Low Voltage Hex Inverter with 5 V Tolerant Inputs

74LCX04

General Description

The LCX04 contains six inverters. The inputs tolerate voltages up to 5.5 V allowing the interface of 5 V systems to 3 V systems.

The 74LCX04 is fabricated with advanced CMOS technology to achieve high speed operation while maintaining CMOS low power dissipation.

Features

- 5 V Tolerant Inputs
- 1.65 V−5.5 V V_{CC} Specifications Provided
- 5.2 ns t_{PD} Max. (V_{CC} = 3.3 V), 10 μA I_{CC} Max.
- Power Down High Impedance Inputs and Outputs
- ±24 mA Output Drive (V_{CC} = 3.0 V)
- Implements Proprietary Noise/EMI Reduction Circuitry
- Latch−up Performance Exceeds JEDEC 78 Conditions
- ESD Performance:
  - Human Body Model > 2000 V
- Leadless DQFN Package
- These Devices are Pb−Free, Halide Free and are RoHS Compliant

PIN DESCRIPTION

Pin Name	Description
A_n, B_n	Inputs
$\overline{O}_n$	Outputs
DAP	No Connect

1. DAP (Die Attach Pad)

Logic Symbol

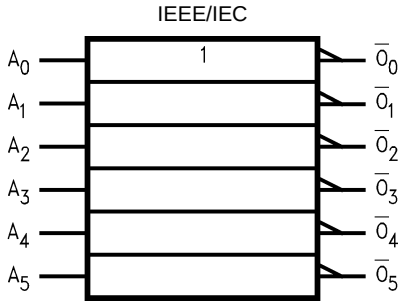
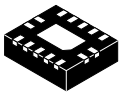


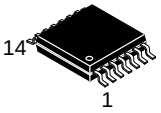
Figure 1. Logic Symbol

MARKING DIAGRAMS

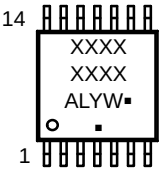


QFN14 3.0x2.5, 0.5P
CASE 510CB

XXXXXX = Specific Device Code
Z = Assembly Plant Code
XY = Date Code (Year & Week)
KK = Lot Run Traceability Code



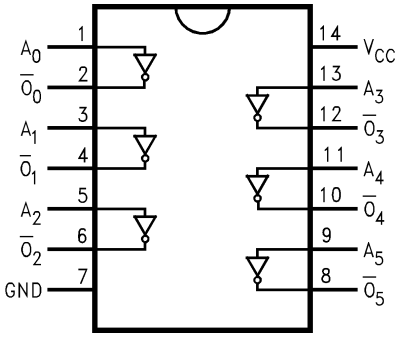
TSSOP−14 WB
DT SUFFIX
CASE 948G



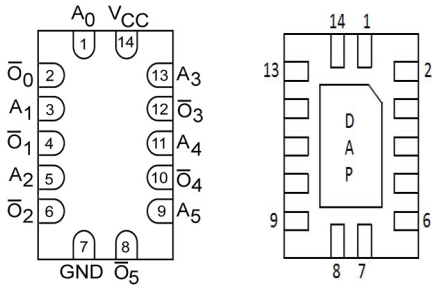
XXXXXX = Specific Device Code
A = Assembly Location
L = Wafer Lot
Y = Year
W = Work Week
▪ = Pb−Free Package

(Note: Microdot may be in either location)

CONNECTION DIAGRAMS



Pin Assignments for TSSOP



(Top View) (Bottom View)

Pad Assignments for DQFN

ORDERING INFORMATION

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

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter		Value	Unit
V_{CC}	DC Supply Voltage		−0.5 to +6.5	V
V_I	DC Input Voltage (Note 2)		−0.5 to +6.5	V
V_O	DC Output Voltage (Note 2)	Active−Mode (High or Low State)	−0.5 to V_{CC} + 0.5	V
		Tri−State Mode	−0.5 to +6.5	
		Power−Down Mode (V_{CC} = 0 V)	−0.5 to +6.5	
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 Seconds		260	°C
T_J	Junction Temperature under Bias		+150	°C
θ_{JA}	Thermal Resistance (Note 2)	QFN14	130	°C/W
		TSSOP−14	150	
P_D	Power Dissipation in Still Air at 125°C	QFN14	962	mW
		TSSOP−14	833	
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 4)	Human Body Model	2000	V
		Charged Device Model	N/A	

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.

2. I_O absolute maximum rating must be observed.
3. 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.
4. 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	1.65	3.3	5.5	V
		Data Retention Only	1.5	3.3	5.5	
V_I	Digital Input Voltage		0	−	5.5	V
V_O	Output Voltage	Active Mode (High or Low State)	0	−	V_{CC}	V
		Tri−State Mode	0	−	5.5	
		Power Down Mode (V_{CC} = 0 V)	0	−	5.5	
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	0	−	20	nS/V
		V_{CC} = 2.3 V to 2.7 V	0	−	20	
		V_{IN} from 0.8 V to 2.0 V, V_{CC} = 3.0 V	0	−	10	
		V_{CC} = 4.5 V to 5.5 V	0	−	5	

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.

5. 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	1.65−5.5	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	1.65−5.5	−	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	1.65−5.5	−	±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	1.65−5.5	−	10	−	10	μA
ΔI_{CC}	Increase in I_{CC} per Input	V_{IH} = V_{CC} – 0.6 V	2.3−3.6	−	500	−	500	μA

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 2 and 3	1.65−1.95	−	10	−	10	ns
			2.3−2.7	−	6.2	−	6.2	
			2.7	−	6.0	−	6.0	
			3.0−3.6	−	5.2	−	5.2	
			4.5−5.5	−	4.2	−	4.2	
t_{OSHL}, t_{OSLH}	Output to Output Skew		1.65−1.95	−	−	−	−	ns
			2.3−2.7	−	−	−	−	
			2.7	−	−	−	−	
			3.0−3.6	−	1.0	−	1.0	
			4.5−5.5	−	−	−	−	

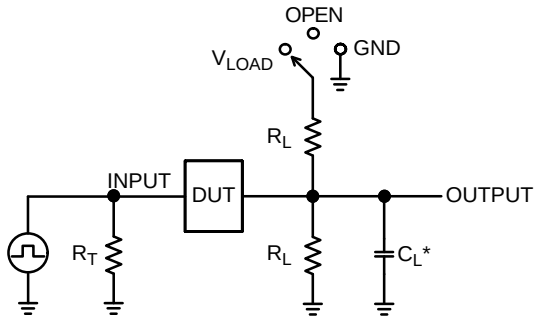
DYNAMIC SWITCHING CHARACTERISTICS

Symbol	Parameter	Condition	V_{CC} (V)	T_A = +25°C Typ	Unit
V_{OLP}	Quiet Output Dynamic Peak V_{OL}	C_L = 50 pF, V_{IH} = 3.3 V, V_{IL} = 0 V	3.3	0.8	V
		C_L = 30 pF, V_{IH} = 2.5 V, V_{IL} = 0 V	2.5	0.6	
V_{OLV}	Quiet Output Dynamic Valley V_{OL}	C_L = 50 pF, V_{IH} = 3.3 V, V_{IL} = 0 V	3.3	–0.8	V
		C_L = 30 pF, V_{IH} = 2.5 V, V_{IL} = 0 V	2.5	–0.6	

CAPACITANCE

Symbol	Parameter	Condition	Typ	Unit
C_{IN}	Input Capacitance	V_{CC} = Open, 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	V_{CC} = 3.3 V, V_I = 0 V or V_{CC}, f = 10 MHz	25	pF

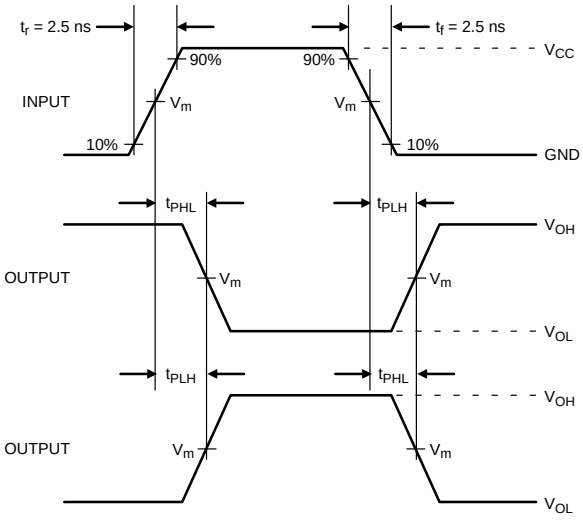
AC Loading and Waveforms (Generic for LCX Family)

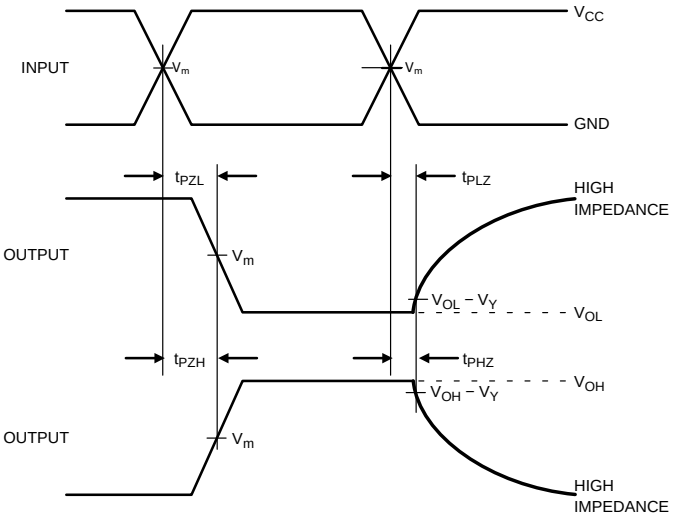


Test	Switch Position
t_{PLH} / t_{PHL}	Open
t_{PLZ} / t_{PZL}	V_{LOAD}
t_{PHZ} / t_{PZH}	GND

C_L includes probe and jig capacitance
R_T is Z_{OUT} of pulse generator (typically 50 Ω)
f = 1 MHz, t_W = 500 ns

Figure 2. 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 3. Switching Waveforms

Schematic Diagram (Generic for LCX Family)

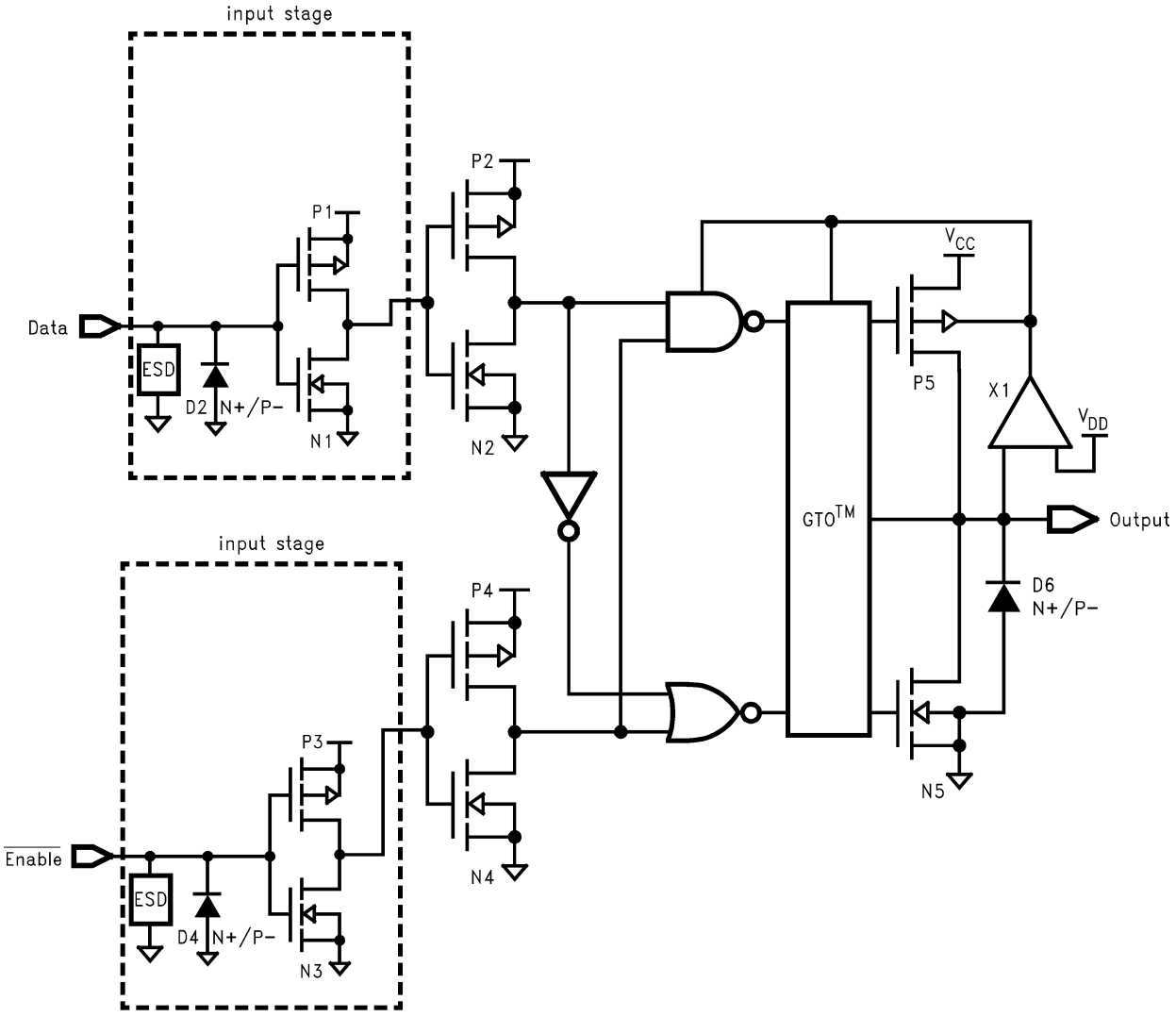


Figure 4. Schematic Diagram

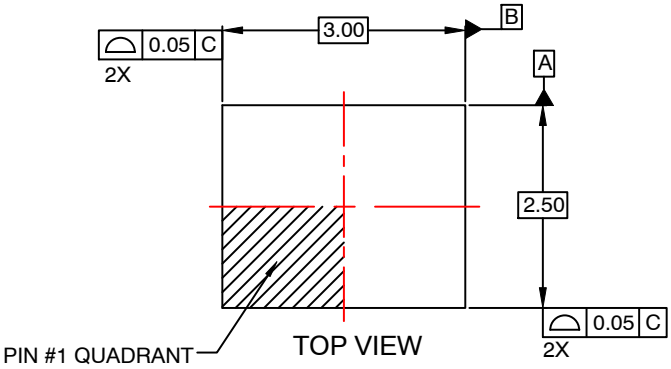
ORDERING INFORMATION

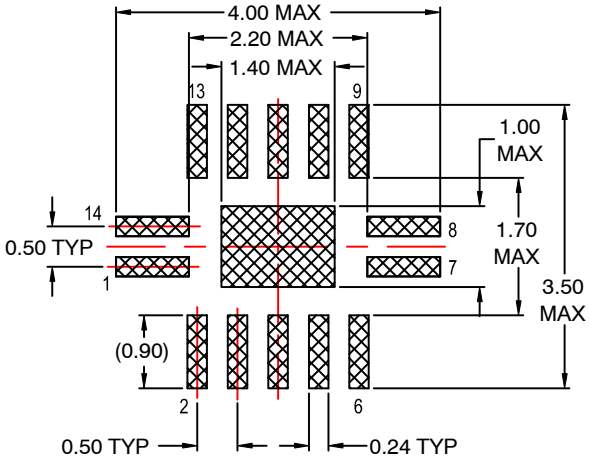
Device	Marking	Package	Shipping†
74LCX04MTC	LCX 04	TSSOP−14 (Pb−Free, Halide Free)	96 Units / Tube
74LCX04MTCX	LCX 04	TSSOP−14 (Pb−Free, Halide Free)	2500 Units / Tape & Reel
74LCX04BQX	LCX04	QFN14 (Pb−Free, Halide Free)	3000 Units / Tape & Reel

†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.

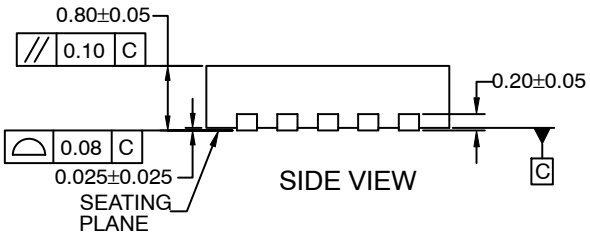
QFN14 3.0x2.5, 0.5P
CASE 510CB
ISSUE O

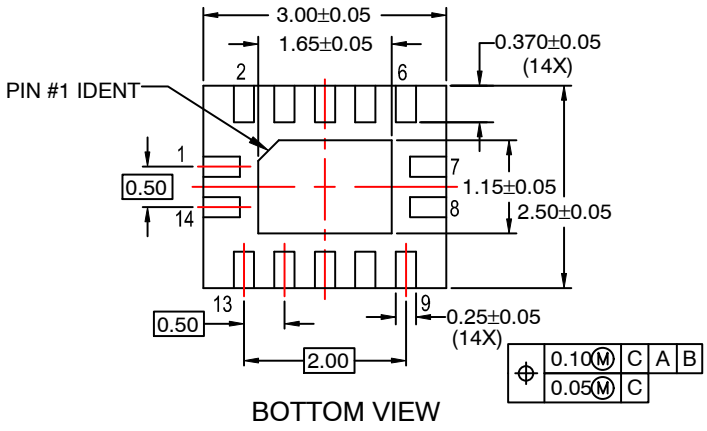
DATE 31 AUG 2016





RECOMMENDED LAND PATTERN





NOTES:

A. CONFORMS TO JEDEC REGISTRATION MO−241, VARIATION AA

B. DIMENSIONS ARE IN MILLIMETERS.

C. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 2009.

D. LAND PATTERN RECOMMENDATION IS EXISTING INDUSTRY LAND PATTERN.

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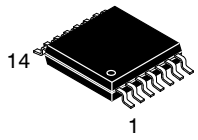
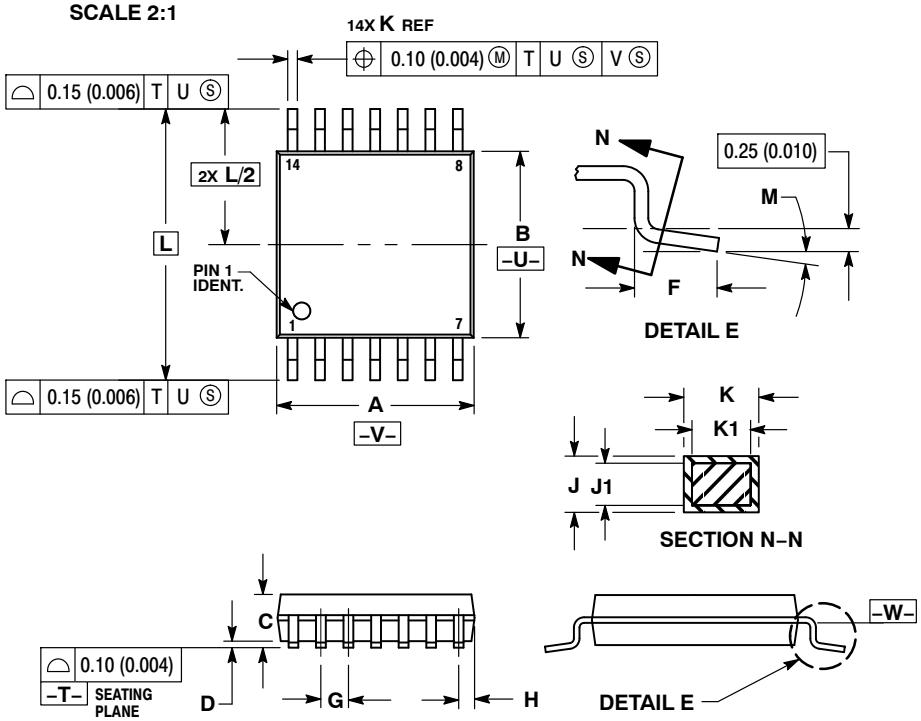
DESCRIPTION:	**QFN14 3.0X2.5, 0.5P**	**PAGE 1 OF 1**



SCALE 2:1

TSSOP−14 WB
CASE 948G
ISSUE C

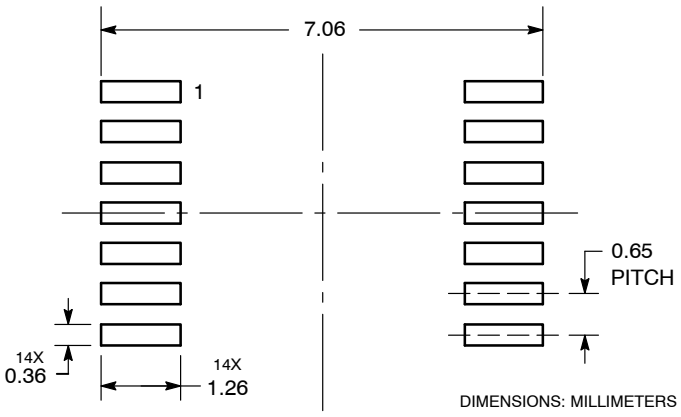
DATE 17 FEB 2016



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−.

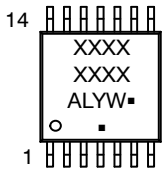
	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	4.90	5.10	0.193	0.200
B	4.30	4.50	0.169	0.177
C	−−−	1.20	−−−	0.047
D	0.05	0.15	0.002	0.006
F	0.50	0.75	0.020	0.030
G	0.65 BSC		0.026 BSC	
H	0.50	0.60	0.020	0.024
J	0.09	0.20	0.004	0.008
J1	0.09	0.16	0.004	0.006
K	0.19	0.30	0.007	0.012
K1	0.19	0.25	0.007	0.010
L	6.40 BSC		0.252 BSC	
M	0 °	8 °	0 °	8 °

RECOMMENDED SOLDERING FOOTPRINT*



*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**

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:
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