Low-Voltage CMOS Quad 2-Input NOR Gate

With 5 V-Tolerant Inputs

MC74LCX02

The MC74LCX02 is a high performance, quad 2-input NOR gate operating from a 1.65 to 5.5 V supply. High impedance TTL compatible inputs significantly reduce current loading to input drivers while TTL compatible outputs offer improved switching noise performance. A V_I specification of 5.5 V allows MC74LCX02 inputs to be safely driven from 5 V devices.

Features

- Designed for 1.65 V to 5.5 V V_{CC} Operation
- 5 V Tolerant Inputs – Interface Capability With 5 V TTL Logic
- LVTTL Compatible
- LVCMOS Compatible
- 24 mA Balanced Output Sink and Source Capability @ 3.0 V
- Near Zero Static Supply Current (10 μA) Substantially Reduces System Power Requirements
- Latchup Performance Exceeds 100 mA
- ESD Performance: Human Body Model >2000 V
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

PIN NAMES

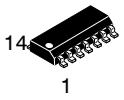
Pins	Function
An, Bn	Data Inputs
$\overline{O}$n	Outputs

TRUTH TABLE

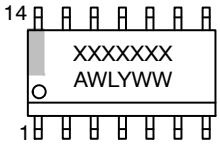
Inputs		Outputs
An	Bn	$\overline{O}$n
L	L	H
H	H	L
H	L	L
H	H	L

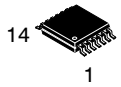
H = High Voltage Level
L = Low Voltage Level
For I_{CC} reasons, DO NOT FLOAT Inputs

MARKING DIAGRAMS



SOIC-14
D SUFFIX
CASE 751A





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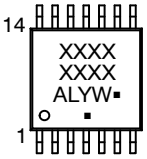
DT SUFFIX
CASE 948G



XXXXXX	= Specific Device Code
A	= Assembly Location
L, WL	= Wafer Lot
Y, YY	= Year
W, WW	= Work Week
G or ▪	= Pb-Free Package

(Note: Microdot may be in either location)

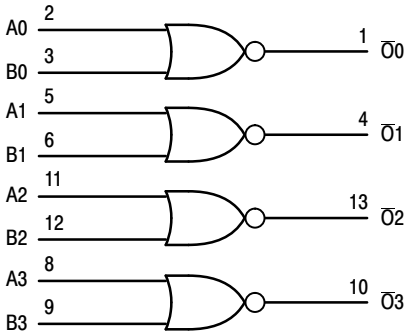


Figure 1. Logic Diagram

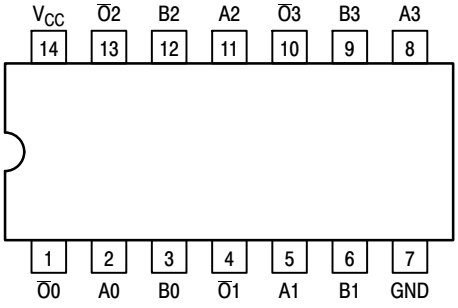


Figure 2. Pin Assignment

ORDERING INFORMATION

See detailed ordering and shipping information on page 6 of this data sheet.

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MAXIMUM RATINGS

Symbol	Parameter		Value	Unit
V_{CC}	DC Supply Voltage		−0.5 to +6.5	V
V_I	DC Input Voltage (Note 1)		−0.5 to +6.5	V
V_O	DC Output Voltage (Note 1)	Active-Mode (High or Low State) Tri-State Mode Power-Down Mode (V_{CC} = 0 V)	−0.5 to V_{CC} + 0.5 −0.5 to +6.5 −0.5 to +6.5	V
I_{IK}	DC Input Diode Current	V_I < GND	−50	mA
I_{OK}	DC Output Diode Current	V_O < GND	−50	mA
I_O	DC Output Source/Sink Current		±50	mA
I_{CC} or I_{GND}	DC Supply Current per Supply Pin or Ground Pin		±100	mA
T_{STG}	Storage Temperature Range		−65 to +150	°C
T_L	Lead Temperature, 1 mm from Case for 10 secs		260	°C
T_J	Junction Temperature Under Bias		+150	°C
θ_{JA}	Thermal Resistance (Note 1)	SOIC-14 QFN14 TSSOP-14	116 130 150	°C/W
P_D	Power Dissipation in Still Air at 125°C	SOIC-14 QFN14 TSSOP-14	1077 962 833	mW
MSL	Moisture Sensitivity		Level 1	–
F_R	Flammability Rating Oxygen Index: 28 to 34		UL 94 V-0 @ 0.125 in	–
V_{ESD}	ESD Withstand Voltage (Note 3)	Human Body Model Charged Device Model	2000 N/A	V

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. I_O absolute maximum rating must be observed.
2. Measured with minimum pad spacing on an FR4 board, using 76 mm-by-114 mm, 2-ounce copper trace no air flow per JESD51−7.
3. HBM tested to EIA / JESD22-A114-A. CDM tested to JESD22-C101-A. JEDEC recommends that ESD qualification to EIA/JESD22-A115A (Machine Model) be discontinued.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter		Min	Typ	Max	Unit
V_{CC}	Supply Voltage	Operating Data Retention Only	1.65 1.5	3.3 3.3	5.5 5.5	V
V_I	Digital Input Voltage		0	–	5.5	V
V_O	Output Voltage	Active Mode (High or Low State) Tri-State Mode Power Down Mode (V_{CC} = 0 V)	0 0 0	– – –	V_{CC} 5.5 5.5	V
T_A	Operating Free-Air Temperature		−40	–	+125	°C
t_r, t_f	Input Rise or Fall Rate	V_{CC} = 1.65 V to 1.95 V V_{CC} = 2.3 V to 2.7 V V_I from 0.8 V to 2.0 V, V_{CC} = 3.0 V V_{CC} = 4.5 V to 5.5 V	0 0 0 0	– – – –	20 20 10 5	nS/V

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

4. 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.

DC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Conditions	V_{CC} (V)	T_A = −40 °C to +85 °C		T_A = −40 °C to +125 °C		Unit
				Min	Max	Min	Max	
V_{IH}	HIGH Level Input Voltage		1.65–1.95	0.65 x V_{CC}	–	0.65 x V_{CC}	–	V
			2.3–2.7	1.7	–	1.7	–	
			3.0–3.6	2.0	–	2.0	–	
			4.5–5.5	0.70 x V_{CC}	–	0.70 x V_{CC}	–	
V_{IL}	LOW Level Input Voltage		1.65–1.95	–	0.35 x V_{CC}	–	0.35 x V_{CC}	V
			2.3–2.7	–	0.7	–	0.7	
			3.0–3.6	–	0.8	–	0.8	
			4.5–5.5	–	0.30 x V_{CC}	–	0.30 x V_{CC}	
V_{OH}	High-Level Output Voltage	V_I = V_{IH} or V_{IL}						V
		I_{OH} = −100 μA	1.65 to 5.5	V_{CC} − 0.1	–	V_{CC} − 0.1	–	
		I_{OH} = −4 mA	1.65	1.29	–	1.29	–	
		I_{OH} = −8 mA	2.3	1.8	–	1.8	–	
		I_{OH} = −12 mA	2.7	2.2	–	2.2	–	
		I_{OH} = −16 mA	3.0	2.4	–	2.4	–	
		I_{OH} = −24 mA	3.0	2.2	–	2.2	–	
		I_{OH} = −32 mA	4.5	3.7		3.7	–	
V_{OL}	Low-Level Output Voltage	V_I = V_{IH} or V_{IL}						V
		I_{OL} = 100 μA	1.65 to 5.5	–	0.1	–	0.1	
		I_{OL} = 4 mA	1.65	–	0.24	–	0.24	
		I_{OL} = 8 mA	2.3	–	0.3	–	0.3	
		I_{OL} = 12 mA	2.7	–	0.4	–	0.4	
		I_{OL} = 16 mA	3.0	–	0.4	–	0.4	
		I_{OL} = 24 mA	3.0	–	0.55	–	0.55	
		I_{OL} = 32 mA	4.5	–	0.6	–	0.6	
I_I	Input Leakage Current	V_I = 0 to 5.5 V	3.6	–	±5.0	–	±5.0	μA
I_{OFF}	Power Off Leakage Current	V_I = 5.5 V or V_O = 5.5 V	0	–	10	–	10	μA
I_{CC}	Quiescent Supply Current	V_I = 5.5 V or GND	3.6	–	10	–	10	μA
ΔI_{CC}	Increase in I_{CC} per Input	V_{IH} = V_{CC} − 0.6 V	2.3 to 3.6	–	500	–	500	μA

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

AC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Test Condition	V_{CC} (V)	T_A = −40 °C to +85 °C		T_A = −40 °C to +125 °C		Unit
				Min	Max	Min	Max	
t_{PLH}, t_{PHL}	Propagation Delay, Input to Output	See Figures 3 and 4	1.65 to 1.95	–	10.3	–	10.3	ns
			2.3 to 2.7	–	6.6	–	6.6	
			2.7	–	6.2	–	6.2	
			3.0 to 3.6	–	5.5	–	5.5	
			4.5 to 5.5	–	4.2	–	4.2	

AC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Test Condition	V_{CC} (V)	T_A = −40 °C to +85 °C		T_A = −40 °C to +125 °C		Unit
				Min	Max	Min	Max	
t_{OSHL}, t_{OSLH}	Output to Output Skew		1.65 to 1.95	–	–	–	–	ns
			2.3 to 2.7	–	–	–	–	
			2.7	–	–	–	–	
			3.0 to 3.6	–	1.0	–	1.0	
			4.5 to 5.5	–	–	–	–	

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

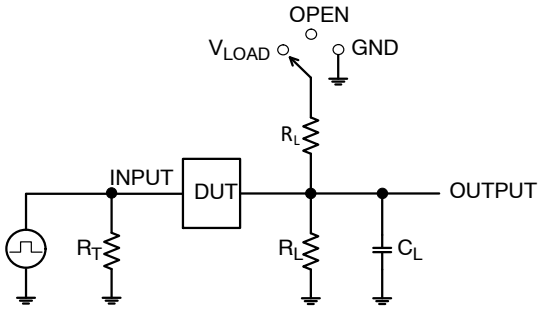
DYNAMIC SWITCHING CHARACTERISTICS

Symbol	Characteristic	Condition	T_A = +25 °C			Unit
			Min	Typ	Max	
V_{OLP}	Dynamic LOW Peak Voltage (Note 5)	V_{CC} = 3.3 V, C_L = 50 pF, V_{IH} = 3.3 V, V_{IL} = 0 V		0.8		V
		V_{CC} = 2.5 V, C_L = 30 pF, V_{IH} = 2.5 V, V_{IL} = 0 V		0.6		V
V_{OLV}	Dynamic LOW Valley Voltage (Note 5)	V_{CC} = 3.3 V, C_L = 50 pF, V_{IH} = 3.3 V, V_{IL} = 0 V		−0.8		V
		V_{CC} = 2.5 V, C_L = 30 pF, V_{IH} = 2.5 V, V_{IL} = 0 V		−0.6		V

5. Number of outputs defined as “n”. Measured with “n-1” outputs switching from HIGH-to-LOW or LOW-to-HIGH. The remaining output is measured in the LOW state.

CAPACITIVE CHARACTERISTICS

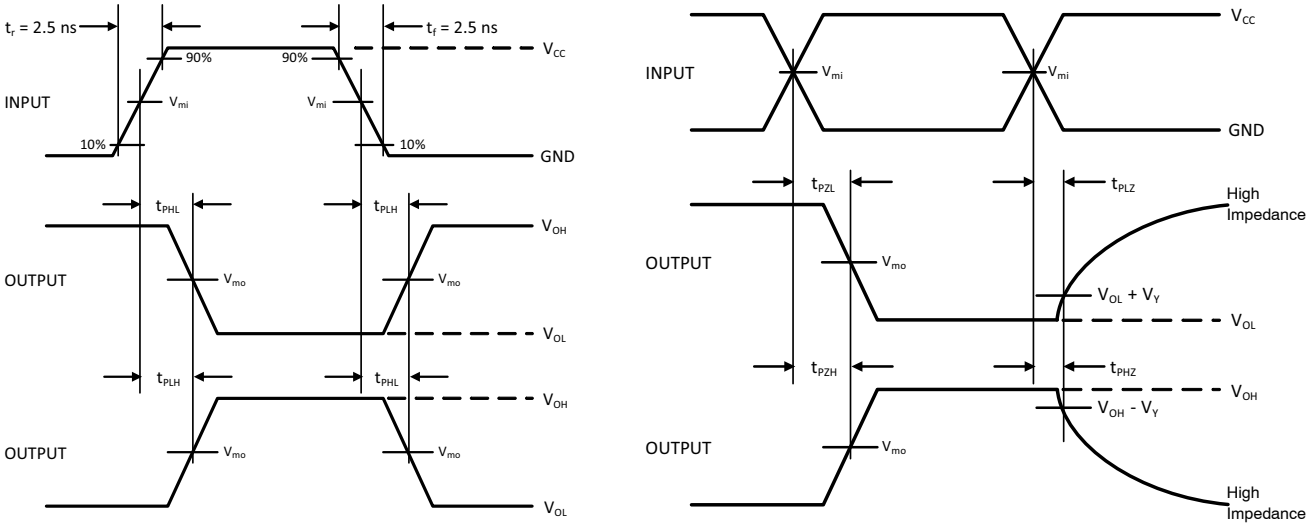
Symbol	Parameter	Condition	Typ	Unit
C_{IN}	Input Capacitance	V_{CC} = 3.3 V, V_I = 0 V or V_{CC}	7	pF
C_{OUT}	Output Capacitance	V_{CC} = 3.3 V, V_I = 0 V or V_{CC}	8	pF
C_{PD}	Power Dissipation Capacitance	10 MHz, V_{CC} = 3.3 V, V_I = 0 V or V_{CC}	25	pF



Test	Switch Position
t_{PLH} / t_{PHL}	Open
t_{PLZ} / t_{PZL}	V_{LOAD}
t_{PHZ} / t_{PZH}	GND

C_L includes probe and jig capacitance
R_T is Z_{OUT} of pulse generator (typically 50 Ω)
f = 1 MHz

Figure 3. Test Circuit



V_{CC}, V	R_L, Ω	C_L, pF	V_{LOAD}	V_m, V	V_Y, V
1.65 to 1.95	500	30	2 x V_{CC}	V_{CC}/2	0.15
2.3 to 2.7	500	30	2 x V_{CC}	V_{CC}/2	0.15
2.7	500	50	6 V	1.5	0.3
3.0 to 3.6	500	50	6 V	1.5	0.3
4.5 to 5.5	500	50	2 x V_{CC}	V_{CC}/2	0.3

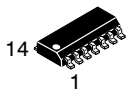
Figure 4. Switching Waveforms

ORDERING INFORMATION

Device	Marking	Package	Shipping†
MC74LCX02DR2G	SOIC-14	LCX02G	2500 / Tape & Reel
MC74LCX02DTG	TSSOP-14	LCX 02	96 Units / Rail
MC74LCX02DTR2G	TSSOP-14	LCX 02	2500 / Tape & Reel
MC74LCX02DTR2G-Q*	TSSOP-14	LCX 02	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.

*-Q Suffix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable.



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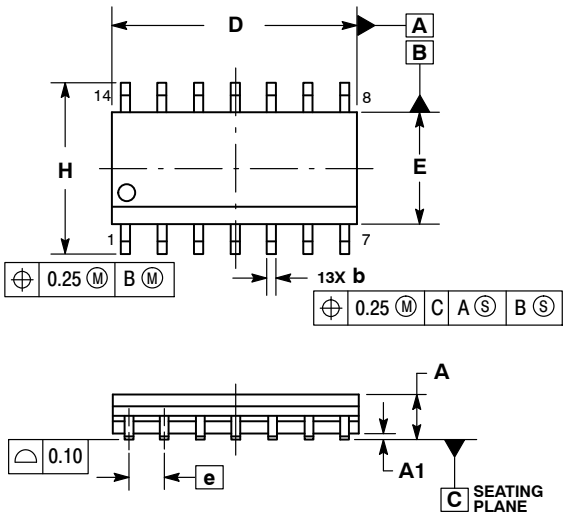
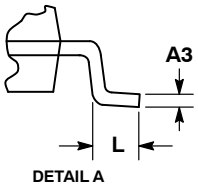
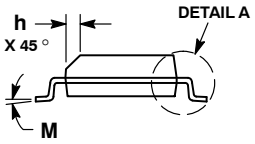
ISSUE L

DATE 03 FEB 2016



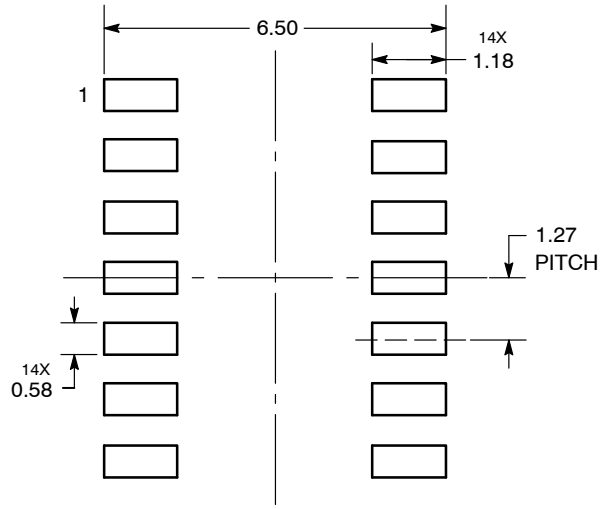




NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF AT MAXIMUM MATERIAL CONDITION.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSIONS.
5. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	1.35	1.75	0.054	0.068
A1	0.10	0.25	0.004	0.010
A3	0.19	0.25	0.008	0.010
b	0.35	0.49	0.014	0.019
D	8.55	8.75	0.337	0.344
E	3.80	4.00	0.150	0.157
e	1.27 BSC		0.050 BSC	
H	5.80	6.20	0.228	0.244
h	0.25	0.50	0.010	0.019
L	0.40	1.25	0.016	0.049
M	0 °	7 °	0 °	7 °

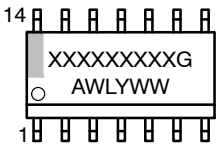
SOLDERING FOOTPRINT*



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.

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.

STYLES ON PAGE 2

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DESCRIPTION:	**SOIC−14 NB**		**PAGE 1 OF 2**

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CASE 751A−03
ISSUE L

DATE 03 FEB 2016

STYLE 1:
PIN 1. COMMON CATHODE
2. ANODE/CATHODE
3. ANODE/CATHODE
4. NO CONNECTION
5. ANODE/CATHODE
6. NO CONNECTION
7. ANODE/CATHODE
8. ANODE/CATHODE
9. ANODE/CATHODE
10. NO CONNECTION
11. ANODE/CATHODE
12. ANODE/CATHODE
13. NO CONNECTION
14. COMMON ANODE

STYLE 2:
CANCELLED

STYLE 3:
PIN 1. NO CONNECTION
2. ANODE
3. ANODE
4. NO CONNECTION
5. ANODE
6. NO CONNECTION
7. ANODE
8. ANODE
9. ANODE
10. NO CONNECTION
11. ANODE
12. ANODE
13. NO CONNECTION
14. COMMON CATHODE

STYLE 4:
PIN 1. NO CONNECTION
2. CATHODE
3. CATHODE
4. NO CONNECTION
5. CATHODE
6. NO CONNECTION
7. CATHODE
8. CATHODE
9. CATHODE
10. NO CONNECTION
11. CATHODE
12. CATHODE
13. NO CONNECTION
14. COMMON ANODE

STYLE 5:
PIN 1. COMMON CATHODE
2. ANODE/CATHODE
3. ANODE/CATHODE
4. ANODE/CATHODE
5. ANODE/CATHODE
6. NO CONNECTION
7. COMMON ANODE
8. COMMON CATHODE
9. ANODE/CATHODE
10. ANODE/CATHODE
11. ANODE/CATHODE
12. ANODE/CATHODE
13. NO CONNECTION
14. COMMON ANODE

STYLE 6:
PIN 1. CATHODE
2. CATHODE
3. CATHODE
4. CATHODE
5. CATHODE
6. CATHODE
7. CATHODE
8. ANODE
9. ANODE
10. ANODE
11. ANODE
12. ANODE
13. ANODE
14. ANODE

STYLE 7:
PIN 1. ANODE/CATHODE
2. COMMON ANODE
3. COMMON CATHODE
4. ANODE/CATHODE
5. ANODE/CATHODE
6. ANODE/CATHODE
7. ANODE/CATHODE
8. ANODE/CATHODE
9. ANODE/CATHODE
10. ANODE/CATHODE
11. COMMON CATHODE
12. COMMON ANODE
13. ANODE/CATHODE
14. ANODE/CATHODE

STYLE 8:
PIN 1. COMMON CATHODE
2. ANODE/CATHODE
3. ANODE/CATHODE
4. NO CONNECTION
5. ANODE/CATHODE
6. ANODE/CATHODE
7. COMMON ANODE
8. COMMON ANODE
9. ANODE/CATHODE
10. ANODE/CATHODE
11. NO CONNECTION
12. ANODE/CATHODE
13. ANODE/CATHODE
14. COMMON CATHODE

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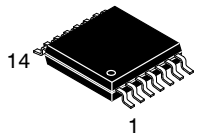

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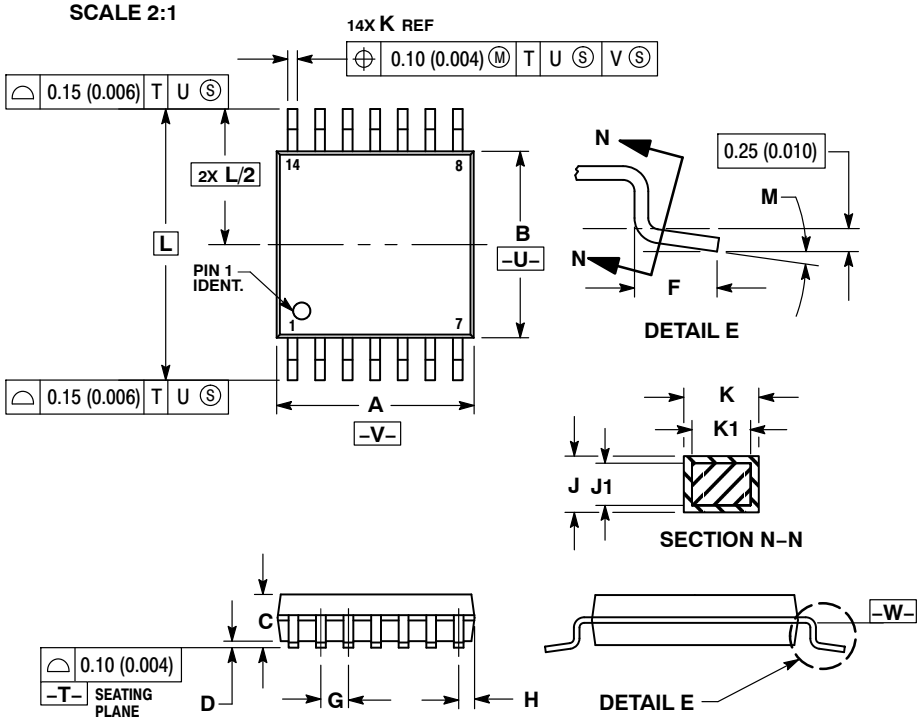
ISSUE C

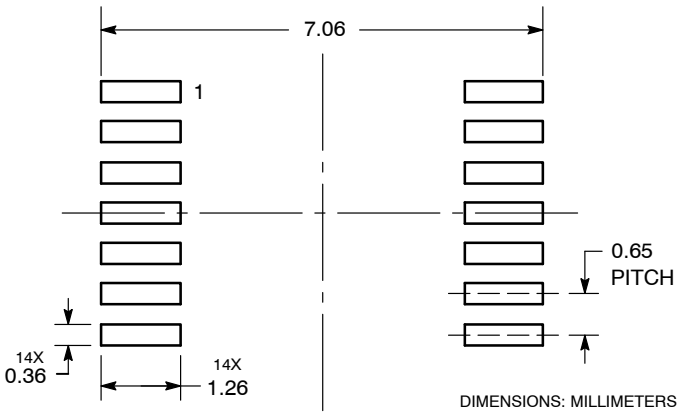
DATE 17 FEB 2016



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	0.50	0.60	0.020	0.024
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 °

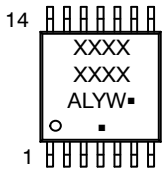
RECOMMENDED SOLDERING FOOTPRINT*



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.

GENERIC MARKING DIAGRAM*



A	= Assembly Location
L	= Wafer Lot
Y	= Year
W	= Work Week
▪	= Pb−Free Package

(Note: Microdot may be in either location)

*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−14 WB**	**PAGE 1 OF 1**

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