

# RD74VT1G32

## 2-input OR Gate / Dual Supply Voltage Translator

REJ03D0515-0100

Rev.1.00

Apr. 14, 2005

### Description

The RD74VT1G32 has two-input OR gate in a 6 pin package. The input is designed to track  $V_{CCIN}$ , which accepts voltage 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:  $V_{CCIN} = 1.2\text{ V to }3.6\text{ V}$

$V_{CCOUT} = 1.2\text{ V to }3.6\text{ V}$

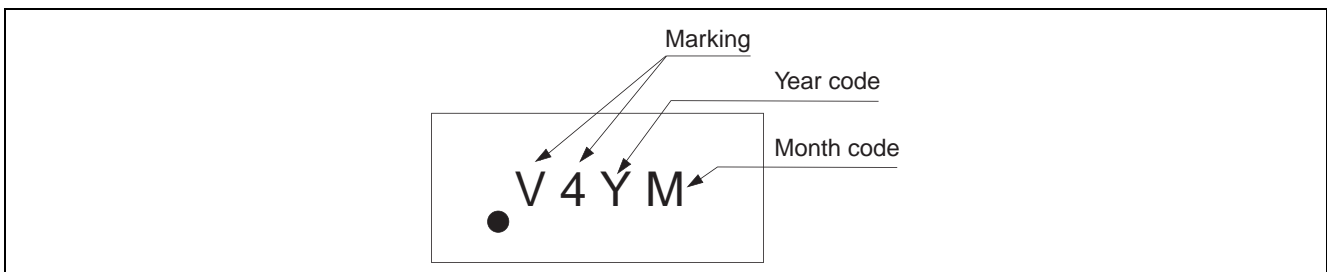
Operating temperature range:  $-40\text{ to }+85^{\circ}\text{C}$

- 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)
RD74VT1G32CLE	WCSP-6 pin	SXBG0006KB-A (TBS-6AV)	CL	E (3,000 pcs/reel)

### Article Indication

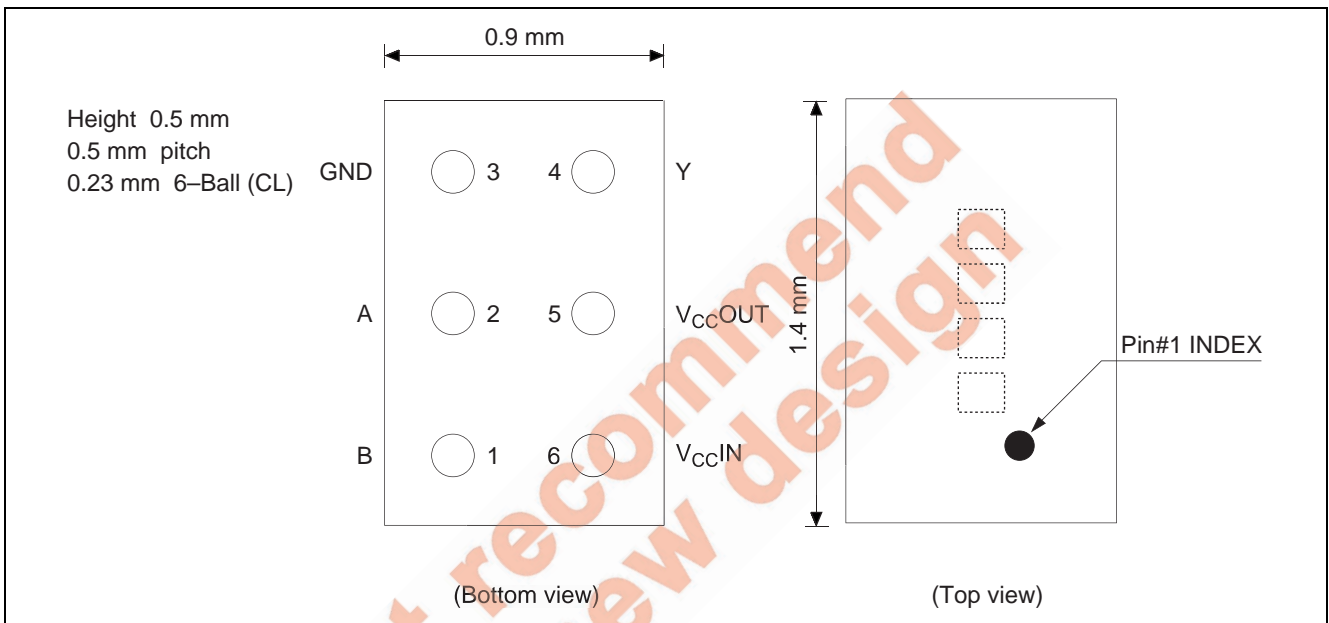


**Function Table**

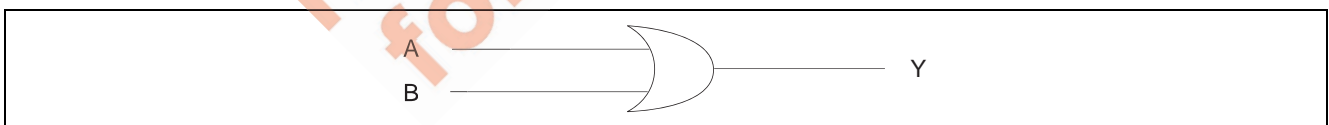
Inputs		Output Y
A	B	
L	L	L
H	L	H
L	H	H
H	H	H

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	Tstg	-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.

- The input and output voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
- 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	$V_{CCOUT} = 1.2$ V
		-4		$V_{CCOUT} = 1.5 \pm 0.1$ V
		-6		$V_{CCOUT} = 1.8 \pm 0.15$ V
		-18		$V_{CCOUT} = 2.5 \pm 0.2$ V
		-24		$V_{CCOUT} = 3.3 \pm 0.3$ V
	$I_{OL}$	2	mA	$V_{CCOUT} = 1.2$ V
		4		$V_{CCOUT} = 1.5 \pm 0.1$ V
		6		$V_{CCOUT} = 1.8 \pm 0.15$ V
		18		$V_{CCOUT} = 2.5 \pm 0.2$ V
		24		$V_{CCOUT} = 3.3 \pm 0.3$ V
Input transition rise or fall time	$\Delta t / \Delta v$	10	ns / V	
Operation free-air temperature	Ta	-40 to 85	°C	

## Electrical Characteristics

(Ta = -40 to 85°C)

Item	Symbol	V <sub>CCIN</sub> (V)*	V <sub>CCOUT</sub> (V)*	Min	Typ	Max	Unit	Test conditions	
Input voltage	V <sub>IH</sub>	1.2	1.2 to 3.6	V <sub>CCIN</sub> ×0.75	—	—	V		
		1.5±0.1		V <sub>CCIN</sub> ×0.70	—	—			
		1.8±0.15		V <sub>CCIN</sub> ×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>CCIN</sub> ×0.25	V		
		1.5±0.1		—	—	V <sub>CCIN</sub> ×0.30			
		1.8±0.15		—	—	V <sub>CCIN</sub> ×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>CCOUT</sub> -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
	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
	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>CCIN</sub>	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>CCIN</sub> or GND	
	I <sub>CCOUT</sub>	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>CCIN</sub> 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>CCIN</sub> -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>CCIN</sub> = 3.3 ± 0.3 V

Item	Symbol	FROM (Input)	TO (Output)	Ta = -40 to 85°C								Unit	Test Conditions		
				V <sub>CCOUT</sub> = 1.2V		V <sub>CCOUT</sub> = 1.5±0.1V		V <sub>CCOUT</sub> = 1.8±0.15V		V <sub>CCOUT</sub> = 2.5±0.2V				V <sub>CCOUT</sub> = 3.3±0.3V	
				Typ	Min	Max	Min	Max	Min	Max	Min			Max	Min
Propagation delay time	t <sub>PLH</sub>	A or B	Y	8.6	2.0	8.0	1.5	5.5	1.0	4.2	1.0	3.7	ns	C <sub>L</sub> = 15 pF R <sub>L</sub> = 2.0 kΩ	
	t <sub>PHL</sub>			8.6	2.0	8.0	1.5	5.5	1.0	4.2	1.0	3.7			

## 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>CCOUT</sub> = 1.2V		V <sub>CCOUT</sub> = 1.5±0.1V		V <sub>CCOUT</sub> = 1.8±0.15V		V <sub>CCOUT</sub> = 2.5±0.2V				V <sub>CCOUT</sub> = 3.3±0.3V	
				Typ	Min	Max	Min	Max	Min	Max	Min			Max	
Propagation delay time	t <sub>PLH</sub>	A or B	Y	8.9	2.0	8.2	1.5	5.8	1.0	4.6	1.0	4.2	ns	C <sub>L</sub> = 15 pF R <sub>L</sub> = 2.0 kΩ	
	t <sub>PHL</sub>			8.9	2.0	8.2	1.5	5.8	1.0	4.6	1.0	4.2			

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

Item	Symbol	FROM (Input)	TO (Output)	Ta = -40 to 85°C								Unit	Test Conditions		
				V <sub>CCOUT</sub> = 1.2V		V <sub>CCOUT</sub> = 1.5±0.1V		V <sub>CCOUT</sub> = 1.8±0.15V		V <sub>CCOUT</sub> = 2.5±0.2V				V <sub>CCOUT</sub> = 3.3±0.3V	
				Typ	Min	Max	Min	Max	Min	Max	Min			Max	
Propagation delay time	t <sub>PLH</sub>	A or B	Y	9.2	2.0	9.0	1.5	6.7	1.0	5.5	1.0	5.3	ns	C <sub>L</sub> = 15 pF R <sub>L</sub> = 2.0 kΩ	
	t <sub>PHL</sub>			9.2	2.0	9.0	1.5	6.7	1.0	5.5	1.0	5.3			

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

Item	Symbol	FROM (Input)	TO (Output)	Ta = -40 to 85°C								Unit	Test Conditions		
				V <sub>CCOUT</sub> = 1.2V		V <sub>CCOUT</sub> = 1.5±0.1V		V <sub>CCOUT</sub> = 1.8±0.15V		V <sub>CCOUT</sub> = 2.5±0.2V				V <sub>CCOUT</sub> = 3.3±0.3V	
				Typ	Min	Max	Min	Max	Min	Max	Min			Max	
Propagation delay time	t <sub>PLH</sub>	A or B	Y	9.7	2.0	10.5	1.5	7.8	1.0	6.6	1.0	6.4	ns	C <sub>L</sub> = 15 pF R <sub>L</sub> = 2.0 kΩ	
	t <sub>PHL</sub>			9.7	2.0	10.5	1.5	7.8	1.0	6.6	1.0	6.4			

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

Item	Symbol	FROM (Input)	TO (Output)	Ta = -40 to 85°C					Unit	Test Conditions
				V <sub>CCOUT</sub> = 1.2V	V <sub>CCOUT</sub> = 1.5±0.1V	V <sub>CCOUT</sub> = 1.8±0.15V	V <sub>CCOUT</sub> = 2.5±0.2V	V <sub>CCOUT</sub> = 3.3±0.3V		
				Typ	Typ	Typ	Typ	Typ		
Propagation delay time	t <sub>PLH</sub>	A or B	Y	10.9	8.6	7.2	5.9	5.4	ns	C <sub>L</sub> = 15 pF R <sub>L</sub> = 2.0 kΩ
	t <sub>PHL</sub>			10.9	8.6	7.2	5.9	5.4		

## Operating Characteristics

Item	Symbol	V <sub>CCIN</sub> (V)	V <sub>CCOUT</sub> (V)	Ta = 25°C			Unit	Test Conditions
				Min	Typ	Max		
Power dissipation capacitance	C <sub>PD</sub>	3.3	3.3	—	12	—	pF	f = 10 MHz C <sub>L</sub> = 0

## Power-up Considerations

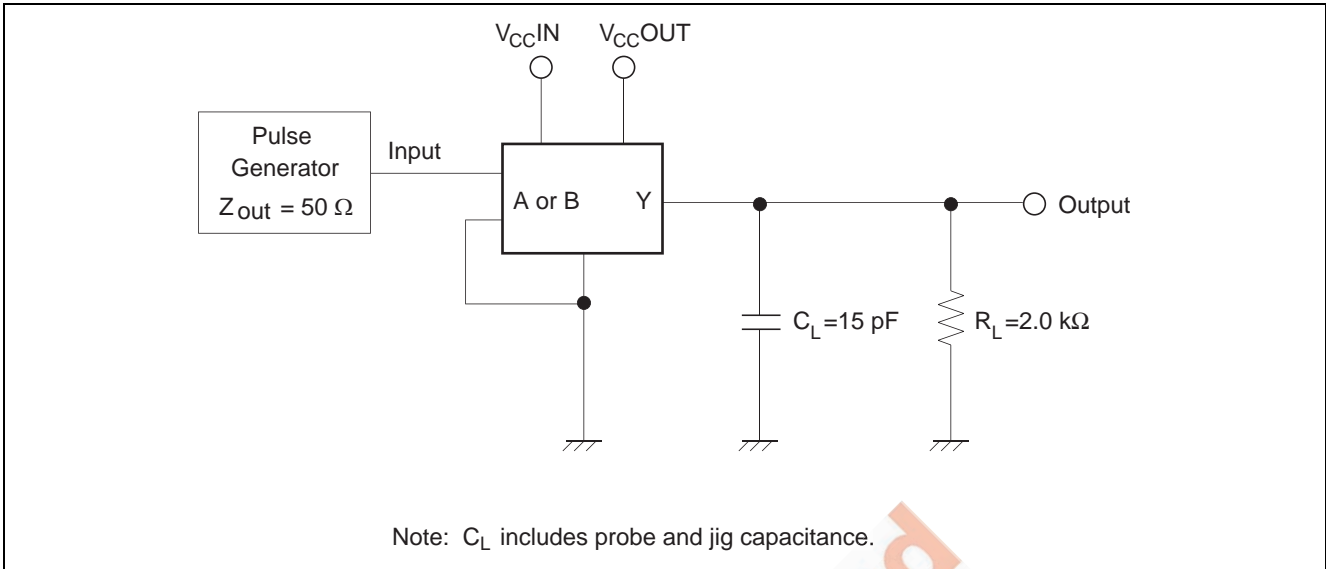
Level-translation devices offer an opportunity for successful mixed-voltage signal design.

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.

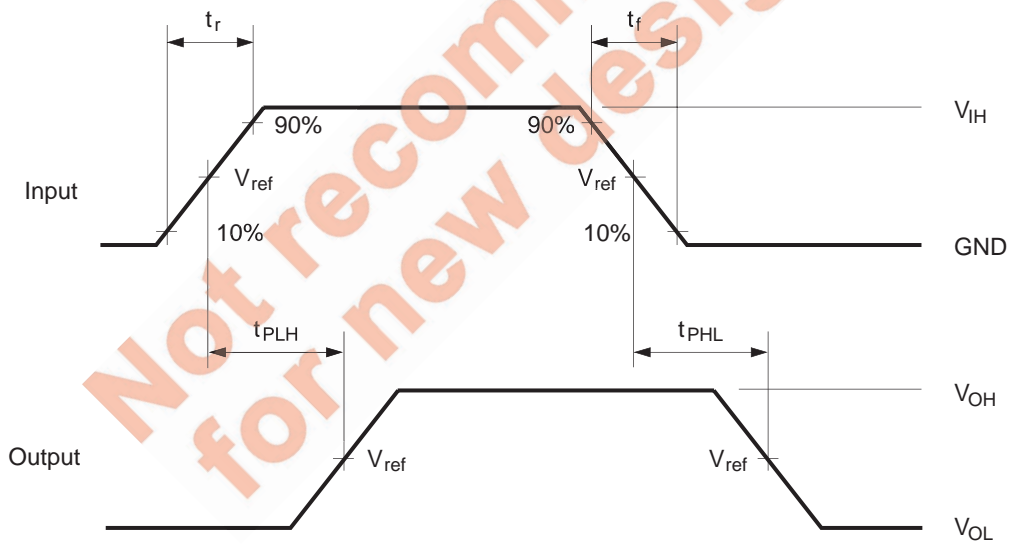
Take these precautions to guard against such power-up problems.

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



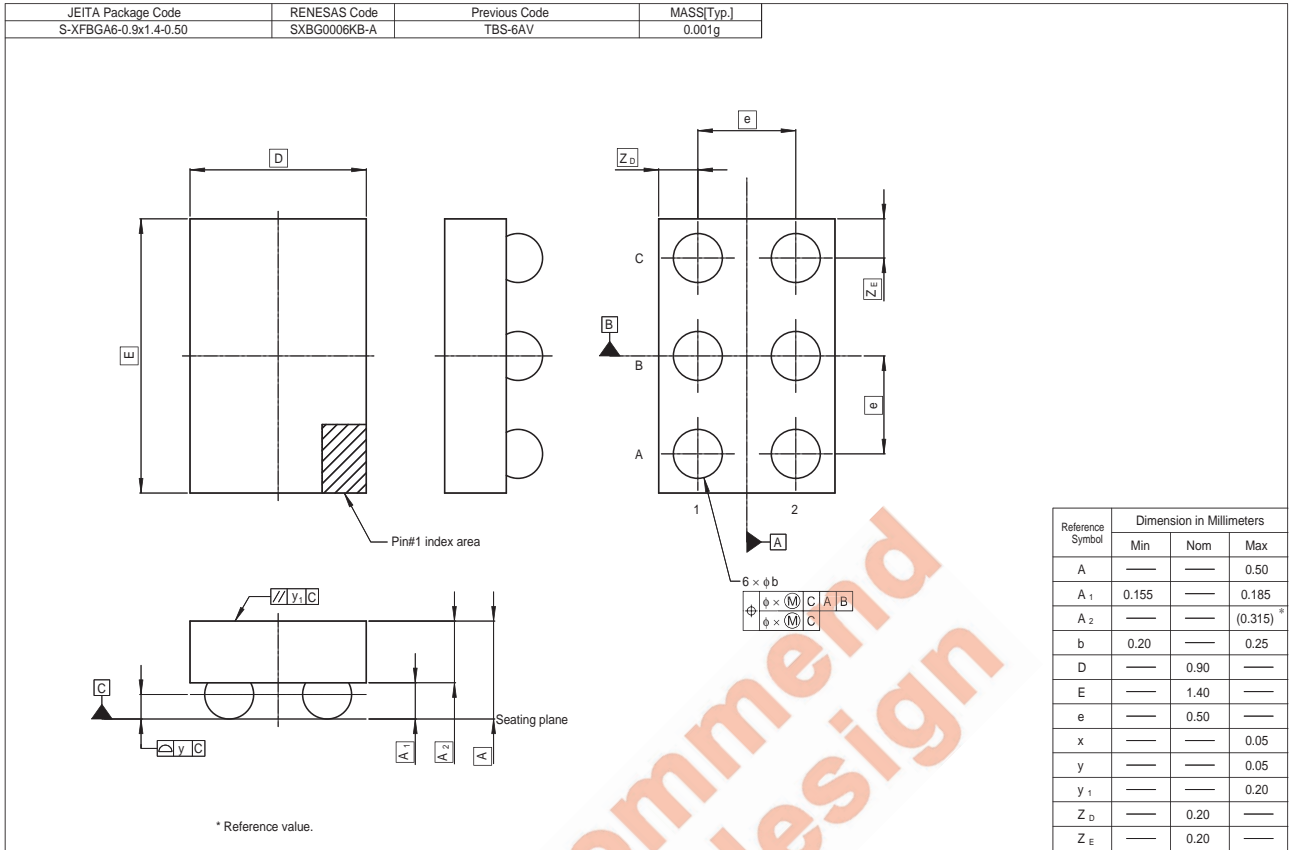
• Waveforms



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



Not recommended for new design

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