

CMOS Digital Integrated Circuits Silicon Monolithic

TC7MBL3257CFT

1. Functional Description

4-Bit 1-of-2 Multiplexer/Demultiplexer

2. General

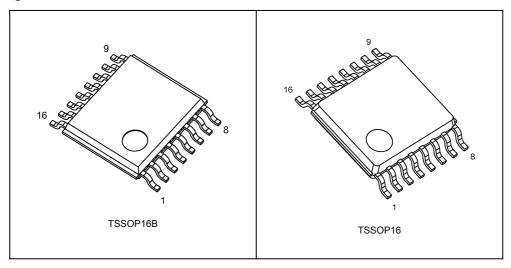
The TC7MBL3257CFT is a low-voltage/low-capacitance CMOS 4bit 1-of-2 Multiplexer/Demultiplexer. The low on-resistance of the switch allows connections to be made with minimal propagation delay time.

This device consists of four individual two-inputs multiplexer/demultiplexer with common select input (S) and output enable (\overline{OE}) . The A input is connected to the B1 or B2 outputs as determined by the combination of both the select input (S) and output enable (\overline{OE}) . When the output enable (\overline{OE}) input is held at "H" level, the switches are open regardless of the state of the select inputs, and a high-impedance state exists between the switches. All inputs are equipped with protection circuits against static discharge.

3. Features

- (1) AEC-Q100 (rev.H) Grade 1 qualified (Note 1)
- (2) Wide operating temperature range: $T_{opr} = -40$ to 125 °C (Note 2)
- (3) Operating voltage: $V_{CC} = 1.65$ to 3.6 V
- (4) -3dB Bandwidth: BW = 510 MHz (typ.) @ V_{CC} = 3.3 V
- (5) ON capacitance: $C_{I/O} = 8 \text{ pF Switch On (typ.)} @V_{CC} = 3.0 \text{ V}$
- (6) ON resistance: $R_{ON} = 8.5 \Omega$ (typ.) @ $V_{CC} = 3.0 \text{ V}$, $V_{IS} = 0 \text{ V}$
- (7) Power-down protection for inputs $(\overline{OE}, S \text{ and } I/O)$
- (8) Package: TSSOP16, TSSOP16B
- Note 1: This device is compliant with the reliability requirements of AEC-Q100. For details, contact your Toshiba sales representative.
- Note 2: Operating Range spec of T_{opr} = -40 °C to 125 °C is applicable only for the products which manufactured after April 2020.

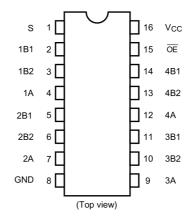
4. Packaging



Start of commercial production



5. Pin Assignment



6. Marking (Note)

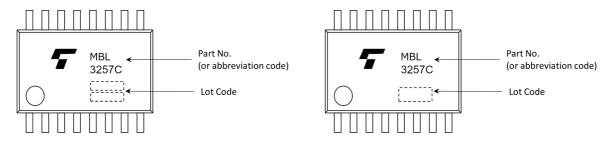
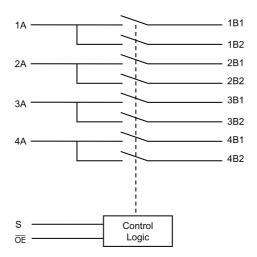


Fig. 6.1 TSSOP16B

Fig. 6.2 TSSOP16

Note: Package name TSSOP16B for devices with the ordering part number ending in J.

7. System Diagram



8. Truth Table

	Inputs OE	Inputs S	Function
Ī	L	L	A port = B1 port
Ī	L	Н	A port = B2 port
ſ	Н	Х	Disconnect

X: Don't care



9. Absolute Maximum Ratings (Note)

Characteristics	Symbol	Note	Test Condition	Rating	Unit
Supply voltage	V _{CC}			-0.5 to 4.6	V
Input voltage	V _{IN}			-0.5 to 4.6	V
Switch I/O voltage	Vs		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	(Note 1)		180	mW
V _{CC} /ground current	I _{CC} /I _{GND}			±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).

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}			1.65 to 3.6	V
Input voltage	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}	(Note 1)		-40 to 125	°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.

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 = -40 to 85 °C)

Characteristics	Symbol	Note	Test Condition	V _{CC} (V)	Min	Тур.	Max	Unit
High-level input voltage (OE, S)	V _{IH}		_	1.65 to 3.6	$0.7 \times V_{CC}$	_	_	V
Low-level input voltage (OE, S)	V _{IL}		_	1.65 to 3.6	_	_	$0.3 \times V_{CC}$	V
Input leakage current (OE, S)	I _{IN}		V _{IN} = 0 to 3.6 V	1.65 to 3.6	_	_	±1.0	μА
Power-OFF leakage current	I _{OFF}		OE, S, A, B = 0 to 3.6 V	0	_	_	10	μА
Switch OFF-state leakage current	I _{SZ}		$\frac{A, B = 0 \text{ V to V}_{CC},}{OE = V_{CC}}$	1.65 to 3.6	_	_	±1.0	μА
ON-resistance	R _{ON}	(Note 1), (Note 2)	$V_{IS} = 0 V,$ $I_{IS} = 30 \text{ mA}$	3.0	_	8.5	13	Ω
			V _{IS} = 3.0 V, I _{IS} = 30 mA	3.0	_	16	24	
			V _{IS} = 2.4 V, I _{IS} = 15 mA	3.0	_	18	27	
			V _{IS} = 0 V, I _{IS} = 24 mA	2.3	_	10	15	
			V _{IS} = 2.3 V, I _{IS} = 24 mA	2.3	_	20	30	
			V _{IS} = 2.0 V, I _{IS} = 15 mA	2.3	_	23	33	
			V _{IS} = 0 V, I _{IS} = 4 mA	1.65	_	12	18	
			V _{IS} = 1.65 V, I _{IS} = 4 mA	1.65	_	26	37	
Quiescent supply current	I _{CC}		V _{IN} = V _{CC} or GND, I _{OUT} = 0 A	3.6	_	_	10	μА

Note 1: All typical values are at T_a = 25 °C.

Rev.9.0

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. DC Characteristics (Note) (Unless otherwise specified, Ta = -40 to 125 °C)

Characteristics	Symbol	Note	Test Condition	V _{CC} (V)	Min	Max	Unit
High-level input voltage (OE, S)	V _{IH}		_	1.65 to 3.6	0.7×V _{CC}	_	V
Low-level input voltage (OE, S)	V _{IL}		_	1.65 to 3.6	_	0.3×V _{CC}	V
Input leakage current (OE, S)	I _{IN}		V _{IN} = 0 to 3.6 V	1.65 to 3.6	_	±10.0	μА
Power-OFF leakage current	I _{OFF}		OE, S, A, B = 0 to 3.6 V	0	_	40	μА
Switch OFF-state leakage current	I _{SZ}		$\frac{A, B = 0 \text{ V to V}_{CC},}{OE = V_{CC}}$	1.65 to 3.6	_	±10.0	μА
ON-resistance	R _{ON}	(Note 1)	V _{IS} = 0 V, I _{IS} = 30 mA	3.0	_	15	Ω
			V _{IS} = 3.0 V, I _{IS} = 30 mA	3.0	_	26	
			V _{IS} = 2.4 V, I _{IS} = 15 mA	3.0	_	30	
			V _{IS} = 0 V, I _{IS} = 24 mA	2.3	_	17	
			V _{IS} = 2.3 V, I _{IS} = 24 mA	2.3	_	33	
			V _{IS} = 2.0 V, I _{IS} = 15 mA	2.3	_	36	
			V _{IS} = 0 V, I _{IS} = 4 mA	1.65		20	
			V _{IS} = 1.65 V, I _{IS} = 4 mA	1.65		39	
Quiescent supply current	I _{CC}		$V_{IN} = V_{CC}$ or GND, $I_{OUT} = 0$ A	3.6	_	40	μА

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: 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.

11.3. AC Characteristics (Unless otherwise specified, $T_a = -40$ to 85 °C)

Characteristics	Symbol	Test Condition	V _{CC} (V)	Min	Max	Unit
Output enable time	t_{PZL}, t_{PZH}	See Fig. 11.7.1, 11.8.1,	3.3 ± 0.3	_	6	ns
(OE to bus)		Table 11.7.1	2.5 ± 0.2	_	7	
			1.8 ± 0.15	_	11	
Output enable time	t_{PZL}, t_{PZH}	_{ZL} ,t _{PZH} See Fig. 11.7.1, 11.8.1,		_	6	ns
(S to bus)		Table 11.7.1	2.5 ± 0.2	_	7	
			1.8 ± 0.15	_	11	
Output disable time	t_{PLZ}, t_{PHZ}	See Fig. 11.7.1, 11.8.1,	3.3 ± 0.3	_	6	ns
(OE to bus)		Table 11.7.1	2.5 ± 0.2	_	7	
			1.8 ± 0.15	_	11	
Output disable time	t_{PLZ}, t_{PHZ}	See Fig. 11.7.1, 11.8.1,	3.3 ± 0.3	_	6	ns
(S to bus)		Table 11.7.1	2.5 ± 0.2	_	7	
			1.8 ± 0.15	_	11	



11.4. AC Characteristics (Note) (Unless otherwise specified, T_a = -40 to 125 °C)

Characteristics	Symbol	Test Condition	V _{CC} (V)	Min	Max	Unit
Output enable time	t_{PZL},t_{PZH}	See Fig. 11.7.1, 11.8.1,	3.3 ± 0.3	_	7	ns
(OE to bus)		Table 11.7.1	2.5 ± 0.2	_	8	
			1.8 ± 0.15	_	12	
Output enable time	t_{PZL}, t_{PZH}	See Fig. 11.7.1, 11.8.1,	3.3 ± 0.3	_	7	ns
(S to bus)		Table 11.7.1	2.5 ± 0.2	_	8	
			1.8 ± 0.15	_	12	
Output disable time	t_{PLZ}, t_{PHZ}	See Fig. 11.7.1, 11.8.1,	3.3 ± 0.3	_	7	ns
(OE to bus)		Table 11.7.1	2.5 ± 0.2	_	8	
			1.8 ± 0.15	_	12	
Output disable time	t_{PLZ}, t_{PHZ}	See Fig. 11.7.1, 11.8.1,	3.3 ± 0.3	_	7	ns
(S to bus)		Table 11.7.1	2.5 ± 0.2	_	8	
			1.8 ± 0.15	_	12	

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

11.5. Switch Characteristics (Note) (Unless otherwise specified, Ta = 25 °C)

Characteristics	Symbol	Test Condition	V _{CC} (V)	Тур.	Unit
-3dB Bandwidth	BW	S21 Single-ended. See Fig. 13.2	3.3	510	MHz

Note: Parameter guaranteed by design.

11.6. Capacitive Characteristics (Note) (Unless otherwise specified, T_a = 25 °C)

Characteristics	Symbol	Test Condition	V _{CC} (V)	Тур.	Unit
Input capacitance (OE, S)	C _{IN}	V _{IN} = 0 V	3.0	4	pF
Switch terminal OFF-capacitance (B1, B2)	C _{I/O}	$\overline{OE} = V_{CC}, V_{IS} = 0 V$	3.0	3	pF
Switch terminal OFF-capacitance (A)	C _{I/O}	$\overline{OE} = V_{CC}, V_{IS} = 0 V$	3.0	5	pF
Switch terminal ON-capacitance (B1, B2)	C _{I/O}	OE = GND, V _{IS} = 0 V	3.0	8	pF
Switch terminal ON-capacitance (A)	C _{I/O}	OE = GND, V _{IS} = 0 V	3.0	8	pF

Note: Parameter guaranteed by design.



11.7. AC Test Circuits

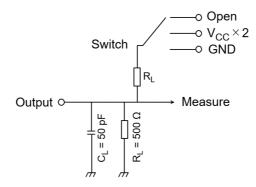


Fig. 11.7.1 AC Test Circuits

Table 11.7.1 Parameter for AC Test Circuit

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

11.8. AC Waveform

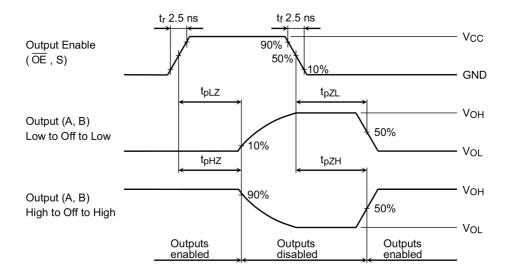


Fig. 11.8.1 AC Waveform t_{PLZ} , t_{PHZ} , t_{PZL} , t_{PZH}



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 TC7MBL3257CFT.

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

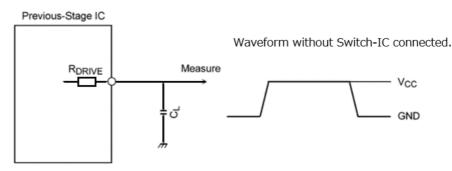
 $t_{r(out)}/t_{f(out)} \ (approx) = - (C_{L/O} + C_L) \ \cdot \ (R_{DRIVE} + R_{ON}) \ \cdot \ ln \ (((V_{OH} - V_{OL}) - V_M) \ / \ (V_{OH} - V_{OL}))$ Where, R_{DRIVE} is the output impedance of the previous-stage circuit.

Calculation example:

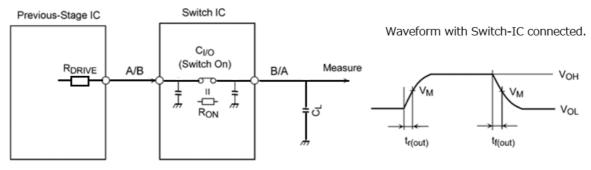
$$t_{r(out)}$$
 (approx) = - (8 + 15) E - 12 · (120 + 8.5) · ln (((3.0 - 0) - 1.5) / (3.0 - 0)) \approx 2.1 ns

Calculation conditions:

 V_{CC} = 3.0 V, C_L = 15 pF, R_{DRIVE} = 120 Ω (output impedance of the previous IC), V_M = 1.5 V (V_{CC} /2) Output of the previous IC = digital (i.e., high-level voltage = V_{CC} , low-level voltage = GND)



R_{DRIVE} = output impedance of the previous-stage IC



RDRIVE = output impedance of the previous-stage IC

Fig. 12.1 Calculation Circuit

Table 12.1 Calculation Circuit

Characteristics	V_{CC} = 3.3 \pm 0.3 V	V_{CC} = 2.5 ± 0.2 V	V _{CC} = 1.8 ± 0.15 V
V _M	V _{CC} /2	V _{CC} /2	V _{CC} /2

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13. Characteristics Curves (Note)

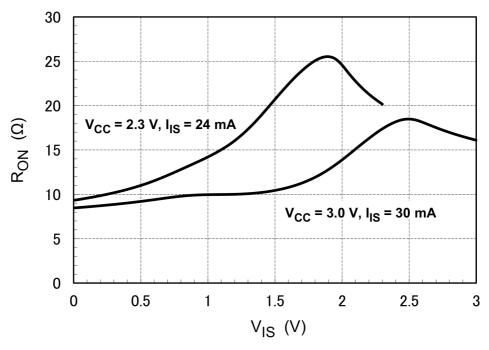


Fig. 13.1 R_{ON} - V_{IS} (typ.) ($T_a = 25$ °C)

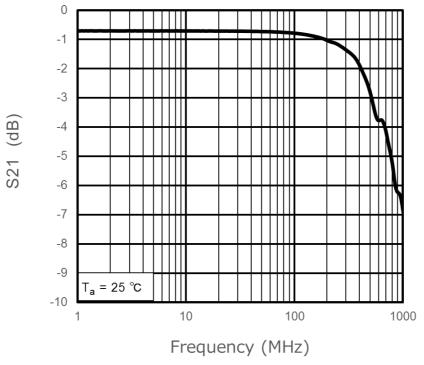


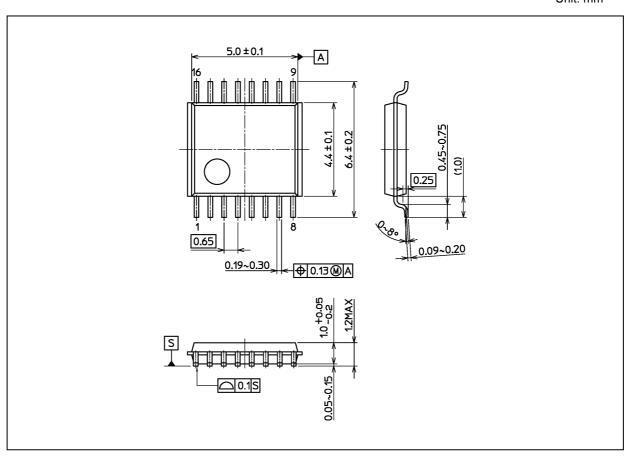
Fig. 13.2 S21 1A-1B1 (Typ.) (Ta = 25 °C)

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



Package Dimensions

Unit: mm



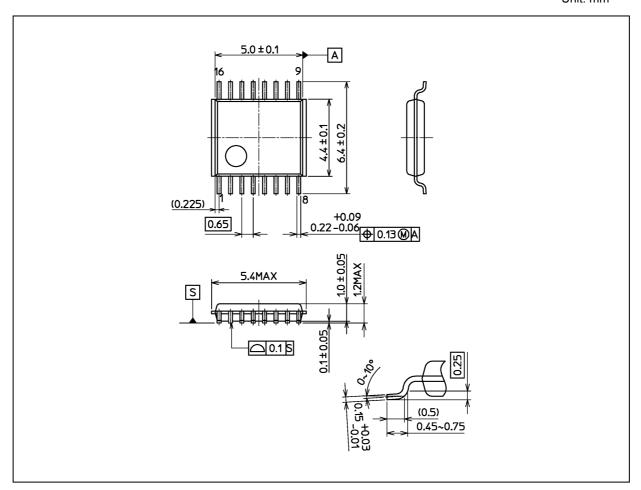
Weight: 0.055 g (typ.)

Package Name(s)
Nickname: TSSOP16B



Package Dimensions

Unit: mm



Weight: 0.06 g (typ.)

ı	Package Name(s)
Nickname: TSSOP16	



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