CY74FCT163952
CY74FCT163H952

16-Bit Registered Transceiver

Features

- **5V tolerant Inputs and Outputs**
- **24 mA balanced drive outputs**
- **Low power, pin-compatible replacement for LCX, LPT, LVC, LVCH & LVT families**
- **FCT-C speed at 6.3 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**
- **Extended commercial range of -40°C to +85°C**
- **V_{CC} = 2.7V to 3.6V**
- **Typical V_{OLP} (ground bounce) <0.6V at V_{CC} = 3.3V, T_A= 25°C**

CY74FCT163H952 Features:

- **Bus hold retains last active state**
- **Eliminates the need for external pull-up or pull-down resistors**

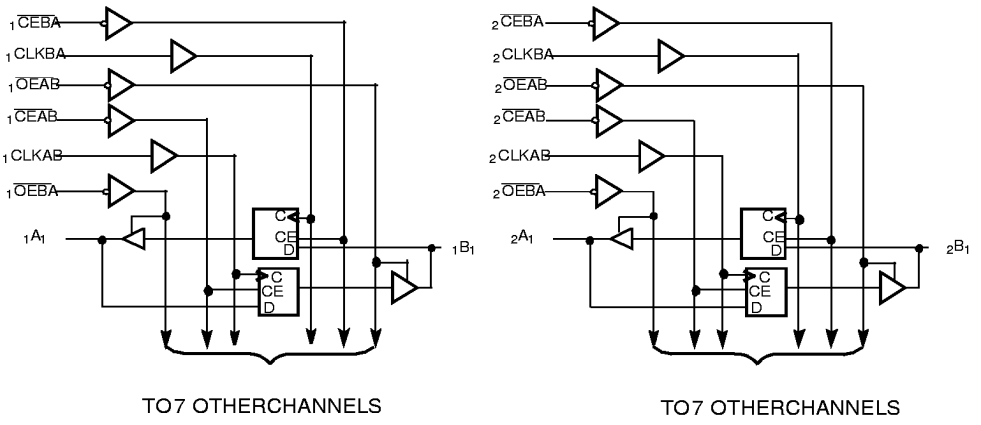
Functional Description

These 16-bit registered transceivers are high-speed, low-power devices. 16-bit operation is achieved by connecting the control lines of the two 8-bit registered transceivers together. For data flow from bus A-to-B, $\overline{CEAB}$ must be LOW to allow data to be stored when CLKAB transitions from LOW-to-HIGH. The stored data will be present on the output when $\overline{OEAB}$ is LOW. Control of data from B-to-A is similar and is controlled by using the $\overline{CEBA}$, CLKBA, and $\overline{OEBA}$ inputs. The outputs are 24-mA balanced output drivers with current limiting resistors to reduce the need for external terminating resistors and provide for minimal undershoot and reduced ground bounce.

The CY74FCT163H952 has "bus hold" on the data inputs, which retain the input's last state whenever the source driving the input goes to high impedance. This eliminates the need for pull-up/down resistors and prevents floating inputs.

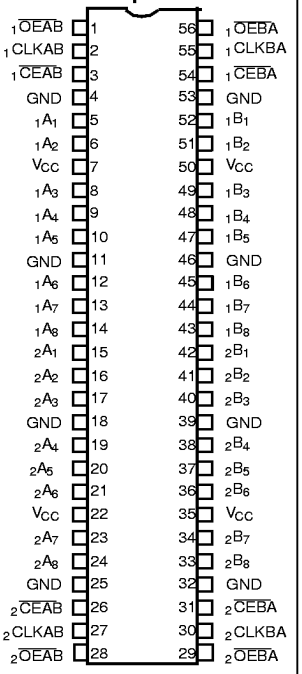
The CY74FCT163952 and the CY74FCT163H952 are designed with inputs and outputs capable of being driven by 5.0V buses, allowing them to be used in mixed voltage systems as translators. The outputs are also designed with a power off disable feature enabling them to be used in applications requiring live insertion.

Logic Block Diagrams



Pin Configuration

SSOP/TSSOP
Top View



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Pin Description

Name	Description
$\overline{OEAB}$	A-to-B Output Enable Input (Active LOW)
$\overline{OEBA}$	B-to-A Output Enable Input (Active LOW)
$\overline{CEAB}$	A-to-B Clock Enable Input (Active LOW)
$\overline{CEBA}$	B-to-A Clock Enable Input (Active LOW)
CLKAB	A-to-B Clock Input
CLKBA	B-to-A Clock Input
A	A-to-B Data Inputs or B-to-A Three-State Outputs[1]
B	B-to-A Data Inputs or A-to-B Three-State Outputs[1]

Function Table[2, 3]

For A-to-B (Symmetric with B-to-A)

Inputs				Outputs
$\overline{CEAB}$	CLKAB	$\overline{OEAB}$	A	B
H	X	L	X	B[4]
X	L	L	X	B[4]
L	⌐	L	L	L
L	⌐	L	H	H
X	X	H	X	Z

Maximum Ratings[5, 6]

(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

Supply Voltage Range ..... 0.5V to +4.6V

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_{CC}
Commercial	–40°C to +85°C	2.7V to3.6V

Notes:

1. On the CY74FCT163H952 these pins have bus hold.
2. A-to-B data flow is shown: B-to-A data flow is similar but uses, $\overline{CEBA}$, CLKBA, and $\overline{OEBA}$.
3. H = HIGH Voltage Level.
   L = LOW Voltage Level.
   X = Don't Care.
   ⌐ = LOW-to-HIGH Transition.
   Z = HIGH Impedance.
4. Level of B before the indicated steady-state input conditions were established.
5. 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.
6. With the exception of inputs with bus hold, unused inputs must always be connected to an appropriate logic voltage level, preferably either V_{CC} or ground.

Electrical Characteristics Over the Operating Range V_{CC}=2.7V to 3.6V

Parameter	Description		Test Conditions		Min.	Typ.[7]	Max.	Unit
V_{IH}	Input HIGH Voltage				2.0		5.5	V
V_{IL}	Input LOW Voltage						0.8	V
V_H	Input Hysteresis[8]					100		mV
V_{IK}	Input Clamp Diode Voltage		V_{CC}=Min., I_{IN}= –18 mA			–0.7	–1.2	V
I_{IH}	Input HIGH Current	Standard	V_{CC}=Max., V_I=5.5				±1	µA
		Bus Hold	V_{CC}=Max., V_I=V_{CC}				±100	
I_{IL}	Input LOW Current	Standard	V_{CC}=Max., V_I=GND				±1	µA
		Bus Hold					±100	
I_{BBH} I_{BBL}	Bus Hold Sustain Current on Bus Hold Input[9]		V_{CC}=Min.	V_I=2.0V	–50			µA
				V_I=0.8V	+50			
I_{BHHO} I_{BHLO}	Bus Hold Overdrive Current on Bus Hold Input[9]		V_{CC}=Max., V_I=1.5V				±500	µA
I_{OZH}	High Impedance Output Current (Three-State Output pins)		V_{CC}=Max., V_{OUT}=5.5V				±1	µA
I_{OZL}	High Impedance Output Current (Three-State Output pins)		V_{CC}=Max., V_{OUT}=GND				±1	µA
I_{ODL}	Output LOW Current[11]		V_{CC}=3.3V, V_{IN}=V_{IH} or V_{IL}, V_{OUT}=1.5V		50	90	200	mA
I_{ODH}	Output HIGH Current[11]		V_{CC}=3.3V, V_{IN}=V_{IH} or V_{IL}, V_{OUT}=1.5V		–36	–60	–110	mA
V_{OH}	Output HIGH Voltage		V_{CC}=Min., I_{OH}= –0.1 mA		V_{CC}–0.2			V
			V_{CC}=3.0, I_{OH}= –8 mA		2.4[10]	3.0		
			V_{CC}=3.0V, I_{OH}= –24 mA		2.0	3.0		
V_{OL}	Output LOW Voltage		V_{CC}=Min., I_{OL}= 0.1mA				0.2	V
			V_{CC}=Min., I_{OL}= 24 mA			0.3	0.5	
I_{OS}	Short Circuit Current[11]		V_{CC}=Max., V_{OUT}=GND		–60	–140	–200	mA
I_{OFF}	Power-Off Disable		V_{CC}=0V, V_{OUT}≤4.5V				±100	µA

Capacitance (T_A = +25°C, f = 1.0 MHz)

Parameter	Description	Test Conditions	Typ.[7]	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

Note:

7. Typical values are at V_{CC}=3.3V, T_A=+25°C ambient.
8. This parameter is guaranteed but not tested.
9. Pins with bus hold are described in the Pin Description.
10. V_{OH}=V_{CC}–0.6V at rated current.
11. 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_{OS} tests should be performed last.

Power Supply Characteristics

Parameter	Description	Test Conditions		Typ.[7]	Max.	Unit
I_{CC}	Quiescent Power Supply Current	V_{CC}=Max.	$V_{IN} \le 0.2V$ $V_{IN} \ge V_{CC}-0.2V$	0.1	10	µA
ΔI_{CC}	Quiescent Power Supply Current (TTL inputs HIGH)	V_{CC}=Max.	$V_{IN}=V_{CC}-0.6V$[12]	2.0	30	µA
I_{CCD}	Dynamic Power Supply Current[13]	V_{CC}=Max., One Input Toggling, 50% Duty Cycle, Outputs Open, $\overline{OEAB}$ or $\overline{OEBA}$=GND	$V_{IN}=V_{CC}$ or V_{IN}=GND	50	75	µA/MHz
I_C	Total Power Supply Current[14]	V_{CC}=Max., f_1=5 MHz, f_0 = 10 MHz (CLKAB) $\overline{OEAB}$ = $\overline{CEAB}$ = GND $\overline{OEBA}$ = V_{CC} 50% Duty Cycle, Outputs Open, One Bit Toggling	$V_{IN}=V_{CC}$ or V_{IN}=GND	0.5	0.8	mA
			$V_{IN}=V_{CC}-0.6V$ or V_{IN}=GND	0.5	0.8	
		V_{CC}=Max., f_0=10 MHz (CLKAB) f_1=2.5 MHz, $\overline{OEAB}$ = $\overline{CEAB}$ = GND $\overline{OEBA}$ = V_{CC} 50% Duty Cycle, Outputs Open, Sixteen Bit Toggling	$V_{IN}=V_{CC}$ or V_{IN}=GND	2.3	3.8[15]	
			$V_{IN}=V_{CC}-0.6V$ or V_{IN}=GND	2.3	4.0[15]	

Notes:

12. Per TTL driven input, all other inputs at V_{CC} or GND.
13. This parameter is not directly testable, but is derived for use in Total Power Supply calculations.
14. $I_C = I_{QUIESCENT} + I_{INPUTS} + I_{DYNAMIC}$
    $I_C = I_{CC}+\Delta I_{CC}D_HN_T+I_{CCD}(f_0N_C/2 + f_1N_1)$
    I_{CC} = Quiescent Current with CMOS input levels
    ΔI_{CC} = Power Supply Current for a TTL HIGH input
    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
    N_C = Number of clock inputs changing at f_1
    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.
15. Values for these conditions are examples of the I_{CC} formula. These limits are guaranteed but not tested.

Switching Characteristics Over the Operating Range V_{CC}=3.0V to 3.6V [16,17]

Parameter	Description	CY74FCT163952A CY74FCT163H952A		CY74FCT163952C CY74FCT163H952C		Unit	Fig. No.[18]
		Min.	Max.	Min.	Max.		
t_{PLH} t_{PHL}	Propagation Delay CLKAB, CLKBA to B, A	2.0	10.0	2.0	6.3	ns	1, 5
t_{PZH} t_{PZL}	Output Enable Time $\overline{OEBA}$, $\overline{OEAB}$ to A, B	1.5	10.5	1.5	7.0	ns	1, 7, 8
t_{PHZ} t_{PLZ}	Output Disable Time $\overline{OEBA}$, $\overline{OEAB}$ to A, B	1.5	10.0	1.5	6.5	ns	1, 7, 8
t_{SU}	Set-Up Time, HIGH or LOW A, B to CLKAB, CLKBA	2.5	—	2.5	—	ns	4
t_H	Hold Time, HIGH or LOW A, B to CLKAB, CLKBA	2.0	—	1.5	—	ns	4
t_{SU}	Set-Up Time, HIGH or LOW $\overline{CEAB}$, $\overline{CEBA}$ to CLKAB, CLKBA	3.0	—	3.0	—	ns	4
t_H	Hold Time, HIGH or LOW $\overline{CEAB}$, $\overline{CEBA}$ to CLKAB, CLKBA	2.0	—	2.0	—	ns	4
t_W	Pulse Width HIGH or LOW CLKAB or CLKBA[19]	3.0	—	3.0	—	ns	5
$t_{SK(O)}$	Output Skew[20]	—	0.5	—	0.5	ns	—

Ordering Information CY74FCT163952

Speed (ns)	Ordering Code	Package Name	Package Type	Operating Range
6.3	CY74FCT163952CPAC	Z56	56-Lead (240-Mil) TSSOP	Commercial
	CY74FCT163952CPVC	O56	56-Lead (300-Mil) SSOP	
10.0	CY74FCT163952APAC	Z56	56-Lead (240-Mil) TSSOP	Commercial
	CY74FCT163952APVC	O56	56-Lead (300-Mil) SSOP	

Ordering Information CY74FCT163H952

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6.3	CY74FCT163H952CPAC	Z56	56-Lead (240-Mil) TSSOP	Commercial
	CY74FCT163H952CPVC	O56	56-Lead (300-Mil) SSOP	
10.0	CY74FCT163H952APAC	Z56	56-Lead (240-Mil) TSSOP	Commercial
	CY74FCT163H952APVC	O56	56-Lead (300-Mil) SSOP	

Notes:
16. Minimum limits are guaranteed but not tested on Propagation Delays.
17. For V_{CC} =2.7, propagation delay, output enable and output disable times should be degraded by 20%
18. See "Parameter Measurement Information" in the General Information section.
19. This parameter is guaranteed but not tested.
20. Skew between any two outputs of the same package switching in the same direction. This parameter is guaranteed by design.

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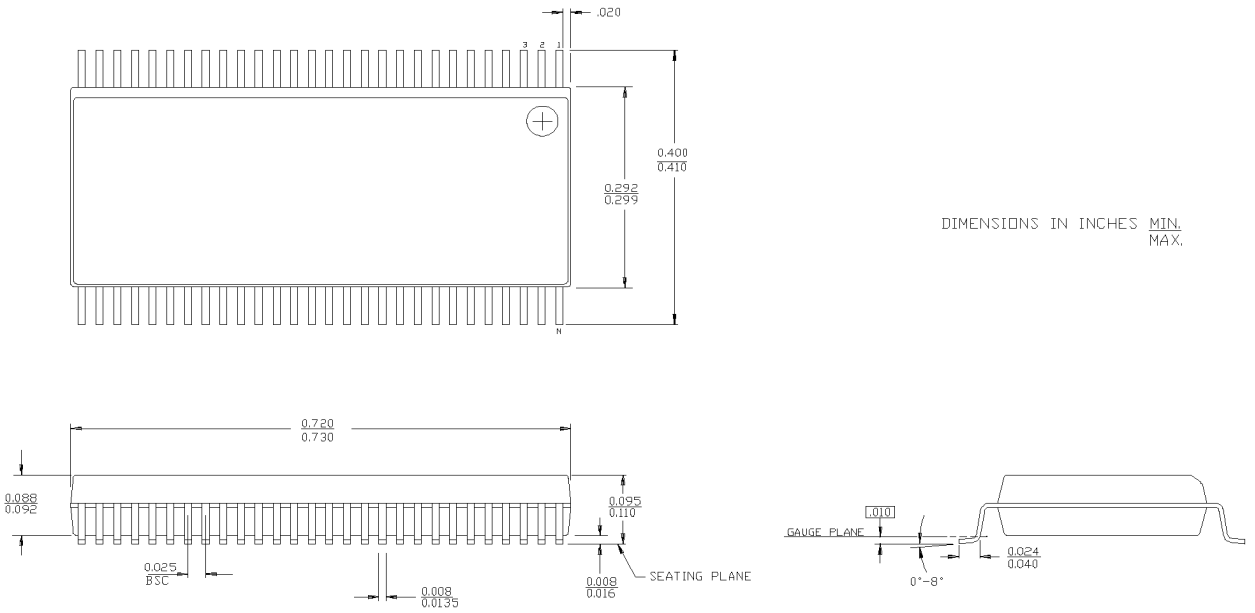
Package Diagrams

56-Lead Shrunk Small Outline Package O56



56-Lead Thin Shrunk Small Outline Package Z56