

# 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.

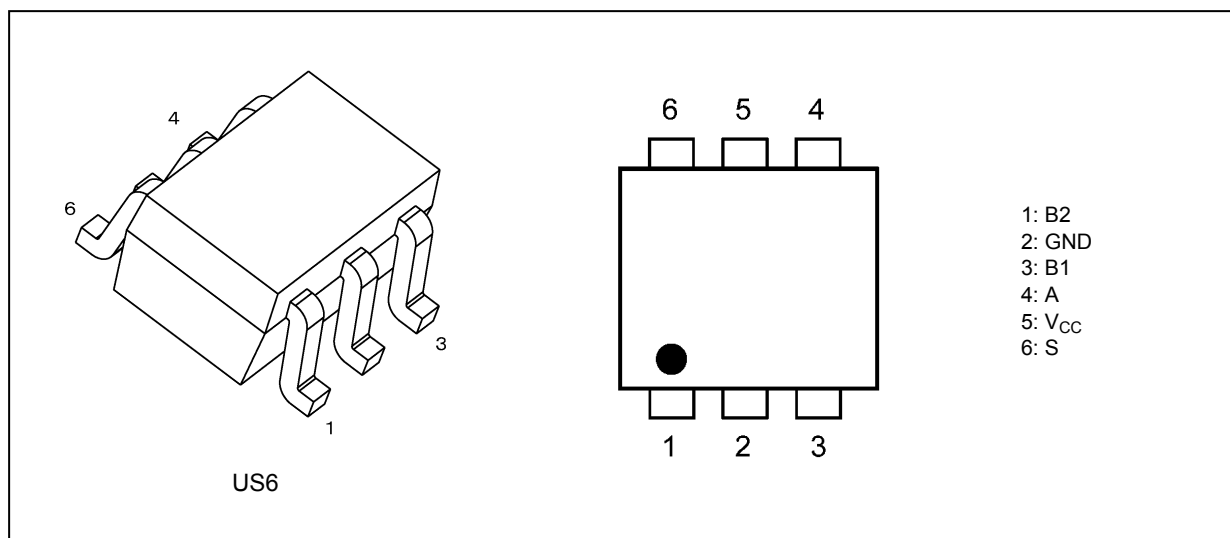
This device is 1 to 2 multiplexer/demultiplexer controlled by the select input (S). The A input is connected to B1 or B2 output based on the selection of Control input (S).

All inputs are equipped with protection circuits against static discharge.

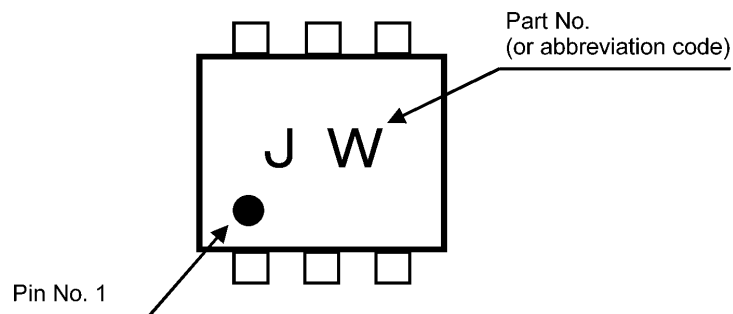
## 3. Features

- (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:  $R_{ON} = 4 \Omega$  (typ.) @  $V_{CC} = 4.5$  V,  $V_{IS} = 0$  V
- (4) ESD performance: Machine model  $\geq \pm 200$  V, Human body model  $\geq \pm 2000$  V
- (5) Package: US6

## 4. Packaging and Pin Assignment

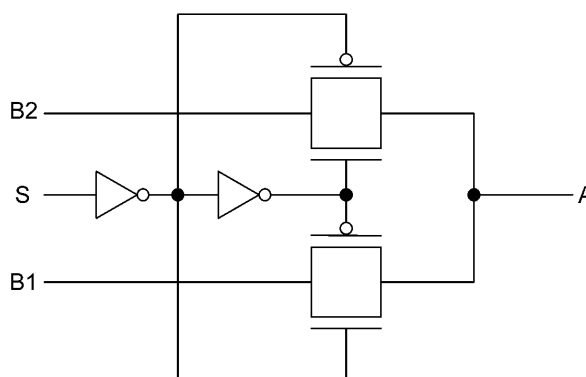


## 5. Marking



Start of commercial production  
2010-03

**6. Block Diagram**



**7. Principle of Operation**

**7.1. Truth Table**

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

**8. Absolute Maximum Ratings (Note)**

Characteristics	Symbol	Note	Rating	Unit
Supply voltage	$V_{CC}$		-0.5 to 7.0	V
Input voltage (S)	$V_{IN}$		-0.5 to 7.0	
Switch I/O voltage	$V_S$		-0.5 to $V_{CC} + 0.5$	
Clamp diode current	$I_{IK}$		-50	mA
Switch I/O current	$I_S$		50	
Power dissipation	$P_D$		200	mW
$V_{CC}$ /ground current	$I_{CC}/I_{GND}$		$\pm 100$	mA
Storage temperature	$T_{stg}$		-65 to 150	$^{\circ}C$

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
Input voltage (S)	$V_{IN}$		0 to 5.5	
Switch I/O voltage	$V_S$		0 to $V_{CC}$	
Operating temperature	$T_{opr}$		-40 to 85	$^{\circ}C$
Input rise time	$dt/dv$		0 to 10	ns/V
Input fall time	$dt/dv$		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  $85\text{ }^\circ\text{C}$ )**

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

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.

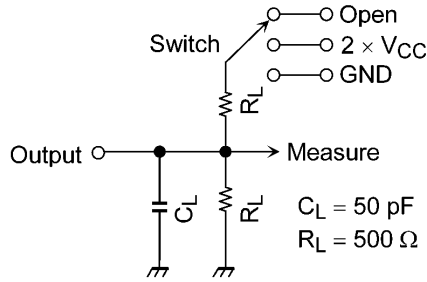
**10.2. AC Characteristics (Unless otherwise specified,  $T_a = -40$  to  $85\text{ }^\circ\text{C}$ )**

Characteristics	Symbol	Note	Test Condition	$V_{CC}$ (V)	Min	Max	Unit
3-state output enable time	$t_{PZL}/t_{PZH}$		See Fig. 10.2.1, 10.2.2, Table 10.2.1.	$5.0 \pm 0.5$	—	4	ns
				$3.3 \pm 0.3$	—	6	
				$2.5 \pm 0.2$	—	8	
				$1.8 \pm 0.15$	—	16	
3-state output disable time	$t_{PLZ}/t_{PHZ}$		See Fig. 10.2.1, 10.2.2, Table 10.2.1.	$5.0 \pm 0.5$	—	4.5	ns
				$3.3 \pm 0.3$	—	7	
				$2.5 \pm 0.2$	—	9	
				$1.8 \pm 0.15$	—	16	

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

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

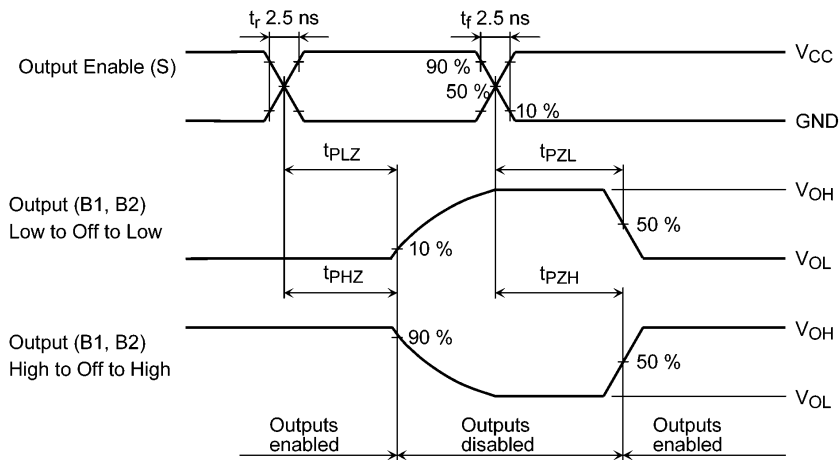
Note 1: Parameter guaranteed by design.



**Fig. 10.2.1 AC Test Circuit**

**Table 10.2.1 Parameter for AC Test Circuit**

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

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

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

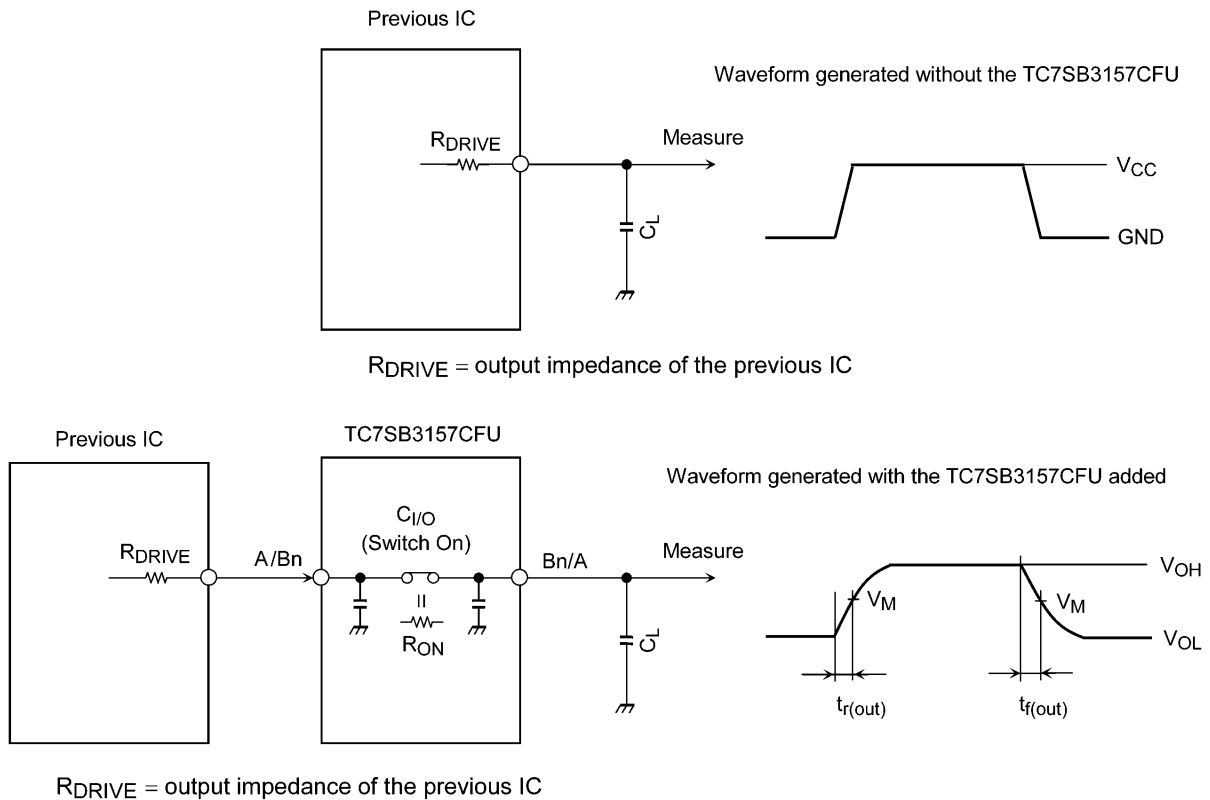
Calculation example:

$$t_{r(out)} \text{ (approx)} = - (15 + 15) \text{ E} \cdot 12 \cdot (120 + 4) \cdot \ln (((4.5 - 0) \cdot 2.25) / (4.5 - 0)) \approx 2.6 \text{ ns}$$

Calculation conditions:

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

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	$V_{CC} = 5.0 \pm 0.5 \text{ V}$
$V_M$	$V_{CC}/2$

12. Characteristics Curves (Note)

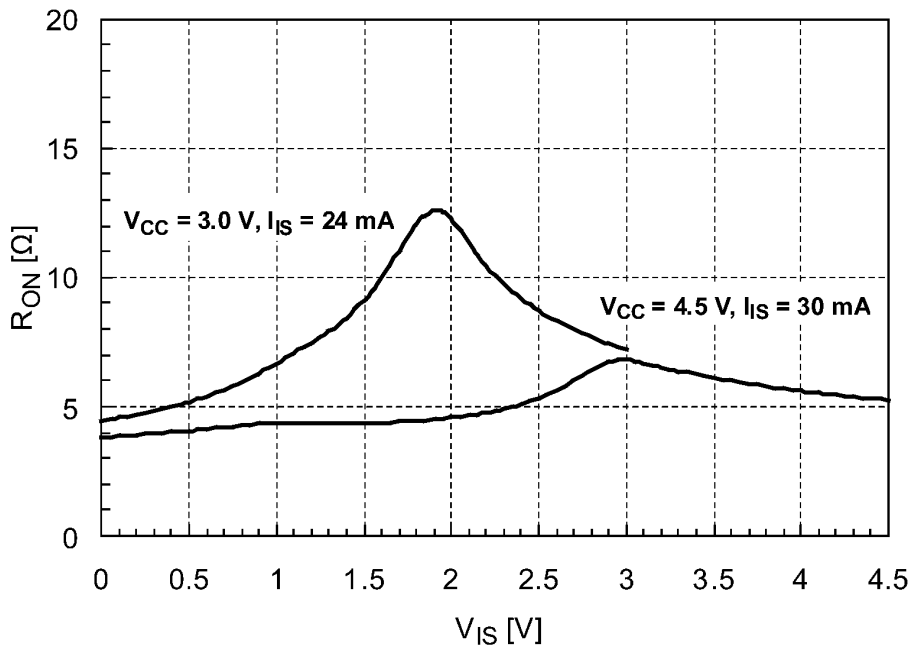
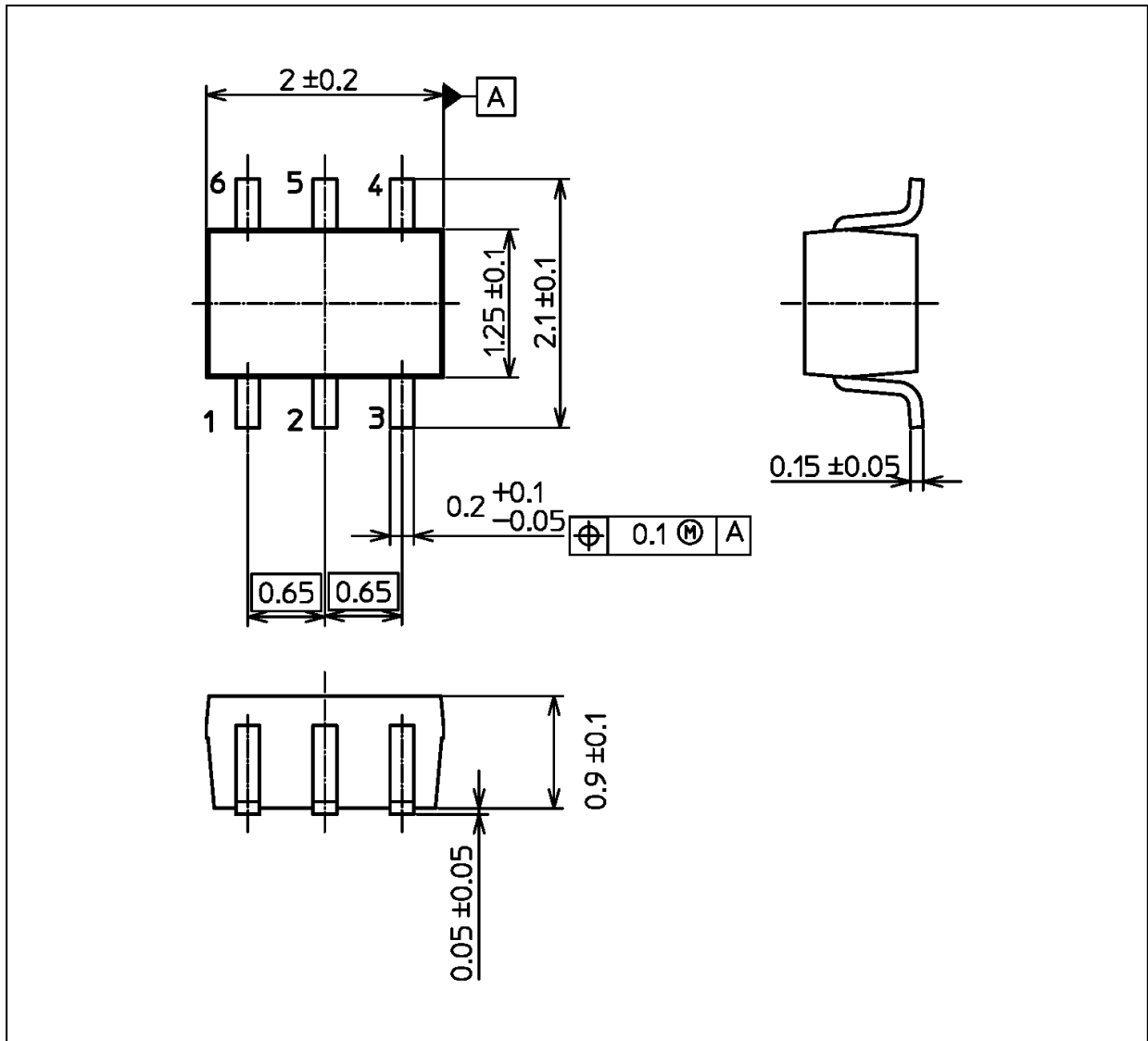


Fig. 12.1  $R_{ON}$  -  $V_{IS}$  Characteristics Curves

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

Package Dimensions

Unit: mm



Weight: 0.007 g (typ.)

Package Name(s)
JEDEC: SOT-363
Nickname: US6

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