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.

- 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
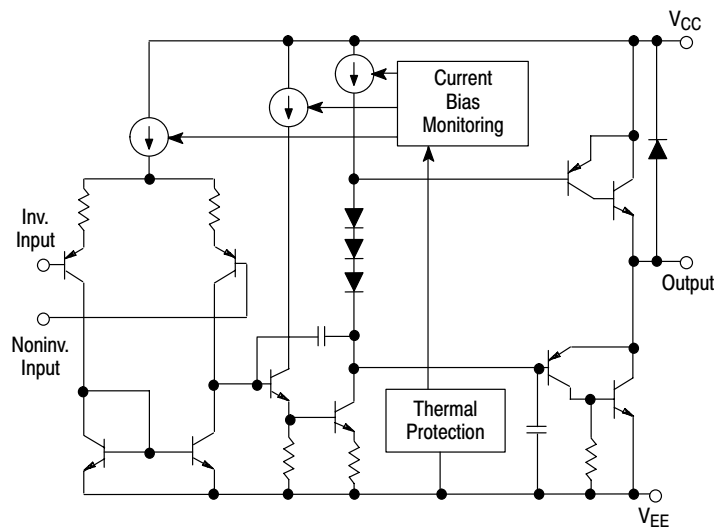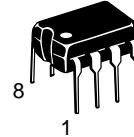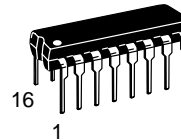- Zero Deadband Crossover Distortion

ON Semiconductor™
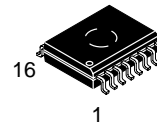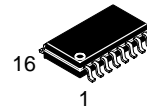
http://onsemi.com

PDIP–8
DP1 SUFFIX
CASE 626

PDIP–16
DP2 SUFFIX
CASE 648

SO–16W
DW SUFFIX
CASE 751G
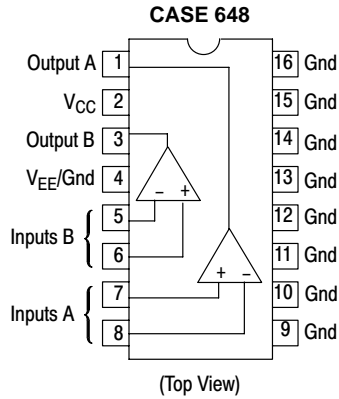
SOEIAJ–16
DM2 SUFFIX
CASE 966

ORDERING INFORMATION

Device	Package	Shipping
TCA0372DW	SO–16W	47 Units/Rail
TCA0372DWR2	SO–16W	1000 Tape & Reel
TCA0372DP1	PDIP–8	50 Units/Rail
TCA0372BDP1	PDIP–8	50 Units/Rail
TCA0372DP2	PDIP–16	25 Units/Rail
TCA0372DM2EL	SOEIAJ–16	2500 Tape & Reel

DEVICE MARKING INFORMATION

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

Figure 1. Representative Block Diagram

TCA0372, TCA0372B

PIN CONNECTIONS

CASE 648

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.

CASE 626

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

(Top View)

CASE 751G

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	} Inputs A
8		9	

(Top View)

CASE 966

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

(Top View)
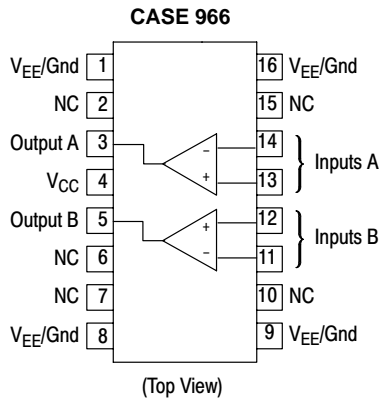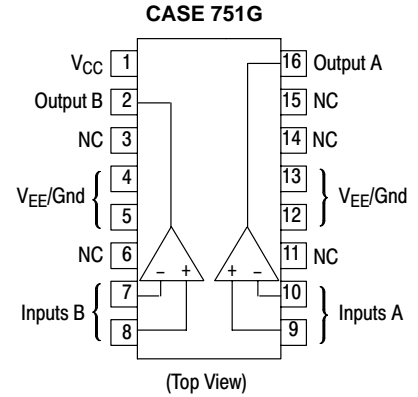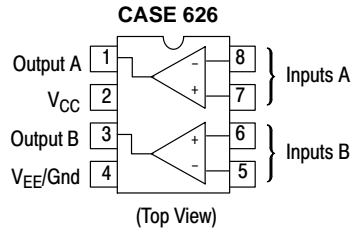
MAXIMUM RATINGS

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

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.

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}	\multicolumn{3}{c	}{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   TCA0372
                    TCA0372B
   T_J = T_{low} to T_{high} TCA0372
                    TCA0372B
	I_D	
		−
		−
		−
		−
			
			5.0
			8.0
			−
			−
				
				10
				10
				14
				14
					mA

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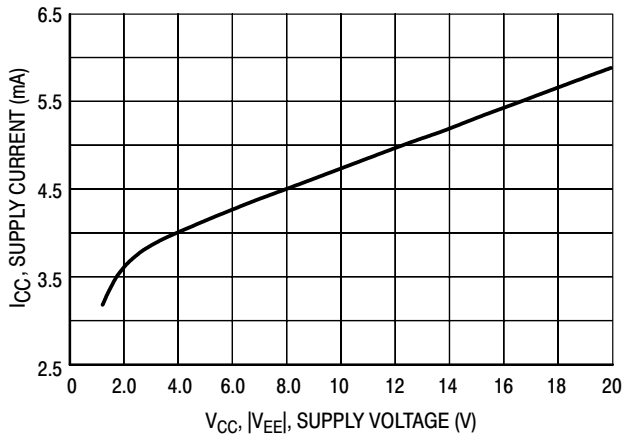
Figure 2. Supply Current versus Suppy Voltage with No Load
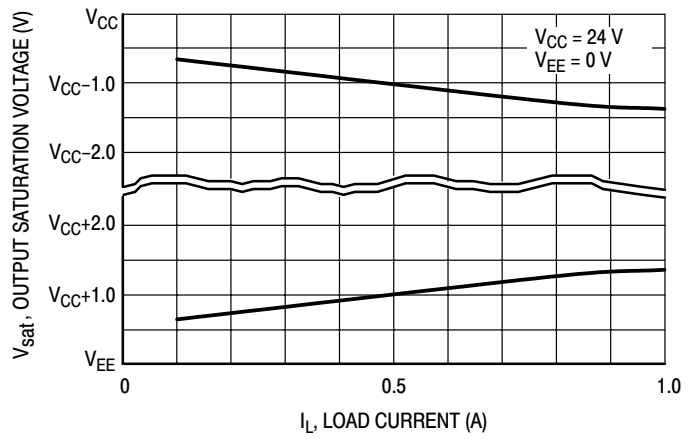

Figure 3. Output Saturation Voltage versus Load Current

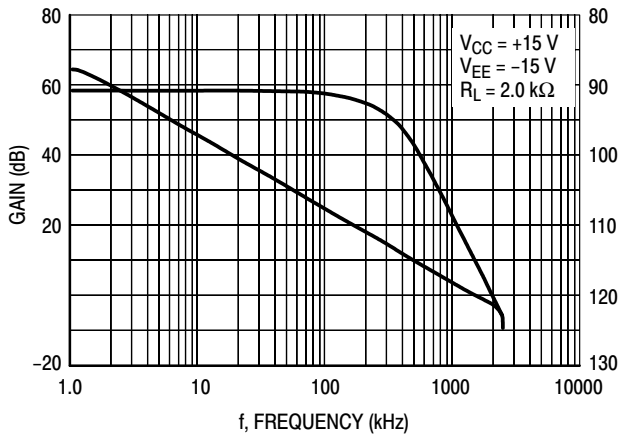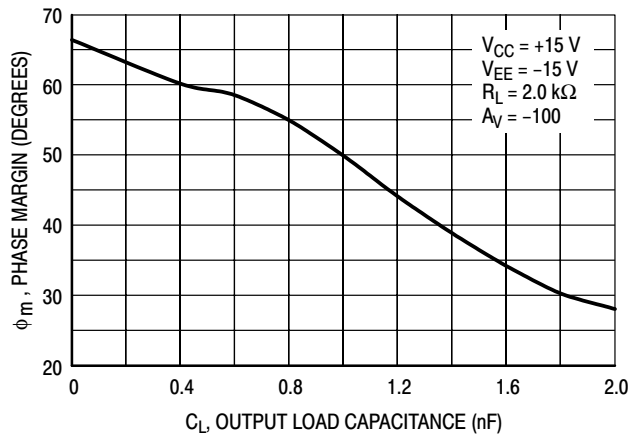**Figure 4. Voltage Gain and Phase versus Frequency**

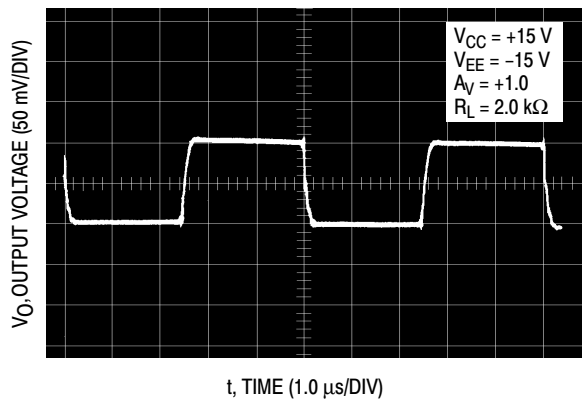**Figure 5. Phase Margin versus Output Load Capacitance**

t, TIME (1.0 μs/DIV)

Figure 6. Small Signal Transient Response

t, TIME (10 μs/DIV)
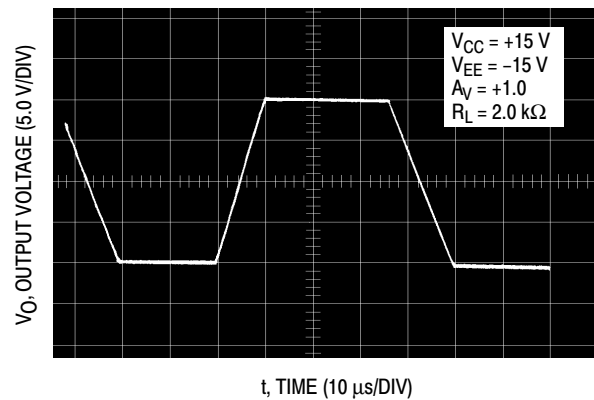
Figure 7. Large Signal Transient Response

TCA0372, TCA0372B

$$V_{CC} = +15\ V$$
$$V_{EE} = -15\ V$$
$$A_V = +100$$
$$R_L = 50\ \Omega$$

t, TIME (100 μs/DIV)
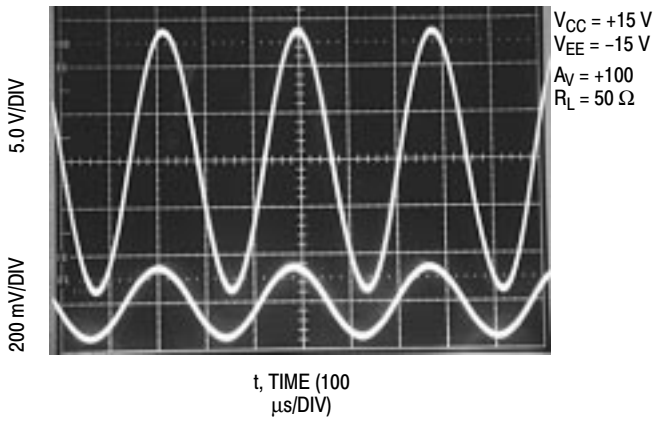
Figure 8. Sine Wave Reponse

V_S = Logic Supply Voltage
Must Have $V_{CC} > V_S$
E1, E2 = Logic Inputs
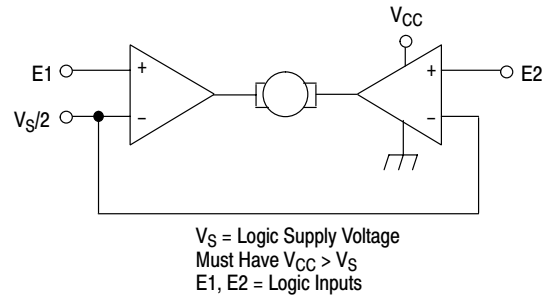
Figure 9. Bidirectional DC Motor Control with Microprocessor–Compatible Inputs
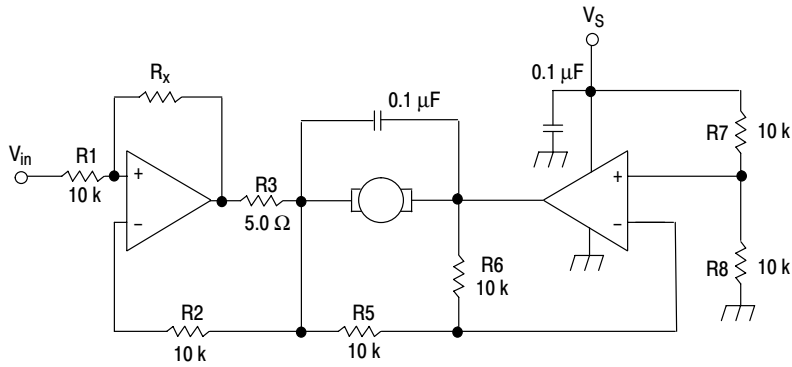
For circuit stability, ensure that $R_x > \dfrac{2R3 \cdot R1}{R_M}$ where, R_M = internal resistance of motor.

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.

Figure 10. Bidirectional Speed Control of DC Motors

TCA0372, TCA0372B

MARKING DIAGRAMS

PDIP−8
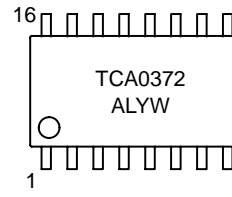**DP1 SUFFIX**
CASE 626
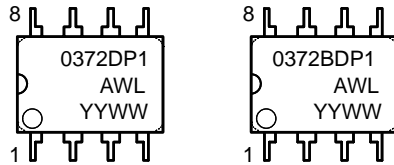
8

```
0372DP1
    AWL
  YYWW
```

1

8

```
0372BDP1
     AWL
   YYWW
```

1

PDIP−16
DP2 SUFFIX
CASE 648

16

```
TCA0372DP2
AWLYYWW
```

1

SO−16W
DW SUFFIX
CASE 751G

16

```
TCA0372DW
AWLYYWW
```

1

SOEIAJ−16
DM2 SUFFIX
CASE 966

16

```
TCA0372
ALYW
```

1
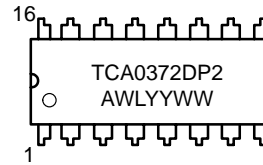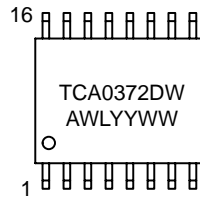
A	= Assembly Location
WL, L	= Wafer Lot
YY, Y	= Year
WW, W	= Work Week

TCA0372, TCA0372B

PACKAGE DIMENSIONS

PDIP–8
DP1 SUFFIX
CASE 626–05
ISSUE L
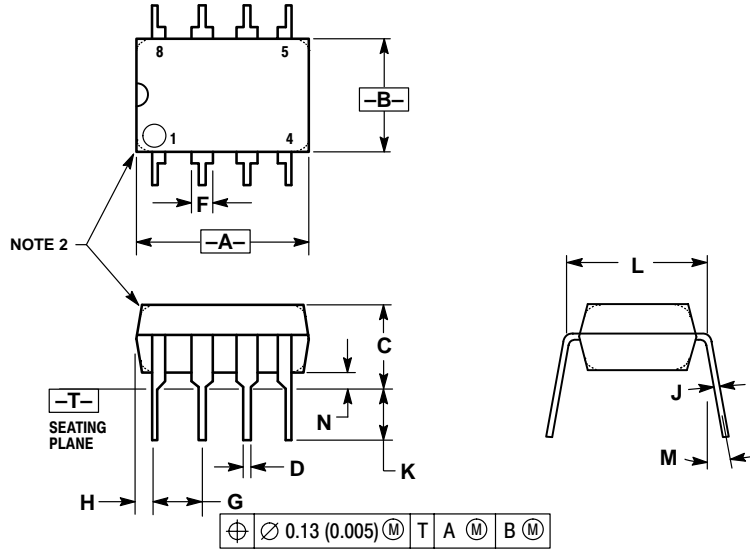
NOTES:
1. DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.
2. PACKAGE CONTOUR OPTIONAL (ROUND OR SQUARE CORNERS).
3. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.

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

⊕ | ⌀ 0.13 (0.005) Ⓜ | T | A Ⓜ | B Ⓜ

PDIP–16
DP2 SUFFIX
CASE 648–08
ISSUE R
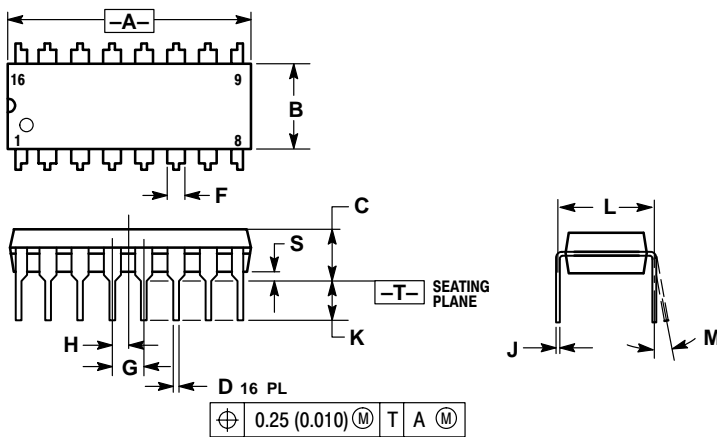
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
5. ROUNDED CORNERS OPTIONAL.

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

⊕ | 0.25 (0.010) Ⓜ | T | A Ⓜ

TCA0372, TCA0372B

PACKAGE DIMENSIONS

SO–16W
DW SUFFIX
CASE 751G–03
ISSUE B
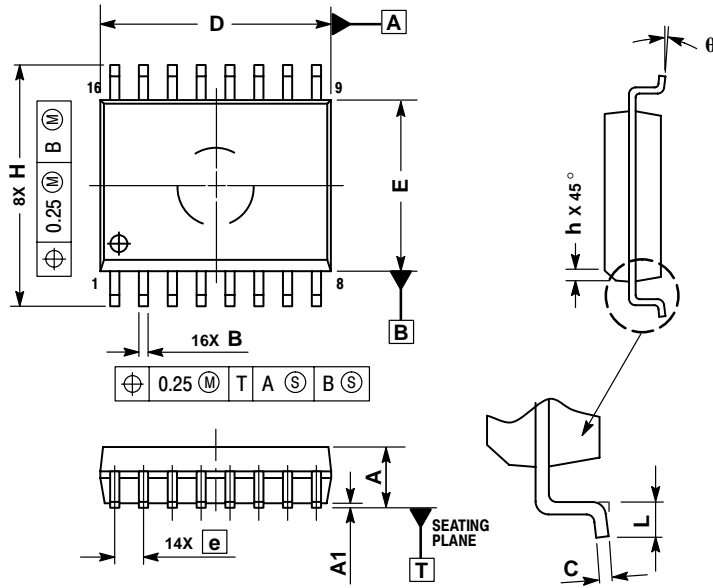
NOTES:
1. DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DIMENSIONS D AND E DO NOT INLCUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.
5. DIMENSION B DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.13 TOTAL IN 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
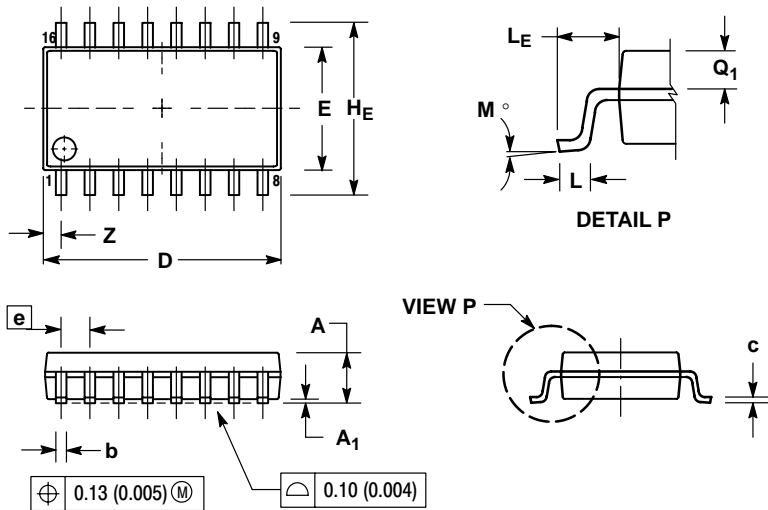
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS AND ARE MEASURED AT THE PARTING LINE. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. TERMINAL NUMBERS ARE SHOWN FOR 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
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

<u>Notes</u>

<u>Notes</u>

<u>Notes</u>

TCA0372, TCA0372B

PUBLICATION ORDERING INFORMATION