

# TC7MBL3245CFK

## 1. Functional Description

- Low-Voltage, Low-Capacitance Octal Bus Switch

## 2. General

The TC7MBL3245CFK is a Low Voltage/Low Capacitance CMOS 8bit Bus Switch. The low on-resistance of the switch allows connections to be made with minimal propagation delay time.

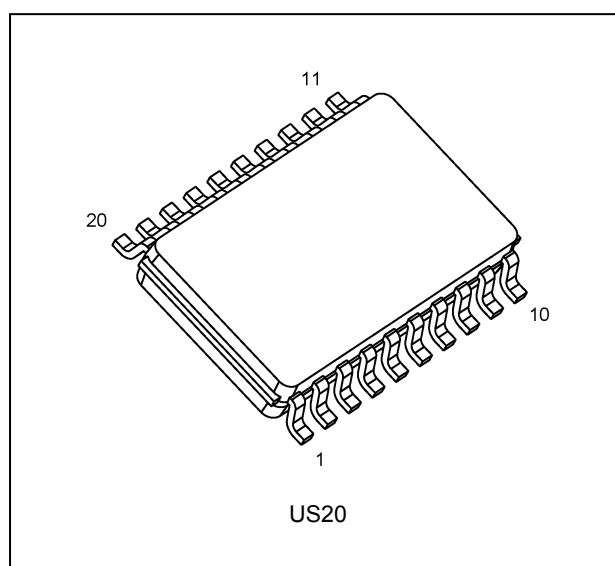
The TC7MBL3245CFK requires the output enable ( $\overline{OE}$ ) input to be set high to place the output into the high impedance.

All inputs are equipped with protection circuits against static discharge.

## 3. Features

- (1) Operating voltage:  $V_{CC} = 1.65$  to  $3.6$  V
- (2) ON capacitance:  $C_{I/O} = 7.5$  pF Switch On (typ.) @  $V_{CC} = 3.0$  V
- (3) ON resistance:  $R_{ON} = 6.5$   $\Omega$  (typ.) @  $V_{CC} = 3.0$  V,  $V_{IS} = 0$  V
- (4) Power-down protection for inputs ( $\overline{OE}$  and I/O)
- (5) Package: VSSOP20 (US20)

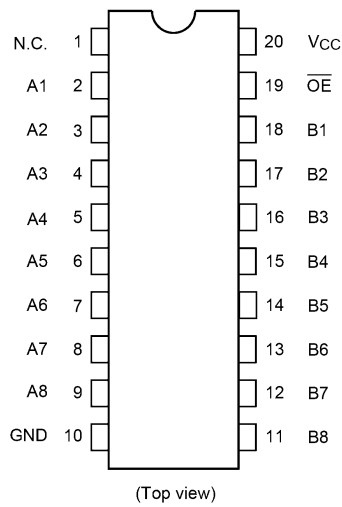
## 4. Packaging



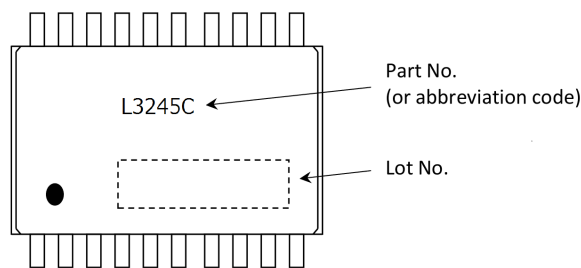
Start of commercial production

2008-06

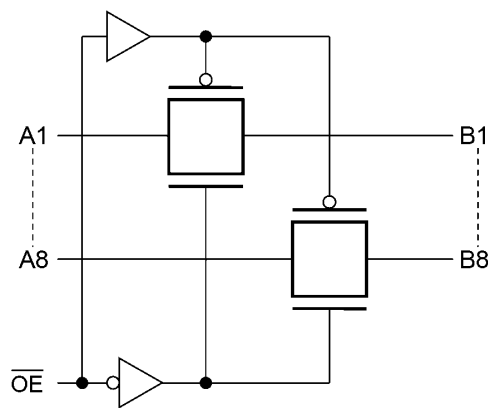
5. Pin Assignment



6. Marking



7. Block Diagram



8. Truth Table

Inputs $\overline{OE}$	Function
L	A port = B port
H	Disconnect

### 9. Absolute Maximum Ratings (Note)

Characteristics	Symbol	Note	Test Condition	Rating	Unit
Supply voltage	$V_{CC}$			-0.5 to 4.6	V
Input voltage ( $\overline{OE}$ )	$V_{IN}$			-0.5 to 4.6	V
Switch I/O voltage	$V_S$		$V_{CC} = 0$ V or Switch = Off	-0.5 to 4.6	V
			Switch = On	-0.5 to $V_{CC} + 0.5$	
Clamp diode current	$I_{IK}$			-50	mA
Switch I/O current	$I_S$			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	°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).

### 10. Operating Ranges (Note)

Characteristics	Symbol	Test Condition	Rating	Unit
Supply voltage	$V_{CC}$		1.65 to 3.6	V
Input voltage ( $\overline{OE}$ )	$V_{IN}$		0 to 3.6	V
Switch I/O voltage	$V_S$	$V_{CC} = 0$ V or Switch = Off	0 to 3.6	V
		Switch = On	0 to $V_{CC}$	
Operating temperature	$T_{opr}$		-40 to 85	°C
Input rise time	$dt/dv$		0 to 10	ns/V

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

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

### 11. Electrical Characteristics

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

Characteristics	Symbol	Note	Test Condition	$V_{CC}$ (V)	Min	Typ.	Max	Unit
High-level input voltage ( $\overline{OE}$ )	$V_{IH}$		—	1.65 to 3.6	$0.7 \times V_{CC}$	—	—	V
Low-level input voltage ( $\overline{OE}$ )	$V_{IL}$		—	1.65 to 3.6	—	—	$0.3 \times V_{CC}$	V
Input leakage current ( $\overline{OE}$ )	$I_{IN}$		$V_{IN} = 0$ to $3.6\text{ V}$	1.65 to 3.6	—	—	$\pm 1.0$	$\mu\text{A}$
Power-OFF leakage current	$I_{OFF}$		$\overline{OE}$ , A, B = $0$ to $3.6\text{ V}$	0	—	—	10	$\mu\text{A}$
Switch OFF-state leakage current	$I_{SZ}$		A, B = $0\text{ V}$ to $V_{CC}$ , $\overline{OE} = V_{CC}$	1.65 to 3.6	—	—	$\pm 1.0$	$\mu\text{A}$
ON-resistance	$R_{ON}$	(Note 1), (Note 2)	$V_{IS} = 0\text{ V}$ , $I_{IS} = 30\text{ mA}$	3.0	—	6.5	11.0	$\Omega$
			$V_{IS} = 3.0\text{ V}$ , $I_{IS} = 30\text{ mA}$	3.0	—	11.0	16.0	
			$V_{IS} = 2.4\text{ V}$ , $I_{IS} = 15\text{ mA}$	3.0	—	12.0	18.0	
			$V_{IS} = 0\text{ V}$ , $I_{IS} = 24\text{ mA}$	2.3	—	7.0	11.0	
			$V_{IS} = 2.3\text{ V}$ , $I_{IS} = 24\text{ mA}$	2.3	—	13.0	20.0	
			$V_{IS} = 2.0\text{ V}$ , $I_{IS} = 15\text{ mA}$	2.3	—	15.0	21.0	
			$V_{IS} = 0\text{ V}$ , $I_{IS} = 4\text{ mA}$	1.65	—	8.0	14.0	
			$V_{IS} = 1.65\text{ V}$ , $I_{IS} = 4\text{ mA}$	1.65	—	17.0	26.0	
Quiescent supply current	$I_{CC}$		$V_{IN} = V_{CC}$ or GND, $I_{OUT} = 0\text{ A}$	3.6	—	—	10	$\mu\text{A}$

Note 1: All typical values are at  $T_a = 25\text{ }^{\circ}\text{C}$ .

Note 2: Measured by the voltage drop between A and B pins at the indicated current through the switch. On-resistance is determined by the lower of the voltages on the two (A or B) pins.

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

Characteristics	Symbol	Test Condition	$V_{CC}$ (V)	Min	Max	Unit
Output enable time	$t_{PZL}, t_{PZH}$	See Fig. 11.4., 11.5.1, Table 11.4.1	$3.3 \pm 0.3$	—	6	ns
			$2.5 \pm 0.2$	—	7	
			$1.8 \pm 0.15$	—	11	
Output disable time	$t_{PLZ}, t_{PHZ}$	See Fig. 11.4., 11.5.1, Table 11.4.1	$3.3 \pm 0.3$	—	6	ns
			$2.5 \pm 0.2$	—	7	
			$1.8 \pm 0.15$	—	11	

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

Characteristics	Symbol	Test Condition	$V_{CC}$ (V)	Typ.	Unit
Input capacitance	$C_{IN}$	$V_{IN} = 0\text{ V}$	3.0	4	pF
Switch terminal OFF-capacitance	$C_{I/O}$	$\overline{OE} = V_{CC}$ , $V_{IS} = 0\text{ V}$	3.0	3.5	pF
Switch terminal ON-capacitance	$C_{I/O}$	$\overline{OE} = \text{GND}$ , $V_{IS} = 0\text{ V}$	3.0	7.5	pF

Note: Parameter guaranteed by design.

11.4. AC Test Circuits

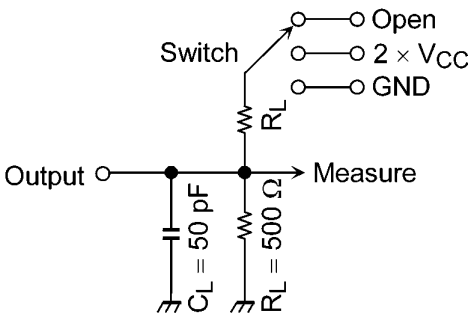


Table 11.4.1 Parameter for AC Test Circuit

Parameter	Switch
$t_{PLZ}, t_{PZL}$	$2 \times V_{CC}$
$t_{PHZ}, t_{PZH}$	GND

11.5. AC Waveform

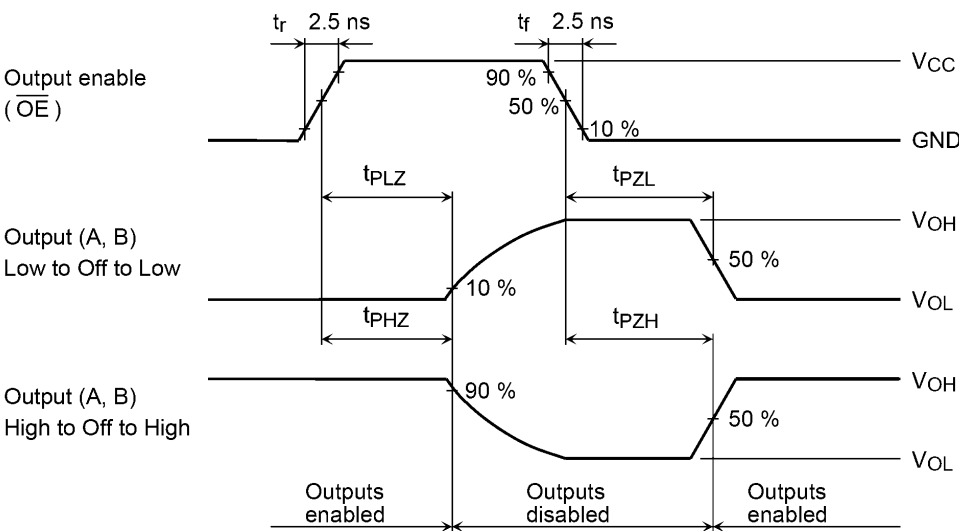


Fig. 11.5.1 AC Waveform  $t_{PLZ}$ ,  $t_{PHZ}$ ,  $t_{PZL}$ ,  $t_{PZH}$

### 12. Rise and Fall Time ( $t_r/t_f$ )

The  $t_{r(out)}$  and  $t_{f(out)}$  values of the output signals are affected by the CR time constant of the input, which consists of the switch terminal capacitance ( $C_{I/O}$ ) and the on-resistance ( $R_{ON}$ ) of the input.

In practice, the  $t_{r(out)}$  and  $t_{f(out)}$  values are also affected by the circuit's capacitance and resistance components other than those of the TC7MBL3245CFK.

The  $t_{r(out)}/t_{f(out)}$  values can be approximated as follows. (Figure 12.1, Table 12.1 shows the test circuit.)

$$t_{r(out)}/t_{f(out)} (\text{approx}) = - (C_{I/O} + C_L) \cdot (R_{DRIVE} + R_{ON}) \cdot \ln ((V_{OH} - V_{OL}) \cdot V_M / (V_{OH} - V_{OL}))$$

Where,  $R_{DRIVE}$  is the output impedance of the previous-stage circuit.

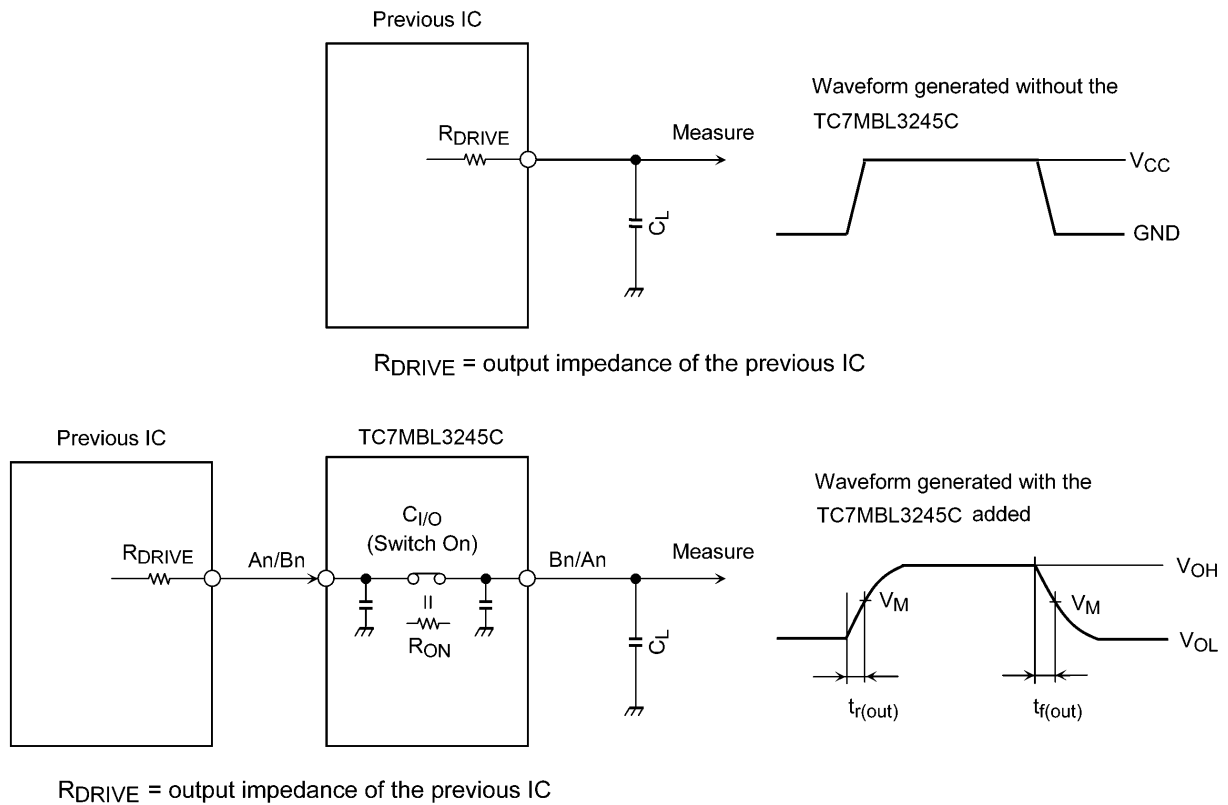
Calculation example:

$$t_{r(out)} (\text{approx}) = - (7.5 + 15) \text{ E } - 12 \cdot (120 + 6.5) \cdot \ln (((3.0 - 0) \cdot 1.5) / (3.0 - 0)) \approx 2.0 \text{ ns}$$

Calculation conditions:

$V_{CC} = 3.0 \text{ V}$ ,  $C_L = 15 \text{ pF}$ ,  $R_{DRIVE} = 120 \Omega$  (output impedance of the previous IC),  $V_M = 1.5 \text{ V}$  ( $V_{CC}/2$ )

Output of the previous IC = digital (i.e., high-level voltage =  $V_{CC}$ , low-level voltage = GND)



**Fig. 12.1 Calculation Circuit**

**Table 12.1 Calculation Circuit**

Characteristics	$V_{CC} = 3.3 \pm 0.3 \text{ V}$	$V_{CC} = 2.5 \pm 0.2 \text{ V}$	$V_{CC} = 1.8 \pm 0.15 \text{ V}$
$V_M$	$V_{CC}/2$	$V_{CC}/2$	$V_{CC}/2$

## 13. Characteristics Curves (Note)

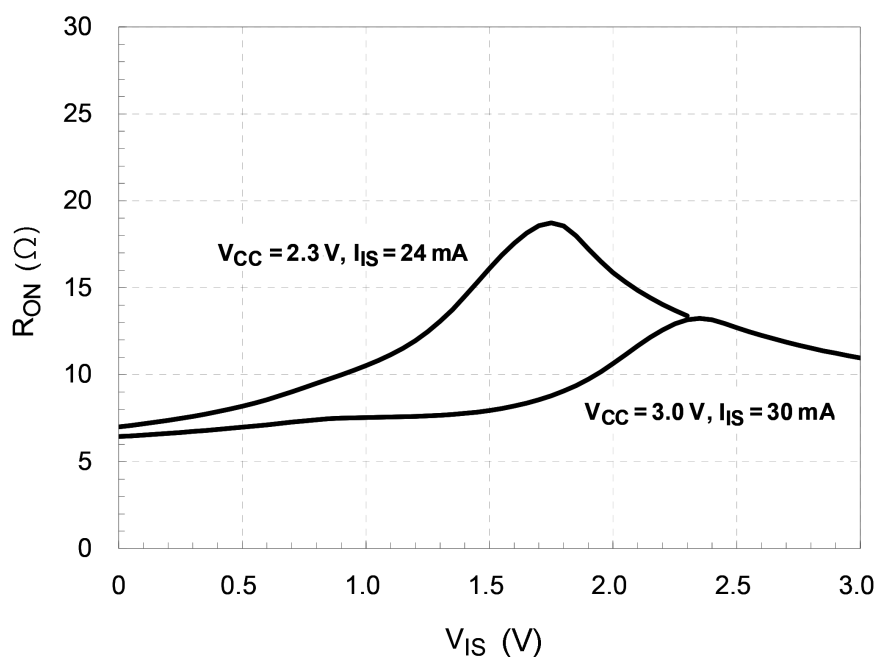
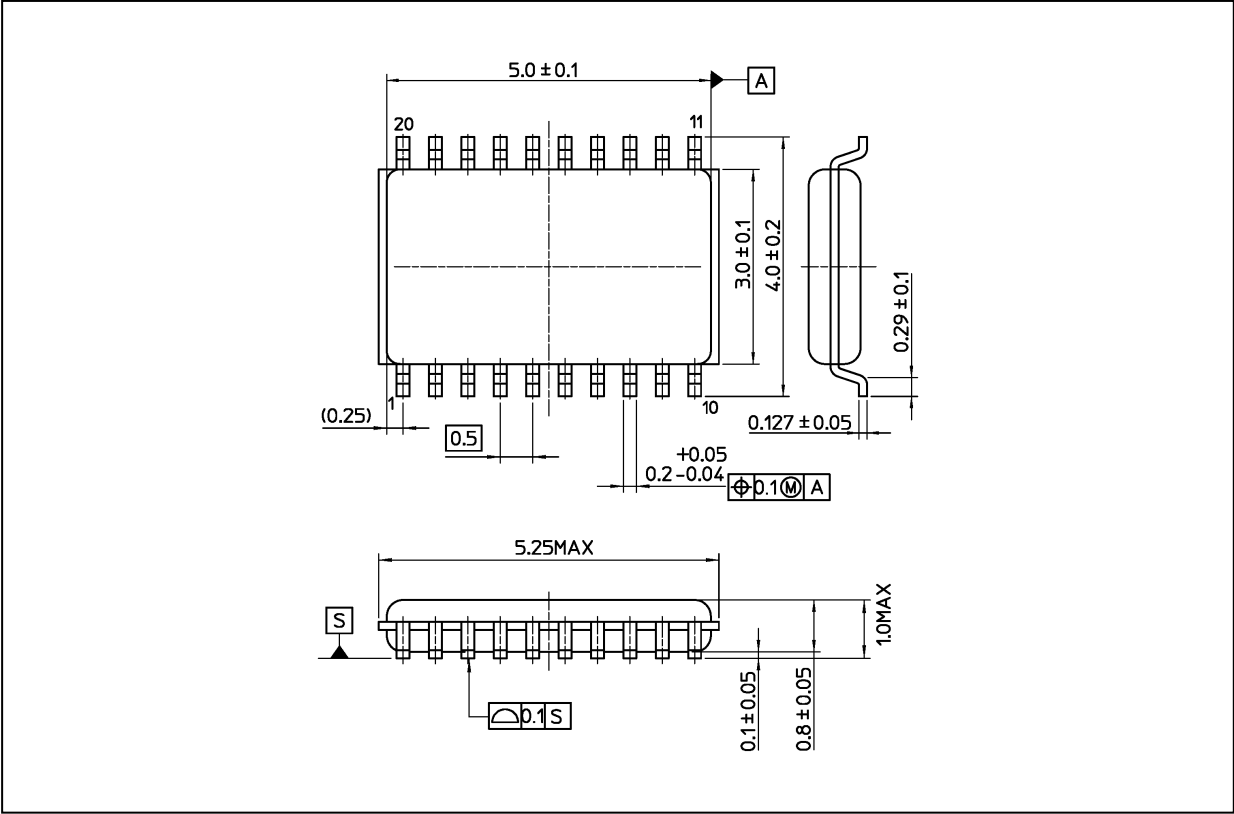


Fig. 13.1  $R_{ON} - V_{IS}$  (typ.) ( $T_a = 25\text{ }^{\circ}\text{C}$ )

Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.

Package Dimensions

Unit: mm



Weight: 0.03 g (typ.)

Package Name(s)
Nickname: US20



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