

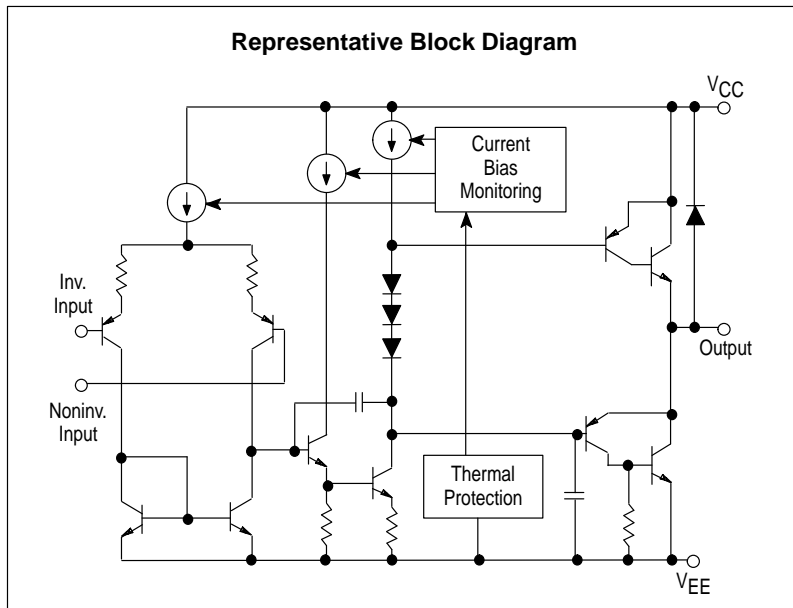
TCA0372

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.

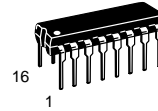
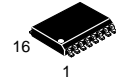
- Output Current to 1.0 A
- Slew Rate of 1.3 V/ μ s
- Wide Bandwidth of 1.1 MHz
- Internal Thermal Shutdown
- Single or Split Supply Operation
- Excellent Gain and Phase Margins
- Common Mode Input Includes Ground
- Zero Deadband Crossover Distortion



ORDERING INFORMATION

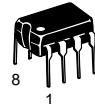
| Device | Operating Temperature Range | Package |
|------------|---|----------------|
| TCA0372DW | $T_J = -40^\circ$ to $+150^\circ\text{C}$ | SOP (12+2+2) L |
| TCA0372DP1 | | Plastic DIP |
| TCA0372DP2 | | Plastic DIP |

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

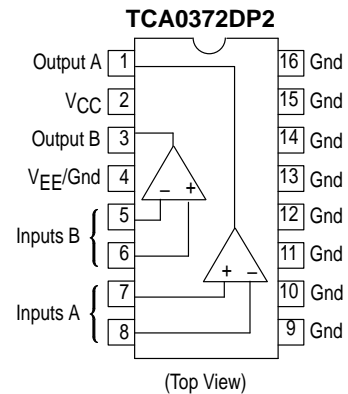


DP2 SUFFIX
PLASTIC PACKAGE
CASE 648

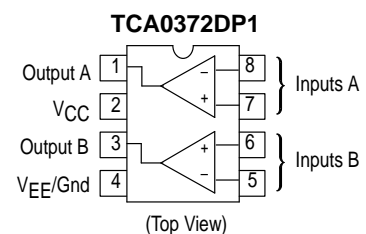
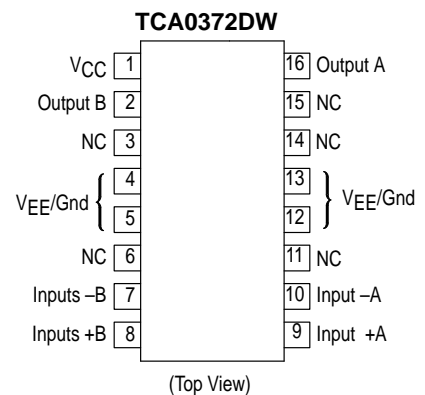
DP1 SUFFIX
PLASTIC PACKAGE
CASE 626



PIN CONNECTIONS



*Pins 4 and 9 to 16 are internally connected.



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, $T_J = -40^\circ$ to $+125^\circ$ C.)

| Characteristics | Symbol | Min | Typ | Max | Unit |
|---|--------------------------|--|-----------|---------------------|------------|
| Input Offset Voltage ($V_{CM} = 0$) $T_J = +25^\circ$ 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 | — | μ V/°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) $T_J = +25^\circ$ C $T_J = T_{low}$ to T_{high} $T_J = +25^\circ$ C $T_J = T_{low}$ to T_{high} | V_{OH} V_{OL} | 14.0 13.9 | 14.2 — | — -14.0 -13.9 | V |
| Output Voltage Swing ($I_L = 1.0$ A) $V_{CC} = +24$ V, $V_{EE} = 0$ V, $T_J = +25^\circ$ C $V_{CC} = +24$ V, $V_{EE} = 0$ V, $T_J = T_{low}$ to T_{high} $V_{CC} = +24$ V, $V_{EE} = 0$ V, $T_J = +25^\circ$ 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 — | — — 1.5 | V |
| Input Common Mode Voltage Range $T_J = +25^\circ$ 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 $T_J = +25^\circ$ 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/ μ s |
| Gain Bandwidth Product ($f = 100$ kHz, $C_L = 100$ pF, $R_L = 2.0$ k) $T_J = 25^\circ$ 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/ $\sqrt{\text{Hz}}$ |
| 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.

Figure 1. Supply Current versus Supply Voltage with No Load

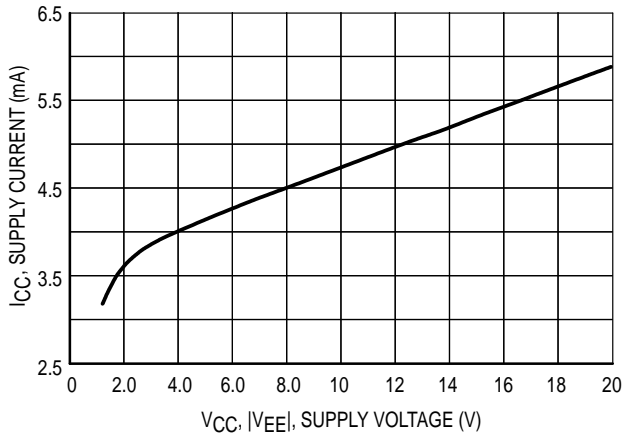


Figure 2. Output Saturation Voltage versus Load Current

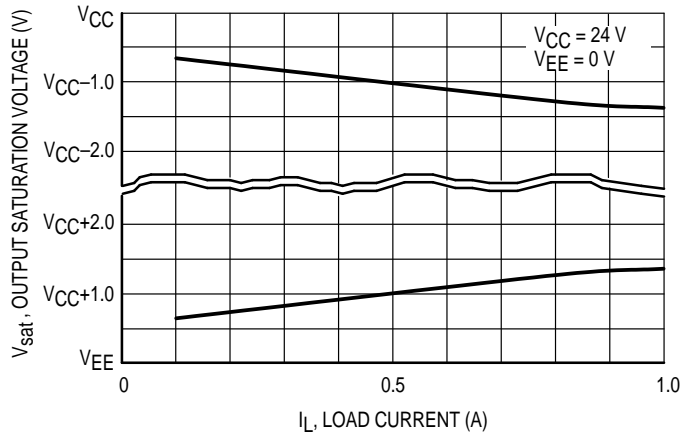


Figure 3. Voltage Gain and Phase versus Frequency

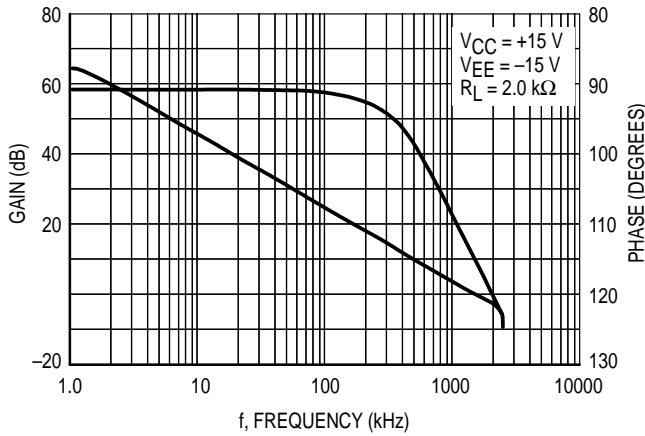


Figure 4. Phase Margin versus Output Load Capacitance

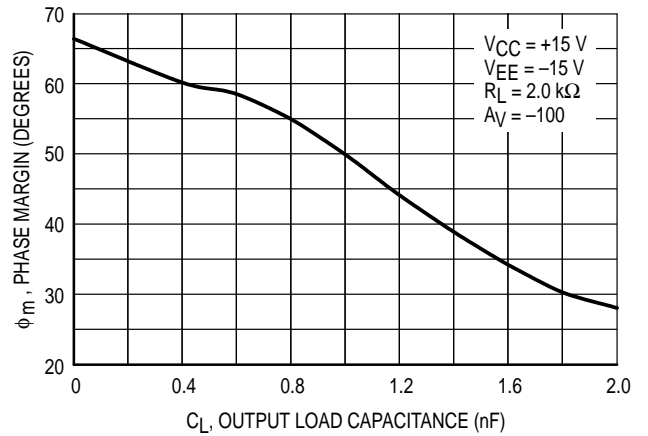


Figure 5. Small Signal Transient Response

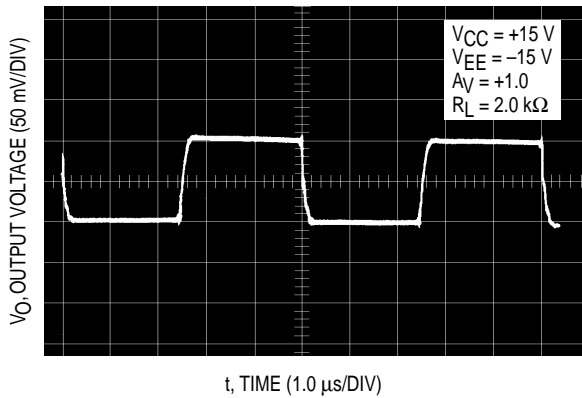


Figure 6. Large Signal Transient Response

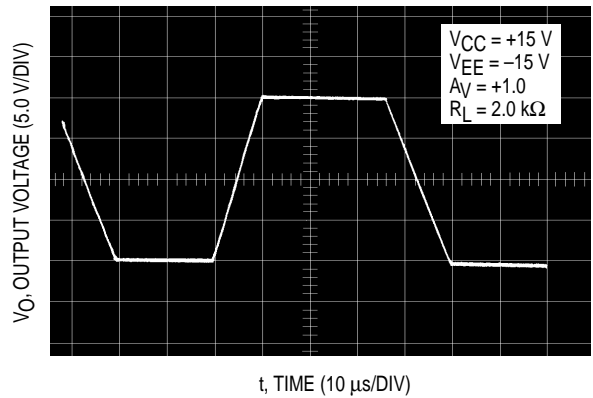


Figure 7. Sine Wave Reponse

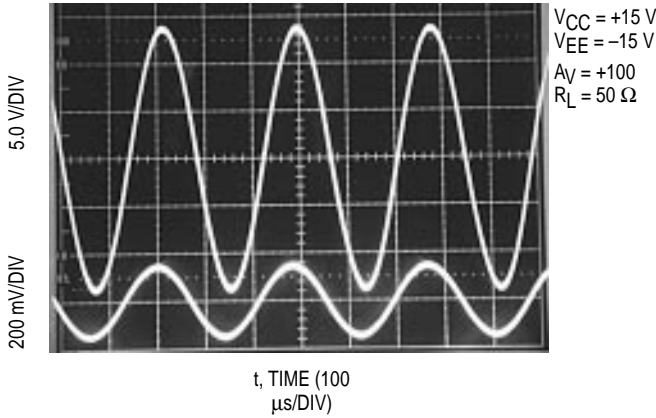


Figure 8. Bidirectional DC Motor Control with Microprocessor-Compatible Inputs

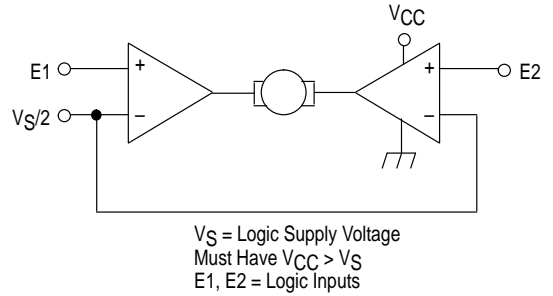
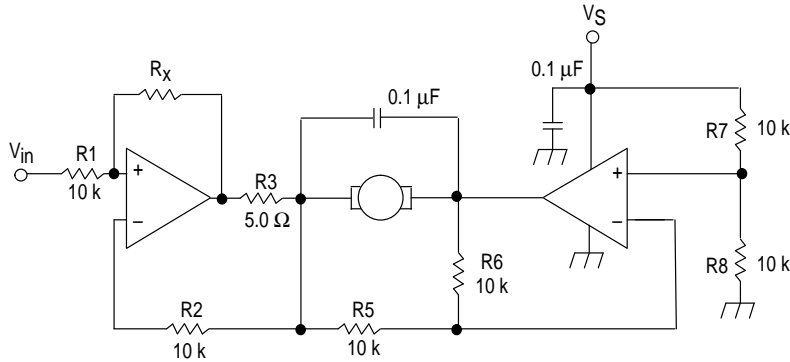


Figure 9. Bidirectional Speed Control of DC Motors



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: $V_M = 2 \left(V_1 - \frac{V_S}{2} \right) + |R_0| \cdot I_M$
where, $|R_0| = \frac{2R_3 \cdot R_1}{R_x}$ 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:

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

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

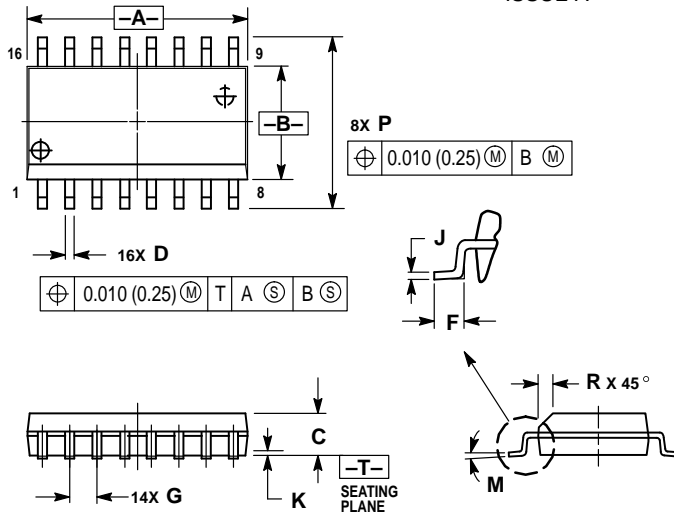
This must be greater than the sum of the products of the supply voltages and supply currents at the worst case operating condition.

- $T_{J(max)}$ = Maximum operating junction temperature as listed in the maximum ratings section.
- T_A = Maximum desired operating ambient temperature.
- $R_{\theta JA}(\text{typ})$ = Typical thermal resistance junction-to-ambient.

TCA0372

OUTLINE DIMENSIONS

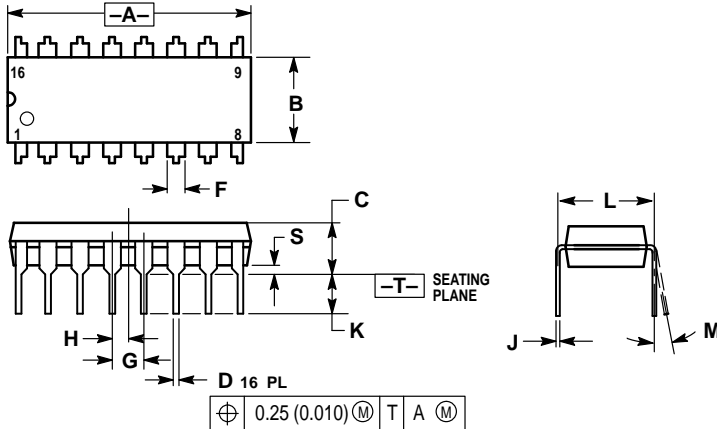
DW SUFFIX PLASTIC PACKAGE CASE 751G-02 (SOP (12+2+2)L) ISSUE A



- 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



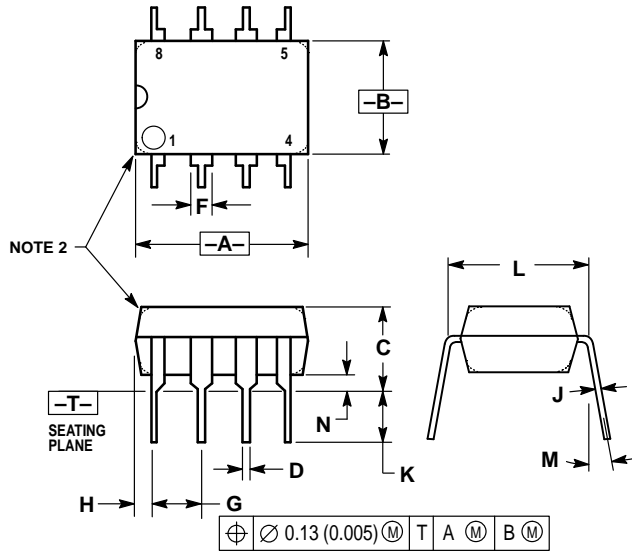
- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: INCH.
 3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
 4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
 5. ROUNDED CORNERS OPTIONAL.

| 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



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 |

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TCA0372

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TCA0372/D

