



# 3.3V CMOS 20-BIT BUFFER WITH 5 VOLT TOLERANT I/O

IDT74LVC16827A

## FEATURES:

- Typical  $t_{SK(0)}$  (Output Skew) < 250ps
- ESD > 2000V per MIL-STD-883, Method 3015;  
> 200V using machine model (C = 200pF, R = 0)
- 0.635mm pitch SSOP, 0.50mm pitch TSSOP  
and 0.40mm pitch TVSOP packages
- Extended commercial range of -40°C to +85°C
- $V_{CC} = 3.3V \pm 0.3V$ , Normal Range
- $V_{CC} = 2.7V$  to 3.6V, Extended Range
- CMOS power levels (0.4μW typ. static)
- All inputs, outputs and I/O are 5 Volt tolerant
- Supports hot insertion

### Drive Features for LVC16827A:

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

## APPLICATIONS:

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

## DESCRIPTION:

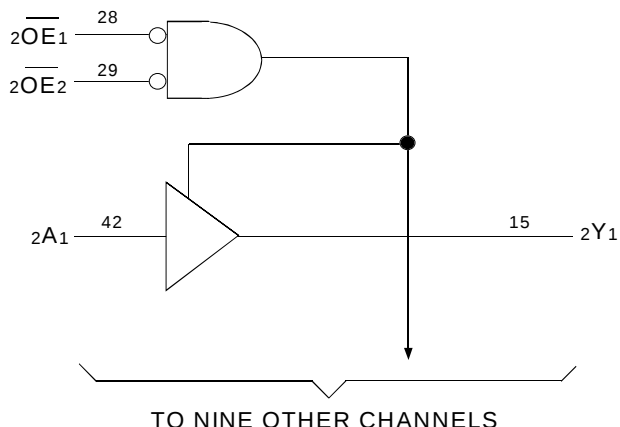
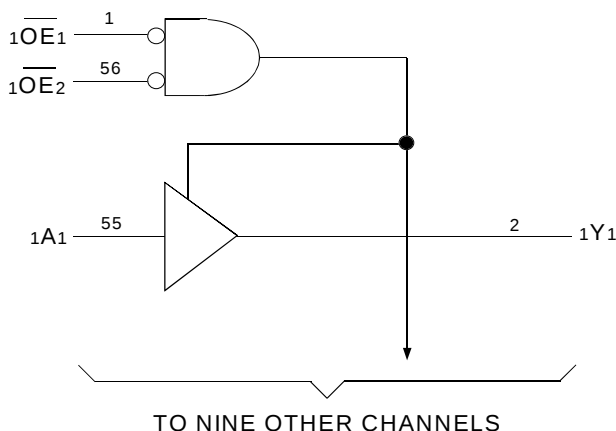
This 20-bit buffer is built using advanced dual metal CMOS technology. The LVC16827A provides high-performance bus interface buffering for wide data/address paths or buses carrying parity. Two pairs of NAND-ed output enable controls offer maximum control flexibility and are organized to operate the device as two 10-bit buffers or one 20-bit buffer. Flow-through organization of signal pins simplifies layout. All inputs are designed with hysteresis for improved noise margin.

The LVC16827A buffer is ideally suited for driving high capacitance loads and low impedance backplanes.

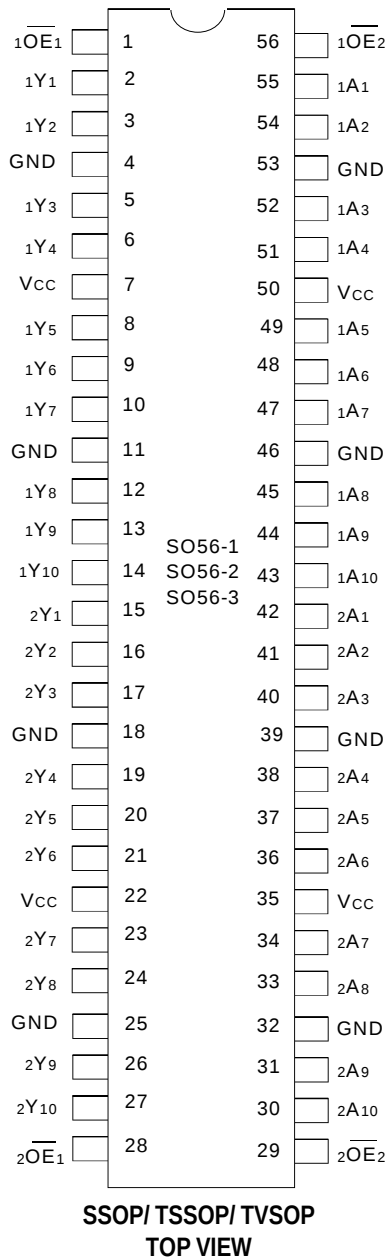
All pins can be driven from either 3.3V or 5V devices. This feature allows the use of the device as a translator in a mixed 3.3V/5V supply system.

The LVC16827A has been designed with a  $\pm 24mA$  output driver. The driver is capable of driving a moderate to heavy load while maintaining speed performance.

## FUNCTIONAL BLOCK DIAGRAM



## PIN CONFIGURATION



## ABSOLUTE MAXIMUM RATINGS (1)

| Symbol               | Description                                   | Max.          | Unit |
|----------------------|-----------------------------------------------|---------------|------|
| VTERM <sup>(2)</sup> | Terminal Voltage with Respect to GND          | – 0.5 to +6.5 | V    |
| VTERM <sup>(3)</sup> | 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   |
| IIK<br>IOLK          | Continuous Clamp Current,<br>Vi < 0 or Vo < 0 | – 50          | mA   |
| ICC<br>ISS           | Continuous Current through<br>each Vcc or GND | ±100          | mA   |

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### NOTES:

- 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.
- Vcc terminals.
- All terminals except Vcc.

## CAPACITANCE (TA = +25°C, f = 1.0MHz)

| Symbol | Parameter <sup>(1)</sup> | Conditions | Typ. | Max. | Unit |
|--------|--------------------------|------------|------|------|------|
| CIN    | Input Capacitance        | VIN = 0V   | 4.5  | 6    | pF   |
| COUT   | Output Capacitance       | VOUT = 0V  | 6.5  | 8    | pF   |
| CIO    | I/O Port Capacitance     | VIN = 0V   | 6.5  | 8    | pF   |

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### NOTE:

- As applicable to the device type.

## PIN DESCRIPTION

| Pin Names | Description                       |
|-----------|-----------------------------------|
| xOEx      | Output Enable Inputs (Active LOW) |
| xAx       | Data Inputs                       |
| XYx       | 3-State Outputs                   |

## FUNCTION TABLE (1)

| Inputs |      |     | Outputs |
|--------|------|-----|---------|
| xOE1   | xOE2 | xAx | XYx     |
| L      | L    | L   | L       |
| L      | L    | H   | H       |
| H      | X    | X   | Z       |
| X      | H    | X   | Z       |

### NOTE:

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

## DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified:

Operating Condition:  $T_A = -40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$

| Symbol                              | Parameter                                              | Test Conditions                                                        |                                          | Min. | Typ. <sup>(1)</sup> | Max.     | Unit          |
|-------------------------------------|--------------------------------------------------------|------------------------------------------------------------------------|------------------------------------------|------|---------------------|----------|---------------|
| $V_{IH}$                            | Input HIGH Voltage Level                               | $V_{CC} = 2.3\text{V}$ to $2.7\text{V}$                                |                                          | 1.7  | —                   | —        | V             |
|                                     |                                                        | $V_{CC} = 2.7\text{V}$ to $3.6\text{V}$                                |                                          | 2    | —                   | —        |               |
| $V_{IL}$                            | Input LOW Voltage Level                                | $V_{CC} = 2.3\text{V}$ to $2.7\text{V}$                                |                                          | —    | —                   | 0.7      | V             |
|                                     |                                                        | $V_{CC} = 2.7\text{V}$ to $3.6\text{V}$                                |                                          | —    | —                   | 0.8      |               |
| $I_{IH}$<br>$I_{IL}$                | Input Leakage Current                                  | $V_{CC} = 3.6\text{V}$                                                 | $V_I = 0$ to $5.5\text{V}$               | —    | —                   | $\pm 5$  | $\mu\text{A}$ |
| $I_{OZH}$<br>$I_{OZL}$              | High Impedance Output Current<br>(3-State Output pins) | $V_{CC} = 3.6\text{V}$                                                 | $V_O = 0$ to $5.5\text{V}$               | —    | —                   | $\pm 10$ | $\mu\text{A}$ |
| $I_{OFF}$                           | Input/Output Power Off Leakage                         | $V_{CC} = 0\text{V}$ , $V_{IN}$ or $V_O \leq 5.5\text{V}$              |                                          | —    | —                   | $\pm 50$ | $\mu\text{A}$ |
| $V_{IK}$                            | Clamp Diode Voltage                                    | $V_{CC} = 2.3\text{V}$ , $I_{IN} = -18\text{mA}$                       |                                          | —    | -0.7                | -1.2     | V             |
| $V_H$                               | Input Hysteresis                                       | $V_{CC} = 3.3\text{V}$                                                 |                                          | —    | 100                 | —        | mV            |
| $I_{CCL}$<br>$I_{CCH}$<br>$I_{CCZ}$ | Quiescent Power Supply Current                         | $V_{CC} = 3.6\text{V}$                                                 | $V_{IN} = \text{GND}$ or $V_{CC}$        | —    | —                   | 10       | $\mu\text{A}$ |
|                                     |                                                        |                                                                        | $3.6 \leq V_{IN} \leq 5.5\text{V}^{(2)}$ | —    | —                   | 10       |               |
| $\Delta I_{CC}$                     | Quiescent Power Supply Current Variation               | One input at $V_{CC} - 0.6\text{V}$<br>other inputs at $V_{CC}$ or GND |                                          | —    | —                   | 500      | $\mu\text{A}$ |

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### NOTES:

- Typical values are at  $V_{CC} = 3.3\text{V}$ ,  $+25^{\circ}\text{C}$  ambient.
- This applies in the disabled state only.

## OUTPUT DRIVE CHARACTERISTICS

| Symbol   | Parameter           | Test Conditions <sup>(1)</sup>          |                          | Min.           | Max. | Unit |
|----------|---------------------|-----------------------------------------|--------------------------|----------------|------|------|
| $V_{OH}$ | Output HIGH Voltage | $V_{CC} = 2.3\text{V}$ to $3.6\text{V}$ | $I_{OH} = -0.1\text{mA}$ | $V_{CC} - 0.2$ | —    | V    |
|          |                     | $V_{CC} = 2.3\text{V}$                  | $I_{OH} = -6\text{mA}$   | 2              | —    |      |
|          |                     | $V_{CC} = 2.3\text{V}$                  | $I_{OH} = -12\text{mA}$  | 1.7            | —    |      |
|          |                     | $V_{CC} = 2.7\text{V}$                  |                          | 2.2            | —    |      |
|          |                     | $V_{CC} = 3.0\text{V}$                  |                          | 2.4            | —    |      |
|          |                     | $V_{CC} = 3.0\text{V}$                  | $I_{OH} = -24\text{mA}$  | 2.2            | —    |      |
| $V_{OL}$ | Output LOW Voltage  | $V_{CC} = 2.3\text{V}$ to $3.6\text{V}$ | $I_{OL} = 0.1\text{mA}$  | —              | 0.2  | V    |
|          |                     | $V_{CC} = 2.3\text{V}$                  | $I_{OL} = 6\text{mA}$    | —              | 0.4  |      |
|          |                     |                                         | $I_{OL} = 12\text{mA}$   | —              | 0.7  |      |
|          |                     | $V_{CC} = 2.7\text{V}$                  | $I_{OL} = 12\text{mA}$   | —              | 0.4  |      |
|          |                     | $V_{CC} = 3.0\text{V}$                  | $I_{OL} = 24\text{mA}$   | —              | 0.55 |      |

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### NOTE:

- $V_{IH}$  and  $V_{IL}$  must be within the min. or max. range shown in the DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE table for the appropriate  $V_{CC}$  range.  $T_A = -40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ .

## OPERATING CHARACTERISTICS, $V_{CC} = 3.3V \pm 0.3V$ , $T_A = 25^\circ C$

| Symbol | Parameter                                                        | Test Conditions           | Typical | Unit |
|--------|------------------------------------------------------------------|---------------------------|---------|------|
| CPD    | Power Dissipation Capacitance per buffer/driver Outputs enabled  | $C_L = 0pF$ , $f = 10MHz$ |         | pF   |
| CPD    | Power Dissipation Capacitance per buffer/driver Outputs disabled |                           |         | pF   |

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

| Symbol                 | Parameter                          | $V_{CC} = 2.7V$ |      | $V_{CC} = 3.3V \pm 0.3V$ |      | Unit |
|------------------------|------------------------------------|-----------------|------|--------------------------|------|------|
|                        |                                    | Min.            | Max. | Min.                     | Max. |      |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay<br>xAX to xYx    | 1.5             | 4.7  | 1.5                      | 4.1  | ns   |
| $t_{PZH}$<br>$t_{PZL}$ | Output Enable Time<br>xOEx to xYx  | 1.5             | 6.5  | 1.5                      | 5.8  | ns   |
| $t_{PHZ}$<br>$t_{PLZ}$ | Output Disable Time<br>xOEx to xYx | 1.5             | 6.4  | 1.5                      | 5.7  | ns   |
| $t_{SK(0)}$            | Output Skew <sup>(2)</sup>         | —               | —    | —                        | 500  | ps   |

### NOTES:

- See test circuits and waveforms.  $T_A = -40^\circ C$  to  $+85^\circ C$ .
- Skew between any two outputs of the same package and switching in the same direction.

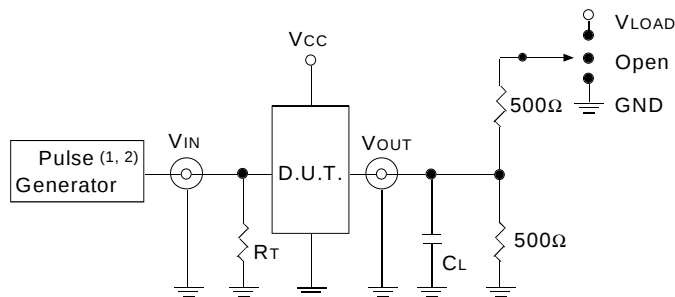
## TEST CIRCUITS AND WAVEFORMS:

### TEST CONDITIONS

| Symbol            | V <sub>CC</sub> (1)= 3.3V ±0.3V | V <sub>CC</sub> (1)= 2.7V | V <sub>CC</sub> (2)= 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   |

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### TEST CIRCUITS FOR ALL OUTPUTS



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#### 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:

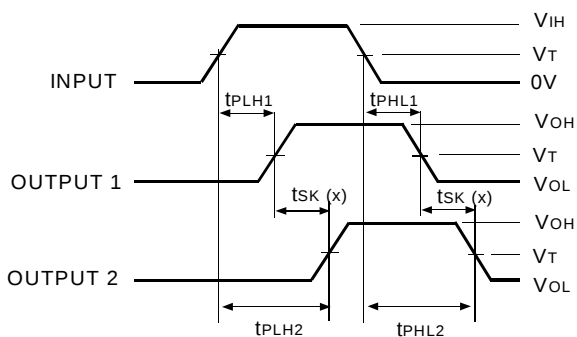
1. Pulse Generator for All Pulses: Rate ≤ 10MHz; t<sub>F</sub> ≤ 2.5ns; t<sub>R</sub> ≤ 2.5ns.
2. Pulse Generator for All Pulses: Rate ≤ 10MHz; t<sub>F</sub> ≤ 2ns; t<sub>R</sub> ≤ 2ns.

### 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              |

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### OUTPUT SKEW - t<sub>SK</sub> (x)



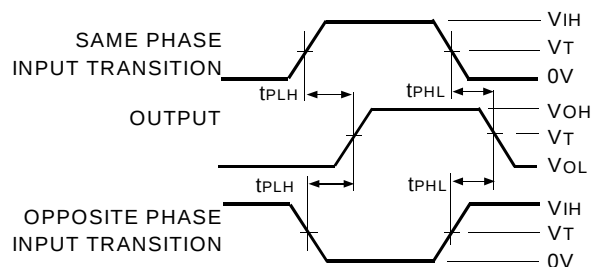
$$t_{SK}(x) = |t_{PLH2} - t_{PLH1}| \text{ or } |t_{PHL2} - t_{PHL1}|$$

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#### NOTES:

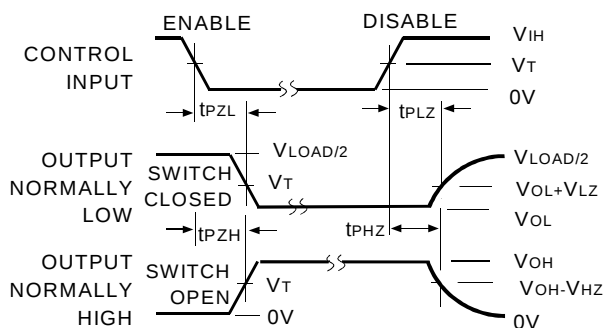
1. For t<sub>SK</sub>(o) OUTPUT1 and OUTPUT2 are any two outputs.
2. For t<sub>SK</sub>(b) OUTPUT1 and OUTPUT2 are in the same bank.

### PROPAGATION DELAY



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### ENABLE AND DISABLE TIMES

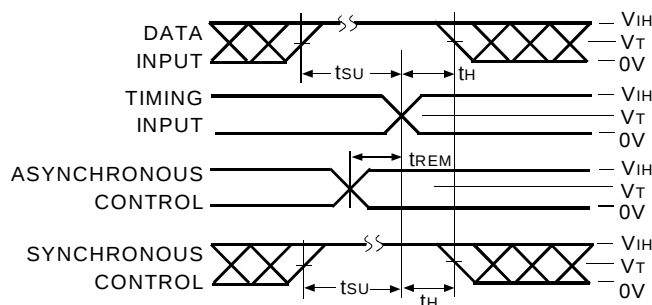


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#### NOTE:

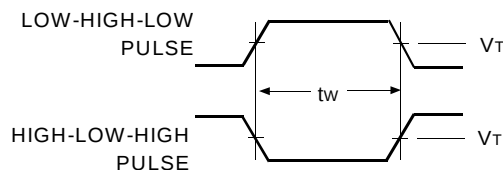
1. Diagram shown for input Control Enable-LOW and input Control Disable-HIGH.

### SET-UP, HOLD, AND RELEASE TIMES



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### PULSE WIDTH



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## ORDERING INFORMATION

| IDT | XX          | LVC | X        | XX     | XXXX        | XX      |                                                  |
|-----|-------------|-----|----------|--------|-------------|---------|--------------------------------------------------|
|     | Temp. Range |     | Bus-Hold | Family | Device Type | Package |                                                  |
|     |             |     |          |        |             |         |                                                  |
|     |             |     |          |        |             | PV      | Shrink Small Outline Package (SO56-1)            |
|     |             |     |          |        |             | PA      | Thin Shrink Small Outline Package (SO56-2)       |
|     |             |     |          |        |             | PF      | Thin Very Small Outline Package (SO56-3)         |
|     |             |     |          |        | 827A        |         | 20-Bit Buffer                                    |
|     |             |     |          | 16     |             |         | Double-Density with Resistors, $\pm 24\text{mA}$ |
|     |             |     |          | Blank  |             |         | No Bus-hold                                      |
|     |             |     |          |        | 74          |         | $-40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$   |



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