

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

## TC74AC245P, TC74AC245F, TC74AC245FT TC74AC640P, TC74AC640F, TC74AC640FT

### Octal Bus Transceiver

TC74AC245P/F/FT 3-State, Non-Inverting

TC74AC640P/F/FT 3-State, Inverting

The TC74AC245, 640 are advanced high speed CMOS OCTAL BUS TRANSCEIVERS fabricated with silicon gate and double-layer metal wiring C<sup>2</sup>MOS technology.

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

They are 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 ( $\bar{G}$ ) can be used to disable the device so that the busses are effectively isolated.

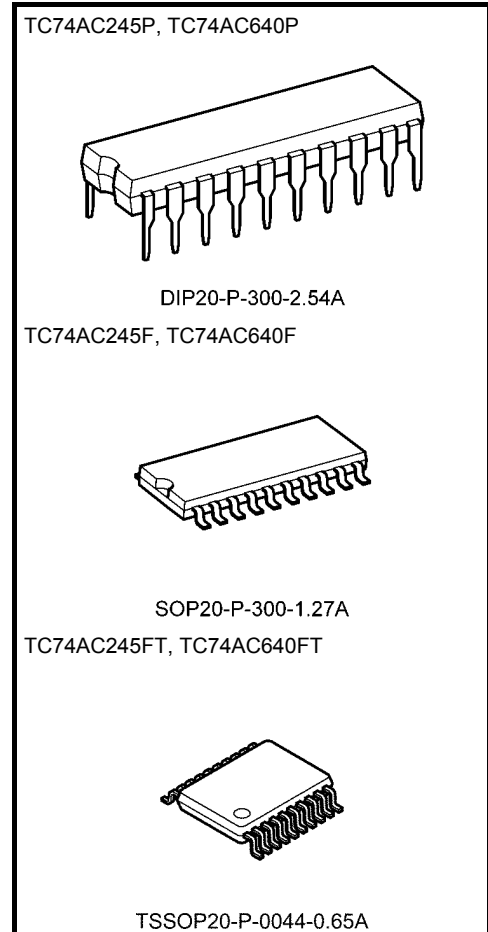
All inputs are equipped with protection circuits against static discharge or transient excess voltage.

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

- High speed:  $t_{pd} = 3.9 \text{ ns (typ.)}$  at  $V_{CC} = 5 \text{ V}$
- Low power dissipation:  $I_{CC} = 8 \mu\text{A (max)}$  at  $T_a = 25^\circ\text{C}$
- High noise immunity:  $V_{NIH} = V_{NIL} = 28\% V_{CC}$  (min)
- Symmetrical output impedance:  
 $|I_{OH}| = I_{OL} = 24 \text{ mA (min)}$   
Capability of driving  $50 \Omega$  transmission lines.
- Balanced propagation delays:  $t_{pLH} \approx t_{pHL}$
- Wide operating voltage range:  $V_{CC} \text{ (opr)} = 2 \text{ V to } 5.5 \text{ V}$
- Pin and function compatible with 74F245/640

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.

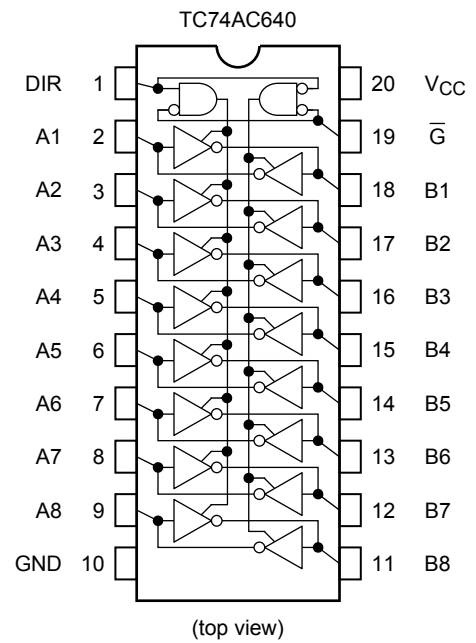
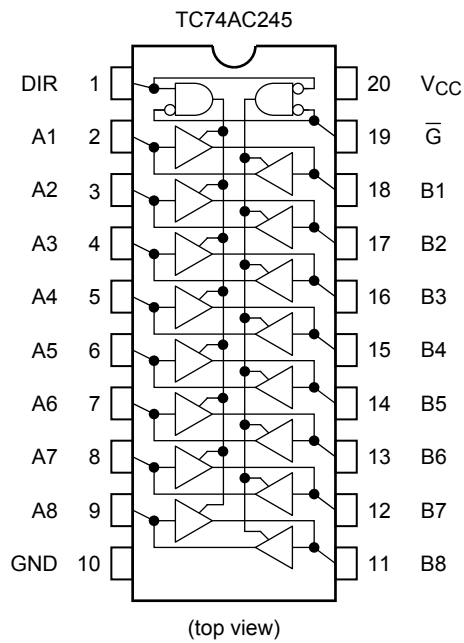


#### Weight

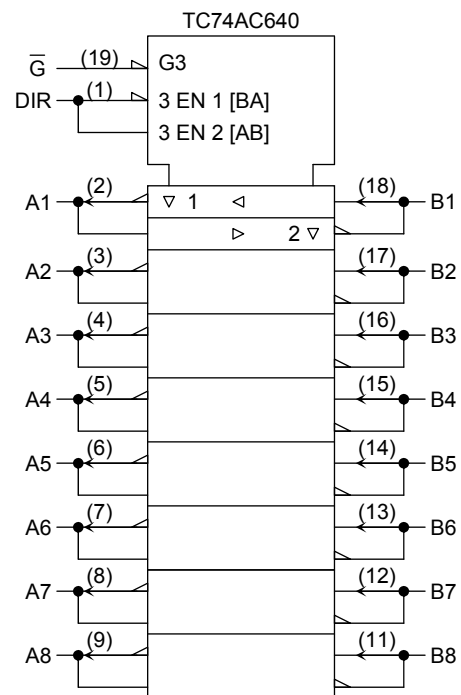
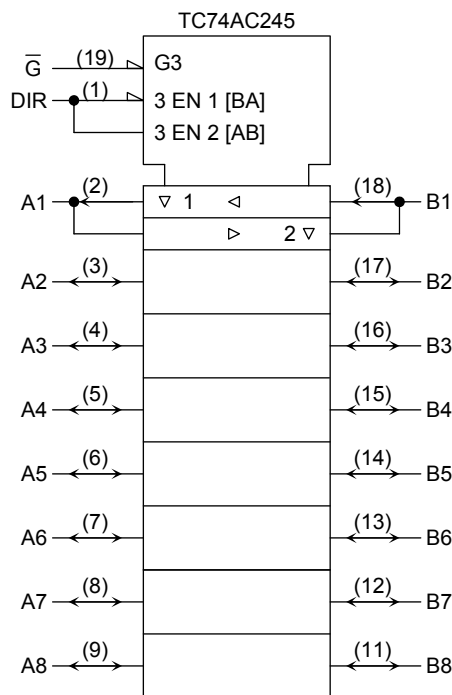
|                      |                 |
|----------------------|-----------------|
| DIP20-P-300-2.54A    | : 1.30 g (typ.) |
| SOP20-P-300-1.27A    | : 0.22 g (typ.) |
| TSSOP20-P-0044-0.65A | : 0.08 g (typ.) |

Start of commercial production  
1986-05

## Pin Assignment



## IEC Logic Symbol



## Truth Table

| Inputs    |     | Function |        | Outputs |               |
|-----------|-----|----------|--------|---------|---------------|
| $\bar{G}$ | DIR | A Bus    | B Bus  | AC245   | AC640         |
| L         | L   | Output   | Input  | A = B   | A = $\bar{B}$ |
| L         | H   | Input    | Output | B = A   | B = $\bar{A}$ |
| H         | X   | Z        |        | Z       | Z             |

X: Don't care

Z: High impedance

## Absolute Maximum Ratings (Note 1)

| Characteristics             | Symbol    | Rating                             | Unit        |
|-----------------------------|-----------|------------------------------------|-------------|
| Supply voltage range        | $V_{CC}$  | -0.5 to 7.0                        | V           |
| DC input voltage            | $V_{IN}$  | -0.5 to $V_{CC} + 0.5$             | V           |
| DC output voltage           | $V_{OUT}$ | -0.5 to $V_{CC} + 0.5$             | V           |
| Input diode current         | $I_{IK}$  | $\pm 20$                           | mA          |
| Output diode current        | $I_{OK}$  | $\pm 50$                           | mA          |
| DC output current           | $I_{OUT}$ | $\pm 50$                           | mA          |
| DC $V_{CC}$ /ground current | $I_{CC}$  | $\pm 200$                          | mA          |
| Power dissipation           | $P_D$     | 500 (DIP) (Note 2)/180 (SOP/TSSOP) | mW          |
| Storage temperature         | $T_{stg}$ | -65 to 150                         | $^{\circ}C$ |

Note 1: 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 2: 500 mW in the range of  $T_a = -40^{\circ}C$  to  $65^{\circ}C$ . From  $T_a = 65^{\circ}C$  to  $85^{\circ}C$  a derating factor of  $-10$  mW/ $^{\circ}C$  should be applied up to 300 mW.

## Operating Ranges (Note)

| Characteristics          | Symbol    | Rating  | Unit        |
|--------------------------|-----------|---|-------------|
| Supply voltage           | $V_{CC}$  | 2.0 to 5.5  | V           |
| Input voltage            | $V_{IN}$  | 0 to $V_{CC}$   | V           |
| Output voltage           | $V_{OUT}$ | 0 to $V_{CC}$   | V           |
| Operating temperature    | $T_{opr}$ | -40 to 85   | $^{\circ}C$ |
| Input rise and fall time | dt/dV     | 0 to 100 ( $V_{CC} = 3.3 \pm 0.3$ V)<br>0 to 20 ( $V_{CC} = 5 \pm 0.5$ V) | ns/V        |

Note: The operating ranges are required 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.

## Electrical Characteristics

### DC Characteristics

| Characteristics                  | Symbol          | Test Condition  |                          | Ta = 25°C           |      |      | Ta = -40 to 85°C |      | Unit |     |
|----------------------------------|-----------------|---|--------------------------|---------------------|------|------|------------------|------|------|-----|
|                                  |                 |   |                          | V <sub>CC</sub> (V) | Min  | Typ. | Max              | Min  |      | Max |
| High-level input voltage         | V <sub>IH</sub> | —   |                          | 2.0                 | 1.50 | —    | —                | 1.50 | —    | V   |
|                                  |                 |   |                          | 3.0                 | 2.10 | —    | —                | 2.10 | —    |     |
|                                  |                 |   |                          | 5.5                 | 3.85 | —    | —                | 3.85 | —    |     |
| Low-level input voltage          | V <sub>IL</sub> | —   |                          | 2.0                 | —    | —    | 0.50             | —    | 0.50 | V   |
|                                  |                 |   |                          | 3.0                 | —    | —    | 0.90             | —    | 0.90 |     |
|                                  |                 |   |                          | 5.5                 | —    | —    | 1.65             | —    | 1.65 |     |
| 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  | —    |     |
|                                  |                 |   | I <sub>OH</sub> = -4 mA  | 3.0                 | 2.58 | —    | —                | 2.48 | —    |     |
|                                  |                 |   | I <sub>OH</sub> = -24 mA | 4.5                 | 3.94 | —    | —                | 3.80 | —    |     |
|                                  |                 | I <sub>OH</sub> = -75 mA (Note)   | 5.5                      | —                   | —    | —    | 3.85             | —    |      |     |
| 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  | V   |
|                                  |                 |   |                          | 3.0                 | —    | 0.0  | 0.1              | —    | 0.1  |     |
|                                  |                 |   |                          | 4.5                 | —    | 0.0  | 0.1              | —    | 0.1  |     |
|                                  |                 |   | I <sub>OL</sub> = 12 mA  | 3.0                 | —    | —    | 0.36             | —    | 0.44 |     |
|                                  |                 |   | I <sub>OL</sub> = 24 mA  | 4.5                 | —    | —    | 0.36             | —    | 0.44 |     |
|                                  |                 | I <sub>OL</sub> = 75 mA (Note)  | 5.5                      | —                   | —    | —    | —                | 1.65 |      |     |
| 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                      | —                   | —    | ±0.5 | —                | ±5.0 | μA   |     |
| Input leakage current            | I <sub>IN</sub> | V <sub>IN</sub> = V <sub>CC</sub> or GND  | 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                      | —                   | —    | 8.0  | —                | 80.0 | μA   |     |

Note: This spec indicates the capability of driving 50 Ω transmission lines.

One output should be tested at a time for a 10 ms maximum duration.

## AC Characteristics (C<sub>L</sub> = 50 pF, R<sub>L</sub> = 500 Ω, input: t<sub>r</sub> = t<sub>f</sub> = 3 ns)

| Characteristics                           | Symbol           | Test Condition                  | Ta = 25°C           |     |      | Ta = -40 to 85°C |     | Unit |     |
|---|------------------|---------------------------------|---------------------|-----|------|------------------|-----|------|-----|
|   |                  |                                 | V <sub>CC</sub> (V) | Min | Typ. | Max              | Min |      | Max |
| Propagation delay time<br>(Note 2)        | t <sub>pLH</sub> | —                               | 3.3 ± 0.3           | —   | 7.0  | 10.9             | 1.0 | 12.4 | ns  |
|   | t <sub>pHL</sub> |                                 | 5.0 ± 0.5           | —   | 5.0  | 7.5              | 1.0 | 8.5  |     |
| Propagation delay time<br>(Note 3)        | t <sub>pLH</sub> | —                               | 3.3 ± 0.3           | —   | 6.4  | 10.0             | 1.0 | 11.4 | ns  |
|   | t <sub>pHL</sub> |                                 | 5.0 ± 0.5           | —   | 4.8  | 7.0              | 1.0 | 8.0  |     |
| Output enable time                        | t <sub>pZL</sub> | —                               | 3.3 ± 0.3           | —   | 9.3  | 15.3             | 1.0 | 17.4 | ns  |
|   | t <sub>pZH</sub> |                                 | 5.0 ± 0.5           | —   | 7.1  | 10.5             | 1.0 | 12.0 |     |
| Output disable time                       | t <sub>pLZ</sub> | —                               | 3.3 ± 0.3           | —   | 7.1  | 11.4             | 1.0 | 13.0 | ns  |
|   | t <sub>pHZ</sub> |                                 | 5.0 ± 0.5           | —   | 5.9  | 8.7              | 1.0 | 10.0 |     |
| Input capacitance                         | C <sub>IN</sub>  | DIR, $\bar{G}$                  | —                   | 5   | 10   | —                | 10  | pF   |     |
| Bus input capacitance                     | C <sub>I/O</sub> | A <sub>n</sub> , B <sub>n</sub> | —                   | 13  | —    | —                | —   | pF   |     |
| Power dissipation capacitance<br>(Note 1) | C <sub>PD</sub>  | TC74AC245                       | —                   | 38  | —    | —                | —   | pF   |     |
|   |                  | TC74AC640                       | —                   | 36  | —    | —                | —   |      |     |

Note 1: C<sub>PD</sub> 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:

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

Note 2: For TC74AC245 only

Note 3: For TC74AC640 only

## Package Dimensions

DIP20-P-300-2.54A

Unit : mm



Weight: 1.30 g (typ.)

## Package Dimensions

SOP20-P-300-1.27A

Unit: mm

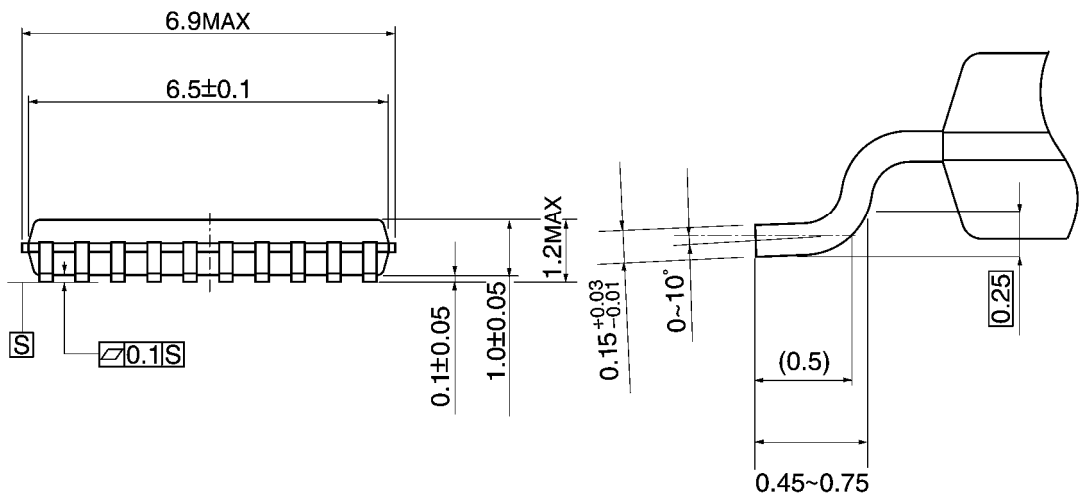
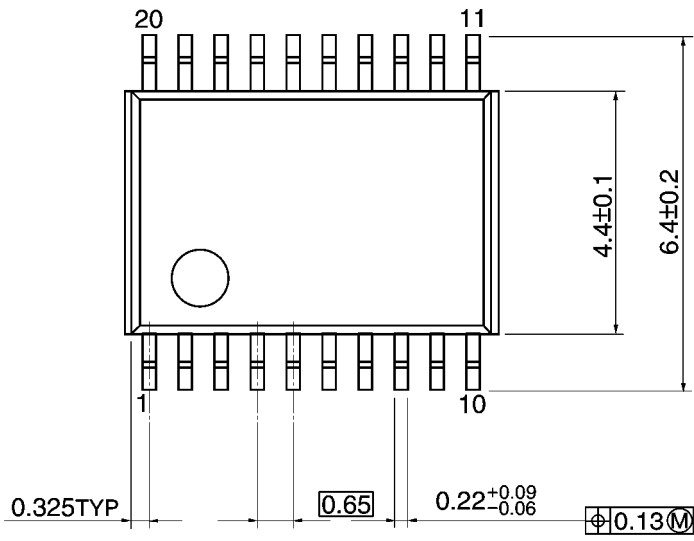


Weight: 0.22 g (typ.)

**Package Dimensions**

TSSOP20-P-0044-0.65A

Unit: mm



Weight: 0.08 g (typ.)



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