

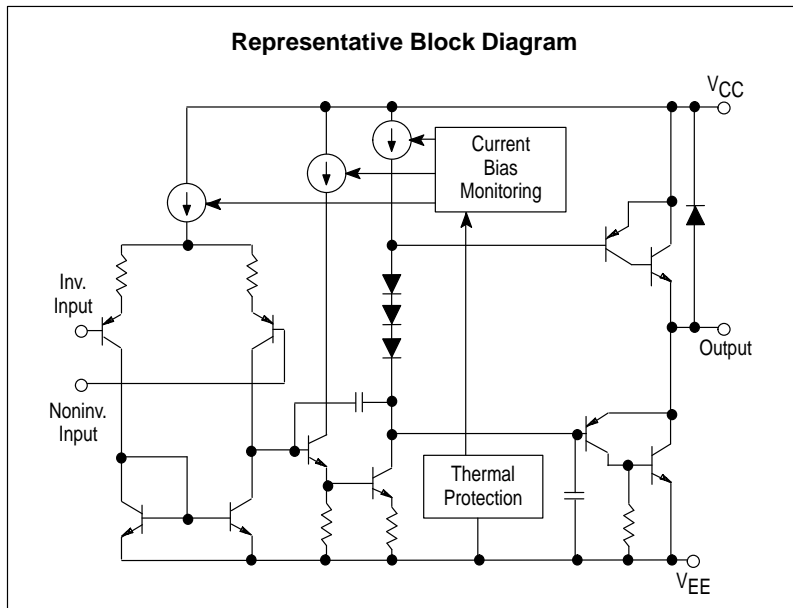
# TCA0372

## 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.

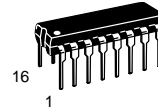
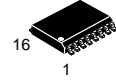
- Output Current to 1.0 A
- Slew Rate of 1.3 V/ $\mu$ s
- Wide Bandwidth of 1.1 MHz
- Internal Thermal Shutdown
- Single or Split Supply Operation
- Excellent Gain and Phase Margins
- Common Mode Input Includes Ground
- Zero Deadband Crossover Distortion



### ORDERING INFORMATION

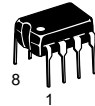
Device	Operating Temperature Range	Package
TCA0372DW	$T_J = -40^\circ$ to $+150^\circ\text{C}$	SOP (12+2+2) L
TCA0372DP1		Plastic DIP
TCA0372DP2		Plastic DIP

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

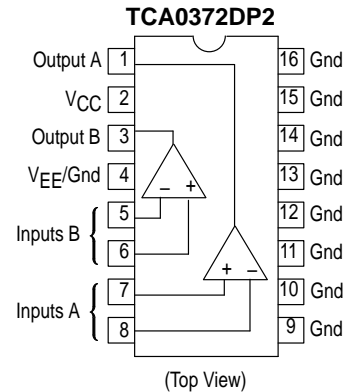


**DP2 SUFFIX**  
PLASTIC PACKAGE  
CASE 648

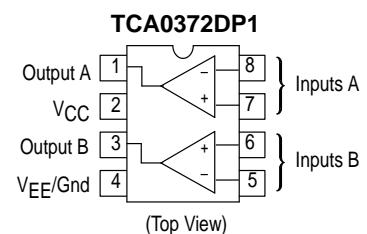
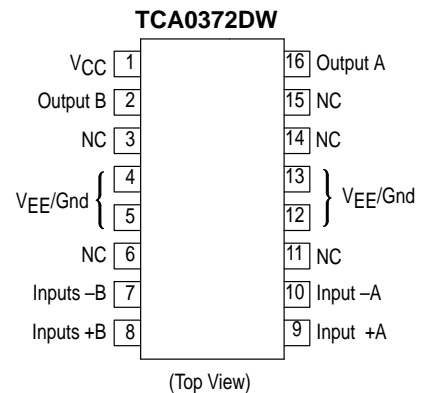
**DP1 SUFFIX**  
PLASTIC PACKAGE  
CASE 626



### 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	—	$\mu$ 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 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 ( $R_S = 100$ $\Omega$ )	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/ $\mu$ 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	$\phi_m$	—	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

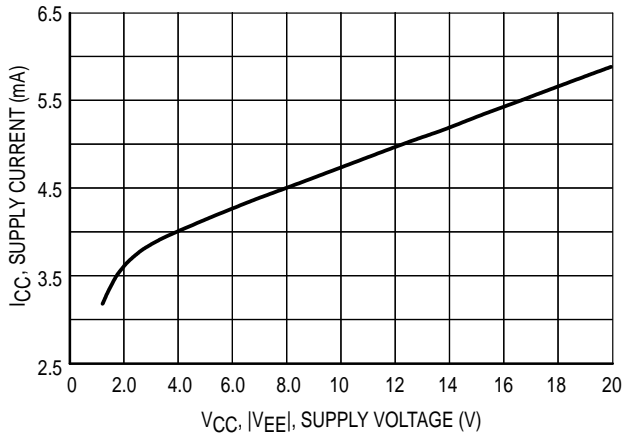


Figure 2. Output Saturation Voltage versus Load Current

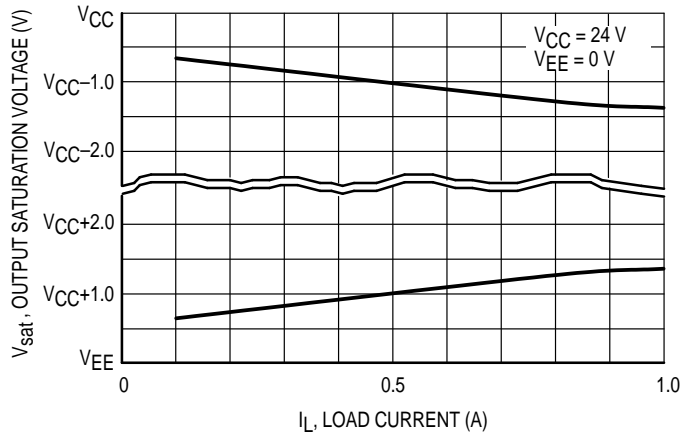


Figure 3. Voltage Gain and Phase versus Frequency

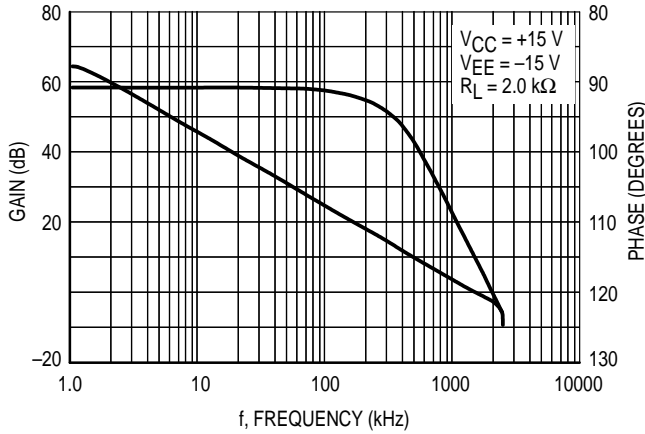


Figure 4. Phase Margin versus Output Load Capacitance

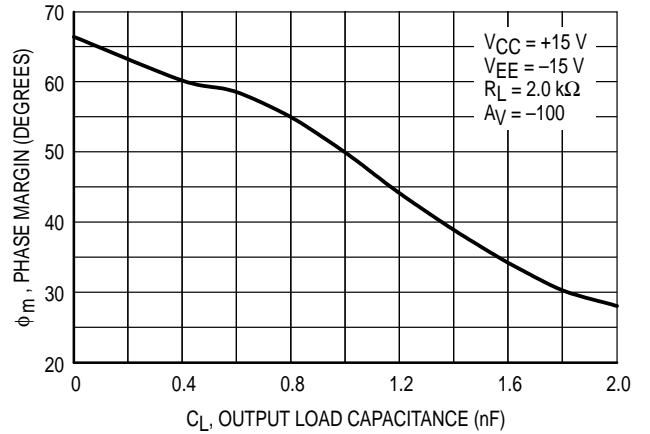


Figure 5. Small Signal Transient Response

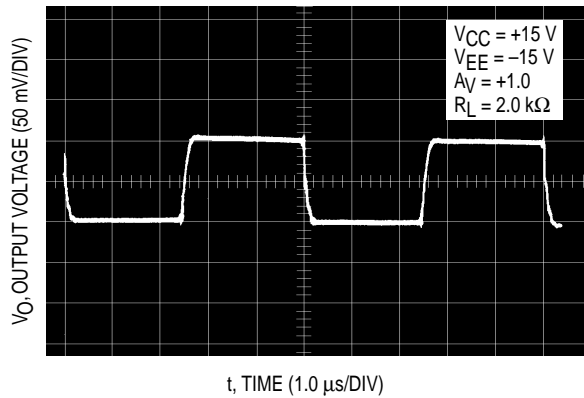


Figure 6. Large Signal Transient Response

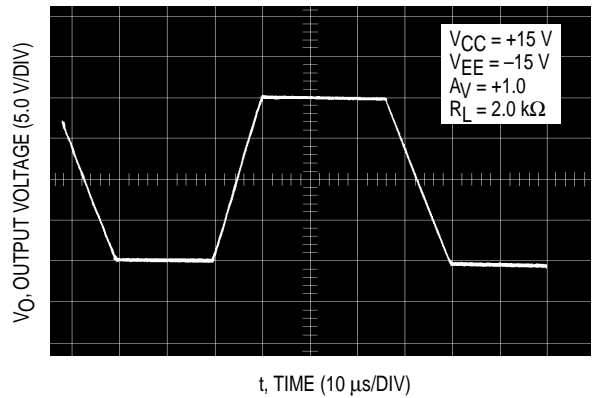


Figure 7. Sine Wave Reponse

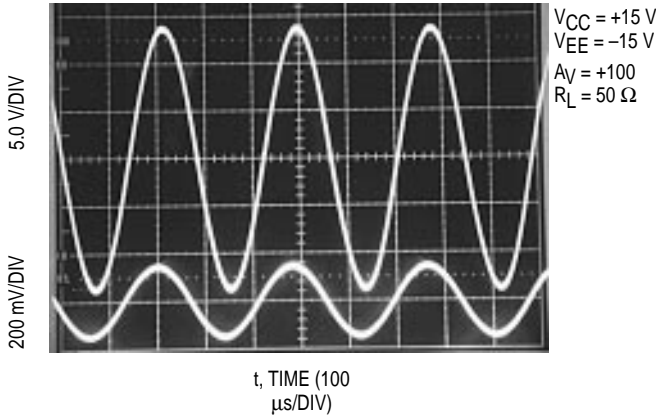


Figure 8. Bidirectional DC Motor Control with Microprocessor-Compatible Inputs

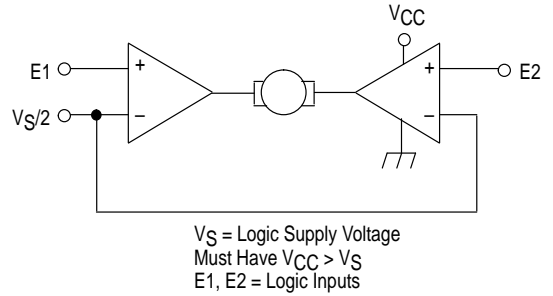
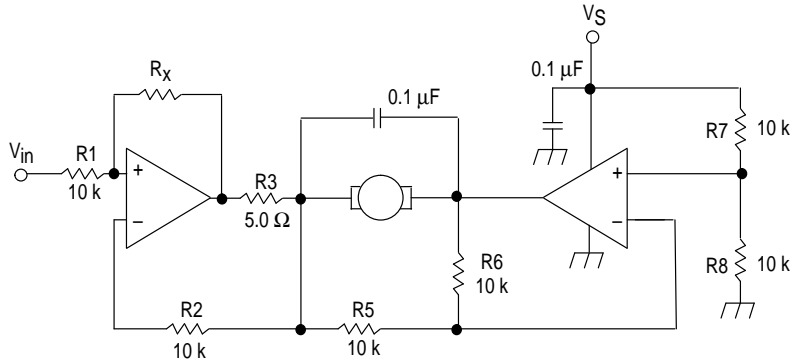


Figure 9. Bidirectional Speed Control of DC Motors



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

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

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

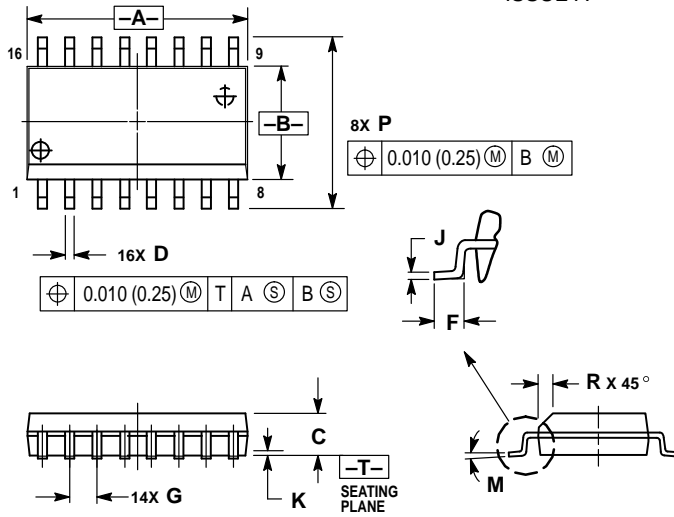
This must be greater than the sum of the products of the supply voltages and supply currents at the worst case operating condition.

- T<sub>J(max)</sub> = Maximum operating junction temperature as listed in the maximum ratings section.
- T<sub>A</sub> = Maximum desired operating ambient temperature.
- R<sub>θJA(typ)</sub> = Typical thermal resistance junction-to-ambient.

# TCA0372

## OUTLINE DIMENSIONS

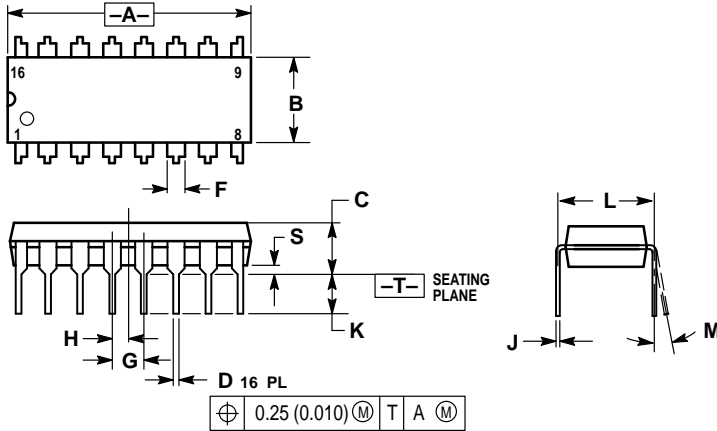
### DW SUFFIX PLASTIC PACKAGE CASE 751G-02 (SOP (12+2+2)L) ISSUE A



- 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



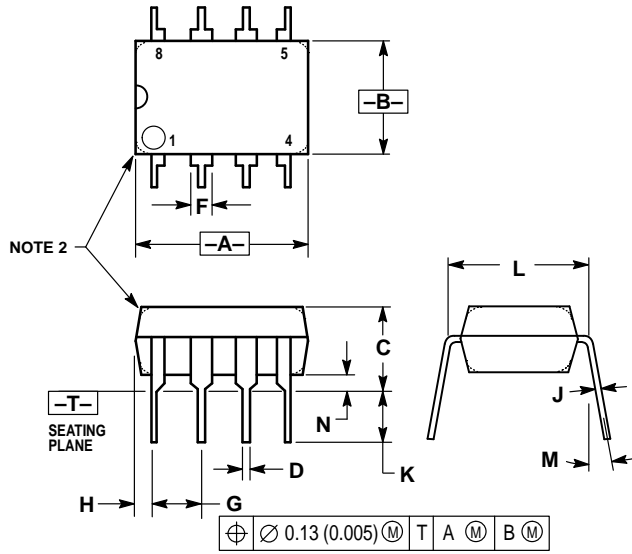
- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.
  3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
  4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
  5. ROUNDED CORNERS OPTIONAL.

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°	
N	0.76	1.01	0.030	0.040

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TCA0372/D

