1. General description

The 74LVC10A-Q100 provides three 3-input NAND functions. Inputs can be driven from either 3.3 V or 5 V devices. This feature allows the use of these devices as translators in mixed 3.3 V and 5 V applications.

This product has been qualified to the Automotive Electronics Council (AEC) standard Q100 (Grade 1) and is suitable for use in automotive applications.

2. Features and benefits

- Automotive product qualification in accordance with AEC-Q100 (Grade 1)
  - Specified from -40 °C to +85 °C and from -40 °C to +125 °C
- Wide supply voltage range from 1.2 V to 3.6 V
- Inputs accept voltages up to 5.5 V
- CMOS low power consumption
- Direct interface with TTL levels
- Latch-up performance exceeds 250 mA
- Complies with JEDEC standard:
  - JESD8-7A (1.65 V to 1.95 V)
  - JESD8-5A (2.3 V to 2.7 V)
  - JESD8-C/JESD36 (2.7 V to 3.6 V)
- ESD protection:
  - HBM: ANSI/ESDA/JEDEC JS-001 class 2 exceeds 2000 V
  - CDM: ANSI/ESDA/JEDEC JS-002 class C3 exceeds 1000 V

3. Ordering information

<table>
<thead>
<tr>
<th>Type number</th>
<th>Package</th>
<th>Temperature range</th>
<th>Name</th>
<th>Description</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>74LVC10APW-Q100</td>
<td>TSSOP14</td>
<td>-40 °C to +125 °C</td>
<td>plastic thin shrink small outline package; 14 leads; body width 4.4 mm</td>
<td>SOT402-1</td>
<td></td>
</tr>
</tbody>
</table>
4. Functional diagram

![Logic symbol](mna757)

**Fig. 1.** Logic symbol

![IEC logic symbol](mna759)

**Fig. 2.** IEC logic symbol

![Logic diagram (one gate)](mna758)

**Fig. 3.** Logic diagram (one gate)

5. Pinning information

5.1. Pinning

![PW package SOT402-1 (TSSOP14)](aaa-037255)

5.2. Pin description

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A, 2A, 3A</td>
<td>1, 3, 9</td>
<td>data input</td>
</tr>
<tr>
<td>1B, 2B, 3B</td>
<td>2, 4, 10</td>
<td>data input</td>
</tr>
<tr>
<td>1C, 2C, 3C</td>
<td>13, 5, 11</td>
<td>data input</td>
</tr>
<tr>
<td>1Y, 2Y, 3Y</td>
<td>12, 6, 8</td>
<td>data output</td>
</tr>
<tr>
<td>GND</td>
<td>7</td>
<td>ground (0 V)</td>
</tr>
<tr>
<td>(V_{\text{CC}})</td>
<td>14</td>
<td>supply voltage</td>
</tr>
</tbody>
</table>
6. Functional description

Table 3. Function selection

$H = \text{HIGH voltage level}; \ L = \text{LOW voltage level}; \ X = \text{don't care}$

<table>
<thead>
<tr>
<th>Input</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>nA</td>
<td>nB</td>
</tr>
<tr>
<td>L</td>
<td>X</td>
</tr>
<tr>
<td>X</td>
<td>L</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>H</td>
<td>H</td>
</tr>
</tbody>
</table>

7. Limiting values

Table 4. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{CC}$</td>
<td>supply voltage</td>
<td></td>
<td>-0.5</td>
<td>+6.5</td>
<td>V</td>
</tr>
<tr>
<td>$I_{IK}$</td>
<td>input clamping current</td>
<td>$V_I &lt; 0 \text{ V}$</td>
<td>-50</td>
<td>-</td>
<td>mA</td>
</tr>
<tr>
<td>$V_I$</td>
<td>input voltage</td>
<td>[1]</td>
<td>-0.5</td>
<td>+6.5</td>
<td>V</td>
</tr>
<tr>
<td>$I_{OK}$</td>
<td>output clamping current</td>
<td>$V_O &gt; V_{CC}$ or $V_O &lt; 0 \text{ V}$</td>
<td>-</td>
<td>±50</td>
<td>mA</td>
</tr>
<tr>
<td>$V_O$</td>
<td>output voltage</td>
<td>[2]</td>
<td>-0.5</td>
<td>$V_{CC} + 0.5 \text{ V}$</td>
<td></td>
</tr>
<tr>
<td>$I_O$</td>
<td>output current</td>
<td>$V_O = 0 \text{ V}$ to $V_{CC}$</td>
<td>-</td>
<td>±50</td>
<td>mA</td>
</tr>
<tr>
<td>$I_{CC}$</td>
<td>supply current</td>
<td></td>
<td>-</td>
<td>100</td>
<td>mA</td>
</tr>
<tr>
<td>$I_{GND}$</td>
<td>ground current</td>
<td></td>
<td>-100</td>
<td>-</td>
<td>mA</td>
</tr>
<tr>
<td>$P_{tot}$</td>
<td>total power dissipation</td>
<td>$T_{amb} = -40 \degree \text{ C}$ to $+125 \degree \text{ C}$</td>
<td>[3]</td>
<td>500</td>
<td>mW</td>
</tr>
<tr>
<td>$T_{stg}$</td>
<td>storage temperature</td>
<td></td>
<td>-65</td>
<td>+150</td>
<td>°C</td>
</tr>
</tbody>
</table>

[1] The minimum input voltage ratings may be exceeded if the input current ratings are observed.
[2] The output voltage ratings may be exceeded if the output current ratings are observed.
[3] For SOT402-1 (TSSOP14) package: $P_{tot}$ derates linearly with 7.3 mW/K above 81 °C.

8. Recommended operating conditions

Table 5. Recommended operating conditions

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{CC}$</td>
<td>supply voltage</td>
<td>functional</td>
<td>1.65</td>
<td>-</td>
<td>3.6</td>
<td>V</td>
</tr>
<tr>
<td>$V_I$</td>
<td>input voltage</td>
<td></td>
<td>1.2</td>
<td>-</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>$T_{amb}$</td>
<td>ambient temperature</td>
<td>in free air</td>
<td>0</td>
<td>-</td>
<td>5.5</td>
<td>V</td>
</tr>
<tr>
<td>$\Delta t/\Delta V$</td>
<td>input transition rise and fall rate</td>
<td>$V_{CC} = 1.65 \text{ V}$ to $2.7 \text{ V}$</td>
<td>0</td>
<td>-</td>
<td>20</td>
<td>ns/V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{CC} = 2.7 \text{ V}$ to $3.6 \text{ V}$</td>
<td>0</td>
<td>-</td>
<td>10</td>
<td>ns/V</td>
</tr>
</tbody>
</table>
# 9. Static characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>-40 °C to +85 °C</th>
<th>-40 °C to +125 °C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Min</td>
<td>Typ[1]</td>
</tr>
<tr>
<td>V_{IH}</td>
<td>HIGH-level input voltage</td>
<td>V_{CC} = 1.2 V</td>
<td>1.08</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V_{CC} = 1.65 V to 1.95 V</td>
<td>0.65 × V_{CC}</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V_{CC} = 2.3 V to 2.7 V</td>
<td>1.7</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V_{CC} = 2.7 V to 3.6 V</td>
<td>2.0</td>
<td>-</td>
</tr>
<tr>
<td>V_{IL}</td>
<td>LOW-level input voltage</td>
<td>V_{CC} = 1.2 V</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V_{CC} = 1.65 V to 1.95 V</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V_{CC} = 2.3 V to 2.7 V</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V_{CC} = 2.7 V to 3.6 V</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>V_{OH}</td>
<td>HIGH-level output voltage</td>
<td>V_{I} = V_{IH} or V_{IL}</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>I_{O} = -100 μA; V_{CC} = 1.65 V to 3.6 V</td>
<td>1.2</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I_{O} = -4 mA; V_{CC} = 1.65 V</td>
<td>1.8</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I_{O} = -8 mA; V_{CC} = 2.3 V</td>
<td>2.2</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I_{O} = -12 mA; V_{CC} = 2.7 V</td>
<td>2.4</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I_{O} = -24 mA; V_{CC} = 3.0 V</td>
<td>2.2</td>
<td>-</td>
</tr>
<tr>
<td>V_{OL}</td>
<td>LOW-level output voltage</td>
<td>V_{I} = V_{IH} or V_{IL}</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>I_{O} = 100 μA; V_{CC} = 1.65 V to 3.6 V</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I_{O} = 4 mA; V_{CC} = 1.65 V</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I_{O} = 8 mA; V_{CC} = 2.3 V</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I_{O} = 12 mA; V_{CC} = 2.7 V</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I_{O} = 24 mA; V_{CC} = 3.0 V</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>I_{I}</td>
<td>input leakage current</td>
<td>V_{CC} = 3.6 V; V_{I} = 5.5 V or GND</td>
<td>-</td>
<td>±0.1</td>
</tr>
<tr>
<td>I_{CC}</td>
<td>supply current</td>
<td>V_{CC} = 3.6 V; V_{I} = V_{CC} or GND; I_{O} = 0 A</td>
<td>-</td>
<td>0.1</td>
</tr>
<tr>
<td>ΔI_{CC}</td>
<td>additional supply current</td>
<td>per input pin; V_{CC} = 2.7 V to 3.6 V; V_{I} = V_{CC} or GND; I_{O} = 0 A</td>
<td>-</td>
<td>5</td>
</tr>
<tr>
<td>C_{I}</td>
<td>input capacitance</td>
<td>V_{CC} = 0 V to 3.6 V; V_{I} = GND to V_{CC}</td>
<td>-</td>
<td>4.0</td>
</tr>
</tbody>
</table>

[1] All typical values are measured at V_{CC} = 3.3 V (unless stated otherwise) and T_{amb} = 25 °C.
10. Dynamic characteristics

Table 7. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V). For test circuit see Fig. 5.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>-40 °C to +85 °C</th>
<th>-40 °C to +125 °C</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Min Typ[1]</td>
<td>Min</td>
<td>Max</td>
</tr>
<tr>
<td>( t_{pd} )</td>
<td>propagation delay</td>
<td>( nA, nB, nC ) to ( nY ); see Fig. 4 [2]</td>
<td>- 13 -</td>
<td>0.5 4.5</td>
<td>11.2 12.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( V_{CC} ) = 1.2 V</td>
<td>0.5</td>
<td>1.0</td>
<td>6.3 7.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( V_{CC} ) = 1.65 V to 1.95 V</td>
<td>1.5</td>
<td>1.5</td>
<td>2.8 7.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( V_{CC} ) = 2.3 V to 2.7 V</td>
<td>1.5</td>
<td>2.4</td>
<td>5.7 6.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( V_{CC} ) = 2.7 V</td>
<td>1.5</td>
<td>2.4</td>
<td>5.7 6.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( V_{CC} ) = 3.0 V to 3.6 V</td>
<td>1.5</td>
<td>2.4</td>
<td>5.7 6.6</td>
</tr>
<tr>
<td>( C_{PD} )</td>
<td>power dissipation</td>
<td>per gate; ( V_i ) = GND to ( V_{CC} ) [3]</td>
<td>- 2.9 -</td>
<td>0.5 4.5</td>
<td>11.2 12.9</td>
</tr>
<tr>
<td></td>
<td>capacitance</td>
<td>( V_{CC} ) = 1.65 V to 1.95 V</td>
<td>- 2.9 -</td>
<td>0.5 4.5</td>
<td>11.2 12.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( V_{CC} ) = 2.3 V to 2.7 V</td>
<td>- 6.0 -</td>
<td>1.0</td>
<td>6.3 7.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( V_{CC} ) = 3.0 V to 3.6 V</td>
<td>- 8.8 -</td>
<td>1.0</td>
<td>6.3 7.4</td>
</tr>
</tbody>
</table>

[1] Typical values are measured at \( T_{amb} = 25 \, ^\circ C \) and \( V_{CC} = 1.2 \, V, 1.8 \, V, 2.5 \, V, 2.7 \, V, \) and 3.3 \, V respectively.

[2] \( t_{pd} \) is the same as \( t_{PLH} \) and \( t_{PHL} \).

[3] \( C_{PD} \) is used to determine the dynamic power dissipation \( (P_D \) in \( \mu W \)).

\[
P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \sum(C_L \times V_{CC}^2 \times f_o)
\]

where:

- \( f_i \) = input frequency in MHz
- \( f_o \) = output frequency in MHz
- \( C_L \) = output load capacitance in pF
- \( V_{CC} \) = supply voltage in Volts
- \( N \) = number of inputs switching
- \( \sum(C_L \times V_{CC}^2 \times f_o) \) = sum of the outputs
10.1. Waveforms and test circuit

![Waveforms and test circuit diagram]

**Fig. 4.** Input (nA, nB and nC) to output (nY) propagation delays

- \( V_M = 1.5 \text{ V} \) at \( V_{CC} \geq 2.7 \text{ V} \)
- \( V_M = 0.5 \times V_{CC} \) at \( V_{CC} \leq 2.7 \text{ V} \)

\( V_{OL} \) and \( V_{OH} \) are typical output voltage levels that occur with the output load.

**Fig. 5.** Test circuit for measuring switching times

Test data is given in **Table 8.** Definitions for test circuit:
- \( R_L \) = Load resistance.
- \( C_L \) = Load capacitance including jig and probe capacitance.
- \( R_T \) = Termination resistance should be equal to output impedance \( Z_o \) of the pulse generator.

**Table 8. Test data**

<table>
<thead>
<tr>
<th>Supply voltage</th>
<th>Input</th>
<th>( t_r, t_f )</th>
<th>Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>( 1.2 \text{ V} )</td>
<td>( V_{CC} )</td>
<td>( \leq 2 \text{ ns} )</td>
<td>( C_L = 30 \text{ pF} )</td>
</tr>
<tr>
<td>( 1.65 \text{ V} ) to ( 1.95 \text{ V} )</td>
<td>( V_{CC} )</td>
<td>( \leq 2 \text{ ns} )</td>
<td>( C_L = 30 \text{ pF} )</td>
</tr>
<tr>
<td>( 2.3 \text{ V} ) to ( 2.7 \text{ V} )</td>
<td>( V_{CC} )</td>
<td>( \leq 2 \text{ ns} )</td>
<td>( C_L = 30 \text{ pF} )</td>
</tr>
<tr>
<td>( 2.7 \text{ V} )</td>
<td>( 2.7 \text{ V} )</td>
<td>( \leq 2.5 \text{ ns} )</td>
<td>( C_L = 50 \text{ pF} )</td>
</tr>
<tr>
<td>( 3.0 \text{ V} ) to ( 3.6 \text{ V} )</td>
<td>( 2.7 \text{ V} )</td>
<td>( \leq 2.5 \text{ ns} )</td>
<td>( C_L = 50 \text{ pF} )</td>
</tr>
</tbody>
</table>
## 11. Package outline

**TSSOP14**: plastic thin shrink small outline package; 14 leads; body width 4.4 mm  

### Dimensions (mm are the original dimensions)

<table>
<thead>
<tr>
<th>Unit</th>
<th>A</th>
<th>A₁</th>
<th>A₂</th>
<th>A₃</th>
<th>bₚ</th>
<th>c</th>
<th>D(1)</th>
<th>E(2)</th>
<th>e</th>
<th>Hₑ</th>
<th>L</th>
<th>Lₚ</th>
<th>v</th>
<th>w</th>
<th>y</th>
<th>θ</th>
</tr>
</thead>
<tbody>
<tr>
<td>max</td>
<td>1.20</td>
<td>0.15</td>
<td>1.05</td>
<td>0.25</td>
<td>0.30</td>
<td>0.2</td>
<td>5.1</td>
<td>4.5</td>
<td>6.6</td>
<td>0.75</td>
<td>1</td>
<td>0.2</td>
<td>0.1</td>
<td>0.1</td>
<td>8°</td>
<td></td>
</tr>
<tr>
<td>nom</td>
<td>0.25</td>
<td>0.05</td>
<td>0.80</td>
<td>0.25</td>
<td>0.19</td>
<td>0.09</td>
<td>4.9</td>
<td>4.3</td>
<td>6.2</td>
<td>0.45</td>
<td>0.65</td>
<td>1</td>
<td>0.2</td>
<td>0.1</td>
<td>0.1</td>
<td>0°</td>
</tr>
</tbody>
</table>

**Note**
1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

### Outline version
- **IEC**
- **JEDEC**
- **JEITA**

<table>
<thead>
<tr>
<th>Outline version</th>
<th>References</th>
</tr>
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<tbody>
<tr>
<td>SOT402-1</td>
<td>MO-153</td>
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</tbody>
</table>

### European projection
- **IEC**
- **JEDEC**
- **JEITA**

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<th>Issue date</th>
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</thead>
<tbody>
<tr>
<td>23-10-27</td>
</tr>
</tbody>
</table>

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**Fig. 6.** Package outline SOT402-1 (TSSOP14)
12. Abbreviations

Table 9. Abbreviations

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>CDM</td>
<td>Charged Device Model</td>
</tr>
<tr>
<td>CMOS</td>
<td>Complementary Metal-Oxide Semiconductor</td>
</tr>
<tr>
<td>DUT</td>
<td>Device Under Test</td>
</tr>
<tr>
<td>ESD</td>
<td>ElectroStatic Discharge</td>
</tr>
<tr>
<td>HBM</td>
<td>Human Body Model</td>
</tr>
<tr>
<td>TTL</td>
<td>Transistor-Transistor Logic</td>
</tr>
</tbody>
</table>

13. Revision history

Table 10. Revision history

<table>
<thead>
<tr>
<th>Document ID</th>
<th>Release date</th>
<th>Data sheet status</th>
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14. Legal information

Data sheet status

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<td>Objective [short] data sheet</td>
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<td>Preliminary [short] data sheet</td>
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[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term "short data sheet" is explained in section "Definitions".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the internet at https://www.nexperia.com.

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