QUALITY SEMICONDUCTOR, INC.

# High-Speed CMOS 20-Bit Buffer

**QS74FCT16827T**
**QS74FCT162827T**

## FEATURES/BENEFITS

- Pin and function compatible with T.I. Widebus™ and IDT Double-Density™ families
- CMOS power levels: <1μW typical standby
- SSOP (PV) and TSSOP (PA) packages
- Low output skew: 0.5ns $t_{SK(O)}$
- Flow-through pinout for easy layout
- Power off disable allows hot plugging
- Industrial temperature: –40°C to +85°C
- Input hysteresis for noise immunity
- Multiple power and ground pins for low noise

**FCT16827T**

- High drive standard FCT-T outputs: $I_{OL}$ = +64mA, $I_{OH}$ = –32mA
- Incident switching for driving buses and large loads

**FCT162827T**

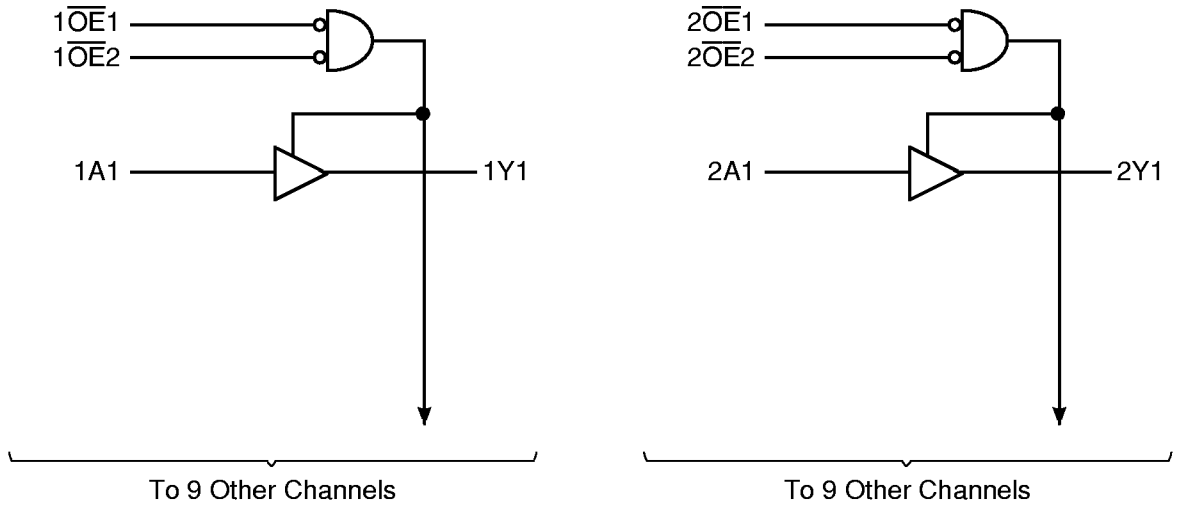
- Balanced output drivers: ±24mA
- Reduced switching noise for point to point signals

## DESCRIPTION

The FCT16827 family of products are 20-bit buffers with three-state outputs that are ideal for driving high-capacitance loads as in memory address and data buses. Easy board layout is facilitated by the use of flow-through pinouts. Independent byte enable controls provide architectural flexibility for system designers. All outputs have ground bounce suppression circuitry (see QSI Application Note AN-01) and many power and ground pins provide low ground bounce. To accommodate hot-plug or live insertion applications, both versions of this product are designed not to load an active bus when $V_{CC}$ is removed. In applications where bus signals are point-to-point or driving light capacitance loads, the balanced drive FCT162827 is recommended.

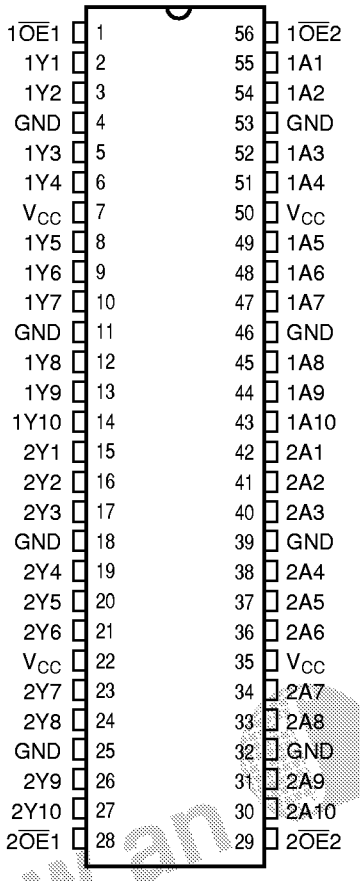


## Figure 1. Functional Block Diagram



## Figure 2. Pin Configuration (All Pins Top View)

**SSOP, TSSOP**




## Table 1. Pin Description

| Name | Description |
|---|---|
| x$\overline{OE}$x | Output Enables |
| xAx | Data Inputs |
| xYx | Data Outputs |



## Table 2. Absolute Maximum Ratings

| | |
|---|---|
| Supply Voltage to Ground | –0.5V to +7.0V |
| DC Output Voltage $V_{OUT}$ | –0.5V to +7.0V |
| DC Input Voltage $V_{IN}$ | –0.5V to +7.0V |
| AC Input Voltage (for a pulse width ≤ 20ns) | –3.0V |
| DC Input Diode Current with $V_{IN} < 0$ | –20mA |
| DC Output Diode Current with $V_{OUT} < 0$ | –50mA |
| DC Output Current Max. Sink Current/Pin | 120mA |
| Maximum Power Dissipation | 1.0W |
| $T_{STG}$ Storage Temperature | –65° to +150°C |

**Note:** Stresses greater than those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to this device resulting in functional or reliability type failures.

## Table 3. Capacitance

$T_A$ = 25°C, f = 1MHz, $V_{IN}$ = 0V, $V_{OUT}$ = 0V

| Pins | Typ | Max | Unit |
|---|---|---|---|
| All | 6.0 | 9.0 | pF |

**Note:** Capacitance is characterized but not tested.

## Table 4. Function Table

| Inputs | | | Output | |
|---|---|---|---|---|
| $\overline{OE}1$ | $\overline{OE}2$ | xAx | xYx | Function |
| L | L | L | L | Enabled |
| L | L | H | H | Enabled |
| H | — | — | Hi-Z | High Impedance |
| — | H | — | Hi-Z | High Impedance |

## Table 5. Recommended Operating Conditions

| Symbol | Parameter | Min | Max | Unit |
|---|---|---|---|---|
| $V_{CC}$ | Supply Voltage | 4.5 | 5.5 | V |
| $V_{IN}$ | Input Voltage | 0 | $V_{CC}$ | V |
| $V_{OUT}$ | Voltage Applied to Output or I/O | 0 | $V_{CC}$ | V |
| $\Delta t/\Delta v$ | Input Transition Slew Rate | — | 10 | ns/V |
| $T_A$ | Operating Free Air Tempeature | –40 | +85 | °C |



## Table 6. DC Electrical Characteristics Over Operating Range

Recommended Operating Ranges apply unless otherwise noted.

| Symbol | Parameter | Test Conditions[1] | Min | Typ[2] | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{IH}$ | Input HIGH Voltage | Logic HIGH for All Inputs | 2.0 | — | — | V |
| $V_{IL}$ | Input LOW Voltage | Logic LOW for All Inputs | — | — | 0.8 | V |
| $\Delta V_T$ | Input Hysteresis[4] | $V_{TLH} - V_{THL}$ for All Inputs | — | 100 | — | mV |
| $\lvert I_{IH} \rvert$<br>$\lvert I_{IL} \rvert$ | Input Current<br>Input HIGH or LOW | $V_{CC}$ = Max., $0 \le V_{IN} < V_{CC}$ | — | — | 1 | µA |
| $\lvert I_{OZ} \rvert$ | Off-State Output Current (Hi-Z) | $V_{CC}$ = Max., $0 \le V_{OUT} \le V_{CC}$ | — | — | 1 | µA |
| $\lvert I_{OFF} \rvert$ | Power off leakage[5] | $V_{CC}$ = 0V, $V_{IN/OUT} \le 4.5V$ | — | — | 1 | µA |
| $I_{OS}$ | Short Circuit Current[3,4] | $V_{CC}$ = Max., $V_{OUT}$ = GND | –80 | –140 | –225 | mA |
| $I_O$ | Output Current Drive[3] | $V_{CC}$ = Max., $V_{OUT}$ = 2.5V | –50 | — | –180 | mA |
| $V_{IK}$ | Input Clamp Voltage | $V_{CC}$= Min., $I_{IN}$ = –18mA | – | –0.7 | –1.2 | V |

**Notes**:
1. For conditions shown as Min. or Max. use appropriate value specified under Recommended Operating Conditions for the applicable device type.
2. Typical values indicate $V_{CC}$ = 5.0V and $T_A$ = 25°C.
3. Not more than one output should be tested at one time. Duration of test should not exceed one second.
4. These parameters are guaranteed by design but not tested.
5. The test limit for this parameter is ± 5µA at $T_A$ = –55°C

## Table 7. Output Drive Characteristics for FCT16827T

| Symbol | Parameter | Test Conditions[1] | | Min | Typ[2] | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_{OH}$ | Output HIGH Voltage | $V_{CC}$ = Min.<br>$V_{IN}$ = $V_{IH}$ or $V_{IL}$ | $I_{OH}$ = –3mA | 2.5 | 3.4 | — | V |
| | | | $I_{OH}$ = –15mA | 2.4 | 3.2 | — | V |
| | | | $I_{OH}$ = –32mA[4] | 2.0 | 3.0 | — | V |
| $V_{OL}$ | Output LOW Voltage | $V_{CC}$ = Min.<br>$V_{IN}$ = $V_{IH}$ or $V_{IL}$ | $I_{OL}$ = 64mA | — | 0.3 | 0.55 | V |

## Table 8. Output Drive Characteristics for FCT162827T

| Symbol | Parameter | Test Conditions[1] | | Min | Typ[2] | Max | Unit |
|---|---|---|---|---|---|---|---|
| $I_{ODL}$ | Output LOW Current[3] | $V_{CC}$ = 5V, $V_{IN}$ = $V_{IH}$ or $V_{IL}$<br>$V_{OUT}$ = 1.5V | | 60 | 115 | 200 | mA |
| $I_{ODH}$ | Output HIGH Current[3] | $V_{CC}$ = 5V, $V_{IN}$ = $V_{IH}$ or $V_{IL}$<br>$V_{OUT}$ = 1.5V | | –60 | –115 | –200 | mA |
| $V_{OH}$ | Output HIGH Voltage | $V_{CC}$ = Min.<br>$V_{IN}$ = $V_{IH}$ or $V_{IL}$ | $I_{OH}$ = –24mA | 2.4 | 3.3 | — | V |
| $V_{OL}$ | Output LOW Voltage | $V_{CC}$ = Min.<br>$V_{IN}$ = $V_{IH}$ or $V_{IL}$ | $I_{OL}$ = 24mA | — | 0.3 | 0.55 | V |

**Notes**:
1. For conditions shown as Min. or Max. use appropriate value specified under Electrical Characteristics for the applicable device type.
2. Typical values indicate $V_{CC}$ = 5.0V and $T_A$ = 25°C.
3. Not more than one output should be shorted and the duration is ≤1 second.
4. Duration of the condition should not exceed one second.

## Table 9. Power Supply Characteristics

| Symbol | Parameter | Test Conditions[1] | | Typ [2] | Max | Unit |
|---|---|---|---|---|---|---|
| $I_{CCL}$<br>$I_{CCH}$<br>$I_{CCZ}$ | Quiescent Power Supply Current | $V_{CC}$ = Max., $V_{IN}$ = GND or $V_{CC}$ | | 5 | 500 | µA |
| $\Delta I_{CC}$ | Supply Current per Input @ TTL HIGH | $V_{CC}$ = Max., $V_{IN}$ = 3.4V[3] | | 0.5 | 1.5 | mA |
| $Q_{CCD}$ | Supply Current per Input per MHz[4] | $V_{CC}$ = Max., Outputs Open<br>One Bit Toggling<br>@ 50% Duty Cycle<br>x$\overline{OE}$1 =x$\overline{OE}$2 = GND | $V_{IN}$ = $V_{CC}$<br>$V_{IN}$ = GND | 75 | 120 | µA/<br>MHz |
| $I_C$ | Total Power Supply Current[6] | $V_{CC}$ = Max., Outputs Open<br>One Bit Toggling | $V_{IN}$ = $V_{CC}$<br>$V_{IN}$ = GND | 0.6 | 1.5[5] | mA |
| | | @ 50% Duty Cycle<br>$f_i$ = 10MHz,<br>x$\overline{OE}$1 = x$\overline{OE}$2 = GND | $V_{IN}$ = 3.4V<br>$V_{IN}$ = GND | 0.9 | 2.3[5] | mA |
| | | $V_{CC}$ = Max., Outputs Open<br>Twenty Bits Toggling | $V_{IN}$ = $V_{CC}$<br>$V_{IN}$ = GND | 3.0 | 5.5[5] | mA |
| | | @ 50% Duty Cycle<br>$f_i$ = 2.5MHz,<br>x$\overline{OE}$1 = x$\overline{OE}$2 = GND | $V_{IN}$ = 3.4V<br>$V_{IN}$ = GND | 8.0 | 20.5[5] | mA |

**Notes:**
1. For conditions shown as Min. or Max., use the appropriate values specified under Recommended Operating Conditions for applicable device type.
2. Typical values are at $V_{CC}$ = 5.0V, +25°C ambient.
3. Per TTL driven input ($V_{IN}$ = 3.4V). All Other Inputs at $V_{CC}$ or GND.
4. This parameter is not directly testable, but is derived for use in Total Power Supply Calculations.
5. Values for these conditions are examples of the $I_{CC}$ formula. These limits are guaranteed by design but not tested.
6. $I_C = I_{QUIESCENT} + I_{INPUTS} = I_{DYNAMIC}$.
   $I_C = I_{CCQ} + \Delta I_{CC} D_H N_T + I_{CCD} (f_{CP} N_{CP}/2 + f_i N_i)$.
   $I_{CCQ}$ = Quiescent Current ($I_{CCL}$, $I_{CCH}$, and $I_{CCZ}$).
   $\Delta I_{CC}$ = Power Supply Current for a TTL-High Input ($V_{IN}$ = 3.4V).
   $D_H$ = Duty Cycle for TTL High Inputs.
   $N_T$ = Number of TTL High Inputs.
   $I_{CCD}$ = Dynamic Current Caused by an Input Transition Pair (HLH or LHL).
   $f_{CP}$ = Clock Frequency for Register devices (Zero for Non-Register Devices).
   $N_{CP}$ = Number of Clock Inputs at $f_{CP}$.
   $f_i$ = Input Frequency.
   $N_i$ = Number of Inputs at $f_i$.

## Table 10. Switching Characteristics Over Operating Range

Recommended Operating Ranges apply unless otherwise specified.

| Symbol | Parameter[1] | Condition | FCT16827AT FCT162827AT | | FCT16827BT FCT162827BT | | FCT16827CT FCT162827CT | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | | Min. | Max. | Min. | Max. | Min. | Max. | |
| $t_{PLH}$ $t_{PHL}$ | Propagation Delay xAx to xYx | $C_L$ = 50pF $R_L$ = 500Ω | 1.5 | 8.0 | 1.5 | 5.0 | 1.5 | 4.4 | ns |
| | | $C_L$ = 300pF[3] $R_L$ = 500Ω | 1.5 | 15.0 | 1.5 | 13.0 | 1.5 | 10.0 | |
| $t_{PZH}$ $t_{PZL}$ | Output Enable Time x$\overline{OE}$ to xYx | $C_L$ = 50pF $R_L$ = 500Ω | 1.5 | 12.0 | 1.5 | 8.0 | 1.5 | 7.0 | ns |
| | | $C_L$ = 300pF[3] $R_L$ = 500Ω | 1.5 | 23.0 | 1.5 | 15.0 | 1.5 | 14.0 | |
| $t_{PHZ}$ $t_{PLZ}$ | Output Disable Time[3] x$\overline{OE}$ to xYx | $C_L$ = 5pF $R_L$ = 500Ω | 1.5 | 9.0 | 1.5 | 6.0 | 1.5 | 5.7 | ns |
| | | $C_L$ = 50pF $R_L$ = 500Ω | 1.5 | 10.0 | 1.5 | 7.0 | 1.5 | 6.0 | ns |
| $t_{SK(O)}$ | Output skew[2] | | — | 0.5 | — | 0.5 | — | 0.5 | ns |

**Notes:**
1. Minimum limits guaranteed but not production tested. See test circuit and waveforms.
2. Skew between any two outputs of the same package switching in the same direction. This parameter is guaranteed by characterization.
3. This condition is guaranteed by characterization, but not production tested.