

# TCA0372

## Advance Information

# Dual Power Operational Amplifier

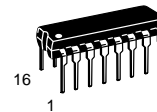
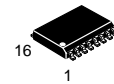
The TCA0372 is a monolithic circuit intended for use as a power operational amplifier in a wide range of applications, including servo amplifiers and power supplies. No deadband crossover distortion provides better performance for driving coils.

- Output Current to 1.0 A
- Slew Rate of 1.3 V/ $\mu$ s
- Wide Bandwidth of 1.1 MHz
- Internal Thermal Shutdown
- Single or Split Supply Operation
- Excellent Gain and Phase Margins
- Common Mode Input Includes Ground
- Zero Deadband Crossover Distortion

## DUAL POWER OPERATIONAL AMPLIFIER

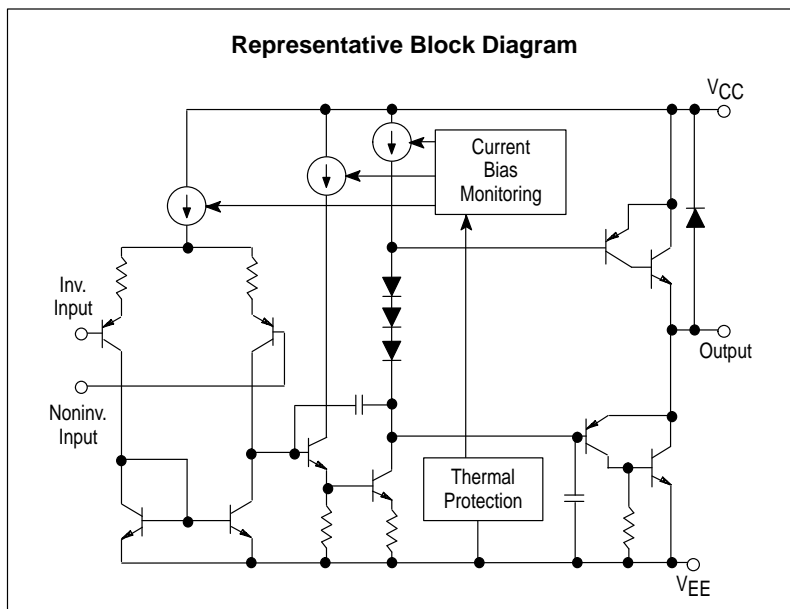
### SEMICONDUCTOR TECHNICAL DATA

**DW SUFFIX**  
PLASTIC PACKAGE  
CASE 751G  
SOP (12+2+2)L



**DP2 SUFFIX**  
PLASTIC PACKAGE  
CASE 648

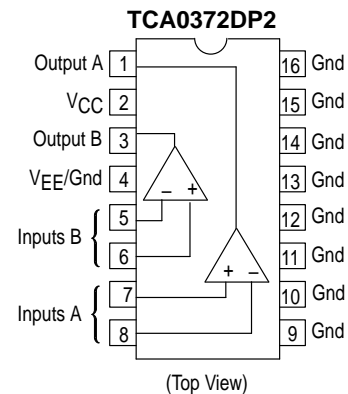
### Representative Block Diagram



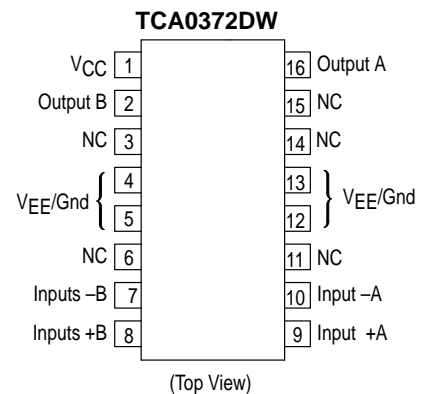
### ORDERING INFORMATION

Device	Operating Temperature Range	Package
TCA0372DW	$T_J = -40^\circ \text{ to } +150^\circ \text{C}$	SOP (12+2+2) L
TCA0372DP2		Plastic DIP

### PIN CONNECTIONS



\*Pins 4 and 9 to 16 are internally connected.



## MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Supply Voltage (from $V_{CC}$ to $V_{EE}$ )	$V_S$	40	V
Input Differential Voltage Range	$V_{IDR}$	(Note 1)	V
Input Voltage Range	$V_{IR}$	(Note 1)	V
Operating Junction Temperature (Note 2)	$T_J$	+125	°C
Storage Temperature Range	$T_{stg}$	-55 to +125	°C
DC Output Current	$I_O$	1.0	A
Peak Output Current (Nonrepetitive)	$I_{(max)}$	1.5	A

DC ELECTRICAL CHARACTERISTICS ( $V_{CC} = +15$  V,  $V_{EE} = -15$  V,  $R_L$  connected to ground,  $T_J = -40^\circ$  to  $+125^\circ$  C.)

Characteristics	Symbol	Min	Typ	Max	Unit
Input Offset Voltage ( $V_{CM} = 0$ ) $T_J = +25^\circ\text{C}$ $T_J, T_{low}$ to $T_{high}$	$V_{IO}$	— —	1.0 —	15 20	mV
Average Temperature Coefficient of Offset Voltage	$\Delta V_{IO}/\Delta T$	—	20	—	$\mu\text{V}/^\circ\text{C}$
Input Bias Current ( $V_{CM} = 0$ )	$I_{IB}$	—	100	500	nA
Input Offset Current ( $V_{CM} = 0$ )	$I_{IO}$	—	10	50	nA
Large Signal Voltage Gain $V_O = \pm 10$ V, $R_L = 2.0$ k	$A_{VOL}$	30	100	—	V/mV
Output Voltage Swing ( $I_L = 100$ mA) $T_J = +25^\circ\text{C}$ $T_J = T_{low}$ to $T_{high}$ $T_J = +25^\circ\text{C}$ $T_J = T_{low}$ to $T_{high}$	$V_{OH}$  $V_{OL}$	14.0 13.9 — —	14.2 — -14.2 —	— — -14.0 -13.9	V
Output Voltage Swing ( $I_L = 1.0$ A) $V_{CC} = +24$ V, $V_{EE} = 0$ V, $T_J = +25^\circ\text{C}$ $V_{CC} = +24$ V, $V_{EE} = 0$ V, $T_J = T_{low}$ to $T_{high}$ $V_{CC} = +24$ V, $V_{EE} = 0$ V, $T_J = +25^\circ\text{C}$ $V_{CC} = +24$ V, $V_{EE} = 0$ V, $T_J = T_{low}$ to $T_{high}$	$V_{OH}$  $V_{OL}$	22.5 22.5 — —	22.7 — 1.3 —	— — 1.5 1.5	V
Input Common Mode Voltage Range $T_J = +25^\circ\text{C}$ $T_J = T_{low}$ to $T_{high}$	$V_{ICR}$	$V_{EE}$ to $(V_{CC} - 1.0)$ $V_{EE}$ to $(V_{CC} - 1.3)$			V
Common Mode Rejection Ratio ( $R_S = 10$ k)	CMRR	70	90	—	dB
Power Supply Rejection Ratio ( $R_S = 100$ $\Omega$ )	PSRR	70	90	—	dB
Power Supply Current $T_J = +25^\circ\text{C}$ $T_J = T_{low}$ to $T_{high}$	$I_D$	— —	5.0 —	10 14	mA

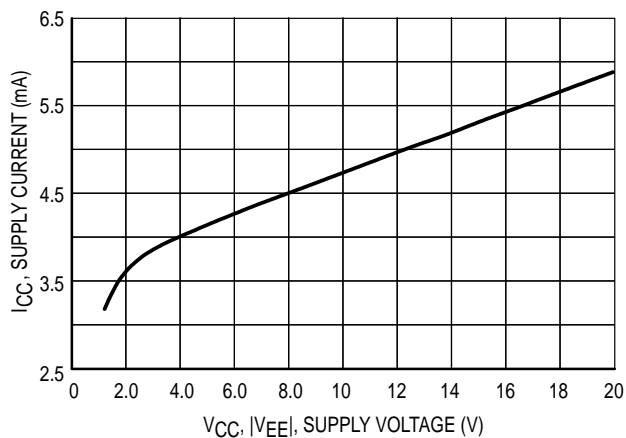
**NOTES:** 1. Either or both input voltages should not exceed the magnitude of  $V_{CC}$  or  $V_{EE}$ .  
2. Power dissipation must be considered to ensure maximum junction temperature ( $T_J$ ) is not exceeded.

AC ELECTRICAL CHARACTERISTICS ( $V_{CC} = +15$  V,  $V_{EE} = -15$  V,  $R_L$  connected to ground,  $T_J = +25^\circ$  C, unless otherwise noted.)

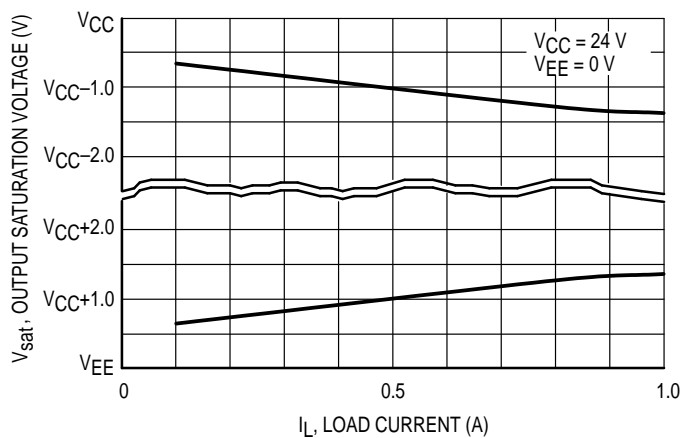
Characteristics	Symbol	Min	Typ	Max	Unit
Slew Rate ( $V_{in} = -10$ V to $+10$ V, $R_L = 2.0$ k, $C_L = 100$ pF) $A_V = -1.0$ , $T_J = T_{low}$ to $T_{high}$	SR	1.0	1.4	—	V/ $\mu\text{s}$
Gain Bandwidth Product ( $f = 100$ kHz, $C_L = 100$ pF, $R_L = 2.0$ k) $T_J = 25^\circ\text{C}$ $T_J = T_{low}$ to $T_{high}$	GBW	0.9 0.7	1.4 —	— —	MHz
Phase Margin $T_J = T_{low}$ to $T_{high}$ $R_L = 2.0$ k, $C_L = 100$ pF	$\phi_m$	—	65	—	Degrees
Gain Margin $R_L = 2.0$ k, $C_L = 100$ pF	$A_m$	—	15	—	dB
Equivalent Input Noise Voltage $R_S = 100$ $\Omega$ , $f = 1.0$ to $100$ kHz	$e_n$	—	22	—	nV/ $\sqrt{\text{Hz}}$
Total Harmonic Distortion $A_V = -1.0$ , $R_L = 50$ $\Omega$ , $V_O = 0.5$ VRMS, $f = 1.0$ kHz	THD	—	0.02	—	%

**NOTE:** In case  $V_{EE}$  is disconnected before  $V_{CC}$ , a diode between  $V_{EE}$  and Ground is recommended to avoid damaging the device.

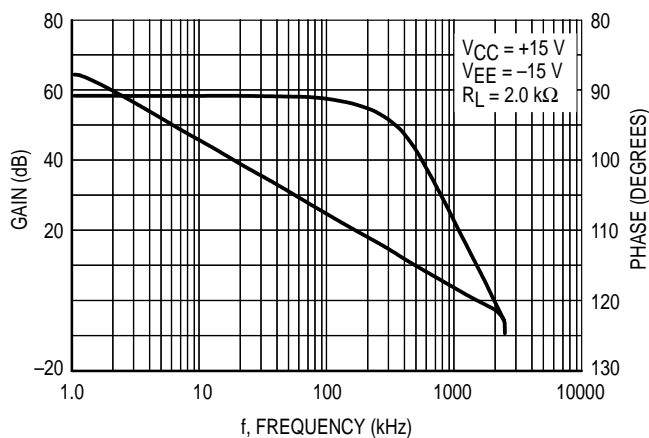
**Figure 1. Supply Current versus Supply Voltage with No Load**



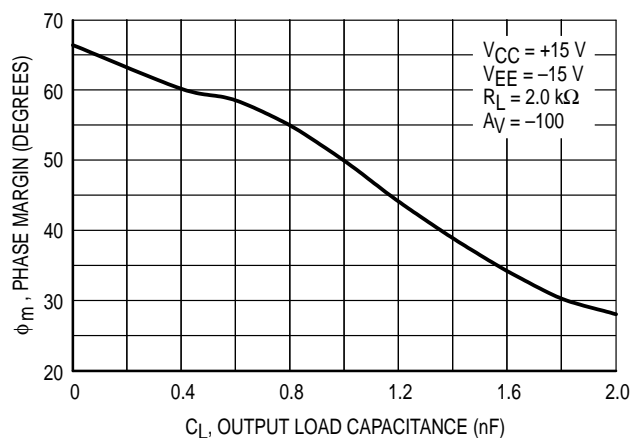
**Figure 2. Output Saturation Voltage versus Load Current**



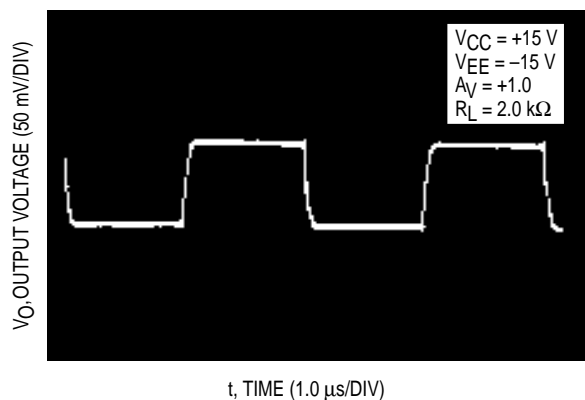
**Figure 3. Voltage Gain and Phase versus Frequency**



**Figure 4. Phase Margin versus Output Load Capacitance**



**Figure 5. Small Signal Transient Response**



**Figure 6. Large Signal Transient Response**

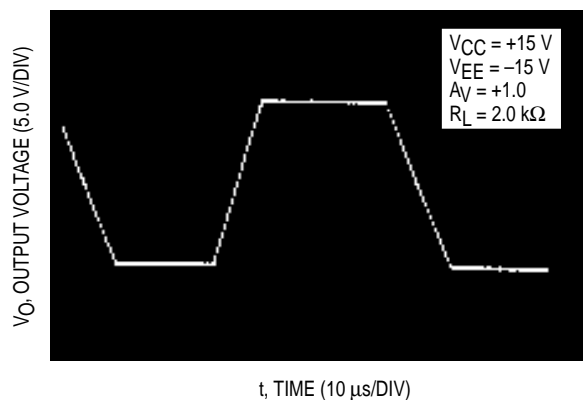


Figure 7. Sine Wave Reponse

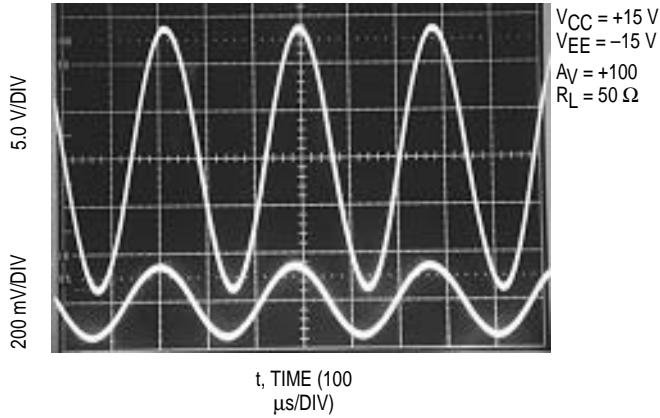


Figure 8. Bidirectional DC Motor Control with Microprocessor-Compatible Inputs

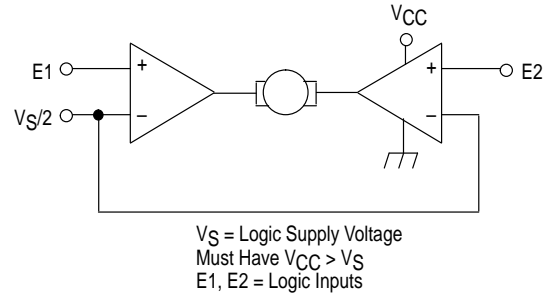
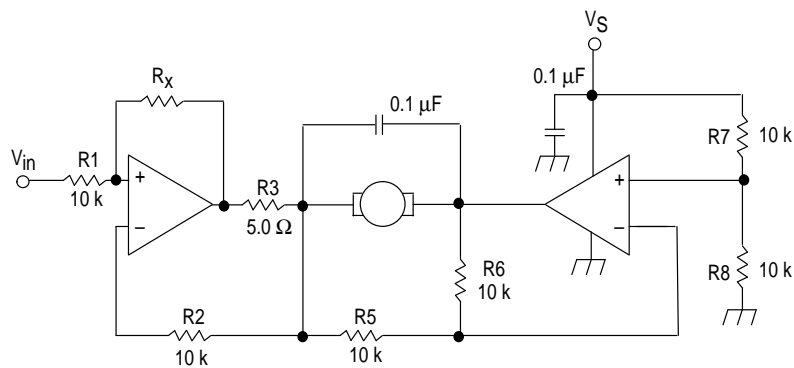


Figure 9. Bidirectional Speed Control of DC Motors



For circuit stability, ensure that  $R_x > \frac{2R_3 \cdot R_1}{R_M}$  where,  $R_M$  = internal resistance of motor.

The voltage available at the terminals of the motor is:  $V_M = 2 \left( V_1 - \frac{V_S}{2} \right) + |R_O| \cdot I_M$

where,  $|R_O| = \frac{2R_3 \cdot R_1}{R_x}$  and  $I_M$  is the motor current.

## THERMAL INFORMATION

The maximum power consumption an integrated circuit can tolerate at a given operating ambient temperature can be found from the equation:

$$P_{D(TA)} = \frac{T_{J(max)} - T_A}{R_{\theta JA} (typ)}$$

where,  $P_{D(TA)}$  = power dissipation allowable at a given operating ambient temperature.

This must be greater than the sum of the products of the supply voltages and supply currents at the worst case operating condition.

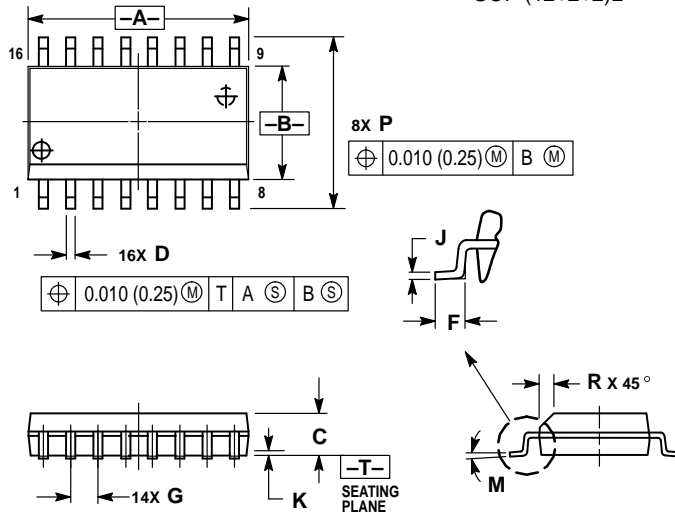
$T_{J(max)}$  = Maximum operating junction temperature as listed in the maximum ratings section.

$T_A$  = Maximum desired operating ambient temperature.

$R_{\theta JA}(typ)$  = Typical thermal resistance junction-to-ambient.

## OUTLINE DIMENSIONS

**DW SUFFIX**  
 PLASTIC PACKAGE  
 CASE 751G-02  
 ISSUE A  
 SOP (12+2+2)L

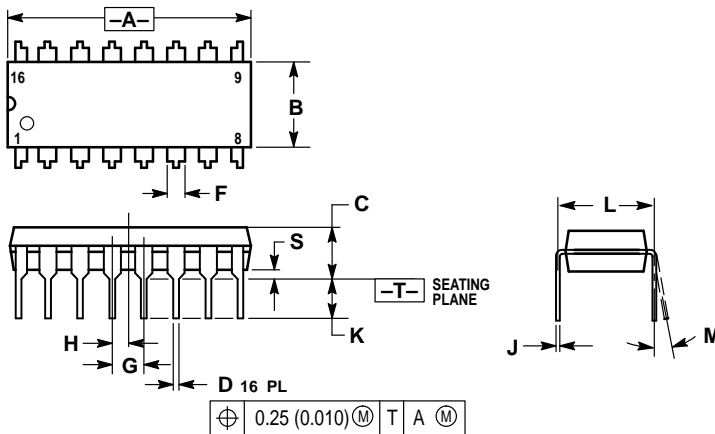


## NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.13 (0.005) TOTAL IN EXCESS OF D DIMENSION AT MAXIMUM MATERIAL CONDITION.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	10.15	10.45	0.400	0.411
B	7.40	7.60	0.292	0.299
C	2.35	2.65	0.093	0.104
D	0.35	0.49	0.014	0.019
F	0.50	0.90	0.020	0.035
G	1.27 BSC		0.050 BSC	
J	0.25	0.32	0.010	0.012
K	0.10	0.25	0.004	0.009
M	0°	7°	0°	7°
P	10.05	10.55	0.395	0.415
R	0.25	0.75	0.010	0.029


**DP2 SUFFIX**  
 PLASTIC PACKAGE  
 CASE 648-08  
 ISSUE R



## NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
5. ROUNDED CORNERS OPTIONAL.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.740	0.770	18.80	19.55
B	0.250	0.270	6.35	6.85
C	0.145	0.175	3.69	4.44
D	0.015	0.021	0.39	0.53
F	0.040	0.70	1.02	1.77
G	0.100 BSC		2.54 BSC	
H	0.050 BSC		1.27 BSC	
J	0.008	0.015	0.21	0.38
K	0.110	0.130	2.80	3.30
L	0.295	0.305	7.50	7.74
M	0°	10°	0°	10°
S	0.020	0.040	0.51	1.01

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 can and do vary in different applications. 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.

**How to reach us:**

**USA / EUROPE:** Motorola Literature Distribution;  
P.O. Box 20912; Phoenix, Arizona 85036. 1-800-441-2447

**MFAX:** RMFAX0@email.sps.mot.com – TOUCHTONE (602) 244-6609  
**INTERNET:** <http://Design-NET.com>

**JAPAN:** Nippon Motorola Ltd.; Tatsumi-SPD-JLDC, Toshikatsu Otsuki,  
6F Seibu-Butsuryu-Center, 3-14-2 Tatsumi Koto-Ku, Tokyo 135, Japan. 03-3521-8315

**HONG KONG:** Motorola Semiconductors H.K. Ltd.; 8B Tai Ping Industrial Park,  
51 Ting Kok Road, Tai Po, N.T., Hong Kong. 852-26629298

**MOTOROLA**

CODELINE TO BE PLACED HERE

**TCA0372/D**