FAIRCHILD SEMICONDUCTOR™

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74VCX162374
Low Voltage 16-Bit D-Type Flip-Flop with 3.6V Tolerant Inputs and Outputs and 26Ω Series Resistors in Outputs

General Description

The VCX162374 contains sixteen non-inverting D-type flip-flops with 3-STATE outputs and is intended for bus oriented applications. The device is byte controlled. A buffered clock (CP) and output enable ($\overline{OE}$) are common to each byte and can be shorted together for full 16-bit operation.

The VCX162374 is also designed with 26Ω series resistors in the outputs. This design reduces line noise in applications such as memory address drivers, clock drivers and bus transceivers/transmitters.

The 74VCX162374 is designed for low voltage (1.4V to 3.6V) V_{CC} applications with I/O compatibility up to 3.6V.

The 74VCX162374 is fabricated with an advanced CMOS technology to achieve high speed operation while maintaining low CMOS power dissipation.

Features

- 1.4V–3.6V V_{CC} supply operation
- 3.6V tolerant inputs and outputs
- 26Ω series resistors in outputs
- t_{PD} (CLK to O_n)
  3.4 ns max for 3.0V to 3.6V V_{CC}
- Power-off high impedance inputs and outputs
- Supports live insertion and withdrawal (Note 1)
- Static Drive (I_{OH}/I_{OL})
  ±12 mA @ 3.0V V_{CC}
- Uses patented noise/EMI reduction circuitry
- Latch-up performance exceeds 300 mA
- ESD performance:
  Human body model > 2000V
  Machine model > 200V

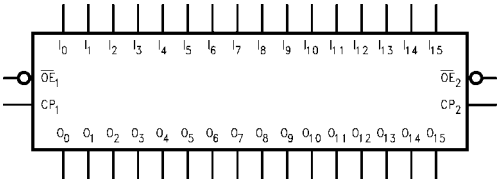
Note 1: To ensure the high-impedance state during power up or power down, $\overline{OE}$ should be tied to V_{CC} through a pull-up resistor; the minimum value of the resistor is determined by the current-sourcing capability of the driver.

Ordering Code:

Order Number	Package Number	Package Descriptions
74VCX162374MTD	MTD48	48-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 6.1mm Wide

Devices also available in Tape and Reel. Specify by appending suffix letter "X" to the ordering code.

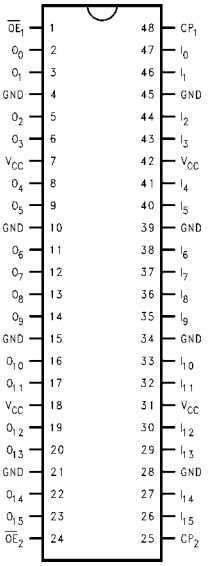
Logic Symbol



Pin Descriptions

Pin Names	Description
$\overline{OE}_n$	Output Enable Input (Active LOW)
CP_n	Clock Pulse Input
I_0–I_{15}	Inputs
O_0–O_{15}	Outputs

Connection Diagram



Truth Tables

Inputs			Outputs
CP_1	$\overline{OE}_1$	I_0–I_7	O_0–O_7
↑	L	H	H
↑	L	L	L
L	L	X	O_0
X	H	X	Z

Inputs			Outputs
CP_2	$\overline{OE}_2$	I_8–I_{15}	O_8–O_{15}
↑	L	H	H
↑	L	L	L
L	L	X	O_0
X	H	X	Z

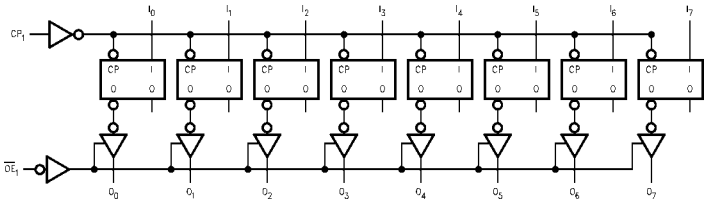
H = HIGH Voltage Level
L = LOW Voltage Level
X = Immaterial (HIGH or LOW, inputs may not float)
Z = High Impedance
O_0 = Previous O_0 before HIGH-to-LOW of CP

Functional Description

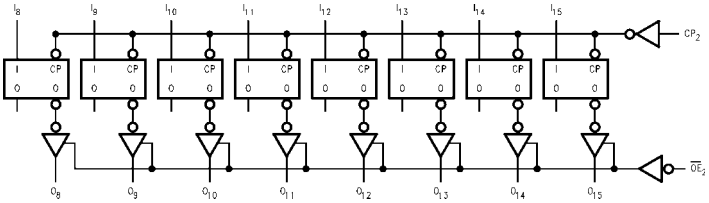
The 74VCX162374 consists of sixteen edge-triggered flip-flops with individual D-type inputs and 3-STATE true outputs. The device is byte controlled with each byte functioning identically, but independent of the other. The control pins can be shorted together to obtain full 16-bit operation. Each clock has a buffered clock and buffered Output Enable common to all flip-flops within that byte. The description which follows applies to each byte. Each flip-flop will store the state of their individual I inputs that meet the setup and hold time requirements on the LOW-to-HIGH Clock (CP_n) transition. With the Output Enable ($\overline{OE}_n$) LOW, the contents of the flip-flops are available at the outputs. When $\overline{OE}_n$ is HIGH, the outputs go to the high impedance state. Operations of the $\overline{OE}_n$ input does not affect the state of the flip-flops.

Logic Diagram

Byte 1 (0:7)



Byte 2 (8:15)



Please note that this diagram is provided only for the understanding of logic operations and should not be used to estimate propagation delays.

Absolute Maximum Ratings (Note 2)

Supply Voltage (V_{CC})	−0.5V to +4.6V
DC Input Voltage (V_I)	−0.5V to +4.6V
Output Voltage (V_O)	
Outputs 3-STATED	−0.5V to +4.6V
Outputs Active (Note 3)	−0.5V to V_{CC} +0.5V
DC Input Diode Current (I_{IK}) V_I < 0V	−50 mA
DC Output Diode Current (I_{OK})	
V_O < 0V	−50 mA
V_O > V_{CC}	+50 mA
DC Output Source/Sink Current (I_{OH}/I_{OL})	±50 mA
DC V_{CC} or GND Current per Supply Pin (I_{CC} or GND)	±100 mA
Storage Temperature Range (T_{STG})	−65°C to +150°C

Recommended Operating Conditions (Note 4)

Power Supply	
Operating	1.4V to 3.6V
Input Voltage	−0.3V to +3.6V
Output Voltage (V_O)	
Output in Active States	0V to V_{CC}
Output in "OFF" State	0.0V to 3.6V
Output Current in I_{OH}/I_{OL}	
V_{CC} = 3.0V to 3.6V	±12 mA
V_{CC} = 2.3V to 2.7V	±8 mA
V_{CC} = 1.65V to 2.3V	±3 mA
V_{CC} = 1.4V to 1.6V	±1 mA
Free Air Operating Temperature (T_A)	−40°C to +85°C
Minimum Input Edge Rate ($\Delta t/\Delta V$)	
V_{IN} = 0.8V to 2.0V, V_{CC} = 3.0V	10 ns/V

Note 2: The Absolute Maximum Ratings are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the Electrical Characteristics tables are not guaranteed at the Absolute Maximum Ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

Note 3: I_O Absolute Maximum Rating must be observed.

Note 4: Floating or unused inputs must be held HIGH or LOW.

DC Electrical Characteristics

Symbol	Parameter	Conditions	V_{CC} (V)	Min	Max	Units
V_{IH}	HIGH Level Input Voltage		2.7 - 3.6	2.0		V
			2.3 - 2.7	1.6		
			1.65 - 2.3	0.65 x V_{CC}		
			1.4 - 1.6	0.65 x V_{CC}		
V_{IL}	LOW Level Input Voltage		2.7 - 3.6		0.8	V
			2.3 - 2.7		0.7	
			1.65 - 2.3		0.35 x V_{CC}	
			1.4 - 1.6		0.35 x V_{CC}	
V_{OH}	HIGH Level Output Voltage	I_{OH} = −100 μA	2.7 - 3.6	V_{CC} - 0.2		V
		I_{OH} = −6 mA	2.7	2.2		
		I_{OH} = −8 mA	3.0	2.4		
		I_{OH} = −12 mA	3.0	2.2		
		I_{OH} = −100 μA	2.3 - 2.7	V_{CC} - 0.2		
		I_{OH} = −4 mA	2.3	2.0		
		I_{OH} = −6 mA	2.3	1.8		
		I_{OH} = −8 mA	2.3	1.7		
		I_{OH} = −100 μA	1.65 - 2.3	V_{CC} - 0.2		
		I_{OH} = −3 mA	1.65	1.25		
		I_{OH} = −100 μA	1.4 - 1.6	V_{CC} - 0.2		
		I_{OH} = −1 mA	1.4	1.05		

DC Electrical Characteristics (Continued)

Symbol	Parameter	Conditions	V_{CC} (V)	Min	Max	Units
V_{OL}	LOW Level Output Voltage	I_{OL} = 100 μA	2.7 - 3.6		0.2	V
		I_{OL} = 6 mA	2.7		0.4	
		I_{OL} = 8 mA	3.0		0.55	
		I_{OL} = 12 mA	3.0		0.8	
		I_{OL} = 100 μA	2.3 - 2.7		0.2	
		I_{OL} = 6 mA	2.3		0.4	
		I_{OL} = 8 mA	2.3		0.6	
		I_{OL} = 100 μA	1.65 - 2.3		0.2	
		I_{OL} = 3 mA	1.65		0.3	
		I_{OL} = 100 μA	1.4 - 1.6		0.2	
		I_{OL} = 1 mA	1.4		0.35	
I_I	Input Leakage Current	0 ≤ V_I ≤ 3.6V	1.4 - 3.6		±5.0	μA
I_{OZ}	3-STATE Output Leakage	0 ≤ V_O ≤ 3.6V, V_I = V_{IH} or V_{IL}	1.4 - 3.6		±10.0	μA
I_{OFF}	Power-OFF Leakage Current	0 ≤ (V_I, V_O) ≤ 3.6V	0		10.0	μA
I_{CC}	Quiescent Supply Current	V_I = V_{CC} or GND	1.4 - 3.6		20.0	μA
		V_{CC} ≤ (V_I, V_O) ≤ 3.6V (Note 5)	1.4 - 3.6		±20.0	
ΔI_{CC}	Increase in I_{CC} per Input	V_{IH} = V_{CC} − 0.6V	2.7 - 3.6		750	μA

Note 5: Outputs disabled or 3-STATE only.

AC Electrical Characteristics (Note 6)

Symbol	Parameter	Conditions	V_{CC} (V)	T_A = −40°C to +85°C		Units	Figure Number
				Min	Max		
f_{MAX}	Maximum Clock Frequency	C_L = 30 pF, R_L = 500Ω	3.3 ± 0.3	250		ns	
			2.5 ± 0.2	200			
			1.8 ± 0.15	100			
		C_L = 15 pF, R_L = 2kΩ	1.5 ± 0.1	80			
t_{PHL} t_{PLH}	Propagation Delay CP_n to O_n	C_L = 30 pF, R_L = 500Ω	3.3 ± 0.3	0.8	3.4	ns	Figures 1, 2
			2.5 ± 0.2	1.0	4.8		
			1.8 ± 0.15	1.5	9.6		
		C_L = 15 pF, R_L = 2kΩ	1.5 ± 0.1	1.0	19.2		Figures 7, 8
t_{PZL} t_{PZH}	Output Enable Time	C_L = 30 pF, R_L = 500Ω	3.3 ± 0.3	0.8	3.9	ns	Figures 1, 3, 4
			2.5 ± 0.2	1.0	5.4		
			1.8 ± 0.15	1.5	9.8		
		C_L = 15 pF, R_L = 2kΩ	1.5 ± 0.1	1.0	19.6		Figures 7, 9, 10
t_{PLZ} t_{PHZ}	Output Disable Time	C_L = 30 pF, R_L = 500Ω	3.3 ± 0.3	0.8	4.0	ns	Figures 1, 3, 4
			2.5 ± 0.2	1.0	4.4		
			1.8 ± 0.15	1.5	7.9		
		C_L = 15 pF, R_L = 2kΩ	1.5 ± 0.1	1.0	15.8		Figures 7, 9, 10
t_S	Setup Time	C_L = 30 pF, R_L = 500Ω	3.3 ± 0.3	1.5		ns	Figures 1, 6
			2.5 ± 0.2	1.5			
			1.8 ± 0.15	2.5			
		C_L = 15 pF, R_L = 2kΩ	1.5 ± 0.1	3.0			Figures 6, 7
t_H	Hold Time	C_L = 30 pF, R_L = 500Ω	3.3 ± 0.3	1.0		ns	Figures 1, 6
			2.5 ± 0.2	1.0			
			1.8 ± 0.15	1.0			
		C_L = 15 pF, R_L = 2kΩ	1.5 ± 0.1	2.0			Figures 6, 7

AC Electrical Characteristics (Continued)

Symbol	Parameter	Conditions	V_{CC} (V)	$T_A = -40°C$ to $+85°C$		Units	Figure Number
				Min	Max		
t_W	Pulse Width	C_L = 30 pF, R_L = 500Ω	3.3 ± 0.3	1.5		ns	Figures 1, 5
			2.5 ± 0.2	1.5			
			1.8 ± 0.15	4.0			
		C_L = 15 pF, R_L = 2kΩ	1.5 ± 0.1	4.0			Figures 5, 7
t_{OSHL}	Output to Output Skew	C_L = 30 pF, R_L = 500Ω	3.3 ± 0.3		0.5	ns	
t_{OSLH}	(Note 7)		2.5 ± 0.2		0.5		
			1.8 ± 0.15		0.75		
		C_L = 15 pF, R_L = 2kΩ	1.5 ± 0.1		1.5		

Note 6: For $C_L = 50_P$F, add approximately 300 ps to the AC maximum specification.

Note 7: Skew is defined as the absolute value of the difference between the actual propagation delay for any two separate outputs of the same device. The specification applies to any outputs switching in the same direction, either HIGH-to-LOW (t_{OSHL}) or LOW-to-HIGH (t_{OSLH}).

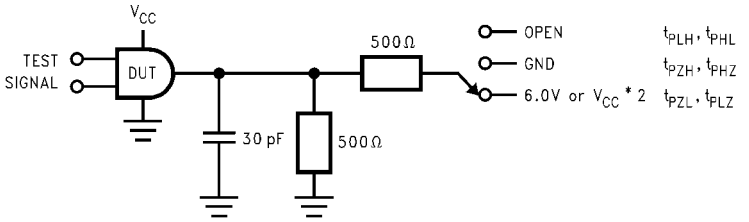
Dynamic Switching Characteristics

Symbol	Parameter	Conditions	V_{CC} (V)	$T_A = +25°C$ Typical	Units
V_{OLP}	Quiet Output Dynamic Peak V_{OL}	C_L = 30 pF, $V_{IH} = V_{CC}$, V_{IL} = 0V	1.8	0.15	V
			2.5	0.25	
			3.3	0.35	
V_{OLV}	Quiet Output Dynamic Valley V_{OL}	C_L = 30 pF, $V_{IH} = V_{CC}$, V_{IL} = 0V	1.8	−0.15	V
			2.5	−0.25	
			3.3	−0.35	
V_{OHV}	Quiet Output Dynamic Valley V_{OH}	C_L = 30 pF, $V_{IH} = V_{CC}$, V_{IL} = 0V	1.8	1.55	V
			2.5	2.05	
			3.3	2.65	

Capacitance

Symbol	Parameter	Conditions	$T_A = +25°C$ Typical	Units
C_{IN}	Input Capacitance	V_{CC} = 1.8V, 2.5V or 3.3V, V_I = 0V or V_{CC}	6.0	pF
C_{OUT}	Output Capacitance	V_I = 0V or V_{CC}, V_{CC} = 1.8V, 2.5V or 3.3V	7.0	pF
C_{PD}	Power Dissipation Capacitance	V_I = 0V or V_{CC}, f = 10 MHz, V_{CC} = 1.8V, 2.5V or 3.3V	20.0	pF

AC Loading and Waveforms (V_{CC} 3.3V ± 0.3V to 1.8V ± 0.15V)



TEST	SWITCH
t_{PLH}, t_{PHL}	Open
t_{PZL}, t_{PLZ}	6V at V_{CC} = 3.3 ± 0.3V; V_{CC} x 2 at V_{CC} = 2.5 ± 0.2V; 1.8V ± 0.15V
t_{PZH}, t_{PHZ}	GND

FIGURE 1. AC Test Circuit

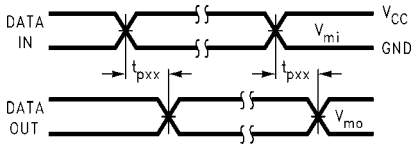


FIGURE 2. Waveform for Inverting and Non-Inverting Functions

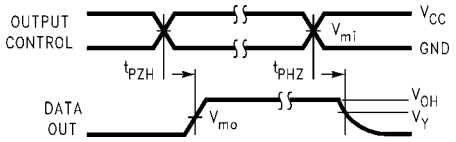


FIGURE 3. 3-STATE Output High Enable and Disable Times for Low Voltage Logic

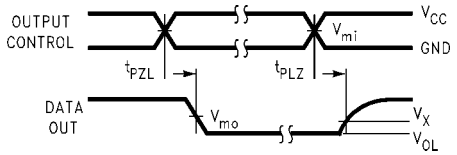


FIGURE 4. 3-STATE Output Low Enable and Disable Times for Low Voltage Logic

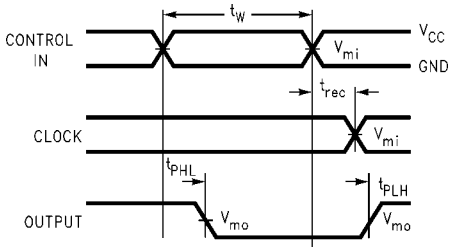


FIGURE 5. Propagation Delay, Pulse Width and t_{REC} Waveforms

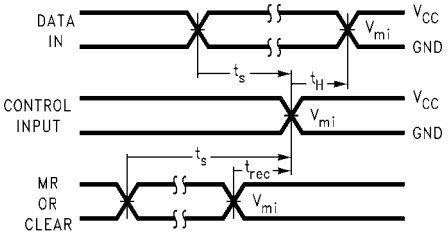
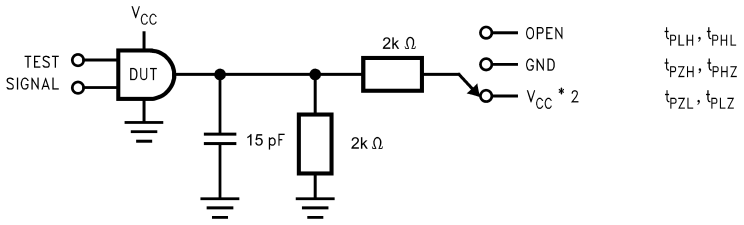


FIGURE 6. Setup Time, Hold Time and Recovery Time for Low Voltage Logic

Symbol	V_{CC}		
	3.3V ± 0.3V	**2.5V ± 0.2V**	**1.8V ± 0.15V**
V_{mi}	1.5V	V_{CC}/2	V_{CC}/2
V_{mo}	1.5V	V_{CC}/2	V_{CC}/2
V_X	V_{OL} +0.3V	V_{OL} +0.15V	V_{OL} +0.15V
V_Y	V_{OH} −0.3V	V_{OH} −0.15V	V_{OH} −0.15V

AC Loading and Waveforms (V_{CC} 1.5V ± 0.1V)



TEST	SWITCH
t_{PLH}, t_{PHL}	Open
t_{PZL}, t_{PLZ}	V_{CC} x 2 at V_{CC} = 1.5 ± 0.1V
t_{PZH}, t_{PHZ}	GND

FIGURE 7. AC Test Circuit

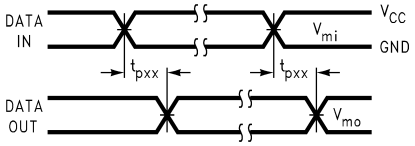


FIGURE 8. Waveform for Inverting and Non-Inverting Functions

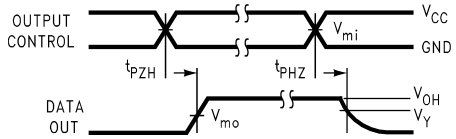


FIGURE 9. 3-STATE Output High Enable and Disable Times for Low Voltage Logic

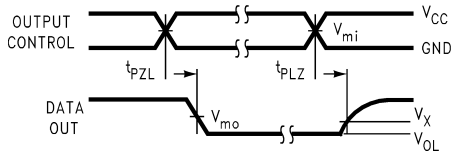
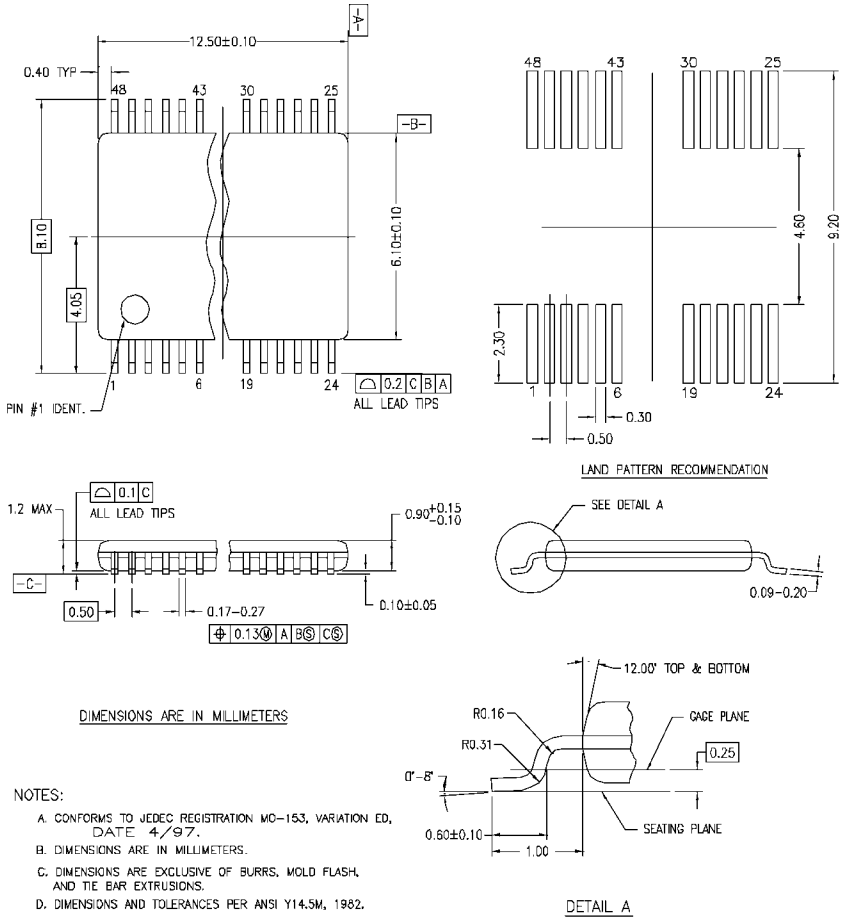


FIGURE 10. 3-STATE Output Low Enable and Disable Times for Low Voltage Logic

Symbol	V_{CC}
	1.5V ± 0.1V
V_{mi}	$V_{CC}/2$
V_{mo}	$V_{CC}/2$
V_X	V_{OL} +0.1V
V_Y	V_{OH} −0.1V

Physical Dimensions inches (millimeters) unless otherwise noted



48-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 6.1mm Wide
Package Number MTD48