

# TC74VHCV245FK

## 1. Functional Description

- Octal Schmitt Bus Transceiver

## 2. General

The TC74VHCV245FK is an advanced high speed CMOS OCTAL BUS TRANSCEIVER 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.

It is intended for two-way asynchronous communication between data busses. The direction of data transmission is determined by the level of the DIR input.

The enable input ( $\overline{G}$ ) can be used to disable the device so that the busses are effectively isolated.

Input pin and bus terminal have hysteresis between the positive-going and negative-going thresholds. Thus the TC74VHCV245FK is capable of squaring up transitions of slowly changing input signals and provides an improved noise immunity.

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: Output in off-state.

## 3. Features (Note)

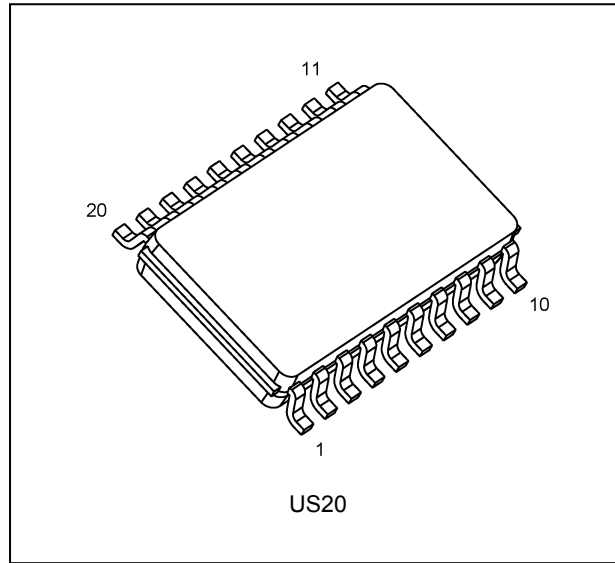
- (1) High speed:  $t_{pd} = 3.8$  ns (typ.) at  $V_{CC} = 5.0$  V
- (2) Low power dissipation:  $I_{CC} = 2.0$   $\mu$ A (max) at  $T_a = 25^\circ$ C
- (3) Wide operating voltage range:  $V_{CC(opr)} = 1.8$  V to 5.5 V
- (4) Output current:  $|I_{OH}|/I_{OL} = 16$  mA (min) ( $V_{CC} = 4.5$  V)
- (5) Power-down protection is provided on all inputs and outputs.
- (6) Pin and function compatible with the 74 series (74AC/HC/AHC/LV etc.) 245 type.

Note: Do not apply a signal to any bus pins when it is in the output mode. Damage may result.

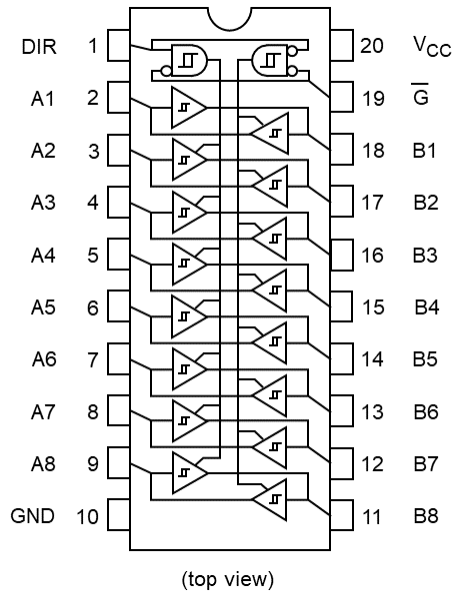
All floating (high impedance) bus pins must have their input levels fixed by means of pull-up or pull-down resistors.

Start of commercial production  
2009-12

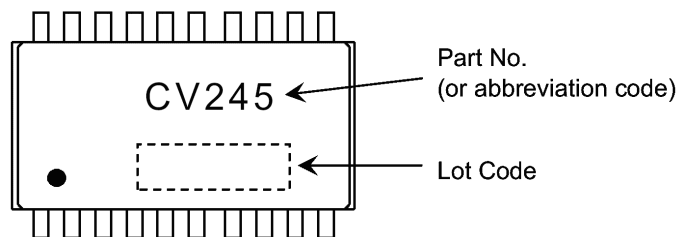
### 4. Packaging



### 5. Pin Assignment



### 6. Marking



### 7. Truth Table

Inputs G	Inputs DIR	Function A Bus	Function B Bus	Output
L	L	Output	Input	A = B
L	H	Input	Output	B = A
H	X	Z	Z	Z

X: Don't care

Z: High Impedance

### 8. Absolute Maximum Ratings (Note)

Characteristics	Symbol	Note	Rating	Unit
Supply voltage	$V_{CC}$		-0.5 to 7.0	V
Input voltage(DIR, $\overline{G}$ )	$V_{IN}$		-0.5 to 7.0	V
Bus I/O voltage	$V_{I/O}$	(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: OFF state.

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	Test Condition	Note	Rating	Unit
Supply voltage	$V_{CC}$	—		1.8 to 5.5	V
Input voltage(DIR, $\overline{G}$ )	$V_{IN}$	—		0 to 5.5	V
Bus I/O voltage	$V_{I/O}$	—	(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	$V_{CC} = 3.3 \pm 0.3 V$		0 to 20	ms/V
		$V_{CC} = 5.0 \pm 0.5 V$		0 to 1	

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

Unused inputs and bus inputs must be tied to either  $V_{CC}$  or GND. Please connect both bus inputs and the bus outputs with  $V_{CC}$  or GND when the I/O of the bus terminal changes by the function. In this case, please note that the output is not short-circuited.

Note 1: OFF state.

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	$V_{OH}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OH} = -50\text{ }\mu\text{A}$	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	$V_{OL}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OL} = 50\text{ }\mu\text{A}$		1.8	—	0.0	0.1
				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	—	—	0.44
3-state output OFF-state leakage current	$I_{OZ}$	$V_{IN} = V_{IH}$ or $V_{IL}$ $V_{OUT} = 0$ to $5.5\text{ V}$	1.8 to 5.5		—	—	$\pm 0.5$	$\mu\text{A}$
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	$V_{OH}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OH} = -50 \mu A$	1.8	1.7	—	V
				3.0	2.9	—	
				4.5	4.4	—	
			$I_{OH} = -8 \text{ mA}$	3.0	2.48	—	
				4.5	3.80	—	
Low-level output voltage	$V_{OL}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OL} = 50 \mu A$	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	
3-state output OFF-state leakage current	$I_{OZ}$	$V_{IN} = V_{IH}$ or $V_{IL}$ $V_{OUT} = 0$ to $5.5 \text{ V}$	1.8 to 5.5	—	$\pm 5.0$	$\mu A$	
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, $T_a = 25\text{ }^\circ\text{C}$ , Input: $t_r = t_f = 3\text{ ns}$ )

Characteristics	Symbol	Note	Test Condition	$V_{CC}$ (V)	$C_L$ (pF)	Min	Typ.	Max	Unit
Propagation delay time	$t_{PLH}, t_{PHL}$		—	$2.5 \pm 0.2$	15	—	5.9	13.0	ns
					50	—	8.7	15.9	
				$3.3 \pm 0.3$	15	—	4.6	8.4	
					50	—	6.9	11.9	
				$5.0 \pm 0.5$	15	—	3.8	5.5	
					50	—	5.4	7.5	
3-state output enable time	$t_{PZL}, t_{PZH}$		$R_L = 1\text{ k}\Omega$	$2.5 \pm 0.2$	15	—	7.0	19.9	ns
					50	—	9.6	22.7	
				$3.3 \pm 0.3$	15	—	5.3	13.2	
					50	—	7.4	16.7	
				$5.0 \pm 0.5$	15	—	4.1	8.5	
					50	—	5.7	10.6	
3-state output disable time	$t_{PLZ}, t_{PHZ}$		$R_L = 1\text{ k}\Omega$	$2.5 \pm 0.2$	50	—	15.0	23.1	ns
				$3.3 \pm 0.3$	50	—	11.6	15.8	
				$5.0 \pm 0.5$	50	—	9.3	9.7	
Output skew	$t_{osLH}, t_{osHL}$	(Note 1)	—	$2.5 \pm 0.2$	50	—	—	2.0	ns
				$3.3 \pm 0.3$	50	—	—	1.5	
				$5.0 \pm 0.5$	50	—	—	1.0	
Input capacitance	$C_{IN}$		DIR, $\bar{G}$			—	4	10	pF
Bus I/O capacitance	$C_{I/O}$		An, Bn			—	6	—	pF
Power dissipation capacitance	$C_{PD}$	(Note 2)	—			—	26	—	pF

Note 1: Parameter guaranteed by design. ( $t_{osLH} = |t_{PLHM} - t_{PLHN}|$ ,  $t_{osHL} = |t_{PHLM} - t_{PHLN}|$ )

Note 2:  $C_{PD}$  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.

$$I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/8 \text{ (per bit)}$$

### 10.4. AC Characteristics

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

Characteristics	Symbol	Note	Test Condition	$V_{CC}$ (V)	$C_L$ (pF)	Min	Max	Unit
Propagation delay time	$t_{PLH}, t_{PHL}$		—	$2.5 \pm 0.2$	15	1.0	15.0	ns
					50	1.0	18.0	
				$3.3 \pm 0.3$	15	1.0	10.0	
					50	1.0	13.5	
				$5.0 \pm 0.5$	15	1.0	6.5	
					50	1.0	8.5	
3-state output enable time	$t_{PZL}, t_{PZH}$		$R_L = 1$ k $\Omega$	$2.5 \pm 0.2$	15	1.0	22.0	ns
					50	1.0	26.0	
				$3.3 \pm 0.3$	15	1.0	15.5	
					50	1.0	19.0	
				$5.0 \pm 0.5$	15	1.0	10.0	
					50	1.0	12.0	
3-state output disable time	$t_{PLZ}, t_{PHZ}$		$R_L = 1$ k $\Omega$	$2.5 \pm 0.2$	50	1.0	25.0	ns
				$3.3 \pm 0.3$	50	1.0	18.0	
				$5.0 \pm 0.5$	50	1.0	11.0	
Output skew	$t_{osLH}, t_{osHL}$	(Note 1)	—	$2.5 \pm 0.2$	50	—	2.0	ns
				$3.3 \pm 0.3$	50	—	1.5	
				$5.0 \pm 0.5$	50	—	1.0	
Input capacitance	$C_{IN}$		DIR, $\bar{G}$			—	10	pF

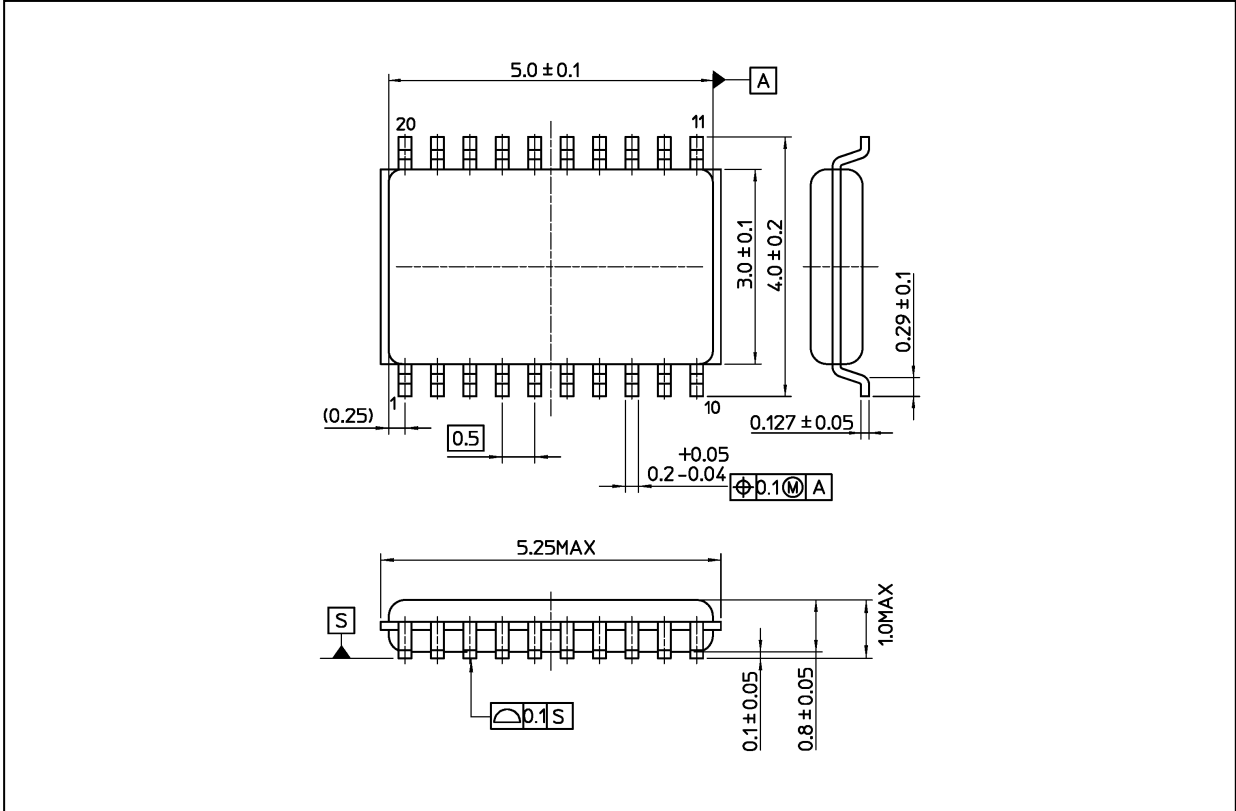
Note 1: Parameter guaranteed by design. ( $t_{osLH} = |t_{PLHM} - t_{PLHN}|$ ,  $t_{osHL} = |t_{PHLM} - t_{PHLN}|$ )

### 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	0.5	—	V
			5.0	1.0	—	
Quiet output minimum dynamic $V_{OL}$	$V_{OLV}$	$C_L = 50$ pF	3.3	-0.1	—	V
			5.0	-0.3	—	
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

Package Dimensions

Unit: mm



Weight: 0.03 g (typ.)

Package Name(s)
Nickname: US20

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