

# Octal Bus Transceiver

The MC74VHCT245A is an advanced high speed CMOS octal bus transceiver fabricated with silicon gate CMOS technology. It achieves high speed operation similar to equivalent Bipolar Schottky TTL while maintaining CMOS low power dissipation.

It is intended for two-way asynchronous communication between data buses. The direction of data transmission is determined by the level of the DIR input. The output enable pin (OE) can be used to disable the device, so that the buses are effectively isolated.

All inputs are equipped with protection circuits against static discharge.

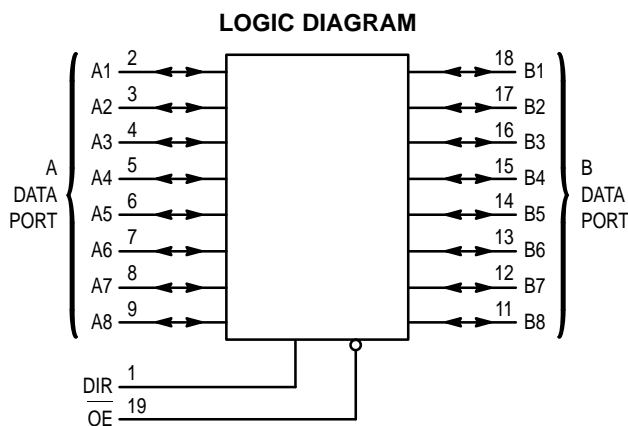
The VHCT inputs are compatible with TTL levels. This device can be used as a level converter for interfacing 3.3V to 5.0V, because it has full 5V CMOS level output swings.

The VHCT245A input and output (when disabled) structures provide protection when voltages between 0V and 5.5V are applied, regardless of the supply voltage. These input and output structures help prevent device destruction caused by supply voltage – input/output voltage mismatch, battery backup, hot insertion, etc.

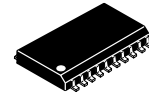
- High Speed:  $t_{PD} = 4.9ns$  (Typ) at  $V_{CC} = 5V$
- Low Power Dissipation:  $I_{CC} = 4\mu A$  (Max) at  $T_A = 25^\circ C$
- TTL-Compatible Inputs:  $V_{IL} = 0.8V$ ;  $V_{IH} = 2.0V$
- Power Down Protection Provided on Inputs and Outputs
- Balanced Propagation Delays
- Designed for 4.5V to 5.5V Operating Range
- Low Noise:  $V_{OLP} = 1.6V$  (Max)
- Pin and Function Compatible with Other Standard Logic Families
- Latchup Performance Exceeds 300mA
- ESD Performance: HBM > 2000V; Machine Model > 200V
- Chip Complexity: 304 FETs or 76 Equivalent Gates

## APPLICATION NOTES

1. Do not force a signal on an I/O pin when it is an active output, damage may occur.
2. All floating (high impedance) input or I/O pins must be fixed by means of pull up or pull down resistors or bus terminator ICs.



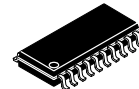
# MC74VHCT245A



**DW SUFFIX**  
20-LEAD SOIC PACKAGE  
CASE 751D-04



**DT SUFFIX**  
20-LEAD TSSOP PACKAGE  
CASE 948E-02

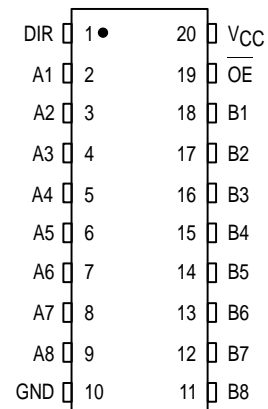


**M SUFFIX**  
20-LEAD SOIC EIAJ PACKAGE  
CASE 967-01

## ORDERING INFORMATION

MC74VHCTXXXADW	SOIC
MC74VHCTXXXADT	TSSOP
MC74VHCTXXXAM	SOIC EIAJ

## PIN ASSIGNMENT



## FUNCTION TABLE

Control Inputs		Operation
OE	DIR	
L	L	Data Tx from Bus B to Bus A
L	H	Data Tx from Bus A to Bus B
H	X	Buses Isolated (High-Z State)



# MC74VHCT245A

## MAXIMUM RATINGS\*

V <sub>CC</sub>	DC Supply Voltage		- 0.5 to + 7.0	V
V <sub>in</sub>	DC Input Voltage		- 0.5 to + 7.0	V
V <sub>I/O</sub>	DC Output Voltage	Outputs in 3-State High or Low State	- 0.5 to + 7.0 - 0.5 to V <sub>CC</sub> + 0.5	V
I <sub>I/K</sub>	Input Diode Current		- 20	mA
I <sub>O/K</sub>	Output Diode Current (V <sub>OUT</sub> < GND; V <sub>OUT</sub> > V <sub>CC</sub> )		± 20	mA
I <sub>out</sub>	DC Output Current, per Pin		± 25	mA
I <sub>CC</sub>	DC Supply Current, V <sub>CC</sub> and GND Pins		± 75	mA
P <sub>D</sub>	Power Dissipation in Still Air,	SOIC Packages† TSSOP Package†	500 450	mW
T <sub>stg</sub>	Storage Temperature		- 65 to + 150	°C

This device contains protection circuitry to guard against damage due to high static voltages or electric fields. However, precautions must be taken to avoid applications of any voltage higher than maximum rated voltages to this high-impedance circuit. For proper operation, V<sub>in</sub> and V<sub>out</sub> should be constrained to the range GND ≤ (V<sub>in</sub> or V<sub>out</sub>) ≤ V<sub>CC</sub>. Unused inputs must always be tied to an appropriate logic voltage level (e.g., either GND or V<sub>CC</sub>). Unused outputs must be left open.

\* Absolute maximum continuous ratings are those values beyond which damage to the device may occur. Exposure to these conditions or conditions beyond those indicated may adversely affect device reliability. Functional operation under absolute-maximum-rated conditions is not implied.

† Derating — SOIC Packages: - 7 mW/°C from 65° to 125°C  
TSSOP Package: - 6.1 mW/°C from 65° to 125°C

## RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Max	Unit	
V <sub>CC</sub>	DC Supply Voltage	4.5	5.5	V	
V <sub>in</sub>	DC Input Voltage	0	5.5	V	
V <sub>I/O</sub>	DC Output Voltage	0	5.5 V <sub>CC</sub>	V	
T <sub>A</sub>	Operating Temperature	- 40	+ 85	°C	
t <sub>r</sub> , t <sub>f</sub>	Input Rise and Fall Time	V <sub>CC</sub> = 5.0V ± 0.5V	0	20	ns/V

## DC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Test Conditions	V <sub>CC</sub> V	T <sub>A</sub> = 25°C			T <sub>A</sub> = - 40 to 85°C		Unit
				Min	Typ	Max	Min	Max	
V <sub>IH</sub>	Minimum High-Level Input Voltage		4.5 to 5.5	2.0			2.0		V
V <sub>IL</sub>	Maximum Low-Level Input Voltage		4.5 to 5.5			0.8		0.8	V
V <sub>OH</sub>	Minimum High-Level Output Voltage V <sub>in</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OH</sub> = - 50μA	4.5	4.4	4.5		4.4		V
		I <sub>OH</sub> = - 8mA	4.5	3.94		3.80			
V <sub>OL</sub>	Maximum Low-Level Output Voltage V <sub>in</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OL</sub> = 50μA	4.5		0.0	0.1		0.1	V
		I <sub>OL</sub> = 8mA	4.5			0.36		0.44	
I <sub>in</sub>	Maximum Input Leakage Current	V <sub>in</sub> = 5.5 V or GND	0 to 5.5			± 0.1		± 1.0	μA
I <sub>OZ</sub>	Maximum 3-State Leakage Current	V <sub>in</sub> = V <sub>IL</sub> or V <sub>IH</sub> V <sub>out</sub> = V <sub>CC</sub> or GND	5.5			± 0.25		± 2.5	μA
I <sub>CC</sub>	Maximum Quiescent Supply Current	V <sub>in</sub> = V <sub>CC</sub> or GND	5.5			4.0		40.0	μA
I <sub>CCCT</sub>	Quiescent Supply Current	Per Input: V <sub>IN</sub> = 3.4V Other Input: V <sub>CC</sub> or GND	5.5			1.35		1.50	mA
I <sub>OPD</sub>	Output Leakage Current	V <sub>OUT</sub> = 5.5V	0			0.5		5.0	μA

**AC ELECTRICAL CHARACTERISTICS** (Input  $t_r = t_f = 3.0\text{ns}$ )

Symbol	Parameter	Test Conditions	$T_A = 25^\circ\text{C}$			$T_A = -40 \text{ to } 85^\circ\text{C}$		Unit
			Min	Typ	Max	Min	Max	
$t_{PLH}$ , $t_{PHL}$	Maximum Propagation Delay A to B or B to A	$V_{CC} = 5.0 \pm 0.5\text{V}$ $C_L = 15\text{pF}$ $C_L = 50\text{pF}$		4.9 5.4	7.7 8.7	1.0 1.0	8.5 9.5	ns
$t_{PZL}$ , $t_{PZH}$	Output Enable Time OE to A or B	$V_{CC} = 5.0 \pm 0.5\text{V}$ $C_L = 15\text{pF}$ $R_L = 1\text{k}\Omega$ $C_L = 50\text{pF}$		9.4 9.9	13.8 14.8	1.0 1.0	15.0 16.0	ns
$t_{PLZ}$ , $t_{PHZ}$	Output Disable Time OE to A or B	$V_{CC} = 5.0 \pm 0.5\text{V}$ $C_L = 50\text{pF}$ $R_L = 1\text{k}\Omega$		10.1	15.4	1.0	16.5	ns
$t_{OSLH}$ , $t_{OSHL}$	Output to Output Skew	$V_{CC} = 5.0 \pm 0.5\text{V}$ $C_L = 50\text{pF}$ (Note NO TAG)			1.0		1.0	pF
$C_{in}$	Maximum Input Capacitance			4	10		10	pF
$C_{out}$	Maximum Three-State Output Capacitance (Output in High-Impedance State)			13				pF

$C_{PD}$	Power Dissipation Capacitance (Note NO TAG)	Typical @ $25^\circ\text{C}$ , $V_{CC} = 5.0\text{V}$		pF
		16		

- Parameter guaranteed by design.  $t_{OSLH} = |t_{PLHm} - t_{PLHn}|$ ,  $t_{OSHL} = |t_{PHLm} - t_{PHLn}|$ .
- $C_{PD}$  is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load. Average operating current can be obtained by the equation:  $I_{CC(OPR)} = C_{PD} \cdot V_{CC} \cdot f_{in} + I_{CC}/8$  (per bit).  $C_{PD}$  is used to determine the no-load dynamic power consumption;  $P_D = C_{PD} \cdot V_{CC}^2 \cdot f_{in} + I_{CC} \cdot V_{CC}$ .

**NOISE CHARACTERISTICS** (Input  $t_r = t_f = 3.0\text{ns}$ ,  $C_L = 50\text{pF}$ ,  $V_{CC} = 5.0\text{V}$ )

Symbol	Parameter	$T_A = 25^\circ\text{C}$		Unit
		Typ	Max	
$V_{OLP}$	Quiet Output Maximum Dynamic $V_{OL}$	1.2	1.6	V
$V_{OLV}$	Quiet Output Minimum Dynamic $V_{OL}$	-1.2	-1.6	V
$V_{IHD}$	Minimum High Level Dynamic Input Voltage		2.0	V
$V_{ILD}$	Maximum Low Level Dynamic Input Voltage		0.8	V

**SWITCHING WAVEFORMS**

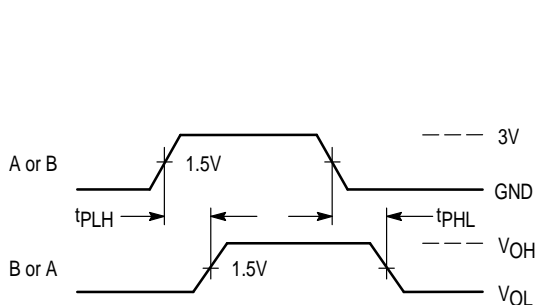


Figure 1.

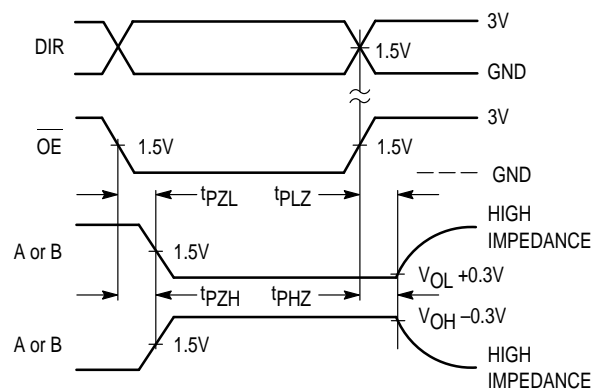
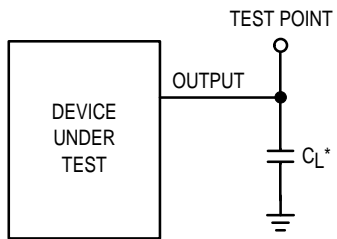


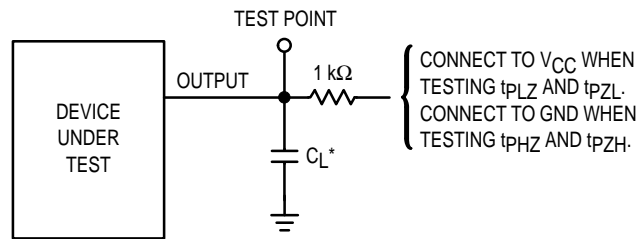
Figure 2.

TEST CIRCUITS



\* Includes all probe and jig capacitance

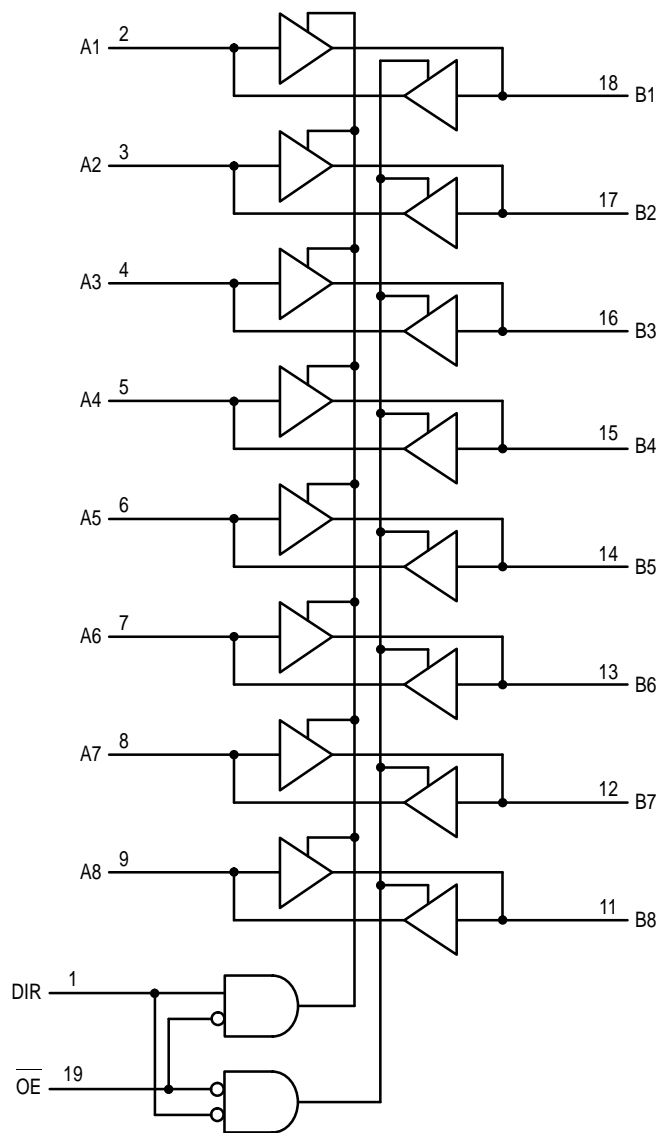
Figure 3.



\* Includes all probe and jig capacitance

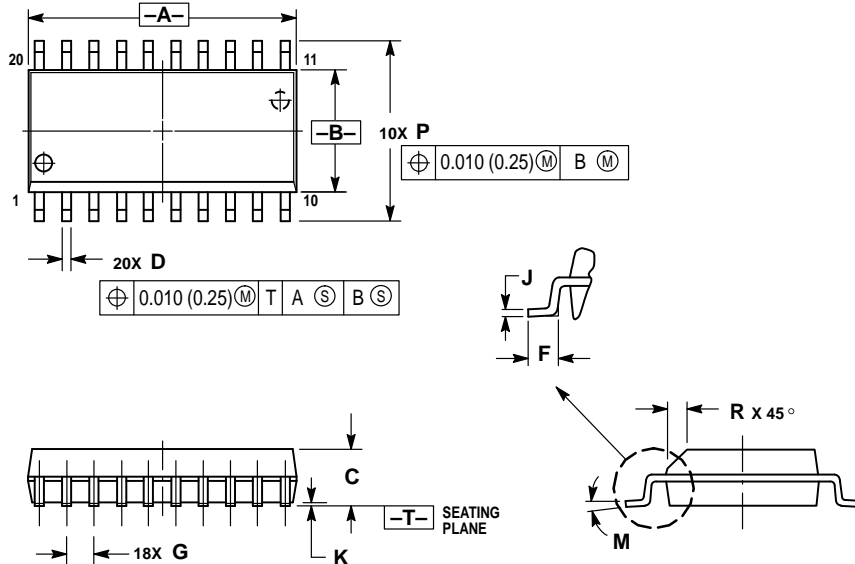
Figure 4.

EXPANDED LOGIC DIAGRAM



OUTLINE DIMENSIONS

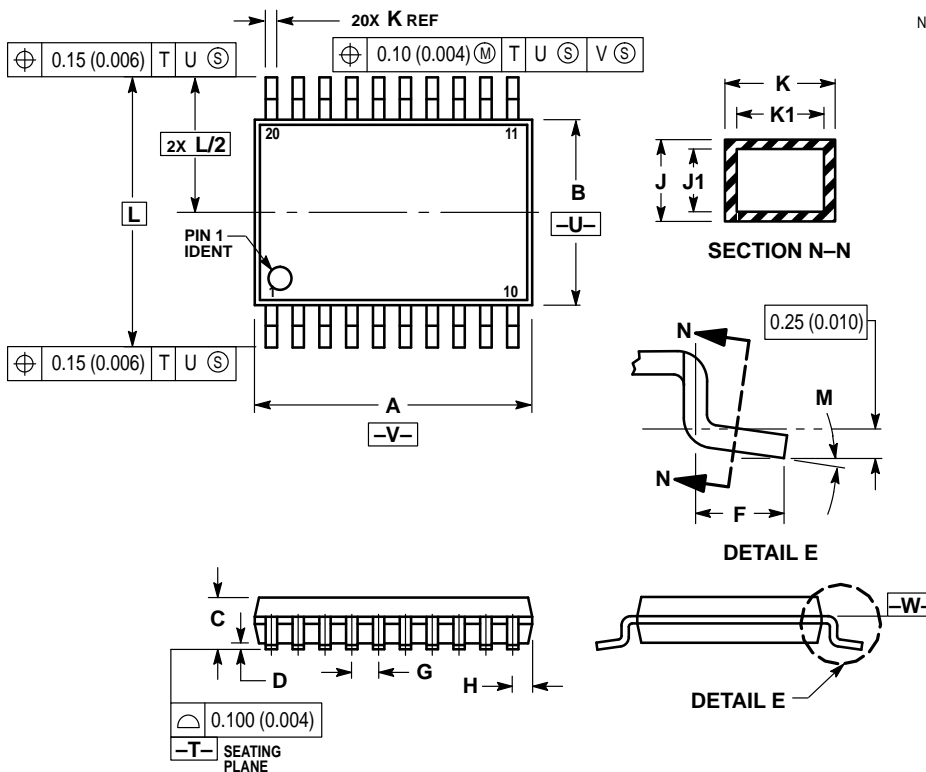
DW SUFFIX  
PLASTIC SOIC PACKAGE  
CASE 751D-04  
ISSUE E



- 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 0.150 (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	12.65	12.95	0.499	0.510
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

DT SUFFIX  
PLASTIC TSSOP PACKAGE  
CASE 948E-02  
ISSUE A

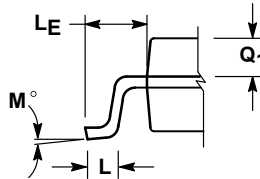
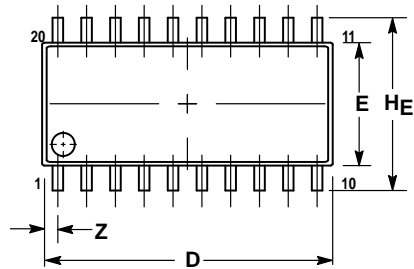


- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: MILLIMETER.
  3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
  4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
  5. DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
  6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
  7. DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE -W-.

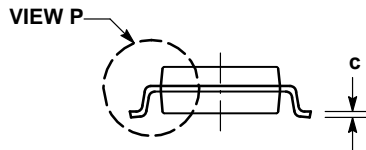
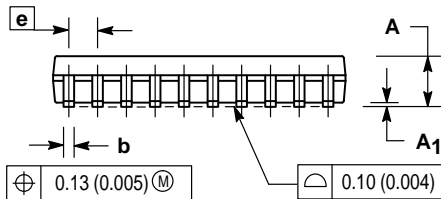
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	6.40	6.60	0.252	0.260
B	4.30	4.50	0.169	0.177
C	—	1.20	—	0.047
D	0.05	0.15	0.002	0.006
F	0.50	0.75	0.020	0.030
G	0.65 BSC		0.026 BSC	
H	0.27	0.37	0.011	0.015
J	0.09	0.20	0.004	0.008
J1	0.09	0.16	0.004	0.006
K	0.19	0.30	0.007	0.012
K1	0.19	0.25	0.007	0.010
L	6.40 BSC		0.252 BSC	
M	0° 8°		0° 8°	

OUTLINE DIMENSIONS

M SUFFIX  
PLASTIC SOIC EIAJ PACKAGE  
CASE 967-01  
ISSUE O



DETAIL P



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).

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	—	2.05	—	0.081
A <sub>1</sub>	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	12.35	12.80	0.486	0.504
E	5.10	5.45	0.201	0.215
e	1.27 BSC	—	0.050 BSC	—
H <sub>E</sub>	7.40	8.20	0.291	0.323
L	0.50	0.85	0.020	0.033
L <sub>E</sub>	1.10	1.50	0.043	0.059
M	0°	10°	0°	10°
Q <sub>1</sub>	0.70	0.90	0.028	0.035
Z	—	0.81	—	0.032

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