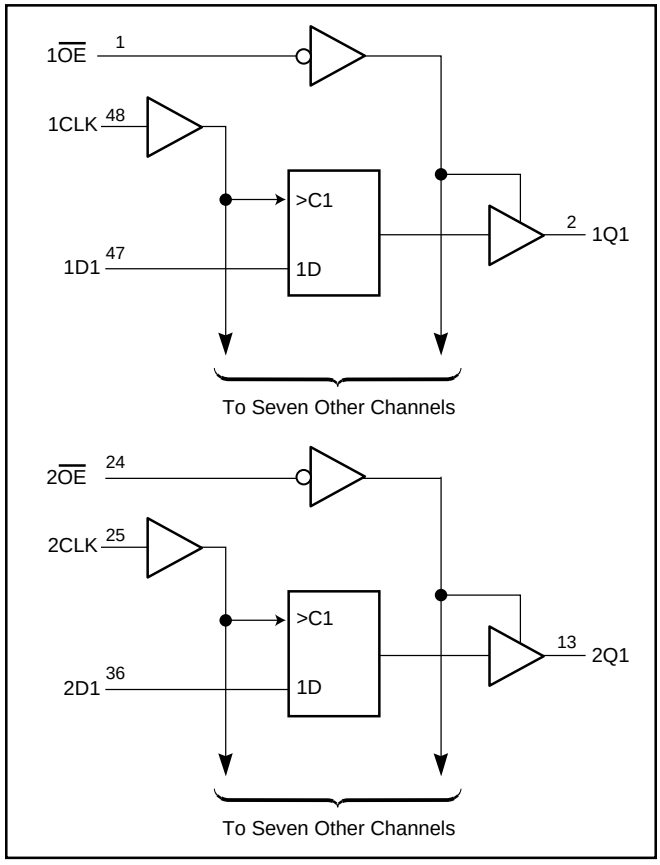
PI74ALVTC16374

16-Bit D-Type Flip-Flop with 3-STATE Outputs

Product Features

- The PI74ALVTC Family is designed for low voltage operation, V_{DD} = 1.8V to 3.6V
- Supports Live Insertion
- 3.6V I/O Tolerant Inputs and Outputs
- Bus Hold
- High Drive, –32/64mA @ 3.3V
- Uses patented Noise Reduction Circuitry
- Power-Off high impedance inputs and outputs
- Industrial operation at –40°C to +85°C
- Packages available:
  - 48-pin 240 mil wide plastic TSSOP (A)
  - 48-pin 173 mil wide plastic SSOP (V)
  - 48-pin 300 mil wide plastic TVSOP (K)

Logic Block Diagram



Product Description

Pericom Semiconductor's PI74ALVTC series of logic circuits are produced in the Company's advanced 0.35 micron CMOS technology, achieving industry leading speed.

The PI74ALVTC16374 is particularly suitable for implementing buffer registers, I/O ports, bidirectional bus drivers, and working registers. This device can be used as two 8-bit Flip-Flops or one 16-bit flip-flop. On the positive transition of the clock (CLK) input, the Q outputs of the flip-flop take on the logic levels set up at the data (D) inputs.

A buffered Output Enable ($\overline{OE}$) input can be used to place the eight outputs in either a normal logic state (high or low logic levels) or a high-impedance state in which the outputs neither load nor drive the bus lines significantly. The high-impedance state and the increased drive provide the capability to drive bus lines without need for interface or pullup components. $\overline{OE}$ does not affect internal operations of the flip-flop. Old data can be retained or new data can be entered while the outputs are in the high impedance state.

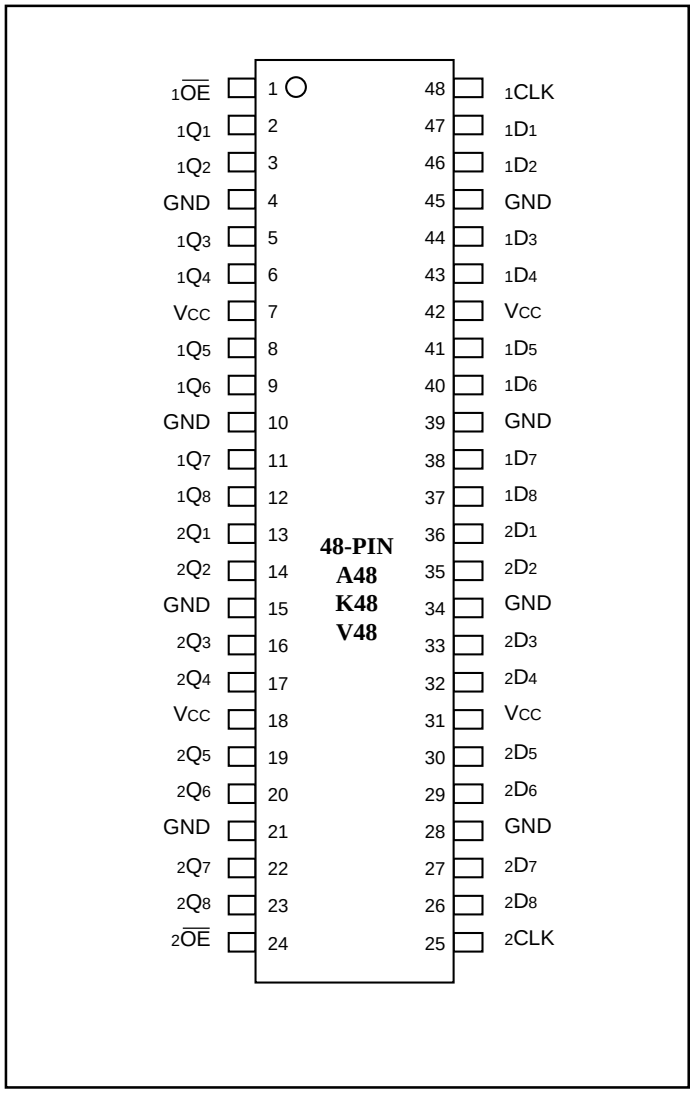
To ensure the high-impedance state during power up or power down, $\overline{OE}$ should be tied to Vdd through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

The family offers both I/O Tolerant, which allows it to operate in mixed 1.8/3.6V systems, and "Bus Hold," which retains the data input's last state whenever the data input goes to high-impedance, preventing "floating" inputs and eliminating the need for pullup/down resistors.

Product Pin Description

Pin Name	Description
$\overline{OE}$	Output Enable Input (Active LOW)
CLK	Clock Input
Dx	Data Inputs
Qx	3-State Outputs
GND	Ground
VCC	Power

Product Pin Configuration



Truth Table[1]

Inputs			Outputs
$\overline{OE}$	CLK	D	Q
L	↑	H	H
L	↑	L	L
L	H or L	X	Q_0
H	X	X	Z

Notes:

1. H = High Signal Level
   L = Low Signal Level
   X = Don't Care or Irrelevant
   Z = High Impedance

Maximum Ratings

(Above which the useful life may be impaired. For user guidelines, not tested.)

Supply Voltage Range, V_{DD} ..... –0.5V to 4.6V
Input Voltage Range, V_I ..... -0.5V to 4.6V
Output Voltage Range, V_O (3-Stated) ..... -0.5V to 4.6V
Output Voltage Range, V_O[1] (Active) ..... –0.5V to V_{DD} +0.5V
DC Input Diode Current (I_{IK}) V_I<0V ..... -50mA
DC Output Diode Current (I_{OK})
V_O<0V ..... -50mA
V_O>V_{DD} ..... ±50mA
DC V_{DD} or GND Current per Supply Pin (I_{CC} or GND) ..... ±100mA
Storage Temperature Range, T_{stg} .....–65°C to150°C

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.

Recommended Operating Conditions[2]

			Min.	Max.	Units
V_{DD}	Supply voltage	Operating	1.8	3.6	V
		Data Retention Only	1.2	3.6	
V_{IH}	High-level input voltage	V_{DD} = 2.7V to 3.6V	2.0		
V_{IL}	Low-level input voltage	V_{DD} = 2.7V to 3.6V		0.8	
V_I	Input voltage		-0.3	3.6	
V_O	Output voltage	Active State	0	V_{DD}	
		Off State	0	3.6	
	Output current in I_{OH}/I_{OL}	V_{DD} = 3.0V to 3.6V V_{DD} = 2.7V to 3.0V V_{DD} = 2.3V to 2.7V V_{DD} = 1.8V		±32/64 ±24 ±18 ±6	mA
$\Delta t/\Delta v$	Input transistion rise or fall rate[3]		0	10	ns/V
T_A	Operating free-air temperature		–40	85	C

Notes

1. Absolute maximum of I_O must be observed.
2. Unused control inputs must be held HIGH or LOW to prevent them from floating.
3 As measured between 0.8V and 2.0V, V_{DD} = 3.0V.

Electrical Characteristics over Recommended Operating Free-Air Temperature Range

(unless otherwise noted).

DC Characteristics ($2.7V<V_{DD} \leq 3.6V$)

	Parameter	Conditions	V_{DD}	Min.	Typ.	Max.	Units
V_{IH}	HIGH Level Input Voltage		2.7 - 3.6	2.0			V
V_{IL}	LOW Level Input Voltage					0.8	
V_{OH}	HIGH Level Output Voltage	I_{OH} = –100µA		V_{DD} - 0.2			
		I_{OH} = –12mA	2.7	2.2			
		I_{OH} = –18mA	3.0	2.4			
		I_{OH} = –24mA		2.2			
		I_{OH} = –32mA		2.0			
V_{OL}	LOW Level Output Voltage	I_{OL} = 100µA	2.7 - 3.6			0.2	
		I_{OL} = 12mA	2.7			0.4	
		I_{OL} = 18mA	3.0			0.4	
		I_{OL} = 24mA				0.45	
		I_{OL} = 32mA				0.5	
		I_{OL} = 64mA				0.55	
I_I	Input Leakage Current	$V_I = V_{DD}$, or GND	3.6			±5.0	µA
I_{OZ}	3-STATE Output Leakage	V_O = 3.6V	2.7			±10	
I_{OFF}	Power-OFF Leakage Current	V_I or $V_O \leq 3.6V$	0			10	
I_{ODL}	Output Current Low	$V_{IN} = V_{IH}$ or V_{IL}, Vo = 1.5V(1)	3.6	150		334	mA
I_{ODH}	Output Current High	$V_{IN} = V_{IH}$ or V_{IL}, Vo = 1.5V(1)		-58		-114	
I_{HOLD}	Bus Hold Current A or B Outputs	V_I = 0.8V	3.0	75			µA
		V_I = 2.0V		-75			
		V_I = 0 to 3.6V	3.6			±500	
I_{DD}	Quiescent Supply Current	$V_I = V_{DD}$ or GND	2.7 - 3.6			50	
		$V_{DD} \leq (V_I, V_O) \leq 3.6V$				±50	
ΔI_{DD}	Increase in I_{DD} per input	$V_{IH} = V_{DD}$ -0.6V, Other inputs at V_{DD} or GND				400	

Notes

1. Duration of test must not exceed 1 second with only 1 output tested at a time.

Electrical Characteristics over Recommended Operating Free-Air Temperature Range

(unless otherwise noted).

DC Characteristics ($2.3V<V_{DD} \leq 2.7V$)

Description	Parameters	Conditions	V_{DD}	Min.	Typ.	Max.	Units
V_{IH}	HIGH Level Input Voltage		2.3 - 2.7	1.6			V
V_{IL}	LOW Level Input Voltage					0.7	
V_{OH}	HIGH Level Output Voltage	I_{OH} = -100µA		V_{DD} - 0.2			
		I_{OH} = -12mA	2.3	1.8			
		I_{OH} = -18mA		1.7			
V_{OL}	LOW Level Output Voltage	I_{OL} = 100µA	2.3 - 2.7			0.2	
		I_{OL} = 12mA	2.3			0.4	
		I_{OL} = 18mA				0.5	
		I_{OL} = 24mA				0.55	
I_I	Input Leakage Current	$V_I = V_{DD}$ or GND	2.7			±5.0	µA
I_{OZ}	3-STATE Output Leakage	V_O = 3.6V	2.3			±10	
I_{OFF}	Power-OFF Leakage Current	V_I or $V_O \leq 3.6V$	0			10	
I_{ODL}	Output Current Low	$V_{IN} = V_{IH}$ or V_{IL}, V_O = 1.5V(2)	2.7	110		264	mA
I_{ODH}	Output Current High	$V_{IN} = V_{IH}$ or V_{IL}, V_O = 1.5V(2)		-30		-60	
I_{HOLD}(1)	Bus Hold Current A or B Outputs	V_I = 0.7V	2.5		90		µA
		V_I = 1.7V			-90		
I_{DD}	Quiescent Supply Current	$V_I = V_{DD}$ or GND	2.3 - 2.7			40	
		$V_{DD} \leq (V_I, V_O) \leq 3.6V$				±40	
ΔI_{DD}	Increase in I_{DD} per input	$V_{IH} = V_{DD}$ -0.6V, Inputs at V_{DD} or GND				400	

Notes:

1. Not Guaranteed
2. Duration of test must not exceed 1 second with only 1 output tested at a time.

Electrical Characteristics over Recommended Operating Free-Air Temperature Range

(unless otherwise noted).

DC Characteristics ($1.8V<V_{DD} \leq 2.3V$)

Description	Parameters	Conditions	V_{DD}	Min.	Typ.	Max.	Units
V_{IH}	HIGH Level Input Voltage		1.8 - 2.3	0.7 x V_{DD}			V
V_{IL}	LOW Level Input Voltage					0.2 x V_{DD}	
V_{OH}	HIGH Level Output Voltage	I_{OH} = -100µA	1.8	V_{DD} -0.2			
		I_{OH} = -6mA		1.4			
V_{OL}	LOW Level Output Voltage	I_{OL} = 100 µA				0.2	
		I_{OL} = 6 mA				0.3	
I_I	Input Leakage Current	$V_I = V_{DD}$ or GND	2.3			±5.0	µA
I_{OZ}	3-State Output Leakage	V_O = 3.6V	1.8			±10	
I_{OFF}	Power-OFF Leakage Current	$V_I = V_O \leq 3.6V$	0			10	
I_{ODL}	Output Current Low	$V_{IN} = V_{IH}$ or V_{IL}, V_O = 0.9V(2)	1.8	50		137	mA
I_{ODH}	Output Current High	$V_{IN} = V_{IH}$ or V_{IL}, V_O = 0.9V(2)		-14		-34	
I_{HOLD}(1)	Bus Hold Current A or B Outputs	V_I = 0.4	1.8		50		µA
		V_I = 1.3			-50		
I_{DD}	Quiescent Supply Current	$V_I = V_{DD}$ or GND				20	
		$V_{DD} \leq (V_I, V_O) \leq 3.6V$				±20	
ΔI_{DD}	Increase in I_{DD} per input	$V_I = V_{DD}$ -06V, Other inputs at V_{DD} or GND				400	

Notes:

1. Not Guaranteed
2. Duration of test must not exceed 1 second with only 1 output tested at a time.

AC Electrical Characteristics

Symbol	Parameter	T_A = -40°C to +85°C, C_L = 50pF, R_L = 500Ω						Units
		V_{DD} = 3.3V ±0.3V		V_{DD} = 2.5V ±0.2V		V_{DD} = 1.8V		
		Min.	Max.	Min.	Max.	Min.	Max.	
f_{MAX}	Maximum Clock Frequency	250		250		250		MHz
t_{PLH}, t_{PHL}	Prop Delay, CLK to Q	1.0	3.2	1.5	4.2	1.5	4.8	ns
t_{PZH}, t_{PZL}	Output Enable Time	1.0	3.2	1.0	4.7	1.5	5.0	
t_{PHZ}, t_{PLZ}	Output Disable Time	1.0	3.4	1.0	3.8	1.5	4.0	
t_{OSHL}, t_{OSLH}	Output to Output Skew(1)		0.5		0.5		0.5	

Notes:

1. 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 or LOW (t_{OSHL}) or LOW to HIGH (t_{OSLH}).

AC Setup Requirements

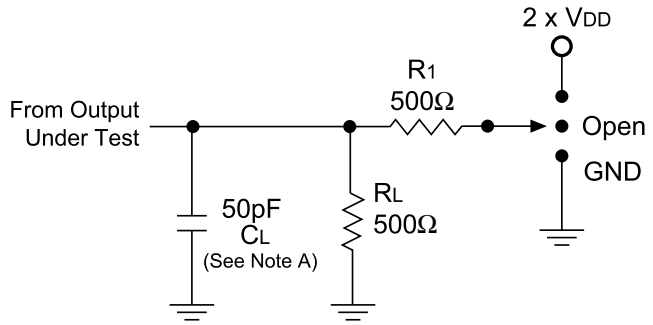
Symbol	Parameter	T_A = -40°C to +85°C, C_L = 50pF, R_L = 500Ω						
		V_{DD} =3.3V ± 0.3V		V_{DD} =2.5V ± 0.2V		V_{DD} =1.8V		
		Min.	Typ.	Min.	Typ.	Min.	Typ.	Units
t_{SU}	Setup Time	1.0		1.0		1.0		ns
t_H	Hold Time	0.5		0.5		1.0		
t_W	Pulse Width	1.5		1.5		1.5		

Capacitance

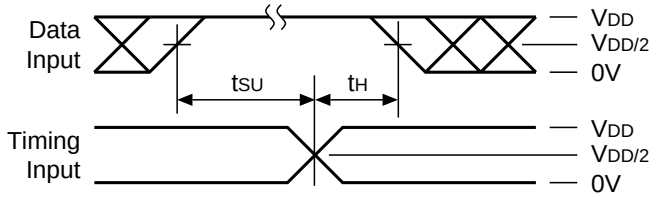
Symbol	Parameter	Conditions	T_A = +25°C Typical	Units
C_{IN}	Input Capacitance	V_{DD} = 1.8, 2.5V or 3.3V, V_I = 0V or V_{DD}	6	pF
C_{OUT}	Output Capacitance	V_I = 0V or V_{DD}, V_{DD} = 1.8V, 2.5V or 3.3V	7	
C_{PD}	Power Dissipation Capacitance	V_I = 0V or V_{DD}, F = 10 MHz V_{DD} = 1.8V, 2.5V or 3.3V	20	

Test Circuits and Switching Waveforms

Parameter Measurement Information (V_{DD} = 1.8V - 3.6V)



Setup, Hold, and Release Timing



Notes:

A. C_L includes probe and jig capacitance.

B. Waveform 1 is for an output with internal conditions such that the output is LOW except when disabled by the output control.
Waveform 2 is for an output with internal conditions such that the output is HIGH except when disabled by the output control.

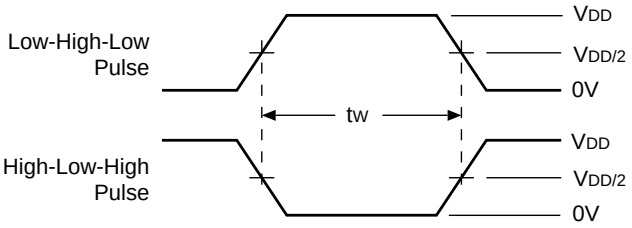
C. All input pulses are supplied by generators having the following characteristics: PRR ≤ 10 MHz, Z_O = 50Ω, t_r ≤ 2ns, t_f ≤ 2ns, ***measured from 10% to 90%, unless otherwise specified.***

D. The outputs are measured one at a time with one transition per measurement.

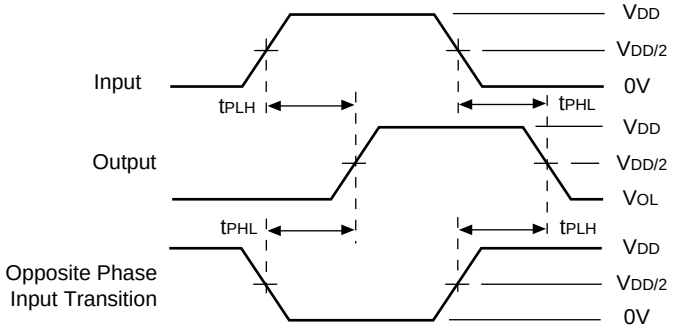
Switch Position

Test	S1
tpd	Open
t_{PLZ}/t_{PZL}	2 x V_{DD}
t_{PHZ}/t_{PZH}	GND

Pulse Width



Propagation Delay



Enable Disable Timing