

## FEATURES/BENEFITS

- Pin and function compatible with T.I. Widebus™ and IDT Double-Density™ families
- CMOS power levels: <1 μW typical standby
- SSOP (PV) and TSSOP (PA) packages
- Low output skew: 0.5 ns  $t_{SK(O)}$
- Flow-through pinout for easy layout
- Extended commercial temperature: -40°C to +85°C
- Extended 3.3V supply range 2.7V to 3.6V
- JEDEC compatible LVTTTL output levels for 3.3V
- Input hysteresis for noise immunity
- Multiple power and ground pins for low noise
- A and C speed grades: 4.1 ns  $t_{PD}$  for C
- 5V tolerant inputs for 5V to 3.3V translation

## DESCRIPTION

The FCT163244 16-bit bus interface buffer is ideal for data or address buffering in either 3.3V or mixed 3.3V/5V systems. Four 3-state output enable pins allow independent 4-bit, 8-bit or 16-bit operation. Easy board layout is facilitated by the use of flow-through pinouts. All outputs have ground bounce suppression circuitry (see QSI Application Note AN-01). Multiple power and ground pins result in low ground and  $V_{CC}$  bounce. This JEDEC LVTTTL compliant 3.3V device is useful for 5V to 3.3V buffering applications, since all inputs will support 5V signals.

**Figure 1. Functional Block Diagram**

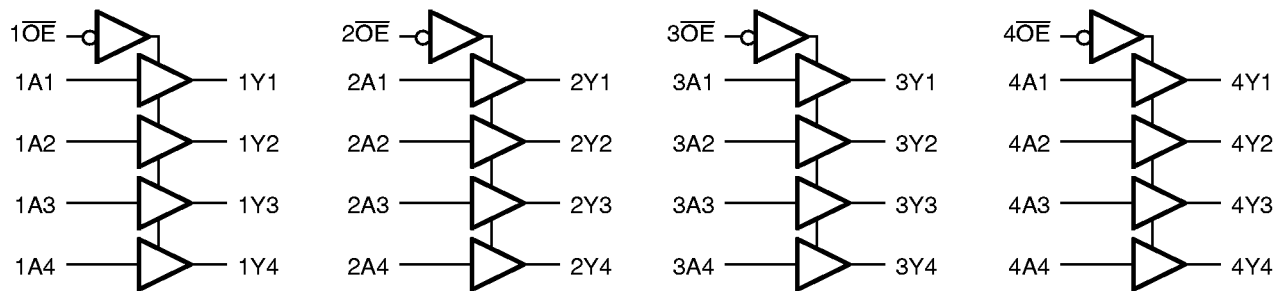


Figure 2. Pin Configuration (All Pins Top View)

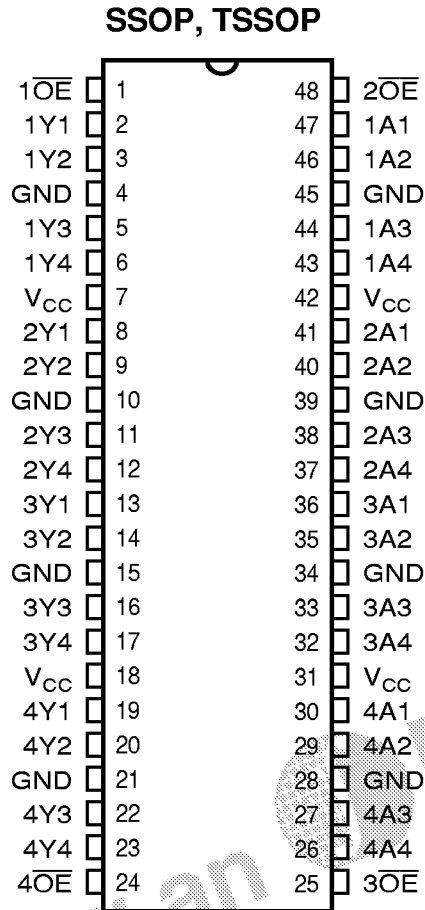


Table 1. Pin Description

Name	Description
$x\overline{OE}$	3-State Output Enable Inputs
$xAx$	Data Inputs
$xYx$	3-State Outputs

Table 2. Function Table

Inputs		Outputs
$x\overline{OE}$	$xAx$	$xYx$
L	L	L
L	H	H
H	X	Hi-Z

**Table 3. Capacitance**

$T_A = 25^\circ\text{C}$ ,  $f = 1\text{ MHz}$ ,  $V_{IN} = 0\text{V}$ ,  $V_{OUT} = 0\text{V}$

Symbol	Parameter	Typ	Unit
$C_{IN}$	Input Capacitance	7.0	pF
$C_{OUT}$	Output Capacitance	8.0	pF

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

**Table 4. Absolute Maximum Ratings**

Supply Voltage to Ground .....	-0.5V to +4.6V
DC Output Voltage $V_{OUT}$ .....	-0.5V to $V_{CC} + 0.5\text{V}$
DC Input Voltage $V_{IN}$ .....	-0.5V to +7.0V
AC Input Voltage (for a pulse width $\leq 20\text{ ns}$ ) .....	-3.0V
DC Input Diode Current with $V_{IN} < 0$ .....	-20 mA
DC Output Diode Current with $V_{OUT} < 0$ .....	-50 mA
DC Output Current Max. Sink Current/Pin .....	120 mA
$T_{STG}$ 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 5. Recommended Operating Conditions**

Symbol		Min	Max	Unit
$V_{CC}$	Supply Voltage	2.7	3.6	V
$V_{IN}$	Input Voltage	-0.5	5.5	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 Temperature	-40	+85	°C

**Table 6. DC Electrical Characteristics Over Operating Range**

Recommended Operating Ranges apply unless otherwise noted.

Symbol	Parameter	Test Conditions <sup>(1)</sup>	Min	Typ <sup>(2)</sup>	Max	Unit	
$V_{IH}$	Input HIGH Voltage	Logic HIGH for All Inputs	2.0	—	5.5	V	
$V_{IL}$	Input LOW Voltage	Logic LOW for All Inputs	-0.5	—	0.8	V	
$\Delta V_T$	Input Hysteresis <sup>(4)</sup>	$V_{TLH} - V_{THL}$ for All Inputs	—	150	—	mV	
$ I_{IH} $ $ I_{IL} $	Input Current Input HIGH or LOW	$V_{CC} = \text{Max.}, 0 \leq V_{IN} < 5.5V$	—	—	1	$\mu A$	
$ I_{OZ} $	Off-State Output Current (Hi-Z)	$V_{CC} = \text{Max.}, 0 \leq V_{OUT} \leq V_{CC}$	—	—	1	$\mu A$	
$I_{OS}$	Short Circuit Current <sup>(3,4)</sup>	$V_{CC} = \text{Max.}, V_{OUT} = \text{GND}$	-60	-140	-240	mA	
$V_{OH}$	Output HIGH Voltage	$V_{CC} = 2.7V$ $V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OH} = -0.1 \text{ mA}$ $I_{OH} = -3.0 \text{ mA}$	$V_{CC} - 0.2$ 2.4	— —	— —	V
		$V_{CC} = 3.0V$ $V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OH} = -8 \text{ mA}$	2.4	—	—	V
$V_{OL}$	Output LOW Voltage	$V_{CC} = 2.7V$ $V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OL} = 0.1 \text{ mA}$	—	—	0.2	V
			$I_{OL} = 16 \text{ mA}$	—	—	0.4	
			$I_{OL} = 24 \text{ mA}$	—	—	0.55	
		$V_{CC} = 3.0V$ $V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OL} = 24 \text{ mA}$	—	—	0.5	V
$V_{IK}$	Input Clamp Voltage <sup>(4)</sup>	$V_{CC} = \text{Min.}, I_{IN} = -18 \text{ mA}$	—	-0.7	-1.2	V	

**Notes:**

1. For conditions shown as Max or Min use appropriate value specified under Electrical Characteristics for the applicable device type.
2. Typical values indicate  $V_{CC} = 3.3V$  and  $T_A = 25^\circ C$ .
3. Not more than one output should be shorted at one time. Duration of test should not exceed one second.
4. These parameters are guaranteed by design but not production tested.

**Table 7. Power Supply Characteristics**

Symbol	Parameter	Test Conditions <sup>(1)</sup>	Typ <sup>(2)</sup>	Max	Unit	
$I_{CCQ}$	Quiescent Power Supply Current	$V_{CC} = \text{Max.}, \text{Freq} = 0$ $V_{IN} = \text{GND or } V_{CC}$	1	10	$\mu\text{A}$	
$\Delta I_{CC}$	Supply Current per Input @ TTL HIGH <sup>(3)</sup>	$V_{CC} = \text{Max.}, V_{IN} = V_{CC} - 0.6\text{V}$	2.0	30	$\mu\text{A}$	
$I_{CCD}$	Supply Current per Input per MHz <sup>(4)</sup>	$V_{CC} = \text{Max.}, \text{Outputs Open}$ One Bit Toggling @ 50% Duty Cycle $\times \text{OE} = \text{GND}$	50	75	$\mu\text{A}/\text{MHz}$	
$I_C$	Total Power Supply Current <sup>(6)</sup>	$V_{CC} = \text{Max.}, \text{Outputs Open}$ One Bit Toggling @ 50% Duty Cycle $\times \text{OE} = \text{GND}, f_I = 10 \text{ MHz}$	$V_{IN} = V_{CC} - 0.6\text{V}$ $V_{IN} = \text{GND}$	0.5 <sup>(5)</sup>	0.8 <sup>(5)</sup>	$\text{mA}$
		$V_{CC} = \text{Max.}, \text{Outputs Open}$ Sixteen Bits Toggling @ 50% Duty Cycle $\times \text{OE} = \text{GND}, f_I = 2.5 \text{ MHz}$	$V_{IN} = V_{CC} - 0.6\text{V}$ $V_{IN} = \text{GND}$	2.0 <sup>(5)</sup>	3.3 <sup>(5)</sup>	$\text{mA}$

**Notes:**

- For conditions shown as Min. or Max., use the appropriate values specified under Recommended Operating Conditions for applicable device type.
- Typical values are at  $V_{CC} = 3.3\text{V}, +25^\circ\text{C}$  ambient.
- Per TTL driven input. All Other Inputs at  $V_{CC}$  or GND.
- This parameter is not directly testable, but is derived for use in Total Power Supply Calculations.
- Values for these conditions are examples of the  $I_{CC}$  formula. These limits are guaranteed by design but not tested.
- $I_C = I_{CCQ} + I_{inputs} = I_{dynamic}$   
 $I_C = I_{CCQ} + \Delta I_{CC} D_H N_T + I_{CCD} (f_{CP} N_{CP} / 2 + f_I N_I)$   
 $I_{CCQ}$  = Quiescent Current ( $I_{CCL}, I_{CCH},$  and  $I_{CCZ}$ ).  
 $\Delta I_{CC}$  = Power Supply Current for a TTL-High Input ( $V_{IN} = V_{CC} - 0.6\text{V}$ ).  
 $D_H$  = 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 8. Switching Characteristics Over Operating Range**

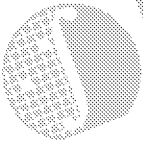
Recommended Operating Ranges apply unless otherwise specified.

$C_{LOAD} = 50 \text{ pF}$ ,  $R_{LOAD} = 500\Omega$  unless otherwise noted.

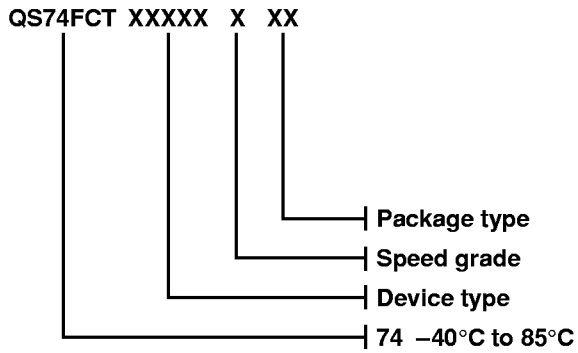
Symbol	Description <sup>(1,2)</sup>	FCT163244A		FCT163244C		Unit
		Min	Max	Min	Max	
$t_{PHL}$ $t_{PLH}$	Propagation Delay xAx to xYx	1.5	4.8	1.5	4.1	ns
$t_{PZH}$ $t_{PZL}$	Output Enable Time x $\overline{OE}$ to xYx	1.5	6.2	1.5	5.8	ns
$t_{PHZ}$ $t_{PLZ}$	Output Disable Time <sup>(3)</sup> x $\overline{OE}$ to xYx	1.5	5.6	1.5	5.2	ns
$t_{SK(O)}$	Output Skew <sup>(4)</sup>	—	0.5	—	0.5	ns

**Notes:**

1. Minimums guaranteed but not tested. See Test Circuit and Waveforms.
2. Switching Characteristics are with  $V_{CC} = 3.3V \pm 0.3V$   
For 2.7V  $V_{CC}$  operation, parameters should be degraded by 20%.
3. Guaranteed by design, but not production tested.
4. Skew between any two outputs of the same package switching in the same direction.  
This parameter is guaranteed by design but not tested.

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**ORDERING INFORMATION**



**Device Type:**  
163244

**Speed Grades:**  
A  
C

**Package Type:**  
PV – SSOP, 300 mil  
PA – TSSOP, 240 mil

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