

# TC7SB3157DL6X

## 1. Functional Description

- Single 1-of-2 Multiplexer/Demultiplexer

## 2. General

The TC7SB3157DL6X 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.

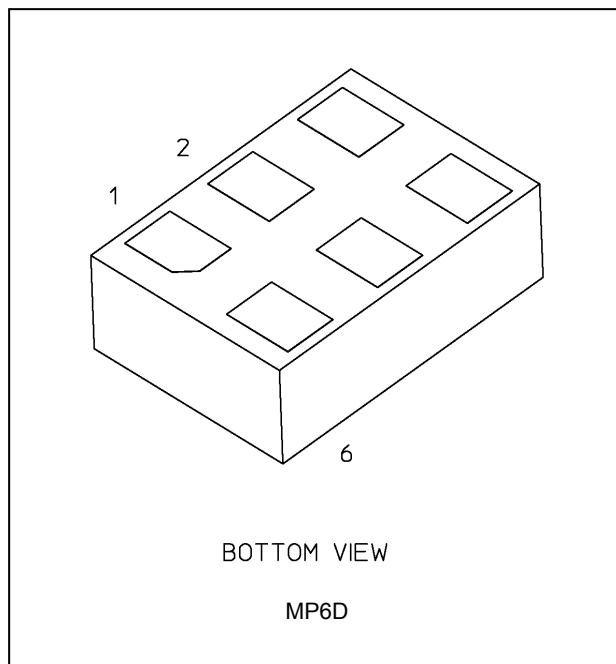
This device is 1 to 2 multiplexer/demultiplexer controlled by the select input (S). The A input is connected to B1 or B2 output based on the selection of Control input (S).

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:  $C_{IO} = 15$  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: MP6D

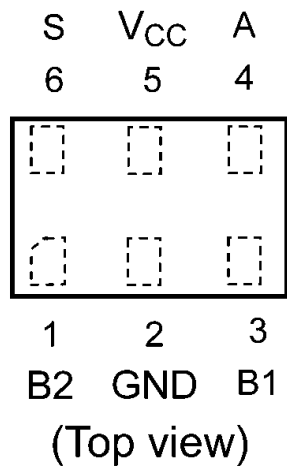
## 4. Packaging



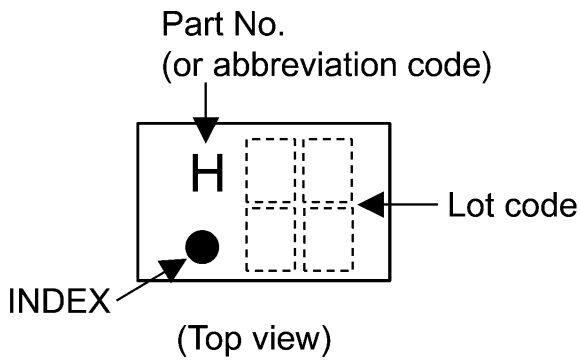
Start of commercial production

2017-06

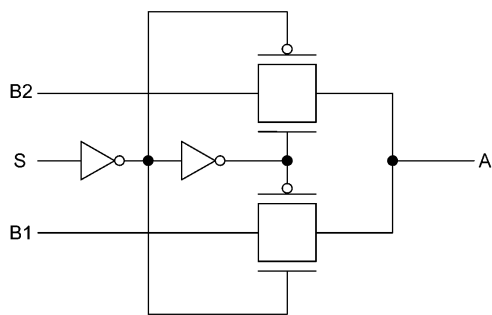
**5. Pin Assignment**



**6. Marking**



**7. Block Diagram**



**8. Principle of Operation**

**8.1. Truth Table**

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

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

| Characteristics          | Symbol           | Note     | Rating           | Unit        |
|--------------------------|------------------|----------|------------------|-------------|
| Supply voltage           | $V_{CC}$         |          | -0.5 to 6.5      | V           |
| Input voltage (S)        | $V_{IN}$         |          | -0.5 to 6.5      |             |
| Switch I/O voltage       | $V_S$            |          | -0.5 to $V_{CC}$ |             |
| Clamp diode current      | $I_{IK}$         |          | -50              | mA          |
| Switch I/O current       | $I_S$            |          | 50               |             |
| Power dissipation        | $P_D$            | (Note 1) | 250              | 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).

Note 1: Mounted on an FR4 board

**10. 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 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 (S)     | $V_{IH}$        |                    | —   | 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 (S)      | $V_{IL}$        |                    | —   | 1.65 to 1.95 | —                   | —    | $0.2 \times V_{CC}$ |               |
|                                  |                 |                    |   | 2.3 to 5.5   | —                   | —    | $0.3 \times V_{CC}$ |               |
| Input leakage current            | $I_{IN}$        |                    | $V_{IN} = 0$ to $5.5$ 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  | —                   | —    | $\pm 10$            |               |
| ON-resistance                    | $R_{ON}$        | (Note 1), (Note 2) | $V_{IS} = 0$ V, $I_{IS} = 30$ mA          | 4.5          | —                   | 4    | 7                   | $\Omega$      |
|                                  |                 |                    | $V_{IS} = 2.4$ 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                  | $\mu\text{A}$ |
|                                  | $\Delta I_{CC}$ |                    | $V_{IN} = V_{CC} - 0.6$ V                 | 5.5          | —                   | —    | 50                  | $\mu\text{A}$ |

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            | Note | Test Condition                        | $V_{CC}$ (V)   | Min | Max | Unit |
|-----------------------------|-------------------|------|---------------------------------------|----------------|-----|-----|------|
| 3-state output enable time  | $t_{PZL}/t_{PZH}$ |      | See Fig. 11.2.1, 11.2.2, Table 11.2.1 | $5.0 \pm 0.5$  | —   | 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. 11.2.1, 11.2.2, Table 11.2.1 | $5.0 \pm 0.5$  | —   | 4.5 |      |
|                             |                   |      |                                       | $3.3 \pm 0.3$  | —   | 7   |      |
|                             |                   |      |                                       | $2.5 \pm 0.2$  | —   | 9   |      |
|                             |                   |      |                                       | $1.8 \pm 0.15$ | —   | 16  |      |

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

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

Note: Parameter guaranteed by design.

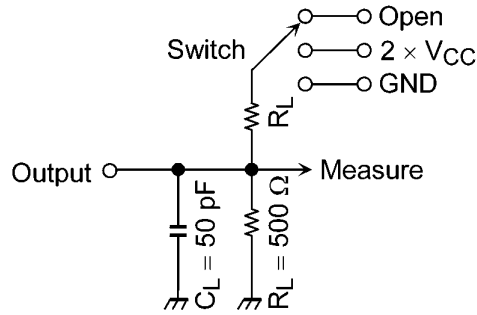


Fig. 11.2.1 AC Test Circuit

Table 11.2.1 Parameter for AC Test Circuit

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

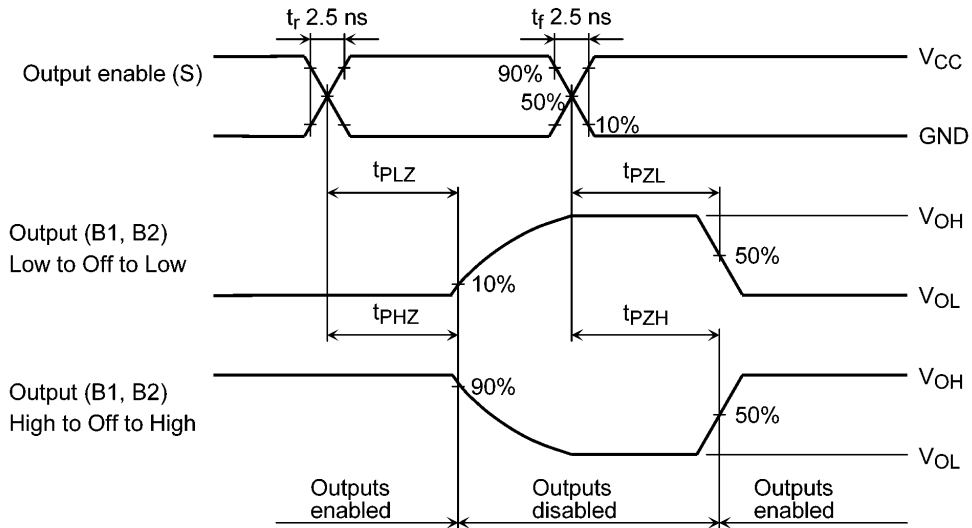


Fig. 11.2.2 AC Waveform  $t_{PLZ}, t_{PHZ}, t_{PZL}, t_{PZH}$

**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 the capacitance of TC7SB3157DL6X

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

(Figure 12.1, Table 12.1 shows the test circuit.)

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

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

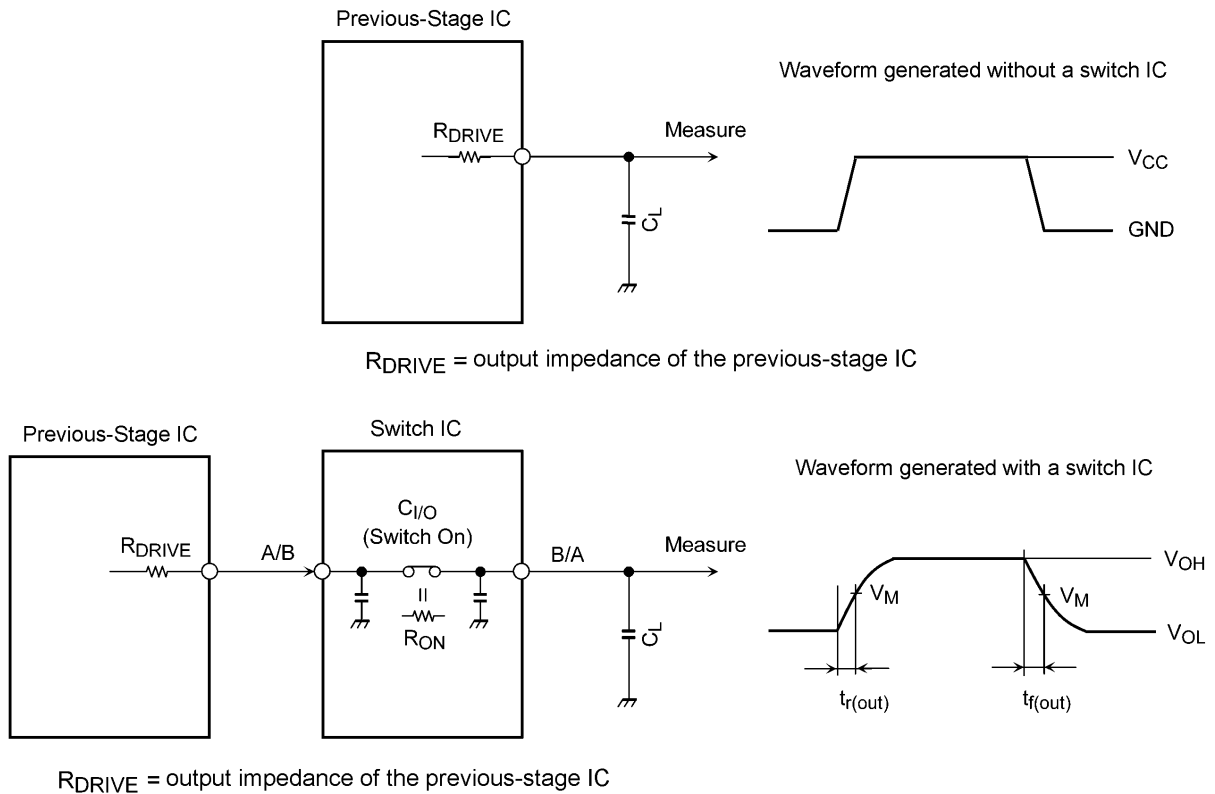
Calculation example:

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

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. 12.1 Calculation Circuit**

**Table 12.1 Calculation Circuit**

| Characteristics | $V_{CC} = 5.0 \pm 0.5 \text{ V}$ | $V_{CC} = 3.3 \pm 0.3 \text{ V}$ | $V_{CC} = 2.5 \pm 0.2 \text{ V}$ | $V_{CC} = 1.8 \pm 0.15 \text{ V}$ |
|-----------------|----------------------------------|----------------------------------|----------------------------------|-----------------------------------|
| $V_M$           | $V_{CC}/2$                       | $V_{CC}/2$                       | $V_{CC}/2$                       | $V_{CC}/2$                        |

13. Characteristics Curves (Note)

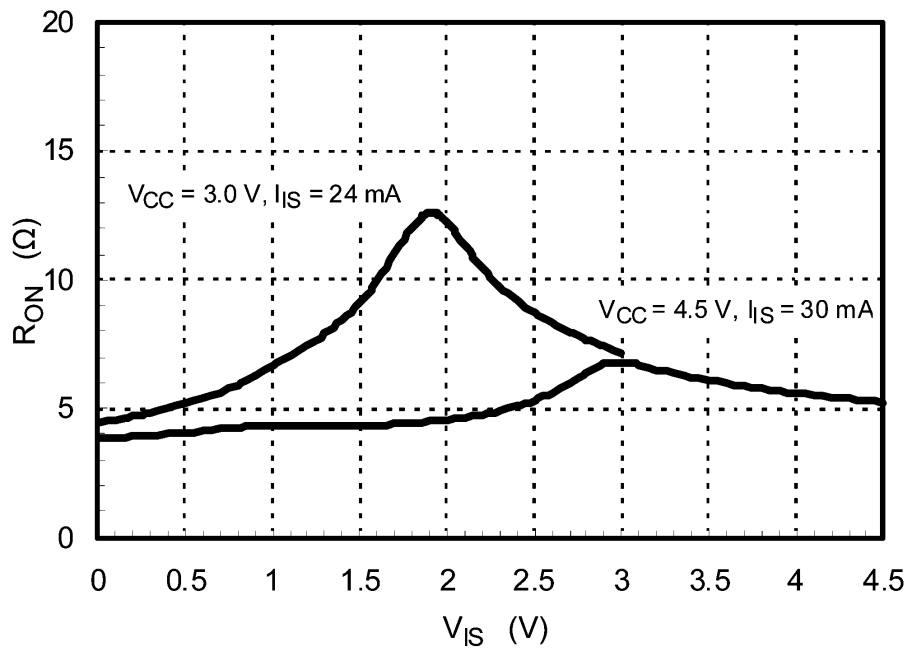
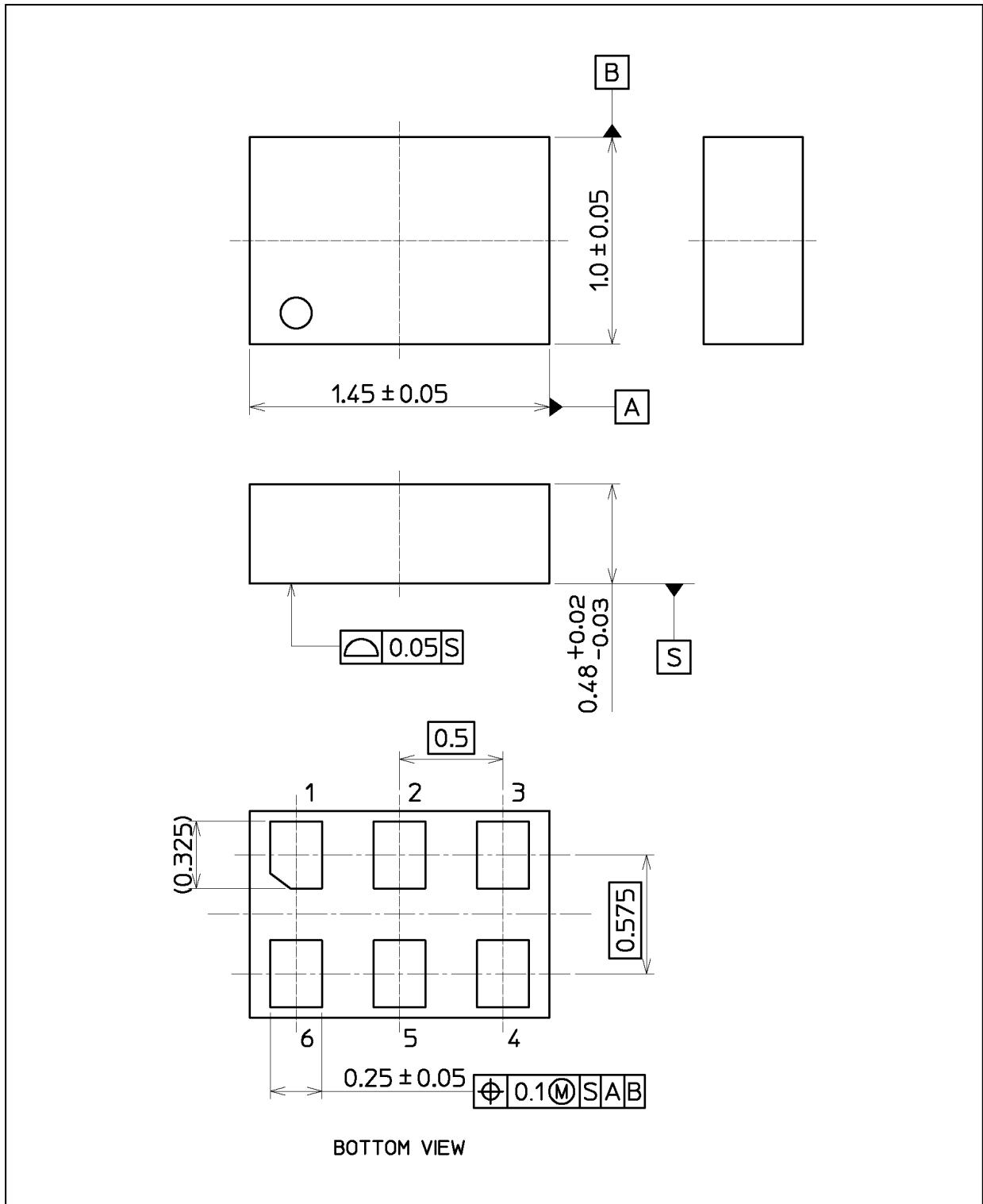


Fig. 13.1  $R_{ON} - V_{IS}$

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

Package Dimensions

Unit: mm



Weight: 0.002 g (typ.)

|                 |
|-----------------|
| Package Name(s) |
| Nickname: MP6D  |



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