Hex Unbuffered Inverter

High−Performance Silicon−Gate CMOS

MC74HCU04A

The MC74HCU04A is identical in pinout to the LS04 and the MC14069UB. The device inputs are compatible with standard CMOS outputs; with pullup resistors, they are compatible with LSTTL outputs.

This device consists of six single−stage inverters. These inverters are well suited for use as oscillators, pulse shapers, and in many other applications requiring a high−input impedance amplifier. For digital applications, the HC04A is recommended.

Features

- Output Drive Capability: 10 LSTTL Loads
- Outputs Directly Interface to CMOS, NMOS, and TTL
- Operating Voltage Range: 2.0 to 6.0 V; 2.5 to 6.0 V in Oscillator Configurations
- Low Input Current: 1 μA
- High Noise Immunity Characteristic of CMOS Devices
- In Compliance With the JEDEC Standard No. 7.0 A Requirements
- Chip Complexity: 12 FETs or 3 Equivalent Gates
- −Q Suffix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC−Q100 Qualified and PPAP Capable
- These Devices are Pb−Free, Halogen Free and are RoHS Compliant

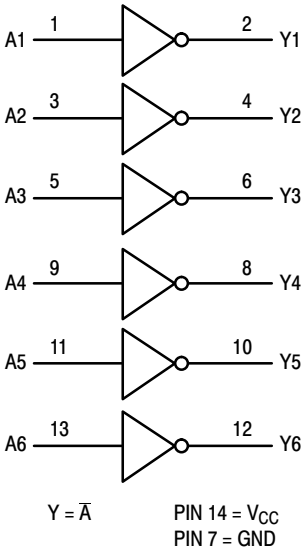
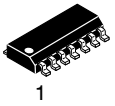
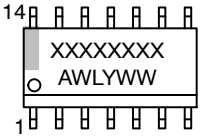


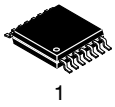
Figure 1. Logic Diagram

MARKING DIAGRAMS

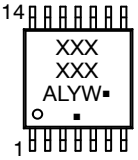


SOIC−14
D SUFFIX
CASE 751A





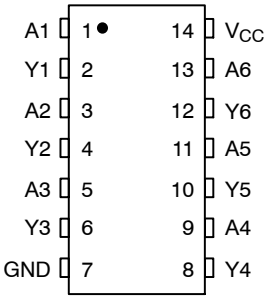
TSSOP−14
DT SUFFIX
CASE 948G



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

(Note: Microdot may be in either location)

PIN ASSIGNMENT



FUNCTION TABLE

Inputs A	Outputs Y
L	H
H	L

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_{in}	DC Input Voltage		−0.5 to +6.5	V
V_{out}	DC Output Voltage		−0.5 to V_{CC}+0.5	V
I_{IN}	DC Input Current, per Pin		±20	mA
I_{OUT}	DC Output Current, Per Pin		±25	mA
I_{CC}	DC Supply Current, V_{CC} and GND Pins		±50	mA
I_{IK}	Input Clamp Current		±20	mA
I_{OK}	Output Clamp Current		±20	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 25°C	SOIC−14 QFN14 TSSOP−20	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 2)	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. 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.
2. 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	Max	Unit
V_{CC}	DC Supply Voltage (Referenced to GND)	2.0	6.0	V
V_{in}, V_{out}	DC Input Voltage, Output Voltage (Referenced to GND)	0	V_{CC}	V
T_A	Operating Temperature, All Package Types	−55	+125	°C
t_r, t_f	Input Rise and Fall Time (Figure 2)	−	No Limit	ns

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.

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DC ELECTRICAL CHARACTERISTICS (MC74HCU04A)

Symbol	Parameter	Test Conditions	V_{CC} V	Guaranteed Limit –55 to 25°C	Guaranteed Limit ≤ 85°C	Guaranteed Limit ≤ 125°C	Unit
V_{IH}	Minimum High−Level Input Voltage		2.0 3.0 4.5 6.0	1.7 2.5 3.6 4.8	1.7 2.5 3.6 4.8	l.7 2.5 3.6 4.8	V
V_{IL}	Maximum Low−Level Input Voltage		2.0 3.0 4.5 6.0	0.3 0.5 0.8 1.1	0.3 0.5 0.8 1.1	0.3 0.5 0.8 1.1	V
V_{OH}	Minimum High−Level Output Voltage	V_{in} = GND $\|I_{out}\| \le 20$ μA	2.0 4.5 6.0	1.8 4.0 5.5	1.8 4.0 5.5	1.8 4.0 5.5	V
		V_{in} = GND $\|I_{out}\| \le 2.4$ mA $\|I_{out}\| \le 4.0$ mA $\|I_{out}\| \le 5.2$ mA	3.0 4.5 6.0	2.36 3.86 5.36	2.26 3.76 5.26	2.20 3.70 5.20	
V_{OL}	Maximum Low−Level Output Voltage	$V_{in} = V_{CC}$ $\|I_{out}\| \le 20$ μA	2.0 4.5 6.0	0.2 0.5 0.5	0.2 0.5 0.5	0.2 0.5 0.5	V
		$V_{in} = V_{CC}$ $\|I_{out}\| \le 2.4$ mA $\|I_{out}\| \le 4.0$ mA $\|I_{out}\| \le 5.2$ mA	3.0 4.5 6.0	0.32 0.32 0.32	0.32 0.37 0.37	0.32 0.40 0.40	
I_{in}	Maximum Input Leakage Current	$V_{in} = V_{CC}$ or GND	6.0	±0.1	±1.0	±1.0	μA
I_{CC}	Maximum Quiescent Supply Current (per Package)	$V_{in} = V_{CC}$ or GND I_{out} = 0 μA	6.0	1	10	40	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.

3. For V_{CC} = 2.0 V, V_{out} = 0.2 V or V_{CC} − 0.2 V.

AC ELECTRICAL CHARACTERISTICS (MC74HCU04A)

Symbol	Parameter	V_{CC} V	Guaranteed Limit –55 to 25°C	Guaranteed Limit ≤ 85°C	Guaranteed Limit ≤ 125°C	Unit
t_{PLH}, t_{PHL}	Maximum Propagation Delay, Input A to Output Y (Figures 2 and 3)	2.0 3.0 4.5 6.0	70 40 14 12	90 45 18 15	105 50 21 18	ns
t_{TLH}, t_{THL}	Maximum Output Transition Time, Any Output (Figures 2 and 3)	2.0 3.0 4.5 6.0	75 27 15 13	95 32 19 16	110 36 22 19	ns
C_{in}	Maximum Input Capacitance	–	10	10	10	pF

		Typical @ 25°C, V_{CC} = 5.0 V	
C_{PD}	Power Dissipation Capacitance (Per Inverter) (Note 4)	15	pF

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.

4. Used to determine the no−load dynamic power consumption: $P_D = C_{PD} V_{CC}^2 f + I_{CC} V_{CC}$.

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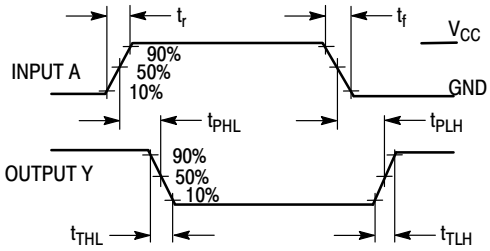
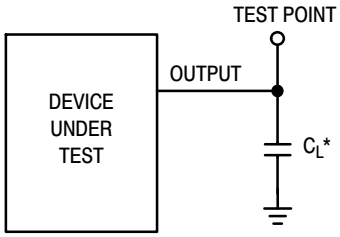


Figure 2. Switching Waveforms



*Includes all probe and jig capacitance

Figure 3. Test Circuit

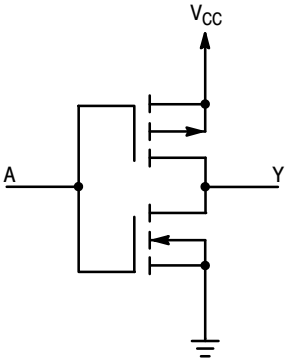


Figure 4. Logic Detail
(1/6 of Device Shown)

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TYPICAL APPLICATIONS

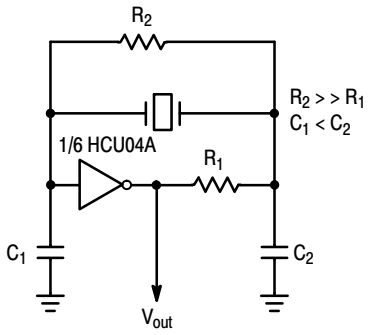


Figure 5. Crystal Oscillator

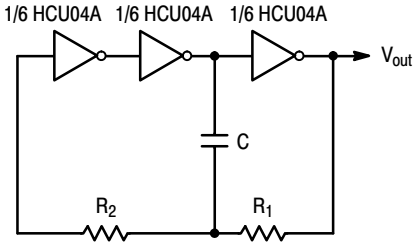


Figure 6. Stable RC Oscillator

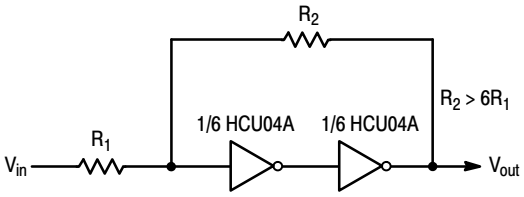


Figure 7. Schmitt Trigger

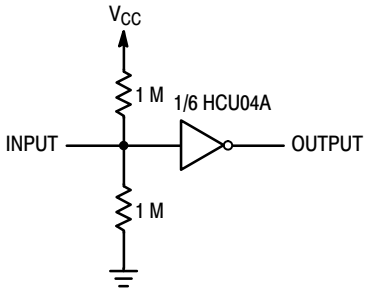


Figure 8. High Input Impedance Single−Stage Amplifier with a 2 to 6 V Supply Range

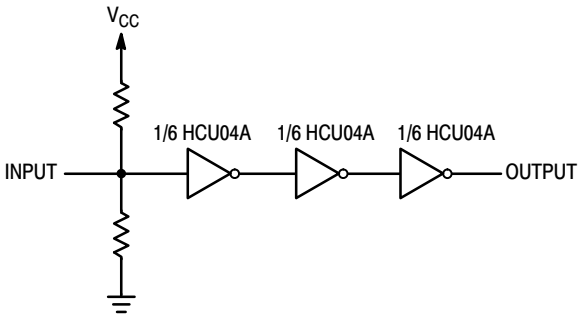
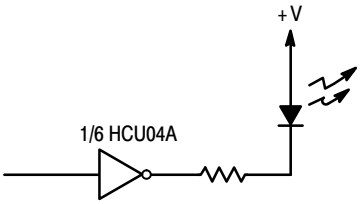


Figure 9. Multi−Stage Amplifier



For reduced power supply current, use high−efficiency LEDs such as the Hewlett−Packard HLMP series or equivalent.

Figure 10. LED Driver

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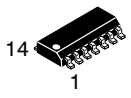
ORDERING INFORMATION

Device	Package	Marking	Shipping†
MC74HCU04ADG	SOIC−14	HCU04AG	55 Units / Rail
MC74HCU04ADR2G	SOIC−14	HCU04AG	2500 / Tape & Reel
MC74HCU04ADR2G−Q*	SOIC−14	HCU04AG	2500 / Tape & Reel
MC74HCU04ADTR2G	TSSOP−14	HCU 04A	2500 / Tape & Reel
MC74HCU04ADTR2G−Q*	TSSOP−14	HCU 04A	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.

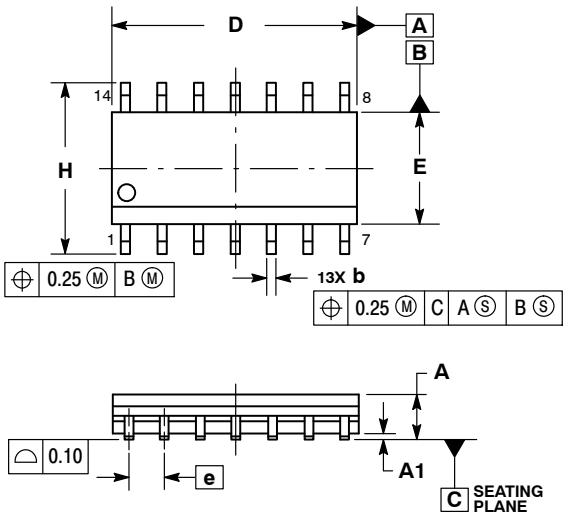
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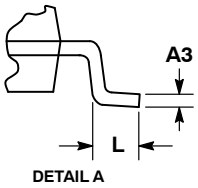


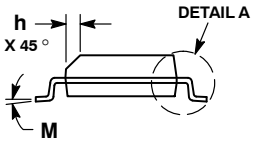
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ISSUE L

DATE 03 FEB 2016



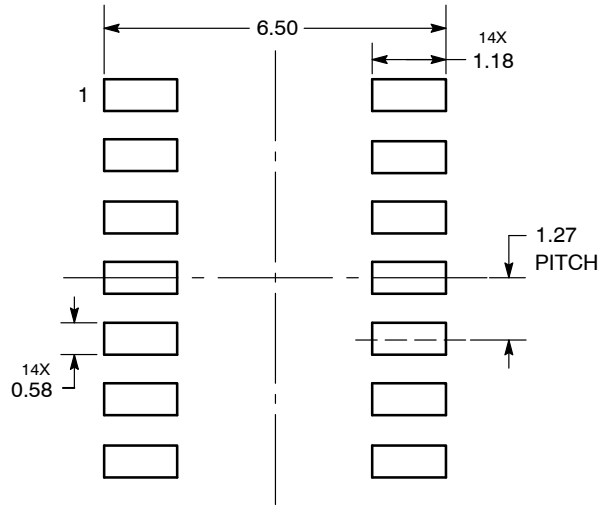




NOTES:
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2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF AT MAXIMUM MATERIAL CONDITION.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSIONS.
5. MAXIMUM 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 °

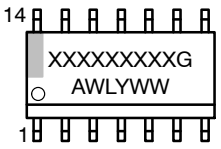
SOLDERING FOOTPRINT*



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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CASE 751A−03
ISSUE L

DATE 03 FEB 2016

STYLE 1:
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2. ANODE/CATHODE
3. ANODE/CATHODE
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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
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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
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9. ANODE/CATHODE
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14. COMMON ANODE

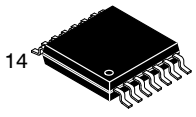
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13. ANODE
14. ANODE

STYLE 7:
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9. ANODE/CATHODE
10. ANODE/CATHODE
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12. COMMON ANODE
13. ANODE/CATHODE
14. ANODE/CATHODE

STYLE 8:
PIN 1. COMMON CATHODE
2. ANODE/CATHODE
3. ANODE/CATHODE
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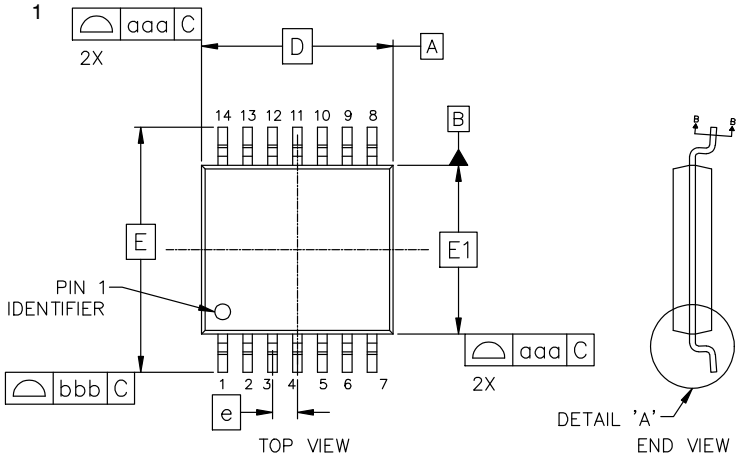
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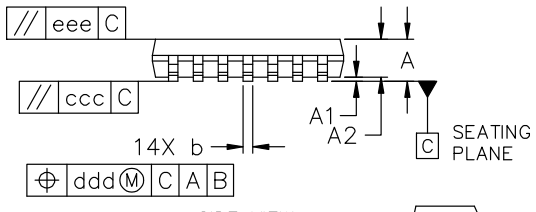
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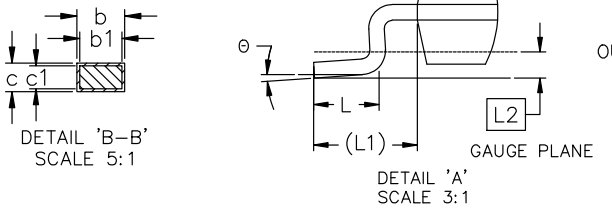


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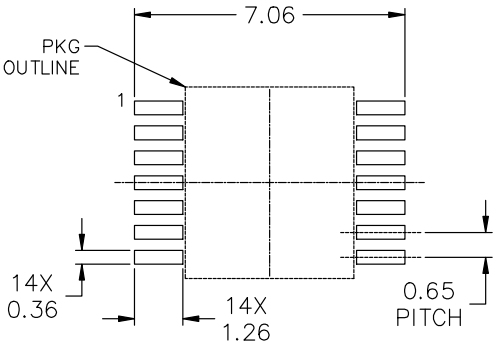
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MILLIMETERS			
DIM	MIN	NOM	MAX
A	−−−	−−−	1.20
A1	0.05	0.10	0.15
A2	0.85	0.95	1.05
b	0.19	0.25	0.30
b1	0.19	0.22	0.25
c	0.09	0.15	0.20
c1	0.09	0.12	0.16
D	5.00 BSC		
E	6.40 BSC		
E1	4.40 BSC		
e	0.65 BSC		
L	0.50	0.63	0.75
L1	1.00 REF		
L2	0.25 BSC		
θ	0°	4°	8°
TOLERANCE FORM & POSITION			
aaa	0.10		
bbb	0.15		
ccc	0.08		
ddd	0.10		
eee	0.10		

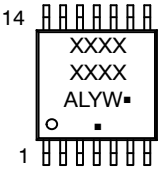


RECOMMENDED MOUNTING FOOTPRINT

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

NOTES:
1. DIMENSIONING AND TOLERANCING AS PER ASME Y14.5M, 2018.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION D DOES NOT INCLIDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 PER SIDE.
4. DIMENSION E1 DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 PER SIDE.
5. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 TOTAL IN EXCESS OF THE b DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.

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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