CMOS Digital Integrated Circuits Silicon Monolithic

TC7WB66CFK,TC7WB66CL8X TC7WB67CFK,TC7WB67CL8X

1. Functional Description

- Dual SPST Bus Switch

2. General

The TC7WB66CFK/L8X and TC7WB67CFK/L8X are low ON-resistance, high-speed CMOS 2-bit bus switches. These bus switches allow connections or disconnections to be made with minimal propagation delay while maintaining Low power dissipation which is the feature of CMOS.

TC7WB66CFK/L8X requires the output enable (OE) input to be set low to place the output into the high impedance state,whereas the TC7WB67CFK/L8X requires the output enable ($\overline{OE}$) input to be set high to place the output into the high impedance.

These Bus switches consist of P-MOS and N-MOS structure, meaning these devices are suitable for analog signal transmission.

All inputs are equipped with protector circuits to protect the device from static discharge.

3. Features

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

(2) ON capacitance: $C_{I/O}$ = 10 pF Switch On (typ.) @V_{CC} = 5.0 V

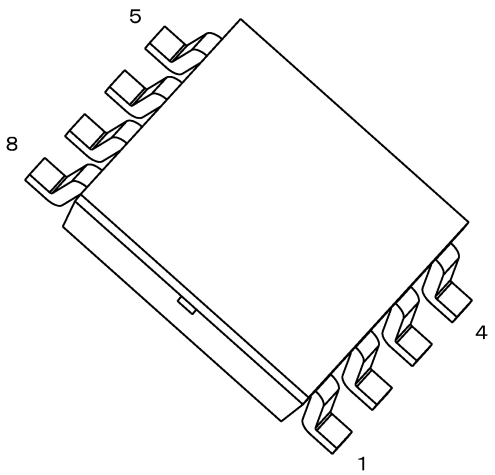
(3) ON resistance: R_{ON} = 4 Ω (typ.) @V_{CC} = 4.5 V, V_{IS} = 0 V

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

(5) Package: US8, MP8

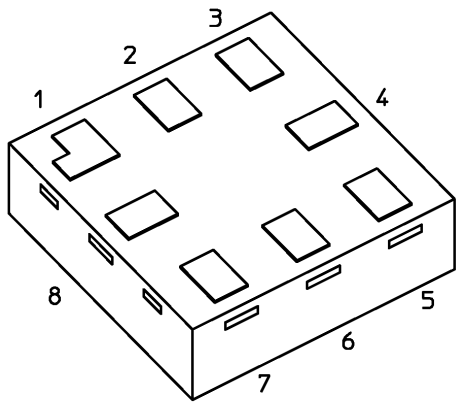
4. Packaging

TC7WB66CFK,TC7WB67CFK



US8

TC7WB66CL8X,TC7WB67CL8X

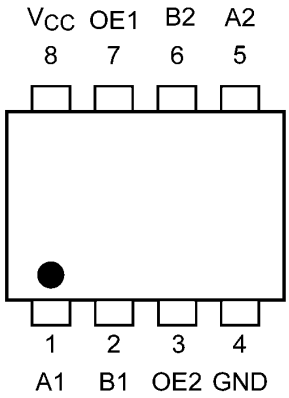


BOTTOM VIEW

MP8

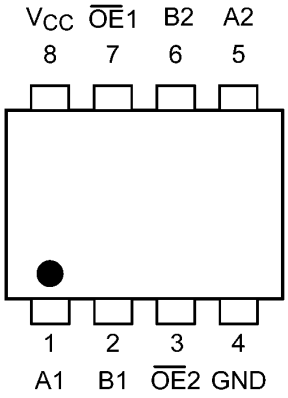
5. Pin Assignment

TC7WB66CFK



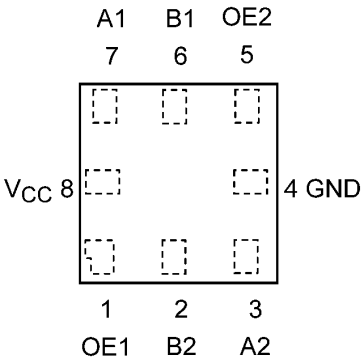
(Top view)

TC7WB67CFK



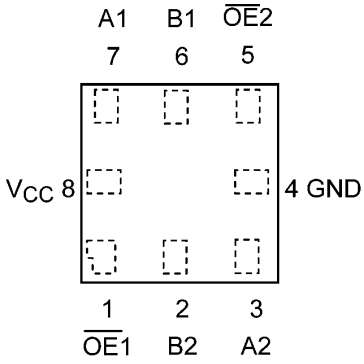
(Top view)

TC7WB66CL8X



(Top view)

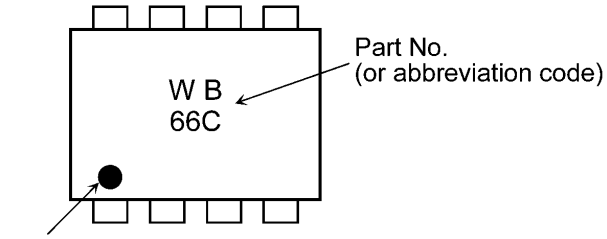
TC7WB67CL8X



(Top view)

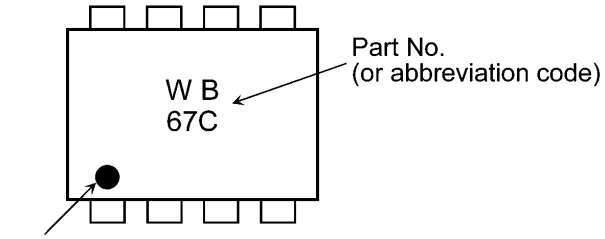
6. Marking

TC7WB66CFK



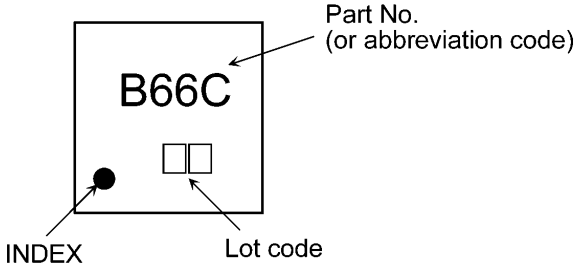
(Top view)

TC7WB67CFK



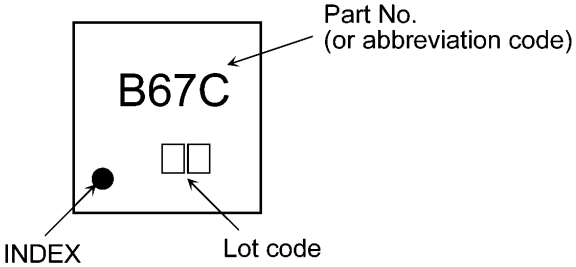
(Top view)

TC7WB66CL8X



(Top view)

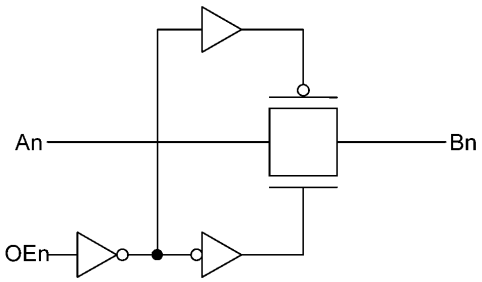
TC7WB67CL8X



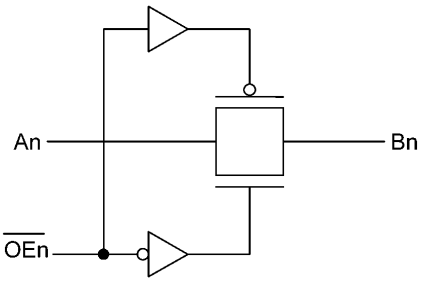
(Top view)

7. Block Diagram

TC7WB66CFK,TC7WB66CL8X



TC7WB67CFK,TC7WB67CL8X



8. Principle of Operation

8.1. Truth Table

Inputs OE (TC7WB66CFK/L8X)	Inputs $\overline{OE}$ (TC7WB67CFK/L8X)	Function
H	L	A port = B port
L	H	Disconnect

9. Absolute Maximum Ratings (Note)

Characteristics	Part Number	Symbol	Note	Rating	Unit
Supply voltage		V_{CC}		-0.5 to 7.0	V
Input voltage (OE, $\overline{OE}$)		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	TC7WB66CFK,TC7WB67CFK	P_D		200	mW
	TC7WB66CL8X,TC7WB67CL8X		(Note 1)	300	
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: 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 (OE, $\overline{OE}$)	V_{IN}		0 to 5.5	
Switch 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	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 °C)

Characteristics	Part Number	Symbol	Note	Test Condition	V_{CC} (V)	Min	Typ.	Max	Unit
High-level input voltage (OE, $\overline{OE}$)		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 (OE, $\overline{OE}$)		V_{IL}		—	1.65 to 1.95	—	—	0.2 × V_{CC}	
					2.3 to 5.5	—	—	0.3 × V_{CC}	
Input leakage current (OE, $\overline{OE}$)		I_{IN}		V_{IN} = 0 to 5.5 V	1.65 to 5.5	—	—	±1.0	μA
Switch OFF-state leakage current	TC7WB66-CFK/L8X	I_{SZ}		A, B = 0 to V_{CC}, OE = GND	1.65 to 5.5	—	—	±10	
	TC7WB67-CFK/L8X			A, B = 0 to V_{CC}, $\overline{OE}$ = 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.

11.2. AC Characteristics (Unless otherwise specified, T_a = -40 to 85 °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 ± 0.5	—	4	ns
				3.3 ± 0.3	—	6	
				2.5 ± 0.2	—	9	
				1.8 ± 0.15	—	18	
3-state output disable time	t_{PLZ}/t_{PHZ}		See Fig. 11.2.1, 11.2.2, Table 11.2.1	5.0 ± 0.5	—	4.5	
				3.3 ± 0.3	—	7	
				2.5 ± 0.2	—	9	
				1.8 ± 0.15	—	18	

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

Characteristics	Part Number	Symbol	Note	Test Condition	V_{CC} (V)	Typ.	Unit
Input capacitance (OE, $\overline{OE}$)		C_{IN}		V_{IN} = 0 V	5.0	4	pF
Switch terminal OFF-capacitance	TC7WB66CFK/L8X	$C_{I/O}$		OE = GND, $V_{I/O}$ = 0 V	5.0	5	
	TC7WB67CFK/L8X			$\overline{OE}$ = V_{CC}, $V_{I/O}$ = 0 V	5.0	5	
Switch terminal ON-capacitance	TC7WB66CFK/L8X	$C_{I/O}$		OE = V_{CC}, $V_{I/O}$ = 0 V	5.0	10	
	TC7WB67CFK/L8X			$\overline{OE}$ = GND, $V_{I/O}$ = 0 V	5.0	10	

Note: Parameter guaranteed by design.

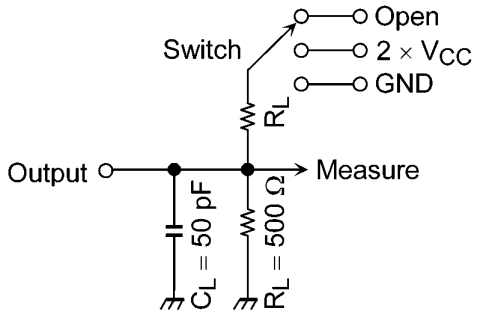


Fig. 11.2.1 AC Test Circuit

Table 11.2.1 Parameter for AC Test Circuit

Parameter	Switch
t_{PLZ}, t_{PZL}	2 × V_{CC}
t_{PHZ}, t_{PZH}	GND

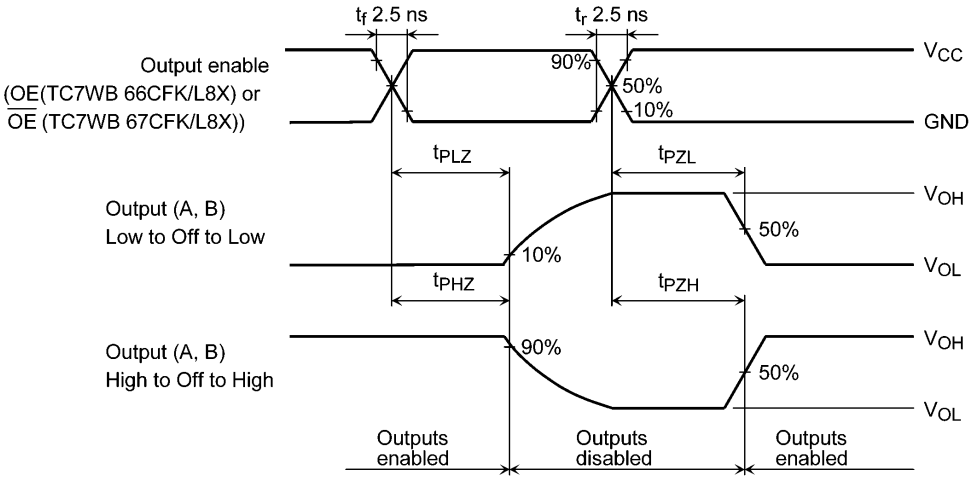


Fig. 11.2.2 AC Waveform t_{PLZ}, t_{PHZ}, t_{PZL}, t_{PZH}

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 TC7WB66CFK/L8X, TC7WB67CFK/L8X

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

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

$t_r/t_{f(out)}$ (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) = - (10 + 15) E - 12 · (120 + 4) · ln ((4.5 - 0) - 2.25) / (4.5 - 0)) = ≈2.1 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)

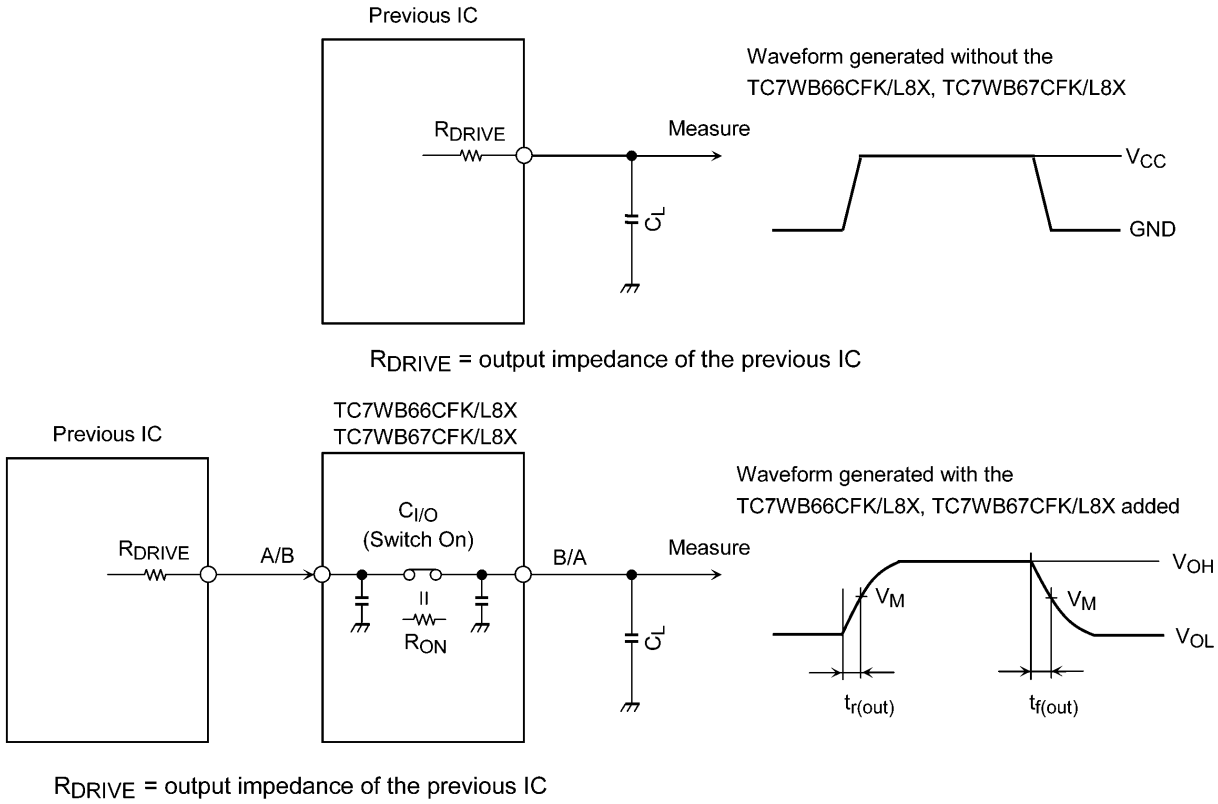


Fig. 12.1 Calculation Circuit

Table 12.1 Calculation Circuit

Characteristics	V_{CC} = 5.0 ± 0.5 V	V_{CC} = 3.3 ± 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	V_{CC}/2

13. Characteristics Curves (Note)

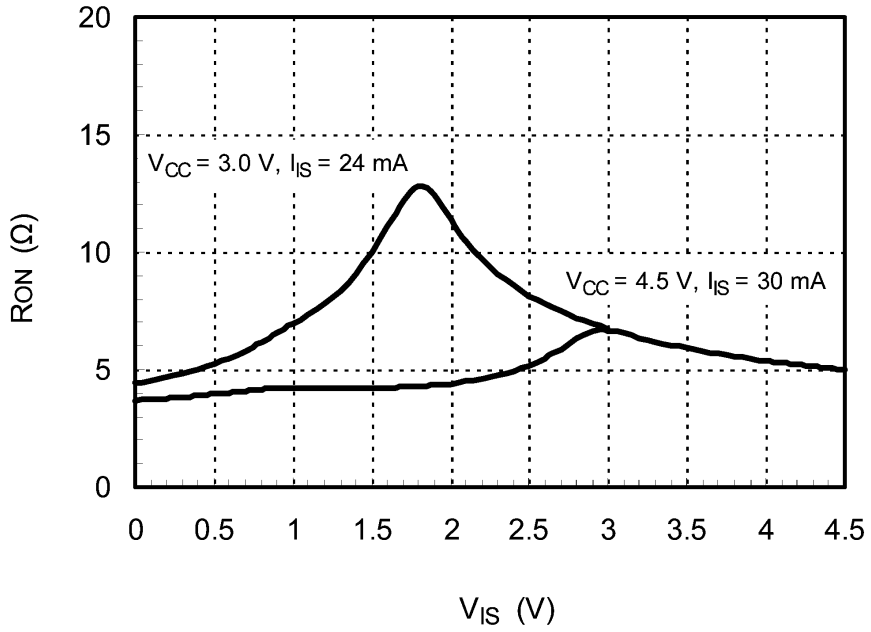


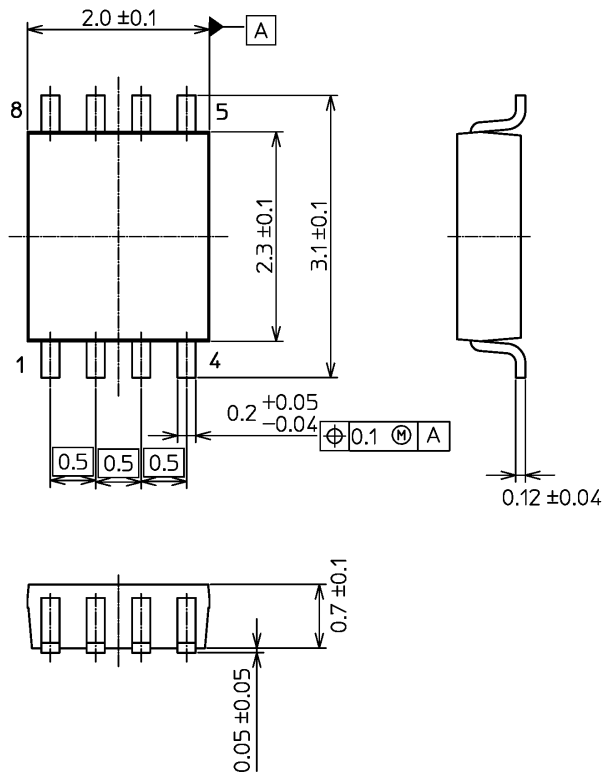
Fig. 13.1 R_{ON} - V_{IS}

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

Package Dimensions

Unit: mm

TC7WB66CFK,TC7WB67CFK



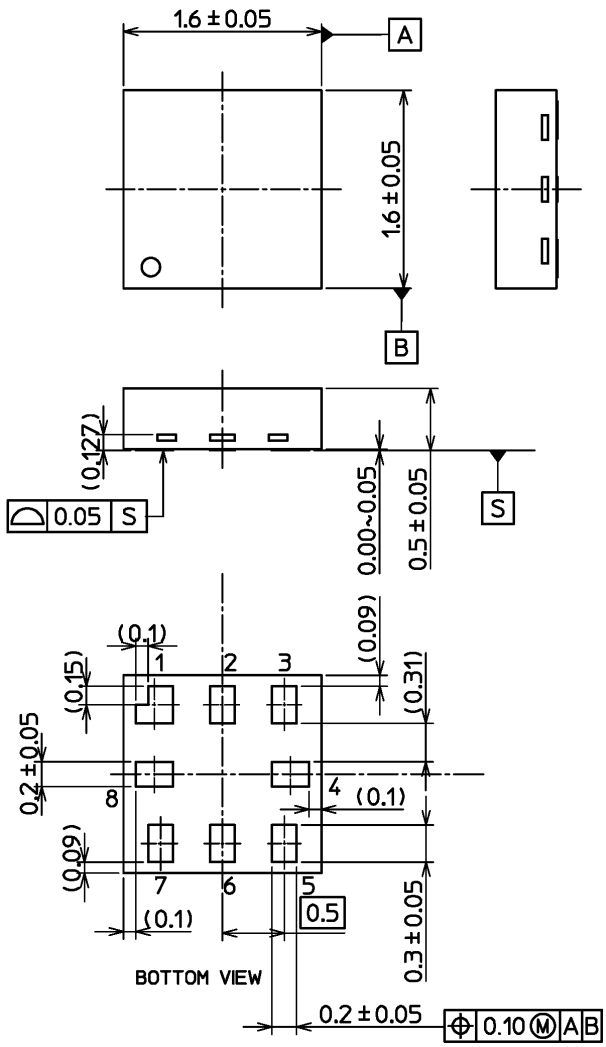
Weight: 0.01 g (typ.)

Package Name(s)
TOSHIBA: SSOP8-P-0.50S
Nickname: US8

Package Dimensions

Unit: mm

TC7WB66CL8X,TC7WB67CL8X



Weight: 0.0039 g (typ.)

Package Name(s)
TOSHIBA: P-UFLGA8-0202-0.50-002
Nickname: MP8

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