

CMOS Digital Integrated Circuits Silicon Monolithic

# TC74AC245FT, TC74AC640FT

## 1. Functional Description

- Octal Bus Transceiver
- TC74AC245FT: 3-State, Non-Inverting
- TC74AC640FT: 3-State, Inverting

## 2. General

The TC74AC245FT, TC74AC640FT 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 ( $\overline{G}$ ) can be used to disable the device so that the busses are effectively isolated.

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

## 3. Features (Note)

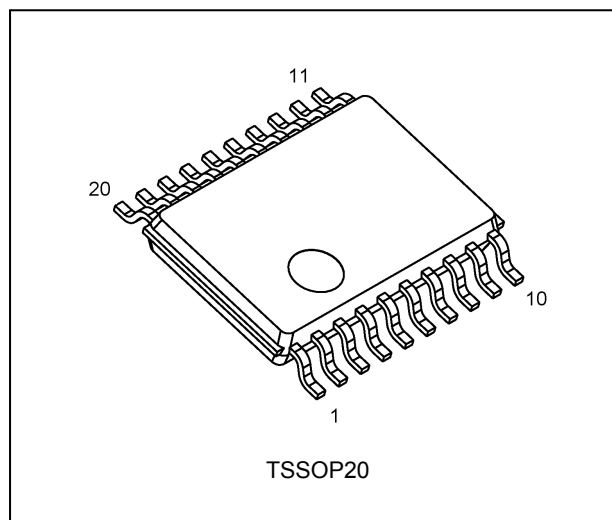
- (1) Wide operating temperature range:  $T_{opr} = -40$  to  $125$  °C (Note 1)
- (2) High speed:  $t_{pd} = 3.9$  ns (typ.) at  $V_{CC} = 5.0$  V
- (3) Low power dissipation:  $I_{CC} = 8.0$   $\mu$ A (max) at  $T_a = 25$  °C
- (4) High noise immunity:  $V_{NIH} = V_{NIL} = 28\%$   $V_{CC}$  (min)
- (5) Output current:  $|I_{OH}|/I_{OL} = 24$  mA (min) ( $V_{CC} = 4.5$  V)
- (6) Balanced propagation delays:  $t_{PLH} \approx t_{PHL}$
- (7) Wide operating voltage range:  $V_{CC(opr)} = 2.0$  V to  $5.5$  V
- (8) Pin and function compatible with 74F245/640.

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.

Note 1: Operating Range spec of  $T_{opr} = -40$  °C to  $125$  °C is applicable only for the products which manufactured after April 2020.

## 4. Packaging

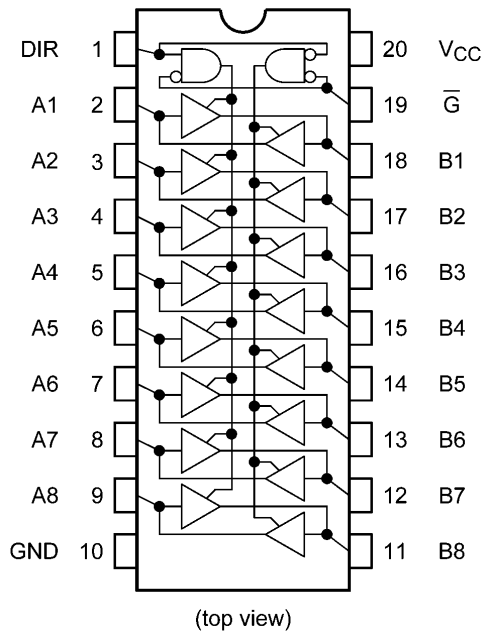


Start of commercial production

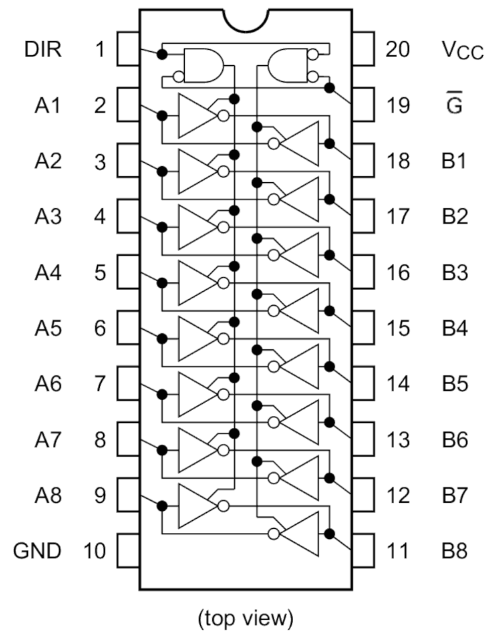
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### 5. Pin Assignment

TC74AC245FT

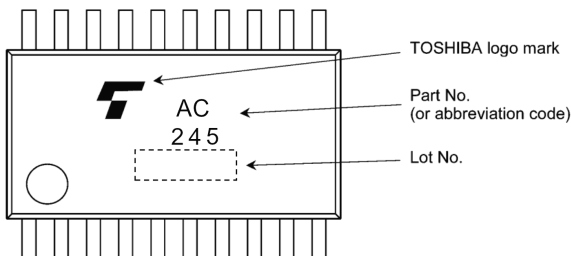


TC74AC640FT

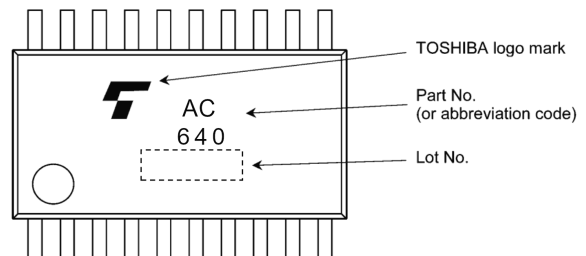


### 6. Marking

TC74AC245FT

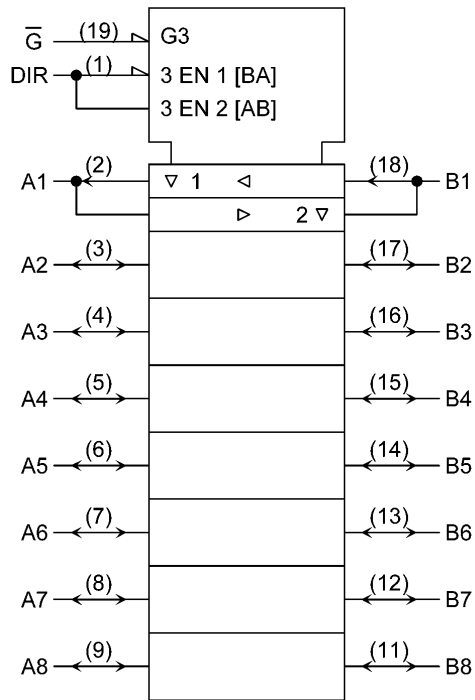


TC74AC640FT

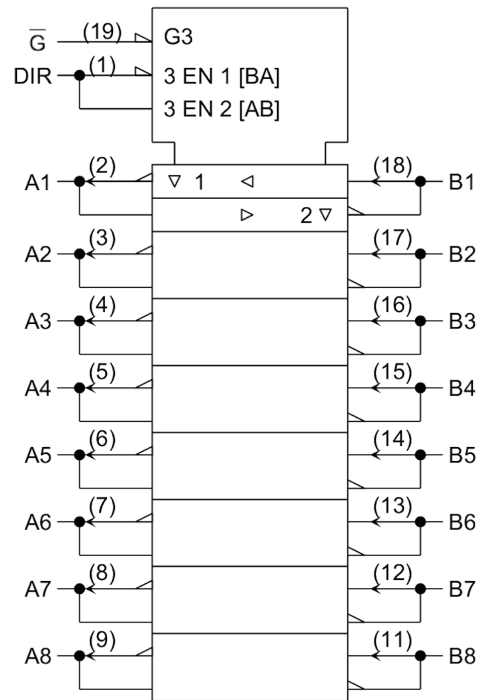


### 7. IEC Logic Symbol

TC74AC245FT



TC74AC640FT



### 8. Truth Table

Input $\bar{G}$	Input DIR	A BUS	B BUS	Output TC74AC245FT	Output TC74AC640FT
L	L	Output	Input	A = B	A = $\bar{B}$
L	H	Input	Output	B = A	B = $\bar{A}$
H	X	Z	Z	Z	Z

X: Don't care

Z: High impedance

### 9. 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 $V_{CC} + 0.5$	V
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
Output current	$I_{OUT}$		$\pm 50$	mA
$V_{CC}$ /ground current	$I_{CC}$		$\pm 200$	mA
Power dissipation	$P_D$	(Note 1)	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).

Note 1: 180 mW in the range of  $T_a = -40$  to  $85$  °C. From  $T_a = 85$  to  $125$  °C a derating factor of  $-3.25$  mW/°C shall be applied until 50 mW.

### 10. Operating Ranges (Note)

Characteristics	Symbol	Note	Test Condition	Rating	Unit
Supply voltage	$V_{CC}$			2.0 to 5.5	V
Input voltage	$V_{IN}$			0 to $V_{CC}$	V
Bus I/O voltage	$V_{I/O}$			0 to $V_{CC}$	V
Operating temperature	$T_{opr}$	(Note 1)		-40 to 125	°C
Input rise and fall times	dt/dv		$V_{CC} = 3.3 \pm 0.3$ V	0 to 100	ns/V
			$V_{CC} = 5.0 \pm 0.5$ V	0 to 20	

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.

Note 1: Operating Range spec of  $T_{opr} = -40$  °C to  $125$  °C is applicable only for the products which manufactured after April 2020.

### 11. Electrical Characteristics

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

Characteristics	Symbol	Test Condition	$V_{CC}$ (V)	Min	Typ.	Max	Unit	
High-level input voltage	$V_{IH}$	—	2.0	1.50	—	—	V	
			3.0	2.10	—	—		
			5.5	3.85	—	—		
Low-level input voltage	$V_{IL}$	—	2.0	—	—	0.50	V	
			3.0	—	—	0.90		
			5.5	—	—	1.65		
High-level output voltage	$V_{OH}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OH} = -50\text{ }\mu\text{A}$	2.0	1.9	2.0	—	V
				3.0	2.9	3.0	—	
			4.5	4.4	4.5	—		
			$I_{OH} = -4\text{ mA}$	3.0	2.58	—	—	
			$I_{OH} = -24\text{ mA}$	4.5	3.94	—	—	
Low-level output voltage	$V_{OL}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OL} = 50\text{ }\mu\text{A}$	2.0	—	0.0	0.1	V
				3.0	—	0.0	0.1	
				4.5	—	0.0	0.1	
			$I_{OL} = 12\text{ mA}$	3.0	—	—	0.36	
			$I_{OL} = 24\text{ mA}$	4.5	—	—	0.36	
3-state output OFF-state leakage current	$I_{OZ}$	$V_{IN} = V_{IH}$ or $V_{IL}$ $V_{OUT} = V_{CC}$ or GND	5.5	—	—	$\pm 0.5$	$\mu\text{A}$	
Input leakage current	$I_{IN}$	$V_{IN} = V_{CC}$ or GND	5.5	—	—	$\pm 0.1$	$\mu\text{A}$	
Quiescent supply current	$I_{CC}$	$V_{IN} = V_{CC}$ or GND	5.5	—	—	8.0	$\mu\text{A}$	

#### 11.2. DC Characteristics (Unless otherwise specified, $T_a = -40$ to $85\text{ }^\circ\text{C}$ )

Characteristics	Symbol	Test Condition	Note	$V_{CC}$ (V)	Min	Max	Unit
High-level input voltage	$V_{IH}$	—		2.0	1.50	—	V
				3.0	2.10	—	
				5.5	3.85	—	
Low-level input voltage	$V_{IL}$	—		2.0	—	0.50	V
				3.0	—	0.90	
				5.5	—	1.65	
High-level output voltage	$V_{OH}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OH} = -50\text{ }\mu\text{A}$	2.0	1.9	—	V
				3.0	2.9	—	
			4.5	4.4	—		
			$I_{OH} = -4\text{ mA}$	3.0	2.48	—	
			$I_{OH} = -24\text{ mA}$	4.5	3.80	—	
			$I_{OH} = -75\text{ mA}$ (Note 1)	5.5	3.85	—	
Low-level output voltage	$V_{OL}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OL} = 50\text{ }\mu\text{A}$	2.0	—	0.1	V
				3.0	—	0.1	
				4.5	—	0.1	
			$I_{OL} = 12\text{ mA}$	3.0	—	0.44	
			$I_{OL} = 24\text{ mA}$	4.5	—	0.44	
			$I_{OL} = 75\text{ mA}$ (Note 1)	5.5	—	1.65	
3-state output OFF-state leakage current	$I_{OZ}$	$V_{IN} = V_{IH}$ or $V_{IL}$ $V_{OUT} = V_{CC}$ or GND		5.5	—	$\pm 5.0$	$\mu\text{A}$
Input leakage current	$I_{IN}$	$V_{IN} = V_{CC}$ or GND		5.5	—	$\pm 1.0$	$\mu\text{A}$
Quiescent supply current	$I_{CC}$	$V_{IN} = V_{CC}$ or GND		5.5	—	80.0	$\mu\text{A}$

Note 1: This spec indicates the capability of driving  $50\text{ }\Omega$  transmission lines.

One output should be tested within a 10 ms maximum duration.

### 11.3. DC Characteristics (Note) (Unless otherwise specified, $T_a = -40$ to $125$ °C)

Characteristics	Symbol	Test Condition		Note	$V_{CC}$ (V)	Min	Max	Unit	
High-level input voltage	$V_{IH}$	—			2.0	1.50	—	V	
					3.0	2.10	—		
					5.5	3.85	—		
Low-level input voltage	$V_{IL}$	—			2.0	—	0.50	V	
					3.0	—	0.90		
					5.5	—	1.65		
High-level output voltage	$V_{OH}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OH} = -50 \mu A$		2.0	1.9	—	V	
					3.0	2.9	—		
					4.5	4.4	—		
					$I_{OH} = -4$ mA	3.0	2.48		—
					$I_{OH} = -24$ mA	4.5	3.70		—
Low-level output voltage	$V_{OL}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OL} = 50 \mu A$		2.0	—	0.1	V	
					3.0	—	0.1		
					4.5	—	0.1		
					$I_{OL} = 12$ mA	3.0	—		0.44
					$I_{OL} = 24$ mA	4.5	—		0.50
3-state output OFF-state leakage current	$I_{OZ}$	$V_{IN} = V_{IH}$ or $V_{IL}$ $V_{OUT} = V_{CC}$ or GND			5.5	—	$\pm 10.0$	$\mu A$	
Input leakage current	$I_{IN}$	$V_{IN} = V_{CC}$ or GND			5.5	—	$\pm 1.0$	$\mu A$	
Quiescent supply current	$I_{CC}$	$V_{IN} = V_{CC}$ or GND			5.5	—	160.0	$\mu A$	

Note: Operating Range spec of  $T_{opr} = -40$  °C to  $125$  °C is applicable only for the products which manufactured after April 2020.

Note 1: This spec indicates the capability of driving  $50 \Omega$  transmission lines.  
One output should be tested within a 10 ms maximum duration.

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

Characteristics	Symbol	Note	Test Condition	$V_{CC}$ (V)	Min	Typ.	Max	Unit
Propagation delay time	$t_{PLH}, t_{PHL}$	(Note 2)	$C_L = 50$ pF $R_L = 500 \Omega$	3.3 $\pm$ 0.3	—	7.0	10.9	ns
				5.0 $\pm$ 0.5	—	5.0	7.5	
		(Note 3)	$C_L = 50$ pF $R_L = 500 \Omega$	3.3 $\pm$ 0.3	—	6.4	10.0	ns
				5.0 $\pm$ 0.5	—	4.8	7.0	
3-state output enable time	$t_{PZL}, t_{PZH}$		$C_L = 50$ pF $R_L = 500 \Omega$	3.3 $\pm$ 0.3	—	9.3	15.3	ns
				5.0 $\pm$ 0.5	—	7.1	10.5	
3-state output disable time	$t_{PLZ}, t_{PHZ}$		$C_L = 50$ pF $R_L = 500 \Omega$	3.3 $\pm$ 0.3	—	7.1	11.4	ns
				5.0 $\pm$ 0.5	—	5.9	8.7	
Input capacitance	$C_{IN}$		DIR, $\bar{G}$		—	5	10	pF
Bus I/O capacitance	$C_{I/O}$		An, Bn		—	13	—	pF
Power dissipation capacitance	$C_{PD}$	(Note 1)	TC74AC245FT		—	38	—	pF
			TC74AC640FT		—	36	—	

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.

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

Note 2: For TC74AC245FT only

Note 3: For TC74AC640FT only

### 11.5. 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)	Min	Max	Unit
Propagation delay time	$t_{PLH}, t_{PHL}$	(Note 1)	$C_L = 50$ pF $R_L = 500$ $\Omega$	$3.3 \pm 0.3$	1.0	12.4	ns
				$5.0 \pm 0.5$	1.0	8.5	
		(Note 2)	$C_L = 50$ pF $R_L = 500$ $\Omega$	$3.3 \pm 0.3$	1.0	11.4	ns
				$5.0 \pm 0.5$	1.0	8.0	
3-state output enable time	$t_{PZL}, t_{PZH}$		$C_L = 50$ pF $R_L = 500$ $\Omega$	$3.3 \pm 0.3$	1.0	17.4	ns
				$5.0 \pm 0.5$	1.0	12.0	
3-state output disable time	$t_{PLZ}, t_{PHZ}$		$C_L = 50$ pF $R_L = 500$ $\Omega$	$3.3 \pm 0.3$	1.0	13.0	ns
				$5.0 \pm 0.5$	1.0	10.0	
Input capacitance	$C_{IN}$		DIR, $\bar{G}$		—	10	pF

Note 1: For TC74AC245FT only

Note 2: For TC74AC640FT only

### 11.6. AC Characteristics (Note)

(Unless otherwise specified,  $T_a = -40$  to  $125$  °C, Input:  $t_r = t_f = 3$  ns)

Characteristics	Symbol	Note	Test Condition	$V_{CC}$ (V)	Min	Max	Unit
Propagation delay time	$t_{PLH}, t_{PHL}$	(Note 1)	$C_L = 50$ pF $R_L = 500$ $\Omega$	$3.3 \pm 0.3$	1.0	13.4	ns
				$5.0 \pm 0.5$	1.0	9.2	
		(Note 2)	$C_L = 50$ pF $R_L = 500$ $\Omega$	$3.3 \pm 0.3$	1.0	12.4	ns
				$5.0 \pm 0.5$	1.0	8.7	
3-state output enable time	$t_{PZL}, t_{PZH}$		$C_L = 50$ pF $R_L = 500$ $\Omega$	$3.3 \pm 0.3$	1.0	18.8	ns
				$5.0 \pm 0.5$	1.0	13.0	
3-state output disable time	$t_{PLZ}, t_{PHZ}$		$C_L = 50$ pF $R_L = 500$ $\Omega$	$3.3 \pm 0.3$	1.0	13.0	ns
				$5.0 \pm 0.5$	1.0	10.0	
Input capacitance	$C_{IN}$		DIR, $\bar{G}$		—	10	pF

Note: Operating Range spec of  $T_{opr} = -40$  °C to  $125$  °C is applicable only for the products which manufactured after April 2020.

Note 1: For TC74AC245FT only

Note 2: For TC74AC640FT only





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