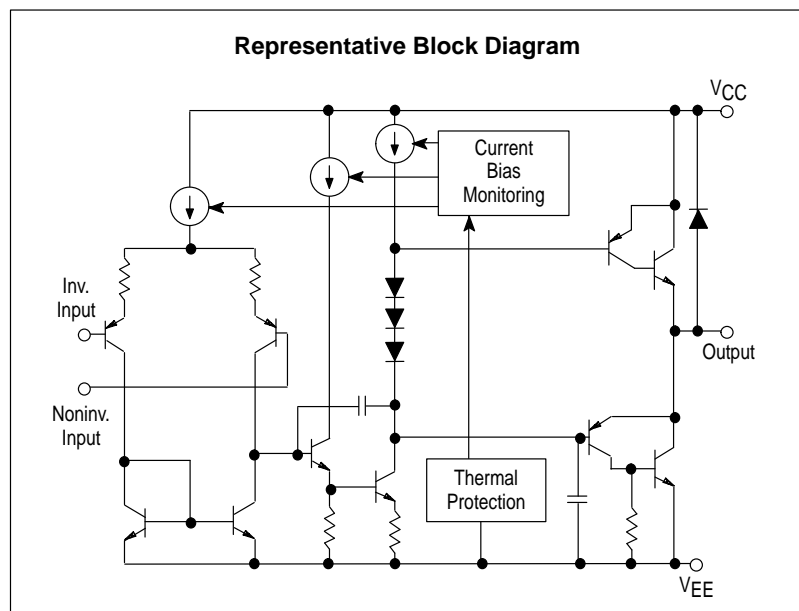


# TCA0372

## 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.

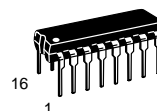
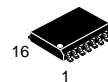
- Output Current to 1.0 A
- Slew Rate of 1.3 V/μs
- Wide Bandwidth of 1.1 MHz
- Internal Thermal Shutdown
- Single or Split Supply Operation
- Excellent Gain and Phase Margins
- Common Mode Input Includes Ground
- Zero Deadband Crossover Distortion



### ORDERING INFORMATION

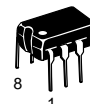
Device	Operating Temperature Range	Package
TCA0372DW	$T_J = -40^\circ \text{ to } +150^\circ \text{C}$	SOP (12+2+2) L
TCA0372DP1		Plastic DIP
TCA0372DP2		Plastic DIP

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

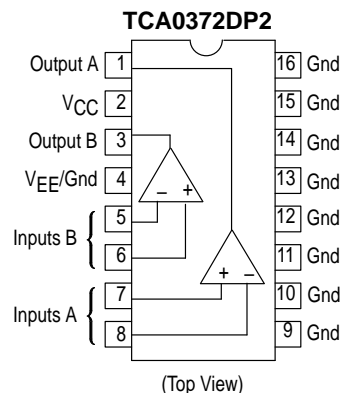


**DP2 SUFFIX**  
PLASTIC PACKAGE  
CASE 648

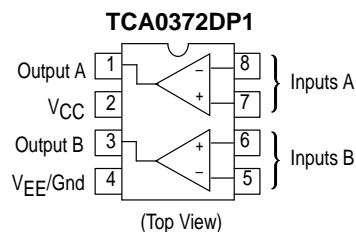
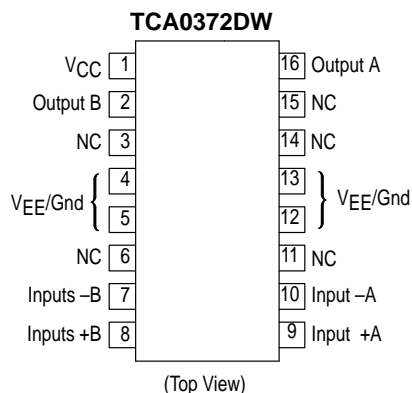
**DP1 SUFFIX**  
PLASTIC PACKAGE  
CASE 626



### PIN CONNECTIONS



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



**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 ( $V_{CM} = 0$ ) $T_J = +25^\circ\text{C}$ $T_J, T_{low}$ 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

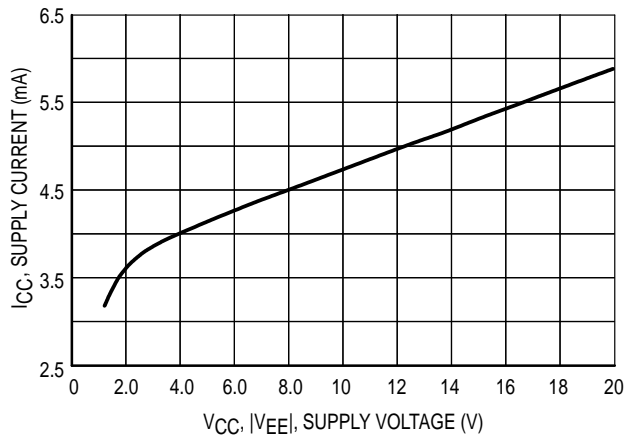
**NOTES:** 1. Either or both input voltages should not exceed the magnitude of  $V_{CC}$  or  $V_{EE}$ .  
2. Power dissipation must be considered to ensure maximum junction temperature ( $T_J$ ) is not exceeded.

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

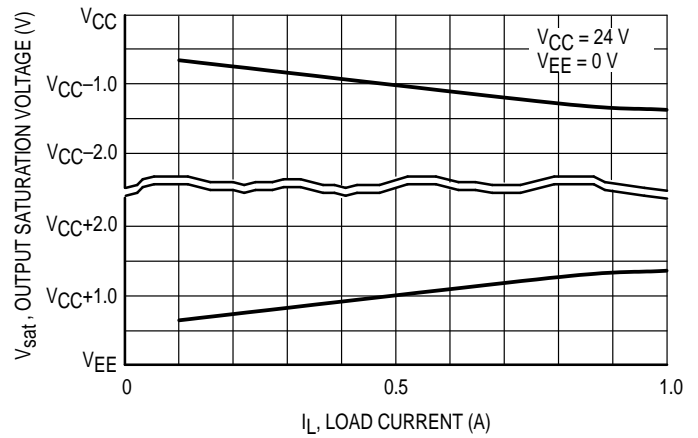
Characteristics	Symbol	Min	Typ	Max	Unit
Slew Rate ( $V_{in} = -10$ V to $+10$ V, $R_L = 2.0$ k, $C_L = 100$ pF) $A_V = -1.0$ , $T_J = T_{low}$ to $T_{high}$	SR	1.0	1.4	—	V/ $\mu\text{s}$
Gain Bandwidth Product ( $f = 100$ kHz, $C_L = 100$ pF, $R_L = 2.0$ k) $T_J = 25^\circ\text{C}$ $T_J = T_{low}$ to $T_{high}$	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	—	$\text{nV}/\sqrt{\text{Hz}}$
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.

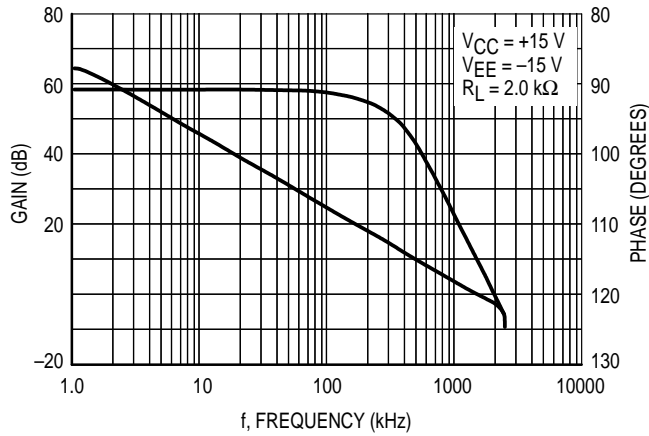
**Figure 1. Supply Current versus Supply Voltage with No Load**



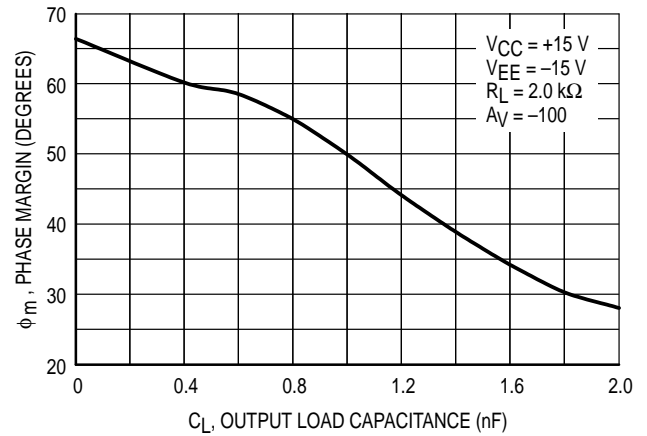
**Figure 2. Output Saturation Voltage versus Load Current**



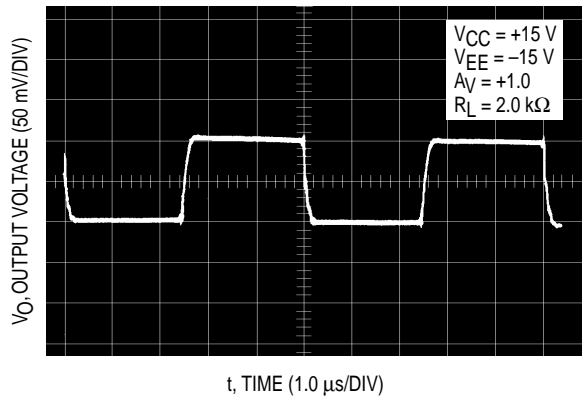
**Figure 3. Voltage Gain and Phase versus Frequency**



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



**Figure 5. Small Signal Transient Response**



**Figure 6. Large Signal Transient Response**

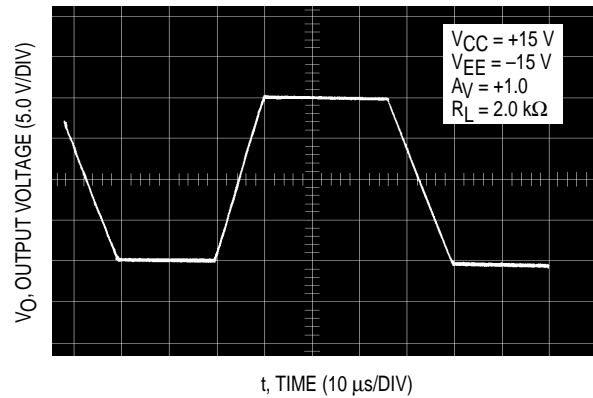


Figure 7. Sine Wave Reponse

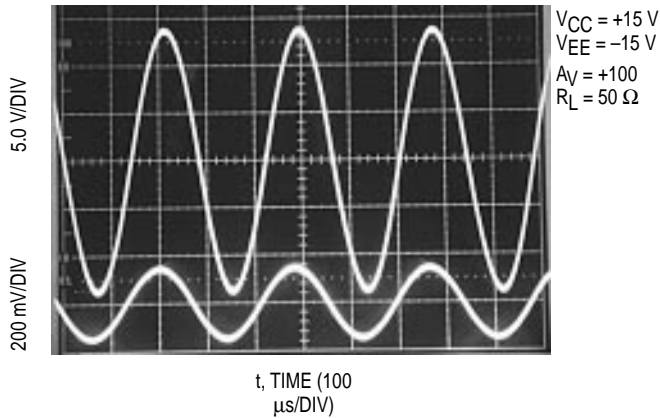


Figure 8. Bidirectional DC Motor Control with Microprocessor-Compatible Inputs

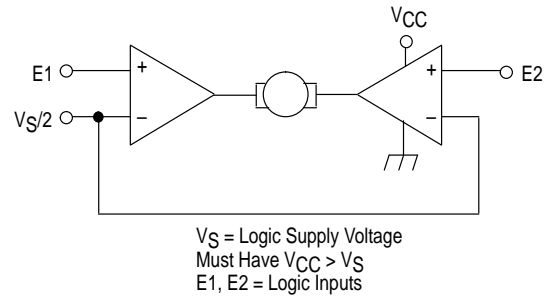
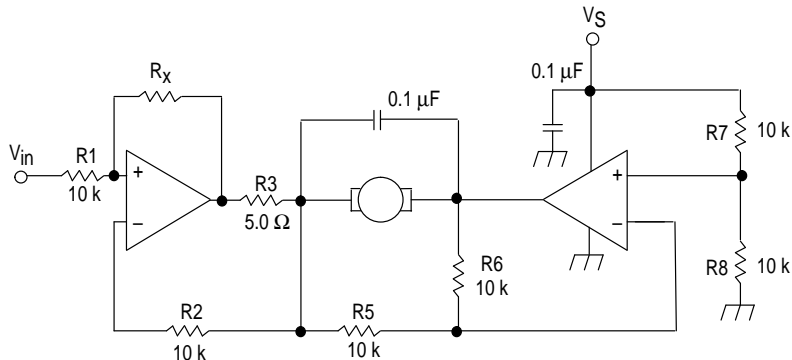


Figure 9. Bidirectional Speed Control of DC Motors



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:

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

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.

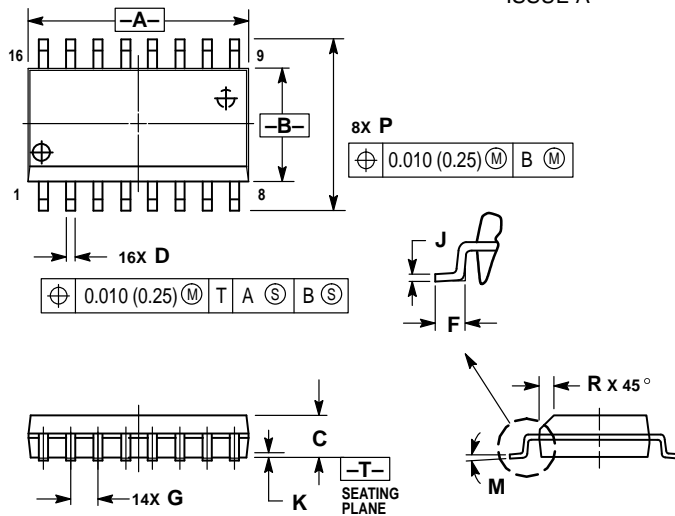
$T_{J(max)}$  = Maximum operating junction temperature as listed in the maximum ratings section.

$T_A$  = Maximum desired operating ambient temperature.

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

## OUTLINE DIMENSIONS

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

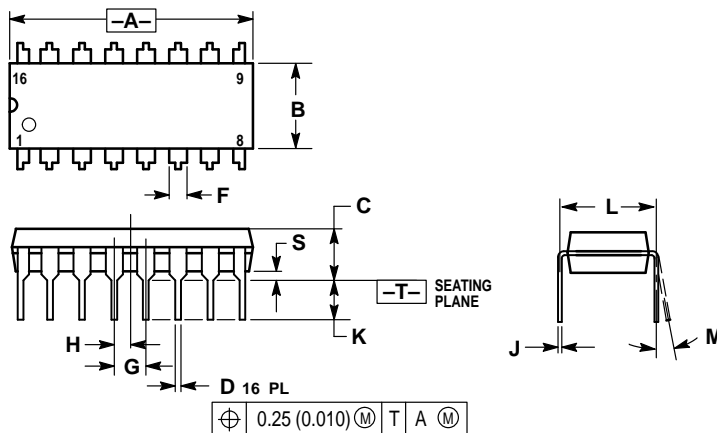


## NOTES:

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
E	0.50	0.90	0.020	0.035
F	1.27 BSC		0.050 BSC	
G	0.25	0.32	0.010	0.012
H	0.10	0.25	0.004	0.009
J	0°	7°	0°	7°
K	10.05	10.55	0.395	0.415
L	0.25	0.75	0.010	0.029

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



## NOTES:

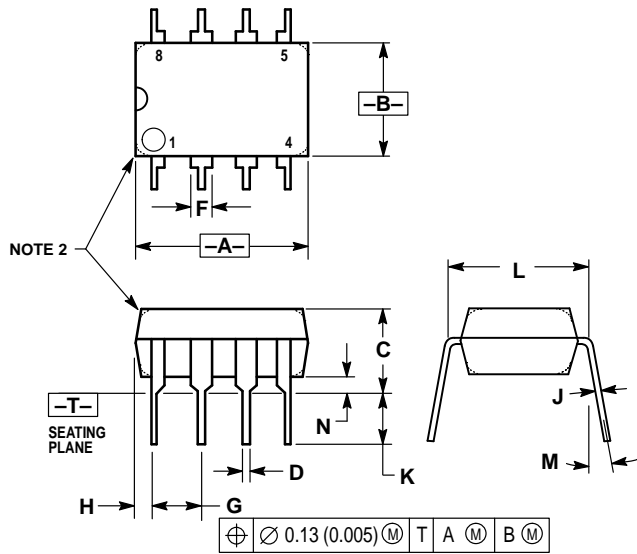
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
5. ROUNDED CORNERS OPTIONAL.

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
E	0.040	0.70	1.02	1.77
F	0.100 BSC		2.54 BSC	
G	0.050 BSC		1.27 BSC	
H	0.008	0.015	0.21	0.38
J	0.110	0.130	2.80	3.30
K	0.295	0.305	7.50	7.74
L	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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