TCA0372, TCA0372B, NCV0372B

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/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
- NCV devices are AEC−Q100 Qualified and PPAP Capable
- These Devices are Pb−Free, Halogen Free/BFR Free and are RoHS Compliant

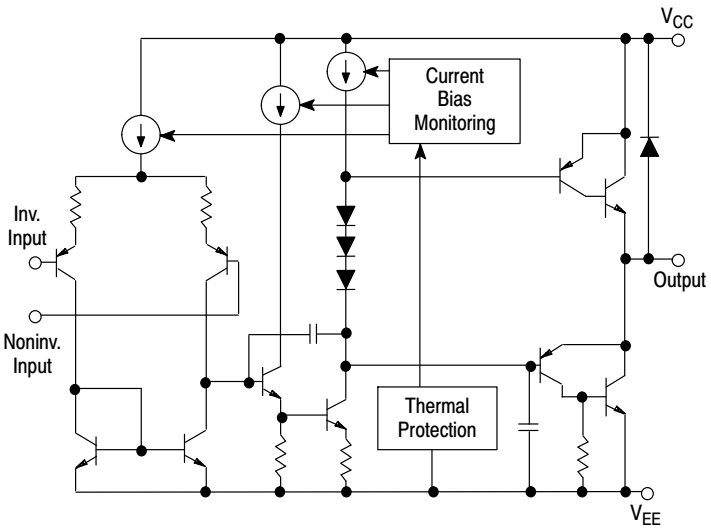

Figure 1. Representative Block Diagram

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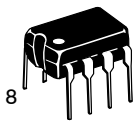
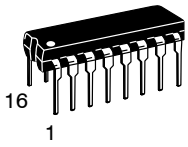
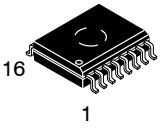


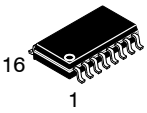
PDIP−8
DP1 SUFFIX
CASE 626



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 6 of this data sheet.

DEVICE MARKING INFORMATION

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

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

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

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_A = −40° to +125°C.)

Characteristics	Symbol	Min	Typ	Max	Unit
Input Offset Voltage (V_{CM} = 0)	V_{IO}				mV
T_A = +25°C		–	1.0	15	
T_A, T_{low} to T_{high}		–	–	20	
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	A_{VOL}	30	100	–	V/mV
V_O = ±10 V, R_L = 2.0 k					
Output Voltage Swing (I_L = 100 mA)	V_{OH}				V
T_A = +25°C		14.0	14.2	–	
T_A = T_{low} to T_{high}		13.9	–	–	
T_A = +25°C	V_{OL}	–	−14.2	−14.0	
T_A = T_{low} to T_{high}		–	–	−13.9	
Output Voltage Swing (I_L = 1.0 A)	V_{OH}				V
V_{CC} = +24 V, V_{EE} = 0 V, T_A = +25°C		22.5	22.7	–	
V_{CC} = +24 V, V_{EE} = 0 V, T_A = T_{low} to T_{high}		22.5	–	–	
V_{CC} = +24 V, V_{EE} = 0 V, T_A = +25°C	V_{OL}	–	1.3	1.5	
V_{CC} = +24 V, V_{EE} = 0 V, T_A = T_{low} to T_{high}		–	–	1.6	
Input Common Mode Voltage Range	V_{ICR}				V
T_A = +25°C			V_{EE} to (V_{CC} −1.0)		
T_A = T_{low} to T_{high}			V_{EE} to (V_{CC} −1.3)		
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	I_D				mA
T_A = +25°C TCA0372		–	5.0	10	
TCA0372B/NCV0372B		–	8.0	10	
T_A = T_{low} to T_{high} TCA0372		–	–	14	
TCA0372B/NCV0372B		–	–	14	

AC ELECTRICAL CHARACTERISTICS (V_{CC} = +15 V, V_{EE} = −15 V, R_L connected to ground, T_A = +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)	SR	1.0	1.4	–	V/μs
A_V = −1.0, T_A = T_{low} to T_{high}					
Gain Bandwidth Product (f = 100 kHz, C_L = 100 pF, R_L = 2.0 k)	GBW				MHz
T_A = 25°C		0.9	1.4	–	
T_A = T_{low} to T_{high}		0.7	–	–	
Phase Margin T_J = T_{low} to T_{high}	ϕ_m	–	65	–	Degrees
R_L = 2.0 k, C_L = 100 pF					
Gain Margin	A_m	–	15	–	dB
R_L = 2.0 k, C_L = 100 pF					
Equivalent Input Noise Voltage	e_n	–	22	–	$nV/\sqrt{Hz}$
R_S = 100 Ω, f = 1.0 to 100 kHz					
Total Harmonic Distortion	THD	–	0.02	–	%
A_V = −1.0, R_L = 50 Ω, V_O = 0.5 VRMS, f = 1.0 kHz					

NOTE: In case V_{EE} is disconnected before V_{CC}, a diode between V_{EE} and Ground is recommended to avoid damaging the device.

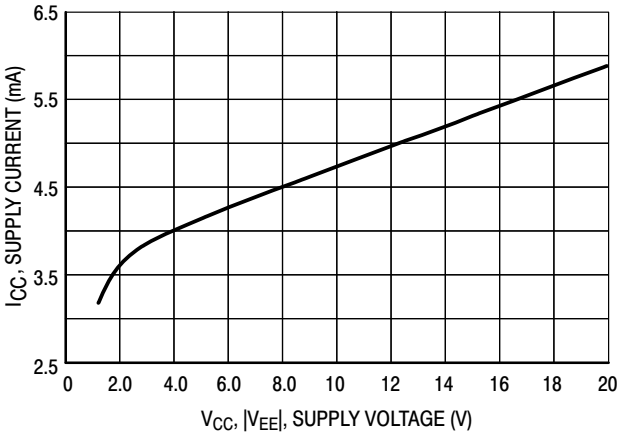


Figure 2. Supply Current versus Supply Voltage with No Load

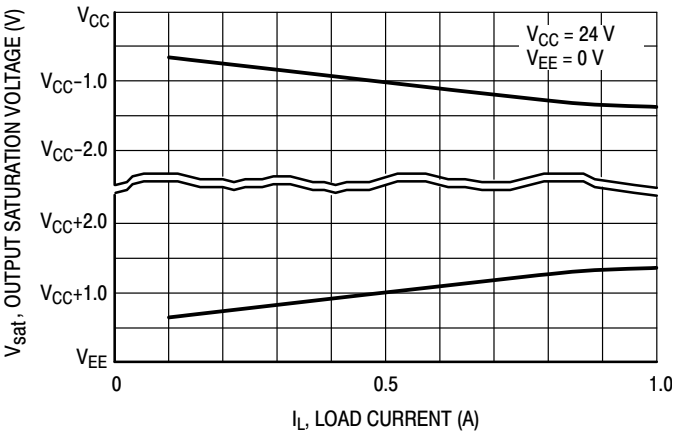


Figure 3. Output Saturation Voltage versus Load Current

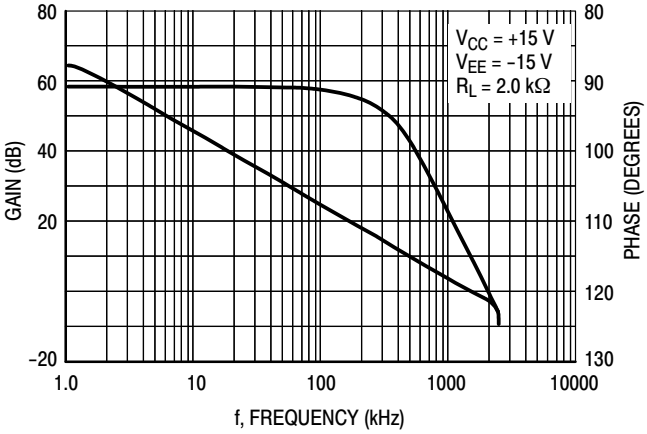


Figure 4. Voltage Gain and Phase versus Frequency

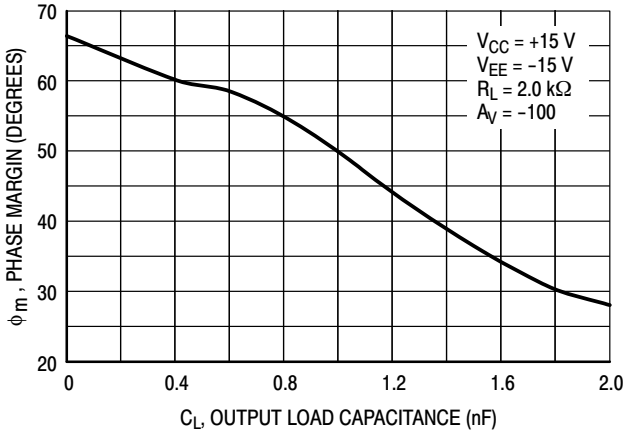


Figure 5. Phase Margin versus Output Load Capacitance

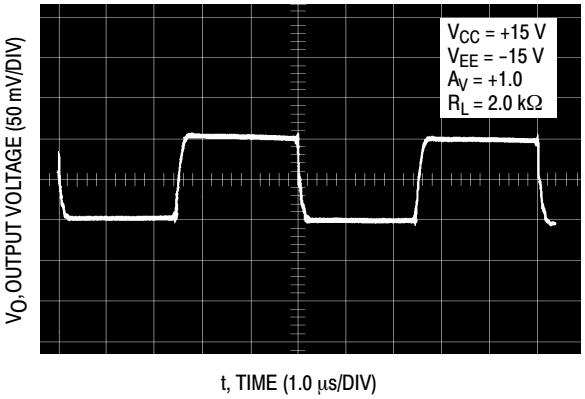


Figure 6. Small Signal Transient Response

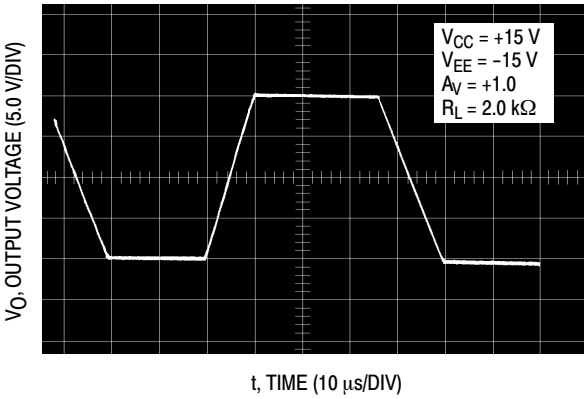


Figure 7. Large Signal Transient Response

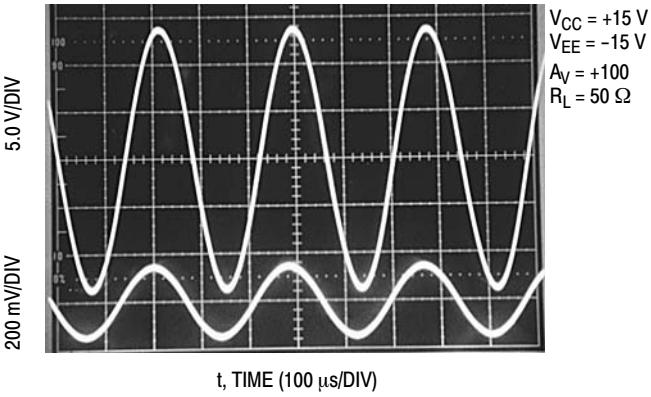


Figure 8. Sine Wave Response

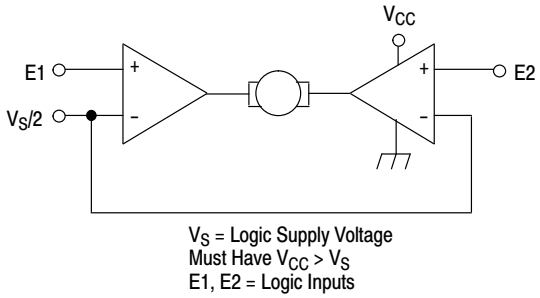
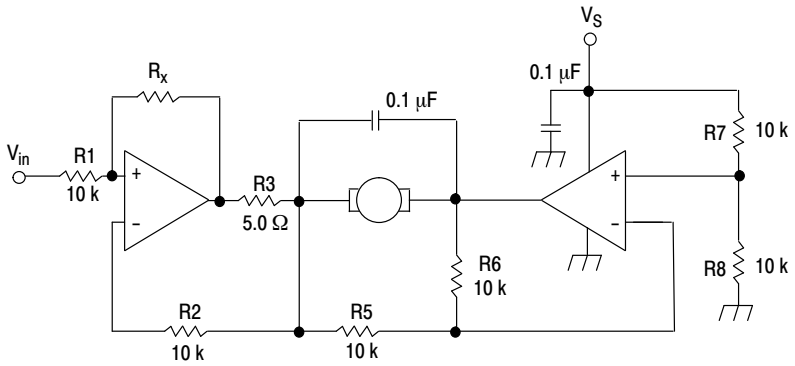


Figure 9. Bidirectional DC Motor Control with Microprocessor−Compatible Inputs



For circuit stability, ensure that $R_x > \frac{2R3 \cdot R1}{R_M}$ where, R_M = internal resistance of motor.

The voltage available at the terminals of the motor is: $V_M = 2\left(V_1 - \frac{V_S}{2}\right) + |R_o| \cdot I_M$

where, $|R_o| = \frac{2R3 \cdot R1}{R_x}$ and I_M is the motor current.

Figure 10. Bidirectional Speed Control of DC Motors

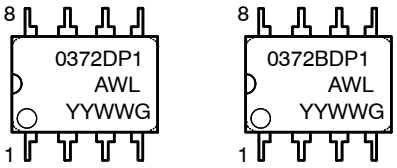
ORDERING INFORMATION

Device	Package	Shipping†
TCA0372DWG	SOIC−16W (Pb−Free)	47 Units / Rail
TCA0372DWR2G	SOIC−16W (Pb−Free)	1000 / Tape & Reel
TCA0372BDWR2G	SOIC−16W (Pb−Free)	1000 / Tape & Reel
NCV0372BDWR2G*	SOIC−16W (Pb−Free)	1000 / Tape & Reel
TCA0372DP1G	PDIP−8 (Pb−Free)	50 Units / Rail
TCA0372BDP1G	PDIP−8 (Pb−Free)	50 Units / Rail
TCA0372DP2G	PDIP−16 (Pb−Free)	25 Units / Rail
TCA0372DM2ELG	SOEIAJ−16 (Pb−Free)	2500 / Tape & Reel

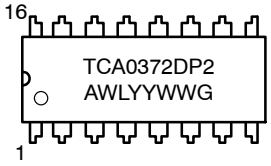
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.
*AEC−Q100 Qualified and PPAP Capable

MARKING DIAGRAMS

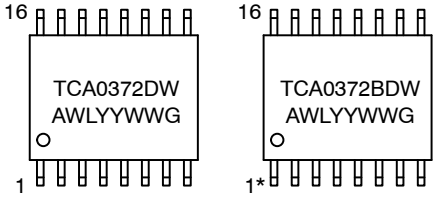
PDIP−8
DP1 SUFFIX
CASE 626



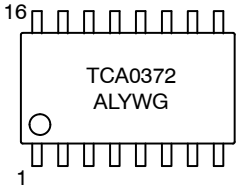
PDIP−16
DP2 SUFFIX
CASE 648



SOIC−16W
DW SUFFIX
CASE 751G



SOEIAJ−16
DM2 SUFFIX
CASE 966

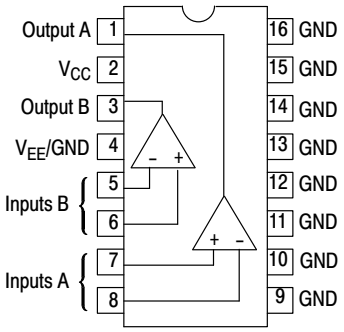


*Also applies to NCV0372BDWR2G.

A	= Assembly Location
WL, L	= Wafer Lot
YY, Y	= Year
WW, W	= Work Week
G	= Pb−Free Package

PIN CONNECTIONS

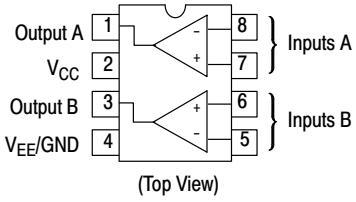
CASE 648



(Top View)

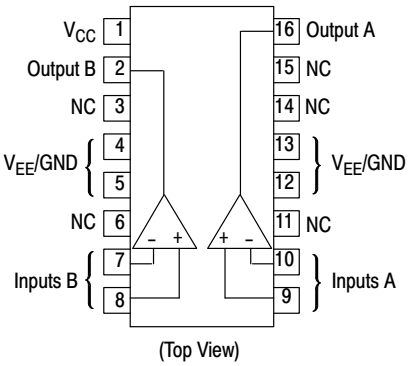
*Pins 4 and 9 to 16 are internally connected.

CASE 626



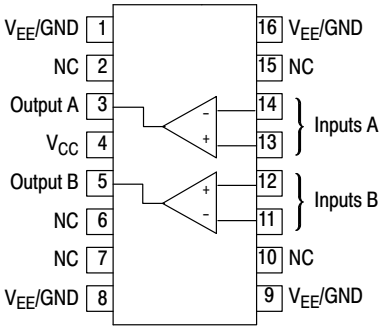
(Top View)

CASE 751G



(Top View)

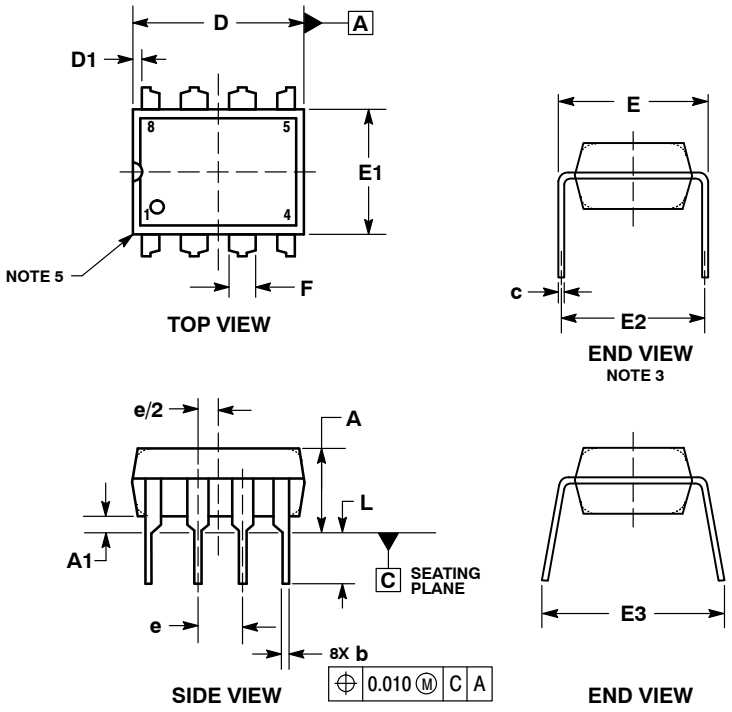
CASE 966



(Top View)

PACKAGE DIMENSIONS

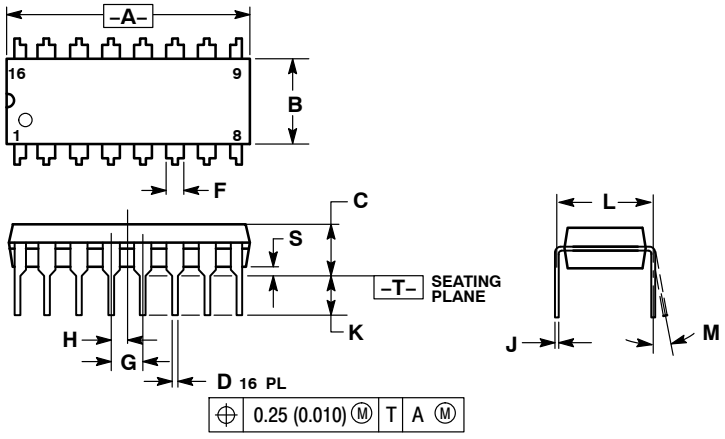
PDIP−8
DP1 SUFFIX
CASE 626−05
ISSUE M



NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: INCHES.
3. DIMENSION E IS MEASURED WITH THE LEADS RESTRAINED PARALLEL AT WIDTH E2.
4. DIMENSION E1 DOES NOT INCLUDE MOLD FLASH.
5. ROUNDED CORNERS OPTIONAL.

	INCHES			MILLIMETERS		
DIM	MIN	NOM	MAX	MIN	NOM	MAX
A	----	----	0.210	----	----	5.33
A1	0.015	----	----	0.38	----	----
b	0.014	0.018	0.022	0.35	0.46	0.56
C	0.008	0.010	0.014	0.20	0.25	0.36
D	0.355	0.365	0.400	9.02	9.27	10.02
D1	0.005	----	----	0.13	----	----
E	0.300	0.310	0.325	7.62	7.87	8.26
E1	0.240	0.250	0.280	6.10	6.35	7.11
E2	0.300 BSC			7.62 BSC		
E3	----	----	0.430	----	----	10.92
e	0.100 BSC			2.54 BSC		
L	0.115	0.130	0.150	2.92	3.30	3.81

PDIP−16
DP2 SUFFIX
CASE 648−08
ISSUE T

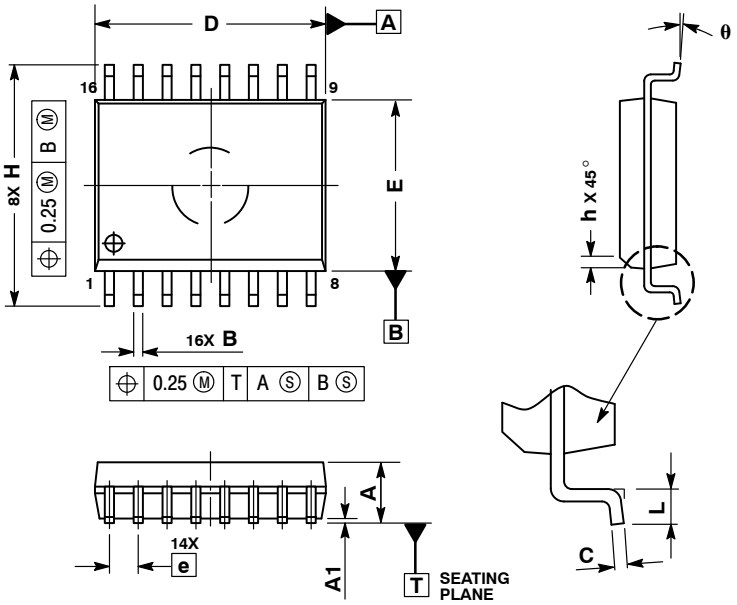


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
5. ROUNDED CORNERS OPTIONAL.

	INCHES		MILLIMETERS	
DIM	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

PACKAGE DIMENSIONS

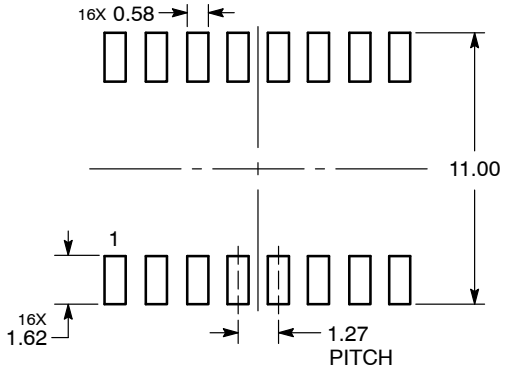
SOIC−16 WB
CASE 751G−03
ISSUE D



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
q	0 °	7 °

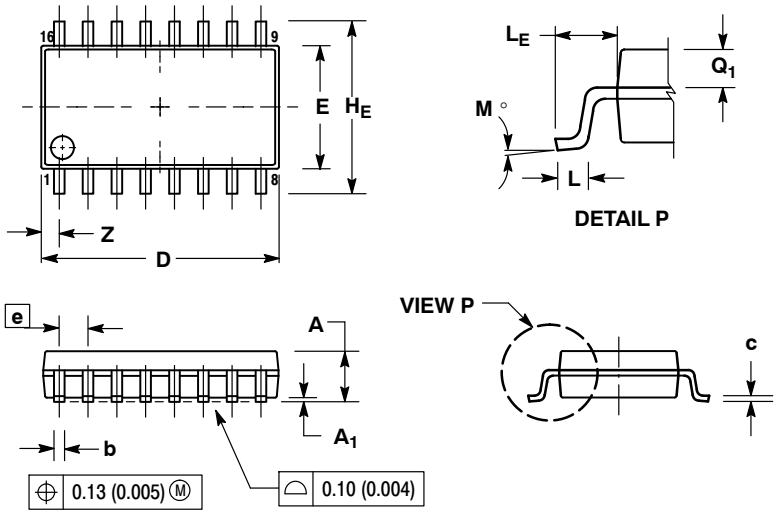
SOLDERING FOOTPRINT*



DIMENSIONS: MILLIMETERS

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

SOEIAJ−16
DM2 SUFFIX
CASE 966
ISSUE A



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
A_1	0.05	0.20	0.002	0.008
b	0.35	0.50	0.014	0.020
c	0.10	0.20	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	
H_E	7.40	8.20	0.291	0.323
L	0.50	0.85	0.020	0.033
L_E	1.10	1.50	0.043	0.059
M	0 °	10 °	0 °	10 °
Q_1	0.70	0.90	0.028	0.035
Z	---	0.78	---	0.031

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
Literature Distribution Center for ON Semiconductor
P.O. Box 5163, Denver, Colorado 80217 USA
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Fax: 303−675−2176 or 800−344−3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

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TCA0372/D

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