

# TCA0372, TCA0372B

## 1.0 A Output Current, Dual Power Operational Amplifiers

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.

### Features

- 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
- Pb-Free Packages are Available

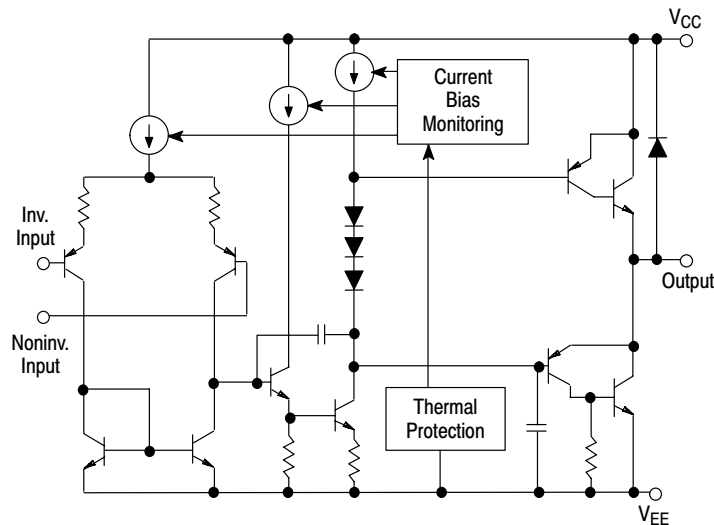
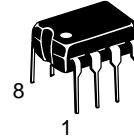


Figure 1. Representative Block Diagram

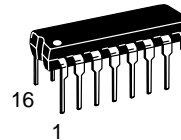


**ON Semiconductor®**

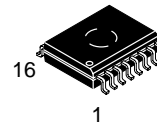
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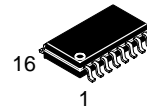
PDIP-8  
DP1 SUFFIX  
CASE 626



PDIP-16  
DP2 SUFFIX  
CASE 648



SOIC-16W  
DW SUFFIX  
CASE 751G



SOEIAJ-16  
DM2 SUFFIX  
CASE 966

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 5 of this data sheet.

### DEVICE MARKING INFORMATION

See general marking information in the device marking section on page 6 of this data sheet.

\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

## TCA0372, TCA0372B

### 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
Operating Temperature Range	$T_A$	-40 to +125	°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
Thermal Resistance, Junction-to-Air Case 626 Case 648 Case 751G	$R_{\theta JA}$	137 72 80	°C/W
Thermal Resistance, Junction-to-Case Case 626 Case 648 Case 751G	$R_{\theta JC}$	23 10 12	°C/W

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

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.

# TCA0372, TCA0372B

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

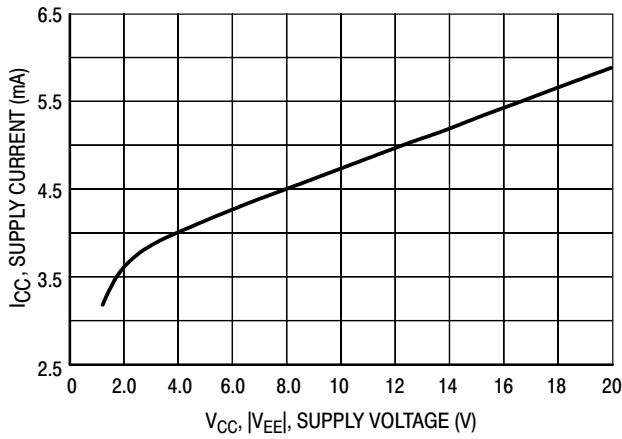
Characteristics	Symbol	Min	Typ	Max	Unit
Input Offset Voltage ( $V_{CM} = 0$ ) $T_A = +25^\circ\text{C}$ $T_A, T_{low}$ to $T_{high}$	$V_{IO}$	–	1.0	15 20	mV
Average Temperature Coefficient of Offset Voltage	$\Delta V_{IO}/\Delta T$	–	20	–	$\mu\text{V}/^\circ\text{C}$
Input Bias Current ( $V_{CM} = 0$ )	$I_{IB}$	–	100	500	nA
Input Offset Current ( $V_{CM} = 0$ )	$I_{IO}$	–	10	50	nA
Large Signal Voltage Gain $V_O = \pm 10\text{ V}$ , $R_L = 2.0\text{ k}$	$A_{VOL}$	30	100	–	V/mV
Output Voltage Swing ( $I_L = 100\text{ mA}$ ) $T_A = +25^\circ\text{C}$ $T_A = T_{low}$ to $T_{high}$ $T_A = +25^\circ\text{C}$ $T_A = T_{low}$ to $T_{high}$	$V_{OH}$ $V_{OL}$	14.0 13.9	14.2 –	– –	V
Output Voltage Swing ( $I_L = 1.0\text{ A}$ ) $V_{CC} = +24\text{ V}$ , $V_{EE} = 0\text{ V}$ , $T_A = +25^\circ\text{C}$ $V_{CC} = +24\text{ V}$ , $V_{EE} = 0\text{ V}$ , $T_A = T_{low}$ to $T_{high}$ $V_{CC} = +24\text{ V}$ , $V_{EE} = 0\text{ V}$ , $T_A = +25^\circ\text{C}$ $V_{CC} = +24\text{ V}$ , $V_{EE} = 0\text{ V}$ , $T_A = T_{low}$ to $T_{high}$	$V_{OH}$ $V_{OL}$	22.5 22.5	22.7 –	– –	V
Input Common Mode Voltage Range $T_A = +25^\circ\text{C}$ $T_A = T_{low}$ to $T_{high}$	$V_{ICR}$	$V_{EE}$ to $(V_{CC} - 1.0)$ $V_{EE}$ to $(V_{CC} - 1.3)$			V
Common Mode Rejection Ratio ( $R_S = 10\text{ k}$ )	CMRR	70	90	–	dB
Power Supply Rejection Ratio ( $R_S = 100\ \Omega$ )	PSRR	70	90	–	dB
Power Supply Current $T_A = +25^\circ\text{C}$ $T_A = T_{low}$ to $T_{high}$	$I_D$	–	5.0 8.0	10 10	mA
TCA0372	–	–	–	14	
TCA0372B	–	–	–	14	
TCA0372	–	–	–	14	

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

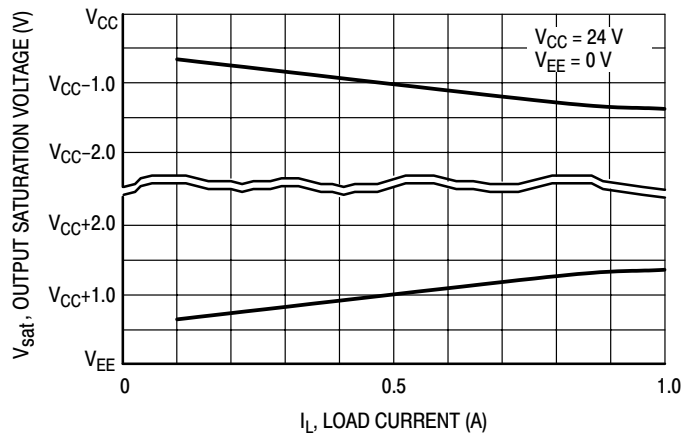
Characteristics	Symbol	Min	Typ	Max	Unit
Slew Rate ( $V_{in} = -10\text{ V}$ to $+10\text{ V}$ , $R_L = 2.0\text{ k}$ , $C_L = 100\text{ pF}$ ) $A_V = -1.0$ , $T_A = T_{low}$ to $T_{high}$	SR	1.0	1.4	–	V/ $\mu\text{s}$
Gain Bandwidth Product ( $f = 100\text{ kHz}$ , $C_L = 100\text{ pF}$ , $R_L = 2.0\text{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

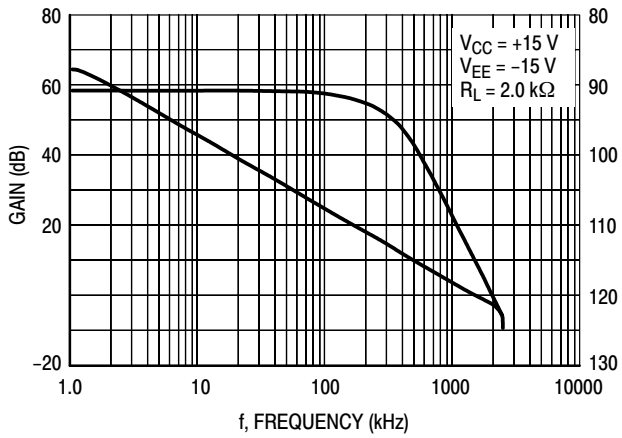
# TCA0372, TCA0372B



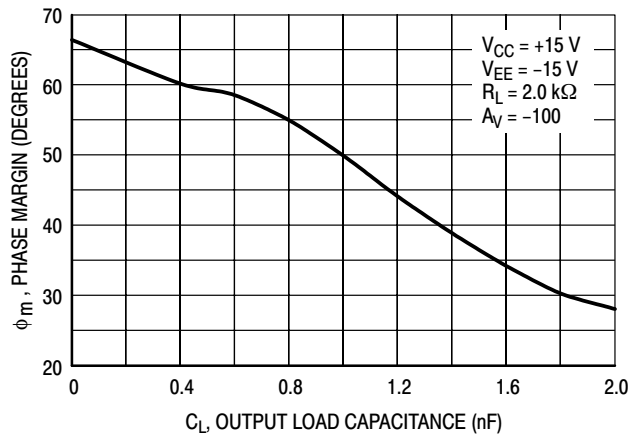
**Figure 2. Supply Current versus Supply Voltage with No Load**



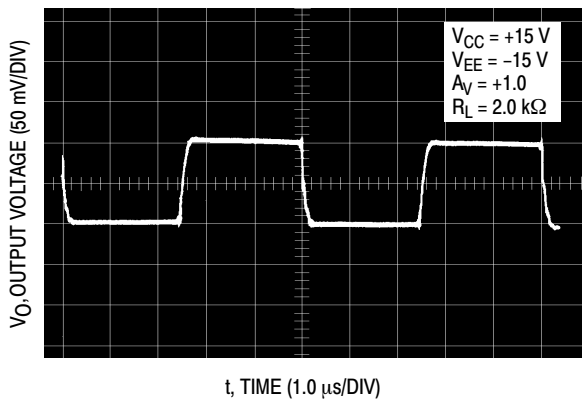
**Figure 3. Output Saturation Voltage versus Load Current**



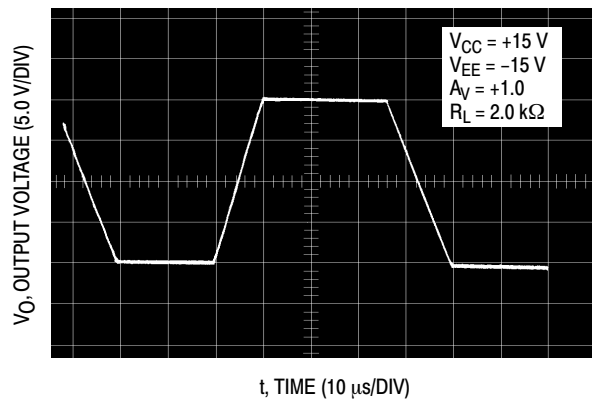
**Figure 4. Voltage Gain and Phase versus Frequency**



**Figure 5. Phase Margin versus Output Load Capacitance**



**Figure 6. Small Signal Transient Response**



**Figure 7. Large Signal Transient Response**

# TCA0372, TCA0372B

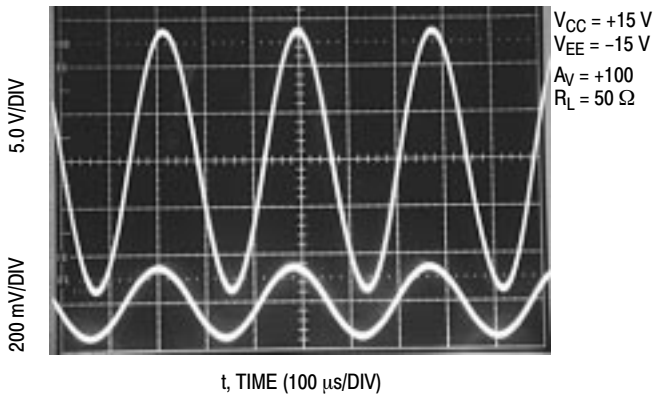


Figure 8. Sine Wave Response

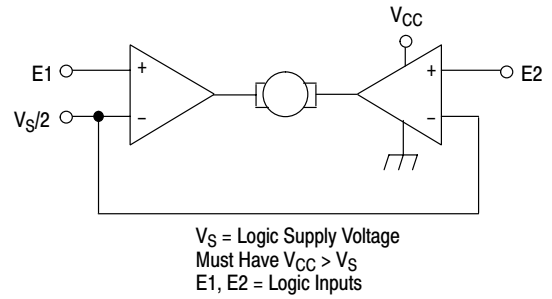
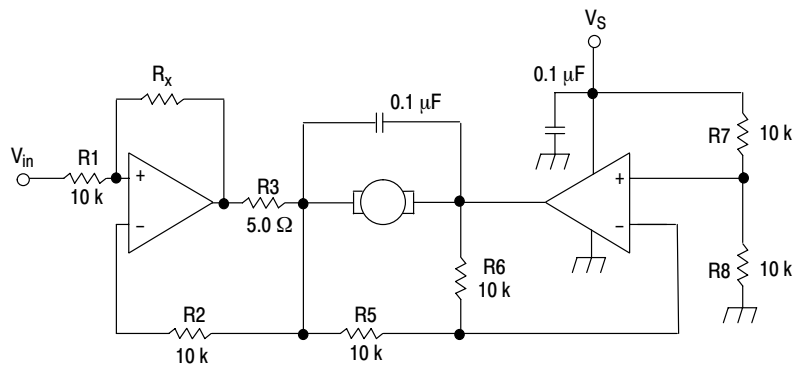


Figure 9. Bidirectional DC Motor Control with Microprocessor-Compatible Inputs



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:  $V_M = 2(V_1 - \frac{V_S}{2}) + |R_o| \cdot I_M$   
 where,  $|R_o| = \frac{2R_3 \cdot R_1}{R_x}$  and  $I_M$  is the motor current.

Figure 10. Bidirectional Speed Control of DC Motors

## ORDERING INFORMATION

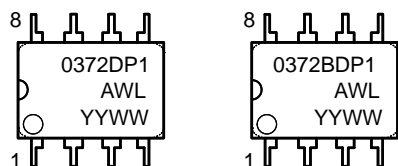
Device	Package	Shipping†
TCA0372DW	SOIC-16W	47 Units / Rail
TCA0372DWR2	SOIC-16W	1000 Tape & Reel
TCA0372BDWR2	SOIC-16W	1000 Tape & Reel
TCA0372DP1	PDIP-8	50 Units / Rail
TCA0372DP1G	PDIP-8 (Pb-Free)	50 Units / Rail
TCA0372BDP1	PDIP-8	50 Units / Rail
TCA0372DP2	PDIP-16	25 Units / Rail
TCA0372DM2EL	SOEIAJ-16	2500 Tape & Reel
TCA0372DM2ELG	SOEIAJ-16 (Pb-Free)	2500 Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

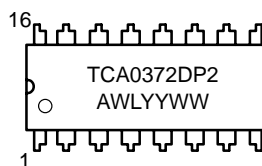
# TCA0372, TCA0372B

## MARKING DIAGRAMS

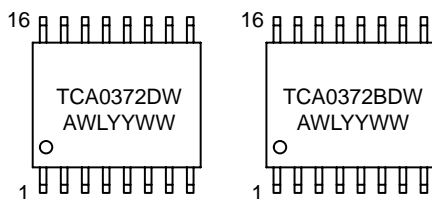
**PDIP-8  
DP1 SUFFIX  
CASE 626**



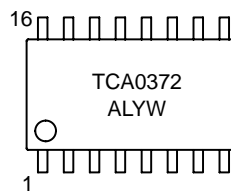
**PDIP-16  
DP2 SUFFIX  
CASE 648**



**SOIC-16W  
DW SUFFIX  
CASE 751G**



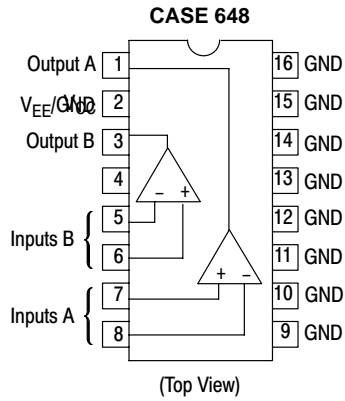
**SOEIAJ-16  
DM2 SUFFIX  
CASE 966**



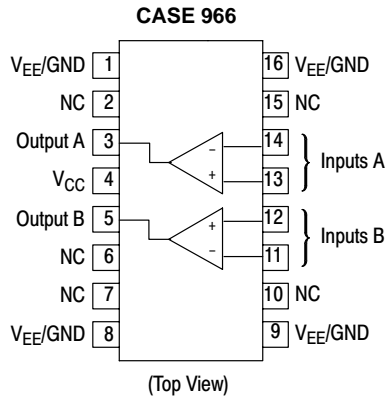
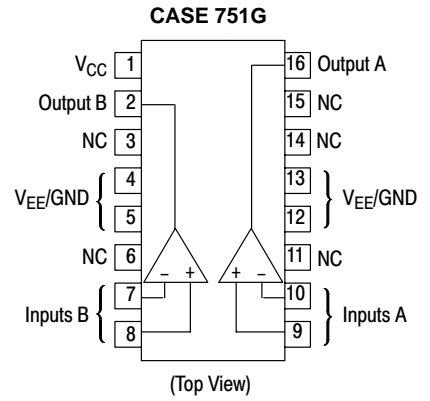
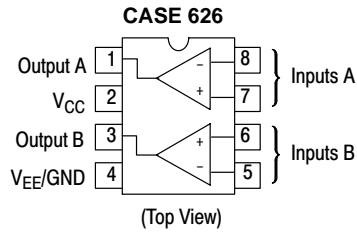
A = Assembly Location  
WL, L = Wafer Lot  
YY, Y = Year  
WW, W = Work Week

# TCA0372, TCA0372B

## PIN CONNECTIONS



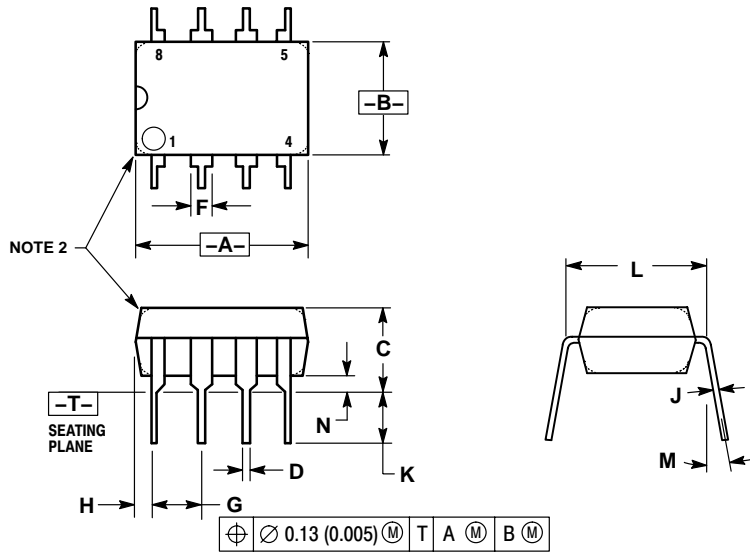
\*Pins 4 and 9 to 16 are internally connected.



# TCA0372, TCA0372B

## PACKAGE DIMENSIONS

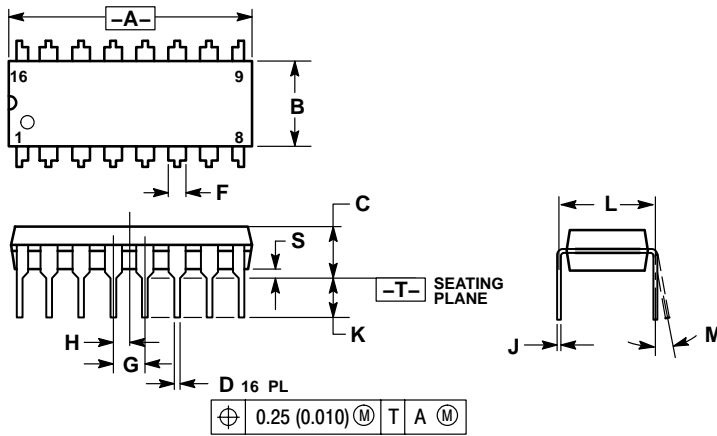
PDIP-8  
DP1 SUFFIX  
CASE 626-05  
ISSUE L



- 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

PDIP-16  
DP2 SUFFIX  
CASE 648-08  
ISSUE T



- 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.

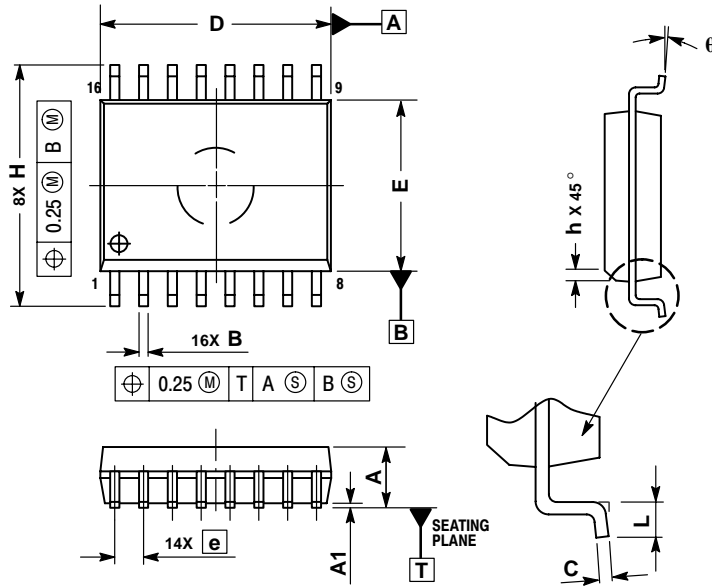
DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.740	0.770	18.80	19.55
B	0.250	0.270	6.35	6.85
C	0.145	0.175	3.69	4.44
D	0.015	0.021	0.39	0.53
F	0.040	0.70	1.02	1.77
G	0.100 BSC		2.54 BSC	
H	0.050 BSC		1.27 BSC	
J	0.008	0.015	0.21	0.38
K	0.110	0.130	2.80	3.30
L	0.295	0.305	7.50	7.74
M	0°	10°	0°	10°
S	0.020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



# TCA0372, TCA0372B

## PACKAGE DIMENSIONS

SOIC-16W  
DW SUFFIX  
CASE 751G-03  
ISSUE B

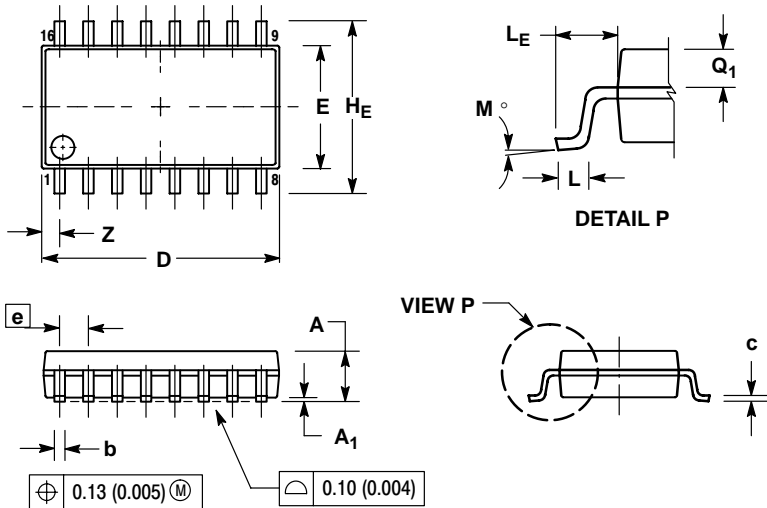


NOTES:

1. DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.
5. DIMENSION B DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF THE B DIMENSION AT MAXIMUM MATERIAL CONDITION.

MILLIMETERS		
DIM	MIN	MAX
A	2.35	2.65
A1	0.10	0.25
B	0.35	0.49
C	0.23	0.32
D	10.15	10.45
E	7.40	7.60
e	1.27 BSC	
H	10.05	10.55
h	0.25	0.75
L	0.50	0.90
θ	0°	7°


SOEIAJ-16  
DM2 SUFFIX  
CASE 966-01  
ISSUE O



NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS AND ARE MEASURED AT THE PARTING LINE. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
5. THE LEAD WIDTH DIMENSION (b) DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE LEAD WIDTH DIMENSION AT MAXIMUM MATERIAL CONDITION. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE FOOT. MINIMUM SPACE BETWEEN PROTRUSIONS AND ADJACENT LEAD TO BE 0.46 (0.018).

MILLIMETERS			INCHES		
DIM	MIN	MAX	MIN	MAX	MAX
A	---	2.05	---	0.081	
A1	0.05	0.20	0.002	0.008	
b	0.35	0.50	0.014	0.020	
c	0.18	0.27	0.007	0.011	
D	9.90	10.50	0.390	0.413	
E	5.10	5.45	0.201	0.215	
e	1.27 BSC		0.050 BSC		
HE	7.40	8.20	0.291	0.323	
L	0.50	0.85	0.020	0.033	
LE	1.10	1.50	0.043	0.059	
M	0°	10°	0°	10°	
Q1	0.70	0.90	0.028	0.035	
Z	---	0.78	---	0.031	

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