MC74VHC257

Quad 2-Channel Multiplexer with 3-State Outputs

The MC74VHC257 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 ($\overline{OE}$) inputs. When ($\overline{OE}$) 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 inputs tolerate voltages up to 7 V, allowing the interface of 5 V systems to 3 V systems.

- High Speed: t_{PD} = 4.1 ns (Typ) at V_{CC} = 5.0 V
- Low Power Dissipation: I_{CC} = 4.0 μA (Max) at T_A = 25°C
- High Noise Immunity: $V_{NIH} = V_{NIL}$ = 28% V_{CC}
- Power Down Protection Provided on Inputs
- Balanced Propagation Delays
- Designed for 2.0 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 300 mA
- ESD Performance: HBM > 2000 V; Machine Model > 200 V
- Chip Complexity: FETs = 100; Equivalent Gates = 25
- These Devices are Pb−Free and are RoHS Compliant

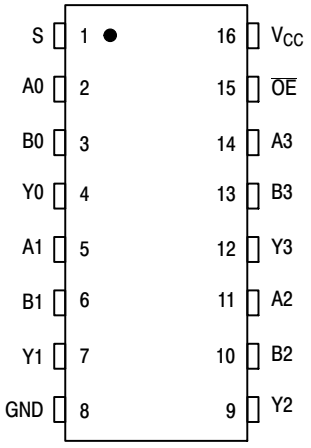

Figure 1. Pin Assignment

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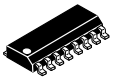
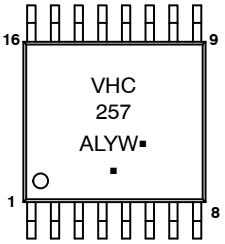
MARKING DIAGRAMS

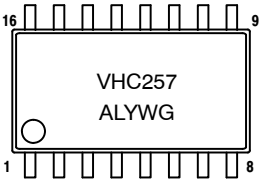


SO−16
D SUFFIX
CASE 751B

TSSOP−16
DT SUFFIX
CASE 948F



EIAJ SO−16
M SUFFIX
CASE 966



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

ORDERING INFORMATION

Device	Package	Shipping
MC74VHC257DG	SO−16	48 Units/Rail
MC74VHC257DR2G	SO−16	2500 Units/Reel
MC74VHC257DTG	TSSOP−16	96 Units/Rail
MC74VHC257DTR2G	TSSOP−16	2500 Units/Reel
MC74VHC257MG	EIAJSO−16	50 Units/Rail

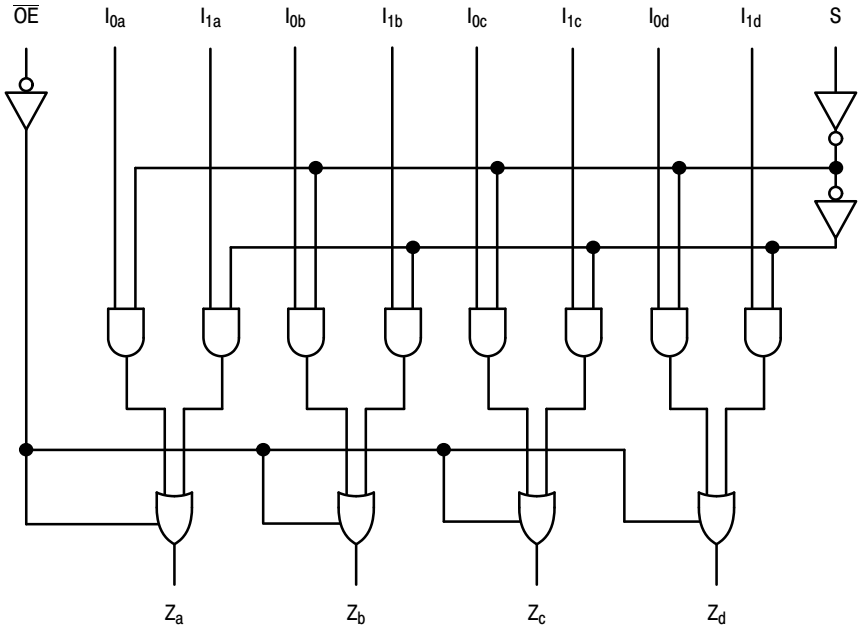


Figure 2. Expanded Logic Diagram

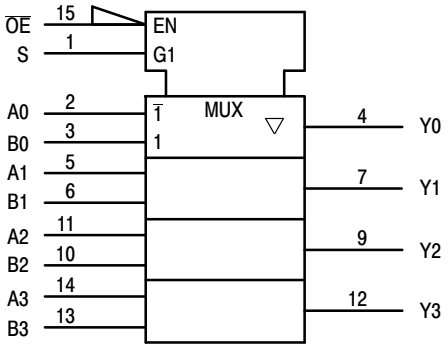


Figure 3. IEC Logic Symbol

FUNCTION TABLE

Inputs		Outputs
$\overline{OE}$	S	Y0 – Y3
H	X	Z
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 ≤ (V_{in} or V_{out}) ≤ 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

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		−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 1) Machine Model (Note 2) Charged Device Model (Note 3)	>2000 >200 >2000	V
$I_{LATCHUP}$	Latchup Performance	Above V_{CC} and Below GND at 125°C (Note 4)	±300	mA
θ_{JA}	Thermal Resistance, Junction−to−Ambient	SOIC Package TSSOP	143 164	°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 Tested to EIA/JESD22−A114−A
2 Tested to EIA/JESD22−A115−A
3 Tested to JESD22−C101−A
4 Tested to EIA/JESD78

RECOMMENDED OPERATING CONDITIONS

Symbol	Characteristics		Min	Max	Unit
V_{CC}	DC Supply Voltage		2.0	5.5	V
V_{IN}	DC Input Voltage		0	5.5	V
V_{OUT}	DC Output Voltage		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} = 3.3 V ± 0.3 V V_{CC} = 5.0 V ± 0.5 V	0	100 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

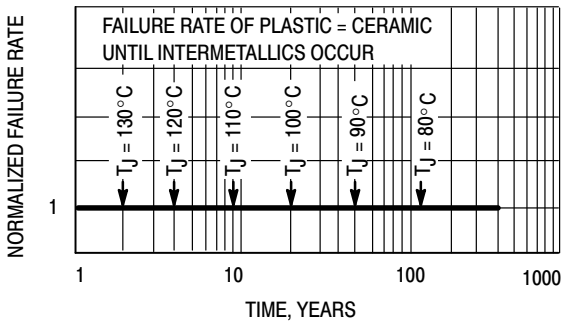


Figure 4. Failure Rate vs. Time Junction Temperature

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		2.0 3.0 to 5.5	1.5 V_{CCX} 0.7			1.5 V_{CCX} 0.7	1.5 V_{CCX} 0.7	1.5 V_{CCX} 0.7		V
V_{IL}	Maximum Low–Level Input Voltage		2.0 3.0 to 5.5			0.5 V_{CCX} 0.3		0.5 V_{CCX} 0.3		0.5 V_{CCX} 0.3	V
V_{OH}	Maximum High–Level Output Voltage	V_{IN} = V_{IH} or V_{IL} I_{OH} = –50 μA	2.0 3.0 4.5	1.9 2.9 4.4	2.0 3.0 4.5		1.9 2.9 4.4		1.9 2.9 4.4		V
		V_{IN} = V_{IH} or V_{IL} I_{OH} = –4 mA I_{OH} = –8 mA	3.0 4.5	2.58 3.94			2.48 3.8		2.34 3.66		
V_{OL}	Maximum Low–Level Output Voltage	V_{IN} = V_{IH} or V_{IL} I_{OL} = 50 μA	2.0 3.0 4.5		0.0 0.0 0.0	0.1 0.1 0.1		0.1 0.1 0.1		0.1 0.1 0.1	V
		V_{IN} = V_{IH} or V_{IL} I_{OH} = 4 mA I_{OH} = 8 mA	3.0 4.5			0.36 0.36		0.44 0.44		0.52 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_{OZ}	Maximum 3–State Leakage Current	V_{IN} = V_{IH} or V_{IL} V_{OUT} = V_{CC} or GND	5.5			±0.25		±2.5		±2.5	μA
I_{CC}	Maximum Quiescent Supply Current (per package)	V_{IN} = V_{CC} or GND	5.5			4.0		40.0		40.0	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 or B to Y	V_{CC} = 3.3 ± 0.3 V C_L = 15 pF		5.8	9.3	1.0	11.0	1.0	11.0	ns
		V_{CC} = 3.3 ± 0.3 V C_L = 50 pF		8.3	12.8	1.0	14.5	1.0	14.5	
		V_{CC} = 5.0 ± 0.5 V C_L = 15 pF		3.6	5.9	1.0	7.0	1.0	7.0	
		V_{CC} = 5.0 ± 0.5 V C_L = 50 pF		5.1	7.9	1.0	9.0	1.0	9.0	
t_{PLH}, t_{PHL}	Maximum Propagation Delay S to Y	V_{CC} = 3.3 ± 0.3 V C_L = 15 pF		7.0	11.0	1.0	13.0	1.0	13.0	ns
		V_{CC} = 3.3 ± 0.3 V C_L = 50 pF		9.5	14.5	1.0	16.5	1.0	16.5	
		V_{CC} = 5.0 ± 0.5 V C_L = 15 pF		4.0	6.8	1.0	8.0	1.0	8.0	
		V_{CC} = 5.0 ± 0.5 V C_L = 50 pF		5.5	8.8	1.0	10.0	1.0	10.0	
t_{PZL}, t_{PZH}	Maximum Output Enable Time $\overline{OE}$ to Y	V_{CC} = 3.3 ± 0.3 V C_L = 15 pF R_L = 1 kΩ C_L = 50 pF		6.7 9.2	10.5 14.0	1.0 1.0	12.5 16.0	1.0 1.0	12.5 16.0	ns
		V_{CC} = 5.0 ± 0.5 V C_L = 15 pF R_L = 1 kΩ C_L = 50 pF		3.6 5.1	6.8 8.8	1.0 1.0	8.0 10.0	1.0 1.0	8.0 10.0	
t_{PLZ}, t_{PHZ}	Maximum Output Disable Time $\overline{OE}$ to Y	V_{CC} = 3.3 ± 0.3 V C_L = 50 pF R_L = 1 kΩ		12.0	15.0	1.0	16.0	1.0	17.5	ns
		V_{CC} = 5.0 ± 0.5 V C_L = 50 pF R_L = 1 kΩ		5.7	13.0	1.0	14.0	1.0	15.0	
C_{IN}	Maximum Input Capacitance			4	10		10		10	pF

		Typical @ 25°C, V_{CC} = 5.0V	
C_{PD}	Power Dissipation Capacitance (Note 5)	20	pF

5. 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		3.5	V
V_{ILD}	Maximum Low Level Dynamic Input Voltage		1.5	V

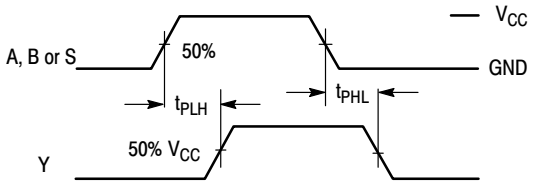


Figure 5. Switching Waveform

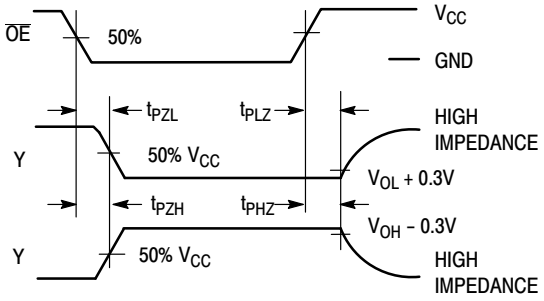
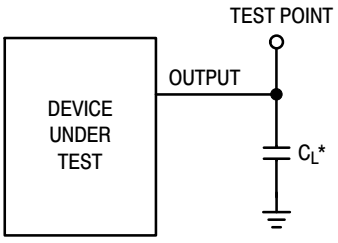
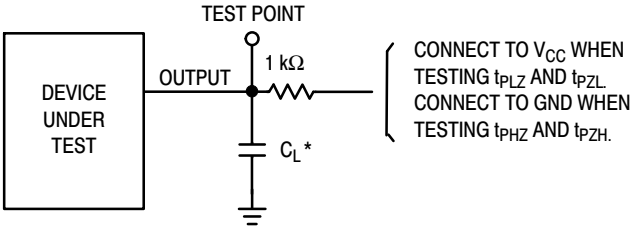


Figure 6. Switching Waveform



*Includes all probe and jig capacitance

Figure 7. Test Circuit



*Includes all probe and jig capacitance

Figure 8. Test Circuit

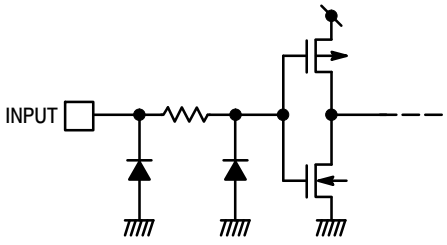
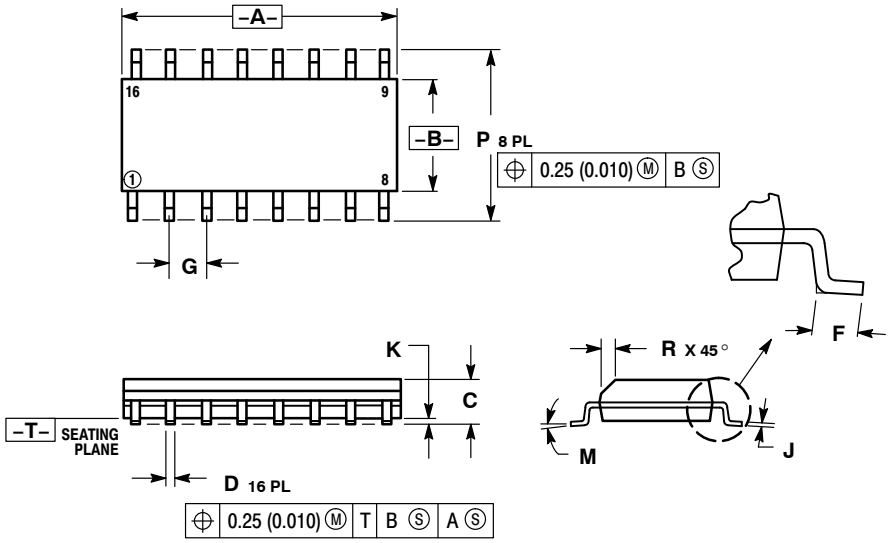


Figure 9. Input Equivalent Circuit

PACKAGE DIMENSIONS

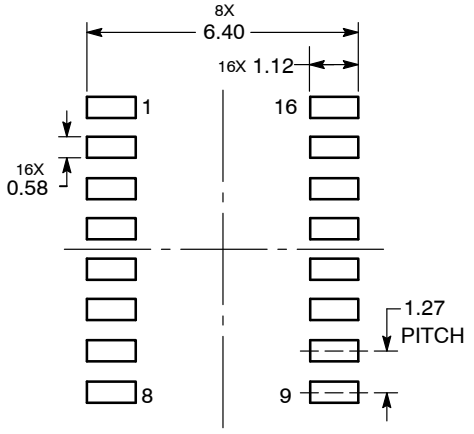
SOIC−16
CASE 751B−05
ISSUE K



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

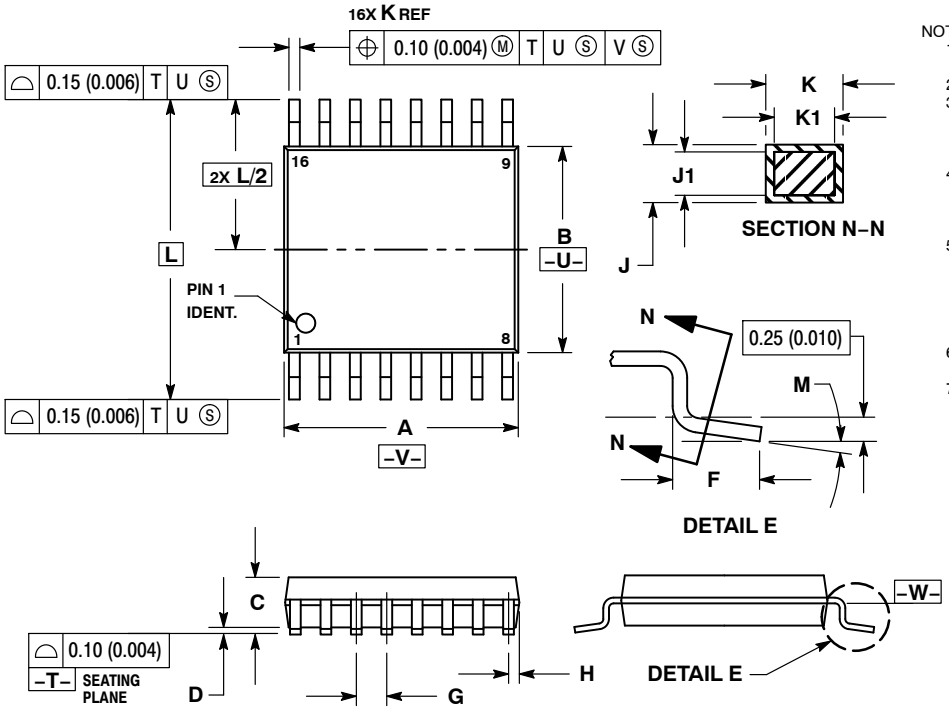
SOLDERING FOOTPRINT



DIMENSIONS: MILLIMETERS

PACKAGE DIMENSIONS

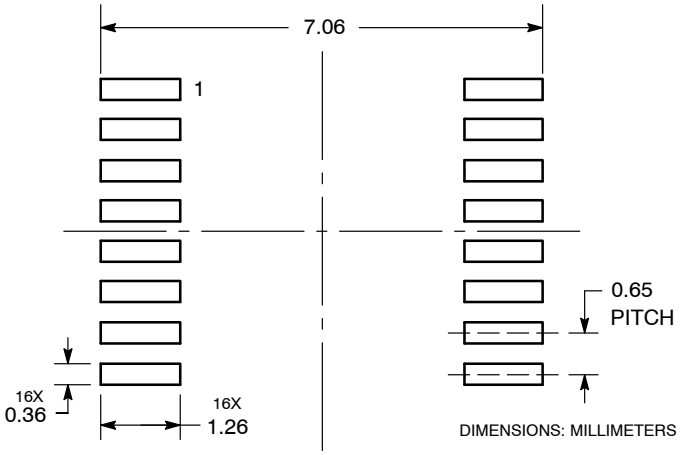
TSSOP−16
CASE 948F−01
ISSUE B



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−.

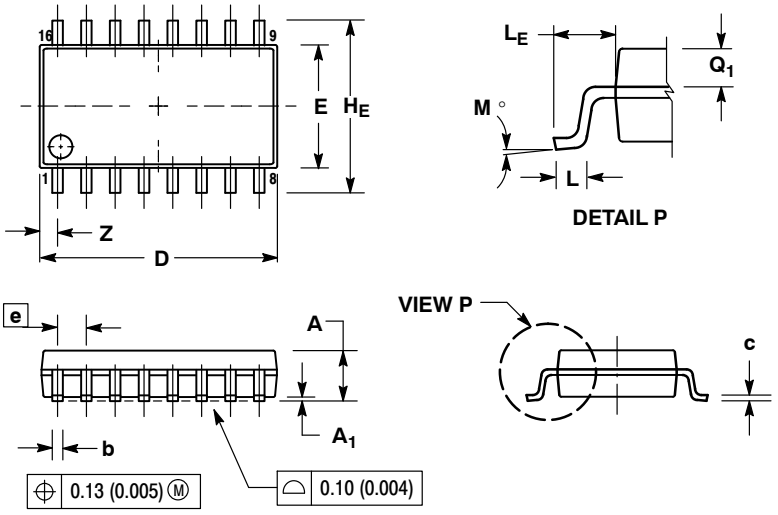
	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	4.90	5.10	0.193	0.200
B	4.30	4.50	0.169	0.177
C	−−−	1.20	−−−	0.047
D	0.05	0.15	0.002	0.006
F	0.50	0.75	0.020	0.030
G	0.65 BSC		0.026 BSC	
H	0.18	0.28	0.007	0.011
J	0.09	0.20	0.004	0.008
J1	0.09	0.16	0.004	0.006
K	0.19	0.30	0.007	0.012
K1	0.19	0.25	0.007	0.010
L	6.40 BSC		0.252 BSC	
M	0 °	8 °	0 °	8 °

SOLDERING FOOTPRINT



PACKAGE DIMENSIONS

SOEIAJ−16
CASE 966−01
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

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