



SCCS064 - August 1994 - Revised March 2000

# CY74FCT16827T CY74FCT162827T

## 20-Bit Buffers/Line Drivers

### Features

- FCT-E speed at 3.2 ns
- Power-off disable outputs permits live insertion
- Edge-rate control circuitry for significantly improved noise characteristics
- Typical output skew < 250 ps
- ESD > 2000V
- TSSOP (19.6-mil pitch) and SSOP (25-mil pitch) packages
- Industrial temperature range of -40°C to +85°C
- $V_{CC} = 5V \pm 10\%$

### CY74FCT16827T Features:

- 64 mA sink current, 32 mA source current
- Typical  $V_{OLP}$  (ground bounce) < 1.0V at  $V_{CC} = 5V$ ,  $T_A = 25^\circ C$

### CY74FCT162827T Features:

- Balanced 24 mA output drivers
- Reduced system switching noise
- Typical  $V_{OLP}$  (ground bounce) < 0.6V at  $V_{CC} = 5V$ ,  $T_A = 25^\circ C$

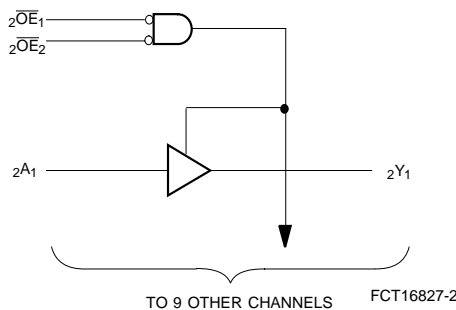
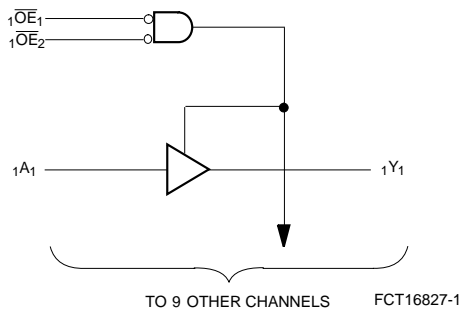
### Functional Description

The CY74FCT16827T 20-bit buffer/line driver and the CY74FCT162827T 20-bit buffer/line driver provide high-performance bus interface buffering for wide data/address paths or buses carrying parity. These parts can be used as a single 20-bit buffer or two 10-bit buffers. Each 10-bit buffer has a pair of NANDed  $\overline{OE}$  for increased flexibility. The outputs are designed with a power-off disable feature to allow for live insertion of boards.

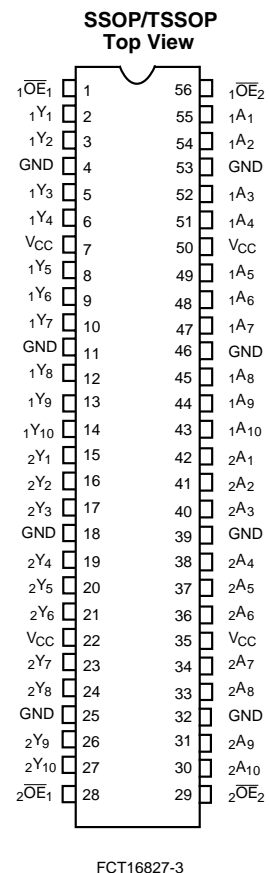
The CY74FCT16827T is ideally suited for driving high-capacitance loads and low-impedance backplanes.

The CY74FCT162827T has 24-mA balanced output drivers with current-limiting resistors in the outputs. This reduces the need for external terminating resistors and provides for minimal undershoot and reduced ground bounce. The CY74FCT162827T is ideal for driving transmission lines.

### Logic Block Diagrams



### Pin Configuration



**Pin Description**

Name	Description
$\overline{OE}$	Output Enable Inputs (Active LOW)
A	Data Inputs
Y	Three-State Outputs

**Function Table<sup>[1]</sup>**

Inputs			Outputs
$\overline{OE}_1$	$\overline{OE}_2$	A	Y
L	L	L	L
L	L	H	H
H	X	X	Z
X	H	X	Z

**Maximum Ratings<sup>[2, 3]</sup>**

(Above which the useful life may be impaired. For user guidelines, not tested.)

Storage Temperature .....	-55°C to +125°C
Ambient Temperature with Power Applied .....	-55°C to +125°C
DC Input Voltage .....	-0.5V to +7.0V
DC Output Voltage .....	-0.5V to +7.0V
DC Output Current (Maximum Sink Current/Pin) .....	-60 to +120 mA
Power Dissipation .....	1.0W
Static Discharge Voltage.....	>2001V (per MIL-STD-883, Method 3015)

**Operating Range**

Range	Ambient Temperature	V <sub>CC</sub>
Industrial	-40°C to +85°C	5V ± 10%

**Electrical Characteristics** Over the Operating Range

Parameter	Description	Test Conditions	Min.	Typ. <sup>[4]</sup>	Max.	Unit
V <sub>IH</sub>	Input HIGH Voltage		2.0			V
V <sub>IL</sub>	Input LOW Voltage				0.8	V
V <sub>H</sub>	Input Hysteresis <sup>[5]</sup>			100		mV
V <sub>IK</sub>	Input Clamp Diode Voltage	V <sub>CC</sub> =Min., I <sub>IN</sub> =-18 mA		-0.7	-1.2	V
I <sub>IH</sub>	Input HIGH Current	V <sub>CC</sub> =Max., V <sub>I</sub> =V <sub>CC</sub>			±1	µA
I <sub>IL</sub>	Input LOW Current	V <sub>CC</sub> =Max., V <sub>I</sub> =GND			±1	µA
I <sub>OZH</sub>	High Impedance Output Current (Three-State Output pins)	V <sub>CC</sub> =Max., V <sub>OUT</sub> =2.7V			±1	µA
I <sub>OZL</sub>	High Impedance Output Current (Three-State Output pins)	V <sub>CC</sub> =Max., V <sub>OUT</sub> =0.5V			±1	µA
I <sub>OS</sub>	Short Circuit Current <sup>[6]</sup>	V <sub>CC</sub> =Max., V <sub>OUT</sub> =GND	-80	-140	-200	mA
I <sub>O</sub>	Output Drive Current <sup>[6]</sup>	V <sub>CC</sub> =Max., V <sub>OUT</sub> =2.5V	-50		-180	mA
I <sub>OFF</sub>	Power-Off Disable	V <sub>CC</sub> =0V, V <sub>OUT</sub> ≤4.5V <sup>[7]</sup>			±1	µA

**Output Drive Characteristics for CY74FCT16827T**

Parameter	Description	Test Conditions	Min.	Typ. <sup>[4]</sup>	Max.	Unit
V <sub>OH</sub>	Output HIGH Voltage	V <sub>CC</sub> =Min., I <sub>OH</sub> =-3 mA	2.5	3.5		V
		V <sub>CC</sub> =Min., I <sub>OH</sub> =-15 mA	2.4	3.5		
		V <sub>CC</sub> =Min., I <sub>OH</sub> =-32 mA	2.0	3.0		
V <sub>OL</sub>	Output LOW Voltage	V <sub>CC</sub> =Min., I <sub>OL</sub> =64 mA		0.2	0.55	V

- H = HIGH Voltage Level. L = LOW Voltage Level. X = Don't Care. Z = HIGH Impedance.
- Operation beyond the limits set forth may impair the useful life of the device. Unless noted, these limits are over the operating free-air temperature range.
- Unused inputs must always be connected to an appropriate logic voltage level, preferably either V<sub>CC</sub> or ground.
- Typical values are at V<sub>CC</sub>= 5.0V, T<sub>A</sub>= +25°C ambient.
- This parameter is specified but not tested.
- Not more than one output should be shorted at a time. Duration of short should not exceed one second. The use of high-speed test apparatus and/or sample and hold techniques are preferable in order to minimize internal chip heating and more accurately reflect operational values. Otherwise prolonged shorting of a high output may raise the chip temperature well above normal and thereby cause invalid readings in other parametric tests. In any sequence of parameter tests, I<sub>OS</sub> tests should be performed last.
- Tested at +25°C.

**Output Drive Characteristics for CY74FCT162827T**

Parameter	Description	Test Conditions	Min.	Typ. <sup>[4]</sup>	Max.	Unit
I <sub>ODL</sub>	Output LOW Current <sup>[6]</sup>	V <sub>CC</sub> =5V, V <sub>IN</sub> =V <sub>IH</sub> or V <sub>IL</sub> , V <sub>OUT</sub> =1.5V	60	115	150	mA
I <sub>ODH</sub>	Output HIGH Current <sup>[6]</sup>	V <sub>CC</sub> =5V, V <sub>IN</sub> =V <sub>IH</sub> or V <sub>IL</sub> , V <sub>OUT</sub> =1.5V	-60	-115	-150	mA
V <sub>OH</sub>	Output HIGH Voltage	V <sub>CC</sub> =Min., I <sub>OH</sub> =-24 mA	2.4	3.3		V
V <sub>OL</sub>	Output LOW Voltage	V <sub>CC</sub> =Min., I <sub>OL</sub> =24 mA		0.3	0.55	V

**Capacitance<sup>[5]</sup>** (T<sub>A</sub> = +25°C, f = 1.0 MHz)

Parameter	Description	Test Conditions	Typ. <sup>[4]</sup>	Max.	Unit
C <sub>IN</sub>	Input Capacitance	V <sub>IN</sub> = 0V	4.5	6.0	pF
C <sub>OUT</sub>	Output Capacitance	V <sub>OUT</sub> = 0V	5.5	8.0	pF

**Power Supply Characteristics**

Parameter	Description	Test Conditions	Min.	Typ. <sup>[4]</sup>	Max.	Unit	
I <sub>CC</sub>	Quiescent Power Supply Current	V <sub>CC</sub> =Max. V <sub>IN</sub> ≤0.2V, V <sub>IN</sub> ≥V <sub>CC</sub> -0.2V	—	5	500	μA	
ΔI <sub>CC</sub>	Quiescent Power Supply Current (TTL inputs HIGH)	V <sub>CC</sub> =Max. V <sub>IN</sub> =3.4V <sup>[8]</sup>	—	0.5	1.5	mA	
I <sub>CCD</sub>	Dynamic Power Supply Current <sup>[9]</sup>	V <sub>CC</sub> =Max., One Input Toggling, 50% Duty Cycle, Outputs Open, OE <sub>1</sub> =OE <sub>2</sub> =GND,	—	60	100	μA/MHz	
I <sub>C</sub>	Total Power Supply Current <sup>[10]</sup>	V <sub>CC</sub> =Max., f <sub>1</sub> =10 MHz, 50% Duty Cycle, Outputs Open, One Bit Toggling, OE <sub>1</sub> =OE <sub>2</sub> =GND	V <sub>IN</sub> =V <sub>CC</sub> or V <sub>IN</sub> =GND	—	0.6	1.5	mA
			V <sub>IN</sub> =3.4V or V <sub>IN</sub> =GND	—	0.9	2.3	
		V <sub>CC</sub> =Max., f <sub>1</sub> =2.5 MHz, 50% Duty Cycle, Outputs Open, Twenty Bits Toggling, OE <sub>1</sub> =OE <sub>2</sub> =GND	V <sub>IN</sub> =V <sub>CC</sub> or V <sub>IN</sub> =GND	—	3.0	5.5 <sup>[11]</sup>	
			V <sub>IN</sub> =3.4V or V <sub>IN</sub> =GND	—	8.0	20.5 <sup>[11]</sup>	

**Notes:**

8. Per TTL driven input (V<sub>IN</sub>=3.4V); all other inputs at V<sub>CC</sub> or GND.
9. This parameter is not directly testable, but is derived for use in Total Power Supply calculations.
10. I<sub>C</sub> = I<sub>QUIESCENT</sub> + I<sub>INPUTS</sub> + I<sub>DYNAMIC</sub>  
I<sub>C</sub> = I<sub>CC</sub> + ΔI<sub>CC</sub>D<sub>H</sub>N<sub>T</sub> + I<sub>CCD</sub>(f<sub>0</sub>/2 + f<sub>1</sub>N<sub>1</sub>)  
I<sub>CC</sub> = Quiescent Current with CMOS input levels  
ΔI<sub>CC</sub> = Power Supply Current for a TTL HIGH input (V<sub>IN</sub>=3.4V)  
D<sub>H</sub> = Duty Cycle for TTL inputs HIGH  
N<sub>T</sub> = Number of TTL inputs at D<sub>H</sub>  
I<sub>CCD</sub> = Dynamic Current caused by an input transition pair (HLH or LHL)  
f<sub>0</sub> = Clock frequency for registered devices, otherwise zero  
f<sub>1</sub> = Input signal frequency  
N<sub>1</sub> = Number of inputs changing at f<sub>1</sub>  
All currents are in milliamps and all frequencies are in megahertz.
11. Values for these conditions are examples of the I<sub>CC</sub> formula. These limits are specified but not tested.

**Switching Characteristics** Over the Operating Range<sup>[12]</sup>

Parameter	Description	Condition <sup>[13]</sup>	CY74FCT16827AT CY74FCT162827AT		CY74FCT162827BT		Unit	Fig. No. <sup>[13]</sup>
			Min.	Max.	Min.	Max.		
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation Delay A to Y	C <sub>L</sub> =50 pF R <sub>L</sub> =500Ω	1.5	8.0	1.5	5.0	ns	1, 3
		C <sub>L</sub> =300 pF R <sub>L</sub> =500Ω	1.5	15.0	1.5	13.0		
t <sub>PZH</sub> t <sub>PZL</sub>	Output Enable Time OE to Y	C <sub>L</sub> =50 pF R <sub>L</sub> =500Ω	1.5	12.0	1.5	8.0	ns	1, 7, 8
		C <sub>L</sub> =300 pF R <sub>L</sub> =500Ω	1.5	23.0	1.5	15.0		
t <sub>PHZ</sub> t <sub>PLZ</sub>	Output Disable Time OE to Y	C <sub>L</sub> =5 pF R <sub>L</sub> =500Ω	1.5	9.0	1.5	6.0	ns	1, 7, 8
		C <sub>L</sub> =50 pF R <sub>L</sub> =500Ω	1.5	10.0	1.5	7.0		
t <sub>SK(O)</sub>	Output Skew <sup>[14]</sup>		—	0.5	—	0.5	ns	—

Parameter	Description	Condition <sup>[12]</sup>	CY74FCT16827CT CY74FCT162827CT		CY74FCT16827ET CY74FCT162827ET		Unit	Fig. No. <sup>[13]</sup>
			Min.	Max.	Min.	Max.		
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation Delay A to Y	C <sub>L</sub> =50 pF R <sub>L</sub> =500Ω	1.5	4.2	1.5	3.2	ns	1, 3
		C <sub>L</sub> =300 pF R <sub>L</sub> =500Ω	1.5	10.0	1.5	7.0		
t <sub>PZH</sub> t <sub>PZL</sub>	Output Enable Time OE to Y	C <sub>L</sub> =50 pF R <sub>L</sub> =500Ω	1.5	5.6	1.5	4.8	ns	1, 7, 8
		C <sub>L</sub> =300 pF R <sub>L</sub> =500Ω	1.5	14.0	1.5	9.0		
t <sub>PHZ</sub> t <sub>PLZ</sub>	Output Disable Time OE to Y	C <sub>L</sub> =5 pF R <sub>L</sub> =500Ω	1.5	5.7	1.5	4.0	ns	1, 7, 8
		C <sub>L</sub> =50 pF R <sub>L</sub> =500Ω	1.5	6.0	1.5	4.0		
t <sub>SK(O)</sub>	Output Skew <sup>[14]</sup>		—	0.5	—	0.5	ns	—

**Notes:**

12. Minimum limits are specified but not tested on Propagation Delays.
13. See "Parameter Measurement Information" in the General Information section.
14. Skew between any two outputs of the same package switching in the same direction. This parameter is ensured by design.

**Ordering Information CY74FCT16827**

Speed (ns)	Ordering Code	Package Name	Package Type	Operating Range
3.2	CY74FCT16827ETPACT	Z56	56-Lead (240-Mil) TSSOP	Industrial
	CY74FCT16827ETPVC/PVCT	O56	56-Lead (300-Mil) SSOP	
4.2	CY74FCT16827CTPACT	Z56	56-Lead (240-Mil) TSSOP	Industrial
	CY74FCT16827CTPVC/PVCT	O56	56-Lead (300-Mil) SSOP	
8.0	CY74FCT16827ATPVC/PVCT	Z56	56-Lead (240-Mil) TSSOP	Industrial

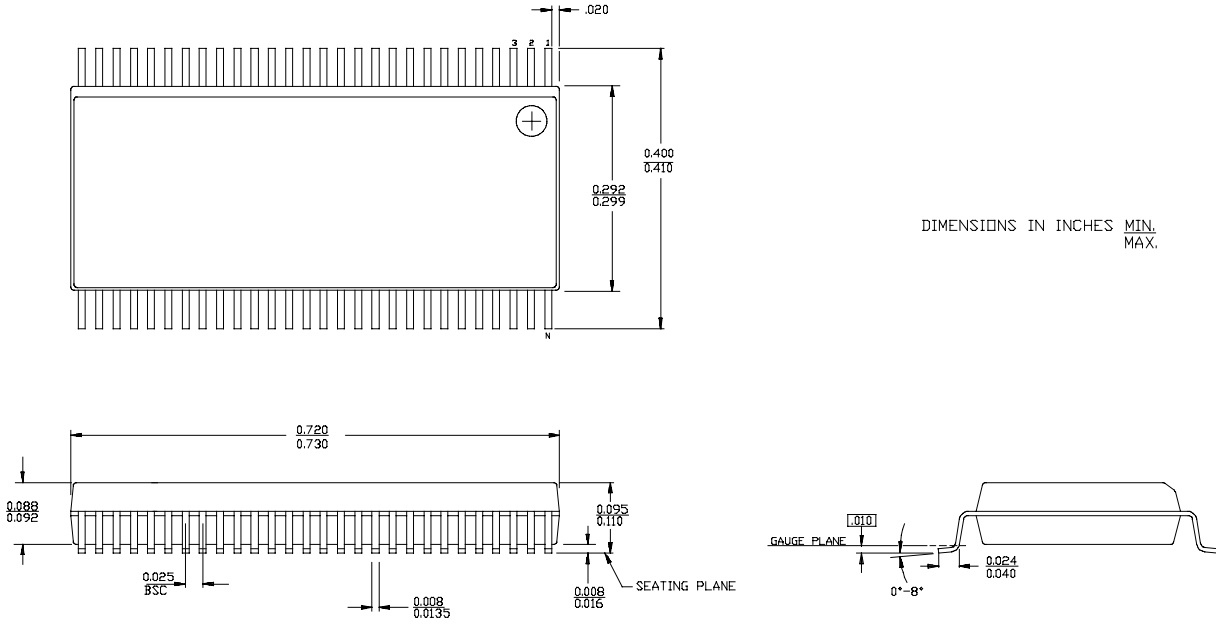
Document #: 38-00393-C

**Ordering Information CY74FCT162827**

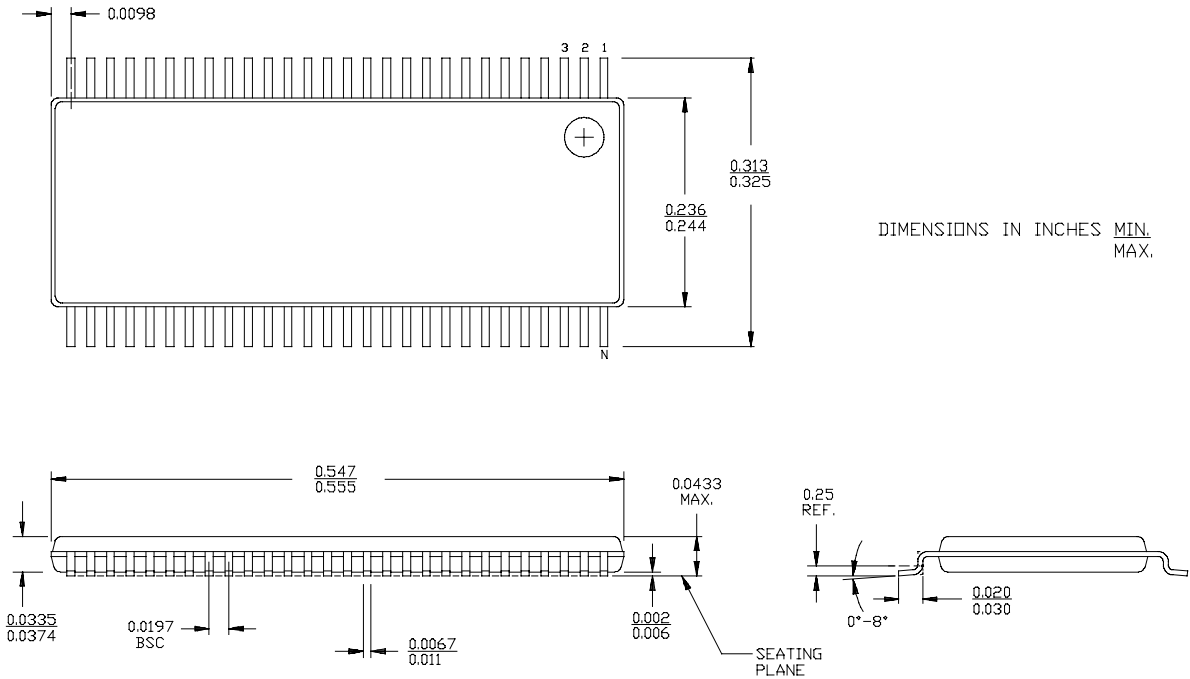
Speed (ns)	Ordering Code	Package Name	Package Type	Operating Range
3.2	74FCT162827ETPACT	Z56	56-Lead (240-Mil) TSSOP	Industrial
	CY74FCT162827ETPVC	O56	56-Lead (300-Mil) SSOP	
	74FCT162827ETPVCT	O56	56-Lead (300-Mil) SSOP	
4.2	74FCT162827CTPACT	Z56	56-Lead (240-Mil) TSSOP	Industrial
	CY74FCT162827CTPVC	Z56	56-Lead (240-Mil) TSSOP	
	74FCT162827CTPVCT	Z56	56-Lead (240-Mil) TSSOP	
5.0	CY74FCT162827BTPVC	O56	56-Lead (300-Mil) SSOP	Industrial
	74FCT162827BTPVCT	O56	56-Lead (300-Mil) SSOP	
8.0	CY74FCT162827ATPVC	O56	56-Lead (300-Mil) SSOP	Industrial
	74FCT162827ATPVCT	O56	56-Lead (300-Mil) SSOP	

**Package Diagrams**

**56-Lead Shrunk Small Outline Package O56**



**56-Lead Thin Shrunk Small Outline Package Z56**



## **IMPORTANT NOTICE**

Texas Instruments and its subsidiaries (TI) reserve the right to make changes to their products or to discontinue any product or service without notice, and advise customers to obtain the latest version of relevant information to verify, before placing orders, that information being relied on is current and complete. All products are sold subject to the terms and conditions of sale supplied at the time of order acknowledgement, including those pertaining to warranty, patent infringement, and limitation of liability.

TI warrants performance of its semiconductor products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are utilized to the extent TI deems necessary to support this warranty. Specific testing of all parameters of each device is not necessarily performed, except those mandated by government requirements.

CERTAIN APPLICATIONS USING SEMICONDUCTOR PRODUCTS MAY INVOLVE POTENTIAL RISKS OF DEATH, PERSONAL INJURY, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE ("CRITICAL APPLICATIONS"). TI SEMICONDUCTOR PRODUCTS ARE NOT DESIGNED, AUTHORIZED, OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT DEVICES OR SYSTEMS OR OTHER CRITICAL APPLICATIONS. INCLUSION OF TI PRODUCTS IN SUCH APPLICATIONS IS UNDERSTOOD TO BE FULLY AT THE CUSTOMER'S RISK.

In order to minimize risks associated with the customer's applications, adequate design and operating safeguards must be provided by the customer to minimize inherent or procedural hazards.

TI assumes no liability for applications assistance or customer product design. TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right of TI covering or relating to any combination, machine, or process in which such semiconductor products or services might be or are used. TI's publication of information regarding any third party's products or services does not constitute TI's approval, warranty or endorsement thereof.