

# 3-to-8 Line Decoder

## MM74HC138

### Description

The MM74HC138 decoder utilizes advanced silicon-gate CMOS technology and is well suited to memory address decoding or data routing applications. The circuit features high noise immunity and low power consumption usually associated with CMOS circuitry, yet has speeds comparable to low power Schottky TTL logic. The MM74HC138 has 3 binary select inputs (A, B, and C). If the device is enabled, these inputs determine which one of the eight normally HIGH outputs will go LOW. Two active LOW and one active HIGH enables ( $\overline{G1}$ ,  $\overline{G2A}$  and  $\overline{G2B}$ ) are provided to ease the cascading of decoders. The decoder's outputs can drive 10 low power Schottky TTL equivalent loads, and are functionally and pin equivalent to the 74LS138. All inputs are protected from damage due to static discharge by diodes to  $V_{CC}$  and ground.

### Features

- Typical Propagation Delay: 18 ns
- Wide Power Supply Range: 2 V–6 V
- Low Quiescent Current: 80  $\mu$ A Maximum (74HC Series)
- Low Input Current: 1  $\mu$ A maximum
- Fanout of 10 LS–TTL Loads
- These are Pb–Free Devices

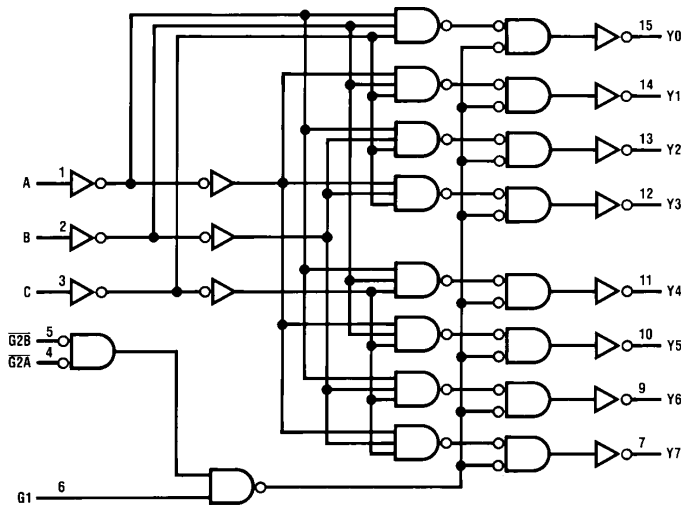
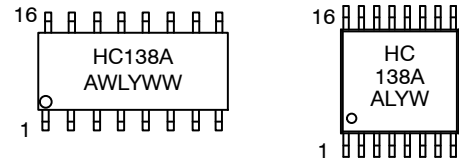


Figure 1. Logic Diagram

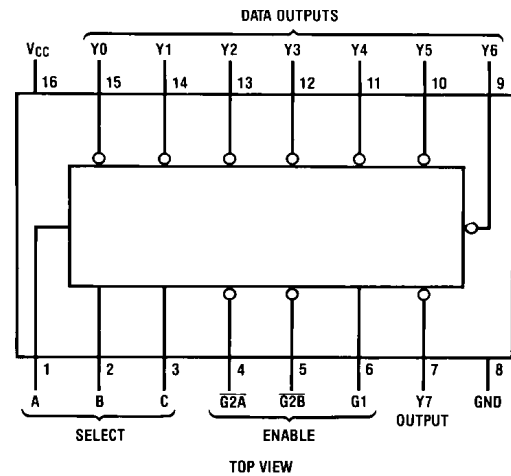


### MARKING DIAGRAMS



- HC138A = Specific Device Code
- A = Assembly Location
- L/WL = Wafer Lot
- Y/YY = Year, Last Number
- W/WW = Work Week

### CONNECTION DIAGRAM



### ORDERING INFORMATION

Device	Package	Shipping†
MM74HC138M	SOIC–16 (Pb–Free)	48 Units/Tube
MM74HC138MX	SOIC–16 (Pb–Free)	2500/Tape & Reel
MM74HC138MTCX	TSSOP–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](#).

# MM74HC138

## TRUTH TABLE

Inputs					Outputs							
Enable		Select			Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7
G1	G2 (Note 1)	C	B	A								
X	H	X	X	X	H	H	H	H	H	H	H	H
L	X	X	X	X	H	H	H	H	H	H	H	H
H	L	L	L	L	L	H	H	H	H	H	H	H
H	L	L	L	H	H	L	H	H	H	H	H	H
H	L	L	H	L	H	H	L	H	H	H	H	H
H	L	L	H	H	H	H	H	L	H	H	H	H
H	L	H	L	L	H	H	H	H	L	H	H	H
H	L	H	L	H	H	H	H	H	H	L	H	H
H	L	H	H	L	H	H	H	H	H	H	L	H
H	L	H	H	H	H	H	H	H	H	H	H	L

H = high level; L = low level X = don't care

Note 1:  $G2 = G2A + G2B$

## ABSOLUTE MAXIMUM RATINGS (note 1)

Symbol	Parameter	Value	Unit
$V_{CC}$	Supply Voltage	-0.5 to +6.5	V
$V_{in}$	DC Input Voltage	-0.5 to $V_{CC} + 0.5$	V
$V_{out}$	DC Output Voltage	-0.5 to $V_{CC} + 0.5$	V
$I_{IK}, I_{OK}$	Clamp Diode Current	$\pm 20$	mA
$I_{out}$	DC Output Current, per Pin	$\pm 25$	mA
$I_{CC}$	DC $V_{CC}$ or GND Current per Pins	$\pm 50$	mA
$T_{stg}$	Storage Temperature, Range	-65 to +150	°C
$P_D$	Power Dissipation (Note 2) S. O. Package Only	600 500	mW
$T_L$	Lead Temperature (Soldering 10 seconds)	260	°C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Unless otherwise specified all voltages are referenced to ground.

2. Power Dissipation temperature derating — plastic "N" package: -12 mW/°C from 65°C to 85°C.

## RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Max	Unit
$V_{CC}$	Supply Voltage	2	6	V
$V_{in}, V_{out}$	DC Input Voltage or Output Voltage	0	$V_{CC}$	V
$T_A$	Operating Temperature	-40	+85	°C
$t_r, t_f$	Input Rise or Fall Times $V_{CC} = 2.0\text{ V}$ $V_{CC} = 4.5\text{ V}$ $V_{CC} = 6.0\text{ V}$	-	1000 500 400	ns

# MM74HC138

## DC ELECTRICAL CHARACTERISTICS (note 3)

Symbol	Parameter	Conditions	V <sub>CC</sub> (V)	T <sub>A</sub> = 25°C		T <sub>A</sub> = -40 to 85°C	Unit		
				Typ	Guaranteed Limits				
V <sub>IH</sub>	Minimum HIGH-Level Input Voltage		2.0	-	1.5	1.5	V		
			4.5		3.15	3.15			
			6.0		4.2	4.2			
V <sub>IL</sub>	Maximum LOW-Level Input Voltage		2.0	-	0.5	0.5	V		
			4.5		1.35	1.35			
			6.0		1.8	1.8			
V <sub>OH</sub>	Minimum HIGH-Level Output Voltage	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>  I <sub>OUT</sub>   ≤ 20 μA	2.0	2.0	1.9	1.9	V		
			4.5	4.5	4.4	4.4			
			6.0	6.0	5.9	5.9			
		V <sub>OL</sub>	Maximum LOW-Level Output Voltage	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>  I <sub>OUT</sub>   ≤ 20 μA	2.0	0	0.1	0.1	V
					4.5	0	0.1	0.1	
					6.0	0	0.1	0.1	
V <sub>OL</sub>	Maximum LOW-Level Output Voltage	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>  I <sub>OUT</sub>   ≤ 4.0 mA  I <sub>OUT</sub>   ≤ 5.2 mA	4.5	0.2	0.26	0.33	V		
			6.0	0.2	0.26	0.33			
I <sub>IN</sub>	Maximum Input Current	V <sub>IN</sub> = V <sub>CC</sub> or GND	6.0	-	±0.1	±0.1	μA		
I <sub>CC</sub>	Maximum Quiescent Supply Current	V <sub>IN</sub> = V <sub>CC</sub> or GND I <sub>OUT</sub> = 0 μA	6.0	-	8.0	80	μA		

3. For a power supply of 5 V ±10% the worst case output voltages (V<sub>OH</sub>, and V<sub>OL</sub>) occur for HC at 4.5 V. Thus the 4.5 V values should be used when designing with this supply. Worst case V<sub>IH</sub> and V<sub>IL</sub> occur at V<sub>CC</sub> = 5.5 V and 4.5 V respectively. (The V<sub>IH</sub> value at 5.5 V is 3.85 V.) The worst case leakage current (I<sub>IN</sub>, I<sub>CC</sub>, and I<sub>OZ</sub>) occur for CMOS at the higher voltage and so the 6.0 V values should be used.

## AC ELECTRICAL CHARACTERISTICS (V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C, C<sub>L</sub> = 15 pF, t<sub>r</sub> = t<sub>f</sub> = 6 ns)

Symbol	Parameter	Conditions	Typ	Guaranteed Limit	Unit
t <sub>PLH</sub>	Maximum Propagation Delay, Binary Select to any Output		18	25	ns
t <sub>PHL</sub>	Maximum Propagation Delay, Binary Select to any Output		28	35	ns
t <sub>PHL</sub> , t <sub>PLH</sub>	Maximum Propagation Delay, G1 to any Output		18	25	ns
t <sub>PHL</sub>	Maximum Propagation Delay, $\overline{G2A}$ or $\overline{G2B}$ to Output		23	30	ns
t <sub>PLH</sub>	Maximum Propagation Delay, $\overline{G2A}$ or $\overline{G2B}$ to Output		18	25	ns

## AC ELECTRICAL CHARACTERISTICS (C<sub>L</sub> = 50 pF, t<sub>r</sub> = t<sub>f</sub> = 6 ns unless otherwise specified)

Symbol	Parameter	Conditions	V <sub>CC</sub> (V)	T <sub>A</sub> = 25°C		T <sub>A</sub> = -40 to 85°C	Unit
				Typ	Guaranteed Limit		
t <sub>PLH</sub>	Maximum Propagation Delay, Binary Select to any Output LOW-to-HIGH		2.0	75	150	189	ns
			4.5	15	30	38	
			6.0	13	26	32	
t <sub>PHL</sub>	Maximum Propagation Delay, Binary Select to any Output HIGH-to-LOW		2.0	100	200	252	ns
			4.5	20	40	50	
			6.0	17	34	43	
t <sub>PHL</sub> , t <sub>PLH</sub>	Maximum Propagation Delay G1 to any Output		2.0	75	150	189	ns
			4.5	15	30	38	
			6.0	13	26	32	

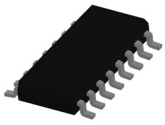
# MM74HC138

## AC ELECTRICAL CHARACTERISTICS ( $C_L = 50 \text{ pF}$ , $t_r = t_f = 6 \text{ ns}$ unless otherwise specified) (continued)

Symbol	Parameter	Conditions	$V_{CC}$ (V)	$T_A = 25^\circ\text{C}$		$T_A = -40 \text{ to } 85^\circ\text{C}$	Unit
				Typ	Guaranteed Limit		
$t_{PHL}$	Maximum Propagation Delay $\overline{G2A}$ or $\overline{G2B}$ to Output		2.0	82	175	221	ns
			4.5	28	35	44	
			6.0	22	30	37	
$t_{PLH}$	Maximum Propagation Delay $\overline{G2A}$ or $\overline{G2B}$ to Output		2.0	75	150	189	ns
			4.5	15	30	38	
			6.0	13	26	32	
$t_{TLH}$ , $t_{THL}$	Output Rise and Fall Time		2.0	30	75	95	ns
			4.5	8	15	19	
			6.0	7	13	16	
$C_{IN}$	Maximum Input Capacitance		–	3	10	10	pF
$C_{PD}$	Power Dissipation Capacitance	(Note 4)	–	75	–	–	pF

4.  $C_{PD}$  determines the no load dynamic power consumption,  $P_D = C_{PD} V_{CC}^2 f + I_{CC} V_{CC}$ , and the no load dynamic current consumption,  $I_S = C_{PD} V_{CC} f + I_{CC}$ .

# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

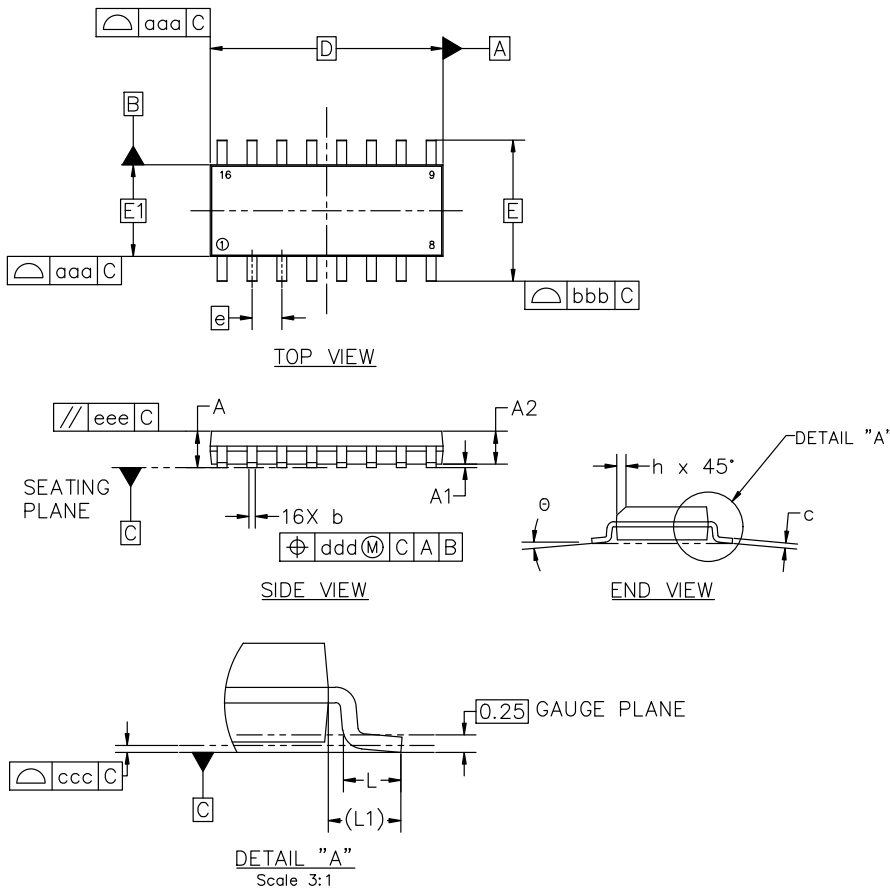


**SOIC-16 9.90x3.90x1.50 1.27P**  
CASE 751B  
ISSUE L

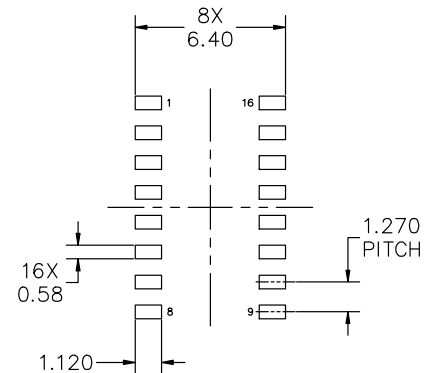
DATE 29 MAY 2024

**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2018.
2. DIMENSION IN MILLIMETERS. ANGLE IN DEGREES.
3. DIMENSIONS D AND E1 DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15mm PER SIDE.
5. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127mm TOTAL IN EXCESS OF THE b DIMENSION AT MAXIMUM MATERIAL CONDITION.



MILLIMETERS			
DIM	MIN	NOM	MAX
A	1.35	1.55	1.75
A1	0.00	0.05	0.10
A2	1.35	1.50	1.65
b	0.35	0.42	0.49
c	0.19	0.22	0.25
D	9.90 BSC		
E	6.00 BSC		
E1	3.90 BSC		
e	1.27 BSC		
h	0.25	---	0.50
L	0.40	0.83	1.25
L1	1.05 REF		
θ	0°	---	7°
TOLERANCE OF FORM AND POSITION			
aaa	0.10		
bbb	0.20		
ccc	0.10		
ddd	0.25		
eee	0.10		



**RECOMMENDED MOUNTING FOOTPRINT**

\*FOR ADDITIONAL INFORMATION ON OUR PB-FREE STRATEGY AND SOLDERING DETAILS, PLEASE DOWNLOAD THE onsemi SOLDERING AND MOUNTING TECHNIQUES REFERENCE MANUAL, SOLDERRM/D

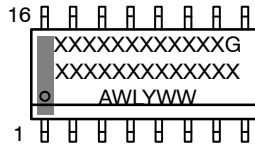
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**SOIC-16 9.90x3.90x1.50 1.27P**  
**CASE 751B**  
**ISSUE L**

DATE 29 MAY 2024

**GENERIC MARKING DIAGRAM\***



XXXXX = Specific Device Code  
 A = Assembly Location  
 WL = Wafer Lot  
 Y = Year  
 WW = Work Week  
 G = Pb-Free Package

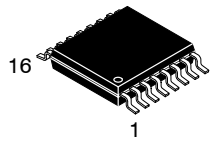
\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "•", may or may not be present. Some products may not follow the Generic Marking.

<p><b>STYLE 1:</b></p> <p>PIN 1. COLLECTOR                  2. BASE                  3. EMITTER                  4. NO CONNECTION                  5. EMITTER                  6. BASE                  7. COLLECTOR                  8. COLLECTOR                  9. BASE                  10. EMITTER                  11. NO CONNECTION                  12. EMITTER                  13. BASE                  14. COLLECTOR                  15. EMITTER                  16. COLLECTOR</p>	<p><b>STYLE 2:</b></p> <p>PIN 1. CATHODE                  2. ANODE                  3. NO CONNECTION                  4. CATHODE                  5. CATHODE                  6. NO CONNECTION                  7. ANODE                  8. CATHODE                  9. CATHODE                  10. ANODE                  11. NO CONNECTION                  12. CATHODE                  13. CATHODE                  14. NO CONNECTION                  15. ANODE                  16. CATHODE</p>	<p><b>STYLE 3:</b></p> <p>PIN 1. COLLECTOR, DYE #1                  2. BASE, #1                  3. EMITTER, #1                  4. COLLECTOR, #1                  5. COLLECTOR, #2                  6. BASE, #2                  7. EMITTER, #2                  8. COLLECTOR, #2                  9. COLLECTOR, #3                  10. BASE, #3                  11. EMITTER, #3                  12. COLLECTOR, #3                  13. COLLECTOR, #4                  14. BASE, #4                  15. EMITTER, #4                  16. COLLECTOR, #4</p>	<p><b>STYLE 4:</b></p> <p>PIN 1. COLLECTOR, DYE #1                  2. COLLECTOR, #1                  3. COLLECTOR, #2                  4. COLLECTOR, #2                  5. COLLECTOR, #3                  6. COLLECTOR, #3                  7. COLLECTOR, #4                  8. COLLECTOR, #4                  9. BASE, #4                  10. EMITTER, #4                  11. BASE, #3                  12. EMITTER, #3                  13. BASE, #2                  14. EMITTER, #2                  15. BASE, #1                  16. EMITTER, #1</p>
<p><b>STYLE 5:</b></p> <p>PIN 1. DRAIN, DYE #1                  2. DRAIN, #1                  3. DRAIN, #2                  4. DRAIN, #2                  5. DRAIN, #3                  6. DRAIN, #3                  7. DRAIN, #4                  8. DRAIN, #4                  9. GATE, #4                  10. SOURCE, #4                  11. GATE, #3                  12. SOURCE, #3                  13. GATE, #2                  14. SOURCE, #2                  15. GATE, #1                  16. SOURCE, #1</p>	<p><b>STYLE 6:</b></p> <p>PIN 1. CATHODE                  2. CATHODE                  3. CATHODE                  4. CATHODE                  5. CATHODE                  6. CATHODE                  7. CATHODE                  8. CATHODE                  9. ANODE                  10. ANODE                  11. ANODE                  12. ANODE                  13. ANODE                  14. ANODE                  15. ANODE                  16. ANODE</p>	<p><b>STYLE 7:</b></p> <p>PIN 1. SOURCE N-CH                  2. COMMON DRAIN (OUTPUT)                  3. COMMON DRAIN (OUTPUT)                  4. GATE P-CH                  5. COMMON DRAIN (OUTPUT)                  6. COMMON DRAIN (OUTPUT)                  7. COMMON DRAIN (OUTPUT)                  8. SOURCE P-CH                  9. SOURCE P-CH                  10. COMMON DRAIN (OUTPUT)                  11. COMMON DRAIN (OUTPUT)                  12. COMMON DRAIN (OUTPUT)                  13. GATE N-CH                  14. COMMON DRAIN (OUTPUT)                  15. COMMON DRAIN (OUTPUT)                  16. SOURCE N-CH</p>	

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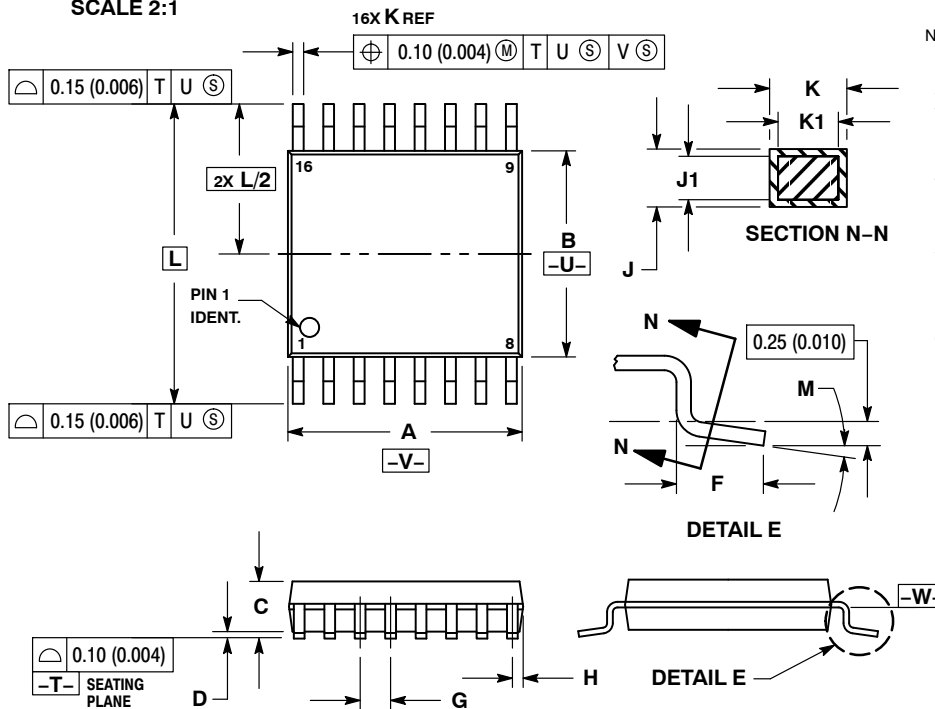
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# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



**TSSOP-16 WB**  
CASE 948F  
ISSUE B

DATE 19 OCT 2006

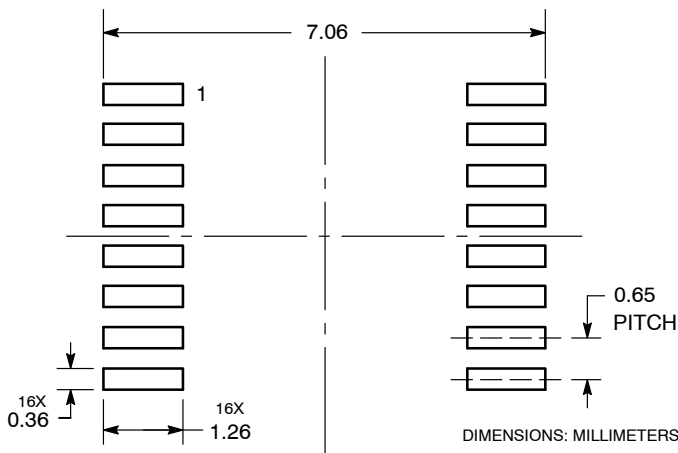


**NOTES:**

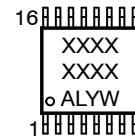
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD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

**RECOMMENDED  
SOLDERING FOOTPRINT\***



**GENERIC  
MARKING DIAGRAM\***



- XXXX = Specific Device Code
- A = Assembly Location
- L = Wafer Lot
- Y = Year
- W = Work Week
- G or ■ = Pb-Free Package

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "■", may or may not be present. Some products may not follow the Generic Marking.

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

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