

# MC74LCX374

## Low-Voltage CMOS Octal D-Type Flip-Flop

### With 5 V-Tolerant Inputs and Outputs (3-State, Non-Inverting)

The MC74LCX374 is a high performance, non-inverting octal D-type flip-flop operating from a 2.3 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 MC74LCX374 inputs to be safely driven from 5 V devices.

The MC74LCX374 consists of 8 edge-triggered flip-flops with individual D-type inputs and 3-state true outputs. The buffered clock and buffered Output Enable ( $\overline{OE}$ ) are common to all flip-flops. The eight flip-flops will store the state of individual D inputs that meet the setup and hold time requirements on the LOW-to-HIGH Clock (CP) transition. With the  $\overline{OE}$  LOW, the contents of the eight flip-flops are available at the outputs. When the  $\overline{OE}$  is HIGH, the outputs go to the high impedance state. The  $\overline{OE}$  input level does not affect the operation of the flip-flops.

#### Features

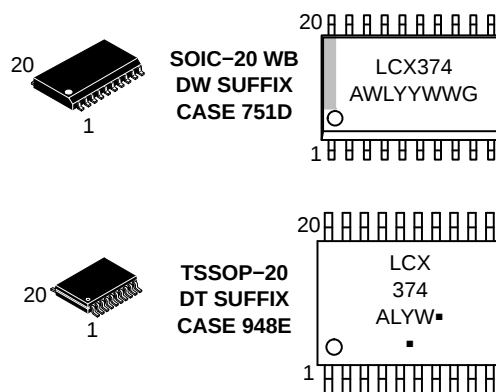
- Designed for 2.3 to 3.6 V  $V_{CC}$  Operation
- 5 V Tolerant – Interface Capability With 5 V TTL Logic
- Supports Live Insertion and Withdrawal
- $I_{OFF}$  Specification Guarantees High Impedance When  $V_{CC} = 0$  V
- LVTTTL Compatible
- LVCMOS Compatible
- 24 mA Balanced Output Sink and Source Capability
- Near Zero Static Supply Current in All Three Logic States (10  $\mu$ A)  
Substantially Reduces System Power Requirements
- Latchup Performance Exceeds 500 mA
- ESD Performance:
  - ♦ Human Body Model >2000 V
  - ♦ Machine Model >200 V
- NLV Prefix 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/BFR Free and are RoHS Compliant



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#### MARKING DIAGRAMS



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 3 of this data sheet.

# MC74LCX374

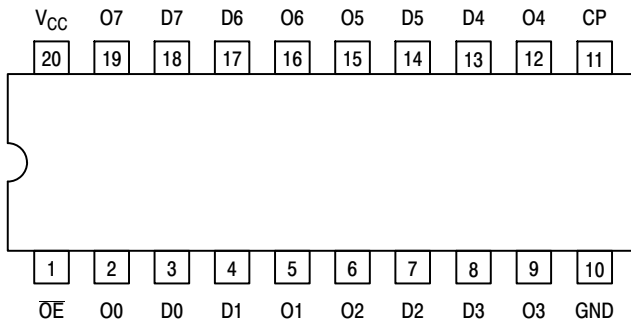


Figure 1. Pinout: 20-Lead (Top View)

## PIN NAMES

| Pins            | Function            |
|-----------------|---------------------|
| $\overline{OE}$ | Output Enable Input |
| CP              | Clock Pulse Input   |
| D0-D7           | Data Inputs         |
| O0-O7           | 3-State Outputs     |

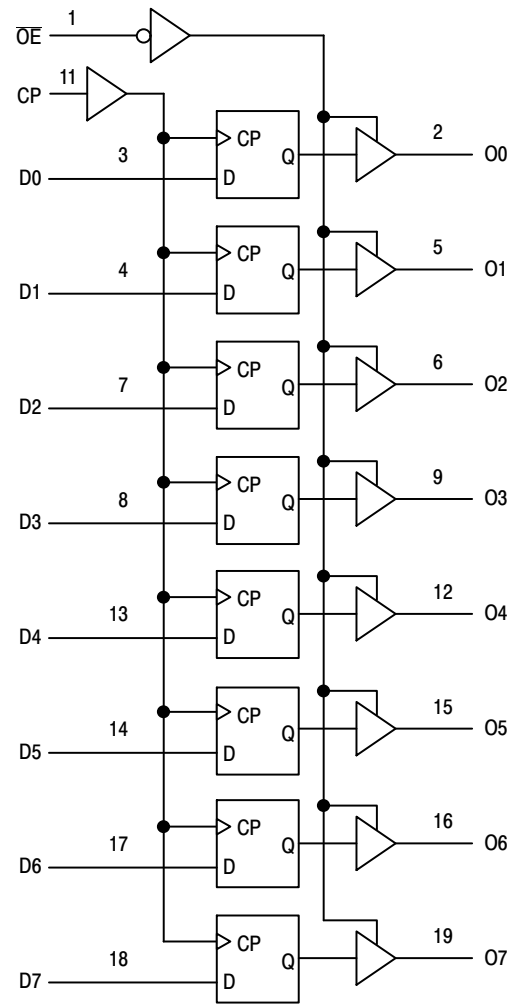


Figure 2. LOGIC DIAGRAM

## TRUTH TABLE

| INPUTS          |            |    | OUTPUTS | OPERATING MODE                             |
|-----------------|------------|----|---------|--------------------------------------------|
| $\overline{OE}$ | CP         | Dn | On      |                                            |
| L               | $\uparrow$ | L  | L       | Load and Read Register                     |
| L               | $\uparrow$ | h  | H       |                                            |
| L               | $\uparrow$ | X  | NC      | Hold and Read Register                     |
| H               | $\uparrow$ | X  | Z       | Hold and Disable Outputs                   |
| H               | $\uparrow$ | L  | Z       | Load Internal Register and Disable Outputs |
| H               | $\uparrow$ | h  | Z       |                                            |

- 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, State Prior to Low-to-High Clock Transition  
 X = High or Low Voltage Level and Transitions are Acceptable  
 Z = High Impedance State  
 $\uparrow$  = Low-to-High Transition  
 $\uparrow$  = Not a Low-to-High Transition; For  $I_{CC}$  Reasons, DO NOT FLOAT Inputs

# MC74LCX374

## MAXIMUM RATINGS

| Symbol    | Parameter                        | Value                             | Condition         | Units |
|-----------|----------------------------------|-----------------------------------|-------------------|-------|
| $V_{CC}$  | DC Supply Voltage                | -0.5 to +7.0                      |                   | V     |
| $V_I$     | DC Input Voltage                 | $-0.5 \leq V_I \leq +7.0$         |                   | V     |
| $V_O$     | DC Output Voltage                | $-0.5 \leq V_O \leq +7.0$         | Output in 3-State | V     |
|           |                                  | $-0.5 \leq V_O \leq V_{CC} + 0.5$ | (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    | $\pm 50$                          |                   | mA    |
| $I_{CC}$  | DC Supply Current Per Supply Pin | $\pm 100$                         |                   | mA    |
| $I_{GND}$ | DC Ground Current Per Ground Pin | $\pm 100$                         |                   | mA    |
| $T_{STG}$ | Storage Temperature Range        | -65 to +150                       |                   | °C    |
| 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. Output in HIGH or LOW State.  $I_O$  absolute maximum rating must be observed.

## RECOMMENDED OPERATING CONDITIONS

| Symbol              | Parameter                                                                                 | Min        | Typ        | Max             | Units |
|---------------------|-------------------------------------------------------------------------------------------|------------|------------|-----------------|-------|
| $V_{CC}$            | Supply Voltage<br>Operating<br>Data Retention Only                                        | 2.0<br>1.5 | 3.3<br>3.3 | 3.6<br>3.6      | V     |
| $V_I$               | Input Voltage                                                                             | 0          |            | 5.5             | V     |
| $V_O$               | Output Voltage<br>(HIGH or LOW State)<br>(3-State)                                        | 0<br>0     |            | $V_{CC}$<br>5.5 | V     |
| $I_{OH}$            | HIGH Level Output Current, $V_{CC} = 3.0\text{ V} - 3.6\text{ V}$                         |            |            | -24             | mA    |
| $I_{OL}$            | LOW Level Output Current, $V_{CC} = 3.0\text{ V} - 3.6\text{ V}$                          |            |            | 24              | mA    |
| $I_{OH}$            | HIGH Level Output Current, $V_{CC} = 2.7\text{ V} - 3.0\text{ V}$                         |            |            | -12             | mA    |
| $I_{OL}$            | LOW Level Output Current, $V_{CC} = 2.7\text{ V} - 3.0\text{ V}$                          |            |            | 12              | mA    |
| $T_A$               | Operating Free-Air Temperature                                                            | -40        |            | +85             | °C    |
| $\Delta t/\Delta V$ | Input Transition Rise or Fall Rate, $V_{IN}$ from 0.8 V to 2.0 V, $V_{CC} = 3.0\text{ V}$ | 0          |            | 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.

## ORDERING INFORMATION

| Device            | Package                 | Shipping†          |
|-------------------|-------------------------|--------------------|
| MC74LCX374DWR2G   | SOIC-20 WB<br>(Pb-Free) | 1000 / Tape & Reel |
| MC74LCX374DTR2G   | TSSOP-20<br>(Pb-Free)   | 2500 / Tape & Reel |
| NLV74LCX374DTR2G* | TSSOP-20<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.

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

# MC74LCX374

## DC ELECTRICAL CHARACTERISTICS

| Symbol           | Characteristic                        | Condition                                                                                                        | T <sub>A</sub> = -40°C to +85°C |      | Units |
|------------------|---------------------------------------|------------------------------------------------------------------------------------------------------------------|---------------------------------|------|-------|
|                  |                                       |                                                                                                                  | Min                             | Max  |       |
| V <sub>IH</sub>  | HIGH Level Input Voltage (Note 2)     | 2.7 V ≤ V <sub>CC</sub> ≤ 3.6 V                                                                                  | 2.0                             |      | V     |
| V <sub>IL</sub>  | LOW Level Input Voltage (Note 2)      | 2.7 V ≤ V <sub>CC</sub> ≤ 3.6 V                                                                                  |                                 | 0.8  | V     |
| V <sub>OH</sub>  | HIGH Level Output Voltage             | 2.7 V ≤ V <sub>CC</sub> ≤ 3.6 V; I <sub>OH</sub> = -100 μA                                                       | V <sub>CC</sub> - 0.2           |      | V     |
|                  |                                       | V <sub>CC</sub> = 2.7 V; I <sub>OH</sub> = -12 mA                                                                | 2.2                             |      |       |
|                  |                                       | V <sub>CC</sub> = 3.0 V; I <sub>OH</sub> = -18 mA                                                                | 2.4                             |      |       |
|                  |                                       | V <sub>CC</sub> = 3.0 V; I <sub>OH</sub> = -24 mA                                                                | 2.2                             |      |       |
| V <sub>OL</sub>  | LOW Level Output Voltage              | 2.7 V ≤ V <sub>CC</sub> ≤ 3.6 V; I <sub>OL</sub> = 100 μA                                                        |                                 | 0.2  | V     |
|                  |                                       | V <sub>CC</sub> = 2.7 V; I <sub>OL</sub> = 12 mA                                                                 |                                 | 0.4  |       |
|                  |                                       | V <sub>CC</sub> = 3.0 V; I <sub>OL</sub> = 16 mA                                                                 |                                 | 0.4  |       |
|                  |                                       | V <sub>CC</sub> = 3.0 V; I <sub>OL</sub> = 24 mA                                                                 |                                 | 0.55 |       |
| I <sub>OZ</sub>  | 3-State Output Current                | V <sub>CC</sub> = 3.6 V, V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> ,<br>V <sub>OUT</sub> = 0 to 5.5 V |                                 | ±5   | μA    |
| I <sub>OFF</sub> | Power Off Leakage Current             | V <sub>CC</sub> = 0, V <sub>IN</sub> = 5.5 V or V <sub>OUT</sub> = 5.5 V                                         |                                 | 10   | μA    |
| I <sub>IN</sub>  | Input Leakage Current                 | V <sub>CC</sub> = 3.6 V, V <sub>IN</sub> = 5.5 V or GND                                                          |                                 | ±5   | μA    |
| I <sub>CC</sub>  | Quiescent Supply Current              | V <sub>CC</sub> = 3.6 V, V <sub>IN</sub> = 5.5 V or GND                                                          |                                 | 10   | μA    |
| ΔI <sub>CC</sub> | Increase in I <sub>CC</sub> per Input | 2.3 ≤ V <sub>CC</sub> ≤ 3.6 V; V <sub>IH</sub> = V <sub>CC</sub> - 0.6 V                                         |                                 | 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.

2. These values of V<sub>I</sub> are used to test DC electrical characteristics only.

## AC CHARACTERISTICS (t<sub>R</sub> = t<sub>F</sub> = 2.5 ns; C<sub>L</sub> = 50 pF; R<sub>L</sub> = 500 Ω)

| Symbol                                 | Parameter                                       | Waveform | Limits                           |            |                         |            | Units |
|----------------------------------------|-------------------------------------------------|----------|----------------------------------|------------|-------------------------|------------|-------|
|                                        |                                                 |          | T <sub>A</sub> = −40°C to +85°C  |            |                         |            |       |
|                                        |                                                 |          | V <sub>CC</sub> = 3.0 V to 3.6 V |            | V <sub>CC</sub> = 2.7 V |            |       |
|                                        |                                                 |          | Min                              | Max        | Min                     | Max        |       |
| f <sub>max</sub>                       | Clock Pulse Frequency                           | 1        | 150                              |            |                         |            | MHz   |
| t <sub>PLH</sub><br>t <sub>PHL</sub>   | Propagation Delay<br>CP to O <sub>n</sub>       | 1        | 1.5<br>1.5                       | 8.5<br>8.5 | 1.5<br>1.5              | 9.5<br>9.5 | ns    |
| t <sub>PZH</sub><br>t <sub>PZL</sub>   | Output Enable Time to HIGH and<br>LOW Levels    | 2        | 1.5<br>1.5                       | 8.5<br>8.5 | 1.5<br>1.5              | 9.5<br>9.5 | ns    |
| t <sub>PHZ</sub><br>t <sub>PLZ</sub>   | Output Disable Time from HIGH and<br>LOW Levels | 2        | 1.5<br>1.5                       | 7.5<br>7.5 | 1.5<br>1.5              | 8.5<br>8.5 | ns    |
| t <sub>s</sub>                         | Setup Time, HIGH or LOW D <sub>n</sub> to CP    | 1        | 2.5                              |            | 2.5                     |            | ns    |
| t <sub>h</sub>                         | Hold Time, HIGH or LOW D <sub>n</sub> to CP     | 1        | 1.5                              |            | 1.5                     |            | ns    |
| t <sub>w</sub>                         | CP Pulse Width, HIGH or LOW                     | 3        | 3.3                              |            | 3.3                     |            | ns    |
| t <sub>OSHL</sub><br>t <sub>OSLH</sub> | Output-to-Output Skew (Note 3)                  |          |                                  | 1.0<br>1.0 |                         |            | ns    |

3. 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<sub>OSHL</sub>) or LOW-to-HIGH (t<sub>OSLH</sub>); parameter guaranteed by design.

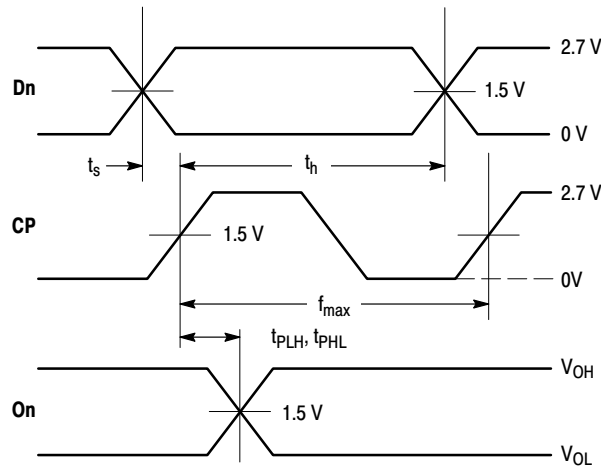
## DYNAMIC SWITCHING CHARACTERISTICS

| Symbol    | Characteristic                      | Condition                                                                                        | $T_A = +25^\circ\text{C}$ |     |     | Units |
|-----------|-------------------------------------|--------------------------------------------------------------------------------------------------|---------------------------|-----|-----|-------|
|           |                                     |                                                                                                  | Min                       | Typ | Max |       |
| $V_{OLP}$ | Dynamic LOW Peak Voltage (Note 4)   | $V_{CC} = 3.3\text{ V}$ , $C_L = 50\text{ pF}$ , $V_{IH} = 3.3\text{ V}$ , $V_{IL} = 0\text{ V}$ |                           | 0.8 |     | V     |
| $V_{OLV}$ | Dynamic LOW Valley Voltage (Note 4) | $V_{CC} = 3.3\text{ V}$ , $C_L = 50\text{ pF}$ , $V_{IH} = 3.3\text{ V}$ , $V_{IL} = 0\text{ V}$ |                           | 0.8 |     | V     |

4. 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.

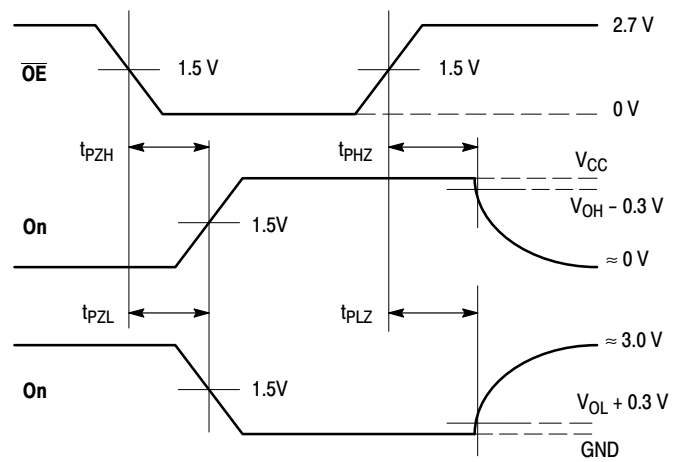
## CAPACITIVE CHARACTERISTICS

| Symbol    | Parameter                     | Condition                                                        | Typical | Units |
|-----------|-------------------------------|------------------------------------------------------------------|---------|-------|
| $C_{IN}$  | Input Capacitance             | $V_{CC} = 3.3\text{ V}$ , $V_I = 0\text{ V}$ or $V_{CC}$         | 7       | pF    |
| $C_{OUT}$ | Output Capacitance            | $V_{CC} = 3.3\text{ V}$ , $V_I = 0\text{ V}$ or $V_{CC}$         | 8       | pF    |
| $C_{PD}$  | Power Dissipation Capacitance | 10 MHz, $V_{CC} = 3.3\text{ V}$ , $V_I = 0\text{ V}$ or $V_{CC}$ | 25      | pF    |



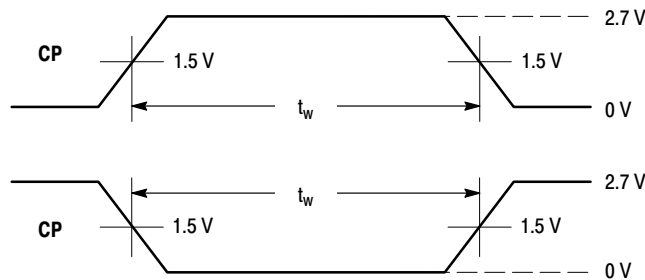
WAVEFORM 1 - PROPAGATION DELAYS, SETUP AND HOLD TIMES

$t_R = t_F = 2.5\text{ ns}$ , 10% to 90%;  $f = 1\text{ MHz}$ ;  $t_W = 500\text{ ns}$



WAVEFORM 2 - OUTPUT ENABLE AND DISABLE TIMES

$t_R = t_F = 2.5\text{ ns}$ , 10% to 90%;  $f = 1\text{ MHz}$ ;  $t_W = 500\text{ ns}$

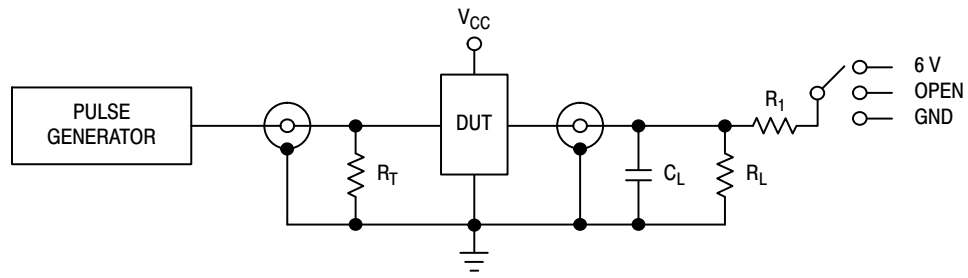


WAVEFORM 3 - PULSE WIDTH

$t_R = t_F = 2.5\text{ ns}$  (or fast as required) from 10% to 90%;  
Output requirements:  $V_{OL} \leq 0.8\text{ V}$ ,  $V_{OH} \geq 2.0\text{ V}$

Figure 3. AC Waveforms

## MC74LCX374



| TEST                                         | SWITCH |
|----------------------------------------------|--------|
| $t_{PLH}$ , $t_{PHL}$                        | Open   |
| $t_{PZL}$ , $t_{PLZ}$                        | 6 V    |
| Open Collector/Drain $t_{PLH}$ and $t_{PHL}$ | 6 V    |
| $t_{PZH}$ , $t_{PHZ}$                        | GND    |

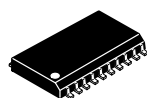
$C_L = 50$  pF or equivalent (Includes jig and probe capacitance)

$R_L = R_1 = 500 \Omega$  or equivalent

$R_T = Z_{OUT}$  of pulse generator (typically  $50 \Omega$ )

**Figure 4. Test Circuit**

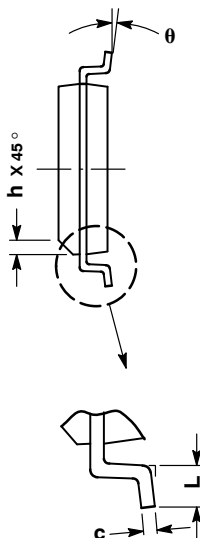
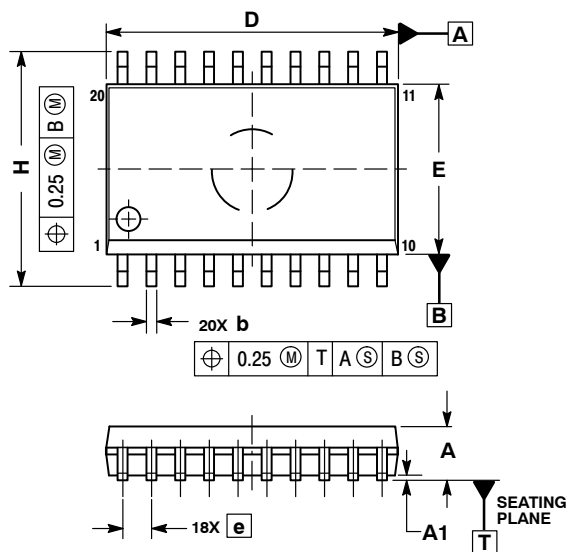
# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



SCALE 1:1

SOIC-20 WB  
CASE 751D-05  
ISSUE H

DATE 22 APR 2015

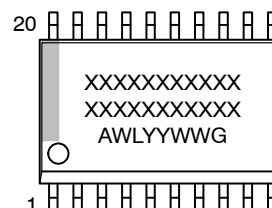


## NOTES:

1. DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.
5. DIMENSION B DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF B DIMENSION AT MAXIMUM MATERIAL CONDITION.

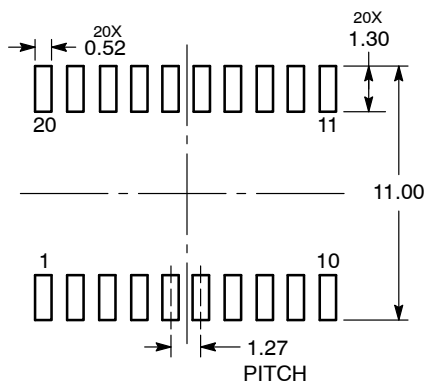
| DIM | MILLIMETERS |       |
|-----|-------------|-------|
|     | MIN         | MAX   |
| A   | 2.35        | 2.65  |
| A1  | 0.10        | 0.25  |
| b   | 0.35        | 0.49  |
| c   | 0.23        | 0.32  |
| D   | 12.65       | 12.95 |
| E   | 7.40        | 7.60  |
| e   | 1.27 BSC    |       |
| H   | 10.05       | 10.55 |
| h   | 0.25        | 0.75  |
| L   | 0.50        | 0.90  |
| θ   | 0°          | 7°    |

## GENERIC MARKING DIAGRAM\*



XXXXXX = Specific Device Code  
A = Assembly Location  
WL = Wafer Lot  
YY = Year  
WW = Work Week  
G = Pb-Free Package

## RECOMMENDED 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.

\*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:     | SOIC-20 WB  | PAGE 1 OF 1                                                                                                                                                                         |

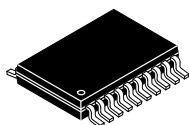
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# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

ON Semiconductor®

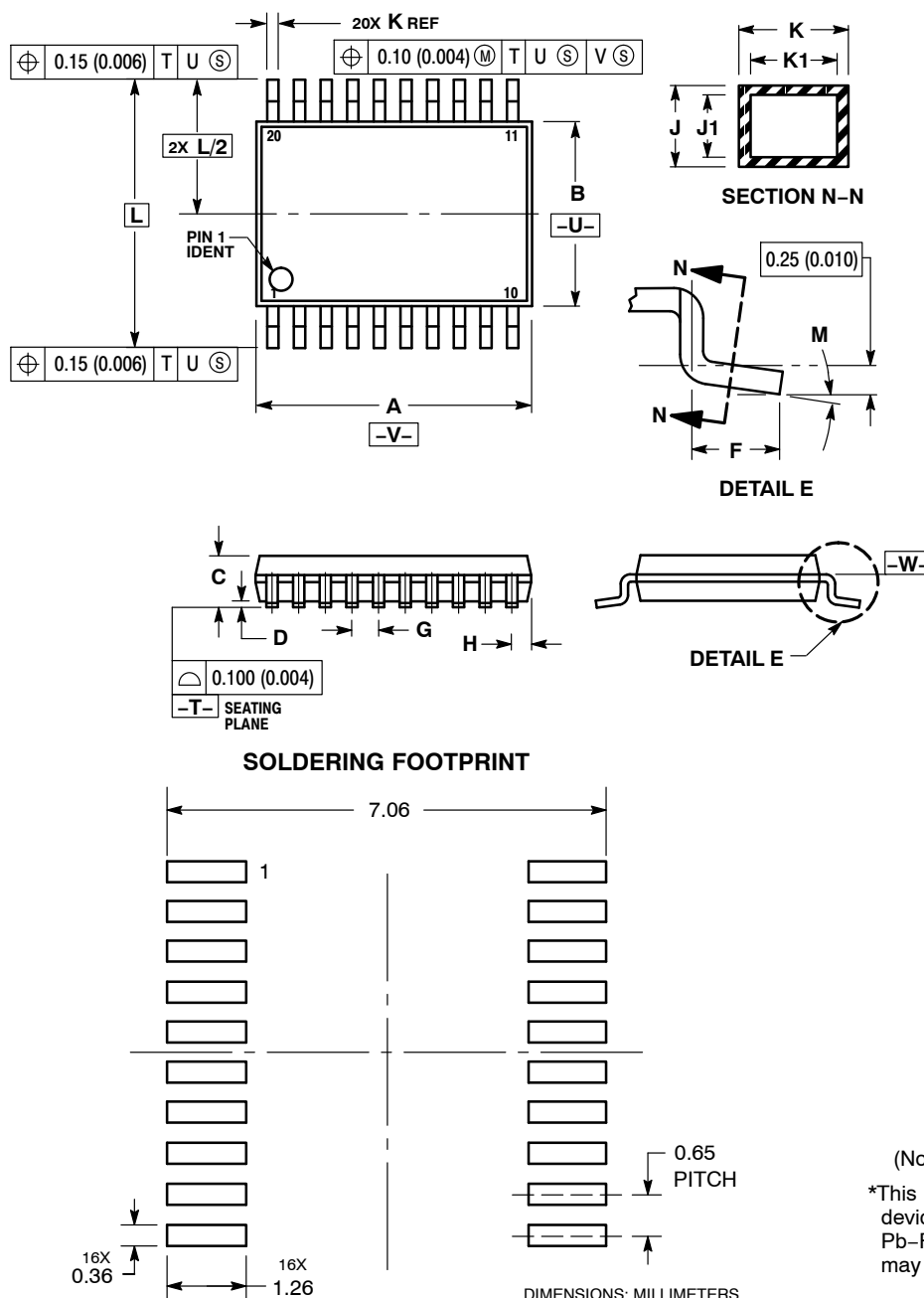
ON



SCALE 2:1

TSSOP-20 WB  
CASE 948E  
ISSUE D

DATE 17 FEB 2016

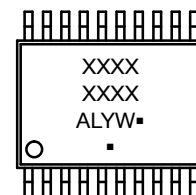


### NOTES:

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-.

| DIM | MILLIMETERS |      | INCHES    |       |
|-----|-------------|------|-----------|-------|
|     | MIN         | MAX  | MIN       | MAX   |
| A   | 6.40        | 6.60 | 0.252     | 0.260 |
| 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   | 0.27        | 0.37 | 0.011     | 0.015 |
| 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°    |

### 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.

|                  |             |                                                                                                                                                                                  |
|------------------|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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| DESCRIPTION:     | TSSOP-20 WB | PAGE 1 OF 1                                                                                                                                                                      |

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