MC74VHCT157A

Quad 2-Channel Multiplexer

The MC74VHCT157A is an advanced high speed CMOS quad 2–channel multiplexer fabricated with silicon gate CMOS technology. It achieves high speed operation similar to equivalent Bipolar Schottky TTL while maintaining CMOS low power dissipation.

It consists of four 2–input digital multiplexers with common select (S) and enable ($\overline{E}$) inputs. When $\overline{E}$ is held High, selection of data is inhibited and all the outputs go Low.

The select decoding determines whether the A or B inputs get routed to the corresponding Y outputs.

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

The VHCT157A input structures provide protection when voltages between 0 V and 5.5 V are applied, regardless of the supply voltage. The output structures also provide protection when V_{CC} = 0 V. These input and output structures help prevent device destruction caused by supply voltage—input/output voltage mismatch, battery backup, hot insertion, etc.

The inputs tolerate voltages up to 7 V, allowing the interface of 5 V systems to 3 V systems.

- High Speed: t_{PD} = 4.1ns (Typ) at V_{CC} = 5 V
- Low Power Dissipation: I_{CC} = 4μA (Max) at T_A = 25°C
- TTL–Compatible Inputs: V_{IL} = 0.8 V; V_{IH} = 2.0 V
- Power Down Protection Provided on Inputs and Outputs
- Balanced Propagation Delays
- Designed for 2 V to 5.5 V Operating Range
- Low Noise: V_{OLP} = 0.8 V (Max)
- Pin and Function Compatible with Other Standard Logic Families
- Latchup Performance Exceeds 300mA
- ESD Performance: HBM > 2000 V; Machine Model > 200 V
- Chip Complexity: 82 FETs or 20 Equivalent Gates

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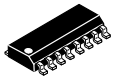
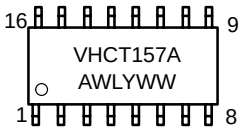
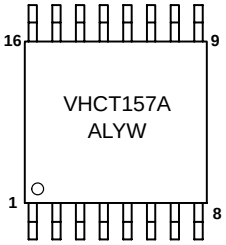
MARKING DIAGRAMS

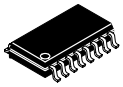


SO–16
D SUFFIX
CASE 751B

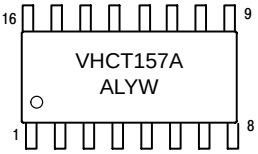


TSSOP–16
DT SUFFIX
CASE 948F





EIAJ SO–16
M SUFFIX
CASE 966



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

ORDERING INFORMATION

Device	Package	Shipping
MC74VHCT157AD	SO–16	48 Units/Rail
MC74VHCT157ADR2	SO–16	2500 Tape & Reel
MC74VHCT157ADT	TSSOP–16	96 Units/Rail
MC74VHCT157ADTR2	TSSOP–16	2500 Tape & Reel
MC74VHCT157AM	EIAJ–SO–16	50 Units/Rail
MC74VHCT157AMEL	EIAJ–SO–16	2000 Tape & Reel

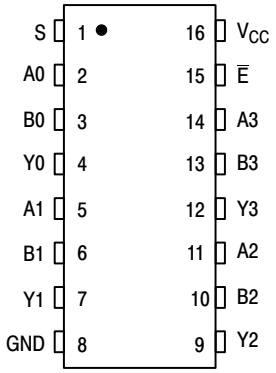


Figure 1. Pin Assignment

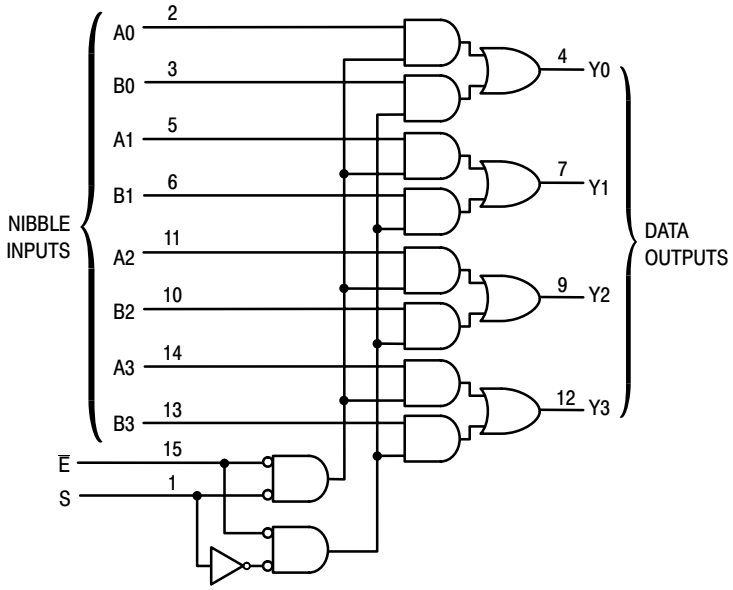


Figure 2. Expanded Logic Diagram

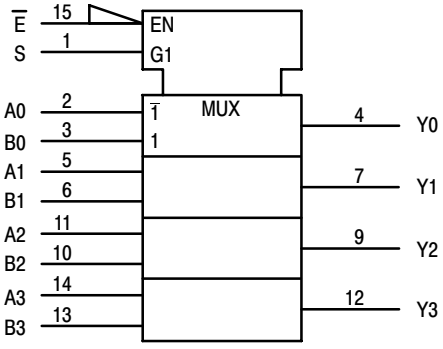


Figure 3. IEC Logic Symbol

FUNCTION TABLE

Inputs		Outputs
$\overline{E}$	S	Y0 – Y3
H	X	L
L	L	A0–A3
L	H	B0–B3

A0 – A3, B0 – B3 = the levels of the respective Data–Word Inputs.

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_{in} and V_{out} should be constrained to the range GND $\leq$ (V_{in} or V_{out}) $\leq$ V_{CC}.

Unused inputs must always be tied to an appropriate logic voltage level (e.g., either GND or V_{CC}). Unused outputs must be left open.

MAXIMUM RATINGS (Note 1.)

Symbol	Parameter		Value	Unit
V_{CC}	Positive DC Supply Voltage		–0.5 to +7.0	V
V_{IN}	Digital Input Voltage		–0.5 to +7.0	V
V_{OUT}	DC Output Voltage	Output in 3–State High or Low State	–0.5 to +7.0 –0.5 to V_{CC} +0.5	V
I_{IK}	Input Diode Current		–20	mA
I_{OK}	Output Diode Current		±20	mA
I_{OUT}	DC Output Current, per Pin		±25	mA
I_{CC}	DC Supply Current, V_{CC} and GND Pins		±75	mA
P_D	Power Dissipation in Still Air	SOIC Package TSSOP	200 180	mW
T_{STG}	Storage Temperature Range		–65 to +150	°C
V_{ESD}	ESD Withstand Voltage	Human Body Model (Note 2.) Machine Model (Note 3.) Charged Device Model (Note 4.)	>2000 >200 >2000	V
$I_{LATCH–UP}$	Latch–Up Performance	Above V_{CC} and Below GND at 125°C (Note 5.)	±300	mA
θ_{JA}	Thermal Resistance, Junction to Ambient	SOIC Package TSSOP	143 164	°C/W

1. Maximum Ratings are those values beyond which damage to the device may occur. Functional operation should be restricted to the Recommended Operating Conditions.
2. Tested to EIA/JESD22–A114–A
3. Tested to EIA/JESD22–A115–A
4. Tested to JESD22–C101–A
5. Tested to EIA/JESD78

RECOMMENDED OPERATING CONDITIONS

Symbol	Characteristics		Min	Max	Unit
V_{CC}	DC Supply Voltage		4.5	5.5	V
V_{IN}	DC Input Voltage		0	5.5	V
V_{OUT}	DC Output Voltage	Output in 3–State High or Low State	0	V_{CC}	V
T_A	Operating Temperature Range, all Package Types		–55	125	°C
t_r, t_f	Input Rise or Fall Time	V_{CC} = 5.0 V ± 0.5 V	0	20	ns/V

DEVICE JUNCTION TEMPERATURE VERSUS TIME TO 0.1% BOND FAILURES

Junction Temperature °C	Time, Hours	Time, Years
80	1,032,200	117.8
90	419,300	47.9
100	178,700	20.4
110	79,600	9.4
120	37,000	4.2
130	17,800	2.0
140	8,900	1.0

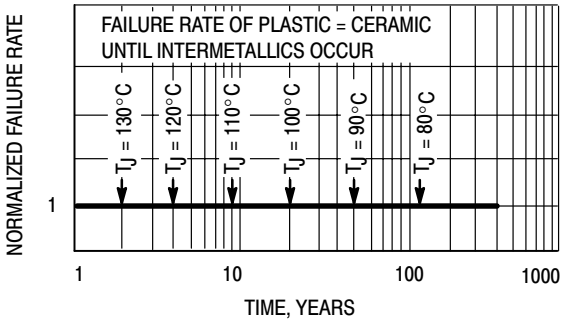


Figure 4. Failure Rate vs. Time Junction Temperature

DC CHARACTERISTICS (Voltages Referenced to GND)

Symbol	Parameter	Condition	V_{CC} (V)	T_A = 25°C Min	T_A = 25°C Typ	T_A = 25°C Max	$T_A \le 85°C$ Min	$T_A \le 85°C$ Max	$-55°C \le T_A \le 125°C$ Min	$-55°C \le T_A \le 125°C$ Max	Unit
V_{IH}	Minimum High–Level Input Voltage		4.5 to 5.5	2			2	0.8	2		V
V_{IL}	Maximum Low–Level Input Voltage		4.5 to 5.5			0.8		0.8		0.8	V
V_{OH}	Maximum High–Level Output Voltage	$V_{IN} = V_{IH}$ or V_{IL} $I_{OH} = -50$ μA	4.5	4.4	4.5		4.4		4.4		V
		$V_{IN} = V_{IH}$ or V_{IL} $I_{OH} = -8$ mA	4.5	3.94			3.8		3.66		
V_{OL}	Maximum Low–Level Output Voltage	$V_{IN} = V_{IH}$ or V_{IL} $I_{OL} = 50$ μA	4.5		0.0	0.1		0.1		0.1	V
		$V_{IN} = V_{IH}$ or V_{IL} $I_{OH} = 8$ mA	4.5			0.36		0.44		0.52	
I_{IN}	Input Leakage Current	V_{IN} = 5.5 V or GND	0 to 5.5			±0.1		±1.0		±1.0	μA
I_{CC}	Maximum Quiescent Supply Current	$V_{IN} = V_{CC}$ or GND	5.5			4.0		40.0		40.0	μA
I_{CCT}	Additional Quiescent Supply Current (per Pin)	Any one input: V_{IN} = 3.4 V All other inputs: $V_{IN} = V_{CC}$ or GND	5.5			1.35		1.5		1.5	μA
I_{OPD}	Output Leakage Current	V_{OUT} = 5.5 V	0			0.5		5		5	μA

AC ELECTRICAL CHARACTERISTICS (Input $t_r = t_f$ = 3.0ns)

Symbol	Parameter	Test Conditions		T_A = 25°C Min	T_A = 25°C Typ	T_A = 25°C Max	$T_A = \le 85°C$ Min	$T_A = \le 85°C$ Max	$-55°C \le T_A \le 125°C$ Min	$-55°C \le T_A \le 125°C$ Max	Unit
t_{PLH}, t_{PHL}	Maximum Propagation Delay A to B to Y	V_{CC} = 3.3 ± 0.3 V	C_L = 15pF		5.6	7.0	1.0	7.7	1.0	7.7	ns
			C_L = 50pF		8.0	10.0	1.0	11.0	1.0	11.0	
		V_{CC} = 5.0 ± 0.5 V	C_L = 15pF		4.1	6.4	1.0	7.5	1.0	7.5	
			C_L = 50pF		5.6	8.4	1.0	9.5	1.0	9.5	
t_{PLH}, t_{PHL}	Maximum Propagation Delay S to Y	V_{CC} = 3.3 ± 0.3 V	C_L = 15pF		6.1	7.5	1.0	8.2	1.0	8.2	ns
			C_L = 50pF		8.5	10.5	1.0	11.5	1.0	11.5	
		V_{CC} = 5.0 ± 0.5 V	C_L = 15pF		5.3	8.1	1.0	9.5	1.0	9.5	
			C_L = 50pF		6.8	10.1	1.0	11.5	1.0	11.5	
t_{PLH}, t_{PHL}	Maximum Propagation Delay $\overline{E}$ to Y	V_{CC} = 3.3 ± 0.3 V	C_L = 15pF		6.1	7.5	1.0	8.2	1.0	8.2	ns
			C_L = 50pF		8.5	10.5	1.0	11.5	1.0	11.5	
		V_{CC} = 5.0 ± 0.5 V	C_L = 15pF		5.6	8.6	1.0	10.0	1.0	10.0	
			C_L = 50pF		7.1	10.6	1.0	12.0	1.0	12.0	
C_{IN}	Maximum Input Capacitance				4	10		10		10	pF

		Typical @ 25°C, V_{CC} = 5.0 V	
C_{PD}	Power Dissipation Capacitance (Note 6.)	20	pF

6. 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: $I_{CC(OPR)} = C_{PD} \bullet V_{CC} \bullet f_{in} + I_{CC}$. C_{PD} is used to determine the no–load dynamic power consumption; $P_D = C_{PD} \bullet V_{CC}^2 \bullet f_{in} + I_{CC} \bullet V_{CC}$.

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

Symbol	Characteristic	$T_A = 25°C$		Unit
		Typ	Max	
V_{OLP}	Quiet Output Maximum Dynamic V_{OL}	0.3	0.8	V
V_{OLV}	Quiet Output Minimum Dynamic V_{OL}	– 0.3	– 0.8	V
V_{IHD}	Minimum High Level Dynamic Input Voltage		2.0	V
V_{ILD}	Maximum Low Level Dynamic Input Voltage		0.8	V

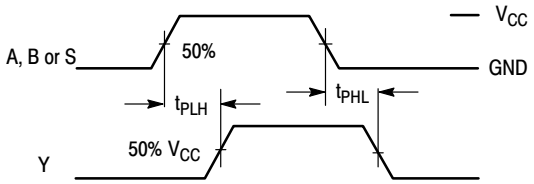


Figure 5. Switching Waveform

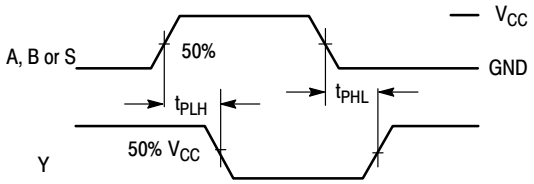
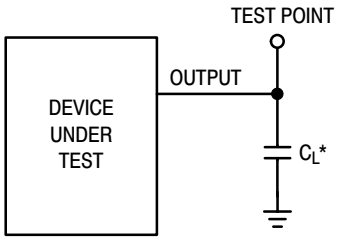


Figure 6. Inverting Switching



*Includes all probe and jig capacitance

Figure 7. Test Circuit

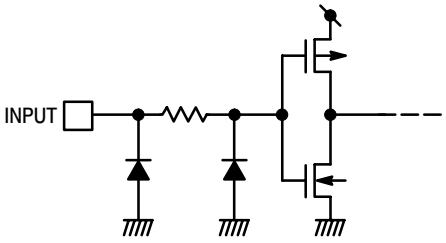
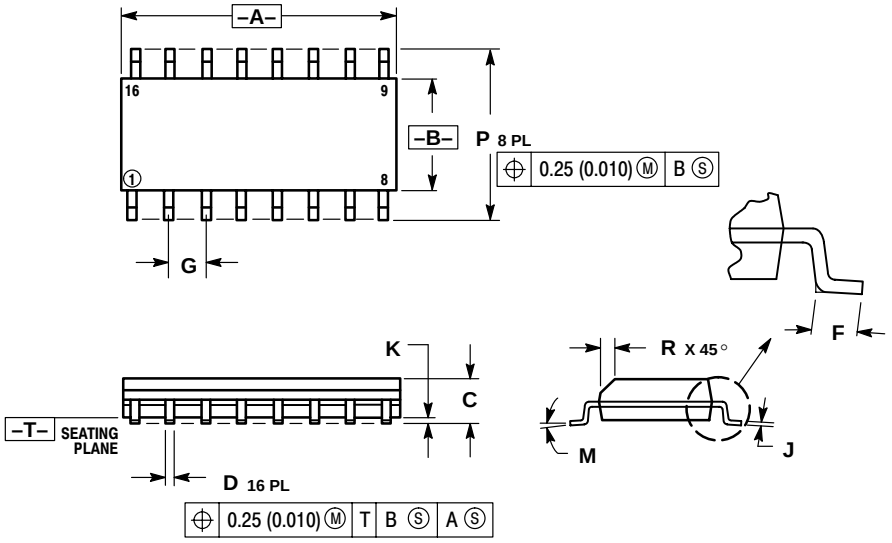


Figure 8. Input Equivalent Circuit

PACKAGE DIMENSIONS

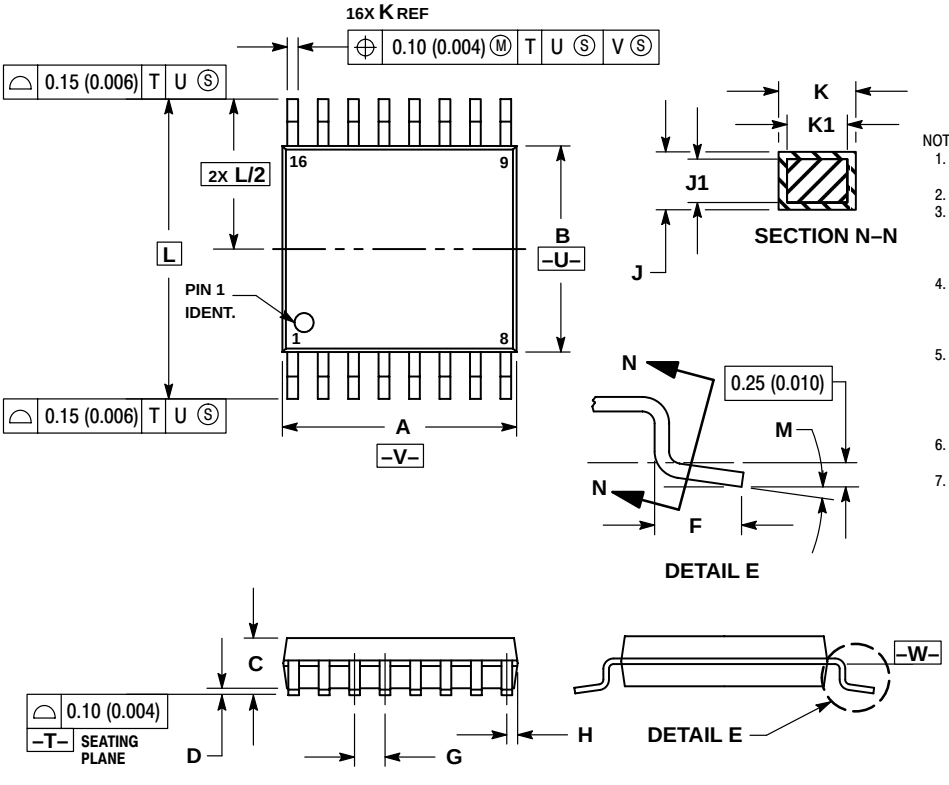
SOIC–16
D SUFFIX
CASE 751B–05
ISSUE J



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 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	9.80	10.00	0.386	0.393
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.054	0.068
D	0.35	0.49	0.014	0.019
F	0.40	1.25	0.016	0.049
G	1.27 BSC		0.050 BSC	
J	0.19	0.25	0.008	0.009
K	0.10	0.25	0.004	0.009
M	0°	7°	0°	7°
P	5.80	6.20	0.229	0.244
R	0.25	0.50	0.010	0.019

TSSOP–16
DT SUFFIX
CASE 948F–01
ISSUE O

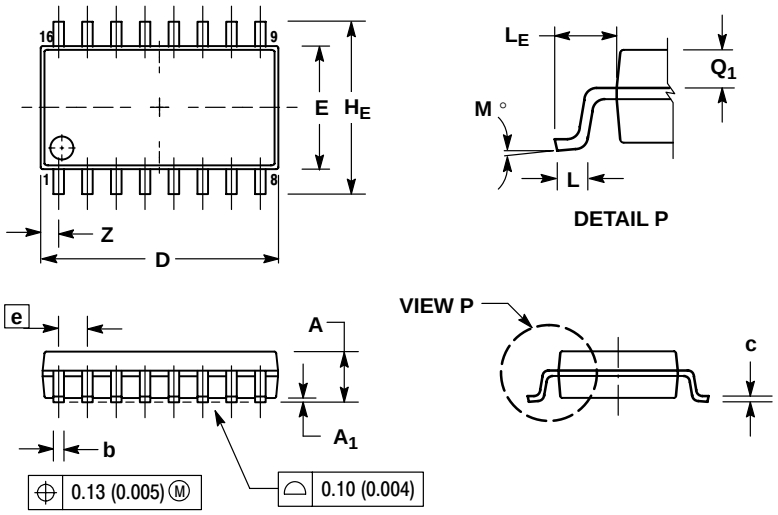


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH. PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD 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–.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	4.90	5.10	0.193	0.200
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	0.18	0.28	0.007	0.011
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°

PACKAGE DIMENSIONS

SOIC EIAJ–16
M 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
A_1	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	
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

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