

# 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:  $I_{CC} = 2$   $\mu$ A (Max) at  $T_A = 25^\circ\text{C}$
- 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
- Pb-Free Packages are Available\*

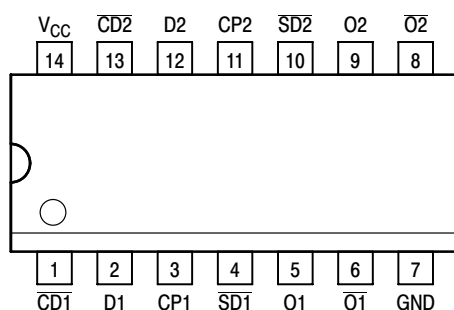


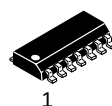
Figure 1. 14-Lead Pinout  
(Top View)



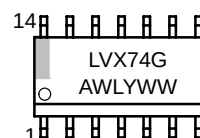
ON Semiconductor®

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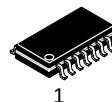
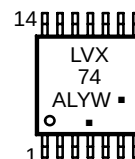
#### MARKING DIAGRAMS



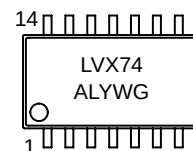
SOIC-14  
D SUFFIX  
CASE 751A



TSSOP-14  
DT SUFFIX  
CASE 948G



SOEIAJ-14  
M SUFFIX  
CASE 965



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         |
| $\overline{CD}1$ , $\overline{CD}2$ | Direct Clear Inputs |
| $\overline{SD}1$ , $\overline{SD}2$ | Direct Set Inputs   |
| O <sub>n</sub> , $\overline{O}n$    | Outputs             |

#### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 4 of this data sheet.

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

## MC74LVX74

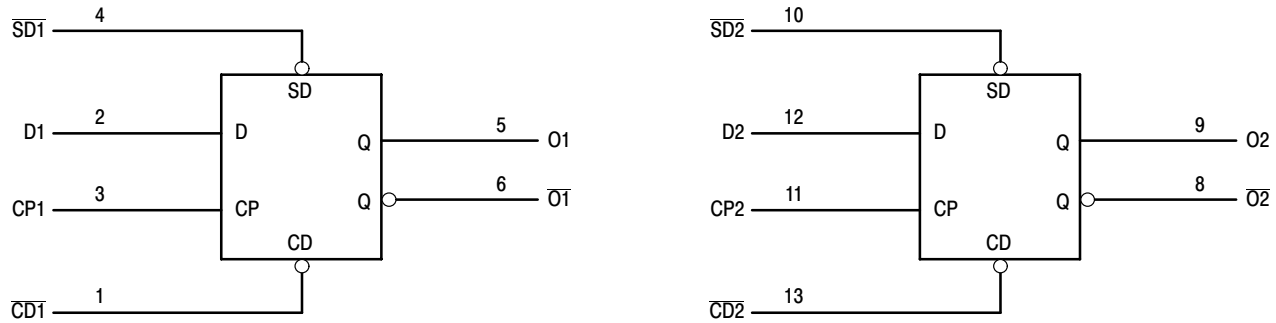


Figure 2. Logic Diagram

| INPUTS |     |     |    | OUTPUTS |    | OPERATING MODE                                         |
|--------|-----|-----|----|---------|----|--------------------------------------------------------|
| SDn    | CDn | CPn | Dn | On      | On |                                                        |
| L      | H   | X   | X  | H       | L  | Asynchronous Set<br>Asynchronous Clear<br>Undetermined |
| H      | L   | X   | X  | L       | H  |                                                        |
| L      | L   | X   | X  | H       | H  |                                                        |
| 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<sub>CC</sub> Reasons DO NOT FLOAT Inputs

### MAXIMUM RATINGS

| Symbol           | Parameter                                       | Value                        | Unit |
|------------------|-------------------------------------------------|------------------------------|------|
| V <sub>CC</sub>  | DC Supply Voltage                               | −0.5 to +7.0                 | V    |
| V <sub>in</sub>  | DC Input Voltage                                | −0.5 to +7.0                 | V    |
| V <sub>out</sub> | DC Output Voltage                               | −0.5 to V <sub>CC</sub> +0.5 | V    |
| I <sub>IK</sub>  | Input Diode Current                             | −20                          | mA   |
| I <sub>OK</sub>  | Output Diode Current                            | ±20                          | mA   |
| I <sub>out</sub> | DC Output Current, per Pin                      | ±25                          | mA   |
| I <sub>CC</sub>  | DC Supply Current, V <sub>CC</sub> and GND Pins | ±50                          | mA   |
| P <sub>D</sub>   | Power Dissipation                               | 180                          | mW   |
| T <sub>stg</sub> | Storage Temperature                             | −65 to +150                  | °C   |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

### RECOMMENDED OPERATING CONDITIONS

| Symbol           | Parameter                                | Min | Max             | Unit |
|------------------|------------------------------------------|-----|-----------------|------|
| V <sub>CC</sub>  | DC Supply Voltage                        | 2.0 | 3.6             | V    |
| V <sub>in</sub>  | DC Input Voltage                         | 0   | 5.5             | V    |
| V <sub>out</sub> | DC Output Voltage                        | 0   | V <sub>CC</sub> | V    |
| T <sub>A</sub>   | Operating Temperature, All Package Types | −40 | +85             | °C   |
| Δt/ΔV            | Input Rise and Fall Time                 | 0   | 100             | ns/V |

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## DC ELECTRICAL CHARACTERISTICS

| Symbol          | Parameter                                                                            | Test Conditions                                                              | V <sub>CC</sub><br>V | T <sub>A</sub> = 25°C |            |                    | T <sub>A</sub> = - 40 to 85°C |                    | Unit |
|-----------------|--------------------------------------------------------------------------------------|------------------------------------------------------------------------------|----------------------|-----------------------|------------|--------------------|-------------------------------|--------------------|------|
|                 |                                                                                      |                                                                              |                      | Min                   | Typ        | Max                | Min                           | Max                |      |
| V <sub>IH</sub> | 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 <sub>IL</sub> | 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 <sub>OH</sub> | High-Level Output Voltage<br>(V <sub>in</sub> = V <sub>IH</sub> or V <sub>IL</sub> ) | I <sub>OH</sub> = -50μA<br>I <sub>OH</sub> = -50μA<br>I <sub>OH</sub> = -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 <sub>OL</sub> | Low-Level Output Voltage<br>(V <sub>in</sub> = V <sub>IH</sub> or V <sub>IL</sub> )  | I <sub>OL</sub> = 50μA<br>I <sub>OL</sub> = 50μA<br>I <sub>OL</sub> = 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 <sub>in</sub> | Input Leakage Current                                                                | V <sub>in</sub> = 5.5V or GND                                                | 3.6                  |                       |            | ±0.1               |                               | ±1.0               | μA   |
| I <sub>CC</sub> | Quiescent Supply Current                                                             | V <sub>in</sub> = V <sub>CC</sub> or GND                                     | 3.6                  |                       |            | 2.0                |                               | 20.0               | μA   |

## AC ELECTRICAL CHARACTERISTICS (Input t<sub>r</sub> = t<sub>f</sub> = 3.0ns)

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

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

## TIMING REQUIREMENTS (Input t<sub>r</sub> = t<sub>f</sub> = 3.0ns)

| Symbol           | Parameter                                             | V <sub>CC</sub><br>V | Guaranteed Limit      |                               | Unit |
|------------------|-------------------------------------------------------|----------------------|-----------------------|-------------------------------|------|
|                  |                                                       |                      | T <sub>A</sub> = 25°C | T <sub>A</sub> = - 40 to 85°C |      |
| t <sub>w</sub>   | Minimum Pulse Width, CP                               | 2.7V<br>3.3V ± 0.3   | 8.5<br>6.0            | 10.0<br>7.0                   | ns   |
| t <sub>w</sub>   | Minimum Pulse Width, $\bar{CD}$ or $\bar{SD}$         | 2.7V<br>3.3V ± 0.3   | 8.5<br>6.0            | 10.0<br>7.0                   | ns   |
| t <sub>su</sub>  | Minimum Setup Time, D to CP                           | 2.7V<br>3.3V ± 0.3   | 8.0<br>5.5            | 9.5<br>6.5                    | ns   |
| t <sub>h</sub>   | Minimum Hold Time, D to CP                            | 2.7V<br>3.3V ± 0.3   | 0.5<br>0.5            | 0.5<br>0.5                    | ns   |
| t <sub>rec</sub> | Minimum Recovery Time, $\bar{SD}$ or $\bar{CD}$ to CP | 2.7V<br>3.3V ± 0.3   | 6.5<br>5.0            | 7.5<br>5.0                    | ns   |

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## CAPACITIVE CHARACTERISTICS

| Symbol          | Parameter                              | T <sub>A</sub> = 25°C |     |     | T <sub>A</sub> = - 40 to 85°C |     | Unit |
|-----------------|----------------------------------------|-----------------------|-----|-----|-------------------------------|-----|------|
|                 |                                        | Min                   | Typ | Max | Min                           | Max |      |
| C <sub>in</sub> | Input Capacitance                      |                       | 4   | 10  |                               | 10  | pF   |
| C <sub>PD</sub> | Power Dissipation Capacitance (Note 2) |                       | 25  |     |                               |     | pF   |

2. C<sub>PD</sub> 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:  $I_{CC(OPR)} = C_{PD} \cdot V_{CC} \cdot f_{in} + I_{CC}/2$  (per flip-flop). C<sub>PD</sub> is used to determine the no-load dynamic power consumption;  $P_D = C_{PD} \cdot V_{CC}^2 \cdot f_{in} + I_{CC} \cdot V_{CC}$ .

## NOISE CHARACTERISTICS (Input t<sub>r</sub> = t<sub>f</sub> = 3.0ns, C<sub>L</sub> = 50pF, V<sub>CC</sub> = 3.3V, Measured in SOIC Package)

| Symbol           | Characteristic                               | T <sub>A</sub> = 25°C |      | Unit |
|------------------|----------------------------------------------|-----------------------|------|------|
|                  |                                              | Typ                   | Max  |      |
| V <sub>OLP</sub> | Quiet Output Maximum Dynamic V <sub>OL</sub> | 0.3                   | 0.5  | V    |
| V <sub>OLV</sub> | Quiet Output Minimum Dynamic V <sub>OL</sub> | -0.3                  | -0.5 | V    |
| V <sub>IHD</sub> | Minimum High Level Dynamic Input Voltage     |                       | 2.0  | V    |
| V <sub>ILD</sub> | Maximum Low Level Dynamic Input Voltage      |                       | 0.8  | V    |

## ORDERING INFORMATION

| Device         | Package             | Shipping <sup>†</sup> |
|----------------|---------------------|-----------------------|
| MC74LVX74DR2   | SOIC-14             | 2500 Tape & Reel      |
| MC74LVX74DR2G  | SOIC-14 (Pb-Free)   |                       |
| MC74LVX74DT    | TSSOP-14*           | 96 Units / Rail       |
| MC74LVX74DTG   | TSSOP-14*           |                       |
| MC74LVX74DTR2  | TSSOP-14*           | 2500 Tape & Reel      |
| MC74LVX74DTR2G | TSSOP-14*           |                       |
| MC74LVX74M     | SOEIAJ-14           | 50 Units / Rail       |
| MC74LVX74MG    | SOEIAJ-14 (Pb-Free) |                       |
| MC74LVX74MEL   | SOEIAJ-14           | 2000 Tape & Reel      |
| MC74LVX74MELG  | SOEIAJ-14 (Pb-Free) |                       |

<sup>†</sup>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.

\*This package is inherently Pb-Free.

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## SWITCHING WAVEFORMS

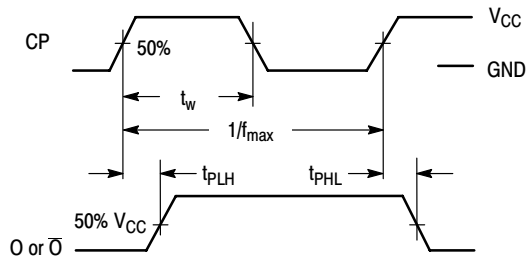


Figure 3.

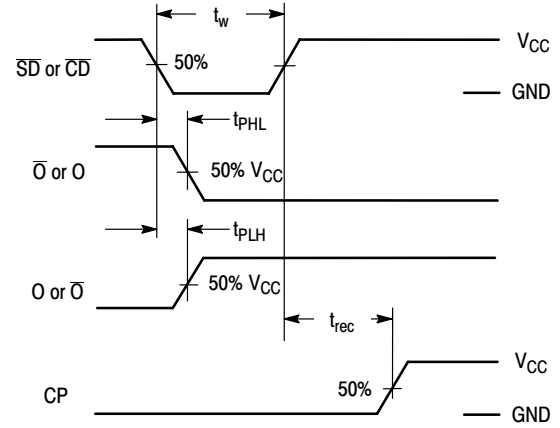


Figure 4.

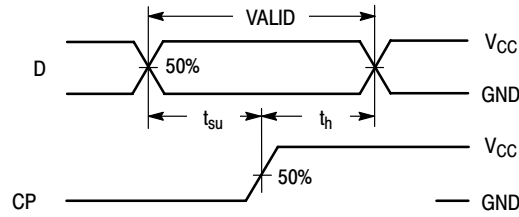
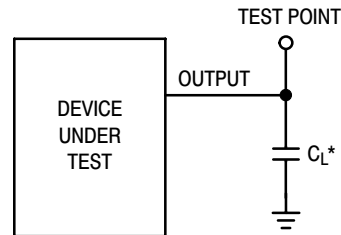


Figure 5.

## TEST CIRCUIT



\*Includes all probe and jig capacitance

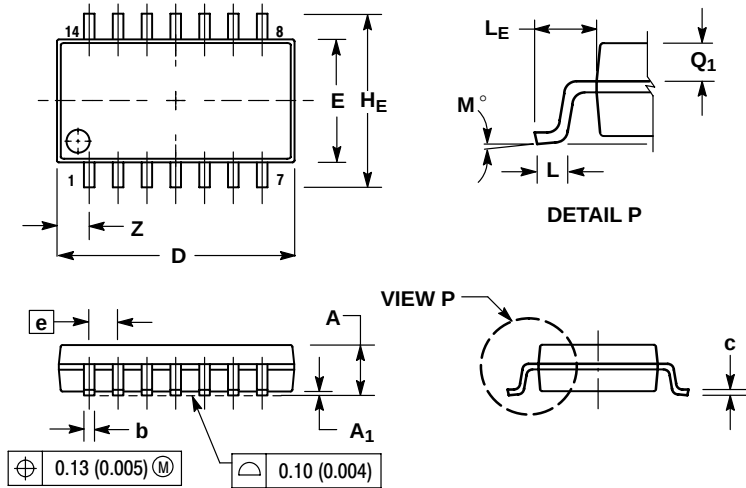
Figure 6.



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## PACKAGE DIMENSIONS

SOEIAJ-14  
CASE 965-01  
ISSUE A



### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS AND ARE MEASURED AT THE PARTING LINE. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
5. THE LEAD WIDTH DIMENSION (b) DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE LEAD WIDTH DIMENSION AT MAXIMUM MATERIAL CONDITION. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE FOOT. MINIMUM SPACE BETWEEN PROTRUSIONS AND ADJACENT LEAD TO BE 0.46 (0.018).

|                | MILLIMETERS |       | INCHES    |       |
|----------------|-------------|-------|-----------|-------|
| DIM            | MIN         | MAX   | MIN       | MAX   |
| A              | ---         | 2.05  | ---       | 0.081 |
| A <sub>1</sub> | 0.05        | 0.20  | 0.002     | 0.008 |
| b              | 0.35        | 0.50  | 0.014     | 0.020 |
| c              | 0.10        | 0.20  | 0.004     | 0.008 |
| D              | 9.90        | 10.50 | 0.390     | 0.413 |
| E              | 5.10        | 5.45  | 0.201     | 0.215 |
| e              | 1.27 BSC    |       | 0.050 BSC |       |
| H <sub>E</sub> | 7.40        | 8.20  | 0.291     | 0.323 |
| 0.50           | 0.50        | 0.85  | 0.020     | 0.033 |
| L <sub>E</sub> | 1.10        | 1.50  | 0.043     | 0.059 |
| M              | 0 °         | 10 °  | 0 °       | 10 °  |
| Q <sub>1</sub> | 0.70        | 0.90  | 0.028     | 0.035 |
| Z              | ---         | 1.42  | ---       | 0.056 |

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