74LVC86A

Low-Voltage CMOS Quad 2-Input XOR Gate

With 5 V−Tolerant Inputs

The 74LVC86A is a high performance, quad 2−input XOR gate operating from a 1.2 to 3.6 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 74LVC86A inputs to be safely driven from 5.0 V devices.

Current drive capability is 24 mA at the outputs.

Features

- Designed for 1.2 to 3.6 V V_{CC} Operation
- 5.0 V Tolerant Inputs − Interface Capability With 5.0 V TTL Logic
- 24 mA Output Sink and Source Capability
- Near Zero Static Supply Current (10 μA) Substantially Reduces System Power Requirements
- ESD Performance: Human Body Model >2000 V
  Machine Model >200 V
- These Devices are Pb−Free, Halogen Free/BFR Free and are RoHS Compliant

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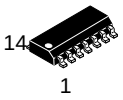
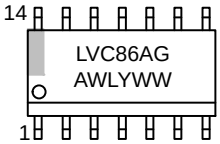
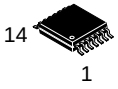
MARKING DIAGRAMS

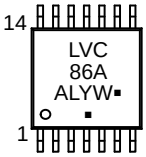


SOIC−14
D SUFFIX
CASE 751A





TSSOP−14
DT SUFFIX
CASE 948G



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)

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 7 of this data sheet.

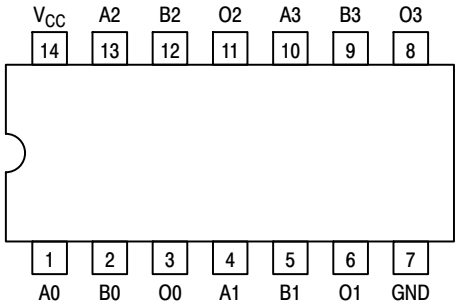


Figure 1. Pinout: 14−Lead (Top View)

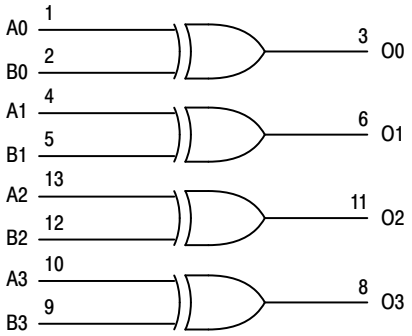


Figure 2. Logic Diagram

PIN NAMES

Pins	Function
An, Bn	Data Inputs
On	Outputs

TRUTH TABLE

Inputs		Outputs
An	**Bn**	**On**
L	L	L
L	H	H
H	L	H
H	H	L

MAXIMUM RATINGS

Symbol	Parameter	Value	Condition	Unit
V_{CC}	DC Supply Voltage	−0.5 to +6.5		V
V_I	DC Input Voltage	$-0.5 \le V_I \le +6.5$		V
V_O	DC Output Voltage	$-0.5 \le V_O \le V_{CC} + 0.5$	Output in HIGH or LOW State (Note 1)	V
I_{IK}	DC Input Diode Current	−50	V_I < GND	mA
I_{OK}	DC Output Diode Current	−50	V_O < GND	mA
		+50	$V_O > V_{CC}$	mA
I_O	DC Output Source/Sink Current	±50		mA
I_{CC}	DC Supply Current Per Supply Pin	±100		mA
I_{GND}	DC Ground Current Per Ground Pin	±100		mA
T_{STG}	Storage Temperature Range	−65 to +150		°C
T_L	Lead Temperature, 1 mm from Case for 10 Seconds	T_L = 260		°C
T_J	Junction Temperature Under Bias	T_J = 135		°C
θ_{JA}	Thermal Resistance (Note 2)	SOIC = 85 TSSOP = 100		°C/W
MSL	Moisture Sensitivity		Level 1	

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 10 mm−by−1 inch, 2 ounce copper trace no air flow.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Typ	Max	Units
V_{CC}	Supply Voltage Operating Functional	 1.65 1.2		 3.6 3.6	V
V_I	Input Voltage	0		5.5	V
V_O	Output Voltage HIGH or LOW State 3−State	 0 0		 V_{CC} 5.5	V
I_{OH}	HIGH Level Output Current V_{CC} = 3.0 V − 3.6 V V_{CC} = 2.7 V − 3.0 V			 −24 −12	mA
I_{OL}	LOW Level Output Current V_{CC} = 3.0 V − 3.6 V V_{CC} = 2.7 V − 3.0 V			 24 12	mA
T_A	Operating Free−Air Temperature	−40		+125	°C
$\Delta t/\Delta V$	Input Transition Rise or Fall Rate V_{CC} = 1.65 V to 2.7 V V_{CC} = 2.7 V to 3.6 V	 0 0		 20 10	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.

DC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Conditions	−40°C to +85°C			−40°C to +125°C			Unit
			Min	Typ (Note 3)	Max	Min	Typ (Note 3)	Max	
V_{IH}	HIGH−level input voltage	V_{CC} = 1.2 V	1.08	−	−	1.08	−	−	V
		V_{CC} = 1.65 V to 1.95 V	0.65 x V_{CC}	−	−	0.65 x V_{CC}	−	−	
		V_{CC} = 2.3 V to 2.7 V	1.7	−	−	1.7	−	−	
		V_{CC} = 2.7 V to 3.6 V	2.0	−	−	2.0	−	−	
V_{IL}	LOW−level input voltage	V_{CC} = 1.2 V	−	−	0.12	−	−	0.12	V
		V_{CC} = 1.65 V to 1.95 V	−	−	0.35 x V_{CC}	−	−	0.35 x V_{CC}	
		V_{CC} = 2.3 V to 2.7 V	−	−	0.7	−	−	0.7	
		V_{CC} = 2.7 V to 3.6 V	−	−	0.8	−	−	0.8	
V_{OH}	HIGH−level output voltage	V_I = V_{IH} or V_{IL}							V
		I_O = −100 μA; V_{CC} = 1.65 V to 3.6 V	V_{CC} − 0.2	−	−	V_{CC} − 0.3	−	−	
		I_O = −4 mA; V_{CC} = 1.65 V	1.2	−	−	1.05	−	−	
		I_O = −8 mA; V_{CC} = 2.3 V	1.8	−	−	1.65	−	−	
		I_O = −12 mA; V_{CC} = 2.7 V	2.2	−	−	2.05	−	−	
		I_O = −18 mA; V_{CC} = 3.0 V	2.4	−	−	2.25	−	−	
		I_O = −24 mA; V_{CC} = 3.0 V	2.2	−	−	2.0	−	−	
V_{OL}	LOW−level output voltage	V_I = V_{IH} or V_{IL}							V
		I_O = 100 μA; V_{CC} = 1.65 V to 3.6 V	−	−	0.2	−	−	0.3	
		I_O = 4 mA; V_{CC} = 1.65 V	−	−	0.45	−	−	0.65	
		I_O = 8 mA; V_{CC} = 2.3 V	−	−	0.6	−	−	0.8	
		I_O = 12 mA; V_{CC} = 2.7 V	−	−	0.4	−	−	0.6	
		I_O = 24 mA; V_{CC} = 3.0 V	−	−	0.55	−	−	0.8	
I_I	Input leakage current	V_I = 5.5V or GND V_{CC} = 3.6 V	−	±0.1	±5	−	±0.1	±20	μA
I_{OFF}	Power−off leakage current	V_I or V_O = 5.5 V; V_{CC} = 0.0 V	−	±0.1	±10	−	±0.1	±20	μA
I_{CC}	Supply current	V_I = V_{CC} or GND; I_O = 0 A; V_{CC} = 3.6 V	−	0.1	10	−	0.1	40	μA
ΔI_{CC}	Additional supply current	per input pin; V_I = V_{CC} − 0.6 V; I_O = 0 A; V_{CC} = 2.7 V to 3.6 V	−	5	500	−	5	5000	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. All typical values are measured at T_A = 25°C and V_{CC} = 3.3 V, unless stated otherwise.

AC ELECTRICAL CHARACTERISTICS ($t_R = t_F$ = 2.5 ns)

Symbol	Parameter	Conditions	−40°C to +85°C			−40°C to +125°C			Unit
			Min	Typ[1]	Max	Min	Typ[1]	Max	
t_{pd}	Propagation Delay (Note 5)	V_{CC} = 1.2 V	−	11.0	−	−	−	−	ns
		V_{CC} = 1.65 V to 1.95 V	0.5	4.1	9.8	0.5	−	11.4	ns
		V_{CC} = 2.3 V to 2.7 V	0.5	2.4	5.6	0.5	−	6.5	
		V_{CC} = 2.7 V	0.5	2.5	5.8	0.5	−	7.0	
		V_{CC} = 3.0 V to 3.6 V	0.5	2.2	5.0	0.5	−	6.0	
$t_{sk(0)}$	Output Skew Time (Note 6)	V_{CC} = 3.0 V to 3.6 V	−	−	1.0	−	−	1.5	ns

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. Typical values are measured at T_A = 25°C and V_{CC} = 3.3 V, unless stated otherwise.
5. t_{pd} is the same as t_{PLH} and t_{PHL}.
6. Skew is defined as the absolute value of the difference between the actual propagation delay for any two separate outputs of the same device. The specification applies to any outputs switching in the same direction, either HIGH−to−LOW (t_{OSHL}) or LOW−to−HIGH (t_{OSLH}); parameter guaranteed by design.

DYNAMIC SWITCHING CHARACTERISTICS

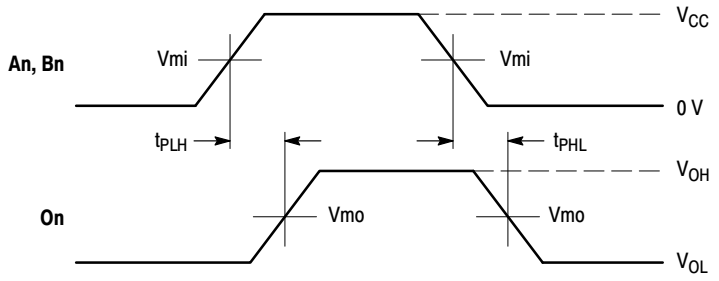
Symbol	Characteristic	Condition	T_A = +25°C			Unit
			Min	Typ	Max	
V_{OLP}	Dynamic LOW Peak Voltage (Note 7)	V_{CC} = 3.3 V, C_L = 50 pF, V_{IH} = 3.3 V, V_{IL} = 0 V V_{CC} = 2.5 V, C_L = 30 pF, V_{IH} = 2.5 V, V_{IL} = 0 V		0.8 0.6		V
V_{OLV}	Dynamic LOW Valley Voltage (Note 7)	V_{CC} = 3.3 V, C_L = 50 pF, V_{IH} = 3.3 V, V_{IL} = 0 V V_{CC} = 2.5 V, C_L = 30 pF, V_{IH} = 2.5 V, V_{IL} = 0 V		−0.8 −0.6		V

7. 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.

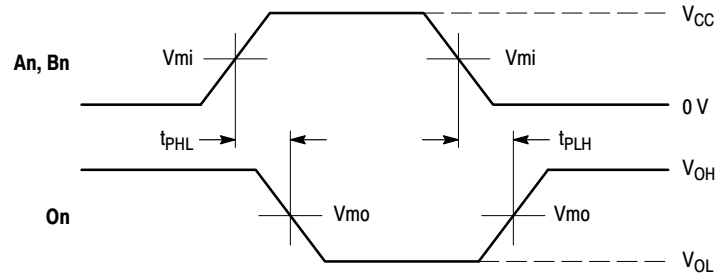
CAPACITIVE CHARACTERISTICS

Symbol	Parameter	Condition	Typical	Unit
C_{IN}	Input Capacitance	V_{CC} = 3.3 V, V_I = 0 V or V_{CC}	4.0	pF
C_{OUT}	Output Capacitance	V_{CC} = 3.3 V, V_I = 0 V or V_{CC}	5.0	pF
C_{PD}	Power Dissipation Capacitance (Note 8)	Per input; V_I = GND or V_{CC}		pF
		V_{CC} = 1.65 V to 1.95 V	12.5	
		V_{CC} = 2.3 V to 2.7 V	16.3	
		V_{CC} = 3.0 V to 3.6 V	19.7	

8. C_{PD} is used to determine the dynamic power dissipation (P_D in μW).
   $P_D = C_{PD} \times V_{CC}^2 \times fi \times N + \Sigma (C_L \times V_{CC}^2 \times fo)$ where:
   fi = input frequency in MHz; fo = output frequency in MHz
   C_L = output load capacitance in pF V_{CC} = supply voltage in Volts
   N = number of outputs switching
   $\Sigma(C_L \times V_{CC}^2 \times fo)$ = sum of the outputs.



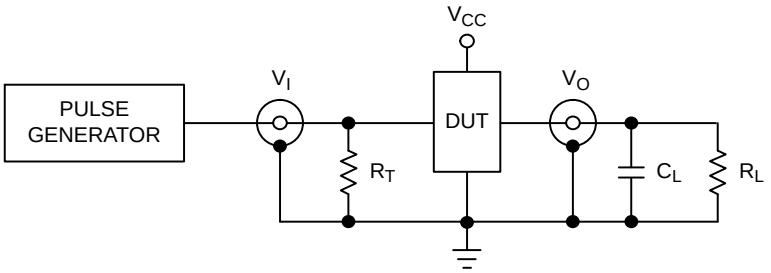
WAVEFORM 1 – NON–INVERTING PROPAGATION DELAYS
$t_R = t_F$ = 2.5 ns, 10% to 90%; f = 1 MHz; t_W = 500 ns



WAVEFORM 2 – INVERTING PROPAGATION DELAYS
$t_R = t_F$ = 2.5 ns, 10% to 90%; f = 1 MHz; t_W = 500 ns

Symbol	Vcc		
	3.3 V ± 0.3 V	**2.7 V**	**V_{CC} < 2.7 V**
Vmi	1.5 V	1.5 V	Vcc/2
Vmo	1.5 V	1.5 V	Vcc/2

Figure 3. AC Waveforms



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

Supply Voltage	Input		Load	
V_{CC} (V)	**V_I**	**t_r, t_f**	**C_L**	**R_L**
1.2	V_{CC}	≤ 2 ns	30 pF	1 kΩ
1.65 − 1.95	V_{CC}	≤ 2 ns	30 pF	1 kΩ
2.3 − 2.7	V_{CC}	≤ 2 ns	30 pF	500 Ω
2.7	2.7 V	≤ 2.5 ns	50 pF	500 Ω
3 − 3.6	2.7 V	≤ 2.5 ns	50 pF	500 Ω

Figure 4. Test Circuit

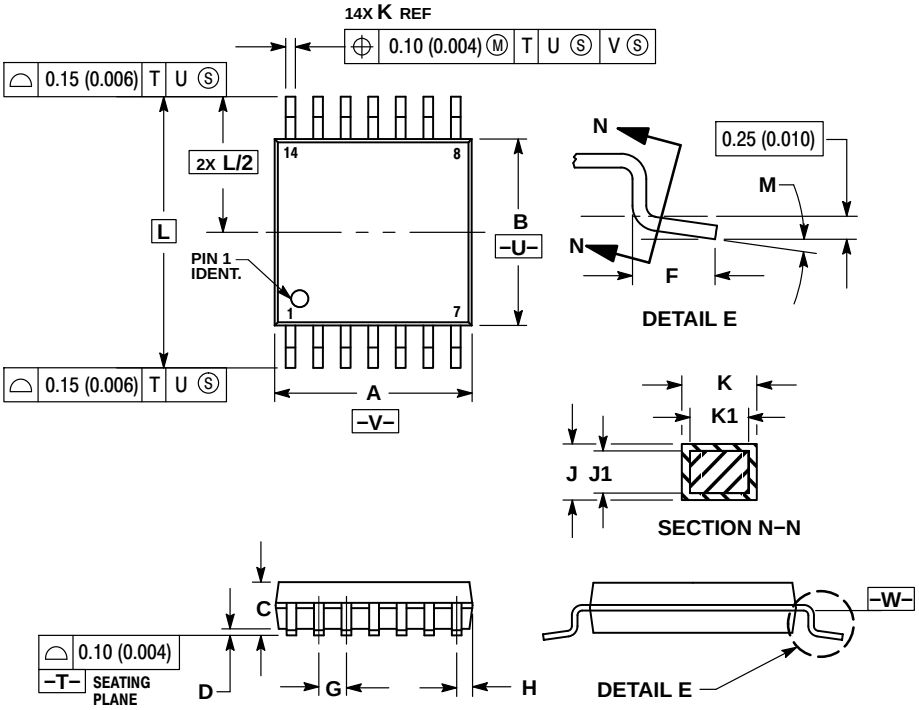
ORDERING INFORMATION

Device	Package	Shipping†
74LVC86ADR2G	SOIC−14 NB (Pb−Free)	2500 / Tape & Reel
74LVC86ADTR2G	TSSOP−14 (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.

PACKAGE DIMENSIONS

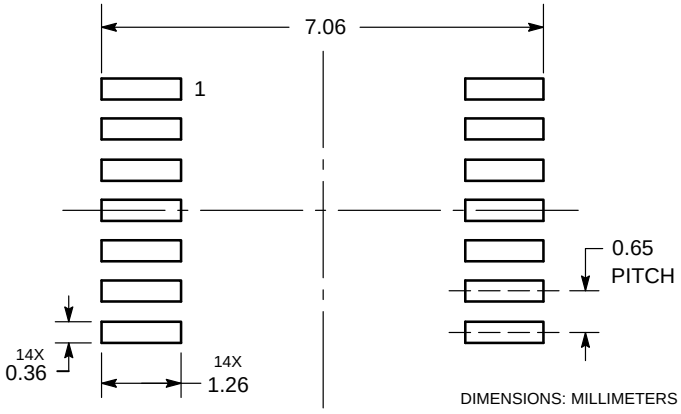
TSSOP−14
CASE 948G
ISSUE B



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 °

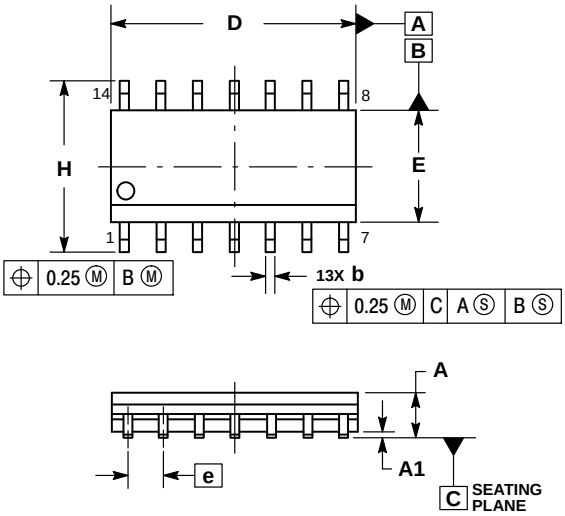
SOLDERING FOOTPRINT*

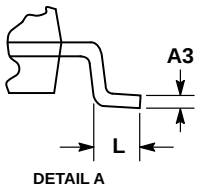


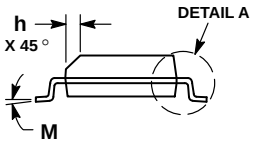
*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

PACKAGE DIMENSIONS

SOIC−14 NB
CASE 751A−03
ISSUE K



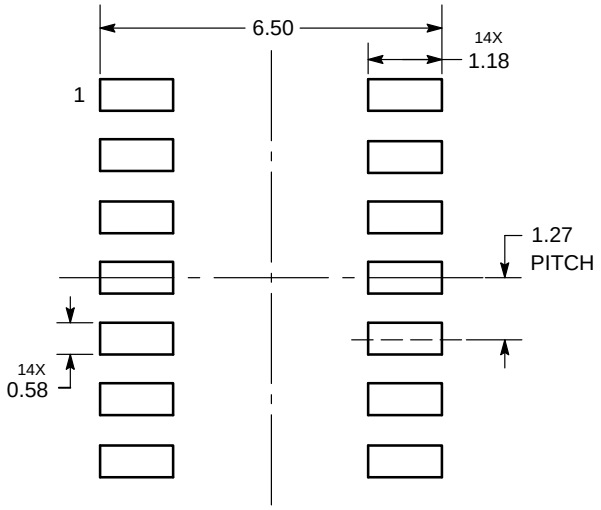




NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF AT MAXIMUM MATERIAL CONDITION.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSIONS.
5. MAXIMUM 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 ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
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Fax: 303−675−2176 or 800−344−3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

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