

**3.3V CMOS  
16-BIT BUFFER/DRIVER  
WITH 3-STATE OUTPUTS,  
5 VOLT TOLERANT I/O AND BUS-HOLD**

**FEATURES:**

- Typical  $t_{SK(o)}$  (Output Skew) < 250ps
- ESD > 2000V per MIL-STD-883, Method 3015; > 200V using machine model (C = 200pF, R = 0)
- $V_{CC} = 3.3V \pm 0.3V$ , Normal Range
- $V_{CC} = 2.7V$  to  $3.6V$ , Extended Range
- CMOS power levels (0.4μ W typ. static)
- All inputs, outputs, and I/O are 5V tolerant
- Available in TSSOP package

**DRIVE FEATURES:**

- High Output Drivers:  $\pm 24mA$
- Reduced system switching noise

**APPLICATIONS:**

- 5V and 3.3V mixed voltage systems
- Data communication and telecommunication systems

**DESCRIPTION:**

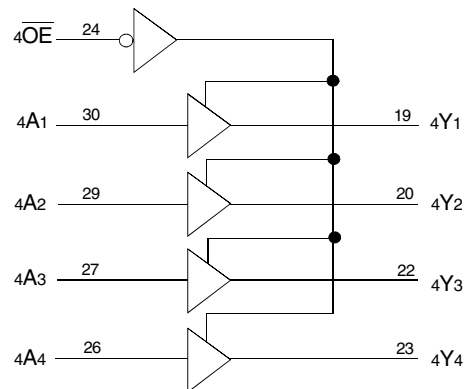
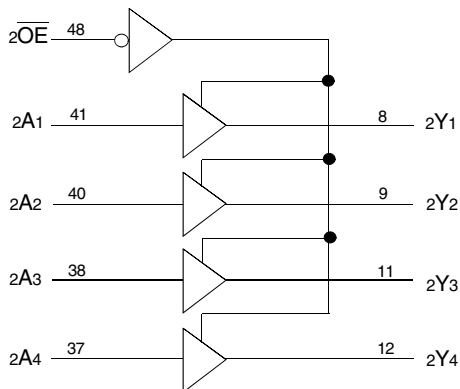
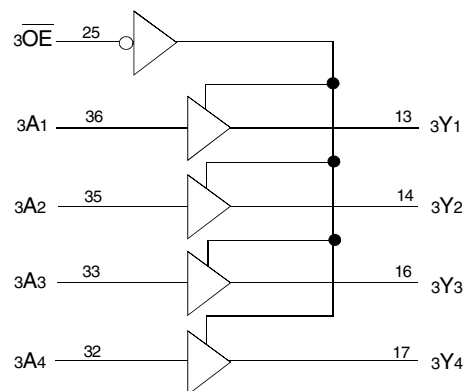
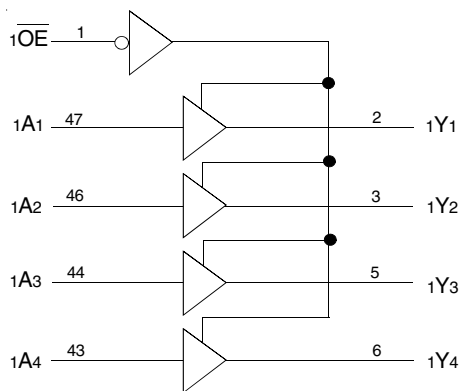
The LVCH16244A 16-bit buffer/driver is built using advanced dual metal CMOS technology. The LVCH16244A is designed specifically to improve the performance and density of 3-state memory address drivers, clock drivers, and bus-oriented receivers and transmitters. The device can be used as four 4-bit buffers, two 8-bit buffers, or one 16-bit buffer. This device provides true outputs and symmetrical active-low output-enable ( $\overline{OE}$ ) inputs.

All pins of this 16-bit buffer/driver can be driven from either 3.3V or 5V devices. This feature allows the use of this device a translator in a mixed 3.3V/5V supply system.

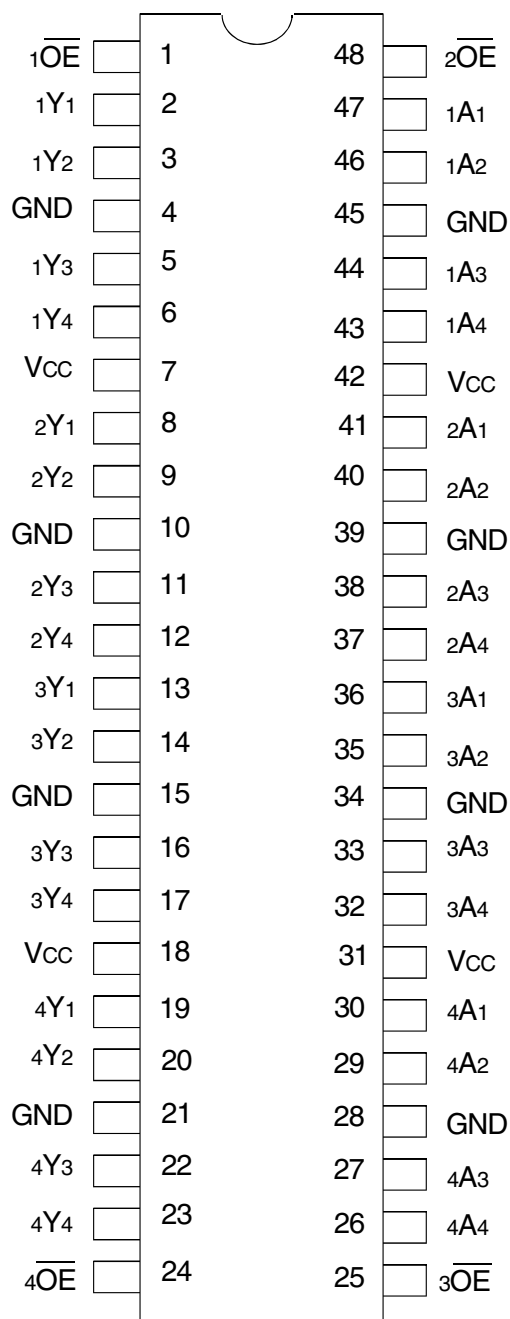
The LVCH16244A has been designed with a  $\pm 24mA$  output driver. The driver is capable of driving a moderate to heavy load while maintaining speed performance.

The LVCH16244A has "bus-hold" which retains the inputs' last state whenever the input goes to a high impedance. This prevents floating inputs and eliminates the need for pull-up/down resistors.

**FUNCTIONAL BLOCK DIAGRAM**



## PIN CONFIGURATION



TSSOP  
TOP VIEW

## ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>

| Symbol                             | Description   | Max          | Unit |
|------------------------------------|---|--------------|------|
| VTERM                              | Terminal Voltage with Respect to GND                                  | -0.5 to +6.5 | V    |
| TSTG                               | Storage Temperature   | -65 to +150  | °C   |
| IOUT                               | DC Output Current   | -50 to +50   | mA   |
| I <sub>IK</sub><br>I <sub>OK</sub> | Continuous Clamp Current,<br>V <sub>I</sub> < 0 or V <sub>O</sub> < 0 | -50          | mA   |
| I <sub>CC</sub><br>I <sub>SS</sub> | Continuous Current through each<br>V <sub>CC</sub> or GND             | ±100         | mA   |

### NOTE:

- Stresses greater than those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

## CAPACITANCE (T<sub>A</sub> = +25°C, F = 1.0MHz)

| Symbol           | Parameter <sup>(1)</sup> | Conditions            | Typ. | Max. | Unit |
|------------------|--------------------------|-----------------------|------|------|------|
| C <sub>IN</sub>  | Input Capacitance        | V <sub>IN</sub> = 0V  | 4.5  | 6    | pF   |
| C <sub>OUT</sub> | Output Capacitance       | V <sub>OUT</sub> = 0V | 6.5  | 8    | pF   |
| C <sub>I/O</sub> | I/O Port Capacitance     | V <sub>IN</sub> = 0V  | 6.5  | 8    | pF   |

### NOTE:

- As applicable to the device type.

## PIN DESCRIPTION

| Pin Names         | Description                               |
|-------------------|---|
| xAx               | Data Inputs <sup>(1)</sup>                |
| xYx               | 3-State Outputs                           |
| x $\overline{OE}$ | 3-State Output Enable Inputs (Active LOW) |

### NOTE:

- These pins have "Bus-Hold". All other pins are standard inputs, outputs, or I/Os.

## FUNCTION TABLE (EACH 4-BIT BUFFER)<sup>(1)</sup>

| Inputs            |     | Outputs |
|-------------------|-----|---------|
| x $\overline{OE}$ | xAx | xYx     |
| L                 | L   | L       |
| L                 | H   | H       |
| H                 | X   | Z       |

### NOTES:

- H = HIGH Voltage Level  
X = Don't Care  
L = LOW Voltage Level  
Z = High-Impedance

## DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified:

Operating Condition: TA = -40°C to +85°C

| Symbol   | Parameter  | Test Conditions   |   | Min. | Typ. <sup>(1)</sup> | Max. | Unit |
|--|--|---|---|------|---------------------|------|------|
| V <sub>IH</sub>  | Input HIGH Voltage Level                               | V <sub>CC</sub> = 2.3V to 2.7V  |   | 1.7  | —                   | —    | V    |
|  |  | V <sub>CC</sub> = 2.7V to 3.6V  |   | 2    | —                   | —    |      |
| V <sub>IL</sub>  | Input LOW Voltage Level                                | V <sub>CC</sub> = 2.3V to 2.7V  |   | —    | —                   | 0.7  | V    |
|  |  | V <sub>CC</sub> = 2.7V to 3.6V  |   | —    | —                   | 0.8  |      |
| I <sub>IH</sub><br>I <sub>IL</sub>                       | Input Leakage Current                                  | V <sub>CC</sub> = 3.6V  | V <sub>I</sub> = 0 to 5.5V                  | —    | —                   | ±5   | μA   |
| I <sub>OZH</sub><br>I <sub>OZL</sub>                     | High Impedance Output Current<br>(3-State Output pins) | V <sub>CC</sub> = 3.6V  | V <sub>O</sub> = 0 to 5.5V                  | —    | —                   | ±10  | μA   |
| I <sub>OFF</sub>   | Input/Output Power Off Leakage                         | V <sub>CC</sub> = 0V, V <sub>IN</sub> or V <sub>O</sub> ≤ 5.5V              |   | —    | —                   | ±50  | μA   |
| V <sub>IK</sub>  | Clamp Diode Voltage                                    | V <sub>CC</sub> = 2.3V, I <sub>IN</sub> = -18mA                             |   | —    | -0.7                | -1.2 | V    |
| V <sub>H</sub>   | Input Hysteresis                                       | V <sub>CC</sub> = 3.3V  |   | —    | 100                 | —    | mV   |
| I <sub>CC1</sub><br>I <sub>CC2</sub><br>I <sub>CC3</sub> | Quiescent Power Supply Current                         | V <sub>CC</sub> = 3.6V  | V <sub>IN</sub> = GND or V <sub>CC</sub>    | —    | —                   | 10   | μA   |
|  |  |   | 3.6 ≤ V <sub>IN</sub> ≤ 5.5V <sup>(2)</sup> | —    | —                   | 10   |      |
| ΔI <sub>CC</sub>   | Quiescent Power Supply Current Variation               | One input at V <sub>CC</sub> - 0.6V, other inputs at V <sub>CC</sub> or GND |   | —    | —                   | 500  | μA   |

### NOTES:

1. Typical values are at V<sub>CC</sub> = 3.3V, +25°C ambient.
2. This applies in the disabled state only.

## BUS-HOLD CHARACTERISTICS

| Symbol                                | Parameter <sup>(1)</sup>         | Test Conditions        |                            | Min. | Typ. <sup>(2)</sup> | Max. | Unit |
|---------------------------------------|----------------------------------|------------------------|----------------------------|------|---------------------|------|------|
| I <sub>BH</sub><br>I <sub>BHL</sub>   | Bus-Hold Input Sustain Current   | V <sub>CC</sub> = 3V   | V <sub>I</sub> = 2V        | -75  | —                   | —    | μA   |
|                                       |                                  |                        | V <sub>I</sub> = 0.8V      | 75   | —                   | —    |      |
| I <sub>BH</sub><br>I <sub>BHL</sub>   | Bus-Hold Input Sustain Current   | V <sub>CC</sub> = 2.3V | V <sub>I</sub> = 1.7V      | —    | —                   | —    | μA   |
|                                       |                                  |                        | V <sub>I</sub> = 0.7V      | —    | —                   | —    |      |
| I <sub>BHO</sub><br>I <sub>BHLO</sub> | Bus-Hold Input Overdrive Current | V <sub>CC</sub> = 3.6V | V <sub>I</sub> = 0 to 3.6V | —    | —                   | ±500 | μA   |

### NOTES:

1. Pins with Bus-Hold are identified in the pin description.
2. Typical values are at V<sub>CC</sub> = 3.3V, +25°C ambient.

## OUTPUT DRIVE CHARACTERISTICS

| Symbol | Parameter           | Test Conditions <sup>(1)</sup> |                           | Min.                  | Max. | Unit |
|--------|---------------------|--------------------------------|---------------------------|-----------------------|------|------|
| VOH    | Output HIGH Voltage | V <sub>CC</sub> = 2.3V to 3.6V | I <sub>OH</sub> = - 0.1mA | V <sub>CC</sub> - 0.2 | —    | V    |
|        |                     | V <sub>CC</sub> = 2.3V         | I <sub>OH</sub> = - 6mA   | 2                     | —    |      |
|        |                     | V <sub>CC</sub> = 2.3V         | I <sub>OH</sub> = - 12mA  | 1.7                   | —    |      |
|        |                     | V <sub>CC</sub> = 2.7V         |                           | 2.2                   | —    |      |
|        |                     | V <sub>CC</sub> = 3V           |                           | 2.4                   | —    |      |
|        |                     | V <sub>CC</sub> = 3V           | I <sub>OH</sub> = - 24mA  | 2.2                   | —    |      |
| VOL    | Output LOW Voltage  | V <sub>CC</sub> = 2.3V to 3.6V | I <sub>OL</sub> = 0.1mA   | —                     | 0.2  | V    |
|        |                     | V <sub>CC</sub> = 2.3V         | I <sub>OL</sub> = 6mA     | —                     | 0.4  |      |
|        |                     |                                | I <sub>OL</sub> = 12mA    | —                     | 0.7  |      |
|        |                     | V <sub>CC</sub> = 2.7V         | I <sub>OL</sub> = 12mA    | —                     | 0.4  |      |
|        |                     | V <sub>CC</sub> = 3V           | I <sub>OL</sub> = 24mA    | —                     | 0.55 |      |

**NOTE:**  
1. V<sub>IH</sub> and V<sub>IL</sub> must be within the min. or max. range shown in the DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE table for the appropriate V<sub>CC</sub> range. T<sub>A</sub> = - 40°C to + 85°C.

## OPERATING CHARACTERISTICS, V<sub>CC</sub> = 3.3V ± 0.3V, T<sub>A</sub> = 25°C

| Symbol | Parameter  | Test Conditions                 | Typical | Unit |
|--------|--|---------------------------------|---------|------|
| CPD    | Power Dissipation Capacitance per Buffer/Driver Outputs enabled  | C <sub>L</sub> = 0pF, f = 10Mhz | 34      | pF   |
| CPD    | Power Dissipation Capacitance per Buffer/Driver Outputs disabled |                                 | 3       |      |

## SWITCHING CHARACTERISTICS<sup>(1)</sup>

| Symbol             | Parameter                  | V <sub>CC</sub> = 2.7V |      | V <sub>CC</sub> = 3.3V ± 0.3V |      | Unit |
|--------------------|----------------------------|------------------------|------|-------------------------------|------|------|
|                    |                            | Min.                   | Max. | Min.                          | Max. |      |
| t <sub>PLH</sub>   | Propagation Delay          | —                      | 4.7  | 1.1                           | 4.1  | ns   |
| t <sub>PHL</sub>   | xAx to xYx                 |                        |      |                               |      |      |
| t <sub>PZH</sub>   | Output Enable Time         | —                      | 5.8  | 1                             | 4.6  | ns   |
| t <sub>PZL</sub>   | x $\overline{OE}$ to xYx   |                        |      |                               |      |      |
| t <sub>PHZ</sub>   | Output Disable Time        | —                      | 6.2  | 1.8                           | 5.8  | ns   |
| t <sub>PLZ</sub>   | x $\overline{OE}$ to xYx   |                        |      |                               |      |      |
| t <sub>SK(0)</sub> | Output Skew <sup>(2)</sup> | —                      | —    | —                             | 1    | ns   |

**NOTES:**  
1. See TEST CIRCUITS AND WAVEFORMS. T<sub>A</sub> = - 40°C to + 85°C.  
2. Skew between any two outputs of the same package and switching in the same direction.

## TEST CIRCUITS AND WAVEFORMS

### TEST CONDITIONS

| Symbol            | V <sub>CC</sub> <sup>(1)</sup> =3.3V±0.3V | V <sub>CC</sub> <sup>(1)</sup> =2.7V | V <sub>CC</sub> <sup>(2)</sup> =2.5V±0.2V | Unit |
|-------------------|---|--------------------------------------|---|------|
| V <sub>LOAD</sub> | 6   | 6                                    | 2 x V <sub>CC</sub>                       | V    |
| V <sub>IH</sub>   | 2.7                                       | 2.7                                  | V <sub>CC</sub>                           | V    |
| V <sub>T</sub>    | 1.5                                       | 1.5                                  | V <sub>CC</sub> / 2                       | V    |
| V <sub>LZ</sub>   | 300                                       | 300                                  | 150                                       | mV   |
| V <sub>HZ</sub>   | 300                                       | 300                                  | 150                                       | mV   |
| C <sub>L</sub>    | 50  | 50                                   | 30  | pF   |



#### DEFINITIONS:

C<sub>L</sub> = Load capacitance: includes jig and probe capacitance.  
R<sub>T</sub> = Termination resistance: should be equal to Z<sub>OUT</sub> of the Pulse Generator.

#### NOTES:

1. Pulse Generator for All Pulses: Rate ≤ 10MHz; t<sub>r</sub> ≤ 2.5ns; t<sub>r</sub> ≤ 2.5ns.
2. Pulse Generator for All Pulses: Rate ≤ 10MHz; t<sub>r</sub> ≤ 2ns; t<sub>r</sub> ≤ 2ns.

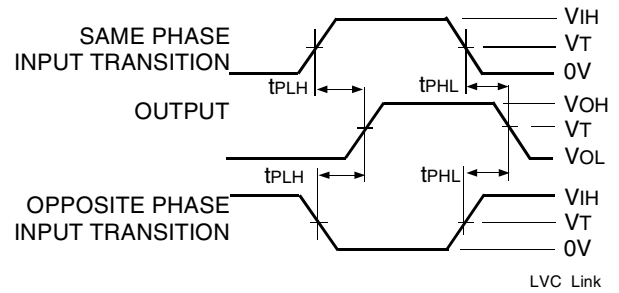
### SWITCH POSITION

| Test                                    | Switch            |
|---|-------------------|
| Open Drain<br>Disable Low<br>Enable Low | V <sub>LOAD</sub> |
| Disable High<br>Enable High             | GND               |
| All Other Tests                         | Open              |

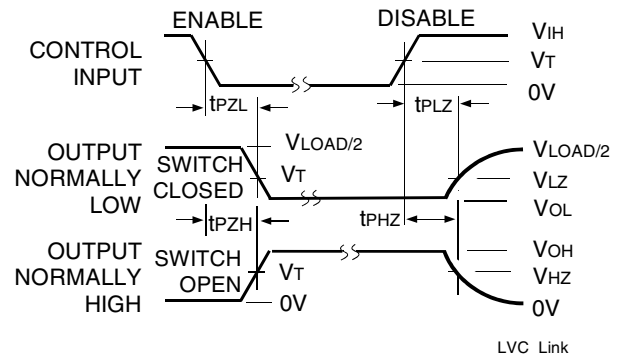


#### NOTES:

1. For tsk(o) OUTPUT1 and OUTPUT2 are any two outputs.
2. For tsk(b) OUTPUT1 and OUTPUT2 are in the same bank.



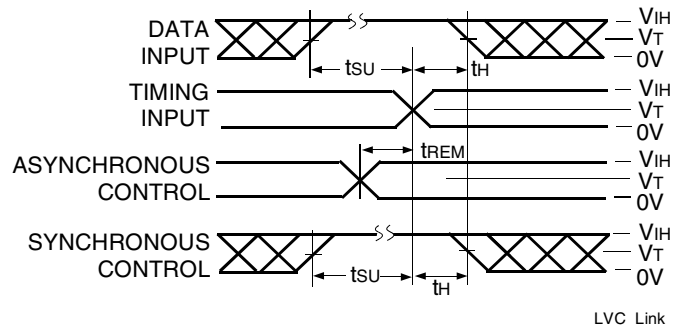
#### Propagation Delay



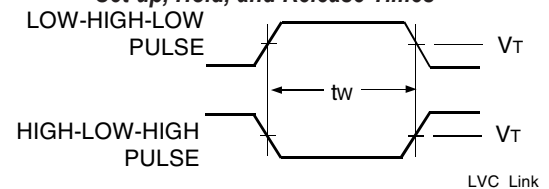
#### Enable and Disable Times

#### NOTE:

1. Diagram shown for input Control Enable-LOW and input Control Disable-HIGH.

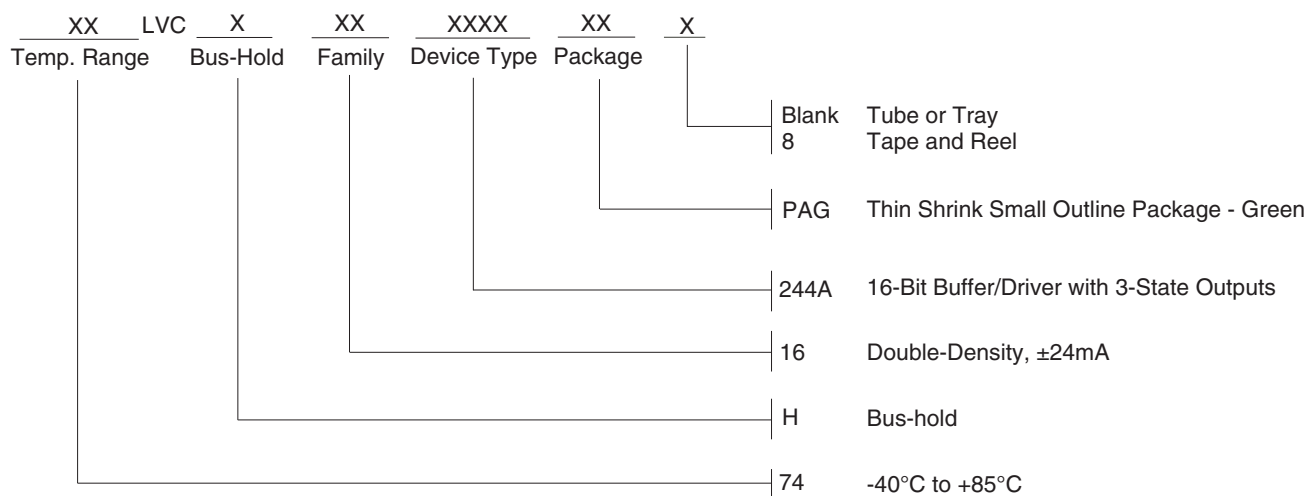


#### Set-up, Hold, and Release Times



#### Pulse Width

## ORDERING INFORMATION



## DATASHEET DOCUMENT HISTORY

10/06/2015 Pg. 1, 2, 6 Updated the ordering information by removing SSOP, non RoHS parts and adding Tape and Reel information.

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