

## DM74ALS14 Hex Inverter with Schmitt Trigger Inputs

### General Description

This device contains six independent gates, each of which performs the logic INVERT function. Each input has hysteresis which increases the noise immunity and transforms a slowly changing input signal to a fast changing, jitter-free output.

### Features

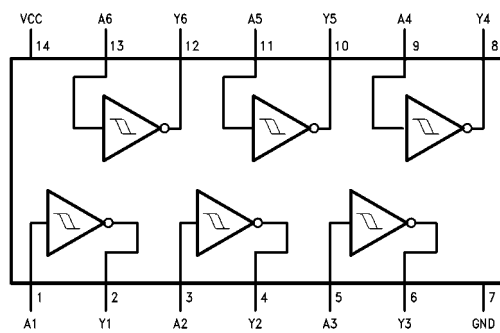
- Input hysteresis
- Low output noise generation
- High input noise immunity
- Switching specification at 50 pF
- Switching specifications guaranteed over full temperature and  $V_{CC}$  range
- Advanced oxide-isolated, ion-implanted Schottky TTL process
- Functionally and pin-for-pin compatible with Schottky and low power Schottky TTL counterparts
- Improved AC performance over low power Schottky counterpart

### Ordering Code:

| Order Number | Package Number | Package Description   |
|--------------|----------------|---|
| DM74ALS14M   | M14A           | 14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150 Narrow |
| DM74ALS14SJ  | M14D           | 14-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide               |
| DM74ALS14N   | N14A           | 14-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300 Wide       |

Devices also available in Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.

### Connection Diagram



### Function Table

$$Y = \bar{A}$$

| Input<br>A | Output<br>Y |
|------------|-------------|
| L          | H           |
| H          | L           |

H = HIGH Logic Level  
L = LOW Logic Level

**Absolute Maximum Ratings**(Note 1)

|                                      |                 |
|--------------------------------------|-----------------|
| Supply Voltage                       | 7V              |
| Input Voltage                        | 7V              |
| Storage Temperature Range            | -65°C to +150°C |
| Operating Free Air Temperature Range | 0°C to +70°C    |
| Typical $\theta_{JA}$                |                 |
| N Package                            | 78.5°C/W        |
| M Package                            | 109.0°C/W       |

**Note 1:** The "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the Electrical Characteristics tables are not guaranteed at the absolute maximum ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

**Recommended Operating Conditions**

| Symbol   | Parameter                              | Min                          | Nom  | Max  | Units |   |
|----------|--|------------------------------|------|------|-------|---|
| $V_{CC}$ | Supply Voltage                         | 4.5                          | 5    | 5.5  | V     |   |
| $V_{T+}$ | Positive-Going Input Threshold Voltage | $V_{CC} = \text{Min to Max}$ | 1.4  |      | 2     | V |
|          |  | $V_{CC} = 5V$                | 1.55 |      | 1.85  |   |
| $V_{T-}$ | Negative-Going Input Threshold Voltage | $V_{CC} = \text{Min to Max}$ | 0.75 |      | 1.2   | V |
|          |  | $V_{CC} = 5V$                | 0.85 |      | 1.1   |   |
| HYS      | Input Hysteresis                       | $V_{CC} = \text{Min to Max}$ | 0.5  |      |       | V |
|          |  | $V_{CC} = 5V$                | 0.6  |      |       |   |
| $I_{OH}$ | HIGH Level Output Current              |                              |      | -0.4 | mA    |   |
| $I_{OL}$ | LOW Level Output Current               |                              |      | 8    | mA    |   |
| $T_A$    | Operating Free Air Temperature Range   | 0                            |      | 70   | °C    |   |

**Electrical Characteristics**

over recommended free air temperature range (unless otherwise noted)

| Symbol    | Parameter   | Test Conditions   | Min                     | Typ  | Max  | Units         |
|-----------|---|---|-------------------------|------|------|---------------|
| $V_{IK}$  | Input Clamp Voltage                               | $V_{CC} = \text{Min}, I_I = -18 \text{ mA}$                                 |                         |      | -1.5 | V             |
| $V_{OH}$  | HIGH Level Output Voltage                         | $V_{CC} = 4.5V \text{ to } 5.5V, I_{OH} = \text{Max}$                       | $V_{CC} - 2$            |      |      | V             |
| $V_{OL}$  | LOW Level Output Voltage                          | $V_{CC} = \text{Min}$<br>$I_{OL} = 4 \text{ mA}$                            |                         | 0.25 | 0.4  | V             |
|           |   |   | $I_{OL} = 8 \text{ mA}$ |      | 0.35 | 0.5           |
| $I_{T+}$  | Input Current at Positive-Going Threshold Voltage | $V_{CC} = 5V, V_I = V_{T+}$   |                         |      | 20   | $\mu\text{A}$ |
| $I_{T-}$  | Input Current at Negative-Going Threshold Voltage | $V_{CC} = 5V, V_I = V_{T-}$   |                         |      | -100 | $\mu\text{A}$ |
| $I_I$     | Input Current at Maximum Input Voltage            | $V_{CC} = \text{Max}, V_I = 7V$   |                         |      | 100  | $\mu\text{A}$ |
| $I_{IH}$  | HIGH Level Input Current                          | $V_{CC} = \text{Max}, V_I = 2.7V$   |                         |      | 20   | $\mu\text{A}$ |
| $I_{IL}$  | LOW Level Input Current                           | $V_{CC} = \text{Max}, V_I = 0.4V$   |                         |      | -100 | $\mu\text{A}$ |
| $I_O$     | Output Drive Current                              | $V_{CC} = \text{Max}, V_O = 2.25V$  | -30                     |      | -112 | mA            |
| $I_{CCH}$ | Supply Current with Outputs HIGH                  | $V_{CC} = \text{Max}$   |                         |      | 12   | mA            |
| $I_{CCL}$ | Supply Current with Outputs LOW                   | $V_{CC} = \text{Max}$   |                         |      | 12   | mA            |
| $V_{OLP}$ | Quiet Output Maximum<br>Dynamic $V_{OL}$          | $V_{CC} = 5.0V, T_A = 25^\circ\text{C}$<br>(Figures 1, 2); (Note 2)(Note 3) | 0.16                    |      |      | V             |
|           |   |   | -0.27                   |      |      | V             |
| $V_{IHD}$ | Minimum HIGH Level<br>Dynamic Input Voltage       | $V_{CC} = 5.0V, T_A = 25^\circ\text{C}$<br>(Note 2)(Note 4)                 | 1.44                    |      |      | V             |
|           |   |   | 1.15                    |      |      | V             |
| $V_{ILD}$ | Maximum LOW Level<br>Dynamic Input Voltage        | $V_{CC} = 5.0V, T_A = 25^\circ\text{C}$<br>(Note 2)(Note 4)                 |                         |      |      | V             |
|           |   |   |                         |      |      | V             |

**Note 2:** Plastic DIP package.

**Note 3:** n = number of device outputs, n - 1 outputs switching, each driven 0V to 3V one output @ GND.

**Note 4:** n = number of device outputs, n outputs switching, n - 1 inputs switching 0V to 3V. Input under test switching 3V to threshold ( $V_{ILD}$ ); 0V to threshold ( $V_{IHD}$ ); f = 1 MHz.

## Switching Characteristics over recommended operating free air temperature range

| Symbol    | Parameter                                       | Conditions                        | Min | Max | Units |
|-----------|---|-----------------------------------|-----|-----|-------|
| $t_{PLH}$ | Propagation Delay Time LOW-to-HIGH Level Output | $V_{CC} = 4.5V$ to $5.5V$         | 2   | 12  | ns    |
| $t_{PHL}$ | Propagation Delay Time HIGH-to-LOW Level Output | $R_L = 500\Omega$ , $C_L = 50$ pF | 2   | 10  | ns    |

### ALS Noise Characteristics

The setup of a noise characteristics measurement is critical to the accuracy and repeatability of the tests. The following is a brief description of the setup used to measure the noise characteristics of ALS.

#### Equipment:

- Word Generator
- Printed Circuit Board Test Fixture
- Dual Trace Oscilloscope

#### Procedure:

1. Verify Test Fixture Loading: Standard Load  $50$  pF,  $500\Omega$ .
2. Deskew the word generator so that no two channels have greater than  $150$  ps skew between them. This requires that the oscilloscope be deskewed first. Swap out the channels that have more than  $150$  ps of skew until all channels being used are within  $150$  ps. It is important to deskew the word generator channels before testing. This will ensure that the outputs switch simultaneously.
3. Terminate all inputs and outputs to ensure proper loading of the outputs and that the input levels are at the correct voltage.
4. Set  $V_{CC}$  to  $5.0V$ .
5. Set the word generator to toggle all but one output at a frequency of  $1$  MHz. Greater frequencies will increase DUT heating and affect the results of the measurement.
6. Set the word generator input levels at  $0V$  LOW and  $3V$  HIGH. Verify levels with a digital volt meter.

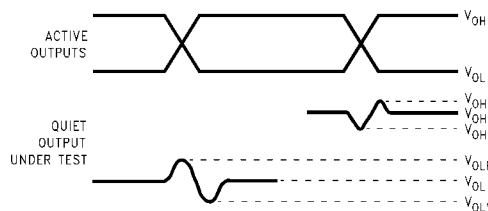
#### $V_{OLP}/V_{OLV}$ and $V_{OHP}/V_{OHV}$ :

- Determine the quiet output pin that demonstrates the greatest noise levels. The worst case pin will usually be the furthest from the ground pin. Monitor the output voltages using a  $50\Omega$  coaxial cable plugged into a standard SMB type connector on the test fixture. Do not use an active FET probe.

- Verify that the GND reference recorded on the oscilloscope has not drifted to ensure the accuracy and repeatability of the measurements.

#### $V_{ILD}$ and $V_{IHD}$ :

- Monitor one of the switching outputs using a  $50\Omega$  coaxial cable plugged into a standard SMB type connector on the test fixture. Do not use an active FET probe.
- First increase the input LOW voltage level,  $V_{IL}$ , until the output begins to oscillate. Oscillation is defined as noise on the output LOW level that exceeds  $V_{IL}$  limits, or on output HIGH levels that exceed  $V_{IH}$  limits. The input LOW voltage level at which oscillation occurs is defined as  $V_{ILD}$ .
- Next decrease the input HIGH voltage level on the word generator,  $V_{IH}$  until the output begins to oscillate. Oscillation is defined as noise on the output LOW level that exceeds  $V_{IL}$  limits, or on output HIGH levels that exceed  $V_{IH}$  limits. The input HIGH voltage level at which oscillation occurs is defined as  $V_{IHD}$ .
- Verify that the GND reference recorded on the oscilloscope has not drifted to ensure the accuracy and repeatability of the measurements.



$V_{OHV}$  and  $V_{OHP}$  are measured with respect to  $V_{OH}$  reference.  $V_{OLV}$  and  $V_{OLP}$  are measured with respect to ground reference.

Input pulses have the following characteristics:  $f = 1$  MHz,  $t_r = 3$  ns,  $t_f = 3$  ns, skew  $< 150$  ps.

FIGURE 1. Quiet Output Noise Voltage Waveforms

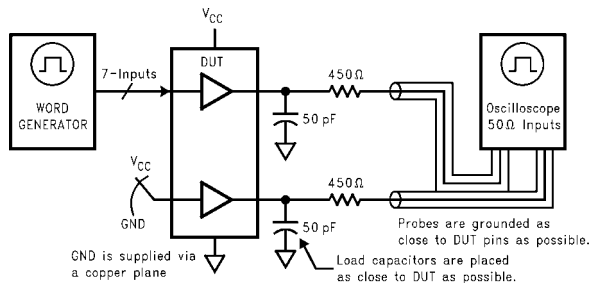
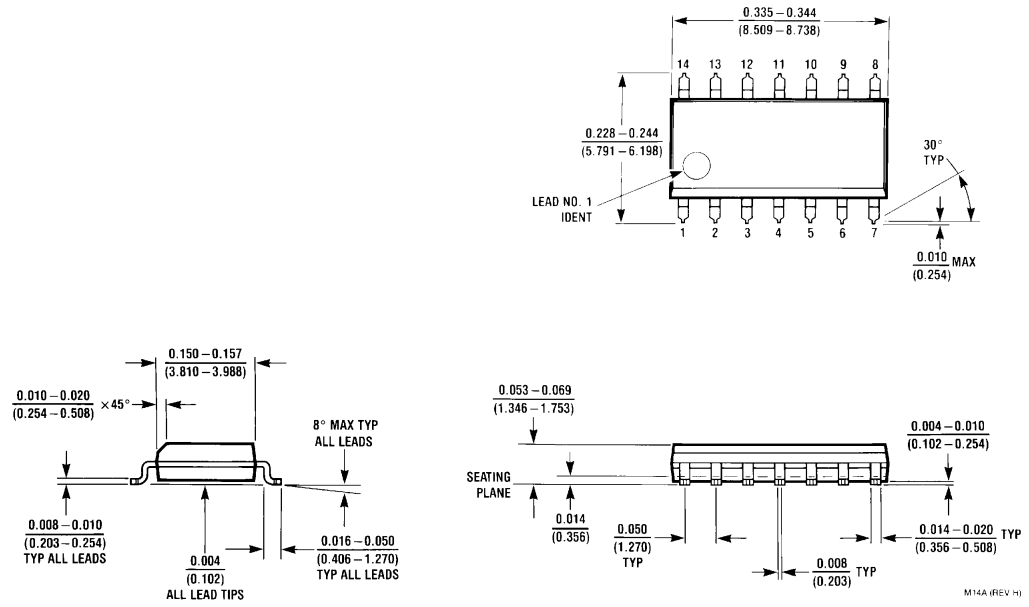


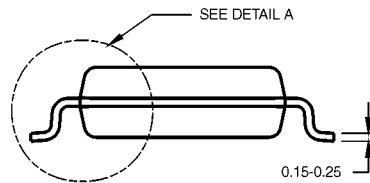
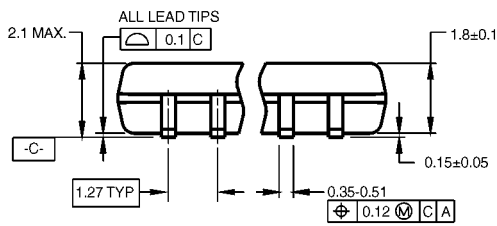
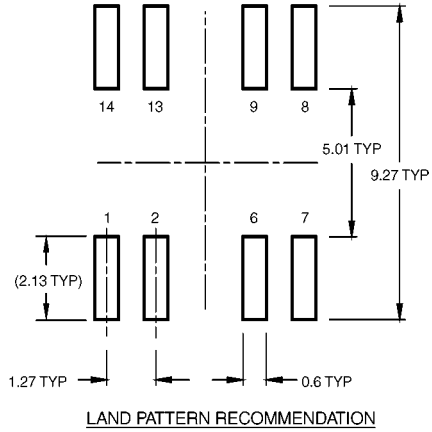
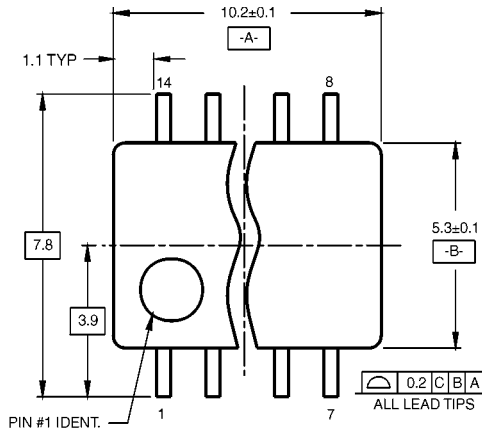
FIGURE 2. Simultaneous Switching Test Circuit

**Physical Dimensions** inches (millimeters) unless otherwise noted



**14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150 Narrow  
Package Number M14A**

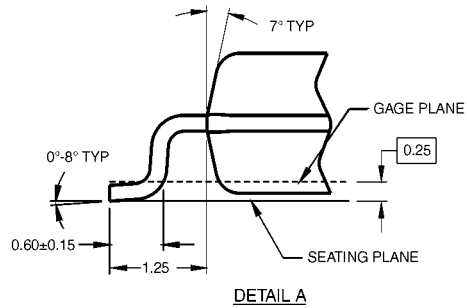
**Physical Dimensions** inches (millimeters) unless otherwise noted (Continued)



DIMENSIONS ARE IN MILLIMETERS

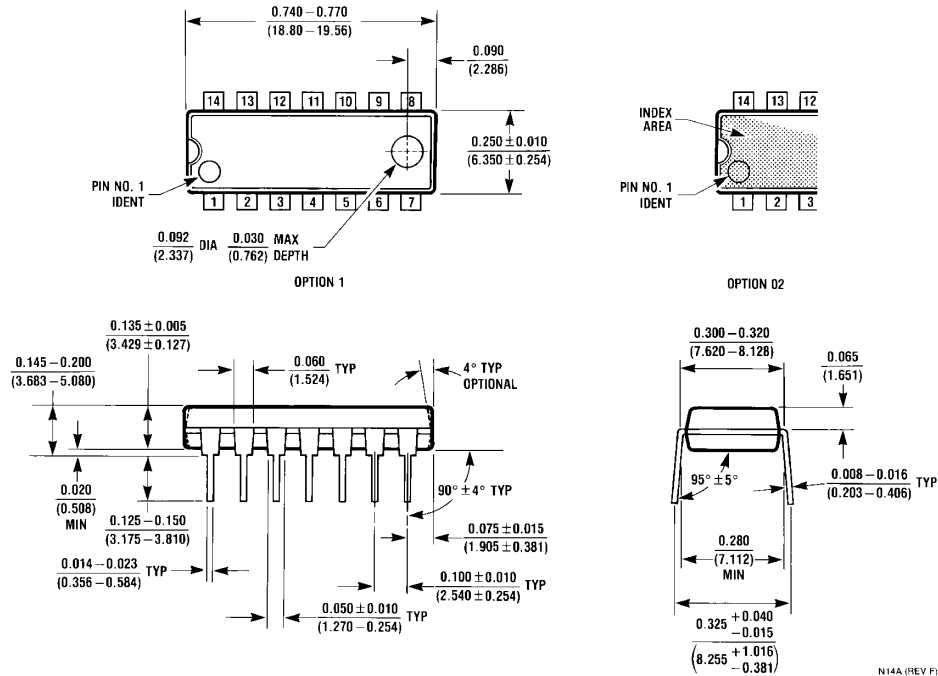
- NOTES:  
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 B. DIMENSIONS ARE IN MILLIMETERS.  
 C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.

M14DRevB1



**14-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide  
 Package Number M14D**

**Physical Dimensions** inches (millimeters) unless otherwise noted (Continued)



14-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300 Wide Package Number N14A

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