



SCCS028 - December 1987 - Revised March 2000

## 16-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
- $V_{CC} = 5V \pm 10\%$

#### CY74FCT16244T Features:

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

#### CY74FCT162244T Features:

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

#### CY74FCT162H244T Features:

- Bus hold on data inputs
- Eliminates the need for external pull-up or pull-down resistors

### Functional Description

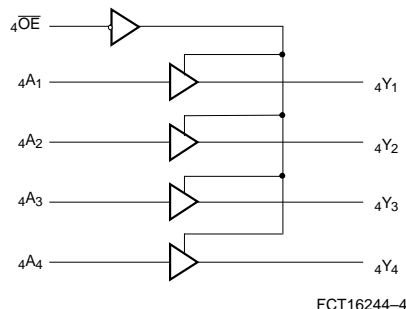
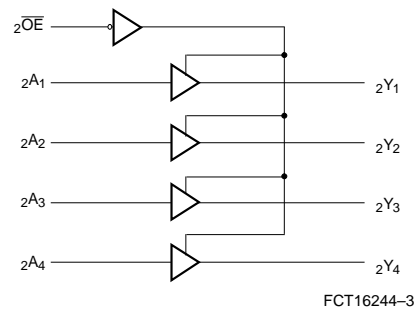
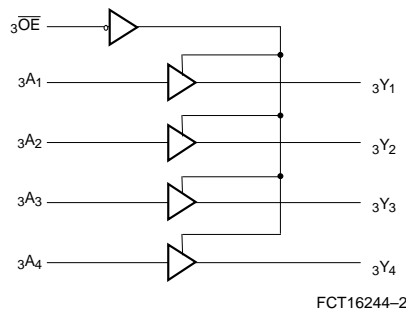
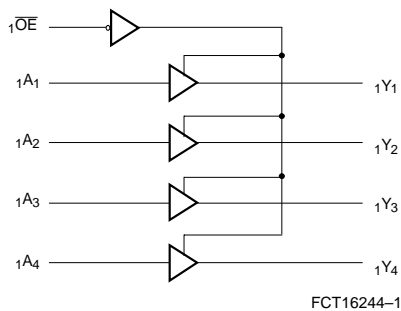
These 16-bit buffers/line drivers are designed for use in memory driver, clock driver, or other bus interface applications, where high-speed and low power are required. With flow-through pinout and small shrink packaging board layout is simplified. The three-state controls are designed to allow 4-bit, 8-bit or combined 16-bit operation. The outputs are designed with a power-off disable feature to allow for live insertion of boards.

The CY74FCT16244T is ideally suited for driving high-capacitance loads and low-impedance backplanes.

The CY74FCT162244T 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 CY74FCT162244T is ideal for driving transmission lines.

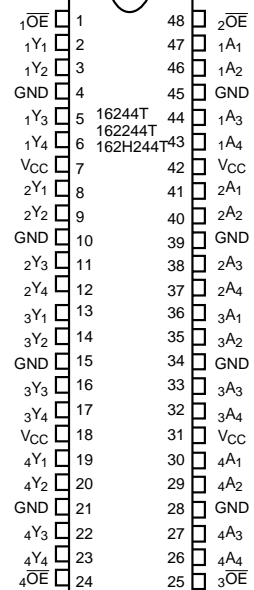
The CY74FCT162H244T is a 24-mA balanced output part that has "bus hold" on the data inputs. The device retains the input's last state whenever the input goes to high impedance. This eliminates the need for pull-up/down resistors and prevents floating inputs.

### Logic Block Diagrams CY74FCT16244T, CY74FCT162244T, CY74FCT162H244T



### Pin Configuration

#### SSOP/TSSOP Top View



FCT16244-5

**Pin Description**

Name	Description
$\overline{OE}$	Three-State Output Enable Inputs (Active LOW)
A	Data Inputs <sup>[1]</sup>
Y	Three-State Outputs

**Function Table<sup>[2]</sup>**

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

**Maximum Ratings<sup>[3,4]</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)

**Ordering Range**

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

**Notes:**

- On CY74FCT162H244T these pins have "bus hold."
- H = HIGH Voltage Level. L = LOW Voltage Level. X = Don't Care. Z = High Importance.
- Operation beyond the limits set forth may impair the useful life of the device. Unless otherwise 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.

**Electrical Characteristics Over the Operating Range**

Parameter	Description	Test Conditions	Min.	Typ. <sup>[5]</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>[6]</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	Standard	V <sub>CC</sub> =Max., V <sub>I</sub> =V <sub>CC</sub>		±1	μA
		Bus Hold				
I <sub>IL</sub>	Input LOW Current	Standard	V <sub>CC</sub> =Max., V <sub>I</sub> =GND		±1	μA
		Bus Hold				
I <sub>BBH</sub> I <sub>BBL</sub>	Bus Hold Sustain Current on Bus Hold Input <sup>[7]</sup>	V <sub>CC</sub> =Min., V <sub>I</sub> =2.0V	-50			μA
		V <sub>I</sub> =0.8V	+50			
I <sub>BHHO</sub> I <sub>BHLO</sub>	Bus Hold Overdrive Current on Bus Hold Input <sup>[7]</sup>	V <sub>CC</sub> =Max., V <sub>I</sub> =1.5V			TBD	mA
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>[8]</sup>	V <sub>CC</sub> =Max., V <sub>OUT</sub> =GND	-80	-140	-200	mA
I <sub>O</sub>	Output Drive Current <sup>[8]</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>[9]</sup>			±1	μA

**Output Drive Characteristics for CY74FCT16244T**

Parameter	Description	Test Conditions	Min.	Typ. <sup>[5]</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
		V <sub>CC</sub> =Min., I <sub>OH</sub> =-32 mA	2.0	3.0		V
V <sub>OL</sub>	Output LOW Voltage	V <sub>CC</sub> =Min., I <sub>OL</sub> =64 mA		0.2	0.55	V

**Output Drive Characteristics for CY74FCT162244T, CY74FCT162H244T**

Parameter	Description	Test Conditions	Min.	Typ. <sup>[5]</sup>	Max.	Unit
I <sub>ODL</sub>	Output LOW Current <sup>[8]</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>[8]</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

**Notes:**

5. Typical values are at V<sub>CC</sub>=5.0V, T<sub>A</sub> = +25°C ambient.
6. This parameter is specified but not tested.
7. Pins with bus hold are described in Pin Description.
8. 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.
9. Tested at +25°C.

**Capacitance**<sup>[6]</sup>( $T_A = +25^\circ\text{C}$ ,  $f = 1.0\text{ MHz}$ )

Parameter	Description	Test Conditions	Typ. <sup>[5]</sup>	Max.	Unit
$C_{IN}$	Input Capacitance	$V_{IN} = 0V$	4.5	6.0	pF
$C_{OUT}$	Output Capacitance	$V_{OUT} = 0V$	5.5	8.0	pF

**Power Supply Characteristics**

Parameter	Description	Test Conditions	Typ. <sup>[5]</sup>	Max.	Unit	
$I_{CC}$	Quiescent Power Supply Current	$V_{CC} = \text{Max.}$ $V_{IN} \leq 0.2V$ , $V_{IN} \leq V_{CC} - 0.2V$	5	500	$\mu\text{A}$	
$\Delta I_{CC}$	Quiescent Power Supply Current (TTL inputs HIGH)	$V_{CC} = \text{Max.}$ $V_{IN} = 3.4V$ <sup>[10]</sup>	0.5	1.5	mA	
$I_{CCD}$	Dynamic Power Supply Current <sup>[11]</sup>	$V_{CC} = \text{Max.}$ , One Input Toggling, 50% Duty Cycle, Outputs Open, $\overline{OE} = \text{GND}$	60	100	$\mu\text{A}/\text{MHz}$	
$I_C$	Total Power Supply Current <sup>[12]</sup>	$V_{CC} = \text{Max.}$ , $f_1 = 10\text{ MHz}$ , 50% Duty Cycle, Outputs Open, One Bit Toggling, $\overline{OE} = \text{GND}$	$V_{IN} = V_{CC}$ or $V_{IN} = \text{GND}$	0.6	1.5	mA
			$V_{IN} = 3.4V$ or $V_{IN} = \text{GND}$	0.9	2.3	mA
		$V_{CC} = \text{Max.}$ , $f_1 = 2.5\text{ MHz}$ , 50% Duty Cycle, Outputs Open, Sixteen Bits Toggling, $\overline{OE} = \text{GND}$	$V_{IN} = V_{CC}$ or $V_{IN} = \text{GND}$	2.4	4.5 <sup>[13]</sup>	mA
			$V_{IN} = 3.4V$ or $V_{IN} = \text{GND}$	6.4	16.5 <sup>[13]</sup>	mA

**Notes:**

10. Per TTL driven input ( $V_{IN} = 3.4V$ ); all other inputs at  $V_{CC}$  or GND.
11. This parameter is not directly testable, but is derived for use in Total Power Supply calculations.
12.  $I_C = I_{CC} + \Delta I_{CC} D_H N_T + I_{CCD}(f_0/2 + f_1 N_1)$   
 $I_C$  =  $I_{CC} + \Delta I_{CC} D_H N_T + I_{CCD}(f_0/2 + f_1 N_1)$   
 $I_{CC}$  = Quiescent Current with CMOS input levels  
 $I_{CC}$  = Power Supply Current for a TTL HIGH input ( $V_{IN} = 3.4V$ )  
 $D_H$  = Duty Cycle for TTL inputs HIGH  
 $N_T$  = Number of TTL inputs at  $D_H$   
 $I_{CCD}$  = Dynamic Current caused by an input transition pair (HLH or LHL)  
 $f_0$  = Clock frequency for registered devices, otherwise zero  
 $f_1$  = Input signal frequency  
 $N_1$  = Number of inputs changing at  $f_1$   
 All currents are in milliamps and all frequencies are in megahertz.
13. Values for these conditions are examples of the  $I_{CC}$  formula. These limits are specified but not tested.

**Switching Characteristics** Over the Operating Range<sup>[14]</sup>

Parameter	Description	CY74FCT16244T CY74FCT162244T		CY74FCT16244AT CY74FCT162244AT CY74FCT162H244AT		Unit	Fig. No. <sup>[15]</sup>
		Min.	Max.	Min.	Max.		
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation Delay Data to Output	1.5	6.5	1.5	4.8	ns	1, 3
t <sub>PZH</sub> t <sub>PZL</sub>	Output Enable Time	1.5	8.0	1.5	6.2	ns	1, 7, 8
t <sub>PHZ</sub> t <sub>PLZ</sub>	Output Disable Time	1.5	7.0	1.5	5.6	ns	1, 7, 8
t <sub>SK(O)</sub>	Output Skew <sup>[16]</sup>		0.5		0.5	ns	—

**Switching Characteristics** Over the Operating Range<sup>[14]</sup> (continued)

Parameter	Description	CY74FCT16244CT CY74FCT162244CT CY74FCT162H244CT		CY74FCT16244ET CY74FCT162244ET CY74FCT162H244ET		Unit	Fig. No. <sup>[15]</sup>
		Min.	Max.	Min.	Max.		
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation Delay Data to Output	1.5	4.1	1.5	3.2	ns	1, 3
t <sub>PZH</sub> t <sub>PZL</sub>	Output Enable Time	1.5	5.8	1.5	4.4	ns	1, 7, 8
t <sub>PHZ</sub> t <sub>PLZ</sub>	Output Disable Time	1.5	5.2	1.5	3.6	ns	1, 7, 8
t <sub>SK(O)</sub>	Output Skew <sup>[16]</sup>		0.5		0.5	ns	—

**Notes:**

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

**Ordering Information CY74FCT16244**

Speed (ns)	Ordering Code	Package Name	Package Type	Operating Range
3.2	CY74FCT16244ETPACT	Z48	48-Lead (240-Mil) TSSOP	Industrial
	CY74FCT16244ETPVC/PVCT	O48	48-Lead (300-Mil) SSOP	
4.1	CY74FCT16244CTPACT	Z48	48-Lead (240-Mil) TSSOP	Industrial
	CY74FCT16244CTPVC/PVCT	O48	48-Lead (300-Mil) SSOP	
4.8	CY74FCT16244ATPACT	Z48	48-Lead (240-Mil) TSSOP	Industrial
	CY74FCT16244ATPVC/PVCT	O48	48-Lead (300-Mil) SSOP	
6.5	CY74FCT16244TPACT	Z48	48-Lead (240-Mil) TSSOP	Industrial
	CY74FCT16244TPVC/PVCT	O48	48-Lead (300-Mil) SSOP	

**Ordering Information CY74FCT162244**

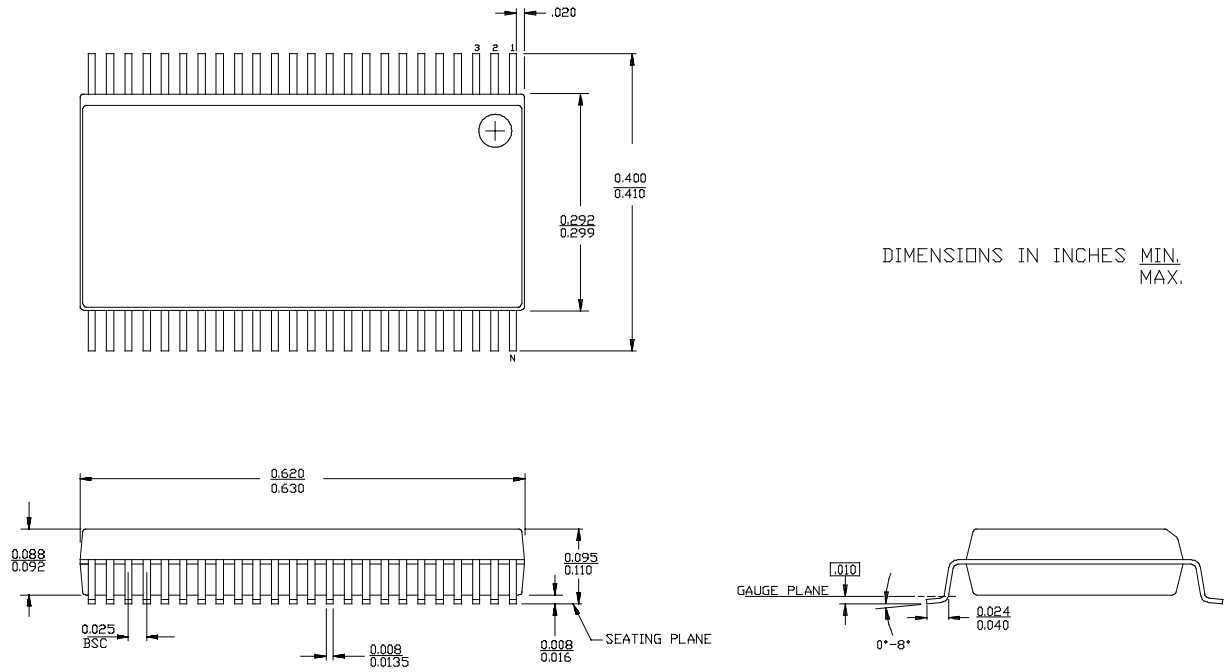
Speed (ns)	Ordering Code	Package Name	Package Type	Operating Range
3.2	74FCT162244ETPACT	Z48	48-Lead (240-Mil) TSSOP	Industrial
	CY74FCT162244ETPVC	O48	48-Lead (300-Mil) SSOP	
	74FCT162244ETPVCT	O48	48-Lead (300-Mil) SSOP	
4.1	74FCT162244CTPACT	Z48	48-Lead (240-Mil) TSSOP	Industrial
	CY74FCT162244CTPVC	O48	48-Lead (300-Mil) SSOP	
	74FCT162244CTPVCT	O48	48-Lead (300-Mil) SSOP	
4.8	74FCT162244ATPACT	Z48	48-Lead (240-Mil) TSSOP	Industrial
	CY74FCT162244ATPVC	O48	48-Lead (300-Mil) SSOP	
	74FCT162244ATPVCT	O48	48-Lead (300-Mil) SSOP	
6.5	CY74FCT162244TPACT	Z48	48-Lead (240-Mil) TSSOP	Industrial
	CY74FCT162244TPVC/PVCT	O48	48-Lead (300-Mil) SSOP	

**Ordering Information CY74FCT162H244**

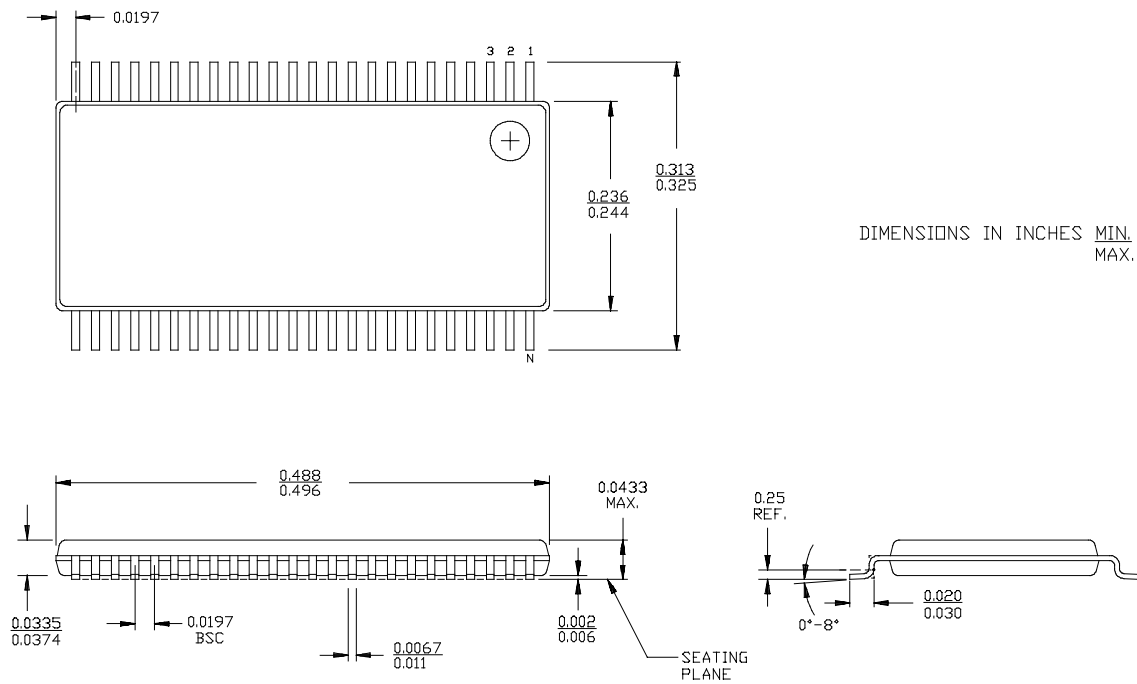
Speed (ns)	Ordering Code	Package Name	Package Type	Operating Range
3.2	74FCT162H244ETPACT	Z48	48-Lead (240-Mil) TSSOP	Industrial
	74FCT162H244ETPVC/PVCT	O48	48-Lead (300-Mil) SSOP	
4.1	74FCT162H244CTPVC/PVCT	O48	48-Lead (300-Mil) SSOP	Industrial
4.8	74FCT162H244ATPACT	Z48	48-Lead (240-Mil) TSSOP	Industrial

**Package Diagrams**

**48-Lead Shrunk Small Outline Package O48**



**48-Lead Thin Shrunk Small Outline Package Z48**



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