CMOS Digital Integrated Circuits Silicon Monolithic

TC7SB3157CFU

1. Functional Description

- Single 1-of-2 Multiplexer/Demultiplexer

2. General

The TC7SB3157CFU is a high-speed CMOS single 1-of-2 multiplexer/demultiplexer. The low ON resistance of the switch allows connections to be made with minimal propagation delay time.

This device is 1 to 2 multiplexer/demultiplexer controlled by the select input (S). The A input is connected to B1 or B2 output based on the selection of Control input (S).

All inputs are equipped with protection circuits against static discharge.

3. Features

(1) Operating voltage: V_{CC} = 1.65 to 5.5 V

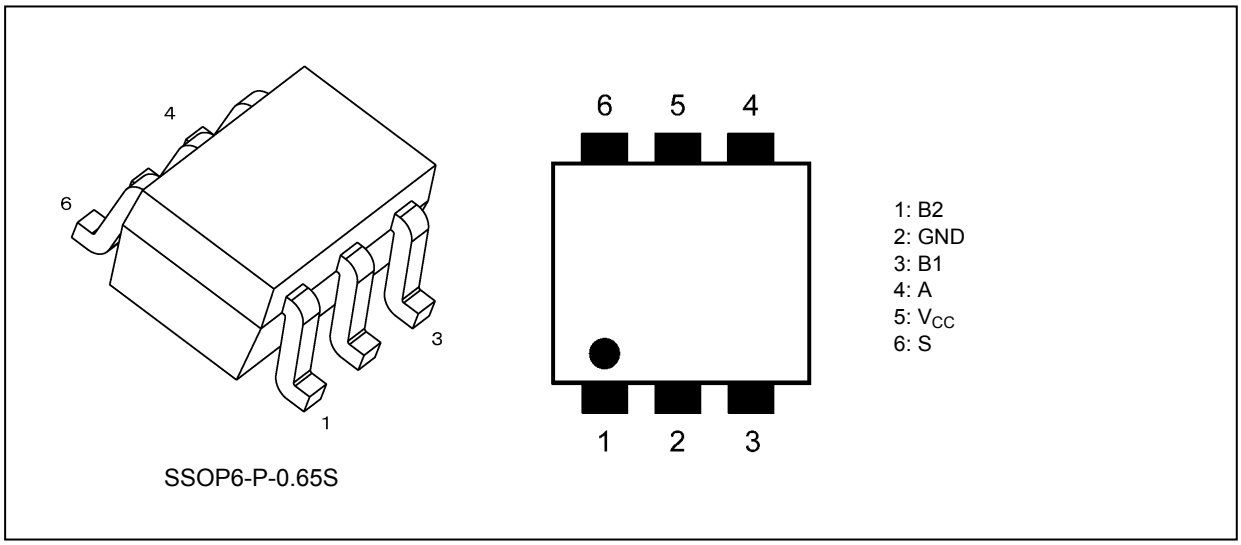
(2) ON capacitance: $C_{I/O}$ = 15 pF Switch On (typ.) @V_{CC} = 5.0 V

(3) ON resistance: R_{ON} = 4 Ω (typ.) @V_{CC} = 4.5 V, V_{IS} = 0 V

(4) ESD performance: Machine model ≥ ±200 V, Human body model ≥ ±2000 V

(5) Package: US6

4. Packaging and Pin Assignment (Top View)



SSOP6-P-0.65S

5. Marking

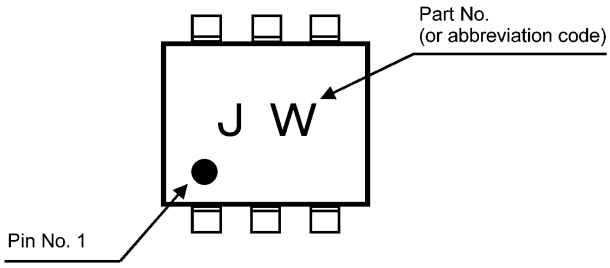


Fig. 5.1 Marking

6. Block Diagram

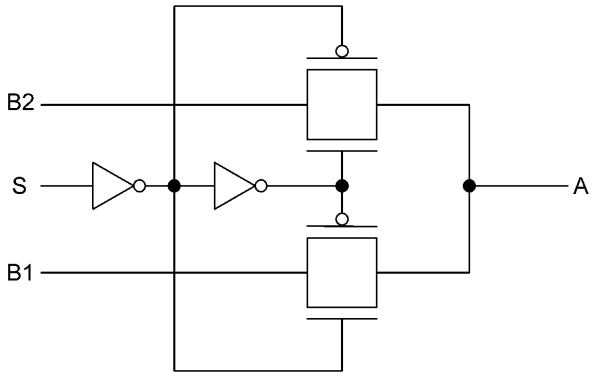


Fig. 6.1 Block Diagram

7. Principle of Operation

7.1. Truth Table

Input S	Function
L	A port = B1 port
H	A port = B2 port

Fig. 7.1. Truth Table

8. Absolute Maximum Ratings (Note)

Characteristics	Symbol	Note	Rating	Unit
Supply voltage	V_{CC}		-0.5 to 7.0	V
DC input voltage (S)	V_{IN}		-0.5 to 7.0	
Switch terminal I/O voltage	V_S		-0.5 to V_{CC} + 0.5	
Clamp diode current	I_{IK}		-50	mA
Switch terminal I/O current	I_S		50	
Power dissipation	P_D		200	mW
DC 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).

9. Operating Ranges (Note)

Characteristics	Symbol	Note	Rating	Unit
Supply voltage	V_{CC}		1.65 to 5.5	V
DC input voltage (S)	V_{IN}		0 to 5.5	
Switch terminal I/O voltage	V_S		0 to V_{CC}	
Operating temperature	T_{opr}		-40 to 85	°C
Input rise time	dt/dv		0 to 10	ns/V
Input fall time			0 to 10	

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_{CC} or GND.

10. Electrical Characteristics

10.1. DC Characteristics

Unless otherwise specified, T_a = -40 to 85°C

Characteristics	Symbol	Note	Test Condition	V_{CC} (V)	Min	Typ.	Max	Unit
High-level input voltage	V_{IH}		—	1.65 to 1.95	0.8 × V_{CC}	—	—	V
				2.3 to 5.5	0.7 × V_{CC}	—	—	
Low-level input voltage	V_{IL}		—	1.65 to 1.95	—	—	0.2 × V_{CC}	
				2.3 to 5.5	—	—	0.3 × V_{CC}	
Input leakage current	I_{IN}		V_{IN} = 0 to 5.5 V	1.65 to 5.5	—	—	±1.0	μA
Switch terminal OFF-state leakage current	I_{SZ}		B1, B2 = 0 to V_{CC}	1.65 to 5.5	—	—	±10	
ON resistance	R_{ON}	(Note 1), (Note 2)	V_{IS} = 0 V, I_{IS} = 30 mA	4.5	—	4	7	Ω
			V_{IS} = 2.4 V, I_{IS} = 30 mA	4.5	—	5	12	
			V_{IS} = 4.5 V, I_{IS} = 30 mA	4.5	—	6	10	
			V_{IS} = 0 V, I_{IS} = 24 mA	3.0	—	5	9	
			V_{IS} = 3.0 V, I_{IS} = 24 mA	3.0	—	7	14	
			V_{IS} = 0 V, I_{IS} = 8 mA	2.3	—	6	12	
			V_{IS} = 2.3 V, I_{IS} = 8 mA	2.3	—	9	18	
			V_{IS} = 0 V, I_{IS} = 4 mA	1.65	—	8	20	
			V_{IS} = 1.65 V, I_{IS} = 4 mA	1.65	—	15	30	
Quiescent supply current	I_{CC}		V_{IN} = V_{CC} or GND, I_{OUT} = 0 A	5.5	—	—	10	μA
	ΔI_{CC}		V_{IN} = V_{CC} - 0.6 V	5.5	—	—	50	

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

10.2. AC Characteristics

Unless otherwise specified, T_a = -40 to 85°C

Characteristics	Symbol	Note	Test Condition	V_{CC} (V)	Min	Max	Unit
Output enable time	t_{pZL} t_{pZH}		Fig. 10.2.1, 10.2.2, Table 10.2.1.	5.5 ± 0.5	—	4	ns
				3.3 ± 0.3	—	6	
				2.5 ± 0.2	—	8	
				1.8 ± 0.15	—	16	
Output disable time	t_{pLZ} t_{pHZ}		Fig. 10.2.1, 10.2.2, Table 10.2.1.	5.5 ± 0.5	—	4.5	
				3.3 ± 0.3	—	7	
				2.5 ± 0.2	—	9	
				1.8 ± 0.15	—	16	

10.3. Capacitive Characteristics

Unless otherwise specified, T_a = 25°C

Characteristics	Symbol	Note	Test Circuit	V_{CC} (V)	Typ.	Unit
Input capacitance	C_{IN}	(Note 1)	V_{IN} = 0 V	5.0	4	pF
Switch terminal OFF capacitance (B port)	$C_{I/O}$		$V_{I/O}$ = 0 V	5.0	5	
Switch terminal ON capacitance (A port)				5.0	15	
Switch terminal ON capacitance (B port)				5.0	15	

Note 1: Parameter guaranteed by design.

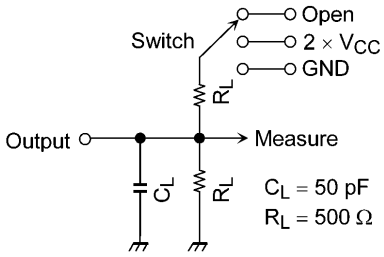


Fig. 10.2.1 AC Test Circuit

Table 10.2.1 Parameter for AC Test Circuit

Parameter	Switch
t_{pLZ}, t_{pZL}	2 × V_{CC}
t_{pHZ}, t_{pZH}	GND

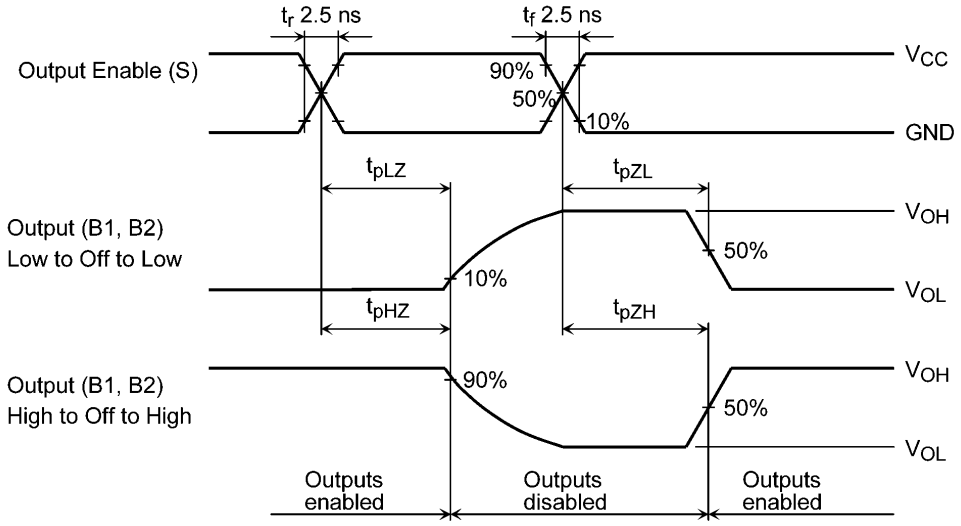


Fig. 10.2.2 AC Waveform t_{pLZ}, t_{pHZ}, t_{pZL}, t_{pZH}

11. 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 the capacitance of TC7SB3157CFU.

The $t_r/t_{f(out)}$ values can be approximated as follows.

(Figure 11.1, Table 11.1 shows the test circuit.)

$t_r/t_{f(out)}$ (approx) = - ($C_{I/O}$ + C_L) · (R_{DRIVE} + R_{ON}) · 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) = - (15 + 15) E - 12 · (120 + 4) · ln ((4.5 - 0) - 2.25) / (4.5 - 0)) ≈ 2.6 ns

Calculation conditions:

V_{CC} = 4.5 V, C_L = 15 pF, R_{DRIVE} = 120 Ω (output impedance of the previous IC), V_M = 2.25 V (V_{CC}/2)

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

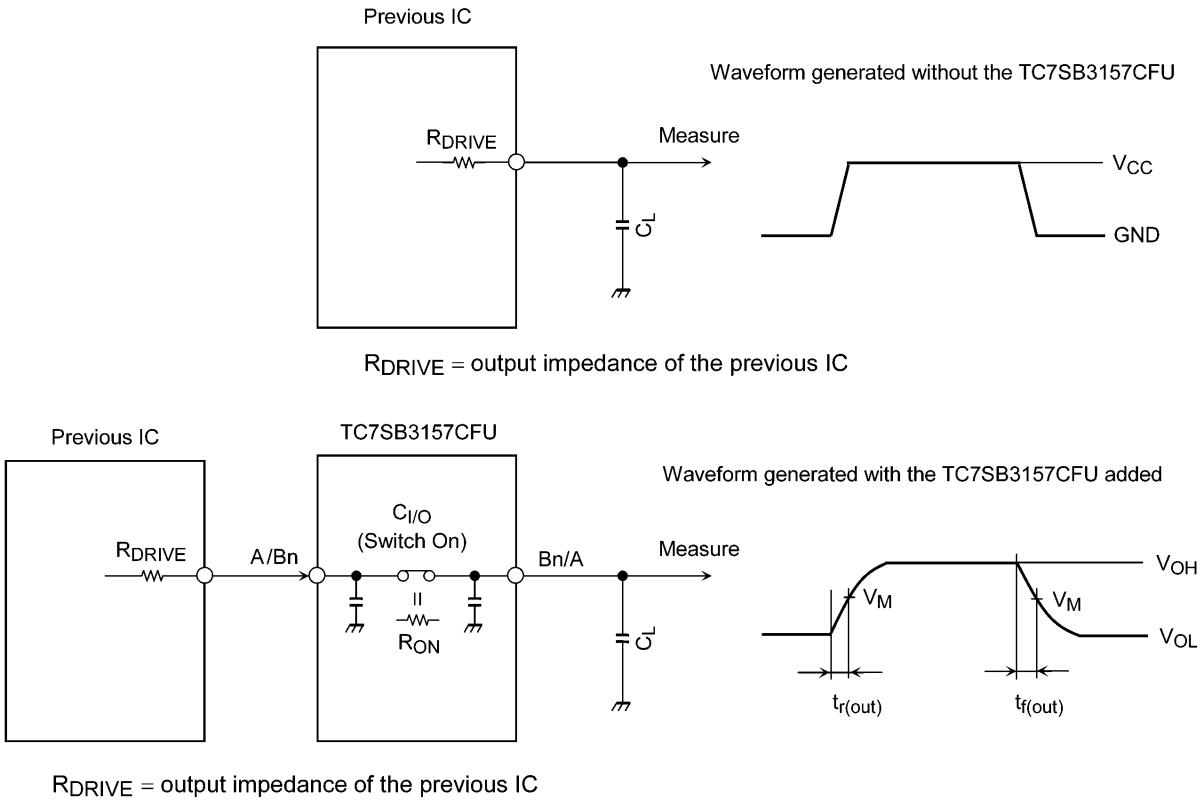


Fig. 11.1 Calculation Circuit

Table 11.1 Calculation Circuit

Characteristics	V_{CC} = 5.0 ± 0.5 V
V_M	V_{CC}/2

12. Characteristics Curves (Note)

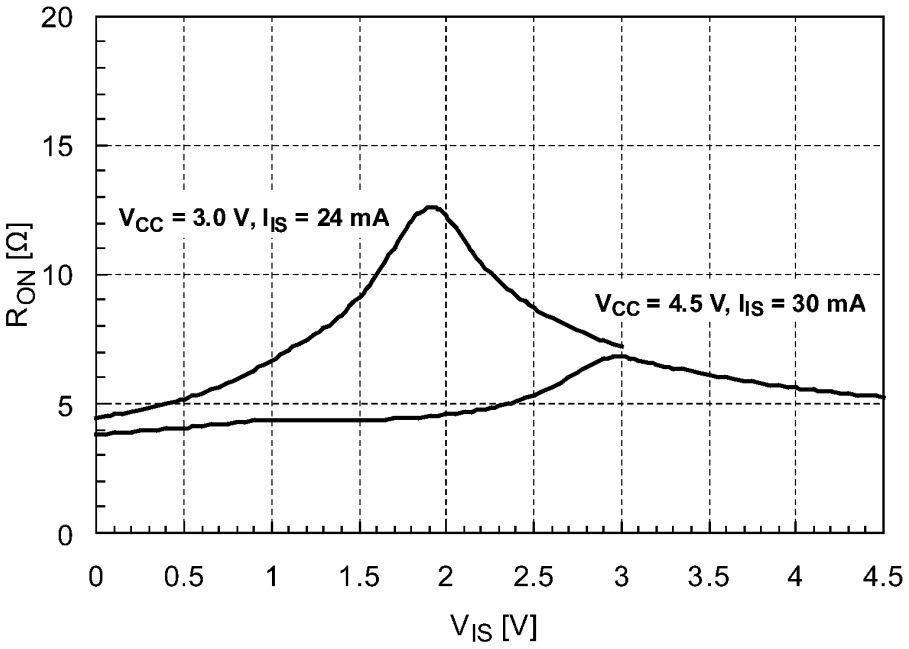
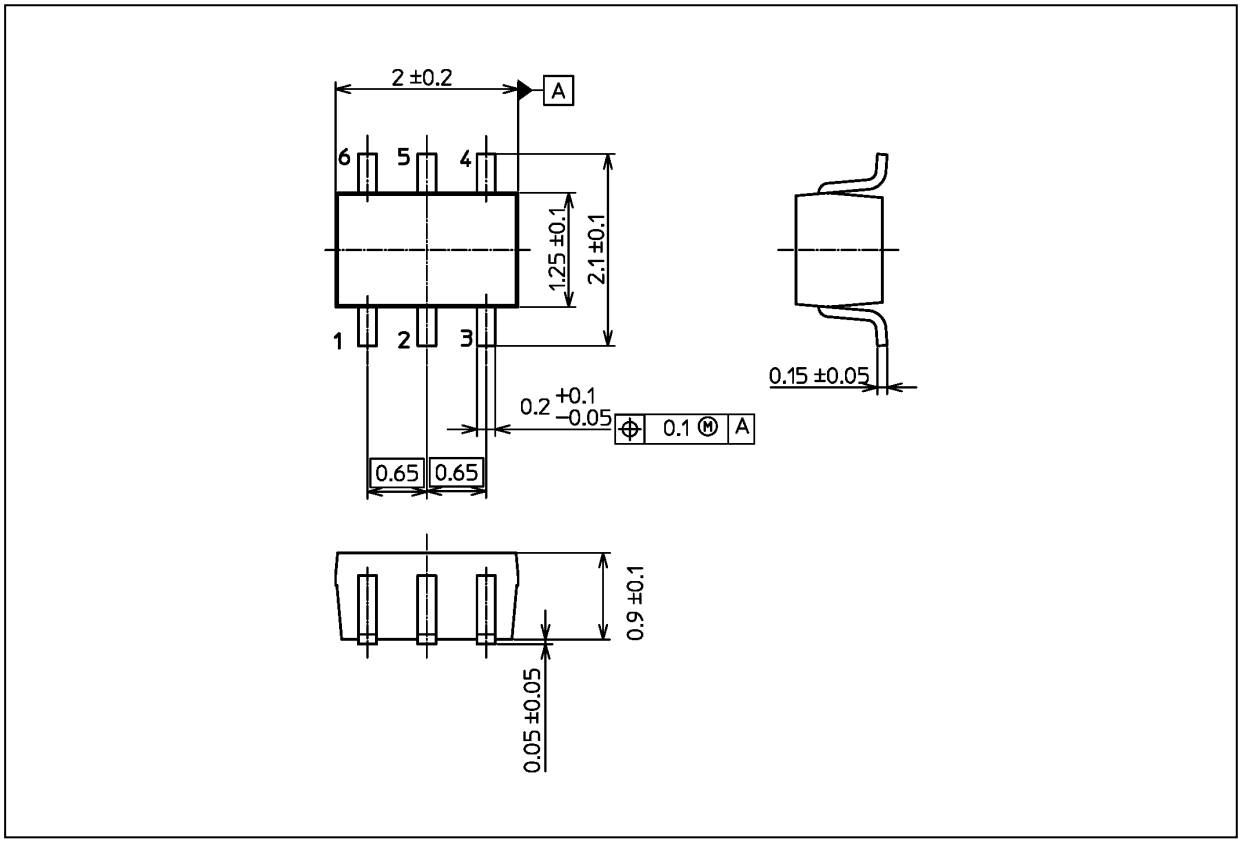


Fig. 12.1 R_{ON} - V_{IS} Characteristics Curves

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

Package Dimensions

Unit: mm



Weight: 6.8 mg (typ.)

Package Name(s)
TOSHIBA: SSOP6-P-0.65S
Nickname: US6

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