

# RD74VT1G02

## 2-input NOR Gate / Dual Supply Voltage Translator

REJ03D0513-0100

Rev.1.00

Jun. 01, 2005

### Description

The RD74VT1G02 has two-input NOR gate in a 6 pin package. The input is designed to track  $V_{CCIN}$ , which accepts voltages from 1.2V to 3.6V, and the output is designed to track  $V_{CCOUT}$ , which operates at 1.2V to 3.6V. Low voltage and high-speed operation is suitable for the battery powered products (e.g., notebook computers), and the low power consumption extends the battery life.

### Features

- This product function as level shift that change  $V_{CCIN}$  input level to  $V_{CCOUT}$  output level by providing different supply voltage to  $V_{CCIN}$  and  $V_{CCOUT}$ .
- The basic gate function is lined up as Renesas uni logic series.
- Supplied on emboss taping for high-speed automatic mounting.
- Supply voltage range:  $V_{CCIN} = 1.2 \text{ V to } 3.6 \text{ V}$   
 $V_{CCOUT} = 1.2 \text{ V to } 3.6 \text{ V}$

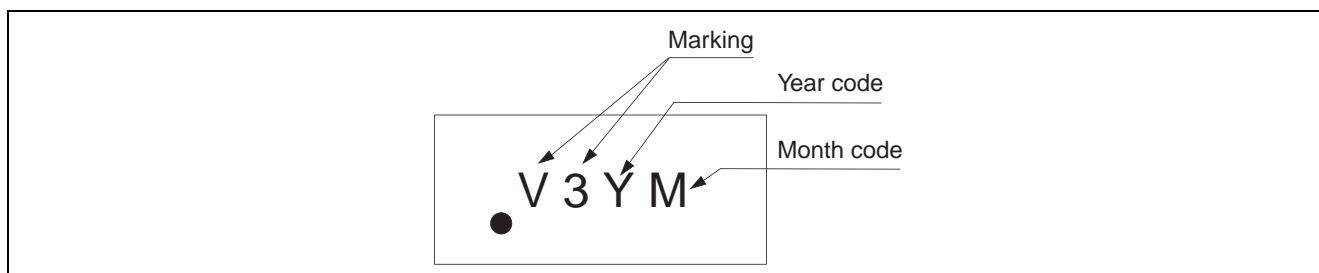
Operating temperature range:  $-40 \text{ to } +85^{\circ}\text{C}$

- All inputs  $V_{IH} (\text{Max.}) = 3.6 \text{ V} (@V_{CCIN} = 0 \text{ V to } 3.6 \text{ V})$   
Outputs  $V_O (\text{Max.}) = 3.6 \text{ V} (@V_{CCOUT} = 0 \text{ V})$
- Output current  $\pm 2 \text{ mA} (@V_{CCOUT} = 1.2 \text{ V})$   
 $\pm 4 \text{ mA} (@V_{CCOUT} = 1.4 \text{ V to } 1.6 \text{ V})$   
 $\pm 6 \text{ mA} (@V_{CCOUT} = 1.65 \text{ V to } 1.95 \text{ V})$   
 $\pm 18 \text{ mA} (@V_{CCOUT} = 2.3 \text{ V to } 2.7 \text{ V})$   
 $\pm 24 \text{ mA} (@V_{CCOUT} = 3.0 \text{ V to } 3.6 \text{ V})$

- Ordering Information

Part Name	Package Type	Package Code (Previous Code)	Package Abbreviation	Taping Abbreviation (Quantity)
RD74VT1G02CLE	WCSP-6 pin	SXBG0006KB-A (TBS-6AV)	CL	E (3,000 pcs/reel)

### Article Indication



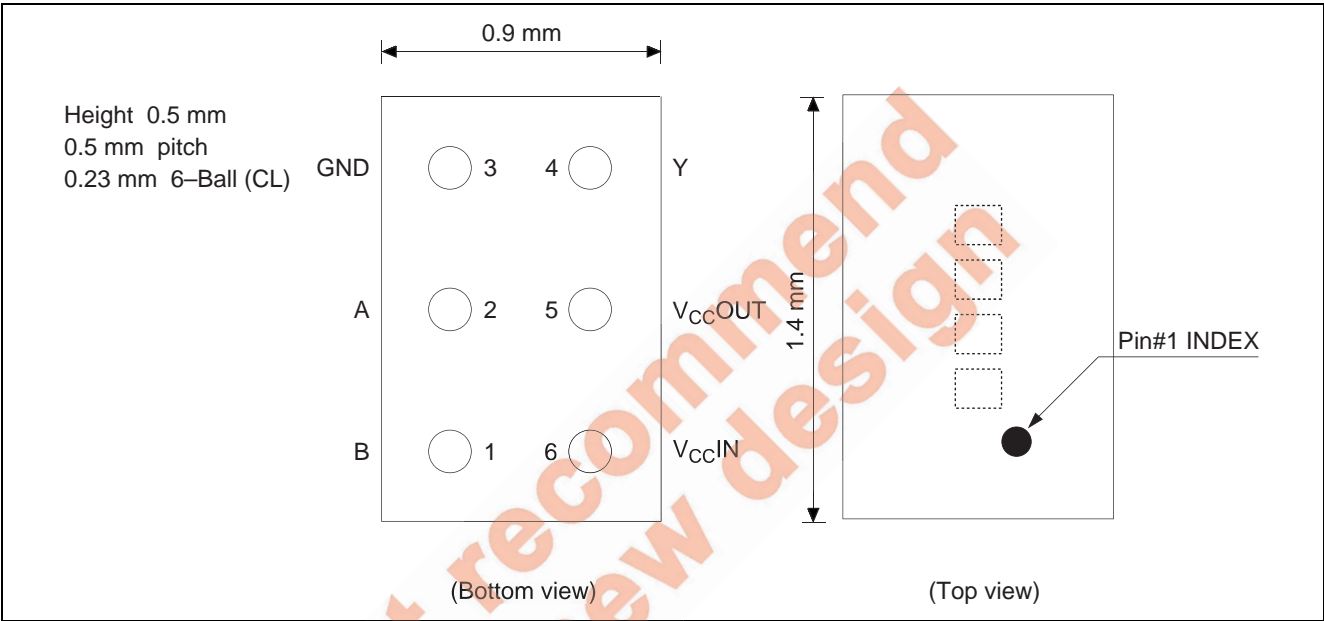
Function Table

Inputs		Output Y
A	B	
L	L	H
L	H	L
H	L	L
H	H	L

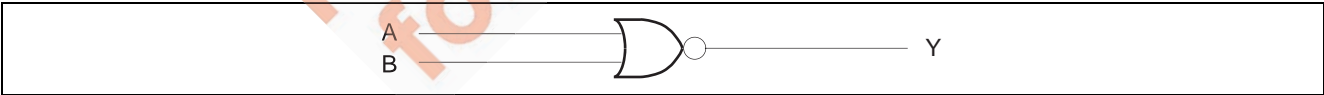
H: High level

L: Low level

Pin Arrangement



Logic Diagram



## Absolute Maximum Ratings

Item	Symbol	Ratings	Unit	Conditions
Supply voltage range	$V_{CCIN}, V_{CCOUT}$	-0.5 to 4.6	V	
Input voltage range <sup>*1</sup>	$V_I$	-0.5 to 4.6	V	
Output voltage range <sup>*1, 2</sup>	$V_O$	-0.5 to $V_{CCOUT}+0.5$	V	Output: "H" or "L"
		-0.5 to 4.6		$V_{CCOUT}$ : OFF
Input clamp current	$I_{IK}$	-50	mA	$V_I < 0$
Output clamp current	$I_{OK}$	-50	mA	$V_O < 0$
		50		$V_O > V_{CC}+0.5$
Continuous output current	$I_O$	$\pm 50$	mA	
Continuous output current $V_{CC}$ or GND	$I_{CCIN}, I_{CCOUT}, I_{GND}$	$\pm 100$	mA	
Package Thermal impedance	$\theta_{ja}$	123	°C/W	
Storage temperature	$T_{stg}$	-65 to 150	°C	

Notes: The absolute maximum ratings are values, which must not individually be exceeded, and furthermore, no two of which may be realized at the same time.

1. The input and output voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
2. This value is limited to 4.6 V maximum.

## Recommended Operating Conditions

Item	Symbol	Ratings	Unit	Conditions
Supply voltage range	$V_{CCIN}$	1.2 to 3.6	V	
	$V_{CCOUT}$	1.2 to 3.6		
Input/Output voltage	$V_I$	0 to 3.6	V	
	$V_O$	0 to $V_{CCOUT}$	V	Output: "H" or "L"
		0 to 3.6		$V_{CCOUT}$ : OFF
Output current	$I_{OH}$	-2	mA	$V_{CCOUT} = 1.2 \text{ V}$
		-4		$V_{CCOUT} = 1.5 \pm 0.1 \text{ V}$
		-6		$V_{CCOUT} = 1.8 \pm 0.15 \text{ V}$
		-18		$V_{CCOUT} = 2.5 \pm 0.2 \text{ V}$
		-24		$V_{CCOUT} = 3.3 \pm 0.3 \text{ V}$
	$I_{OL}$	2	mA	$V_{CCOUT} = 1.2 \text{ V}$
		4		$V_{CCOUT} = 1.5 \pm 0.1 \text{ V}$
		6		$V_{CCOUT} = 1.8 \pm 0.15 \text{ V}$
		18		$V_{CCOUT} = 2.5 \pm 0.2 \text{ V}$
		24		$V_{CCOUT} = 3.3 \pm 0.3 \text{ V}$
Input transition rise or fall time	$\Delta t / \Delta v$	10	ns / V	
Operation free-air temperature	$T_a$	-40 to 85	°C	

## Electrical Characteristics

(Ta = -40 to 85°C)

Item	Symbol	V <sub>CC</sub> IN (V) *	V <sub>CC</sub> OUT (V) *	Min	Typ	Max	Unit	Test conditions
Input voltage	V <sub>IH</sub>	1.2	1.2 to 3.6	V <sub>CC</sub> IN×0.75	—	—	V	
		1.5±0.1		V <sub>CC</sub> IN×0.70	—	—		
		1.8±0.15		V <sub>CC</sub> IN×0.65	—	—		
		2.5±0.2		1.6	—	—		
		3.3±0.3		2.0	—	—		
	V <sub>IL</sub>	1.2	1.2 to 3.6	—	—	V <sub>CC</sub> IN×0.25	V	
		1.5±0.1		—	—	V <sub>CC</sub> IN×0.30		
		1.8±0.15		—	—	V <sub>CC</sub> IN×0.35		
		2.5±0.2		—	—	0.7		
		3.3±0.3		—	—	0.8		
Output voltage	V <sub>OH</sub>	1.2 to 3.6	1.2 to 3.6	V <sub>CC</sub> OUT-0.2	—	—	V	I <sub>OH</sub> = -100 μA
			1.2	0.9	—	—		I <sub>OH</sub> = -2 mA
			1.5±0.1	1.1	—	—		I <sub>OH</sub> = -4 mA
			1.8±0.15	1.25	—	—		I <sub>OH</sub> = -6 mA
			2.5±0.2	1.7	—	—		I <sub>OH</sub> = -18 mA
			3.3±0.3	2.2	—	—		I <sub>OH</sub> = -24 mA
	V <sub>OL</sub>	1.2 to 3.6	1.2 to 3.6	—	—	0.2	V	I <sub>OL</sub> = 100 μA
			1.2	—	—	0.3		I <sub>OL</sub> = 2 mA
			1.5±0.1	—	—	0.3		I <sub>OL</sub> = 4 mA
			1.8±0.15	—	—	0.3		I <sub>OL</sub> = 6 mA
			2.5±0.2	—	—	0.6		I <sub>OL</sub> = 18 mA
			3.3±0.3	—	—	0.55		I <sub>OL</sub> = 24 mA
Input current	I <sub>IN</sub>	3.6	3.6	-1.0	—	1.0	μA	V <sub>IN</sub> = GND or V <sub>CC</sub> IN
Output leakage current	I <sub>OFF</sub>	0	0	—	—	1.5	μA	V <sub>IN</sub> , V <sub>OUT</sub> = 0 to 3.6 V
Quiescent supply current	I <sub>CC</sub> IN	1.2 to 3.6	1.2 to 3.6	-3.0	—	3.0	μA	I <sub>O(Y port)</sub> = 0 V <sub>IN</sub> = V <sub>CC</sub> IN or GND
	I <sub>CC</sub> OUT	1.2 to 3.6	1.2 to 3.6	-3.0	—	3.0		I <sub>O(Y port)</sub> = 0 V <sub>IN</sub> = V <sub>CC</sub> IN or GND
Increase in I <sub>CC</sub> per input	ΔI <sub>CC</sub>	3.6	3.6	—	—	250	μA	A or B port V <sub>CC</sub> IN-0.6 (1 input)
Input capacitance	C <sub>IN</sub>	3.3	3.3	—	3.5	—	pF	V <sub>IN</sub> = V <sub>CC</sub> or GND

Note: For conditions shown as Min or Max, use the appropriate values under recommended operating conditions.

## Switching Characteristics

V<sub>CC</sub>IN = 3.3±0.3 V

Item	Symbol	From (input)	To (output)	Ta = −40 to 85°C									Unit	Test conditions	
				V <sub>CC</sub> OUT=1.2 V		V <sub>CC</sub> OUT=1.5±0.1 V		V <sub>CC</sub> OUT=1.8±0.15 V		V <sub>CC</sub> OUT=2.5±0.2 V		V <sub>CC</sub> OUT=3.3±0.3 V			
				Typ	Min	Max	Min	Max	Min	Max	Min	Max			
Propagation delay time	t <sub>PLH</sub>	A or B	Y	7.8	2.0	7.4	1.5	4.8	1.0	3.4	1.0	3.2	ns	C <sub>L</sub> = 15pF R <sub>L</sub> = 2.0kΩ	
	t <sub>PHL</sub>			7.8	2.0	7.4	1.5	4.8	1.0	3.4	1.0	3.2			

## Switching Characteristics (Cont)

$$V_{CCIN} = 2.5 \pm 0.2 \text{ V}$$

Item	Symbol	From (input)	To (output)	Ta = −40 to 85°C										Unit	Test conditions
				V <sub>CC</sub> OUT=1.2 V		V <sub>CC</sub> OUT=1.5±0.1 V		V <sub>CC</sub> OUT=1.8±0.15 V		V <sub>CC</sub> OUT=2.5±0.2 V		V <sub>CC</sub> OUT=3.3±0.3 V			
				Typ	Min	Max	Min	Max	Min	Max	Min	Max			
Propagation delay time	t <sub>PLH</sub>	A or B	Y	7.8	2.0	7.6	1.5	5.0	1.0	3.7	1.0	3.5	ns	C <sub>L</sub> = 15pF R <sub>L</sub> = 2.0kΩ	
	t <sub>PHL</sub>			7.8	2.0	7.6	1.5	5.0	1.0	3.7	1.0	3.5			

$$V_{CCIN} = 1.8 \pm 0.15 \text{ V}$$

Item	Symbol	From (input)	To (output)	Ta = −40 to 85°C									Unit	Test conditions	
				V <sub>CC</sub> OUT=1.2 V		V <sub>CC</sub> OUT=1.5±0.1 V		V <sub>CC</sub> OUT=1.8±0.15 V		V <sub>CC</sub> OUT=2.5±0.2 V		V <sub>CC</sub> OUT=3.3±0.3 V			
				Typ	Min	Max	Min	Max	Min	Max	Min	Max			
Propagation delay time	t <sub>PLH</sub>	A or B	Y	8.0	2.0	8.0	1.5	5.5	1.0	4.4	1.0	4.0	ns	C <sub>L</sub> = 15pF R <sub>L</sub> = 2.0kΩ	
	t <sub>PHL</sub>			8.0	2.0	8.0	1.5	5.5	1.0	4.4	1.0	4.0			

$$V_{CCIN} = 1.5 \pm 0.1 \text{ V}$$

Item	Symbol	From (input)	To (output)	Ta = −40 to 85°C										Unit	Test conditions
				V <sub>CC</sub> OUT=1.2 V		V <sub>CC</sub> OUT=1.5±0.1 V		V <sub>CC</sub> OUT=1.8±0.15 V		V <sub>CC</sub> OUT=2.5±0.2 V		V <sub>CC</sub> OUT=3.3±0.3 V			
				Typ	Min	Max	Min	Max	Min	Max	Min	Max			
Propagation delay time	t <sub>PLH</sub>	A or B	Y	8.2	2.0	8.5	1.5	6.4	1.0	5.5	1.0	5.2	ns	C <sub>L</sub> = 15pF R <sub>L</sub> = 2.0kΩ	
	t <sub>PHL</sub>			8.2	2.0	8.5	1.5	6.4	1.0	5.5	1.0	5.2			

$$V_{CCIN} = 1.2 \text{ V}$$

Item	Symbol	From (input)	To (output)	Ta = -40 to 85°C					Unit	Test conditions
				V <sub>CC</sub> OUT= 1.2 V	V <sub>CC</sub> OUT= 1.5±0.1 V	V <sub>CC</sub> OUT= 1.8±0.15 V	V <sub>CC</sub> OUT= 2.5±0.2 V	V <sub>CC</sub> OUT= 3.3±0.3 V		
				Typ	Typ	Typ	Typ	Typ		
Propagation delay time	t <sub>PLH</sub>	A or B	Y	8.7	7.0	6.0	5.5	5.5	ns	C <sub>L</sub> = 15pF R <sub>L</sub> = 2.0kΩ
	t <sub>PHL</sub>			8.7	7.0	6.0	5.5	5.5		

## Operating Characteristics

$$T_a = 25^\circ\text{C}$$

Item	Symbol	V <sub>CCIN</sub> (V)	V <sub>CCOUT</sub> (V)	Min	Typ	Max	Unit	Test conditions
Power dissipation capacitance	C <sub>PD</sub>	3.3	3.3	—	12	—	pF	f = 10 MHz C <sub>L</sub> = 0

## Power-up Considerations

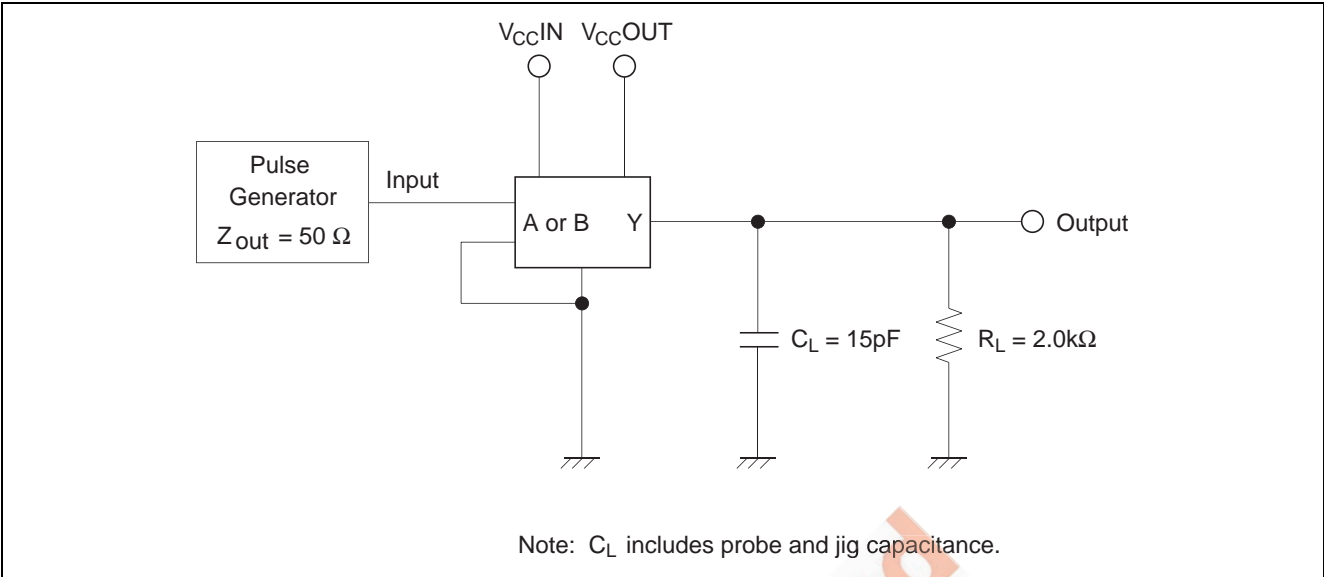
Level-translation devices offer an opportunity for successful mixed-voltage signal design.

A proper power-up sequence always should be followed to avoid excessive supply current, bus contention, oscillations, or other anomalies caused by improperly biased device pins.

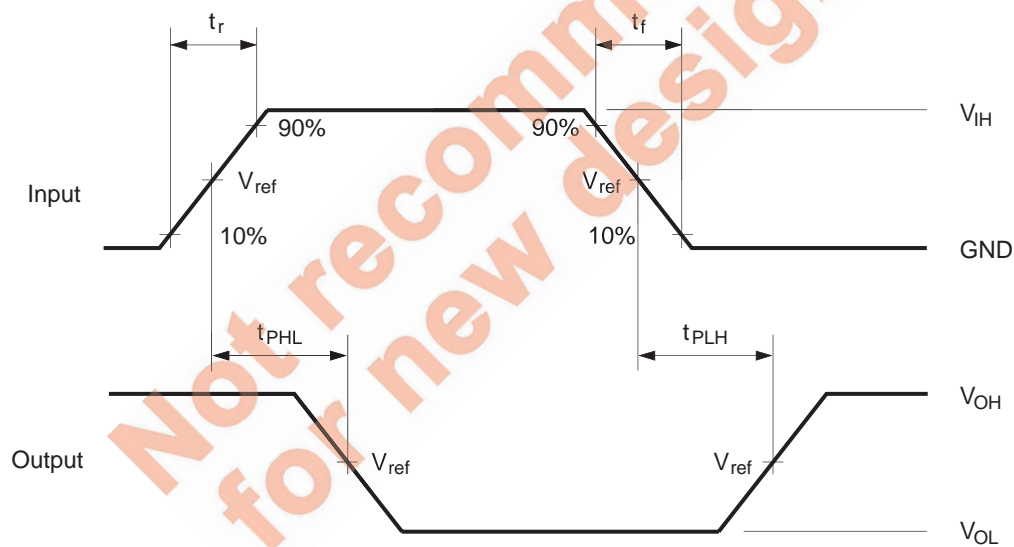
Take these precautions to guard against such power-up problems.

1. Connect ground before any supply voltage is applied.
2. Next, power up the input side of the device.  
(Power up of V<sub>CCIN</sub> is first. Next power up is V<sub>CCOUT</sub>)

Test Circuit



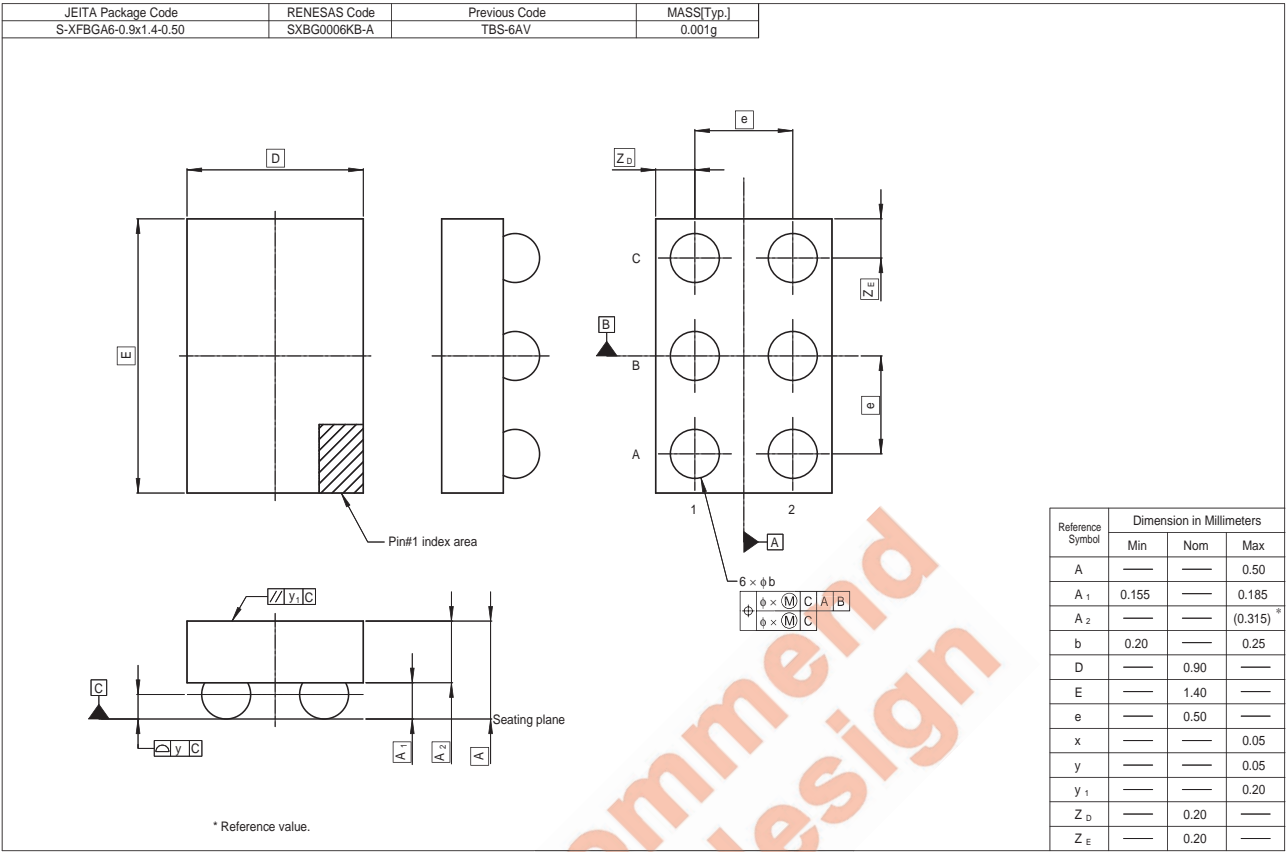
• Waveforms



Symbol	$V_{CC} = 1.2V \text{ to } 3.6V$
$t_r / t_f$	2.0 ns
$V_{IH}$	$V_{CC}$
$V_{ref}$	$1/2 V_{CC}$

Note: Input waveform : PRR  $\leq$  10 MHz,  $Z_O = 50 \Omega$ , duty cycle 50%

Package Dimensions



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