# MC74LVX74

# Dual D-Type Flip-Flop with Set and Clear

## With 5.0 V−Tolerant Inputs

The MC74LVX74 is an advanced high speed CMOS D−type flip−flop. The inputs tolerate voltages up to 7.0 V, allowing the interface of 5.0 V systems to 3.0 V systems.

The signal level applied to the D input is transferred to O output during the positive going transition of the Clock pulse.

Clear ($\overline{CD}$) and Set ($\overline{SD}$) are independent of the Clock (CP) and are accomplished by setting the appropriate input Low.

### Features

- High Speed: $f_{max}$ = 145 MHz (Typ) at $V_{CC}$ = 3.3 V
- Low Power Dissipation: $I_{CC}$ = 2 μA (Max) at $T_A$ = 25°C
- Power Down Protection Provided on Inputs
- Balanced Propagation Delays
- Low Noise: $V_{OLP}$ = 0.5 V (Max)
- Pin and Function Compatible with Other Standard Logic Families
- Latchup Performance Exceeds 300 mA
- ESD Performance:
  - Human Body Model > 2000 V;
  - Machine Model > 200 V
- These Devices are Pb−Free and are RoHS Compliant

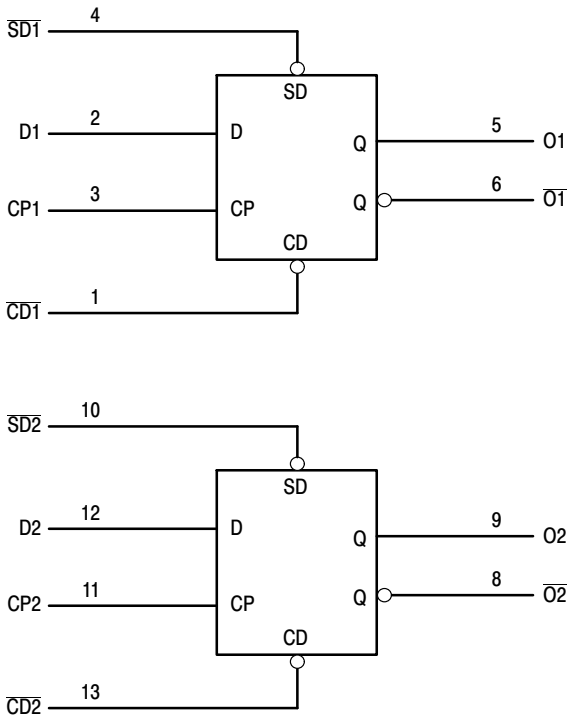


**Figure 1. Logic Diagram**

**ON Semiconductor®**

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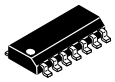
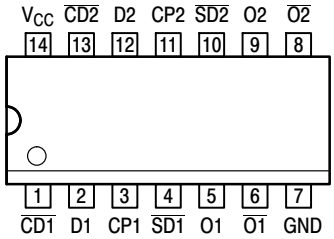


**SOIC−14 NB**
**D SUFFIX**
**CASE 751A**

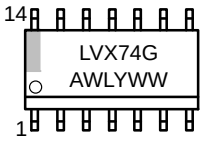
**TSSOP−14**
**DT SUFFIX**
**CASE 948G**

### PIN ASSIGNMENT

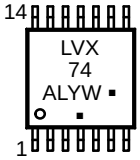



**14−Lead** (Top View)

### MARKING DIAGRAMS




**SOIC−14 NB**




**TSSOP−14**

| | |
|---|---|
| LVX74 | = Specific Device Code |
| A | = Assembly Location |
| WL, L | = Wafer Lot |
| Y | = Year |
| W, WW | = Work Week |
| G or ▪ | = Pb−Free Package |

(Note: Microdot may be in either location)

### PIN NAMES

| Pins | Function |
|---|---|
| CP1, CP2 | Clock Pulse Inputs |
| D1, D2 | Data Inputs |
| $\overline{CD1}$, $\overline{CD2}$ | Direct Clear Inputs |
| $\overline{SD1}$, $\overline{SD2}$ | Direct Set Inputs |
| On, $\overline{On}$ | Outputs |

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 5 of this data sheet.

| INPUTS | | | | OUTPUTS | | OPERATING MODE |
|---|---|---|---|---|---|---|
| $\overline{SDn}$ | $\overline{CDn}$ | CPn | Dn | On | $\overline{On}$ | |
| L | H | X | X | H | L | Asynchronous Set |
| H | L | X | X | L | H | Asynchronous Clear |
| L | L | X | X | H | H | Undetermined |
| H | H | ↑ | h | H | L | Load and Read Register |
| H | H | ↑ | l | L | H | |
| H | H | ↥ | X | NC | NC | Hold |

H = High Voltage Level; h = High Voltage Level One Setup Time Prior to the Low−to−High Clock Transition; L = Low Voltage Level; l = Low Voltage Level One Setup Time Prior to the Low−to−High Clock Transition; NC = No Change; X = High or Low Voltage Level or Transitions are Acceptable; ↑ = Low−to−High Transition; ↥ = Not a Low−to−High Transition; For $I_{CC}$ Reasons DO NOT FLOAT Inputs

## MAXIMUM RATINGS

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{CC}$ | DC Supply Voltage | –0.5 to +7.0 | V |
| $V_{in}$ | DC Input Voltage | –0.5 to +7.0 | V |
| $V_{out}$ | DC Output Voltage | –0.5 to $V_{CC}$ +0.5 | V |
| $I_{IK}$ | Input Diode Current | −20 | mA |
| $I_{OK}$ | Output Diode Current | ±20 | mA |
| $I_{out}$ | DC Output Current, per Pin | ±25 | mA |
| $I_{CC}$ | DC Supply Current, $V_{CC}$ and GND Pins | ±50 | mA |
| $P_D$ | Power Dissipation | 180 | mW |
| $T_{stg}$ | Storage Temperature | –65 to +150 | °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.

## RECOMMENDED OPERATING CONDITIONS

| Symbol | Parameter | Min | Max | Unit |
|---|---|---|---|---|
| $V_{CC}$ | DC Supply Voltage | 2.0 | 3.6 | V |
| $V_{in}$ | DC Input Voltage | 0 | 5.5 | V |
| $V_{out}$ | DC Output Voltage | 0 | $V_{CC}$ | V |
| $T_A$ | Operating Temperature, All Package Types | −40 | +85 | °C |
| $\Delta t/\Delta V$ | Input Rise and Fall Time | 0 | 100 | 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 | Test Conditions | $V_{CC}$ V | $T_A$ = 25°C | | | $T_A$ = − 40 to 85°C | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Min | Typ | Max | Min | Max | |
| $V_{IH}$ | High−Level Input Voltage | | 2.0<br>3.0<br>3.6 | 1.5<br>2.0<br>2.4 | | | 1.5<br>2.0<br>2.4 | | V |
| $V_{IL}$ | Low−Level Input Voltage | | 2.0<br>3.0<br>3.6 | | | 0.5<br>0.8<br>0.8 | | 0.5<br>0.8<br>0.8 | V |
| $V_{OH}$ | High−Level Output Voltage ($V_{in}$ = $V_{IH}$ or $V_{IL}$) | $I_{OH}$ = −50μA<br>$I_{OH}$ = −50μA<br>$I_{OH}$ = −4mA | 2.0<br>3.0<br>3.0 | 1.9<br>2.9<br>2.58 | 2.0<br>3.0 | | 1.9<br>2.9<br>2.48 | | V |
| $V_{OL}$ | Low−Level Output Voltage ($V_{in}$ = $V_{IH}$ or $V_{IL}$) | $I_{OL}$ = 50μA<br>$I_{OL}$ = 50μA<br>$I_{OL}$ = 4mA | 2.0<br>3.0<br>3.0 | | 0.0<br>0.0 | 0.1<br>0.1<br>0.36 | | 0.1<br>0.1<br>0.44 | V |
| $I_{in}$ | Input Leakage Current | $V_{in}$ = 5.5V or GND | 3.6 | | | ±0.1 | | ±1.0 | μA |
| $I_{CC}$ | Quiescent Supply Current | $V_{in}$ = $V_{CC}$ or GND | 3.6 | | | 2.0 | | 20.0 | 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** (Input $t_r = t_f = 3.0$ns)

| Symbol | Parameter | Test Conditions | | $T_A = 25°C$ Min | $T_A = 25°C$ Typ | $T_A = 25°C$ Max | $T_A = -40$ to $85°C$ Min | $T_A = -40$ to $85°C$ Max | Unit |
|---|---|---|---|---|---|---|---|---|---|
| $t_{PLH}$, $t_{PHL}$ | Propagation Delay CP to O or $\overline{O}$ | $V_{CC}$ = 2.7V | $C_L$ = 15pF | | 7.3 | 15.0 | 1.0 | 18.5 | ns |
| | | | $C_L$ = 50pF | | 9.8 | 18.5 | 1.0 | 22.0 | |
| | | $V_{CC}$ = 3.3 ± 0.3V | $C_L$ = 15pF | | 5.7 | 9.7 | 1.0 | 11.5 | |
| | | | $C_L$ = 50pF | | 8.2 | 13.2 | 1.0 | 15.0 | |
| $t_{PLH}$, $t_{PHL}$ | Propagation Delay $\overline{SD}$ or $\overline{CD}$ to O or $\overline{O}$ | $V_{CC}$ = 2.7V | $C_L$ = 15pF | | 8.4 | 15.6 | 1.0 | 18.5 | ns |
| | | | $C_L$ = 50pF | | 10.9 | 19.1 | 1.0 | 22.0 | |
| | | $V_{CC}$ = 3.3 ± 0.3V | $C_L$ = 15pF | | 6.6 | 10.1 | 1.0 | 12.0 | |
| | | | $C_L$ = 50pF | | 9.1 | 13.6 | 1.0 | 15.5 | |
| $f_{max}$ | Maximum Clock Frequency (50% Duty Cycle) | $V_{CC}$ = 2.7V | $C_L$ = 15pF | 55 | 135 | | 50 | | MHz |
| | | | $C_L$ = 50pF | 45 | 60 | | 40 | | |
| | | $V_{CC}$ = 3.3 ± 0.3V | $C_L$ = 15pF | 95 | 145 | | 80 | | |
| | | | $C_L$ = 50pF | 60 | 85 | | 50 | | |
| $t_{OSHL}$ $t_{OSLH}$ | Output−to−Output Skew (Note 1) | $V_{CC}$ = 2.7V | $C_L$ = 50pF | | | 1.5 | | 1.5 | ns |
| | | $V_{CC}$ = 3.3 ±0.3V | $C_L$ = 50pF | | | 1.5 | | 1.5 | |

1. 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.

**TIMING REQUIREMENTS** (Input $t_r = t_f = 3.0$ns)

| Symbol | Parameter | $V_{CC}$ V | Guaranteed Limit $T_A = 25°C$ | Guaranteed Limit $T_A = -40$ to $85°C$ | Unit |
|---|---|---|---|---|---|
| $t_w$ | Minimum Pulse Width, CP | 2.7V | 8.5 | 10.0 | ns |
| | | 3.3V ±0.3 | 6.0 | 7.0 | |
| $t_w$ | Minimum Pulse Width, $\overline{CD}$ or $\overline{SD}$ | 2.7V | 8.5 | 10.0 | ns |
| | | 3.3V ±0.3 | 6.0 | 7.0 | |
| $t_{su}$ | Minimum Setup Time, D to CP | 2.7V | 8.0 | 9.5 | ns |
| | | 3.3V ±0.3 | 5.5 | 6.5 | |
| $t_h$ | Minimum Hold Time, D to CP | 2.7V | 0.5 | 0.5 | ns |
| | | 3.3V ±0.3 | 0.5 | 0.5 | |
| $t_{rec}$ | Minimum Recovery Time, $\overline{SD}$ or $\overline{CD}$ to CP | 2.7V | 6.5 | 7.5 | ns |
| | | 3.3V ±0.3 | 5.0 | 5.0 | |

**CAPACITIVE CHARACTERISTICS**

| Symbol | Parameter | $T_A = 25°C$ Min | $T_A = 25°C$ Typ | $T_A = 25°C$ Max | $T_A = -40$ to $85°C$ Min | $T_A = -40$ to $85°C$ Max | Unit |
|---|---|---|---|---|---|---|---|
| Cin | Input Capacitance | | 4 | 10 | | 10 | pF |
| $C_{PD}$ | Power Dissipation Capacitance (Note 2) | | 25 | | | | pF |

2. $C_{PD}$ is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load. Average operating current can be obtained by the equation: $I_{CC(OPR)} = C_{PD} \bullet V_{CC} \bullet f_{in} + I_{CC}/2$ (per flip−flop). $C_{PD}$ is used to determine the no−load dynamic power consumption; $P_D = C_{PD} \bullet V_{CC}^2 \bullet f_{in} + I_{CC} \bullet V_{CC}$.

**NOISE CHARACTERISTICS** (Input $t_r = t_f = 3.0$ns, $C_L = 50$pF, $V_{CC} = 3.3$V, Measured in SOIC Package)

| Symbol | Characteristic | $T_A = 25°C$ Typ | $T_A = 25°C$ Max | Unit |
|---|---|---|---|---|
| $V_{OLP}$ | Quiet Output Maximum Dynamic $V_{OL}$ | 0.3 | 0.5 | V |
| $V_{OLV}$ | Quiet Output Minimum Dynamic $V_{OL}$ | −0.3 | −0.5 | V |
| $V_{IHD}$ | Minimum High Level Dynamic Input Voltage | | 2.0 | V |
| $V_{ILD}$ | Maximum Low Level Dynamic Input Voltage | | 0.8 | V |

## SWITCHING WAVEFORMS

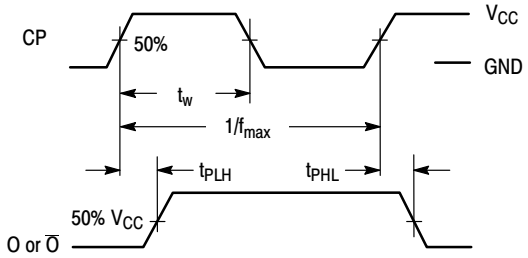



**Figure 2.**

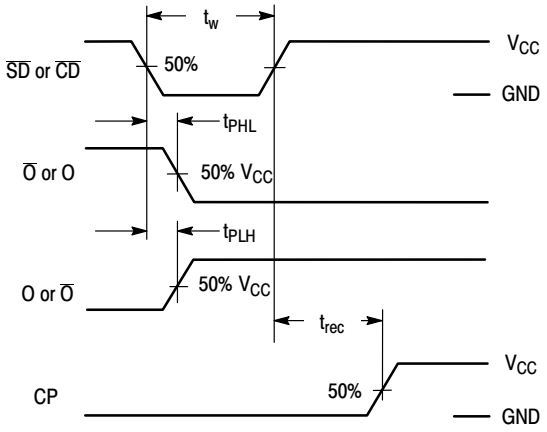



**Figure 3.**

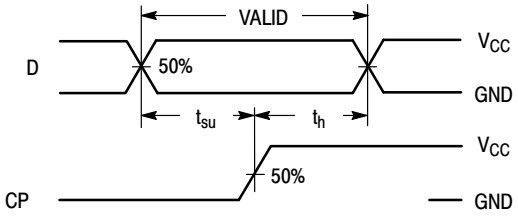
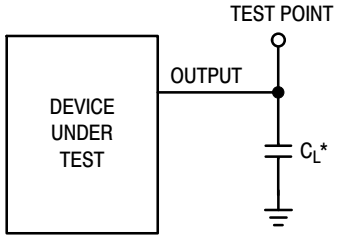



**Figure 4.**

## TEST CIRCUIT




*Includes all probe and jig capacitance

**Figure 5.**

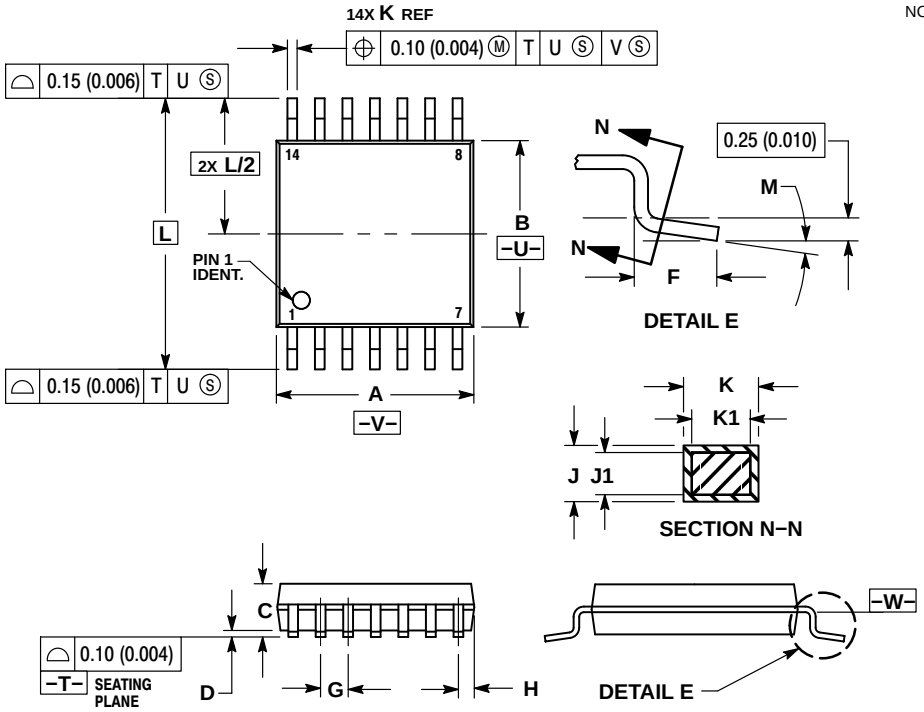
**ORDERING INFORMATION**

| Device | Package | Shipping† |
|---|---|---|
| MC74LVX74DR2G | SOIC−14 NB<br>(Pb−Free) | 2500 Tape & Reel |
| MC74LVX74DTG | TSSOP−14<br>(Pb−Free) | 96 Units / Rail |
| MC74LVX74DTR2G | TSSOP−14<br>(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

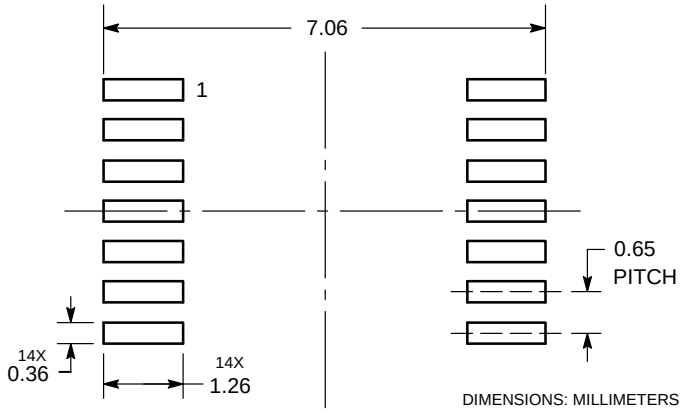
**TSSOP−14**
CASE 948G
ISSUE B




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 ° |

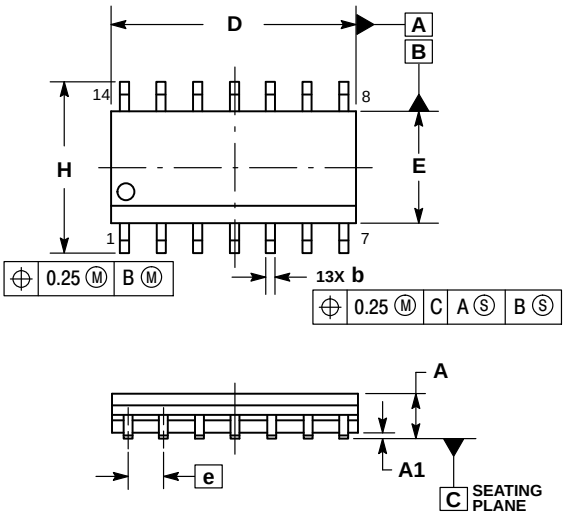
### SOLDERING FOOTPRINT*

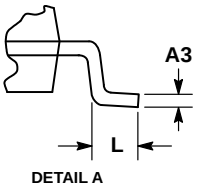


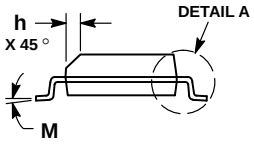

*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

## PACKAGE DIMENSIONS

**SOIC−14 NB**
CASE 751A−03
ISSUE K



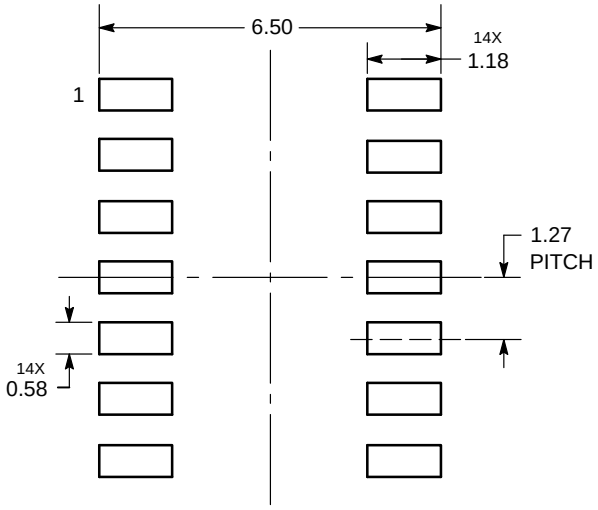




NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF AT MAXIMUM MATERIAL CONDITION.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSIONS.
5. MAXIMUM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

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

**N. American Technical Support**: 800−282−9855 Toll Free USA/Canada
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