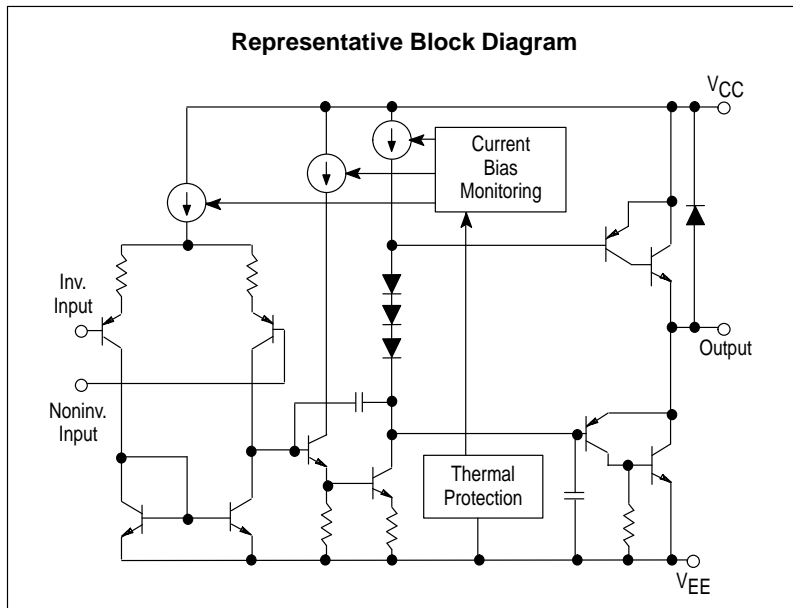**MOTOROLA**

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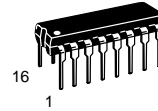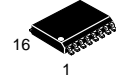
- Output Current to 1.0 A
- Slew Rate of 1.3 V/μs
- Wide Bandwidth of 1.1 MHz
- Internal Thermal Shutdown
- Single or Split Supply Operation
- Excellent Gain and Phase Margins
- Common Mode Input Includes Ground
- Zero Deadband Crossover Distortion

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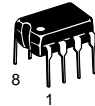PLASTIC PACKAGE
CASE 751G
SOP (12+2+2)L

DP2 SUFFIX
PLASTIC PACKAGE
CASE 648

DP1 SUFFIX
PLASTIC PACKAGE
CASE 626

PIN CONNECTIONS

TCA0372DP2

Output A	1		16	Gnd
V_{CC}	2		15	Gnd
Output B	3		14	Gnd
V_{EE}/Gnd	4		13	Gnd
Inputs B {	5		12	Gnd
	6		11	Gnd
Inputs A {	7		10	Gnd
	8		9	Gnd

(Top View)
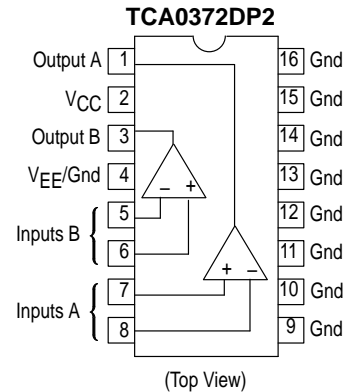
*Pins 4 and 9 to 16 are internally connected.

TCA0372DW

V_{CC}	1		16	Output A
Output B	2		15	NC
NC	3		14	NC
V_{EE}/Gnd {	4		13	} V_{EE}/Gnd
	5		12	
NC	6		11	NC
Inputs –B	7		10	Input –A
Inputs +B	8		9	Input +A

(Top View)

TCA0372DP1

Output A	1		8	} Inputs A
V_{CC}	2		7	
Output B	3		6	} Inputs B
V_{EE}/Gnd	4		5	

(Top View)

Representative Block Diagram

ORDERING INFORMATION

Device	Operating Temperature Range	Package
TCA0372DW		SOP (12+2+2) L
TCA0372DP1	$T_J = -40°$ to $+150°C$	Plastic DIP
TCA0372DP2		Plastic DIP

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Rev 1

TCA0372

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
Junction Temperature (Note 2)	T_J	+150	°C
Storage Temperature Range	T_{stg}	−55 to +150	°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° to +125°C.)

Characteristics	Symbol	Min	Typ	Max	Unit
Input Offset Voltage (V_{CM} = 0) T_J = +25°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	—	µV/°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 = ±10 V, R_L = 2.0 k	A_{VOL}	30	100	—	V/mV
Output Voltage Swing (I_L = 100 mA) T_J = +25°C T_J = T_{low} to T_{high} T_J = +25°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°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°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°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 Ω)	PSRR	70	90	—	dB
Power Supply Current T_J = +25°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°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/µs
Gain Bandwidth Product (f = 100 kHz, C_L = 100 pF, R_L = 2.0 k) T_J = 25°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	ϕ_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 Ω, f = 1.0 to 100 kHz	e_n	—	22	—	nV/$\sqrt{Hz}$
Total Harmonic Distortion A_V = −1.0, R_L = 50 Ω, 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.

TCA0372

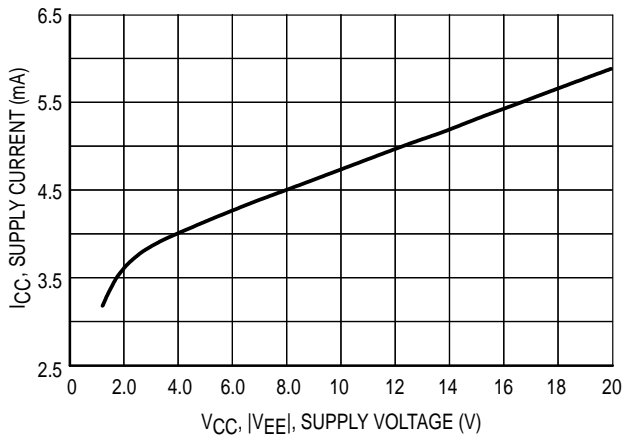### Figure 1. Supply Current versus Suppy Voltage with No Load

ICC, SUPPLY CURRENT (mA) vs VCC, |VEE|, SUPPLY VOLTAGE (V)

Figure 2. Output Saturation Voltage versus Load Current

Vsat, OUTPUT SATURATION VOLTAGE (V) vs IL, LOAD CURRENT (A)

$V_{CC} = 24$ V
$V_{EE} = 0$ V
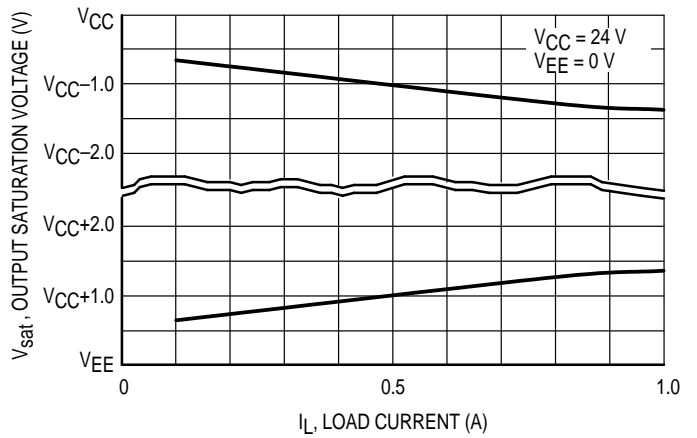
Figure 3. Voltage Gain and Phase versus Frequency

GAIN (dB) and PHASE (DEGREES) vs f, FREQUENCY (kHz)

$V_{CC} = +15$ V
$V_{EE} = -15$ V
$R_L = 2.0$ kΩ
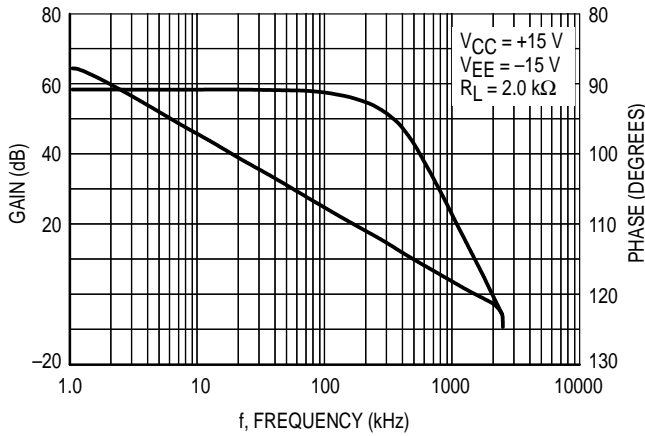
Figure 4. Phase Margin versus Output Load Capacitance

ϕ_m, PHASE MARGIN (DEGREES) vs C_L, OUTPUT LOAD CAPACITANCE (nF)

$V_{CC} = +15$ V
$V_{EE} = -15$ V
$R_L = 2.0$ kΩ
$A_V = -100$
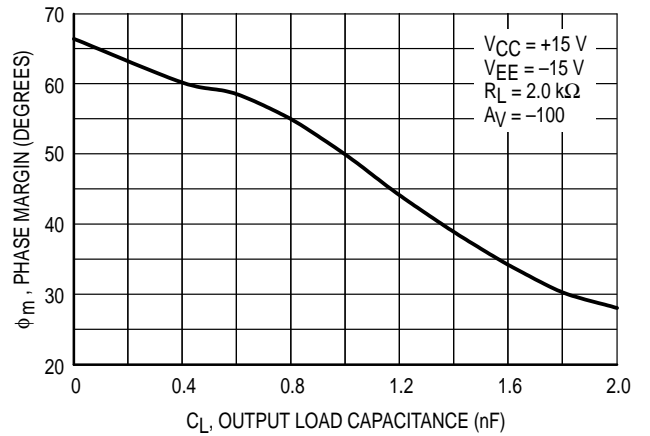
Figure 5. Small Signal Transient Response

VO, OUTPUT VOLTAGE (50 mV/DIV) vs t, TIME (1.0 µs/DIV)

$V_{CC} = +15$ V
$V_{EE} = -15$ V
$A_V = +1.0$
$R_L = 2.0$ kΩ
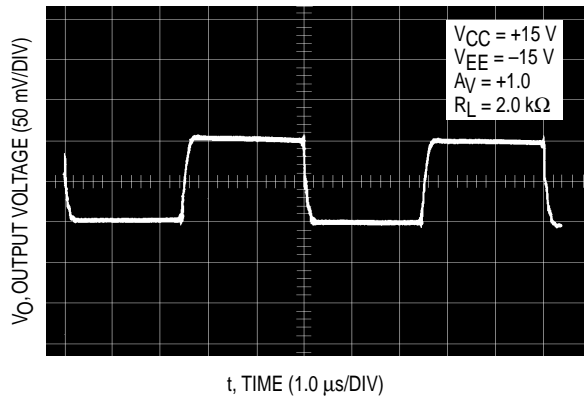
Figure 6. Large Signal Transient Response

VO, OUTPUT VOLTAGE (5.0 V/DIV) vs t, TIME (10 µs/DIV)

$V_{CC} = +15$ V
$V_{EE} = -15$ V
$A_V = +1.0$
$R_L = 2.0$ kΩ

TCA0372
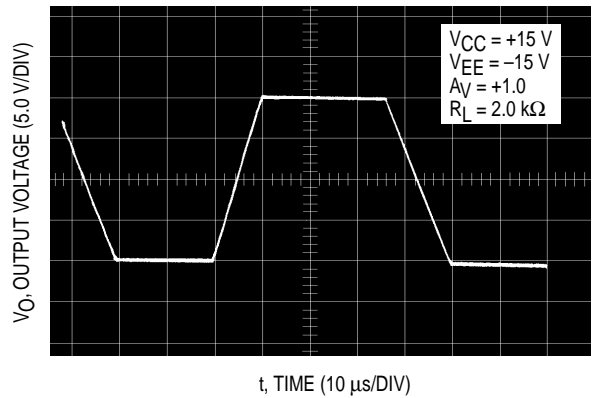
Figure 7. Sine Wave Reponse

$V_{CC} = +15$ V
$V_{EE} = -15$ V

$A_V = +100$
$R_L = 50$ Ω

5.0 V/DIV

200 mV/DIV

t, TIME (100 μs/DIV)
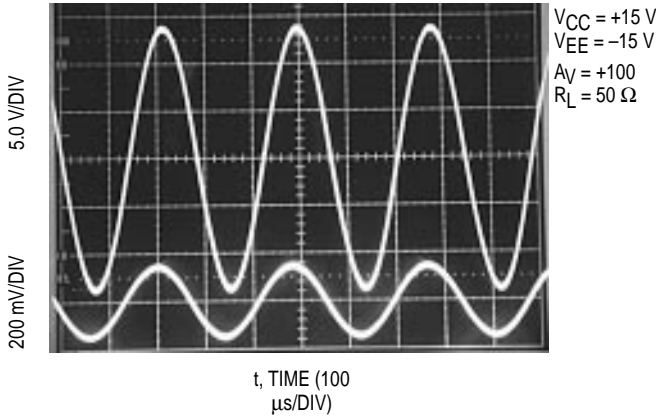
Figure 8. Bidirectional DC Motor Control with Microprocessor–Compatible Inputs

V_S = Logic Supply Voltage
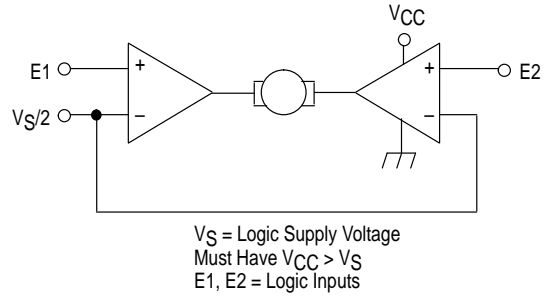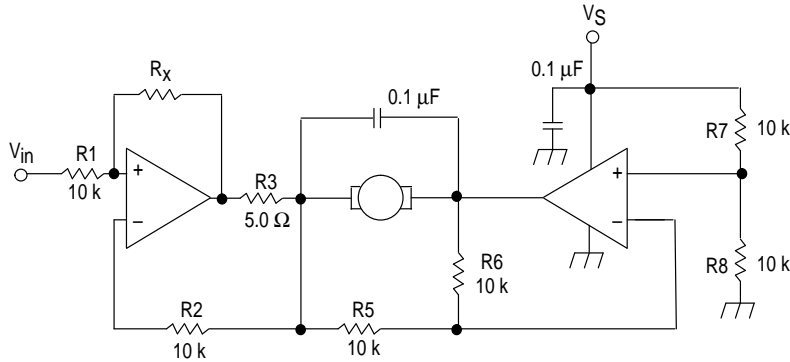Must Have $V_{CC} > V_S$
E1, E2 = Logic Inputs

Figure 9. Bidirectional Speed Control of DC Motors

For circuit stability, ensure that $R_X > \dfrac{2R3 \cdot R1}{R_M}$ where, R_M = internal resistance of motor.

The voltage available at the terminals of the motor is: $V_M = 2 \left(V_1 - \dfrac{V_S}{2}\right) + |R_0| \cdot I_M$

where, $|R_0| = \dfrac{2R3 \cdot R1}{R_X}$ 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:

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

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.

# TCA0372

OUTLINE DIMENSIONS

DW SUFFIX
PLASTIC PACKAGE
CASE 751G–02
(SOP (12+2+2)L)
ISSUE A
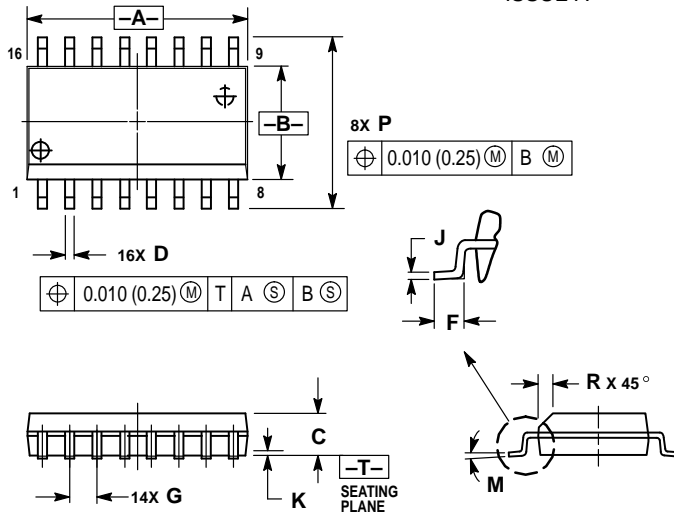
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.13 (0.005) 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
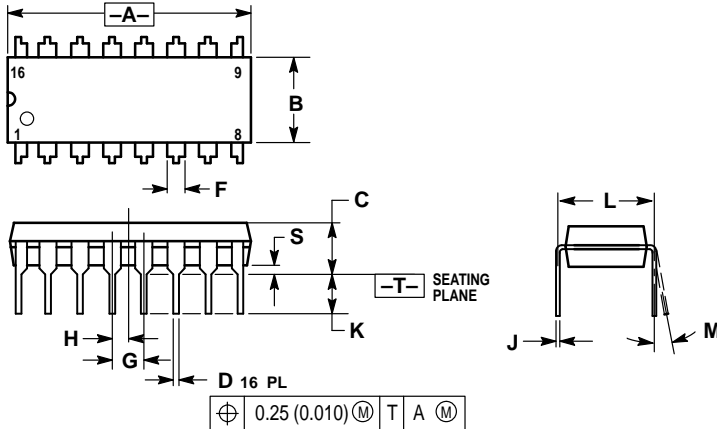
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
5. ROUNDED CORNERS OPTIONAL.

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

TCA0372

OUTLINE DIMENSIONS

DP1 SUFFIX
PLASTIC PACKAGE
CASE 626–05
ISSUE K

NOTE 2

SEATING PLANE

−T−

⊕ | ∅ 0.13 (0.005) Ⓜ | T | A Ⓜ | B Ⓜ
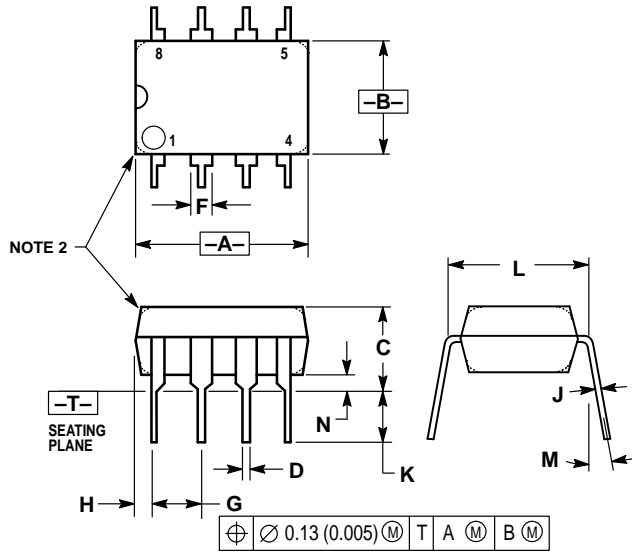
NOTES:
1. DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.
2. PACKAGE CONTOUR OPTIONAL (ROUND OR SQUARE CORNERS).
3. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.

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

TCA0372

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