

# TC74VHCV17FK

## 1. Functional Description

- Hex Schmitt Buffer

## 2. General

The TC74VHCV17FK is an advanced high speed CMOS SCHMITT BUFFER fabricated with silicon gate CMOS technology.

It achieves the high speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation.

Input pin have hysteresis between the positive-going and negative-going thresholds. Thus the TC74VHCV17FK is capable of squaring up transitions of slowly changing input signals such as line receivers.

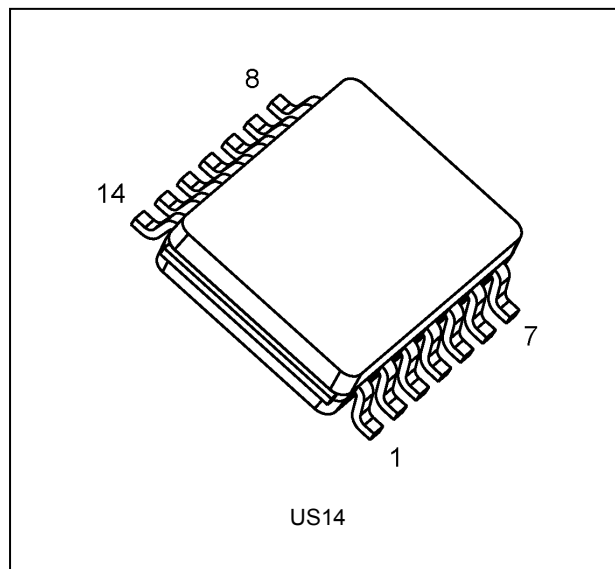
Input protection and output circuit ensure that 0 to 5.5 V can be applied to the input and output (Note) pins without regard to the supply voltage. These structure prevents device destruction due to mismatched supply and input/output voltages such as battery back up, etc.

Note:  $V_{CC} = 0$  V

## 3. Features

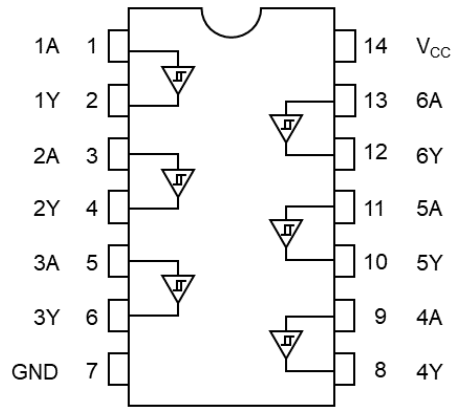
- (1) High speed:  $t_{pd} = 4.5$  ns (typ.) at  $V_{CC} = 5.0$  V
- (2) Low power dissipation:  $I_{CC} = 2.0$   $\mu$ A (max) at  $T_a = 25^\circ$ C
- (3) Wide operating voltage range:  $V_{CC(opr)} = 1.8$  V to 5.5 V
- (4) Output current:  $|I_{OH}|/I_{OL} = 16$  mA (min) ( $V_{CC} = 4.5$  V)
- (5) Power-down protection is provided on all inputs and outputs.

## 4. Packaging



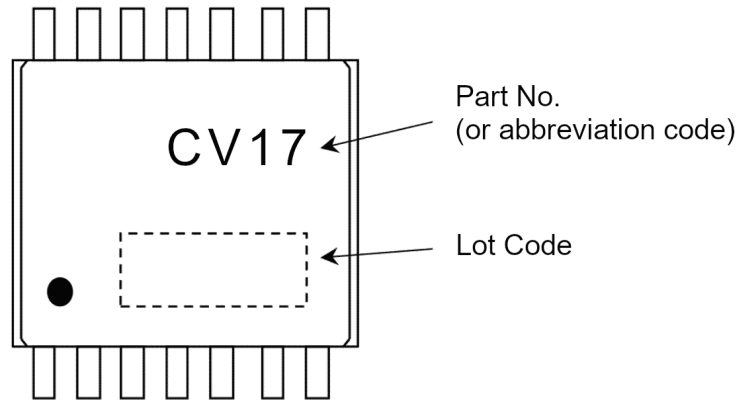
Start of commercial production  
2010-01

## 5. Pin Assignment



(top view)

## 6. Marking



## 7. Truth Table

Input A	Output Y
L	L
H	H

### 8. Absolute Maximum Ratings (Note)

Characteristics	Symbol	Note	Rating	Unit
Supply voltage	$V_{CC}$		-0.5 to 7.0	V
Input voltage	$V_{IN}$		-0.5 to 7.0	V
Output voltage	$V_{OUT}$	(Note 1)	-0.5 to 7.0	V
		(Note 2)	-0.5 to $V_{CC} + 0.5$	
Input diode current	$I_{IK}$		-50	mA
Output diode current	$I_{OK}$	(Note 3)	$\pm 50$	mA
Output current	$I_{OUT}$		$\pm 50$	mA
Power dissipation	$P_D$		180	mW
$V_{CC}$ /ground current	$I_{CC}/I_{GND}$		$\pm 100$	mA
Storage temperature	$T_{stg}$		-65 to 150	$^{\circ}C$

Note: Exceeding any of the absolute maximum ratings, even briefly, lead to deterioration in IC performance or even destruction.

Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook (“Handling Precautions”/“Derating Concept and Methods”) and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Note 1:  $V_{CC} = 0\text{ V}$

Note 2: High (H) or Low (L) state.  $I_{OUT}$  absolute maximum rating must be observed.

Note 3:  $V_{OUT} < GND$ ,  $V_{OUT} > V_{CC}$

### 9. Operating Ranges (Note)

Characteristics	Symbol	Note	Test Condition	Rating	Unit
Supply voltage	$V_{CC}$		—	1.8 to 5.5	V
Input voltage	$V_{IN}$		—	0 to 5.5	V
Output voltage	$V_{OUT}$	(Note 1)	—	0 to 5.5	V
		(Note 2)	—	0 to $V_{CC}$	
Operating temperature	$T_{opr}$		—	-40 to 85	$^{\circ}C$
Input rise and fall times	dt/dv		$V_{CC} = 3.3 \pm 0.3\text{ V}$	0 to 20	ms/V
			$V_{CC} = 5.0 \pm 0.5\text{ V}$	0 to 1	

Note: The operating ranges must be maintained to ensure the normal operation of the device.

Unused inputs must be tied to either  $V_{CC}$  or GND.

Note 1:  $V_{CC} = 0\text{ V}$

Note 2: High (H) or Low (L) state.

### 10. Electrical Characteristics

#### 10.1. DC Characteristics (Unless otherwise specified, $T_a = 25\text{ }^\circ\text{C}$ )

Characteristics	Symbol	Test Condition	$V_{CC}$ (V)	Min	Typ.	Max	Unit	
Positive threshold voltage	$V_P$	—	1.8	—	—	1.65	V	
			2.3	—	—	1.85		
			3.0	—	—	2.20		
			4.5	—	—	3.15		
			5.5	—	—	3.85		
Negative threshold voltage	$V_N$	—	1.8	0.15	—	—	V	
			2.3	0.45	—	—		
			3.0	0.90	—	—		
			4.5	1.35	—	—		
			5.5	1.65	—	—		
Hysteresis voltage	$V_H$	—	1.8	0.15	—	1.05	V	
			2.3	0.20	—	1.10		
			3.0	0.30	—	1.20		
			4.5	0.40	—	1.40		
			5.5	0.50	—	1.60		
High-level output voltage	$V_{OH}$	$V_{IN} = V_{IH}$	$I_{OH} = -50\text{ }\mu\text{A}$	1.8	1.7	1.8	—	V
				3.0	2.9	3.0	—	
			$I_{OH} = -8\text{ mA}$	4.5	4.4	4.5	—	
				$I_{OH} = -16\text{ mA}$	3.0	2.58	—	
Low-level output voltage	$V_{OL}$	$V_{IN} = V_{IL}$	$I_{OL} = 50\text{ }\mu\text{A}$	1.8	—	0.0	0.1	V
				3.0	—	0.0	0.1	
				4.5	—	0.0	0.1	
			$I_{OL} = 8\text{ mA}$	3.0	—	—	0.36	
				$I_{OL} = 16\text{ mA}$	4.5	—	—	
Power-OFF leakage current	$I_{OFF}$	$V_{IN}/V_{OUT} = 5.5\text{ V}$	0	—	—	0.5	$\mu\text{A}$	
Input leakage current	$I_{IN}$	$V_{IN} = 5.5\text{ V}$ or GND	0 to 5.5	—	—	$\pm 0.1$	$\mu\text{A}$	
Quiescent supply current	$I_{CC}$	$V_{IN} = V_{CC}$ or GND	5.5	—	—	2.0	$\mu\text{A}$	

### 10.2. DC Characteristics (Unless otherwise specified, $T_a = -40$ to $85$ °C)

Characteristics	Symbol	Test Condition	$V_{CC}$ (V)	Min	Max	Unit		
Positive threshold voltage	$V_P$	—	1.8	—	1.65	V		
			2.3	—	1.85			
			3.0	—	2.20			
			4.5	—	3.15			
			5.5	—	3.85			
Negative threshold voltage	$V_N$	—	1.8	0.15	—	V		
			2.3	0.45	—			
			3.0	0.90	—			
			4.5	1.35	—			
			5.5	1.65	—			
Hysteresis voltage	$V_H$	—	1.8	0.15	1.05	V		
			2.3	0.20	1.10			
			3.0	0.30	1.20			
			4.5	0.40	1.40			
			5.5	0.50	1.60			
High-level output voltage	$V_{OH}$	$V_{IN} = V_{IH}$	$I_{OH} = -50 \mu A$	1.8	1.7	—	V	
				3.0	2.9	—		
			$I_{OH} = -8 \text{ mA}$	4.5	4.4	—		
				$I_{OH} = -16 \text{ mA}$	3.0	2.48		—
					4.5	3.80		—
Low-level output voltage	$V_{OL}$	$V_{IN} = V_{IL}$	$I_{OL} = 50 \mu A$	1.8	—	0.1	V	
				3.0	—	0.1		
				4.5	—	0.1		
			$I_{OL} = 8 \text{ mA}$	3.0	—	0.44		
				4.5	—	0.55		
Power-OFF leakage current	$I_{OFF}$	$V_{IN}/V_{OUT} = 5.5 \text{ V}$	0	—	5.0	$\mu A$		
Input leakage current	$I_{IN}$	$V_{IN} = 5.5 \text{ V}$ or GND	0 to 5.5	—	$\pm 1.0$	$\mu A$		
Quiescent supply current	$I_{CC}$	$V_{IN} = V_{CC}$ or GND	5.5	—	20.0	$\mu A$		

### 10.3. AC Characteristics (Unless otherwise specified, $T_a = 25$ °C, Input: $t_r = t_f = 3 \text{ ns}$ )

Characteristics	Symbol	Note	$V_{CC}$ (V)	$C_L$ (pF)	Min	Typ.	Max	Unit
Propagation delay time	$t_{PLH}, t_{PHL}$		$2.5 \pm 0.2$	15	—	9.3	19.7	ns
				50	—	12.4	24.0	
			$3.3 \pm 0.3$	15	—	6.5	12.8	
				50	—	8.7	16.3	
			$5.0 \pm 0.5$	15	—	4.5	8.6	
				50	—	6.1	10.6	
Input capacitance	$C_{IN}$		—	—	4	10	pF	
Power dissipation capacitance	$C_{PD}$	(Note 1)	—	—	25	—	pF	

Note 1:  $C_{PD}$  is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load. Average operating current can be obtained by the equation.

$$I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/6 \text{ (per gate)}$$

### 10.4. AC Characteristics

(Unless otherwise specified,  $T_a = -40$  to  $85$  °C, Input:  $t_r = t_f = 3$  ns)

Characteristics	Symbol	$V_{CC}$ (V)	$C_L$ (pF)	Min	Max	Unit
Propagation delay time	$t_{PLH}, t_{PHL}$	$2.5 \pm 0.2$	15	1.0	22.0	ns
			50	1.0	27.0	
		$3.3 \pm 0.3$	15	1.0	15.0	
			50	1.0	18.5	
		$5.0 \pm 0.5$	15	1.0	10.0	
			50	1.0	12.0	
Input capacitance	$C_{IN}$	—	—	—	10	pF

### 10.5. Noise Characteristics (Unless otherwise specified, $T_a = 25$ °C, Input: $t_r = t_f = 3$ ns)

Characteristics	Symbol	Test Condition	$V_{CC}$ (V)	Typ.	Max	Unit
Quiet output maximum dynamic $V_{OL}$	$V_{OLP}$	$C_L = 50$ pF	3.3	0.3	—	V
			5.0	0.7	—	
Quiet output minimum dynamic $V_{OL}$	$V_{OLV}$	$C_L = 50$ pF	3.3	-0.1	—	V
			5.0	-0.2	—	
Minimum high-level dynamic input voltage	$V_{IHD}$	$C_L = 50$ pF	5.0	—	3.5	V
Maximum low-level dynamic input voltage	$V_{ILD}$	$C_L = 50$ pF	5.0	—	1.5	V



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