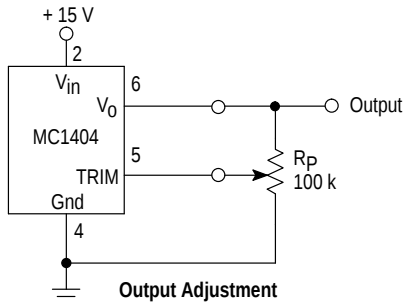


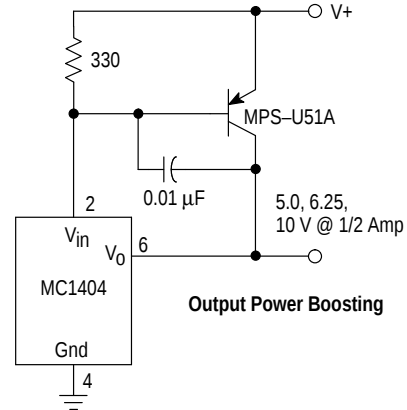
Figure 10. Output Trim Configuration



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 Ω or 200 k Ω trimpot is recommended.

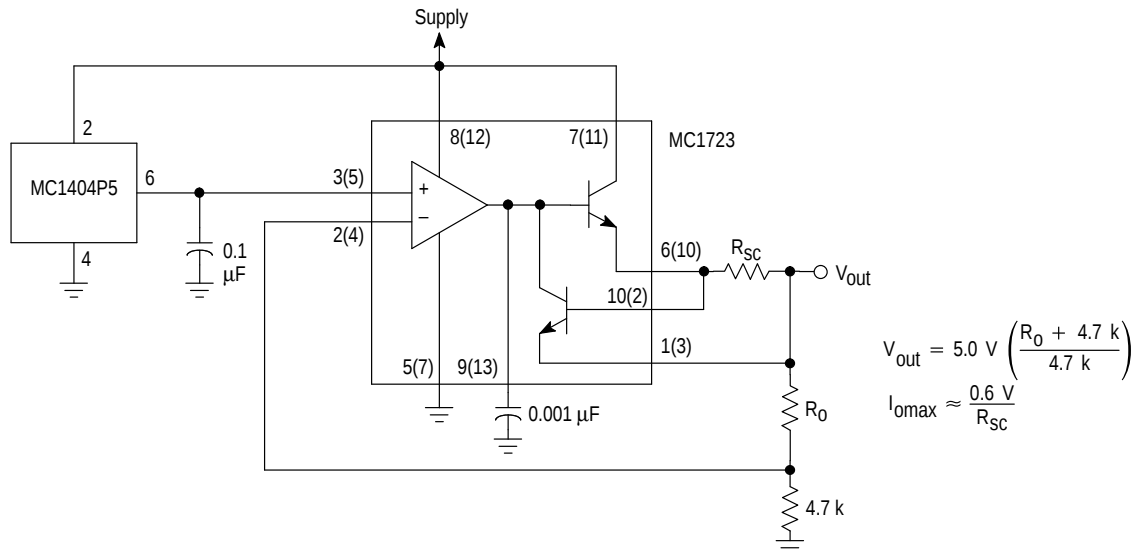
Although Figure 10 illustrates a wide trim range, temperature coefficients may become unpredictable for trim $> \pm 6.0\%$.

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



MC1404

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

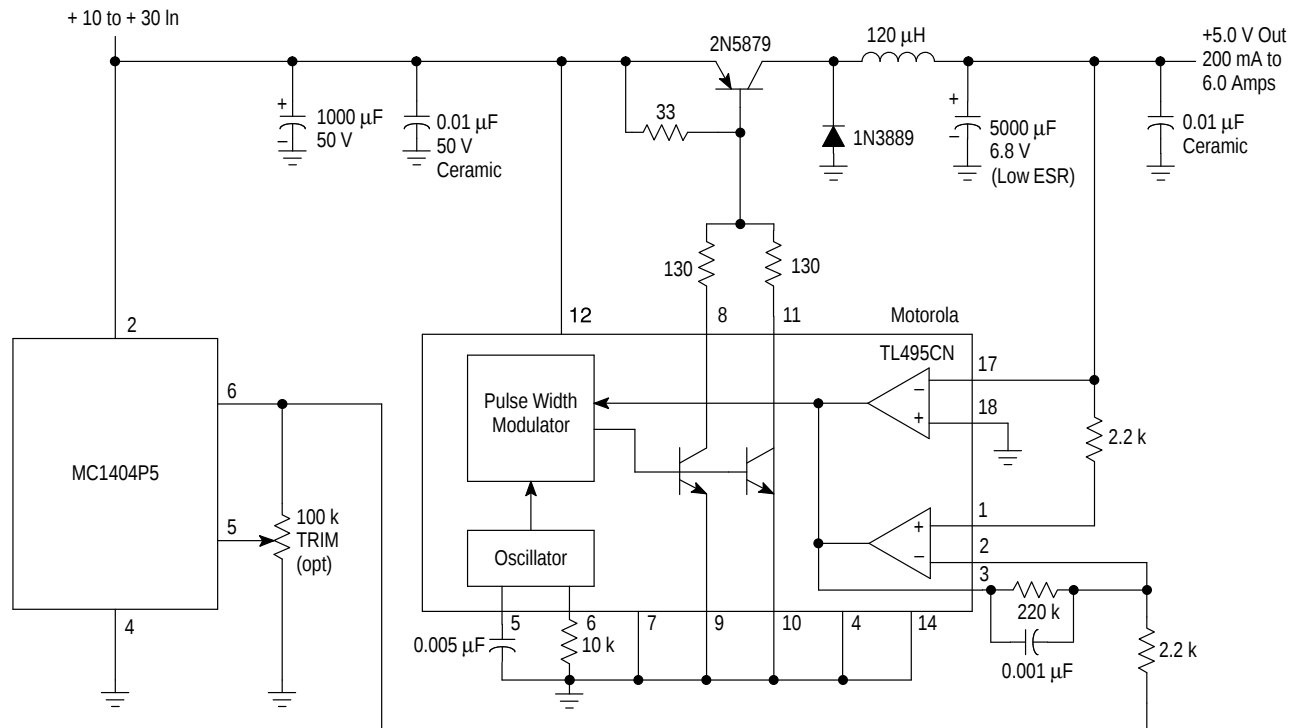
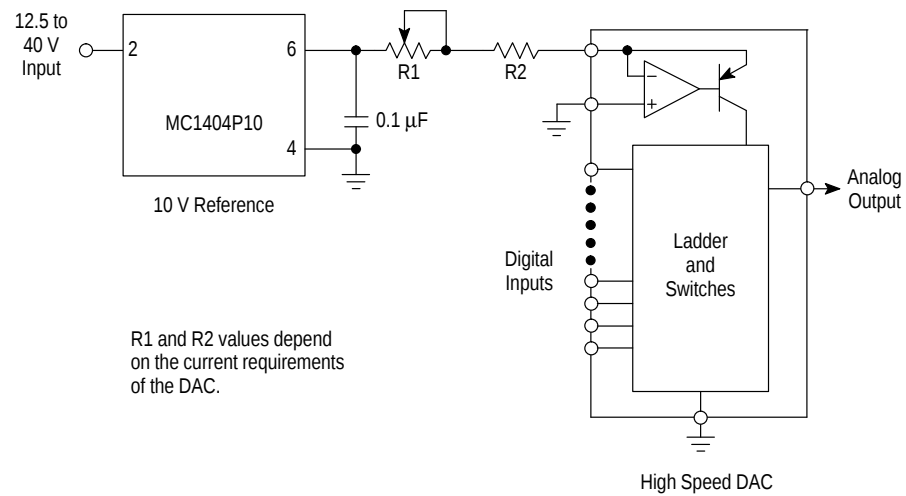


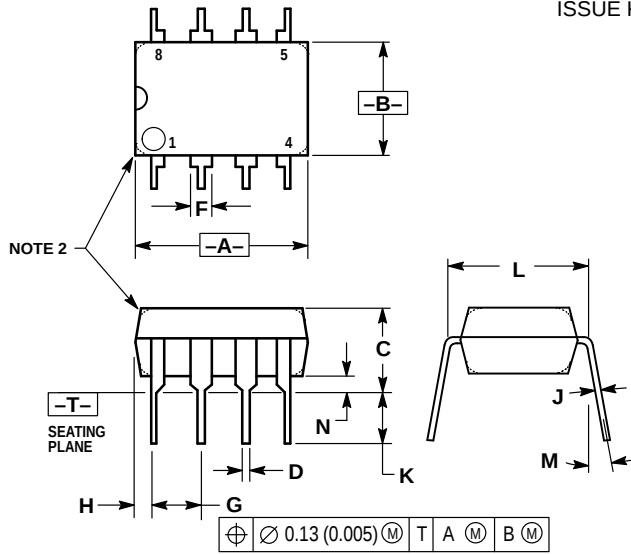
Figure 14. Reference for a High Speed DAC



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.

	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

MC1404
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

