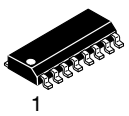
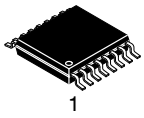
3-to-8 Line Decoder

MM74HC138



SOIC−16
CASE 751B



TSSOP−16
CASE 948F

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 (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 μA Maximum (74HC Series)
- Low Input Current: 1 μA maximum
- Fanout of 10 LS − TTL Loads
- These are Pb−Free Devices

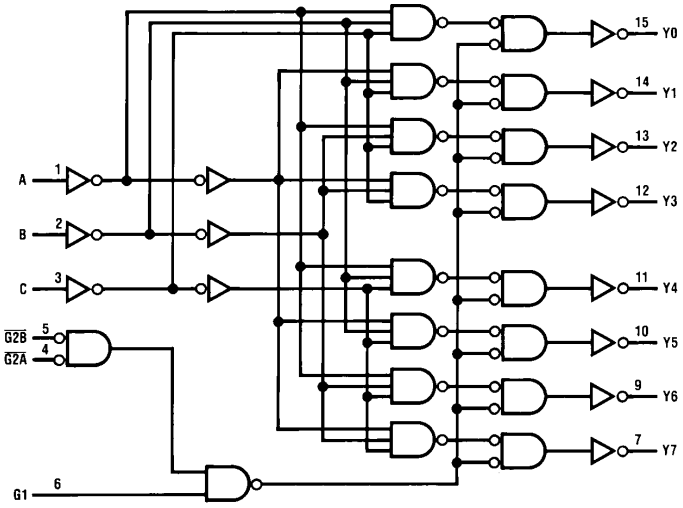
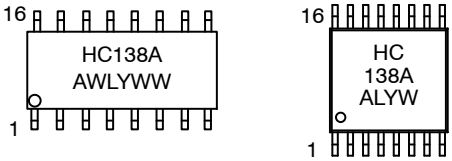


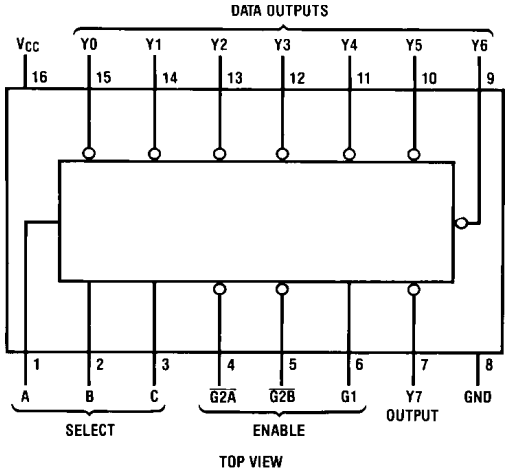
Figure 1. Logic Diagram

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
MM74HC138MTC	TSSOP−16 (Pb−Free)	96 Units/Tube

†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.

TRUTH TABLE

Inputs					Outputs							
Enable		Select										
G1	$\overline{G2}$ (Note 1)	C	B	A	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7
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: $\overline{G2}$ = G2A + G2B

ABSOLUTE MAXIMUM RATINGS (note 1)

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage	–0.5 to + 7.0	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	±20	mA
I_{out}	DC Output Current, per Pin	±25	mA
I_{CC}	DC V_{CC} or GND Current per Pins	±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 V V_{CC} = 4.5 V V_{CC} = 6.0 V	 – – –	 1000 500 400	ns

DC ELECTRICAL CHARACTERISTICS (note 3)

Symbol	Parameter	Conditions	V_{CC} (V)	T_A = 25°C		T_A –40 to 85°C	Unit
				Typ	Guaranteed Limits		
V_{IH}	Minimum HIGH–Level Input Voltage		2.0 4.5 6.0	–	1.5 3.15 4.2	1.5 3.15 4.2	V
V_{IL}	Maximum LOW–Level Input Voltage		2.0 4.5 6.0	–	0.5 1.35 1.8	0.5 1.35 1.8	V
V_{OH}	Minimum HIGH–Level Output Voltage	$V_{IN} = V_{IH}$ or V_{IL} $\|I_{OUT}\| \le 20$ μA	2.0 4.5 6.0	2.0 4.5 6.0	1.9 4.4 5.9	1.9 4.4 5.9	V
		$V_{IN} = V_{IH}$ or V_{IL} $\|I_{OUT}\| \le 4.0$ mA $\|I_{OUT}\| \le 5.2$ mA	4.5 6.0	4.2 5.7	3.98 5.48	3.84 5.34	V
V_{OL}	Maximum LOW–Level Output Voltage	$V_{IN} = V_{IH}$ or V_{IL} $\|I_{OUT}\| \le 20$ μA	2.0 4.5 6.0	0 0 0	0.1 0.1 0.1	0.1 0.1 0.1	V
		$V_{IN} = V_{IH}$ or V_{IL} $\|I_{OUT}\| \le 4.0$ mA $\|I_{OUT}\| \le 5.2$ mA	4.5 6.0	0.2 0.2	0.26 0.26	0.33 0.33	V
I_{IN}	Maximum Input Current	$V_{IN} = V_{CC}$ or GND	6.0	–	±0.1	±0.1	μA
I_{CC}	Maximum Quiescent Supply Current	$V_{IN} = V_{CC}$ or GND I_{OUT} = 0 μA	6.0	–	8.0	80	μA

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

AC ELECTRICAL CHARACTERISTICS (V_{CC} = 5 V, T_A = 25°C, C_L = 15 pF, $t_r = t_f$ = 6 ns)

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

AC ELECTRICAL CHARACTERISTICS (C_L = 50 pF, tr = tf = 6 ns unless otherwise specified)

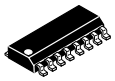
Symbol	Parameter	Conditions	V_{CC} (V)	T_A = 25°C		T_A = –40 to 85°C	Unit
				Typ	Guaranteed Limit		
t_{PLH}	Maximum Propagation Delay, Binary Select to any Output LOW–to–HIGH		2.0 4.5 6.0	75 15 13	150 30 26	189 38 32	ns
t_{PHL}	Maximum Propagation Delay, Binary Select to any Output HIGH–to–LOW		2.0 4.5 6.0	100 20 17	200 40 34	252 50 43	ns
t_{PHL}, t_{PLH}	Maximum Propagation Delay G1 to any Output		2.0 4.5 6.0	75 15 13	150 30 26	189 38 32	ns

AC ELECTRICAL CHARACTERISTICS (C_L = 50 pF, tr = tf = 6 ns unless otherwise specified) (continued)

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

4. CPD 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, $I_S = C_{PD} V_{CC} f + I_{CC}$.

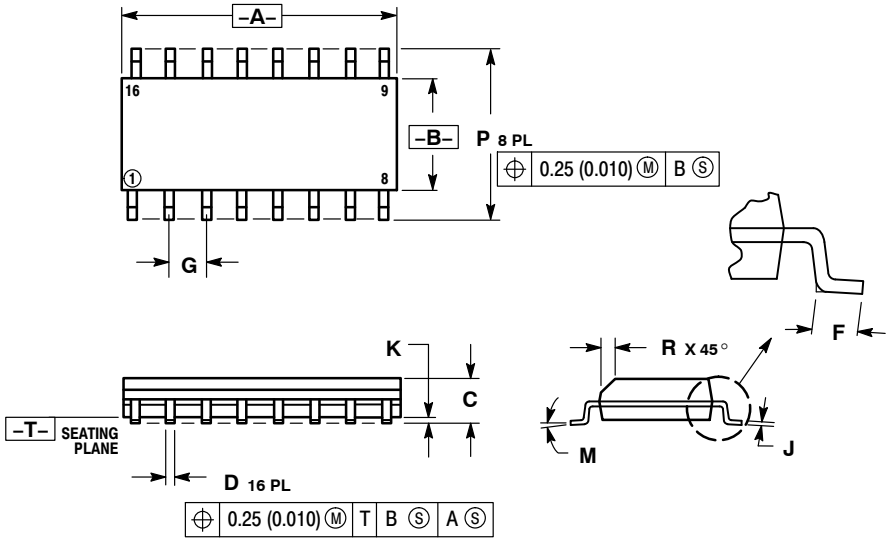
MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS



SCALE 1:1

SOIC−16
CASE 751B−05
ISSUE K

DATE 29 DEC 2006



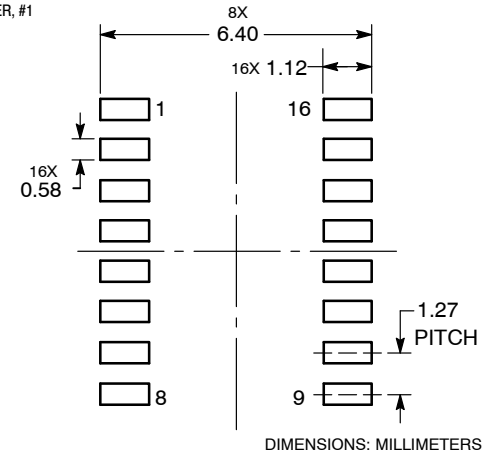
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) 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

STYLE 1:		STYLE 2:		STYLE 3:		STYLE 4:	
PIN 1.	COLLECTOR	PIN 1.	CATHODE	PIN 1.	COLLECTOR, DYE #1	PIN 1.	COLLECTOR, DYE #1
2.	BASE	2.	ANODE	2.	BASE, #1	2.	COLLECTOR, #1
3.	EMITTER	3.	NO CONNECTION	3.	EMITTER, #1	3.	COLLECTOR, #2
4.	NO CONNECTION	4.	CATHODE	4.	COLLECTOR, #1	4.	COLLECTOR, #2
5.	EMITTER	5.	CATHODE	5.	COLLECTOR, #2	5.	COLLECTOR, #3
6.	BASE	6.	NO CONNECTION	6.	BASE, #2	6.	COLLECTOR, #3
7.	COLLECTOR	7.	ANODE	7.	EMITTER, #2	7.	COLLECTOR, #4
8.	COLLECTOR	8.	CATHODE	8.	COLLECTOR, #2	8.	COLLECTOR, #4
9.	BASE	9.	CATHODE	9.	COLLECTOR, #3	9.	BASE, #4
10.	EMITTER	10.	ANODE	10.	BASE, #3	10.	EMITTER, #4
11.	NO CONNECTION	11.	NO CONNECTION	11.	EMITTER, #3	11.	BASE, #3
12.	EMITTER	12.	CATHODE	12.	COLLECTOR, #3	12.	EMITTER, #3
13.	BASE	13.	CATHODE	13.	COLLECTOR, #4	13.	BASE, #2
14.	COLLECTOR	14.	NO CONNECTION	14.	BASE, #4	14.	EMITTER, #2
15.	EMITTER	15.	ANODE	15.	EMITTER, #4	15.	BASE, #1
16.	COLLECTOR	16.	CATHODE	16.	COLLECTOR, #4	16.	EMITTER, #1

STYLE 5:		STYLE 6:		STYLE 7:	
PIN 1.	DRAIN, DYE #1	PIN 1.	CATHODE	PIN 1.	SOURCE N-CH
2.	DRAIN, #1	2.	CATHODE	2.	COMMON DRAIN (OUTPUT)
3.	DRAIN, #2	3.	CATHODE	3.	COMMON DRAIN (OUTPUT)
4.	DRAIN, #2	4.	CATHODE	4.	GATE P-CH
5.	DRAIN, #3	5.	CATHODE	5.	COMMON DRAIN (OUTPUT)
6.	DRAIN, #3	6.	CATHODE	6.	COMMON DRAIN (OUTPUT)
7.	DRAIN, #4	7.	CATHODE	7.	COMMON DRAIN (OUTPUT)
8.	DRAIN, #4	8.	CATHODE	8.	SOURCE P-CH
9.	GATE, #4	9.	ANODE	9.	SOURCE P-CH
10.	SOURCE, #4	10.	ANODE	10.	COMMON DRAIN (OUTPUT)
11.	GATE, #3	11.	ANODE	11.	COMMON DRAIN (OUTPUT)
12.	SOURCE, #3	12.	ANODE	12.	COMMON DRAIN (OUTPUT)
13.	GATE, #2	13.	ANODE	13.	GATE N-CH
14.	SOURCE, #2	14.	ANODE	14.	COMMON DRAIN (OUTPUT)
15.	GATE, #1	15.	ANODE	15.	COMMON DRAIN (OUTPUT)
16.	SOURCE, #1	16.	ANODE	16.	SOURCE N-CH

RECOMMENDED SOLDERING FOOTPRINT*



DIMENSIONS: MILLIMETERS

*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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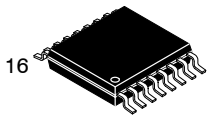
MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

TSSOP−16 WB
CASE 948F
ISSUE B

DATE 19 OCT 2006



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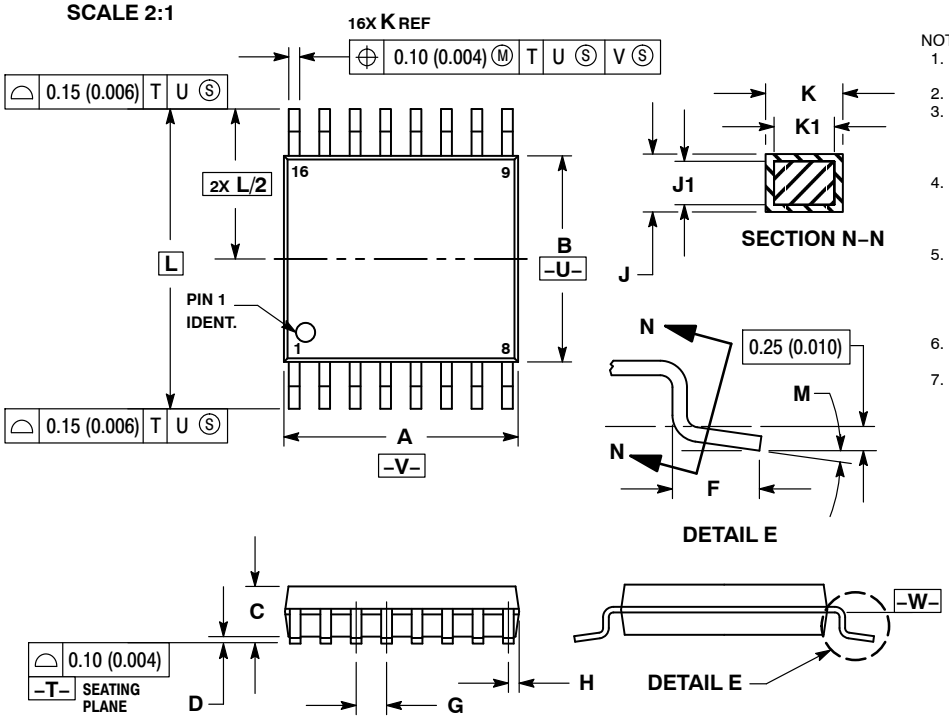
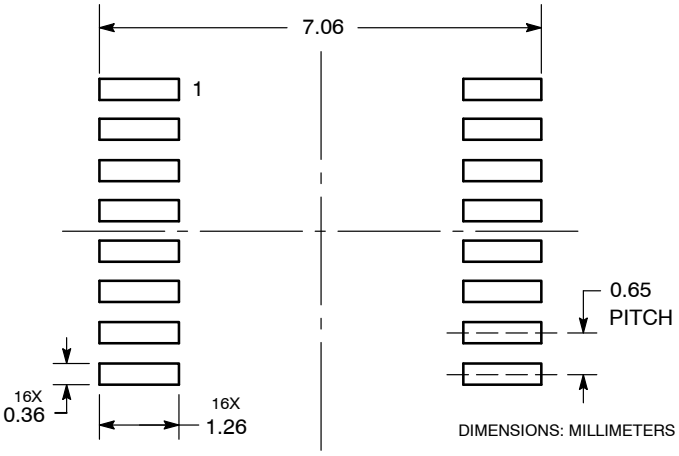


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH. PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD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

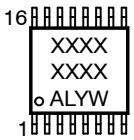
	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	4.90	5.10	0.193	0.200
B	4.30	4.50	0.169	0.177
C	−−−	1.20	−−−	0.047
D	0.05	0.15	0.002	0.006
F	0.50	0.75	0.020	0.030
G	0.65 BSC		0.026 BSC	
H	0.18	0.28	0.007	0.011
J	0.09	0.20	0.004	0.008
J1	0.09	0.16	0.004	0.006
K	0.19	0.30	0.007	0.012
K1	0.19	0.25	0.007	0.010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

RECOMMENDED SOLDERING FOOTPRINT*



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

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.

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DESCRIPTION:	**TSSOP−16**		**PAGE 1 OF 1**

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