

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC74VHC245F, TC74VHC245FK

## Octal Bus Transceiver

The TC74VHC245 is an advanced high speed CMOS OCTAL BUS TRANSCEIVER fabricated with silicon gate C<sup>2</sup>MOS 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.

All inputs are equipped with protection circuits against static discharge.

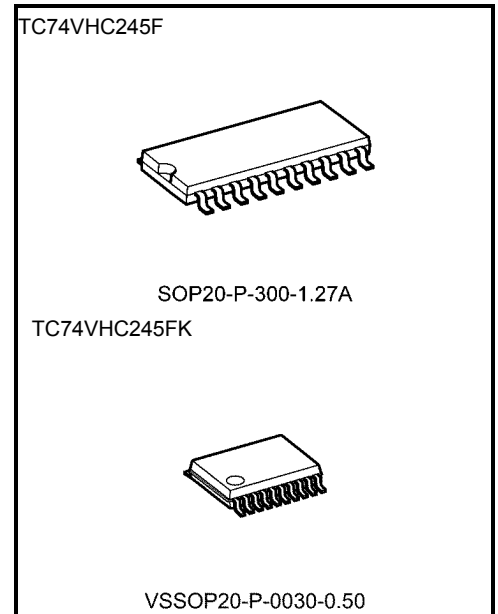
## Features (Note 1) (Note 2) (Note 3)

- High speed:  $t_{pd} = 4.0 \text{ ns (typ.)}$  at  $V_{CC} = 5 \text{ V}$
- Low power dissipation:  $I_{CC} = 4 \text{ } \mu\text{A (max)}$  at  $T_a = 25^\circ\text{C}$
- High noise immunity:  $V_{NIH} = V_{NIL} = 28\% V_{CC} \text{ (min)}$
- Balanced propagation delays:  $t_{pLH} \approx t_{pHL}$
- Wide operating voltage range:  $V_{CC} \text{ (opr)} = 2 \text{ V to } 5.5 \text{ V}$
- Low noise:  $V_{OLP} = 1.0 \text{ V (max)}$
- Pin and function compatible with 74ALS245

Note 1: Do not apply a signal to any bus terminal when it is in the output mode. Damage may result.

Note 2: All floating (high impedance) bus terminals must have their input levels fixed by means of pull up or pull down resistors.

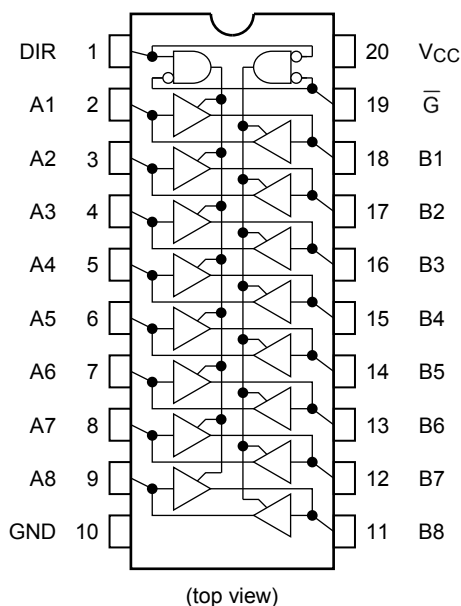
Note 3: A parasitic diode is formed between the bus and VCC terminals. Therefore bus terminal can not be used to interface 5 V to 3 V systems directly.



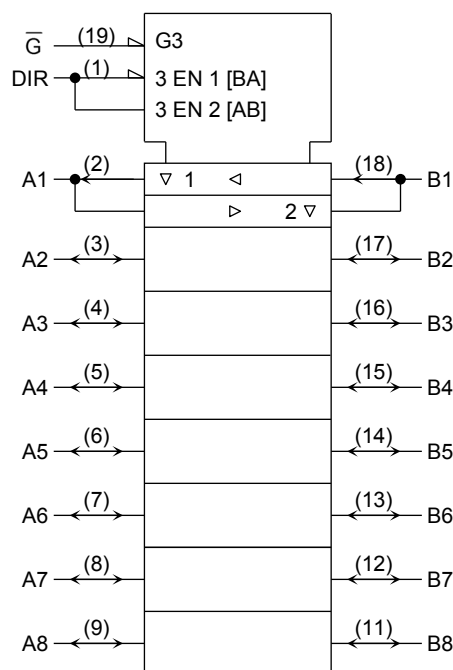
|                     |                 |
|---------------------|-----------------|
| Weight              |                 |
| SOP20-P-300-1.27A   | : 0.22 g (typ.) |
| VSSOP20-P-0030-0.50 | : 0.03 g (typ.) |

Start of commercial production  
1991-05

### Pin Assignment



### IEC Logic Symbol



### Truth Table

| Inputs         |     | Function |        | Output |
|----------------|-----|----------|--------|--------|
| $\overline{G}$ | DIR | A Bus    | B Bus  |        |
| L              | L   | Output   | Input  | A = B  |
| L              | H   | Input    | Output | B = A  |
| H              | X   | Z        |        | Z      |

X: Don't care

Z: High impedance

### Absolute Maximum Ratings (Note)

| Characteristics                         | Symbol    | Rating                 | Unit |
|-----------------------------------------|-----------|------------------------|------|
| Supply voltage range                    | $V_{CC}$  | -0.5 to 7.0            | V    |
| DC input voltage (DIR, $\overline{G}$ ) | $V_{IN}$  | -0.5 to 7.0            | V    |
| DC bus I/O voltage                      | $V_{I/O}$ | -0.5 to $V_{CC} + 0.5$ | V    |
| Input diode current                     | $I_{IK}$  | -20                    | mA   |
| Output diode current                    | $I_{OK}$  | ±20                    | mA   |
| DC output current                       | $I_{OUT}$ | ±25                    | mA   |
| DC $V_{CC}$ /ground current             | $I_{CC}$  | ±75                    | mA   |
| Power dissipation                       | $P_D$     | 180                    | mW   |
| Storage temperature                     | $T_{stg}$ | -65 to 150             | °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).

## Operating Ranges (Note)

| Characteristics                      | Symbol           | Rating                                                                            | Unit |
|--------------------------------------|------------------|-----------------------------------------------------------------------------------|------|
| Supply voltage                       | V <sub>CC</sub>  | 2.0 to 5.5                                                                        | V    |
| Input voltage (DIR, $\overline{G}$ ) | V <sub>IN</sub>  | 0 to 5.5                                                                          | V    |
| Bus I/O voltage                      | V <sub>I/O</sub> | 0 to V <sub>CC</sub>                                                              | V    |
| Operating temperature                | T <sub>opr</sub> | -40 to 85                                                                         | °C   |
| Input rise and fall time             | dt/dv            | 0 to 100 (V <sub>CC</sub> = 3.3 ± 0.3 V)<br>0 to 20 (V <sub>CC</sub> = 5 ± 0.5 V) | ns/V |

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<sub>CC</sub> or GND. Please connect both bus inputs and the bus outputs with V<sub>CC</sub> 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.

## Electrical Characteristics

## DC Characteristics

| Characteristics                  | Symbol          | Test Condition                                                                                    |                                                    | Ta = 25°C               |                               |        | Ta =<br>-40 to 85°C           |                               | Unit                          |     |
|----------------------------------|-----------------|---------------------------------------------------------------------------------------------------|----------------------------------------------------|-------------------------|-------------------------------|--------|-------------------------------|-------------------------------|-------------------------------|-----|
|                                  |                 |                                                                                                   |                                                    | VCC (V)                 | Min                           | Typ.   | Max                           | Min                           |                               | Max |
| High-level input voltage         | V <sub>IH</sub> | —                                                                                                 |                                                    | 2.0<br>3.0 to 5.5       | 1.50<br>V <sub>CC</sub> × 0.7 | —<br>— | —<br>—                        | 1.50<br>V <sub>CC</sub> × 0.7 | —<br>—                        | V   |
| Low-level input voltage          | V <sub>IL</sub> | —                                                                                                 |                                                    | 2.0<br>3.0 to 5.5       | —<br>—                        | —<br>— | 0.50<br>V <sub>CC</sub> × 0.3 | —<br>—                        | 0.50<br>V <sub>CC</sub> × 0.3 | V   |
| High-level output voltage        | V <sub>OH</sub> | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>                                              | I <sub>OH</sub> = -50 μA                           | 2.0                     | 1.9                           | 2.0    | —                             | 1.9                           | —                             | V   |
|                                  |                 |                                                                                                   |                                                    | 3.0                     | 2.9                           | 3.0    | —                             | 2.9                           | —                             |     |
|                                  |                 |                                                                                                   |                                                    | 4.5                     | 4.4                           | 4.5    | —                             | 4.4                           | —                             |     |
|                                  |                 |                                                                                                   | I <sub>OH</sub> = -4 mA<br>I <sub>OH</sub> = -8 mA | 3.0<br>4.5              | 2.58<br>3.94                  | —<br>— | —<br>—                        | 2.48<br>3.80                  | —<br>—                        |     |
| Low-level output voltage         | V <sub>OL</sub> | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>                                              |                                                    | I <sub>OL</sub> = 50 μA | 2.0                           | —      | 0.0                           | 0.1                           | —                             | 0.1 |
|                                  |                 |                                                                                                   | 3.0                                                |                         | —                             | 0.0    | 0.1                           | —                             | 0.1                           |     |
|                                  |                 |                                                                                                   | 4.5                                                |                         | —                             | 0.0    | 0.1                           | —                             | 0.1                           |     |
|                                  |                 |                                                                                                   | I <sub>OL</sub> = 4 mA<br>I <sub>OL</sub> = 8 mA   | 3.0<br>4.5              | —<br>—                        | —<br>— | 0.36<br>0.36                  | —<br>—                        | 0.44<br>0.44                  |     |
| 3-state output off-state current | I <sub>OZ</sub> | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>V <sub>OUT</sub> = V <sub>CC</sub> or GND |                                                    | 5.5                     | —                             | —      | ±0.25                         | —                             | ±2.50                         | μA  |
| Input leakage current            | I <sub>IN</sub> | V <sub>IN</sub> = 5.5 V or GND                                                                    |                                                    | 0 to 5.5                | —                             | —      | ±0.1                          | —                             | ±1.0                          | μA  |
| Quiescent supply current         | I <sub>CC</sub> | V <sub>IN</sub> = V <sub>CC</sub> or GND                                                          |                                                    | 5.5                     | —                             | —      | 4.0                           | —                             | 40.0                          | μA  |

**AC Characteristics (input:  $t_r = t_f = 3$  ns)**

| Characteristics               | Symbol                                 | Test Condition      |           |         | Ta = 25°C |      |      | Ta = -40 to 85°C |      | Unit |
|-------------------------------|----------------------------------------|---------------------|-----------|---------|-----------|------|------|------------------|------|------|
|                               |                                        |                     | VCC (V)   | CL (pF) | Min       | Typ. | Max  | Min              | Max  |      |
| Propagation delay time        | t <sub>pLH</sub><br>t <sub>pHL</sub>   | —                   | 3.3 ± 0.3 | 15      | —         | 5.8  | 8.4  | 1.0              | 10.0 | ns   |
|                               |                                        |                     |           | 50      | —         | 8.3  | 11.9 | 1.0              | 13.5 |      |
|                               |                                        |                     | 5.0 ± 0.5 | 15      | —         | 4.0  | 5.5  | 1.0              | 6.5  |      |
|                               |                                        |                     |           | 50      | —         | 5.5  | 7.5  | 1.0              | 8.5  |      |
| 3-state output enable time    | t <sub>pZL</sub><br>t <sub>pZH</sub>   | RL = 1 kΩ           | 3.3 ± 0.3 | 15      | —         | 8.5  | 13.2 | 1.0              | 15.5 | ns   |
|                               |                                        |                     |           | 50      | —         | 11.0 | 16.7 | 1.0              | 19.0 |      |
|                               |                                        |                     | 5.0 ± 0.5 | 15      | —         | 5.8  | 8.5  | 1.0              | 10.0 |      |
|                               |                                        |                     |           | 50      | —         | 7.3  | 10.6 | 1.0              | 12.0 |      |
| 3-state output disable time   | t <sub>pLZ</sub><br>t <sub>pHZ</sub>   | RL = 1 kΩ           | 3.3 ± 0.3 | 50      | —         | 11.5 | 15.8 | 1.0              | 18.0 | ns   |
|                               |                                        |                     | 5.0 ± 0.5 | 50      | —         | 7.0  | 9.7  | 1.0              | 11.0 |      |
| Output to output skew         | t <sub>osLH</sub><br>t <sub>osHL</sub> | (Note 1)            | 3.3 ± 0.3 | 50      | —         | —    | 1.5  | —                | 1.5  | ns   |
|                               |                                        |                     | 5.0 ± 0.5 | 50      | —         | —    | 1.0  | —                | 1.0  |      |
| Input capacitance             | CIN                                    | DIR, $\overline{G}$ |           |         | —         | 4    | 10   | —                | 10   | pF   |
| Bus input capacitance         | CI/O                                   | An, Bn              |           |         | —         | 8    | —    | —                | —    | pF   |
| Power dissipation capacitance | CPD                                    | (Note 2)            |           |         | —         | 21   | —    | —                | —    | pF   |

Note 1: Parameter guaranteed by design.

$$t_{osLH} = |t_{pLHm} - t_{pLHn}|, t_{osHL} = |t_{pHLm} - t_{pHLn}|$$

Note 2: CPD is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

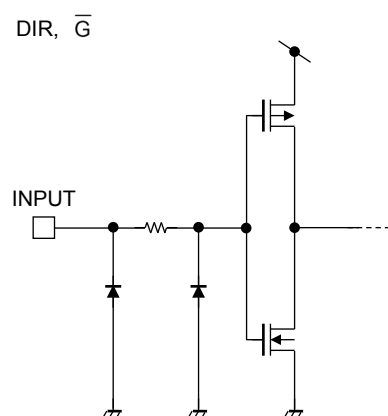
Average operating current can be obtained by the equation:

$$I_{CC}(\text{opr}) = CPD \cdot V_{CC} \cdot f_{IN} + I_{CC} / 8 \text{ (per bit)}$$

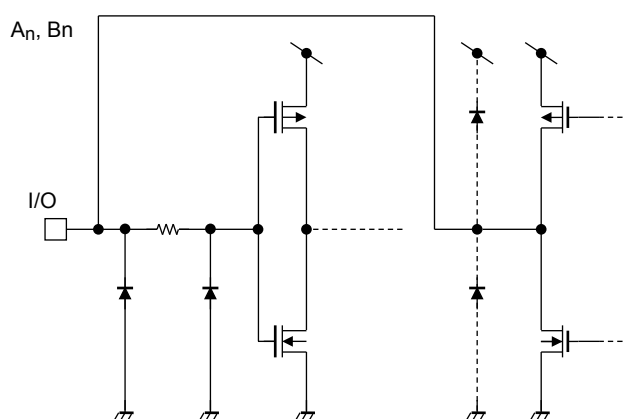
**Noise Characteristics (input:  $t_r = t_f = 3$  ns) (Note)**

| Characteristics                          | Symbol | Test Condition | Ta = 25°C |      | Unit |     |
|------------------------------------------|--------|----------------|-----------|------|------|-----|
|                                          |        |                | VCC (V)   | Typ. |      | Max |
| Quiet output maximum dynamic VOL         | VOLP   | CL = 50 pF     | 5.0       | 0.7  | 1.0  | V   |
| Quiet output minimum dynamic VOL         | VOLV   | CL = 50 pF     | 5.0       | −0.7 | −1.0 | V   |
| Minimum high level dynamic input voltage | VIHD   | CL = 50 pF     | 5.0       | —    | 3.5  | V   |
| Maximum low level dynamic input voltage  | VILD   | CL = 50 pF     | 5.0       | —    | 1.5  | V   |

### Input Equivalent Circuit



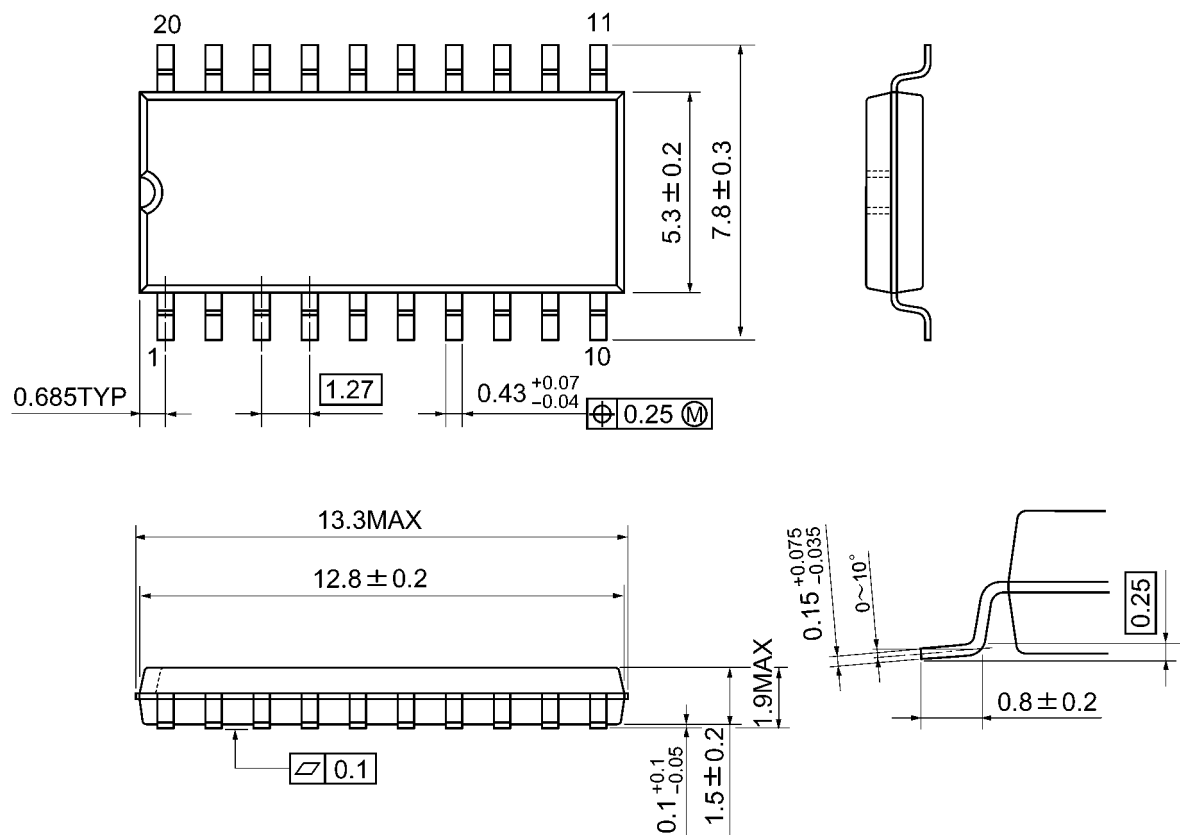
### Bus Terminal Equivalent Circuit



### Package Dimensions

SOP20-P-300-1.27A

Unit: mm

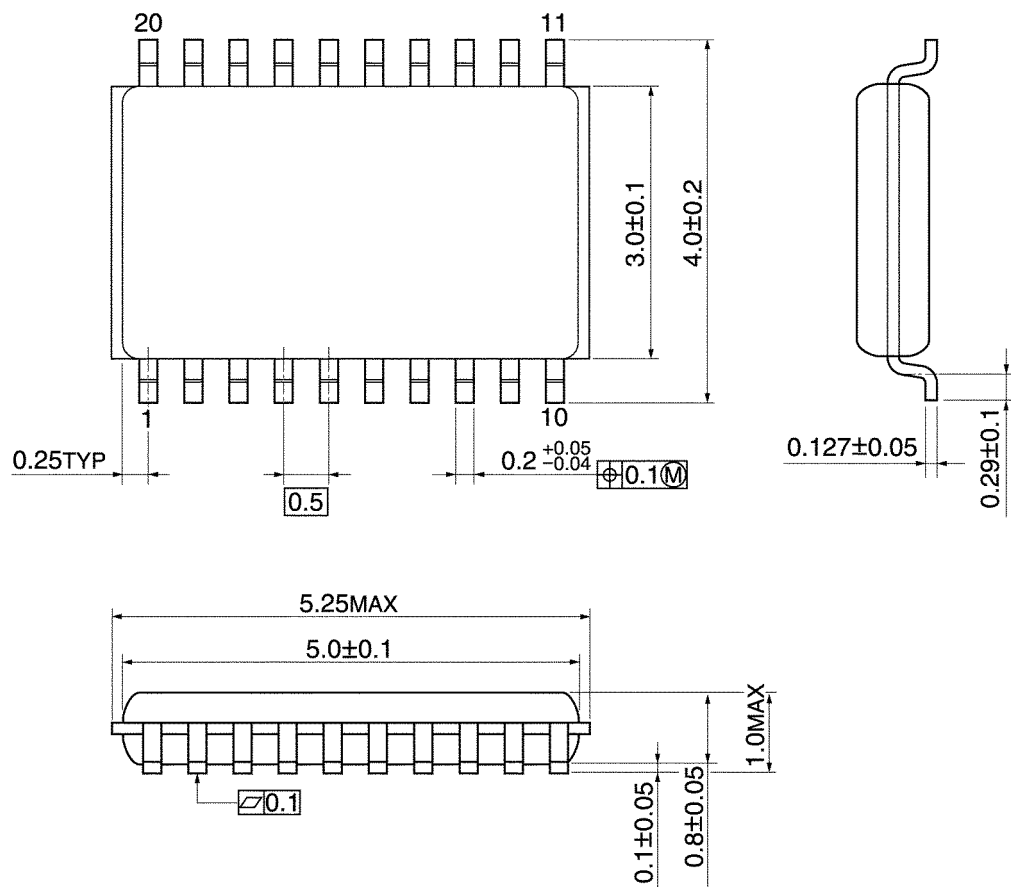


Weight: 0.22 g (typ.)

### Package Dimensions

VSSOP20-P-0030-0.50

Unit: mm



Weight: 0.03 g (typ.)

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