

# Low Voltage Quad 2-Input NOR Gate with 5 V Tolerant Inputs

## 74LCX02

### General Description

The LCX02 contains four 2-input NOR gates. The inputs tolerate voltages up to 5.5 V allowing the interface of 5 V systems to 3 V systems.

The 74LCX02 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  $\mu$ A  $I_{CC}$  Max.
- Power Down High Impedance Inputs and Outputs
- $\pm 24$  mA Output Drive ( $V_{CC} = 3.0$  V)
- Implements Proprietary Noise/EMI Reduction Circuitry
- Latch-up Performance Exceeds 100 mA
- ESD Performance:
  - ♦ Human Body Model > 2000 V
- This Device is Pb-Free, Halide Free and RoHS Compliant

### Logic Symbol

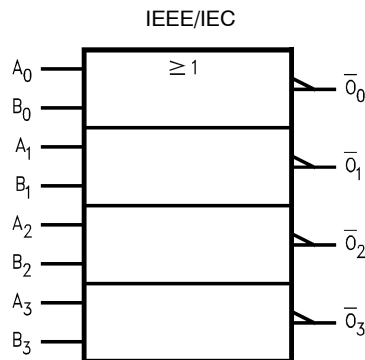
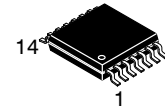


Figure 1. Logic Symbol

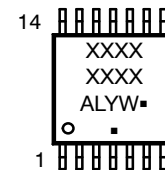
### PIN DESCRIPTION

| Pin Name    | Description |
|-------------|-------------|
| $A_n, B_n$  | Inputs      |
| $\bar{O}_n$ | Outputs     |



TSSOP-14 WB  
CASE 948G

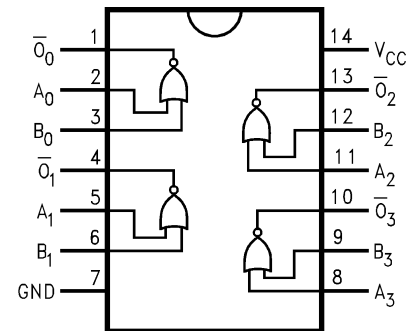
### MARKING DIAGRAMS



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



### 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 1)                      |                                   | -0.5 to +6.5           | V    |
| $V_O$                 | DC Output Voltage (Note 1)                     | Active-Mode (High or Low State)   | -0.5 to $V_{CC} + 0.5$ | V    |
|                       |                                                | Tri-State Mode                    | -0.5 to +6.5           | V    |
|                       |                                                | Power-Down Mode ( $V_{CC} = 0$ V) | -0.5 to +6.5           | V    |
| $I_{IK}$              | 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                |                                   | $\pm 50$               | mA   |
| $I_{CC}$ or $I_{GND}$ | DC Supply Current per Supply Pin or Ground Pin |                                   | $\pm 100$              | 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   |
| $\theta_{JA}$         | Thermal Resistance (Note 1)                    |                                   | 150                    | °C/W |
| $P_D$                 | Power Dissipation in Still Air at 125 °C       |                                   | 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 3)                 | Human Body Model                  | 2000                   | V    |
|                       |                                                | Charged Device Model              | 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.  $I_O$  absolute maximum rating must be observed.
2. 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.
3. 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       |      |
|            |                                | $V_I$ 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.

4. 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.

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## DC ELECTRICAL CHARACTERISTICS

| Symbol           | Parameter                             | Conditions                                          | V <sub>CC</sub> (V) | T <sub>A</sub> = -40 °C to +85 °C |                        | T <sub>A</sub> = -40 °C to +125 °C |                        | Unit |
|------------------|---------------------------------------|-----------------------------------------------------|---------------------|-----------------------------------|------------------------|------------------------------------|------------------------|------|
|                  |                                       |                                                     |                     | Min                               | Max                    | Min                                | Max                    |      |
| V <sub>IH</sub>  | HIGH Level Input Voltage              |                                                     | 1.65 – 1.95         | 0.65 x V <sub>CC</sub>            | –                      | 0.65 x V <sub>CC</sub>             | –                      | 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 <sub>CC</sub>            | –                      | 0.70 x V <sub>CC</sub>             | –                      |      |
| V <sub>IL</sub>  | LOW Level Input Voltage               |                                                     | 1.65 – 1.95         | –                                 | 0.35 x V <sub>CC</sub> | –                                  | 0.35 x V <sub>CC</sub> | 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 <sub>CC</sub> | –                                  | 0.30 x V <sub>CC</sub> |      |
| V <sub>OH</sub>  | High-Level Output Voltage             | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> | 1.65 to 5.5         | V <sub>CC</sub> – 0.1             | –                      | V <sub>CC</sub> – 0.1              | –                      | V    |
|                  |                                       | I <sub>OH</sub> = -100 µA                           | 1.65                | 1.29                              | –                      | 1.29                               | –                      |      |
|                  |                                       | I <sub>OH</sub> = -4 mA                             | 2.3                 | 1.8                               | –                      | 1.8                                | –                      |      |
|                  |                                       | I <sub>OH</sub> = -8 mA                             | 2.7                 | 2.2                               | –                      | 2.2                                | –                      |      |
|                  |                                       | I <sub>OH</sub> = -12 mA                            | 3.0                 | 2.4                               | –                      | 2.4                                | –                      |      |
|                  |                                       | I <sub>OH</sub> = -16 mA                            | 3.0                 | 2.2                               | –                      | 2.2                                | –                      |      |
|                  |                                       | I <sub>OH</sub> = -24 mA                            | 4.5                 | 3.7                               | –                      | 3.7                                | –                      |      |
| V <sub>OL</sub>  | Low-Level Output Voltage              | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> | 1.65 to 5.5         | –                                 | 0.1                    | –                                  | 0.1                    | V    |
|                  |                                       | I <sub>OL</sub> = 100 µA                            | 1.65                | –                                 | 0.24                   | –                                  | 0.24                   |      |
|                  |                                       | I <sub>OL</sub> = 4 mA                              | 2.3                 | –                                 | 0.3                    | –                                  | 0.3                    |      |
|                  |                                       | I <sub>OL</sub> = 8 mA                              | 2.7                 | –                                 | 0.4                    | –                                  | 0.4                    |      |
|                  |                                       | I <sub>OL</sub> = 12 mA                             | 3.0                 | –                                 | 0.4                    | –                                  | 0.4                    |      |
|                  |                                       | I <sub>OL</sub> = 16 mA                             | 3.0                 | –                                 | 0.55                   | –                                  | 0.55                   |      |
|                  |                                       | I <sub>OL</sub> = 24 mA                             | 4.5                 | –                                 | 0.6                    | –                                  | 0.6                    |      |
| I <sub>I</sub>   | Input Leakage Current                 | V <sub>I</sub> = 0 to 5.5 V                         | 1.65 – 5.5          | –                                 | ±5.0                   | –                                  | ±5.0                   | µA   |
| I <sub>OFF</sub> | Power Off Leakage Current             | V <sub>I</sub> = 5.5 V or V <sub>O</sub> = 5.5 V    | 0                   | –                                 | 10                     | –                                  | 10                     | µA   |
| I <sub>CC</sub>  | Quiescent Supply Current              | V <sub>I</sub> = 5.5 V or GND                       | 1.65 – 5.5          | –                                 | 10                     | –                                  | 10                     | µA   |
| ΔI <sub>CC</sub> | Increase in I <sub>CC</sub> per Input | V <sub>IH</sub> = V <sub>CC</sub> – 0.6 V           | 2.3 to 3.6          | –                                 | 500                    | –                                  | 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.

## AC ELECTRICAL CHARACTERISTICS

| Symbol                                   | Parameter                             | Test Condition               | V <sub>CC</sub> (V) | T <sub>A</sub> = -40 °C to +85 °C |      | T <sub>A</sub> = -40 °C to +125 °C |      | Unit |
|------------------------------------------|---------------------------------------|------------------------------|---------------------|-----------------------------------|------|------------------------------------|------|------|
|                                          |                                       |                              |                     | Min                               | Max  | Min                                | Max  |      |
| t <sub>PLH</sub> ,<br>t <sub>PHL</sub>   | Propagation Delay,<br>Input to Output | See Figure 2<br>and Figure 3 | 1.65 – 1.95         | –                                 | 10.3 | –                                  | 10.3 | 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 <sub>OSHL</sub> ,<br>t <sub>OSLH</sub> | 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           | –                                 | –    | –                                  | –    |      |

## 74LCX02

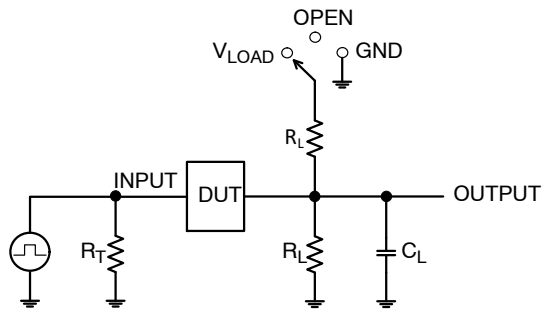
### DYNAMIC SWITCHING CHARACTERISTICS

| Symbol           | Parameter                                   | V <sub>CC</sub> (V) | Condition                                                              | T <sub>A</sub> = 25 °C | Unit |
|------------------|---------------------------------------------|---------------------|------------------------------------------------------------------------|------------------------|------|
|                  |                                             |                     |                                                                        | Typical                |      |
| V <sub>OLP</sub> | Quiet Output Dynamic Peak V <sub>OL</sub>   | 3.3                 | C <sub>L</sub> = 50 pF, V <sub>IH</sub> = 3.3 V, V <sub>IL</sub> = 0 V | 0.8                    | V    |
|                  |                                             | 2.5                 | C <sub>L</sub> = 30 pF, V <sub>IH</sub> = 2.5 V, V <sub>IL</sub> = 0 V | 0.6                    |      |
| V <sub>OLV</sub> | Quiet Output Dynamic Valley V <sub>OL</sub> | 3.3                 | C <sub>L</sub> = 50 pF, V <sub>IH</sub> = 3.3 V, V <sub>IL</sub> = 0 V | -0.8                   | V    |
|                  |                                             | 2.5                 | C <sub>L</sub> = 30 pF, V <sub>IH</sub> = 2.5 V, V <sub>IL</sub> = 0 V | -0.6                   |      |

### CAPACITANCE

| Symbol           | Parameter                     | Condition                                                                     | Typ | Unit |
|------------------|-------------------------------|-------------------------------------------------------------------------------|-----|------|
| C <sub>IN</sub>  | Input Capacitance             | V <sub>CC</sub> = Open, V <sub>I</sub> = 0 V or V <sub>CC</sub>               | 7   | pF   |
| C <sub>OUT</sub> | Output Capacitance            | V <sub>CC</sub> = 3.3 V, V <sub>I</sub> = 0 V or V <sub>CC</sub>              | 8   | pF   |
| C <sub>PD</sub>  | Power Dissipation Capacitance | V <sub>CC</sub> = 3.3 V, V <sub>I</sub> = 0 V or V <sub>CC</sub> , f = 10 MHz | 25  | pF   |

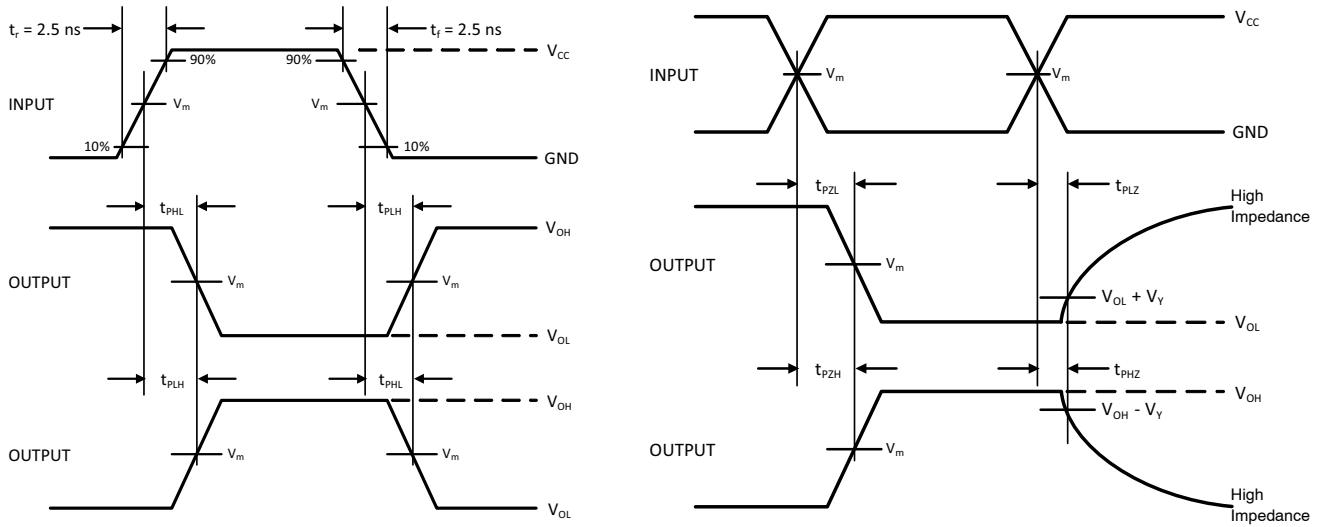
## 74LCX02



$C_L$  includes probe and jig capacitance  
 $R_T$  is  $Z_{OUT}$  of pulse generator (typically 50  $\Omega$ )  
 $f = 1$  MHz

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

Figure 2. Test Circuit



| $V_{CC}, V$  | $R_L, \Omega$ | $C_L, pF$ | $V_{LOAD}$        | $V_m, V$   | $V_Y, V$ |
|--------------|---------------|-----------|-------------------|------------|----------|
| 1.65 to 1.95 | 500           | 30        | $2 \times V_{CC}$ | $V_{CC}/2$ | 0.15     |
| 2.3 to 2.7   | 500           | 30        | $2 \times V_{CC}$ | $V_{CC}/2$ | 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        | $2 \times V_{CC}$ | $V_{CC}/2$ | 0.3      |

Figure 3. Switching Waveforms

# 74LCX02

## Schematic Diagram (Generic for LCX Family)

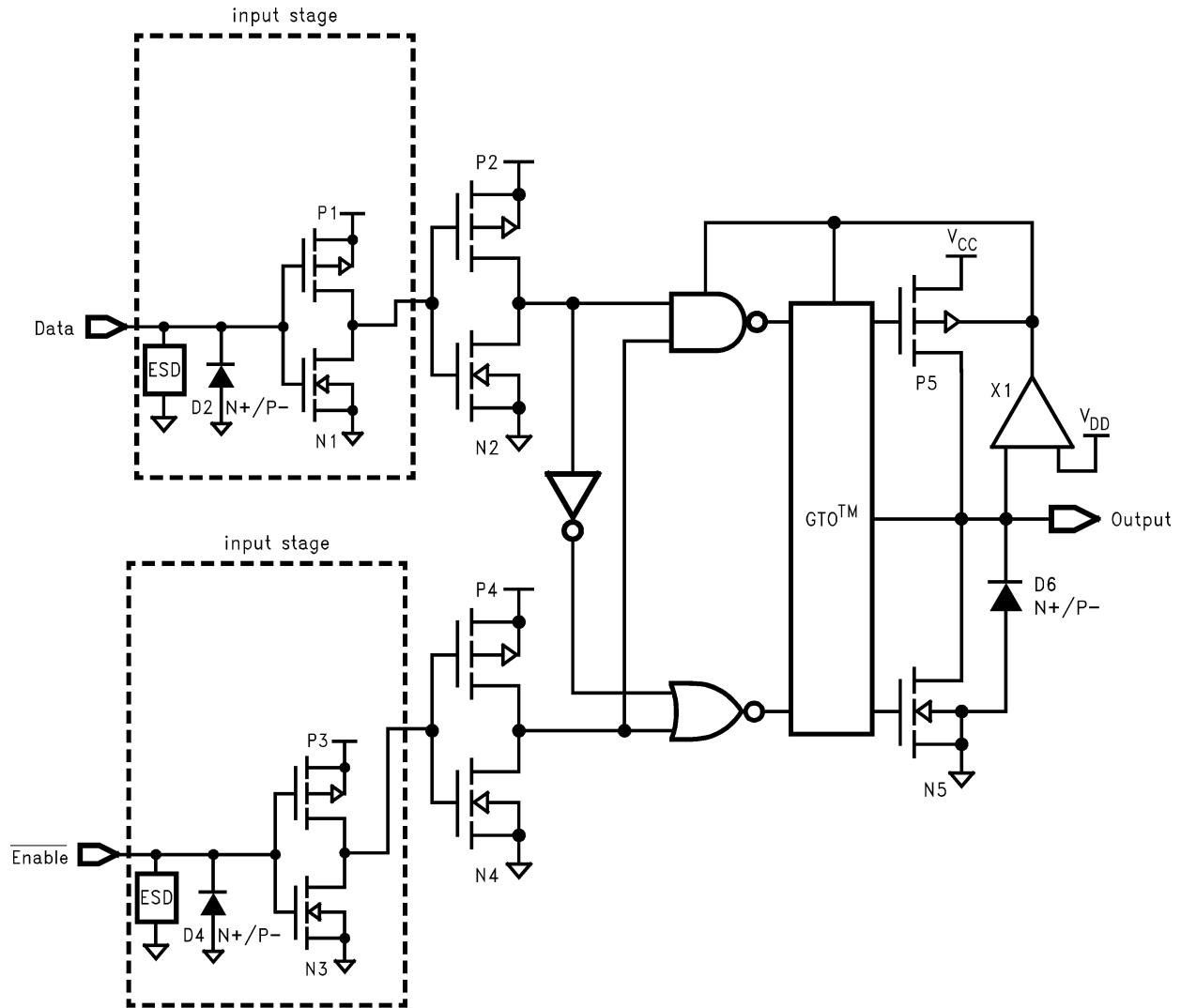
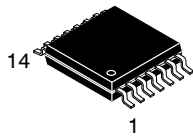


Figure 4. Schematic Diagram

## ORDERING INFORMATION

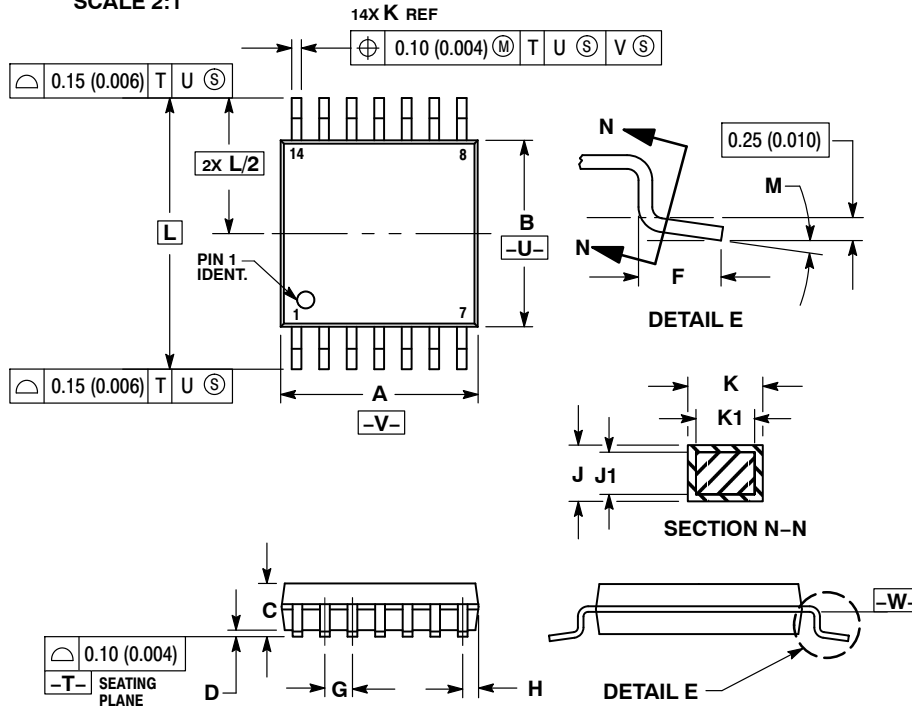
| Device      | Marking   | Package                            | Shipping†                |
|-------------|-----------|------------------------------------|--------------------------|
| 74LCX02MTCX | LCX<br>02 | TSSOP-14<br>(Pb-Free, Halide Free) | 2500 Units / Tape & Reel |

†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.


**TSSOP-14 WB**  
**CASE 948G**  
**ISSUE C**

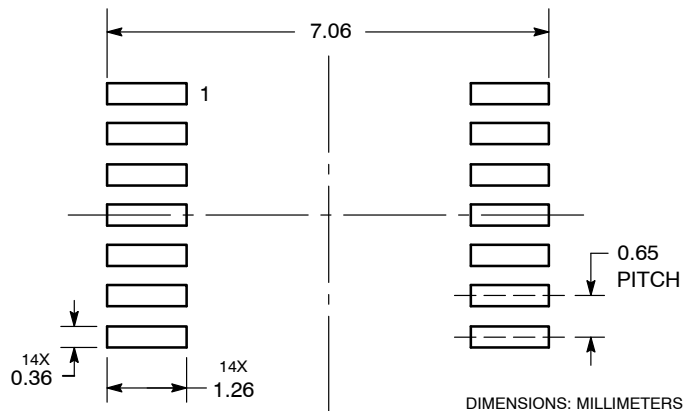
DATE 17 FEB 2016

SCALE 2:1

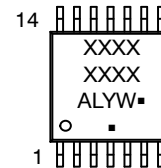

**NOTES:**

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   | 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.

**DOCUMENT NUMBER:** 98ASH70246A

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**DESCRIPTION:** TSSOP-14 WB

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