

## 74ALVC16821

### Low Voltage 20-Bit D-Type Flip-Flops with 3.6V Tolerant Inputs and Outputs

#### General Description

The ALVC16821 contains twenty non-inverting D-type flip-flops with 3-STATE outputs and is intended for bus oriented applications.

The 74ALVC16821 is designed for low voltage (1.65V to 3.6V)  $V_{CC}$  applications with I/O compatibility up to 3.6V.

The 74ALVC16821 is fabricated with an advanced CMOS technology to achieve high speed operation while maintaining low CMOS power dissipation.

#### Features

- 1.65V–3.6V  $V_{CC}$  supply operation
- 3.6V tolerant inputs and outputs
- $t_{PD}$ 
  - 4.0 ns max for 3.0V to 3.6V  $V_{CC}$
  - 4.9 ns max for 2.3V to 2.7V  $V_{CC}$
  - 8.8 ns max for 1.65V to 1.95V  $V_{CC}$
- Power-off high impedance inputs and outputs
- Supports live insertion and withdrawal (Note 1)
- Uses patented noise/EMI reduction circuitry
- Latchup conforms to JEDEC JED78
- ESD performance:
  - Human body model > 2000V
  - Machine model > 200V

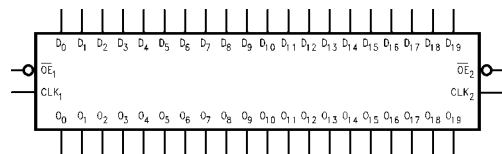
**Note 1:** To ensure the high-impedance state during power up or power down,  $\overline{OE}$  should be tied to  $V_{CC}$  through a pull-up resistor; the minimum value of the resistor is determined by the current-sourcing capability of the driver.

#### Ordering Code:

Order Number	Package Number	Package Descriptions
74ALVC16821MTD	MTD56	56-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 6.1mm Wide

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

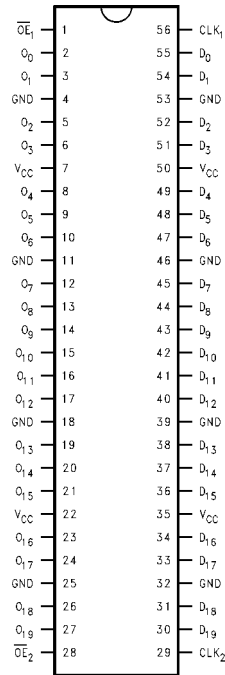
#### Logic Symbol



#### Pin Descriptions

Pin Names	Description
$\overline{OE}_n$	Output Enable Input (Active LOW)
$CLK_n$	Clock Input
$D_0$ – $D_{19}$	Inputs
$O_0$ – $O_{19}$	Outputs

Connection Diagram



Truth Tables

Inputs			Outputs
CLK <sub>1</sub>	$\overline{OE}_1$	D <sub>0</sub> -D <sub>9</sub>	O <sub>0</sub> -O <sub>9</sub>
X	H	X	Z
↗	L	L	L
↗	L	H	H
L or H	L	X	O <sub>0</sub>

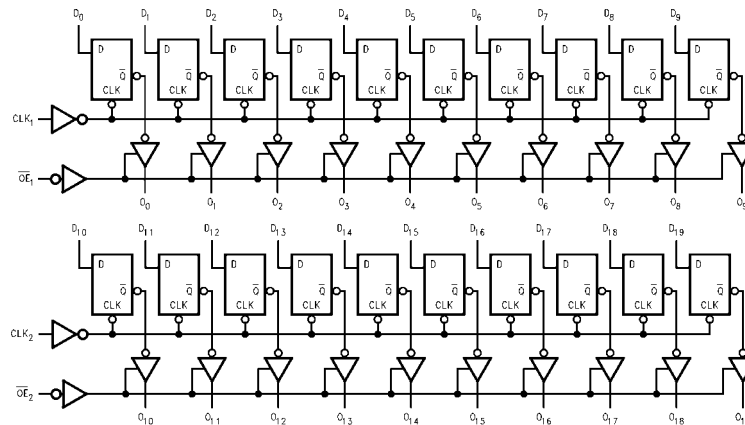
Inputs			Outputs
CLK <sub>2</sub>	$\overline{OE}_2$	D <sub>10</sub> -D <sub>19</sub>	O <sub>10</sub> -O <sub>19</sub>
X	H	X	Z
↗	L	L	L
↗	L	H	H
L or H	L	X	O <sub>0</sub>

H = HIGH Voltage Level  
 L = LOW Voltage Level  
 X = Immaterial (HIGH or LOW, inputs may not float)  
 Z = High Impedance  
 O<sub>0</sub> = Previous O<sub>0</sub> before LOW-to-HIGH transition of Clock  
 ↗ = LOW-to-HIGH transition

Functional Description

The 74ALVC16821 contains twenty D-type flip-flops with 3-STATE standard outputs. The device is byte controlled with each byte functioning identically, but independent of each other. Control pins can be shorted together to obtain full 20-bit operation. The following description applies to each byte. The twenty flip-flops will store the state of their individual D-type inputs that meet the setup and hold time requirements on the LOW-to-HIGH Clock (CLK) transition. The 3-STATE standard outputs are controlled by the Output Enable ( $\overline{OE}_n$ ) input. When  $\overline{OE}_n$  is HIGH, the standard outputs are in the high impedance mode but this does not interfere with entering new data into the flip-flops.

Logic Diagrams



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 ( $V_O$ ) (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
DC Output Source/Sink Current ( $I_{OH}/I_{OL}$ )	$\pm 50$ mA
DC $V_{CC}$ or GND Current per Supply Pin ( $I_{CC}$ or GND)	$\pm 100$ mA
Storage Temperature Range ( $T_{STG}$ )	-65°C to +150°C

**Recommended Operating Conditions** (Note 4)

Power Supply	
Operating	1.65V to 3.6V
Input Voltage ( $V_I$ )	0V to $V_{CC}$
Output Voltage ( $V_O$ )	0V to $V_{CC}$
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 control 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		1.65 - 1.95 2.3 - 2.7 2.7 - 3.6	$0.65 \times V_{CC}$ 1.7 2.0		V
$V_{IL}$	LOW Level Input Voltage		1.65 - 1.95 2.3 - 2.7 2.7 - 3.6		$0.35 \times V_{CC}$ 0.7 0.8	V
$V_{OH}$	HIGH Level Output Voltage	$I_{OH} = 100 \mu A$	1.65 - 3.6	$V_{CC} - 0.2$		V
		$I_{OH} = -4$ mA	1.65	1.2		
		$I_{OH} = -6$ mA	2.3	2.0		
		$I_{OH} = -12$ mA	2.3 2.7 3.0	1.7 2.2 2.4		
		$I_{OH} = -24$ mA	3.0	2		
$V_{OL}$	LOW Level Output Voltage	$I_{OL} = 100 \mu A$	1.65 - 3.6		0.2	V
		$I_{OL} = 4$ mA	1.65		0.45	
		$I_{OL} = 6$ mA	2.3		0.4	
		$I_{OL} = 12$ mA	2.3 2.7		0.7 0.4	
		$I_{OL} = 24$ mA	3.0		0.55	
$I_I$	Input Leakage Current	$0 \leq V_I \leq 3.6V$	3.6		$\pm 5.0$	$\mu A$
$I_{OZ}$	3-STATE Output Leakage	$0 \leq V_O \leq 3.6V$	3.6		$\pm 10$	$\mu A$
$I_{CC}$	Quiescent Supply Current	$V_I = V_{CC}$ or GND, $I_O = 0$	3.6		40	$\mu A$
$\Delta I_{CC}$	Increase in $I_{CC}$ per Input	$V_{IH} = V_{CC} - 0.6V$	3 - 3.6		750	$\mu A$

## AC Electrical Characteristics

Symbol	Parameter	$T_A = -40^\circ\text{C to } +85^\circ\text{C}, R_L = 500\Omega$								Units
		$C_L = 50\text{ pF}$				$C_L = 30\text{ pF}$				
		$V_{CC} = 3.3V \pm 0.3V$		$V_{CC} = 2.7V$		$V_{CC} = 2.5V \pm 0.2V$		$V_{CC} = 1.8V \pm 0.15V$		
		Min	Max	Min	Max	Min	Max	Min	Max	
$f_{MAX}$	Maximum Clock Frequency	250		200		200		100		MHz
$t_{PHL}, t_{PLH}$	Propagation Delay CLK to $O_n$	1.3	4.0	1.5	4.9	1.0	4.4	1.5	8.8	ns
$t_{PZL}, t_{PZH}$	Output Enable Time	1.3	4.2	1.5	5.3	1.0	4.7	1.5	9.8	ns
$t_{PLZ}, t_{PHZ}$	Output Disable Time	1.3	4.2	1.5	4.7	1.0	4.2	1.5	7.6	ns
$t_W$	Pulse Width	1.5		1.5		1.5		4.0		ns
$t_S$	Setup Time	1.5		1.5		1.5		2.5		ns
$t_H$	Hold Time	1.0		1.0		1.0		1.0		ns

## Capacitance

Symbol	Parameter	Conditions	$T_A = +25^\circ\text{C}$		Units
			$V_{CC}$	Typical	
$C_{IN}$	Input Capacitance	$V_I = 0V \text{ or } V_{CC}$	3.3	6	pF
$C_{OUT}$	Output Capacitance	$V_I = 0V \text{ or } V_{CC}$	3.3	7	pF
$C_{PD}$	Power Dissipation Capacitance	Outputs Enabled	$f = 10\text{ MHz}, C_L = 50\text{ pF}$	20	pF
				2.5	

### AC Loading and Waveforms

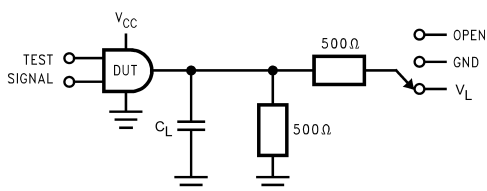


FIGURE 1. AC Test Circuit

TABLE 1. Values for Figure 1

TEST	SWITCH
$t_{PLH}, t_{PHL}$	Open
$t_{PZL}, t_{PLZ}$	$V_L$
$t_{PZH}, t_{PHZ}$	GND

TABLE 2.

Symbol	$V_{CC}$			
	$3.3V \pm 0.3V$	2.7V	$2.5V \pm 0.2V$	$1.8V \pm 0.15V$
$V_{mi}$	1.5V	1.5V	$V_{CC}/2$	$V_{CC}/2$
$V_{mo}$	1.5V	1.5V	$V_{CC}/2$	$V_{CC}/2$
$V_X$	$V_{OL} + 0.3V$	$V_{OL} + 0.3V$	$V_{OL} + 0.15V$	$V_{OL} + 0.15V$
$V_Y$	$V_{OH} - 0.3V$	$V_{OH} - 0.3V$	$V_{OH} - 0.15V$	$V_{OH} - 0.15V$
$V_L$	6V	6V	$V_{CC} * 2$	$V_{CC} * 2$

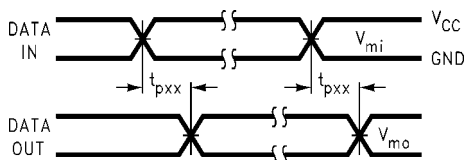


FIGURE 2. Waveform for Inverting and Non-Inverting Functions

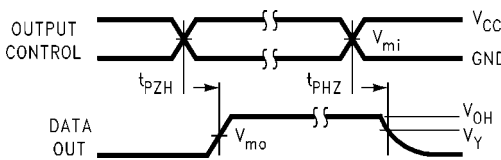


FIGURE 3. 3-STATE Output High Enable and Disable Times for Low Voltage Logic

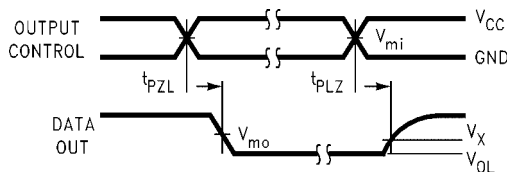


FIGURE 4. 3-STATE Output Low Enable and Disable Times for Low Voltage Logic

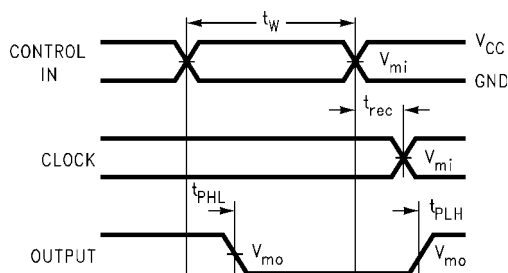


FIGURE 5. Propagation Delay, Pulse Width and  $t_{rec}$  Waveforms

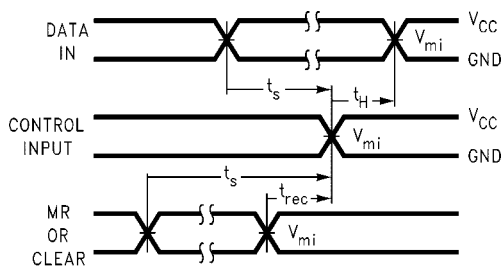
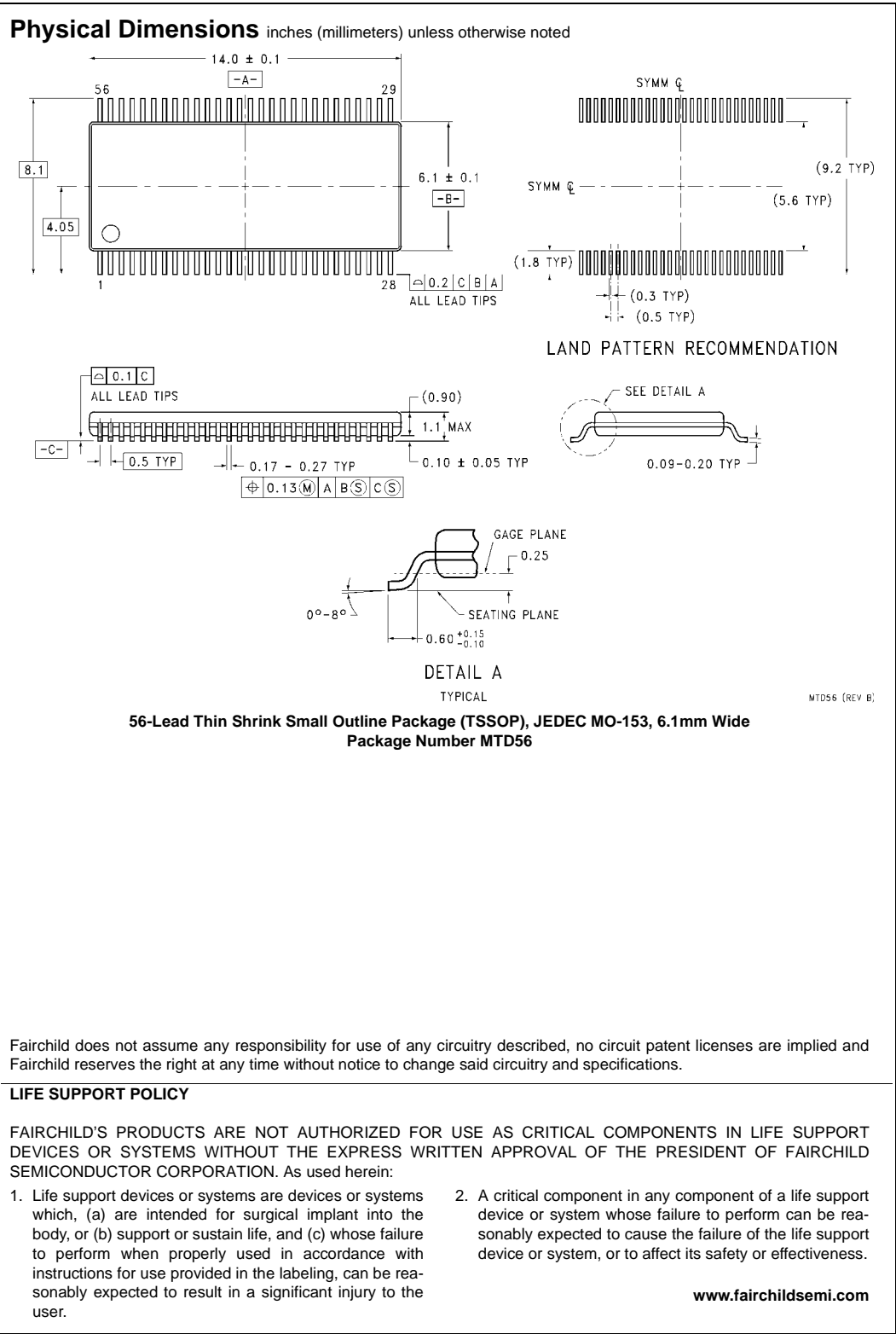


FIGURE 6. Setup Time, Hold Time and Recovery Time for Low Voltage Logic



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