CY74FCT163646

16-Bit Registered Transceiver

Features

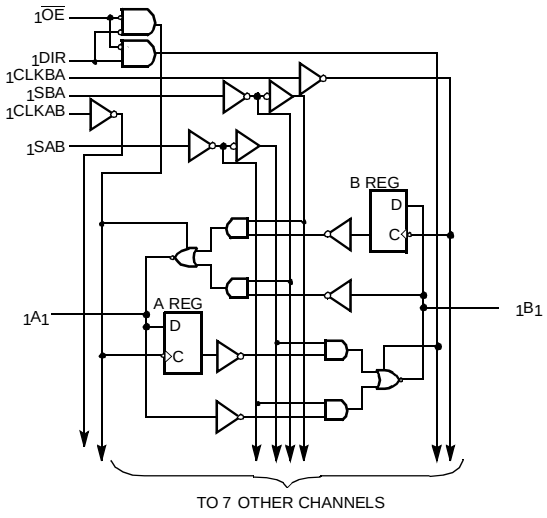
- **5V tolerant Inputs and Outputs**
- **24 mA balanced drive outputs**
- **Low power, pin-compatible replacement for LCX, LPT, LVC, LVCH & LVT families**
- **FCT-C speed at 5.4 ns**
- **Power-off disable outputs permits live insertion**
- **Edge-rate control circuitry for significantly improved noise characteristics**
- **Typical output skew < 250 ps**
- **ESD > 2000V**
- **TSSOP (19.6-mil pitch) and SSOP (25-mil pitch) packages**
- **Extended commercial temperature 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**

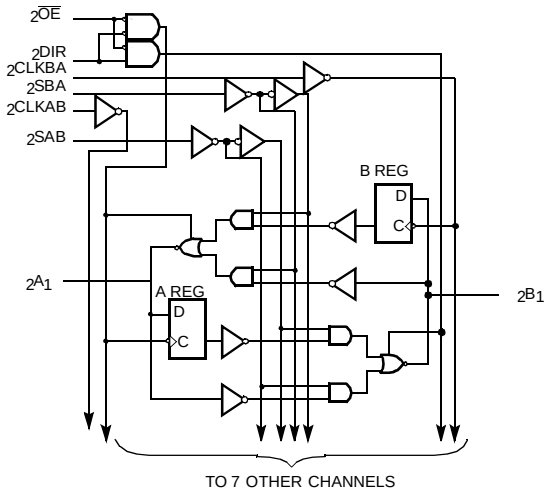
Functional Description

The CY74FCT163646 16-bit transceiver is a three-state, D-type register, and control circuitry arranged for multiplexed transmission of data directly from the input bus or from the internal registers. Data on the A or B bus will be clocked into the registers as the appropriate clock pin goes to a HIGH logic level. Output Enable ($\overline{OE}$) and direction pins (DIR) are provided to control the transceiver function. In the transceiver mode, data present at the high impedance port may be stored in either the A or B register, or in both. The select controls can multiplex stored and real-time (transparent mode) data. The direction control determines which bus will receive data when the Output Enable ($\overline{OE}$) is Active LOW. In the isolation mode (Output Enable ($\overline{OE}$) HIGH), A data may be stored in the B register and/or B data may be stored in the A register.

The CY74FCT163646 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 inputs and outputs were designed to be capable of being driven by 5.0 V busses, 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.

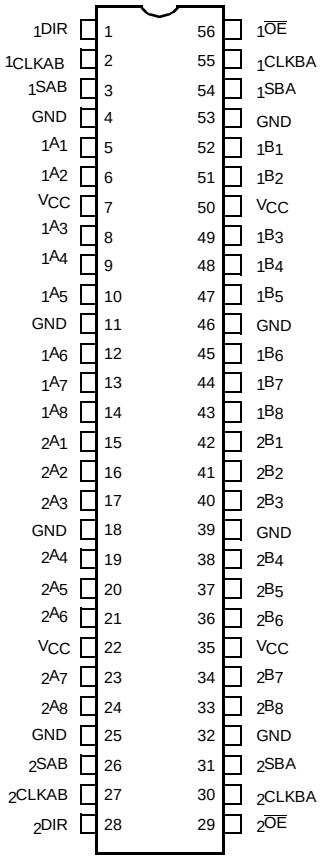
Logic Block Diagrams





Pin Configuration

SSOP/TSSOP
Top View



Pin Description

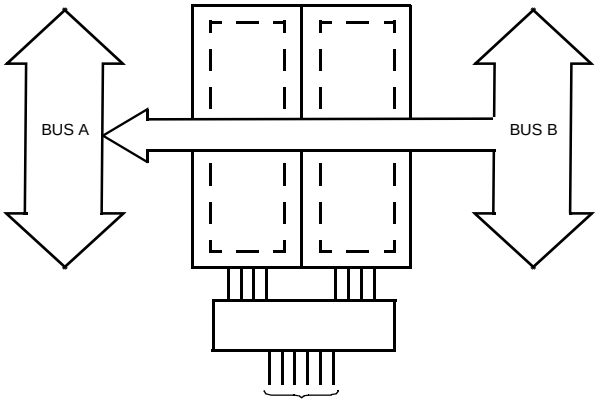
Pin Names	Description
A	Data Register A Inputs Data Register B Outputs
B	Data Register B Inputs Data Register A Outputs
CLKAB, CLKBA	Clock Pulse Inputs
SAB, SBA	Output Data Source Select Inputs
DIR	Direction
$\overline{OE}$	Output Enable (Active LOW)

Function Table[1]

Inputs						Data I/O[2]		Function
$\overline{OE}$	DIR	CLKAB	CLKBA	SAB	SBA	A	B	
H H	X X	H or L ↓	H or L ↓	X X	X X	Input	Input	Isolation Store A and B Data
L L	L L	X X	X H or L	X X	L H	Output	Input	Real Time B Data to A Bus Stored B Data to A Bus
L L	H H	X H or L	X X	L H	X X	Input	Output	Real Time A Data to Bus Stored A Data to B Bus

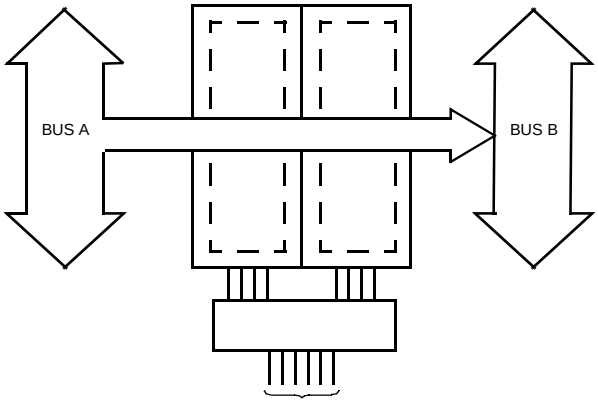
Notes:

1. H = HIGH Voltage Level, L = LOW Voltage Level, X = Don't Care, ↓ = LOW-to-HIGH Transition
2. The data output functions may be enabled or disabled by various signals at the $\overline{OE}$ or DIR inputs. Data input functions are always enabled, i.e., data at the bus pins will be stored on every LOW-to-HIGH transition on the clock inputs.



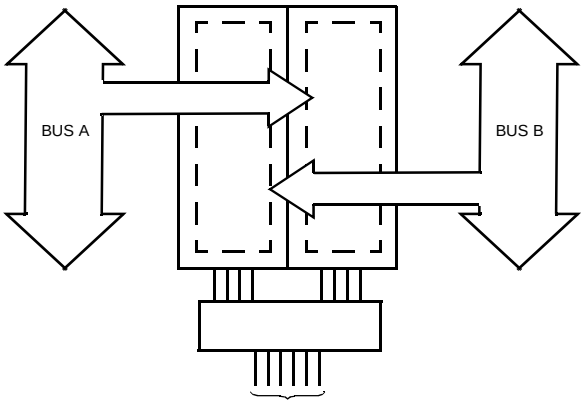
DIR	$\overline{OE}$	CLKAB	CLKBA	SAB	SBA
L	L	X	X	X	L

Real-Time Transfer
Bus B to Bus A



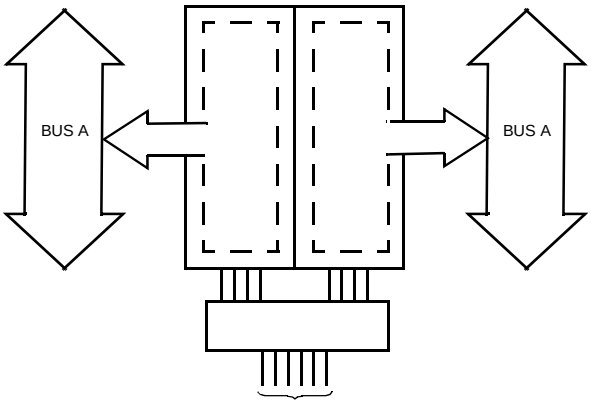
DIR	$\overline{OE}$	CLKAB	CLKBA	SAB	SBA
H	L	X	X	L	X

Real-Time Transfer
Bus A to Bus B



DIR	$\overline{OE}$	CLKAB	CLKBA	SAB	SBA
H	L	⌐	X	X	X
L	L	X	⌐	X	X
X	H	⌐	⌐	X	X

Storage from
A and/or B



DIR[3]	$\overline{OE}$	CLKAB	CLKBA	SAB	SBA
L	L	X	H or L	X	H
H	L	H or L	X	H	X

Transfer Stored Data
to A and/or B

Maximum Ratings[4]

(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)

Range	Ambient Temperature	V_{CC}
Commercial	– 40°C to +85°C	2.7V to 3.6V

Notes:

3. Cannot transfer data to A-bus and B-bus simultaneously.
4. Stresses greater than those listed under Maximum Ratings may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

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

Parameter	Description	Test Conditions	Min.	Typ.[5]	Max.	Unit
V_{IH}	Input HIGH Voltage	All Inputs	2.0		5.5	V
V_{IL}	Input LOW Voltage				0.8	V
V_H	Input Hysteresis[6]			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	V_{CC}=Max., V_I=5.5V			±1	µA
I_{IL}	Input LOW Current	V_{CC}=Max., V_I=GND			±1	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[7]	V_{CC}=3.3V, V_{IN}=V_{IH} or V_{IL}, V_{OUT}=1.5V	50	90	200	mA
I_{ODH}	Output HIGH Current[7]	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}=3.0V, I_{OH}= –8 mA	2.4[8]	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[7]	V_{CC}=Max., V_{OUT}=GND	–60	–135	–240	mA
I_{OFF}	Power-Off Disable	V_{CC}=0V, V_{OUT}≤4.5V			±100	µA

Capacitance[5] (T_A = +25°C, f = 1.0 MHz)

Symbol	Description[9]	Conditions	Typ.	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

Notes:

5. Typical values are at V_{CC}=3.3V, T_A=+25°C ambient.
6. This parameter is guaranteed but not tested.
7. 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 parametrics tests. In any sequence of parameter tests, I_{OS} tests should be performed last.
8. V_{OH}=V_{CC}–0.6 V at rated current.
9. This parameter is measured at characterization but not tested.

Power Supply Characteristics

Parame-ter	Description	Test Conditions		Typ.[5]	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.	$V_{IN}=V_{CC}-0.6V$[10]	2.0	30	µA
I_{CCD}	Dynamic Power Supply Current[11]	V_{CC}=Max., Outputs Open DIR=OE=GND One-Bit Toggling 50% Duty Cycle	$V_{IN}=V_{CC}$ or V_{IN}=GND	50	75	µA/MHz
I_C	Total Power Supply Current[12]	V_{CC}=Max.,Outputs Open f_0=10 MHz (CLKBA) 50% Duty Cycle DIR=$\overline{OE}$=GND One-Bit Toggling, f_1=5 MHz, 50% Duty Cycle	$V_{IN}=V_{CC}$ 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., Outputs Open f_0=10 MHz (CLKBA) 50% Duty Cycle DIR=$\overline{OE}$=GND Sixteen-Bits Toggling f_1=2.5 MHz 50% Duty Cycle	$V_{IN}=V_{CC}$ or V_{IN}=GND	2.5	3.8[13]	
			$V_{IN}=V_{CC}-0.6V$ or V_{IN}=GND	2.6	4.1[13]	

Notes:

10. Per TTL driven input); 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. $I_C = I_{QUIESCENT} + I_{INPUTS} + I_{DYNAMIC}$
    $I_C = I_{CC}+\Delta I_{CC}D_H N_T+I_{CCD}(f_0N_C/2 + f_1N_1)$
    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.
13. 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[14,15]

Parameter	Description	CY74FCT163646A		CY74FCT163646C		Unit	Fig. No.[16]
		Min.	Max.	Min.	Max.		
t_{PLH} t_{PHL}	Propagation Delay Bus to Bus	1.5	6.3	1.5	5.4	ns	1, 2
t_{PZH} t_{PZL}	Output Enable Time DIR or $\overline{OE}$ to Bus	1.5	9.8	1.5	7.8	ns	1, 7, 8
t_{PHZ} t_{PLZ}	Output Disable Time DIR or $\overline{OE}$ to Bus	1.5	6.3	1.5	6.3	ns	1, 7, 8
t_{PLH} t_{PHL}	Propagation Delay Clock to Bus	1.5	6.3	1.5	5.7	ns	1, 5
t_{PLH} t_{PHL}	Propagation Delay SBA or SAB to Bus	1.5	7.7	1.5	6.2	ns	1,5
t_{SU}	Set-Up Time HIGH or LOW Bus to Clock	2.0	—	2.0	—	ns	4
t_H	Hold Time HIGH or LOW Bus to Clock	1.5	—	1.5	—	ns	4
t_W	Clock Pulse Width HIGH or LOW	5.0	—	5.0	—	ns	6
$t_{SK(O)}$	Output Skew[17]	—	0.5	—	0.5	ns	—

Ordering Information CY74FCT163646

Speed (ns)	Ordering Code	Package Name	Package Type	Operating Range
5.4	CY74FCT163646CPAC	Z56	56-Lead (240-Mil) TSSOP	Commercial
	CY74FCT163646CPVC	O56	56-Lead (300-Mil) SSOP	
6.3	CY74FCT163646APAC	Z56	56-Lead (240-Mil) TSSOP	Commercial
	CY74FCT163646APVC	O56	56-Lead (300-Mil) SSOP	

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

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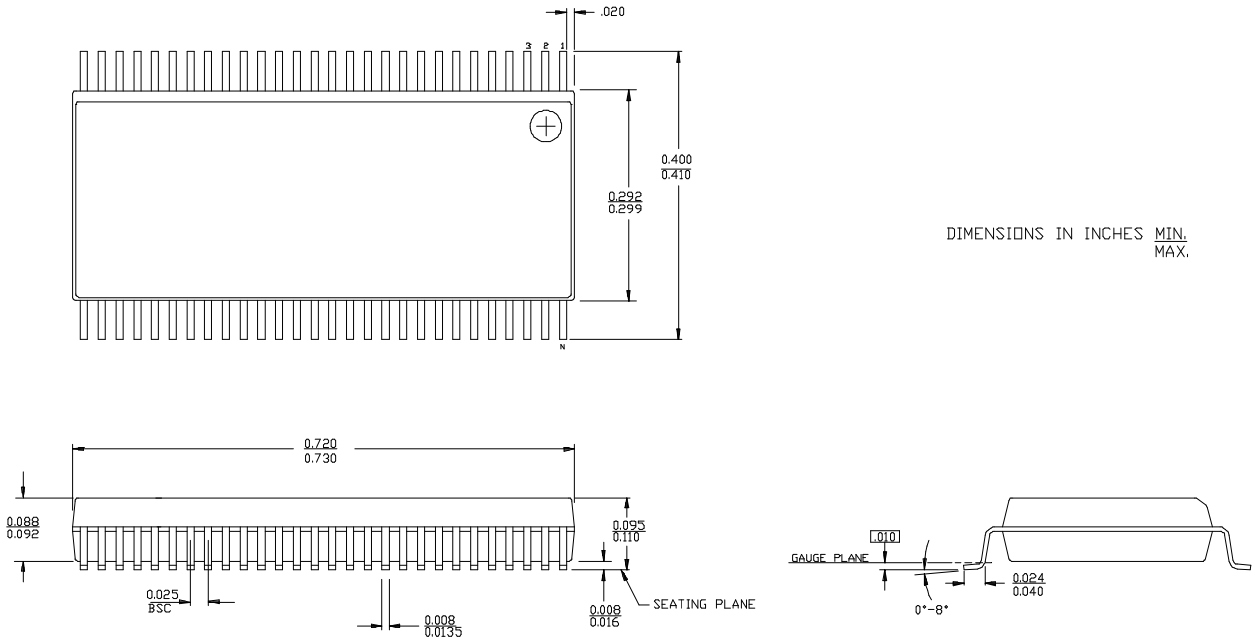
Package Diagrams

56-Lead Shrunk Small Outline Package O56



56-Lead Thin Shrunk Small Outline Package Z56