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

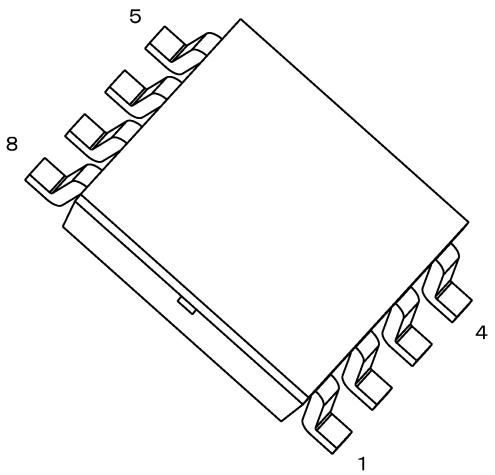
(3) ON resistance: R_{ON} = 4 Ω (typ.) @V_{CC} = 4.5 V, V_{IS} = 0 V

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

(5) Package: US8, MP8

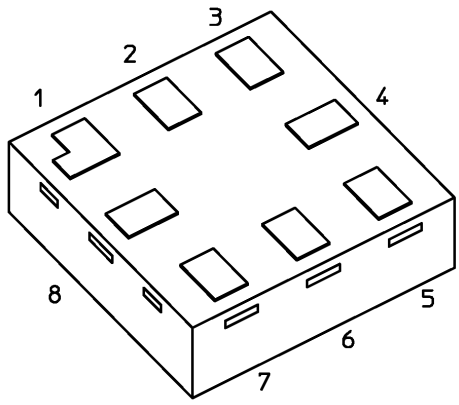
4. Packaging

TC7WB66CFK,TC7WB67CFK



US8

TC7WB66CL8X,TC7WB67CL8X



BOTTOM VIEW

MP8

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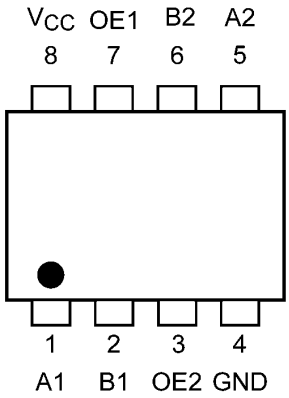
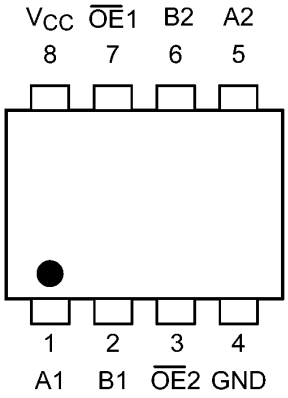
5. Pin Assignment

TC7WB66CFK



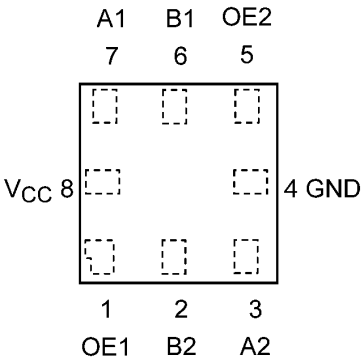
(Top view)

TC7WB67CFK



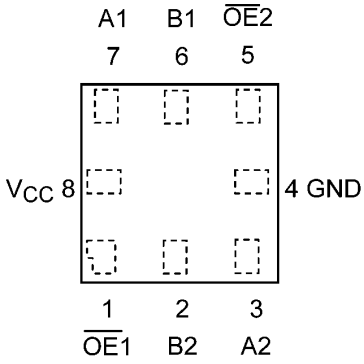
(Top view)

TC7WB66CL8X



(Top view)

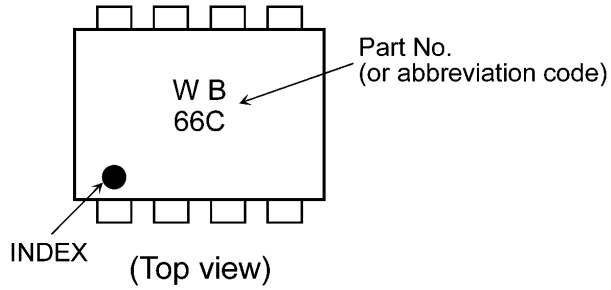
TC7WB67CL8X



(Top view)

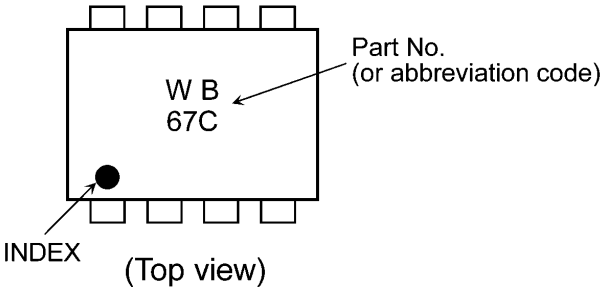
6. Marking

TC7WB66CFK



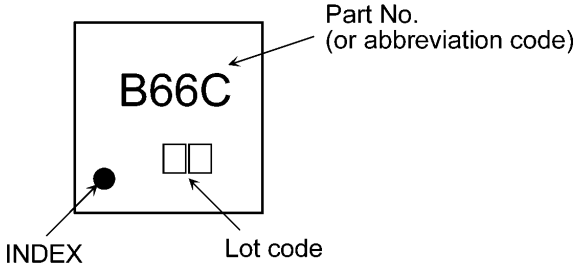
(Top view)

TC7WB67CFK



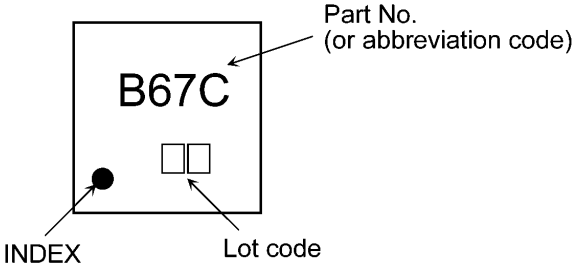
(Top view)

TC7WB66CL8X



(Top view)

TC7WB67CL8X



(Top view)

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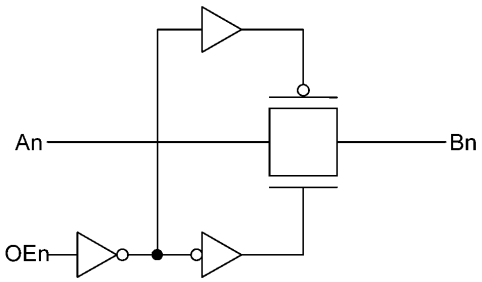
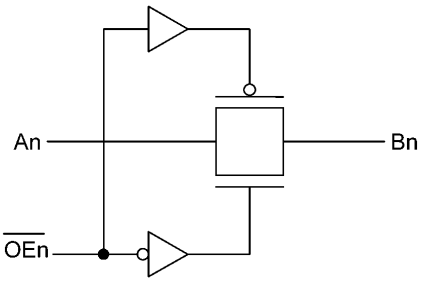
7. Block Diagram

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.

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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, TC7WB66-CL8X	I_{SZ}		A, B = 0 to V_{CC}, OE = GND	1.65 to 5.5	—	—	±10	
	TC7WB67-CFK, TC7WB67-CL8X			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	

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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, TC7WB66CL8X	$C_{I/O}$		OE = GND, $V_{I/O}$ = 0 V	5.0	5	
	TC7WB67CFK, TC7WB67CL8X			$\overline{OE}$ = V_{CC}, $V_{I/O}$ = 0 V	5.0	5	
Switch terminal ON-capacitance	TC7WB66CFK, TC7WB66CL8X	$C_{I/O}$		OE = V_{CC}, $V_{I/O}$ = 0 V	5.0	10	
	TC7WB67CFK, TC7WB67CL8X			$\overline{OE}$ = GND, $V_{I/O}$ = 0 V	5.0	10	

Note: Parameter guaranteed by design.

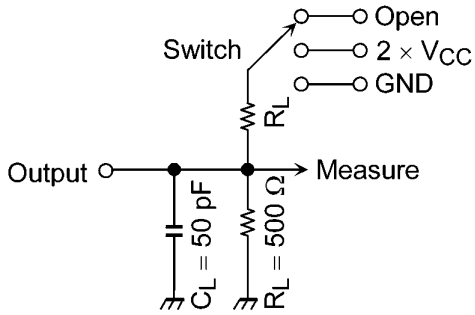


Fig. 11.2.1 AC Test Circuit

Table 11.2.1 Parameter for AC Test Circuit

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

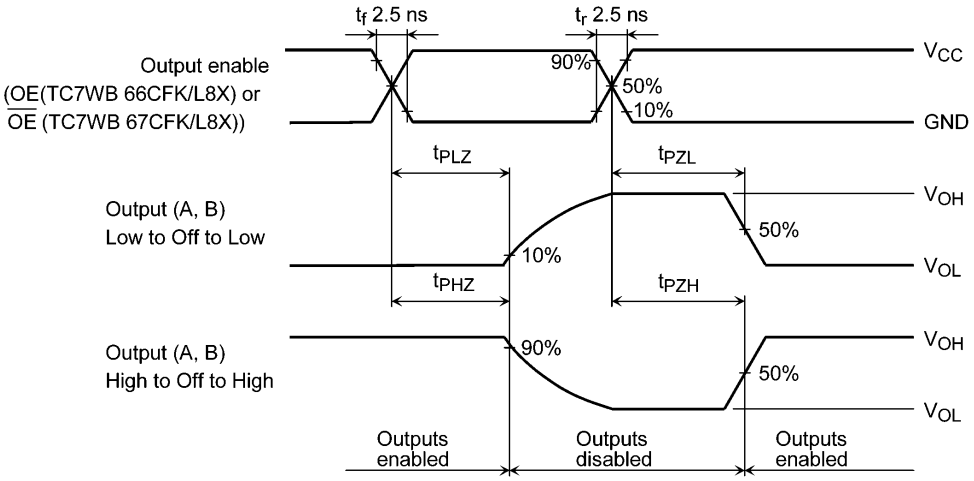


Fig. 11.2.2 AC Waveform t_{PLZ}, t_{PHZ}, t_{PZL}, t_{PZH}

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.)

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

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

Calculation example:

$$t_{r(out)}\ (\text{approx}) = -(10 + 15)\ E-12 \cdot (120 + 4) \cdot \ln(((4.5 - 0) - 2.25) / (4.5 - 0)) = \approx 2.1\ \text{ns}$$

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)

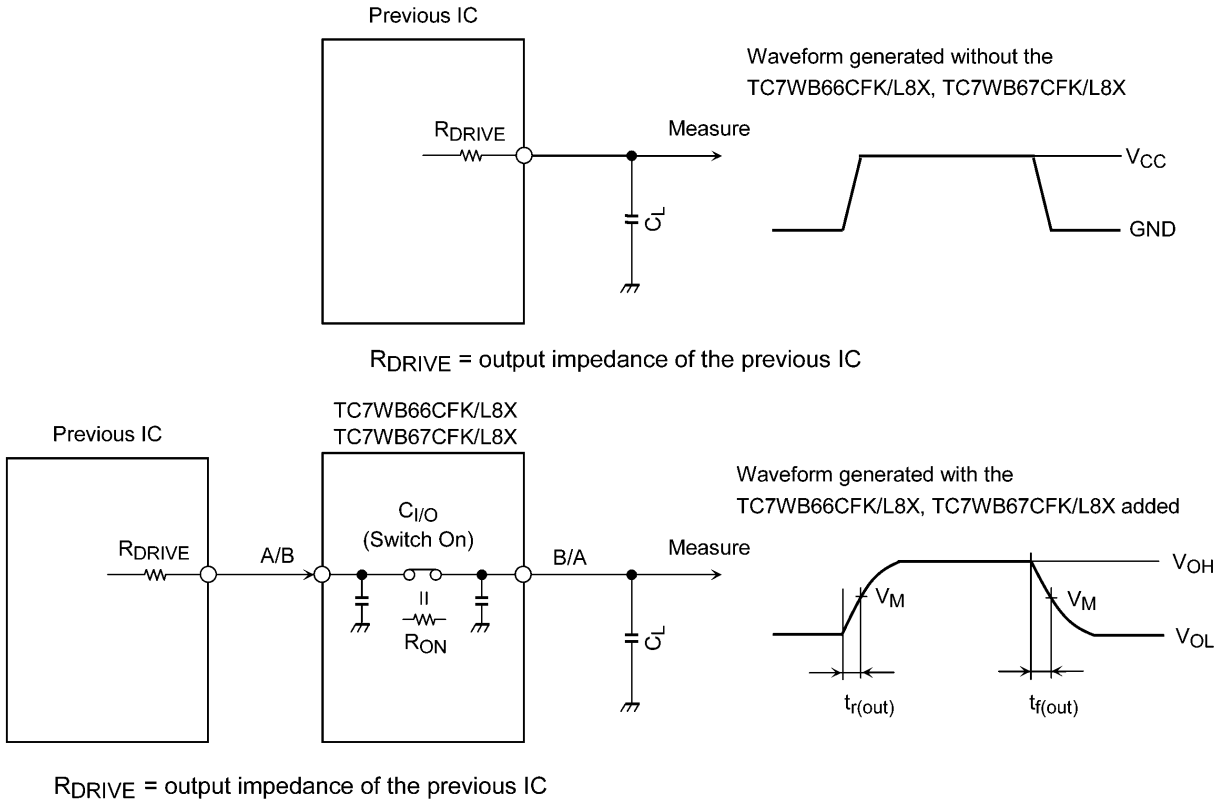


Fig. 12.1 Calculation Circuit

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)

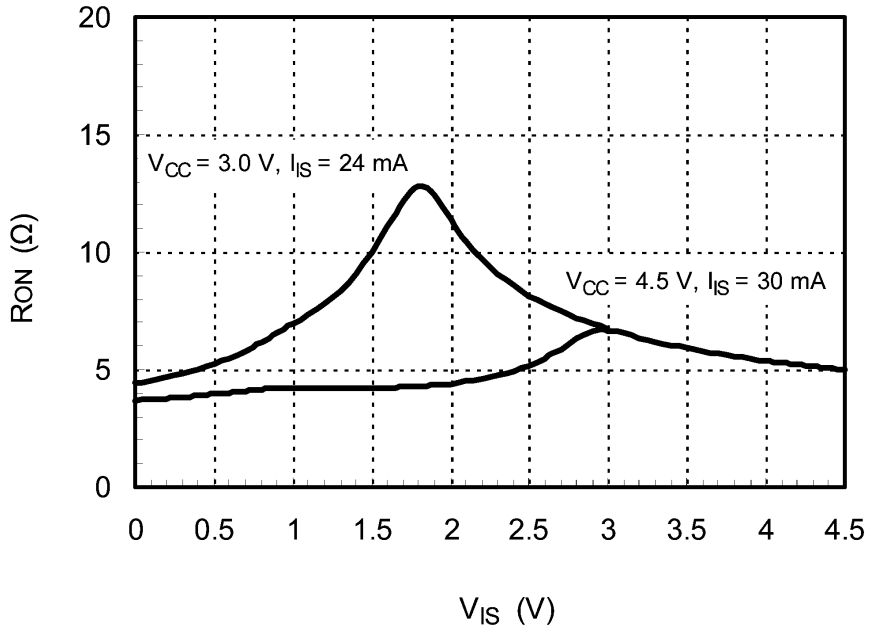


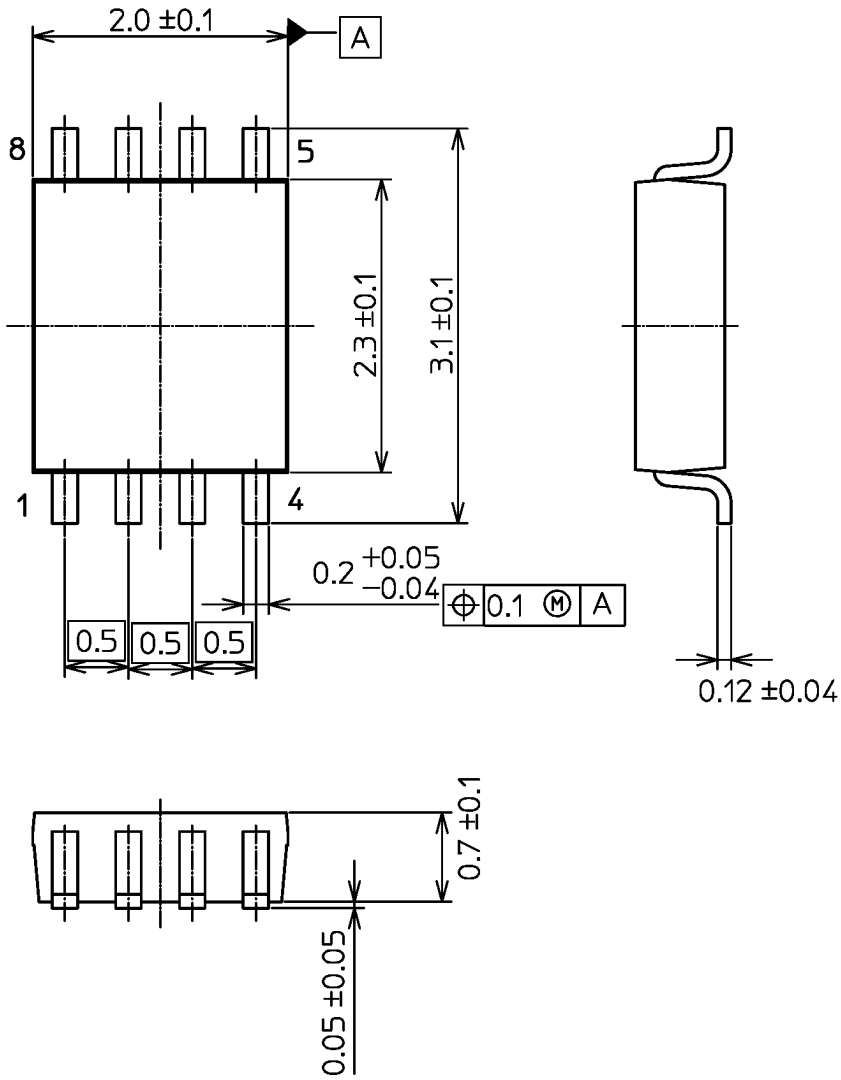
Fig. 13.1 R_{ON} - V_{IS}

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



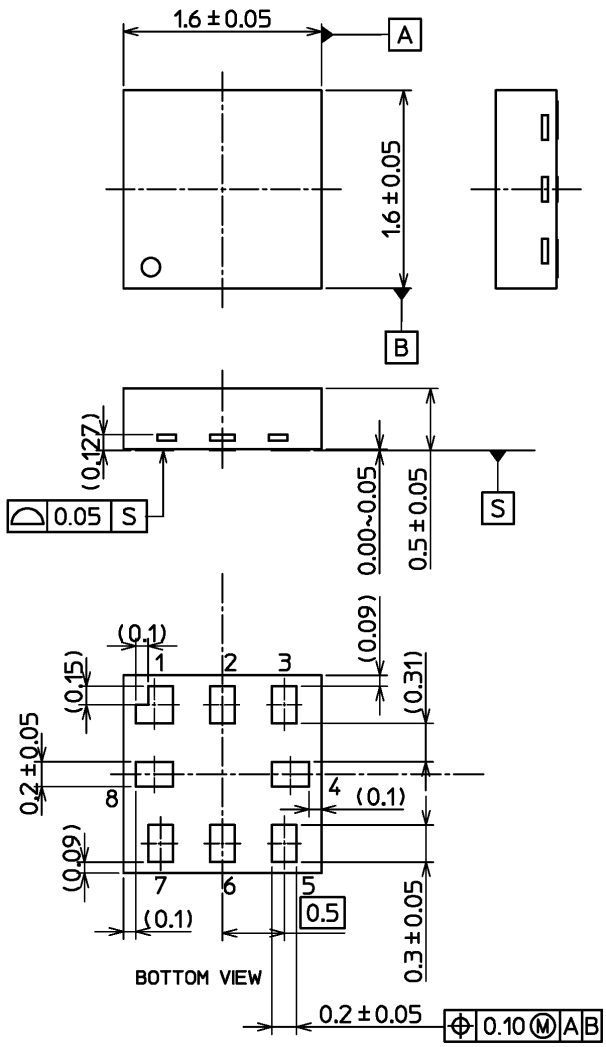
Weight: 0.01 g (typ.)

Package Name(s)
JEDEC: SOT-765
Nickname: US8

Package Dimensions

Unit: mm

TC7WB66CL8X,TC7WB67CL8X



Weight: 0.0039 g (typ.)

Package Name(s)
Nickname: MP8

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