# PI74ALVCH16721

## 3.3V 20-Bit Flip-Flop with 3-STATE Outputs

### Product Features

- PI74ALVCH16721 is designed for low voltage operation
- $V_{CC}$ = 2.3V to 3.6V
- Hysteresis on all inputs
- Typical $V_{OLP}$ (Output Ground Bounce) < 0.8V at $V_{CC}$ = 3.3V, $T_A$ = 25°C
- Typical $V_{OHV}$ (Output $V_{OH}$ Undershoot) < 2.0V at $V_{CC}$ = 3.3V, $T_A$ = 25°C
- Bus Hold retains last active bus state during 3-STATE, eliminating the need for external pullup resistors
- Industrial operation at –40°C to +85°C
- Packages available:
  – 56-pin 240 mil wide plastic TSSOP (A)
  – 56-pin 300 mil wide plastic SSOP (V)

### Product Description

Pericom Semiconductor's PI74ALVCH series of logic circuits are produced in the Company's advanced 0.5 micron CMOS technology, achieving industry leading speed.

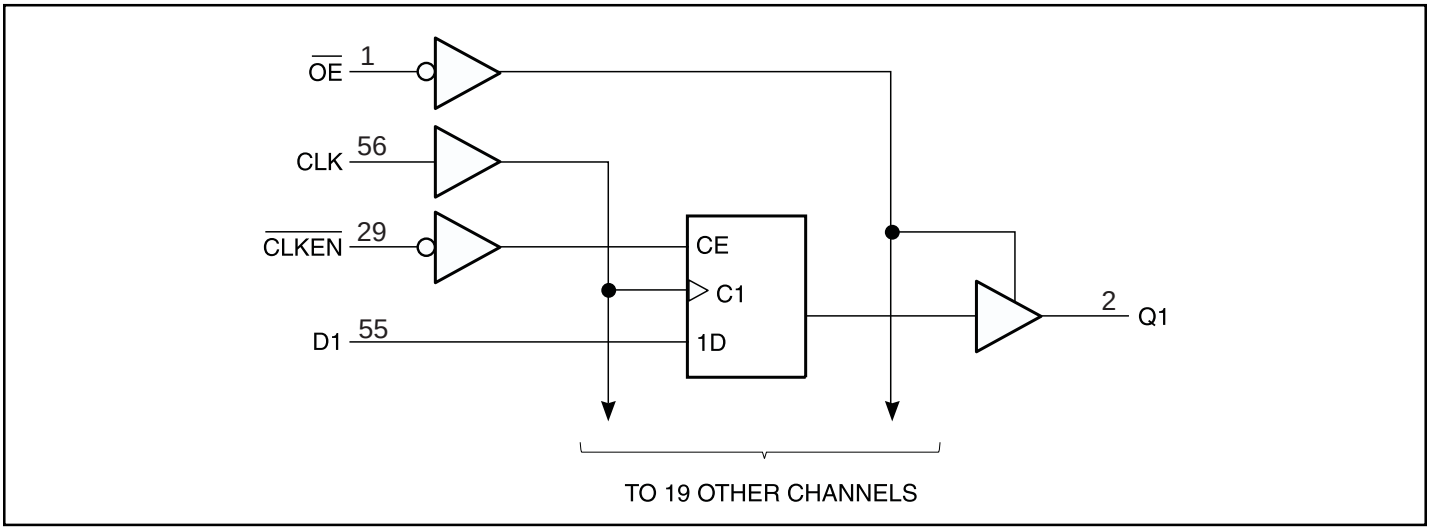
The PI74ALVCH16721 is a 20-bit flip-flop with 3-state outputs designed specifically for 2.3V to 3.6V $V_{CC}$ operation. The PI74ALVCH16721 is designed with edge-triggered D-type flip-flops with qualified clock storage. On the positive transition of clock (CLK) input, the device provides true data at the Q outputs, provided that the clock-enable ($\overline{CLKEN}$) input is LOW. If $\overline{CLKEN}$ is HIGH, no data is stored.

A buffered output-enable ($\overline{OE}$) input can be used to place the 20 outputs in either a normal logic state (HIGH or LOW level) or a high-impedance state. In the high-impedance state, the outputs neither load nor drive the bus lines significantly. The high-impedance state and increased drive provide the capacity to drive bus lines without the need for interface or pullup components. $\overline{OE}$ does not affect the internal operation of the flip-flops. 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 $V_{CC}$ through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

The PI74ALVCH16721 data has "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.

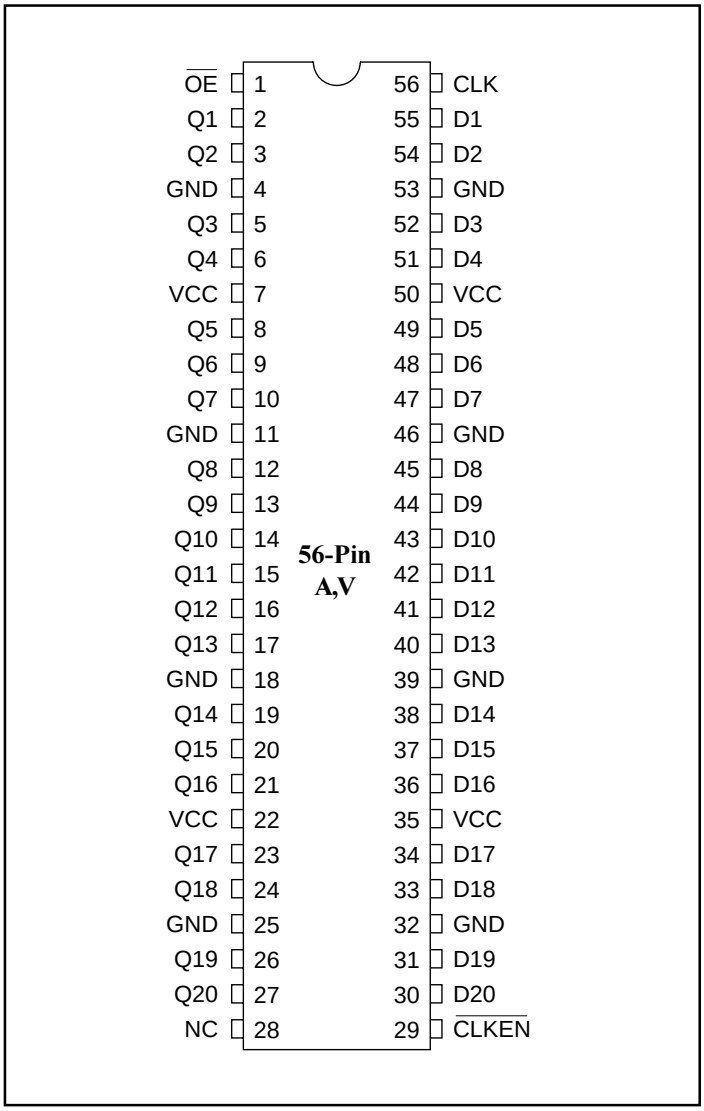
### Logic Block Diagram



## Product Pin Description

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

## Product Pin Configuration




## Truth Table[1]

| Inputs | | | | Outputs |
|---|---|---|---|---|
| $\overline{OE}$ | $\overline{CLKEN}$ | CLK | Dx | Qx |
| L | H | X | X | $Q_0$ |
| L | L | ↑ | H | H |
| L | L | ↑ | L | L |
| L | L | L or H | X | $Q_0$ |
| H | X | X | X | Z |

**Notes:**

1. H = High Signal Level
   L = Low Signal Level
   X = Don't Care or Irrelevant
   Z = High Impedance
   ↑ = LOW-to-HIGH Transition

## Maximum Ratings

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

| | |
|---|---|
| Storage Temperature | –65°C to +150°C |
| Ambient Temperature with Power Applied | –40°C to +85°C |
| Input Voltage Range, $V_{IN}$ | –0.5V to $V_{CC}$ +0.5V |
| Output Voltage Range, $V_{OUT}$ | –0.5V to $V_{CC}$ +0.5V |
| DC Input Voltage | –0.5V to +5.0V |
| DC Output Current | 100 mA |
| Power Dissipation | 1.0W |

**Note:**
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.

## DC Electrical Characteristics (Over the Operating Range, $T_A$ = –40°C to +85°C, $V_{CC}$ = 3.3V ±10%)

| Parameters | Description | Test Conditions[1] | Min. | Typ.[2] | Max. | Units |
|---|---|---|---|---|---|---|
| $V_{CC}$ | Supply Voltage | | 2.3 | | 3.6 | V |
| $V_{IH}$[3] | Input HIGH Voltage | $V_{CC}$ = 2.3V to 2.7V | 1.7 | | | |
| | | $V_{CC}$ = 2.7V to 3.6V | 2.0 | | | |
| $V_{IL}$[3] | Input LOW Voltage | $V_{CC}$ = 2.3V to 2.7V | | | 0.7 | |
| | | $V_{CC}$ = 2.7V to 3.6V | | | 0.8 | |
| $V_{IN}$[3] | Input Voltage | | 0 | | $V_{CC}$ | |
| $V_{OUT}$[3] | Output Voltage | | 0 | | $V_{CC}$ | |
| $V_{OH}$ | Output HIGH Voltage | $I_{OH}$ = -100µA, $V_{CC}$ = Min. to Max. | $V_{CC}$ -0.2 | | | |
| | | $V_{IH}$ = 1.7V, $I_{OH}$ = -6mA, $V_{CC}$ = 2.3V | 2.0 | | | |
| | | $V_{IH}$ = 1.7V, $I_{OH}$ = -12mA, $V_{CC}$ = 2.3V | 1.7 | | | |
| | | $V_{IH}$ = 2.0V, $I_{OH}$ = -12mA, $V_{CC}$ = 2.7V | 2.2 | | | |
| | | $V_{IH}$ = 2.0V, $I_{OH}$ = -12mA, $V_{CC}$ = 3.0V | 2.4 | | | |
| | | $V_{IH}$ = 2.0V, $I_{OH}$ = -24mA, $V_{CC}$ = 3.0V | 2.0 | | | |
| $V_{OL}$ | Output LOW Voltage | $I_{OL}$ = 100µA, $V_{IL}$ = Min. to Max. | | | 0.2 | |
| | | $V_{IL}$ = 0.7V, $I_{OL}$ = 6mA, $V_{CC}$ = 2.3V | | | 0.4 | |
| | | $V_{IL}$ = 0.7V, $I_{OL}$ = 12mA, $V_{CC}$ = 2.3V | | | 0.7 | |
| | | $V_{IL}$ = 0.8V, $I_{OL}$ = 12mA, $V_{CC}$ = 2.7V | | | 0.4 | |
| | | $V_{IL}$ = 0.8V, $I_{OL}$ = 24mA, $V_{CC}$ = 3.0V | | | 0.55 | |
| $I_{OH}$[3] | Output HIGH Current | $V_{CC}$ = 2.3V | | | -12 | mA |
| | | $V_{CC}$ = 2.7V | | | -12 | |
| | | $V_{CC}$ = 3.0V | | | -24 | |
| $I_{OL}$[3] | Output LOW Current | $V_{CC}$ = 2.3V | | | 12 | |
| | | $V_{CC}$ = 2.7V | | | 12 | |
| | | $V_{CC}$ = 3.0V | | | 24 | |

**DC Electrical Characteristics-Continued** (Over the Operating Range, $T_A$ = –40°C to +85°C, $V_{CC}$ = 3.3V ±10%)

| Parameters | Description | Test Conditions[1] | Min. | Typ.[2] | Max. | Units |
|---|---|---|---|---|---|---|
| $I_{IN}$ | Input Current | $V_{IN}$ = $V_{CC}$ or GND, $V_{CC}$ = 3.6V | | | ±5 | μA |
| $I_{IN}$ (HOLD) | Input Hold Current | $V_{IN}$ = 0.7V, $V_{CC}$ = 2.3V | 45 | | | |
| | | $V_{IN}$ = 1.7V, $V_{CC}$ = 2.3V | -45 | | | |
| | | $V_{IN}$ = 0.8V, $V_{CC}$ = 3.0V | 75 | | | |
| | | $V_{IN}$ = 2.0V, $V_{CC}$ = 3.0V | -75 | | | |
| | | $V_{IN}$ = 0 to 3.6V, $V_{CC}$ = 3.6V | | | ±500 | |
| $I_{OZ}$ | Output Current (3-STATE Outputs) | $V_{OUT}$ = $V_{CC}$ or GND, $V_{CC}$ = 3.6V | | | ±10 | |
| $I_{CC}$ | Supply Current | $V_{CC}$ = 3.6V, $I_{OUT}$ = 0μA, $V_{IN}$ = GND or $V_{CC}$ | | | 40 | |
| $\Delta I_{CC}$ | Supply Current per Input @ TTL HIGH | $V_{CC}$ = 3.0V to 3.6V One Input at $V_{CC}$ - 0.6V Other Inputs at $V_{CC}$ or GND | | | 750 | |
| $C_I$ | Control Inputs | $V_{IN}$ = $V_{CC}$ or GND, $V_{CC}$ = 3.3V | | 3 | | pF |
| | Data Inputs | | | 6 | | |
| $C_O$ | Outputs | $V_O$ = $V_{CC}$ or GND, $V_{CC}$ = 3.3V | | 7 | | |

**Notes:**
1. For conditions shown as Max. or Min., use appropriate value specified under Electrical Characteristics for the applicable device type.
2. Typical values are at $V_{CC}$ = 3.3V, +25°C ambient and maximum loading.
3. Unused Control Inputs must be held HIGH or LOW to prevent them from floating.

## Switching Characteristics over Operating Range[1]

| Parameters | Description | Conditions[1] | $V_{CC}$ = 2.5V ±0.2V | | $V_{CC}$ = 2.7V | | $V_{CC}$ = 3.3V ±0.3V | | Units |
|---|---|---|---|---|---|---|---|---|---|
| | | | Min.[2] | Max. | Min.[2] | Max. | Min.[2] | Max. | |
| $f_{CLOCK}$ | Clock Frequency | $C_L$ = 50pF<br>$R_L$ = 500Ω | 0 | 150 | 0 | 150 | 0 | 150 | MHz |
| $f_{MAX}$ | Maximum Frequency | | 150 | | 150 | | 150 | | |
| $t_{PLH}$, $t_{PHL}$ | Propogation Delay<br>CLK to Qx | | 1.0 | 5.6 | 1.0 | 5.1 | 1.0 | 4.3 | ns |
| $t_{PZH}$, $t_{PZL}$ | Output Enable Time<br>$\overline{OE}$ to Qx | | | 6.1 | | 5.8 | | 4.8 | |
| $t_{PHX}$ | Output Disable Time<br>$\overline{OE}$ to Qx | | | 5.5 | | 4.7 | | 4.4 | |
| $t_{SU}$ | Data Before CLK↑ | | 4 | | 3.6 | | 3.1 | | |
| $t_{SU}$ | $\overline{CLKEN}$ Before CLK↑ | | 3.4 | | 3.1 | | 2.7 | | |
| $t_H$ | Data After CLK↑ | | 0 | | 0 | | 0 | | |
| $t_H$ | $\overline{CLKEN}$ After CLK↑ | | 0 | | 0 | | 0 | | |
| $t_W$ | Pulse Width[3]<br>CLK HIGH or LOW | | 3.3 | | 3.3 | | 3.3 | | |
| $\Delta t/\Delta v$[4] | Input Transition RISE or FALL | | 0 | 10 | 0 | 10 | 0 | 10 | ns/V |

**Notes:**
1. See test circuit and waveforms.
2. Minimum limits are guaranteed but not tested on Propagation Delays.
3. Recommended operating condition.

## Operating Characteristics, $T_A$ = 25°C

| Parameter | | Test Conditions | $V_{CC}$ = 2.5V ±0.2V | $V_{CC}$ = 3.3V ±0.3V | Units |
|---|---|---|---|---|---|
| | | | Typ. | | |
| $C_{PD}$ Power Dissipation Capacitance | Outputs Enabled | $C_L$ = 50pF, f = 10 MHz | 55 | 59 | pF |
| | Outputs Disabled | | 46 | 49 | |