FAIRCHILD
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March 1998
Revised October 2004

# 74VCX162827
# Low Voltage 20-Bit Buffer/Line Driver with 3.6V Tolerant Inputs and Outputs and 26Ω Series Resistors in the Outputs

## General Description

The VCX162827 contains twenty non-inverting buffers with 3-STATE outputs to be employed as a memory and address driver, clock driver, or bus oriented transmitter/receiver. The device is byte controlled. Each byte has NOR output enables for maximum control flexibility.

The 74VCX162827 is designed for low voltage (1.4V to 3.6V) $V_{CC}$ applications with I/O capability up to 3.6V. The VCX162827 is also designed with 26Ω resistors in the outputs.

The 74VCX162827 is fabricated with an advanced CMOS technology to achieve high speed operation while maintaining low CMOS power dissipation.

## Features

- 1.4V–3.6V $V_{CC}$ supply operation
- 3.6V tolerant inputs and outputs
- 26Ω series resistors in outputs
- $t_{PD}$
  3.4 ns max for 3.0V to 3.6V $V_{CC}$
- Power-off high impedance inputs and outputs
- Supports live insertion and withdrawal (Note 1)
- Static Drive ($I_{OH}/I_{OL}$)
  ±12 mA @ 3.0V $V_{CC}$
- Uses patented noise/EMI reduction circuitry
- Latch-up performance exceeds 300 mA
- ESD performance:
  Human body model > 2000V
  Machine model > 200V

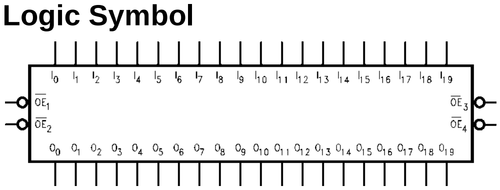
**Note 1:** To ensure the high-impedance state during power up or power down, $\overline{OE}$ should be tied to $V_{CC}$ through a pull-up resistor; the minimum value of the resistor is determined by the current-sourcing capability of the driver.

## Ordering Code:

| Order Number | Package Number | Package Description |
|---|---|---|
| 74VCX162827MTD | MTD56 | 56-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 6.1mm Wide |

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

## Logic Symbol

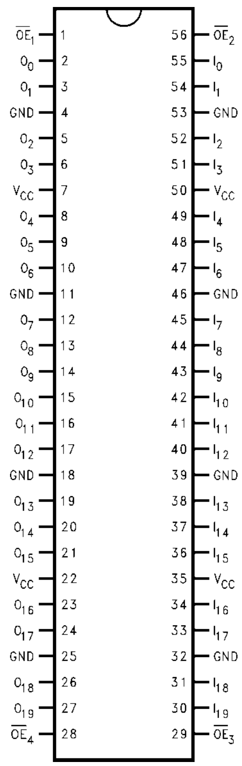



## Pin Descriptions

| Pin Names | Description |
|---|---|
| $\overline{OE}_n$ | Output Enable Input (Active LOW) |
| $I_0$–$I_{19}$ | Inputs |
| $O_0$–$O_{19}$ | Outputs |

## Connection Diagram




## Truth Tables

| Inputs | | | Outputs |
|---|---|---|---|
| $\overline{OE}_1$ | $\overline{OE}_2$ | $I_0$–$I_9$ | $O_0$–$O_9$ |
| L | L | L | L |
| L | L | H | H |
| H | X | X | Z |
| X | H | X | Z |

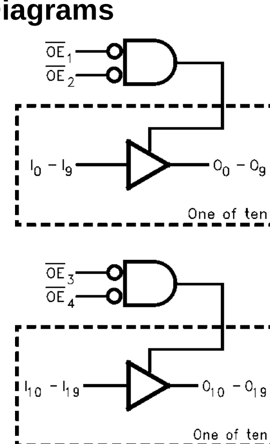
| Inputs | | | Outputs |
|---|---|---|---|
| $\overline{OE}_3$ | $\overline{OE}_4$ | $I_0$–$I_9$ | $O_{10}$–$O_{19}$ |
| L | L | L | L |
| L | L | H | H |
| H | X | X | Z |
| X | H | X | Z |

H = HIGH Voltage Level
L = LOW Voltage Level
X = Immaterial (HIGH or LOW, inputs may not float)
Z = High Impedance

## Functional Description

The 74VCX162827 contains twenty non-inverting buffers with 3-STATE outputs. The device is byte controlled with each byte functioning identically, but independent of each other. The control pins may be shorted together to obtain full 20-bit operation. The 3-STATE outputs are controlled by Output Enable ($\overline{OE}_n$) inputs. When $\overline{OE}_1$, and $\overline{OE}_2$ are LOW, $O_0$–$O_{10}$ are in the 2-state mode. When either $\overline{OE}_1$ or $\overline{OE}_2$ are HIGH, the standard outputs are in the high impedance mode but this does not interfere with entering new data into the inputs. The same applies for byte two with $\overline{OE}_3$ and $\overline{OE}_4$.

## Logic Diagrams



## Absolute Maximum Ratings (Note 2)

| | |
|---|---|
| Supply Voltage ($V_{CC}$) | –0.5V to +4.6V |
| DC Input Voltage ($V_I$) | –0.5V to +4.6V |
| Output Voltage ($V_O$) | |
| Outputs 3-STATE | –0.5V to +4.6V |
| Outputs Active (Note 3) | –0.5V to $V_{CC}$ + 0.5V |
| DC Input Diode Current ($I_{IK}$) $V_I$ < 0V | –50 mA |
| DC Output Diode Current ($I_{OK}$) | |
| $V_O$ < 0V | –50 mA |
| $V_O$ > $V_{CC}$ | +50 mA |
| DC Output Source/Sink Current ($I_{OH}/I_{OL}$) | ±50 mA |
| DC $V_{CC}$ or GND Current per Supply Pin ($I_{CC}$ or GND) | ±100 mA |
| Storage Temperature Range ($T_{STG}$) | –65°C to +150°C |

## Recommended Operating Conditions (Note 4)

| | |
|---|---|
| Power Supply | |
| Operating | 1.4V to 3.6V |
| Input Voltage | –0.3V to +3.6V |
| Output Voltage ($V_O$) | |
| Output in Active States | 0V to $V_{CC}$ |
| Output in 3-STATE | 0.0V to 3.6V |
| Output Current in $I_{OH}/I_{OL}$ | |
| $V_{CC}$ = 3.0V to 3.6V | ±12 mA |
| $V_{CC}$ = 2.3V to 2.7V | ±8 mA |
| $V_{CC}$ = 1.65V to 2.3V | ±3 mA |
| $V_{CC}$ = 1.4V to 1.6V | ±1 mA |
| Free Air Operating Temperature ($T_A$) | –40°C to +85°C |
| Minimum Input Edge Rate ($\Delta t/\Delta V$) | |
| $V_{IN}$ = 0.8V to 2.0V, $V_{CC}$ = 3.0V | 10 ns/V |

**Note 2:** 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 3:** $I_O$ Absolute Maximum Rating must be observed.

**Note 4:** Floating or unused inputs must be held HIGH or LOW.

## DC Electrical Characteristics

| Symbol | Parameter | Conditions | $V_{CC}$ (V) | Min | Max | Units |
|---|---|---|---|---|---|---|
| $V_{IH}$ | HIGH Level Input Voltage | | 2.7 - 3.6 | 2.0 | | V |
| | | | 2.3 - 2.7 | 1.6 | | |
| | | | 1.65 - 2.3 | 0.65 x $V_{CC}$ | | |
| | | | 1.4 - 1.6 | 0.65 x $V_{CC}$ | | |
| $V_{IL}$ | LOW Level Input Voltage | | 2.7 - 3.6 | | 0.8 | V |
| | | | 2.3 - 2.7 | | 0.7 | |
| | | | 1.65 - 2.3 | | 0.35 x $V_{CC}$ | |
| | | | 1.4 - 1.6 | | 0.35 x $V_{CC}$ | |
| $V_{OH}$ | HIGH Level Output Voltage | $I_{OH}$ = –100 µA | 2.7 - 3.6 | $V_{CC}$ - 0.2 | | V |
| | | $I_{OH}$ = –6 mA | 2.7 | 2.2 | | |
| | | $I_{OH}$ = –8 mA | 3.0 | 2.4 | | |
| | | $I_{OH}$ = –12 mA | 3.0 | 2.2 | | |
| | | $I_{OH}$ = –100 µA | 2.3 - 2.7 | $V_{CC}$ - 0.2 | | |
| | | $I_{OH}$ = –4 mA | 2.3 | 2.0 | | |
| | | $I_{OH}$ = –6 mA | 2.3 | 1.8 | | |
| | | $I_{OH}$ = –8 mA | 2.3 | 1.7 | | |
| | | $I_{OH}$ = –100 µA | 1.65 - 2.3 | $V_{CC}$ - 0.2 | | |
| | | $I_{OH}$ = –3 mA | 1.65 | 1.25 | | |
| | | $I_{OH}$ = –100 µA | 1.4 - 1.6 | $V_{CC}$ - 0.2 | | |
| | | $I_{OH}$ = –1 mA | 1.4 | 1.05 | | |

## DC Electrical Characteristics (Continued)

| Symbol | Parameter | Conditions | $V_{CC}$ (V) | Min | Max | Units |
|---|---|---|---|---|---|---|
| $V_{OL}$ | LOW Level Output Voltage | $I_{OL} = 100\ \mu A$ | 2.7 - 3.6 | | 0.2 | V |
| | | $I_{OL} = 6$ mA | 2.7 | | 0.4 | |
| | | $I_{OL} = 8$ mA | 3.0 | | 0.55 | |
| | | $I_{OL} = 12$ mA | 3.0 | | 0.8 | |
| | | $I_{OL} = 100\ \mu A$ | 2.3 - 2.7 | | 0.2 | |
| | | $I_{OL} = 6$ mA | 2.3 | | 0.4 | |
| | | $I_{OL} = 8$ mA | 2.3 | | 0.6 | |
| | | $I_{OL} = 100\ \mu A$ | 1.65 - 2.3 | | 0.2 | |
| | | $I_{OL} = 3$ mA | 1.65 | | 0.3 | |
| | | $I_{OL} = 100\ \mu A$ | 1.4 - 1.6 | | 0.2 | |
| | | $I_{OL} = 1$ mA | 1.4 | | 0.35 | |
| $I_I$ | Input Leakage Current | $0 \le V_I \le 3.6V$ | 1.4 - 3.6 | | ±5.0 | µA |
| $I_{OZ}$ | 3-STATE Output Leakage | $0 \le V_O \le 3.6V$<br>$V_I = V_{IH}$ or $V_{IL}$ | 1.4 - 3.6 | | ±10.0 | µA |
| $I_{OFF}$ | Power-OFF Leakage Current | $0 \le (V_I, V_O) \le 3.6V$ | 0 | | 10.0 | µA |
| $I_{CC}$ | Quiescent Supply Current | $V_I = V_{CC}$ or GND | 1.4 - 3.6 | | 20.0 | µA |
| | | $V_{CC} \le (V_I, V_O) \le 3.6V$ (Note 5) | 1.4 - 3.6 | | ±20.0 | |
| $\Delta I_{CC}$ | Increase in $I_{CC}$ per Input | $V_{IH} = V_{CC} - 0.6V$ | 2.7 - 3.6 | | 750 | µA |

**Note 5:** Outputs disabled or 3-STATE only.

## AC Electrical Characteristics (Note 6)

| Symbol | Parameter | Conditions | $V_{CC}$ (V) | $T_A = -40°C$ to $+85°C$ Min | Max | Units | Figure Number |
|---|---|---|---|---|---|---|---|
| $t_{PHL}$<br>$t_{PLH}$ | Propagation Delay | $C_L = 30$ pF, $R_L = 500\Omega$ | 3.3 ± 0.3 | 0.8 | 3.4 | ns | Figures 1, 2 |
| | | | 2.5 ± 0.2 | 1.0 | 4.1 | | |
| | | | 1.8 ± 0.15 | 1.5 | 8.2 | | |
| | | $C_L = 15$ pF, $R_L = 2k\Omega$ | 1.5 ± 0.1 | 1.0 | 16.4 | | Figures 5, 6 |
| $t_{PZL}$<br>$t_{PZH}$ | Output Enable Time | $C_L = 30$ pF, $R_L = 500\Omega$ | 3.3 ± 0.3 | 0.8 | 4.3 | ns | Figures 1, 3, 4 |
| | | | 2.5 ± 0.2 | 1.0 | 5.9 | | |
| | | | 1.8 ± 0.15 | 1.5 | 9.8 | | |
| | | $C_L = 15$ pF, $R_L = 2k\Omega$ | 1.5 ± 0.1 | 1.0 | 19.6 | | Figures 5, 7, 8 |
| $t_{PLZ}$<br>$t_{PHZ}$ | Output Disable Time | $C_L = 30$ pF, $R_L = 500\Omega$ | 3.3 ± 0.3 | 0.8 | 4.3 | ns | Figures 1, 3, 4 |
| | | | 2.5 ± 0.2 | 1.0 | 4.9 | | |
| | | | 1.8 ± 0.15 | 1.5 | 8.8 | | |
| | | $C_L = 15$ pF, $R_L = 2k\Omega$ | 1.5 ± 0.1 | 1.0 | 17.6 | | Figures 5, 7, 8 |
| $t_{OSHL}$<br>$t_{OSLH}$ | Output to Output Skew (Note 7) | $C_L = 30$ pF, $R_L = 500\Omega$ | 3.3 ± 0.3 | | 0.5 | ns | |
| | | | 2.5 ± 0.2 | | 0.5 | | |
| | | | 1.8 ± 0.15 | | 0.75 | | |
| | | $C_L = 15$ pF, $R_L = 2k\Omega$ | 1.5 ± 0.1 | | 1.5 | | |

**Note 6:** For $C_L = 50$ pF, add approximately 300 ps to the AC maximum specification.

**Note 7:** 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 ($t_{OSHL}$) or LOW-to-HIGH ($t_{OSLH}$).

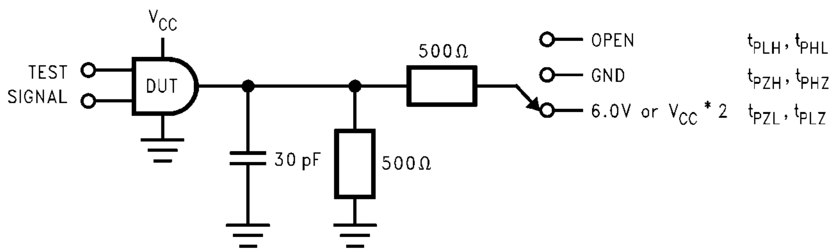
## Dynamic Switching Characteristics

| Symbol | Parameter | Conditions | $V_{CC}$ (V) | $T_A = +25°C$ Typical | Units |
|---|---|---|---|---|---|
| $V_{OLP}$ | Quiet Output Dynamic Peak $V_{OL}$ | $C_L = 30$ pF, $V_{IH} = V_{CC}$, $V_{IL} = 0V$ | 1.8<br>2.5<br>3.3 | 0.15<br>0.25<br>0.35 | V |
| $V_{OLV}$ | Quiet Output Dynamic Valley $V_{OL}$ | $C_L = 30$ pF, $V_{IH} = V_{CC}$, $V_{IL} = 0V$ | 1.8<br>2.5<br>3.3 | −0.15<br>−0.25<br>−0.35 | V |
| $V_{OHV}$ | Quiet Output Dynamic Valley $V_{OH}$ | $C_L = 30$ pF, $V_{IH} = V_{CC}$, $V_{IL} = 0V$ | 1.8<br>2.5<br>3.3 | 1.55<br>2.05<br>2.65 | V |

## Capacitance

| Symbol | Parameter | Conditions | $T_A = +25°C$ Typical | Units |
|---|---|---|---|---|
| $C_{IN}$ | Input Capacitance | $V_{CC} = 1.8$, 2.5V or 3.3V, $V_I = 0V$ or $V_{CC}$ | 6.0 | pF |
| $C_{OUT}$ | Output Capacitance | $V_I = 0V$ or $V_{CC}$, $V_{CC} = 1.8V$, 2.5V or 3.3V | 7.0 | pF |
| $C_{PD}$ | Power Dissipation Capacitance | $V_I = 0V$ or $V_{CC}$, f = 10 MHz, $V_{CC} = 1.8V$, 2.5V or 3.3V | 20.0 | pF |

## AC Loading and Waveforms ($V_{CC}$ 3.3V ± 0.3V to 1.8V ± 0.15V)




| TEST | SWITCH |
|---|---|
| $t_{PLH}$, $t_{PHL}$ | Open |
| $t_{PZL}$, $t_{PLZ}$ | 6V at $V_{CC}$ = 3.3 ± 0.3V;<br>$V_{CC}$ x 2 at $V_{CC}$ = 2.5 ± 0.2V; 1.8V ± 0.15V |
| $t_{PZH}$, $t_{PHZ}$ | GND |

**FIGURE 1. AC Test Circuit**

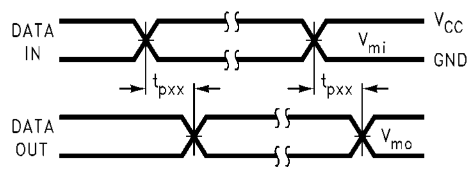



**FIGURE 2. Waveform for Inverting and Non-Inverting Functions**

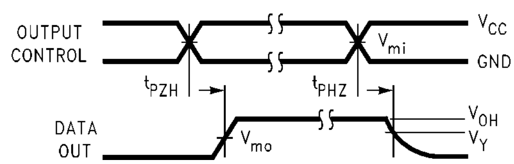



**FIGURE 3. 3-STATE Output High Enable and Disable Times for Low Voltage Logic**

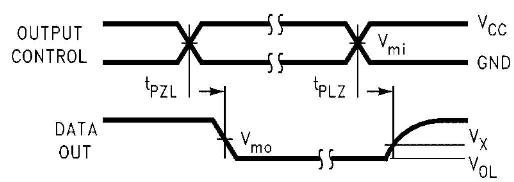
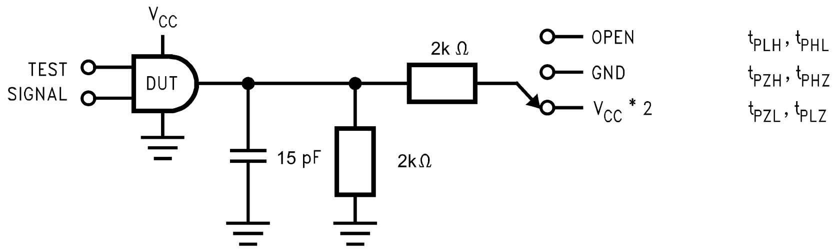



**FIGURE 4. 3-STATE Output Low Enable and Disable Times for Low Voltage Logic**

| Symbol | $V_{CC}$ | | |
|---|---|---|---|
| | **3.3V ± 0.3V** | **2.5V ± 0.2V** | **1.8V ± 0.15V** |
| $V_{mi}$ | 1.5V | $V_{CC}/2$ | $V_{CC}/2$ |
| $V_{mo}$ | 1.5V | $V_{CC}/2$ | $V_{CC}/2$ |
| $V_X$ | $V_{OL}$ + 0.3V | $V_{OL}$ + 0.15V | $V_{OL}$ + 0.15V |
| $V_Y$ | $V_{OH}$ – 0.3V | $V_{OH}$ – 0.15V | $V_{OH}$ – 0.15V |

## AC Loading and Waveforms ($V_{CC}$ 1.5V ± 0.1V)




| TEST | SWITCH |
|---|---|
| $t_{PLH}$, $t_{PHL}$ | Open |
| $t_{PZL}$, $t_{PLZ}$ | $V_{CC}$ x 2 at $V_{CC}$ = 1.5 ± 0.1V |
| $t_{PZH}$, $t_{PHZ}$ | GND |

**FIGURE 5. AC Test Circuit**

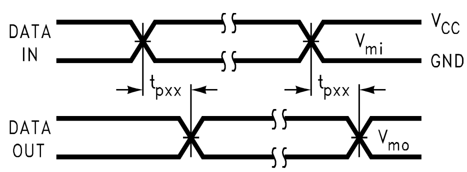



**FIGURE 6. Waveform for Inverting and Non-Inverting Functions**

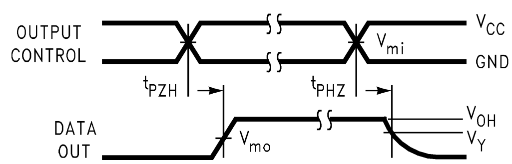



**FIGURE 7. 3-STATE Output High Enable and Disable Times for Low Voltage Logic**

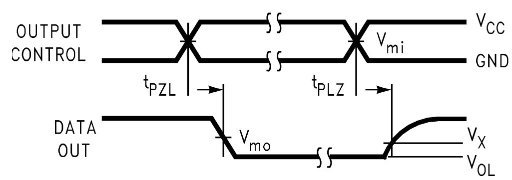
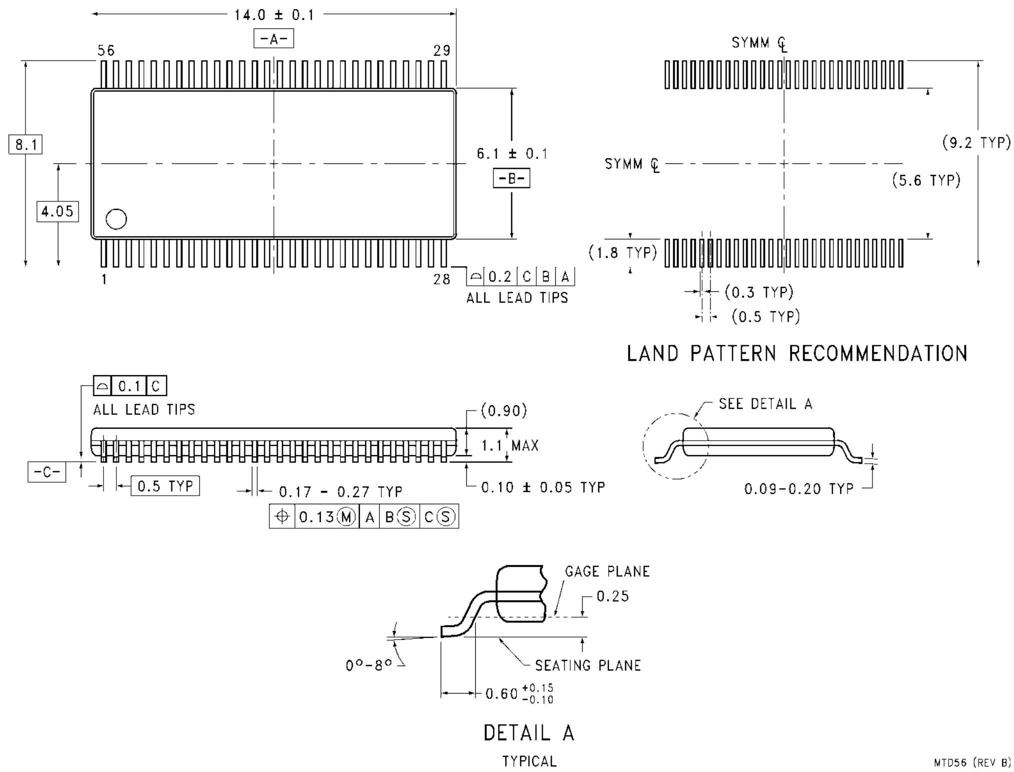



**FIGURE 8. 3-STATE Output Low Enable and Disable Times for Low Voltage Logic**

| Symbol | $V_{CC}$ |
|---|---|
| | **1.5V ± 0.1V** |
| $V_{mi}$ | $V_{CC}/2$ |
| $V_{mo}$ | $V_{CC}/2$ |
| $V_X$ | $V_{OL}$ + 0.1V |
| $V_Y$ | $V_{OH}$ − 0.1V |

## Physical Dimensions inches (millimeters) unless otherwise noted




**56-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 6.1mm Wide**
**Package Number MTD56**