

## 74LVQ374

### Low Voltage Octal D-Type Flip-Flop with 3-STATE Outputs

#### General Description

The LVQ374 is a high-speed, low-power octal D-type flip-flop featuring separate D-type inputs for each flip-flop and 3-STATE outputs for bus-oriented applications. A buffered Clock (CP) and Output Enable ( $\overline{OE}$ ) are common to all flip-flops.

#### Features

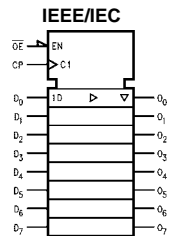
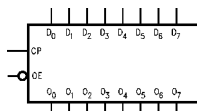
- Ideal for low power/low noise 3.3V applications
- Implements patented EMI reduction circuitry
- Available in SOIC JEDEC, SOIC EIAJ and QSOP packages
- Guaranteed simultaneous switching noise level and dynamic threshold performance
- Improved latch-up immunity
- Guaranteed incident wave switching into 75Ω
- 4 kV minimum ESD immunity
- Buffered positive edge-triggered clock
- 3-STATE outputs drive bus lines or buffer memory address registers

#### Ordering Code:

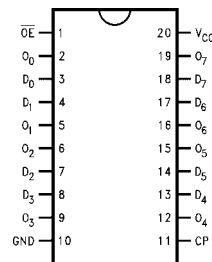
| Order Number | Package Number | Package Description  |
|--------------|----------------|--|
| 74LVQ374SC   | M20B           | 20-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide |
| 74LVQ374SJ   | M20D           | 20-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide              |
| 74LVQ374QSC  | MQA20          | 20-Lead Quarter Size Outline Package (QSOP), JEDEC MO-137, 0.150" Wide     |

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

#### Logic Symbols



#### Connection Diagram



#### Pin Descriptions

| Pin Names                      | Description                 |
|--------------------------------|-----------------------------|
| D <sub>0</sub> -D <sub>7</sub> | Data Inputs                 |
| CP                             | Clock Pulse Input           |
| $\overline{OE}$                | 3-STATE Output Enable Input |
| O <sub>0</sub> -O <sub>7</sub> | 3-STATE Outputs             |

#### Truth Table

| Inputs         |    |                 | Outputs        |
|----------------|----|-----------------|----------------|
| D <sub>n</sub> | CP | $\overline{OE}$ | O <sub>n</sub> |
| H              | ↗  | L               | H              |
| L              | ↗  | L               | L              |
| X              | X  | H               | Z              |

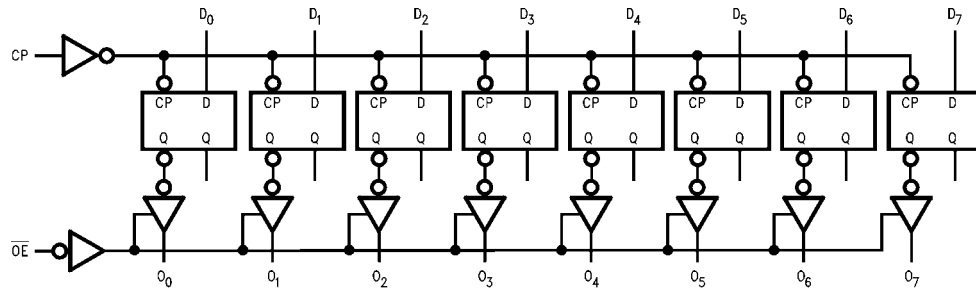
H = HIGH Voltage Level  
X = Immaterial  
↗ = LOW-to-HIGH Transition  
L = LOW Voltage Level  
Z = High Impedance

## Functional Description

The LVQ374 consists of eight edge-triggered flip-flops with individual D-type inputs and 3-STATE true outputs. The buffered clock and buffered Output Enable are common to all flip-flops. The eight flip-flops will store the state of their individual D-type inputs that meet the setup and hold time requirements on the LOW-to-HIGH Clock (CP) transition.

With the Output Enable ( $\overline{OE}$ ) 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. Operation of the  $\overline{OE}$  input does not affect the state of the flip-flops.

## Logic Diagram



Please note that this diagram is provided only for the understanding of logic operations and should not be used to estimate propagation delays.

**Absolute Maximum Ratings**(Note 1)

|                                      |                          |
|--------------------------------------|--------------------------|
| Supply Voltage ( $V_{CC}$ )          | -0.5V to +7.0V           |
| DC Input Diode Current ( $I_{IK}$ )  |                          |
| $V_I = -0.5V$                        | -20 mA                   |
| $V_I = V_{CC} + 0.5V$                | +20 mA                   |
| DC Input Voltage ( $V_I$ )           | -0.5V to $V_{CC} + 0.5V$ |
| DC Output Diode Current ( $I_{OK}$ ) |                          |
| $V_O = -0.5V$                        | -20 mA                   |
| $V_O = V_{CC} + 0.5V$                | +20 mA                   |
| DC Output Voltage ( $V_O$ )          | -0.5V to $V_{CC} + 0.5V$ |
| DC Output Source                     |                          |
| or Sink Current ( $I_O$ )            | $\pm 50$ mA              |
| DC $V_{CC}$ or Ground Current        |                          |
| ( $I_{CC}$ or $I_{GND}$ )            | $\pm 400$ mA             |
| Storage Temperature ( $T_{STG}$ )    | -65°C to +150°C          |
| DC Latch-Up Source or                |                          |
| Sink Current                         | $\pm 300$ mA             |

**Recommended Operating Conditions** (Note 2)

|   |                |
|---|----------------|
| Supply Voltage ( $V_{CC}$ )                     | 2.0V to 3.6V   |
| Input Voltage ( $V_I$ )                         | 0V to $V_{CC}$ |
| Output Voltage ( $V_O$ )                        | 0V to $V_{CC}$ |
| Operating Temperature ( $T_A$ )                 | -40°C to +85°C |
| Minimum Input Edge Rate ( $\Delta V/\Delta t$ ) |                |
| $V_{IN}$ from 0.8V to 2.0V                      |                |
| $V_{CC}$ @ 3.0V                                 | 125 mV/ns      |

**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.

**Note 2:** Unused inputs must be held HIGH or LOW. They may not float.

**DC Electrical Characteristics**

| Symbol    | Parameter                                | $V_{CC}$<br>(V) | $T_A = +25^\circ\text{C}$ |                   | $T_A = -40^\circ\text{C to } +85^\circ\text{C}$ |               | Units  | Conditions |
|-----------|--|-----------------|---------------------------|-------------------|---|---------------|--|------------|
|           |  |                 | Typ                       | Guaranteed Limits |   |               |  |            |
| $V_{IH}$  | Minimum High Level Input Voltage         | 3.0             | 1.5                       | 2.0               | 2.0   | V             | $V_{OUT} = 0.1V$<br>or $V_{CC} - 0.1V$   |            |
| $V_{IL}$  | Maximum Low Level Input Voltage          | 3.0             | 1.5                       | 0.8               | 0.8   | V             | $V_{OUT} = 0.1V$<br>or $V_{CC} - 0.1V$   |            |
| $V_{OH}$  | Minimum High Level Output Voltage        | 3.0             | 2.99                      | 2.9               | 2.9   | V             | $I_{OUT} = -50 \mu\text{A}$  |            |
|           |  | 3.0             |                           | 2.58              | 2.48  | V             | $V_{IN} = V_{IL}$ or $V_{IH}$ (Note 3)<br>$I_{OH} = -12 \text{ mA}$              |            |
| $V_{OL}$  | Maximum Low Level Output Voltage         | 3.0             | 0.002                     | 0.1               | 0.1   | V             | $I_{OUT} = 50 \mu\text{A}$   |            |
|           |  | 3.0             |                           | 0.36              | 0.44  | V             | $V_{IN} = V_{IL}$ or $V_{IH}$ (Note 3)<br>$I_{OL} = 12 \text{ mA}$               |            |
| $I_{IN}$  | Maximum Input Leakage Current            | 3.6             |                           | $\pm 0.1$         | $\pm 1.0$                                       | $\mu\text{A}$ | $V_I = V_{CC}$ , GND   |            |
| $I_{OLD}$ | Minimum Dynamic                          | 3.6             |                           |                   | 36  | mA            | $V_{OLD} = 0.8V$ Max (Note 5)  |            |
| $I_{OHD}$ | Output Current (Note 4)                  | 3.6             |                           |                   | -25   | mA            | $V_{OHD} = 2.0V$ Min (Note 5)  |            |
| $I_{CC}$  | Maximum Quiescent Supply Current         | 3.6             |                           | 4.0               | 40.0  | $\mu\text{A}$ | $V_{IN} = V_{CC}$<br>or GND  |            |
| $I_{OZ}$  | Maximum 3-STATE Leakage Current          | 3.6             |                           | $\pm 0.25$        | $\pm 2.5$                                       | $\mu\text{A}$ | $V_I$ (OE) = $V_{IL}$ , $V_{IH}$<br>$V_I = V_{CC}$ , GND<br>$V_O = V_{CC}$ , GND |            |
| $V_{OLP}$ | Quiet Output Maximum Dynamic $V_{OL}$    | 3.3             | 0.5                       | 0.8               |   | V             | (Note 6)(Note 7)   |            |
| $V_{OLV}$ | Quiet Output Minimum Dynamic $V_{OL}$    | 3.3             | -0.3                      | -0.8              |   | V             | (Note 6)(Note 7)   |            |
| $V_{IHD}$ | Maximum High Level Dynamic Input Voltage | 3.3             | 1.7                       | 2.0               |   | V             | (Note 6)(Note 8)   |            |
| $V_{ILD}$ | Maximum Low Level Dynamic Input Voltage  | 3.3             | 1.6                       | 0.8               |   | V             | (Note 6)(Note 8)   |            |

**Note 3:** All outputs loaded; thresholds on input associated with output under test.

**Note 4:** Maximum test duration 2.0 ms, one output loaded at a time.

**Note 5:** Incident wave switching on transmission lines with impedances as low as 75 $\Omega$  for commercial temperature range is guaranteed for 74LVQ.

**Note 6:** Worst case package.

**Note 7:** Max number of outputs defined as (n). Data inputs are driven 0V to 3.3V; one output at GND.

**Note 8:** Max number of Data Inputs (n) switching. (n - 1) inputs switching 0V to 3.3V. Input-under-test switching: 3.3V to threshold ( $V_{ILD}$ ), 0V to threshold ( $V_{IHD}$ ),  $f = 1$  MHz.

## AC Electrical Characteristics

| Symbol            | Parameter                      | V <sub>CC</sub><br>(V) | T <sub>A</sub> = +25°C<br>C <sub>L</sub> = 50 pF |      |      | T <sub>A</sub> = -40°C to +85°C<br>C <sub>L</sub> = 50 pF |      | Units |
|-------------------|--------------------------------|------------------------|--|------|------|---|------|-------|
|                   |                                |                        | Min  | Typ  | Max  | Min   | Max  |       |
| t <sub>MAX</sub>  | Maximum Clock Frequency        | 2.7<br>3.3 ± 0.3       | 55<br>75   |      |      | 50<br>70  |      | MHz   |
| t <sub>PLH</sub>  | Propagation Delay              | 2.7                    | 3.0  | 11.4 | 18.3 | 3.0   | 19.0 | ns    |
| t <sub>PHL</sub>  | CP to O <sub>n</sub>           | 3.3 ± 0.3              | 3.0  | 9.5  | 13.0 | 3.0   | 13.5 |       |
| t <sub>PZL</sub>  | Output Enable Time             | 2.7                    | 3.0  | 11.4 | 18.3 | 3.0   | 19.0 | ns    |
| t <sub>PZH</sub>  | CP to O <sub>n</sub>           | 3.3 ± 0.3              | 3.0  | 9.5  | 13.0 | 3.0   | 13.5 |       |
| t <sub>PHZ</sub>  | Output Disable Time            | 2.7                    | 1.0  | 11.4 | 20.4 | 1.0   | 21.0 | ns    |
| t <sub>PLZ</sub>  | CP to O <sub>n</sub>           | 3.3 ± 0.3              | 1.0  | 9.5  | 14.5 | 1.0   | 15.0 |       |
| t <sub>OSHL</sub> | Output to Output Skew (Note 9) | 2.7                    |  | 1.0  | 1.5  |   | 1.5  | ns    |
| t <sub>OSLH</sub> | CP to O <sub>n</sub>           | 3.3 ± 0.3              |  | 1.0  | 1.5  |   | 1.5  |       |

**Note 9:** 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.

## AC Operating Requirements

| Symbol         | Parameter                                       | V <sub>CC</sub><br>(V) | T <sub>A</sub> = +25°C<br>C <sub>L</sub> = 50 pF |                    | T <sub>A</sub> = 40°C to +85°C<br>C <sub>L</sub> = 50 pF |                    | Units |
|----------------|---|------------------------|--|--------------------|--|--------------------|-------|
|                |   |                        | Typ  | Guaranteed Minimum | Typ  | Guaranteed Minimum |       |
| t <sub>S</sub> | Setup Time, HIGH or LOW<br>D <sub>n</sub> to CP | 2.7<br>3.3 ± 0.3       | 0  | 4.0                | 4.5  | 3.0                | ns    |
| t <sub>H</sub> | Hold Time, HIGH or LOW<br>D <sub>n</sub> to CP  | 2.7<br>3.3 ± 0.3       | 0  | 1.5                | 1.5  | 1.5                |       |
| t <sub>W</sub> | CP Pulse Width,<br>HIGH or LOW                  | 2.7<br>3.3 ± 0.3       | 2.4  | 5.0                | 6.0  | 4.0                | ns    |
|                |   |                        | 2.0  | 4.0                | 4.0  | 4.0                |       |

## Capacitance

| Symbol                    | Parameter                     | Typ | Units | Conditions             |
|---------------------------|-------------------------------|-----|-------|------------------------|
| C <sub>IN</sub>           | Input Capacitance             | 4.5 | pF    | V <sub>CC</sub> = Open |
| C <sub>PD</sub> (Note 10) | Power Dissipation Capacitance | 39  | pF    | V <sub>CC</sub> = 3.3V |

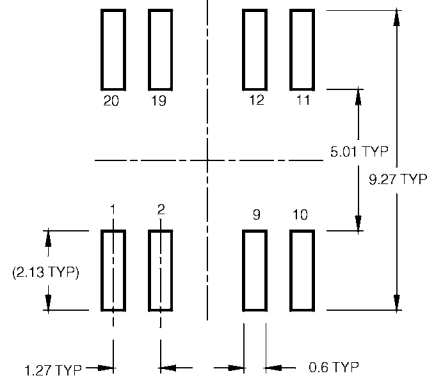
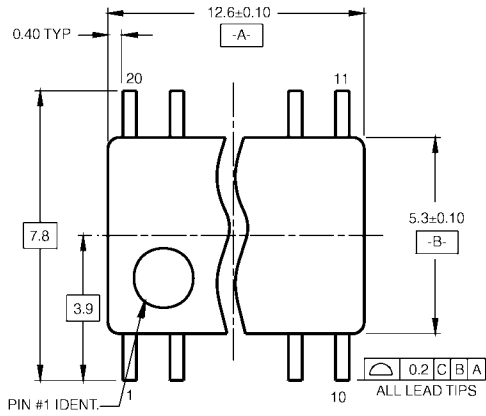
**Note 10:** C<sub>PD</sub> is measured at 10 MHz.

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

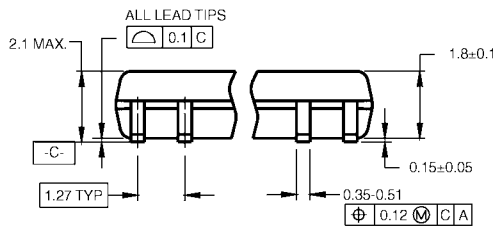


**20-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide  
Package Number M20B**

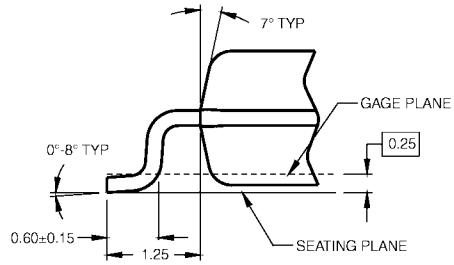
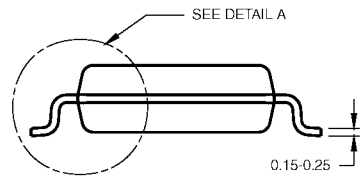
**Physical Dimensions** inches (millimeters) unless otherwise noted (Continued)



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DIMENSIONS ARE IN MILLIMETERS



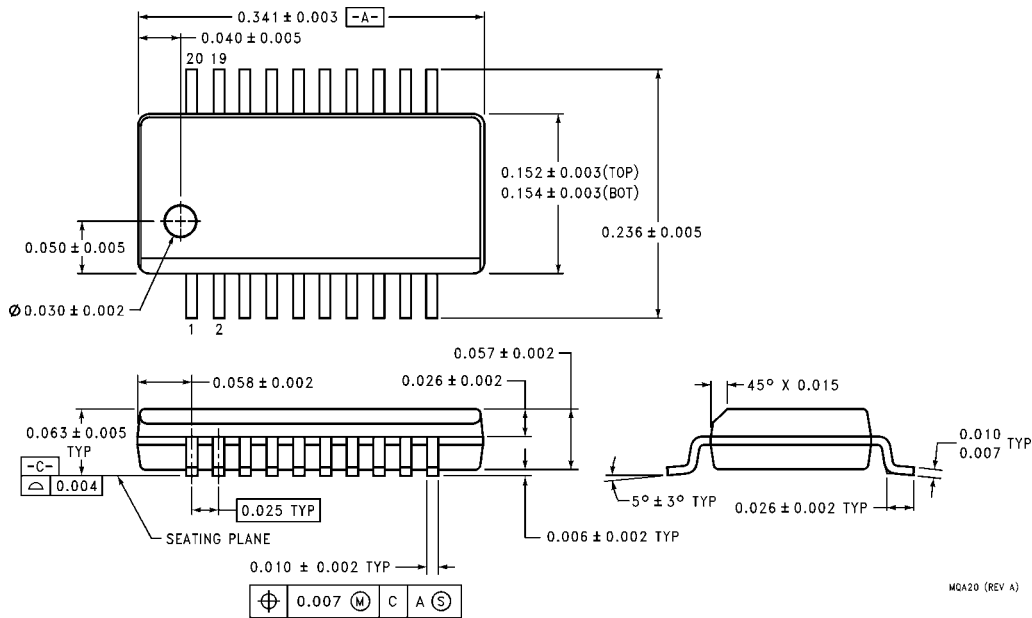
DETAIL A

- NOTES:
- A. CONFORMS TO EIAJ EDR-7320 REGISTRATION, ESTABLISHED IN DECEMBER, 1998.
  - B. DIMENSIONS ARE IN MILLIMETERS.
  - C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.

M20DRevB1

**20-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide  
Package Number M20D**

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



**20-Lead Quarter Size Outline Package (QSOP), JEDEC MO-137, 0.150" Wide  
Package Number MQA20**

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