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April 1st, 2010
Renesas Electronics Corporation

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RD74VT1G125

Bus Buffer Gate with 3-state output / Dual Supply Voltage Translator

REJ03D0496-0200

Rev.2.00

Apr. 01, 2005

Description

The RD74VT1G125 has a bus buffer gate with 3-state output in a 6 pin package. Output is disabled when the associated output enable (\overline{OE}) input is high. To ensure the high impedance state during power up or power down, \overline{OE} should be connected to V_{CCIN} through a pull-up resistor, the minimum value of the resistor is determined by the current sinking capability of the driver. The input is designed to track V_{CCIN} , which accepts voltages from 1.2 V to 3.6 V, and the output is designed to track V_{CCOUT} , which operates at 1.2 V to 3.6 V. 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.

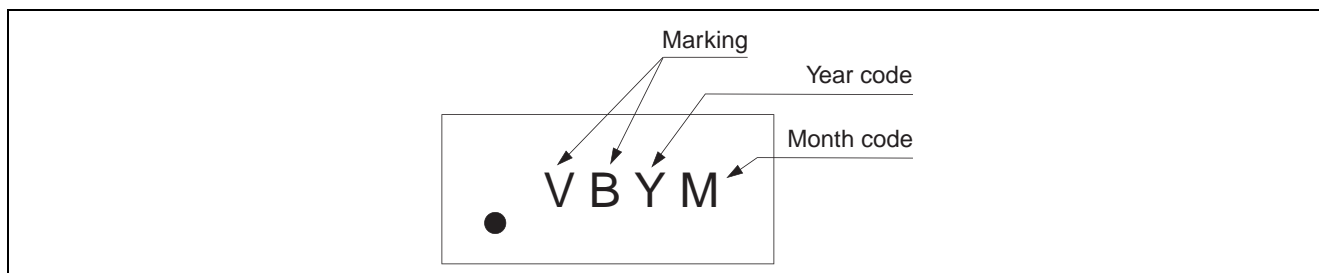
Features

- 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} .
- 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: $-40^{\circ}\text{C to } +85^{\circ}\text{C}$
- 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)
RD74VT1G125CLE	WCSP-6 pin	SXBG0006KB-A (TBS-6AV)	CL	E (3,000 pcs / reel)

Article Indication

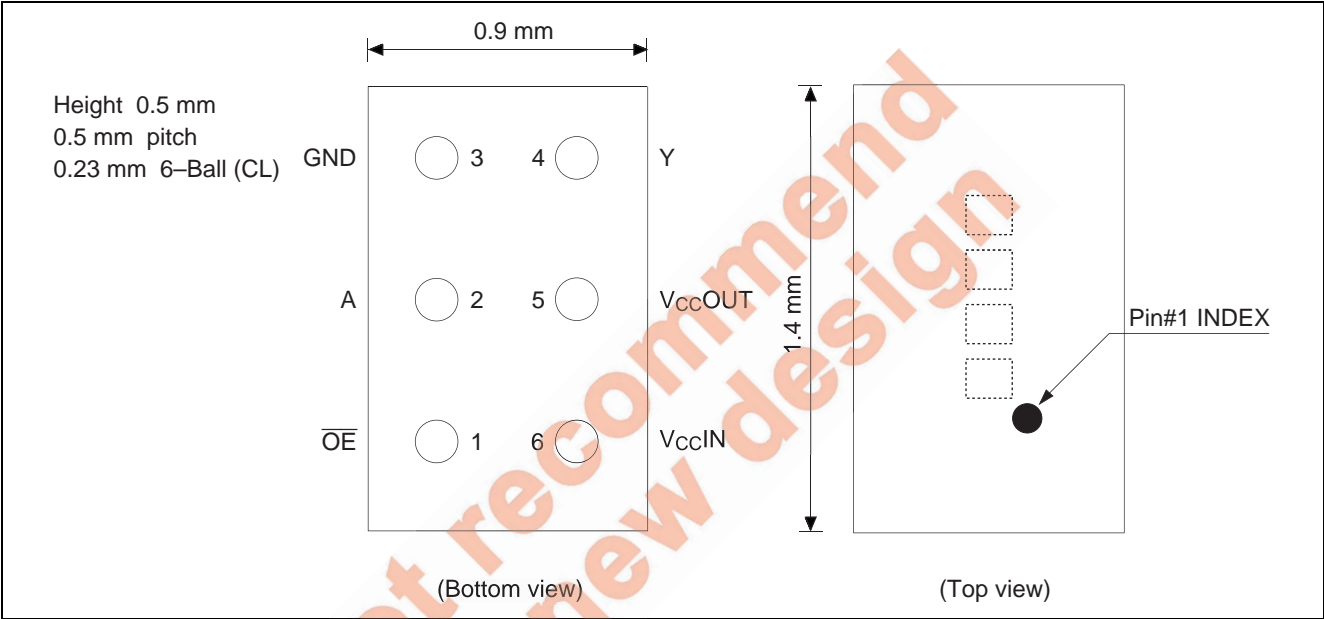


Function Table

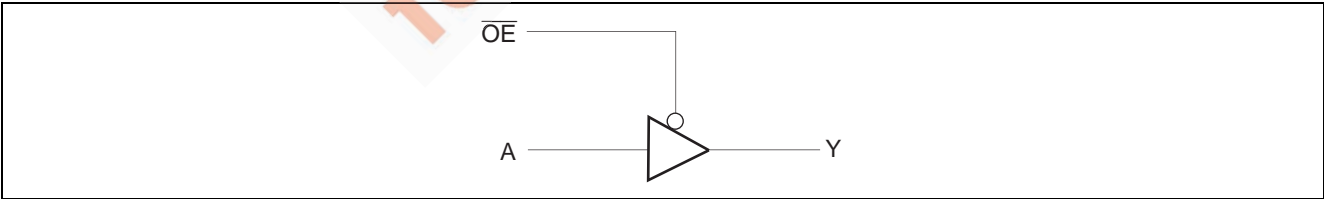
Inputs		OUTPUT Y
\overline{OE}	A	
L	H	H
L	L	L
H	X	Z

H: High level
L: Low level
X: Immaterial
Z: High impedance

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 ^{*1}	V_I	-0.5 to 4.6	V	A port or \overline{OE}
Output voltage range ^{*1, 2}	V_O	-0.5 to $V_{CCOUT}+0.5$	V	Output: "H" or "L"
		-0.5 to 4.6		Output: "Z" or 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	± 50	mA	
Continuous output current V_{CC} or GND	$I_{CCIN}, I_{CCOUT}, I_{GND}$	± 100	mA	
Package Thermal impedance	θ_{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	A port or \overline{OE}
	V_O	0 to V_{CCOUT}	V	Output: "H" or "L"
		0 to 3.6		Output: "Z" or 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 _{CC} IN (V) *	V _{CC} OUT (V) *	Min	Typ	Max	Unit	Test conditions
Input voltage	V _{IH}	1.2	1.2 to 3.6	V _{CC} IN×0.75	—	—	V	A port Control input
		1.5±0.1		V _{CC} IN×0.70	—	—		
		1.8±0.15		V _{CC} IN×0.65	—	—		
		2.5±0.2		1.6	—	—		
		3.3±0.3		2.0	—	—		
	V _{IL}	1.2	1.2 to 3.6	—	—	V _{CC} IN×0.25	V	A port Control input
		1.5±0.1		—	—	V _{CC} IN×0.30		
		1.8±0.15		—	—	V _{CC} IN×0.35		
		2.5±0.2		—	—	0.7		
		3.3±0.3		—	—	0.8		
Output voltage	V _{OH}	1.2 to 3.6	1.2 to 3.6	V _{CC} OUT-0.2	—	—	V	I _{OH} = -100 μA
			1.2	0.9	—	—		I _{OH} = -2 mA
			1.5±0.1	1.1	—	—		I _{OH} = -4 mA
			1.8±0.15	1.25	—	—		I _{OH} = -6 mA
			2.5±0.2	1.7	—	—		I _{OH} = -18 mA
			3.3±0.3	2.2	—	—		I _{OH} = -24 mA
	V _{OL}	1.2 to 3.6	1.2 to 3.6	—	—	0.2	V	I _{OL} = 100 μA
			1.2	—	—	0.3		I _{OL} = 2 mA
			1.5±0.1	—	—	0.3		I _{OL} = 4 mA
			1.8±0.15	—	—	0.3		I _{OL} = 6 mA
			2.5±0.2	—	—	0.6		I _{OL} = 18 mA
			3.3±0.3	—	—	0.55		I _{OL} = 24 mA
Input current	I _{IN}	3.6	3.6	-1.0	—	1.0	μA	V _{IN} = GND or V _{CC} IN control input
Off state output current	I _{OZ}	3.6	3.6	-1.5	—	1.5	μA	V _{IN} = V _{IH} or V _{IL}
Output leakage current	I _{OFF}	0	0	—	—	1.5	μA	V _{IN} , V _{OUT} = 0 to 3.6 V
Quiescent supply current	I _{CC} IN	1.2 to 3.6	1.2 to 3.6	-3.0	—	3.0	μA	I _O (Y port) = 0 V _{IN} = V _{CC} IN or GND
	I _{CC} OUT	1.2 to 3.6	1.2 to 3.6	-3.0	—	3.0		I _O (Y port) = 0 V _{IN} = V _{CC} IN or GND
Increase in I _{CC} per input	ΔI _{CC}	3.6	3.6	—	—	250	μA	A port or control V _{CC} IN-0.6 (1 input)
Input capacitance	C _{IN}	3.3	3.3	—	3.5	—	pF	V _{IN} = V _{CC} or GND

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

Switching Characteristics

$$V_{CCIN} = 3.3 \pm 0.3 \text{ V}$$

Item	Symbol	From (input)	To (output)	Ta = -40 to 85°C									Unit	Test conditions	
				V _{CC} OUT= 1.2 V		V _{CC} OUT= 1.5±0.1 V		V _{CC} OUT= 1.8±0.15 V		V _{CC} OUT= 2.5±0.2 V		V _{CC} OUT= 3.3±0.3 V			
				Typ	Min	Max	Min	Max	Min	Max	Min	Max			
Propagation delay time	t _{PLH}	A	Y	9.2	2.0	8.8	1.5	5.8	1.0	4.2	1.0	3.5	ns	C _L = 15pF R _L = 2.0kΩ	
	t _{PHL}			9.2	2.0	8.8	1.5	5.8	1.0	4.2	1.0	3.5			
Output enable time	t _{ZH}	OE	Y	10.2	2.0	9.6	1.5	6.4	1.0	4.2	1.0	3.7	ns	C _L = 15pF R _L = 2.0kΩ	
	t _{ZL}			10.2	2.0	9.6	1.5	6.4	1.0	4.2	1.0	3.7			
Output disable time	t _{HZ}	OE	Y	5.2	2.0	5.6	1.5	5.2	1.0	4.6	1.0	4.5	ns	C _L = 15pF R _L = 2.0kΩ	
	t _{LZ}			5.2	2.0	5.6	1.5	5.2	1.0	4.6	1.0	4.5			

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

Item	Symbol	From (input)	To (output)	Ta = -40 to 85°C									Unit	Test conditions	
				V _{CC} OUT= 1.2 V		V _{CC} OUT= 1.5±0.1 V		V _{CC} OUT= 1.8±0.15 V		V _{CC} OUT= 2.5±0.2 V		V _{CC} OUT= 3.3±0.3 V			
				Typ	Min	Max	Min	Max	Min	Max	Min	Max			
Propagation delay time	t _{PLH}	A	Y	9.5	2.0	9.0	1.5	6.0	1.0	4.4	1.0	3.7	ns	C _L = 15pF R _L = 2.0kΩ	
	t _{PHL}			9.5	2.0	9.0	1.5	6.0	1.0	4.4	1.0	3.7			
Output enable time	t _{ZH}	OE	Y	10.6	2.0	10.2	1.5	6.6	1.0	4.5	1.0	3.8	ns	C _L = 15pF R _L = 2.0kΩ	
	t _{ZL}			10.6	2.0	10.2	1.5	6.6	1.0	4.5	1.0	3.8			
Output disable time	t _{HZ}	OE	Y	5.4	2.0	5.7	1.5	5.3	1.0	4.5	1.0	4.4	ns	C _L = 15pF R _L = 2.0kΩ	
	t _{LZ}			5.4	2.0	5.7	1.5	5.3	1.0	4.5	1.0	4.4			

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

Item	Symbol	From (input)	To (output)	Ta = -40 to 85°C									Unit	Test conditions	
				V _{CC} OUT= 1.2 V		V _{CC} OUT= 1.5±0.1 V		V _{CC} OUT= 1.8±0.15 V		V _{CC} OUT= 2.5±0.2 V		V _{CC} OUT= 3.3±0.3 V			
				Typ	Min	Max	Min	Max	Min	Max	Min	Max			
Propagation delay time	t _{PLH}	A	Y	9.6	2.0	9.2	1.5	6.5	1.0	4.7	1.0	4.0	ns	C _L = 15pF R _L = 2.0kΩ	
	t _{PHL}			9.6	2.0	9.2	1.5	6.5	1.0	4.7	1.0	4.0			
Output enable time	t _{ZH}	OE	Y	10.8	2.0	10.8	1.5	7.0	1.0	5.2	1.0	4.5	ns	C _L = 15pF R _L = 2.0kΩ	
	t _{ZL}			10.8	2.0	10.8	1.5	7.0	1.0	5.2	1.0	4.5			
Output disable time	t _{HZ}	OE	Y	5.8	2.0	6.0	1.5	5.8	1.0	5.4	1.0	5.2	ns	C _L = 15pF R _L = 2.0kΩ	
	t _{LZ}			5.8	2.0	6.0	1.5	5.8	1.0	5.4	1.0	5.2			

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

Item	Symbol	From (input)	To (output)	Ta = −40 to 85°C									Unit	Test conditions	
				V _{CC} OUT= 1.2 V		V _{CC} OUT= 1.5±0.1 V		V _{CC} OUT= 1.8±0.15 V		V _{CC} OUT= 2.5±0.2 V		V _{CC} OUT= 3.3±0.3 V			
				Typ	Min	Max	Min	Max	Min	Max	Min	Max			
Propagation delay time	t _{PLH}	A	Y	9.8	2.0	10.0	1.5	6.9	1.0	5.1	1.0	4.5	ns	C _L = 15pF R _L = 2.0kΩ	
	t _{PHL}			9.8	2.0	10.0	1.5	6.9	1.0	5.1	1.0	4.5			
Output enable time	t _{ZH}	OE	Y	11.2	2.0	11.2	1.5	7.8	1.0	5.4	1.0	4.8	ns	C _L = 15pF R _L = 2.0kΩ	
	t _{ZL}			11.2	2.0	11.2	1.5	7.8	1.0	5.4	1.0	4.8			
Output disable time	t _{HZ}	OE	Y	6.4	2.0	7.2	1.5	6.4	1.0	5.8	1.0	5.6	ns	C _L = 15pF R _L = 2.0kΩ	
	t _{LZ}			6.4	2.0	7.2	1.5	6.4	1.0	5.8	1.0	5.6			

Switching Characteristics (Cont.)

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

Item	Symbol	From (input)	To (output)	Ta = -40 to 85°C					Unit	Test conditions
				V _{CCOUT} = 1.2 V	V _{CCOUT} = 1.5±0.1 V	V _{CCOUT} = 1.8±0.15 V	V _{CCOUT} = 2.5±0.2 V	V _{CCOUT} = 3.3±0.3 V		
				Typ	Typ	Typ	Typ	Typ		
Propagation delay time	t _{PLH}	A	Y	10.5	7.5	6.0	4.5	4.0	ns	C _L = 15pF R _L = 2.0kΩ
	t _{PHL}			10.5	7.5	6.0	4.5	4.0		
Output enable time	t _{ZH}	\overline{OE}	Y	11.6	8.5	6.5	5.0	4.2	ns	C _L = 15pF R _L = 2.0kΩ
	t _{ZL}			11.6	8.5	6.5	5.0	4.2		
Output disable time	t _{HZ}	\overline{OE}	Y	7.0	6.2	6.0	5.7	5.5	ns	C _L = 15pF R _L = 2.0kΩ
	t _{LZ}			7.0	6.2	6.0	5.7	5.5		

Operating Characteristics

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

Item	Symbol	V _{CCIN} (V)	V _{CCOUT} (V)	Min	Typ	Max	Unit	Test conditions
Power dissipation capacitance	C _{PD}	3.3	3.3	—	12	—	pF	f = 10 MHz C _L = 0

Power-up considerations

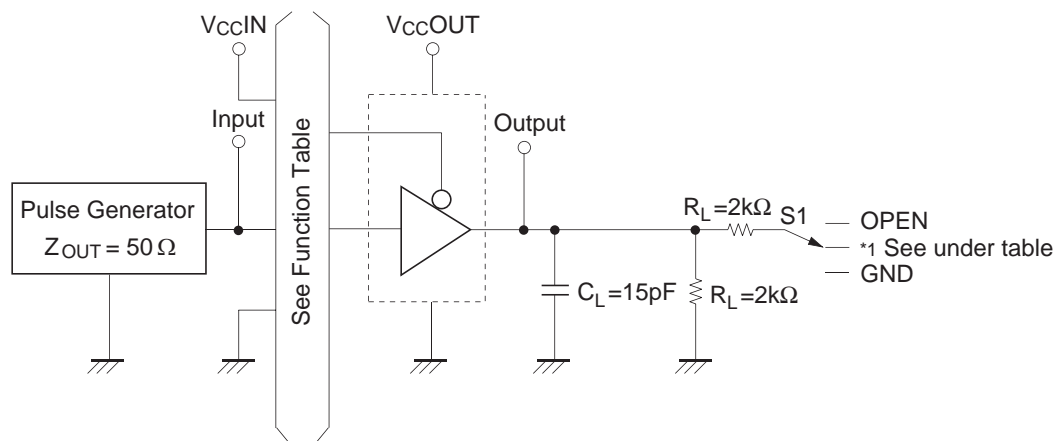
Level-translation devices offer an opportunity for successful mixed-voltage signal design.

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 control side of the device.
(Power up of V_{CCIN} is first. Next power up is V_{CCOUT})
3. Tie \overline{OE} to V_{CCIN} with a pull-up resistor so that it ramps with V_{CCIN}.

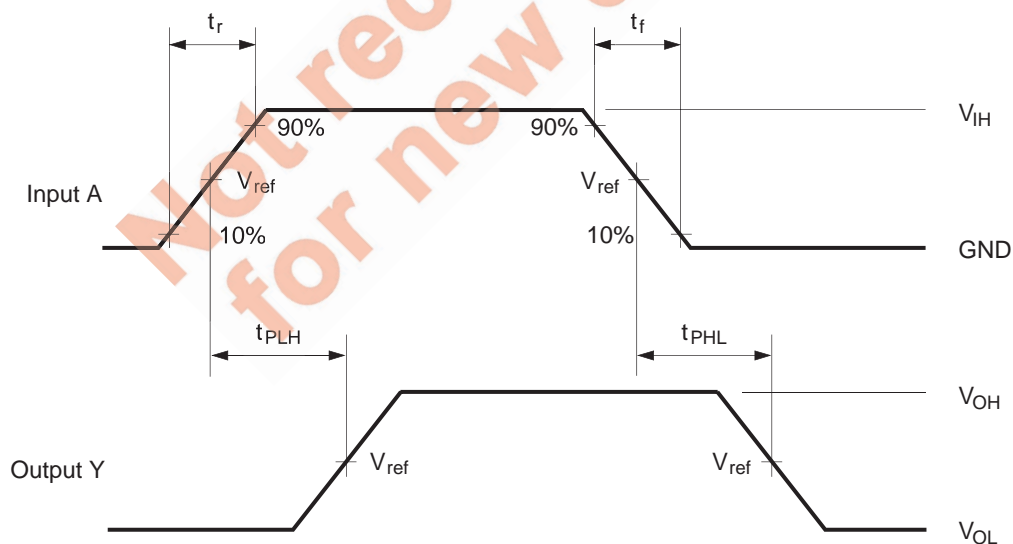
Test Circuit



Symbol	S1
t_{PLH} / t_{PHL}	OPEN
t_{HZ} / t_{ZH}	GND
t_{LZ} / t_{ZL}	$V_{CC} \times 2$

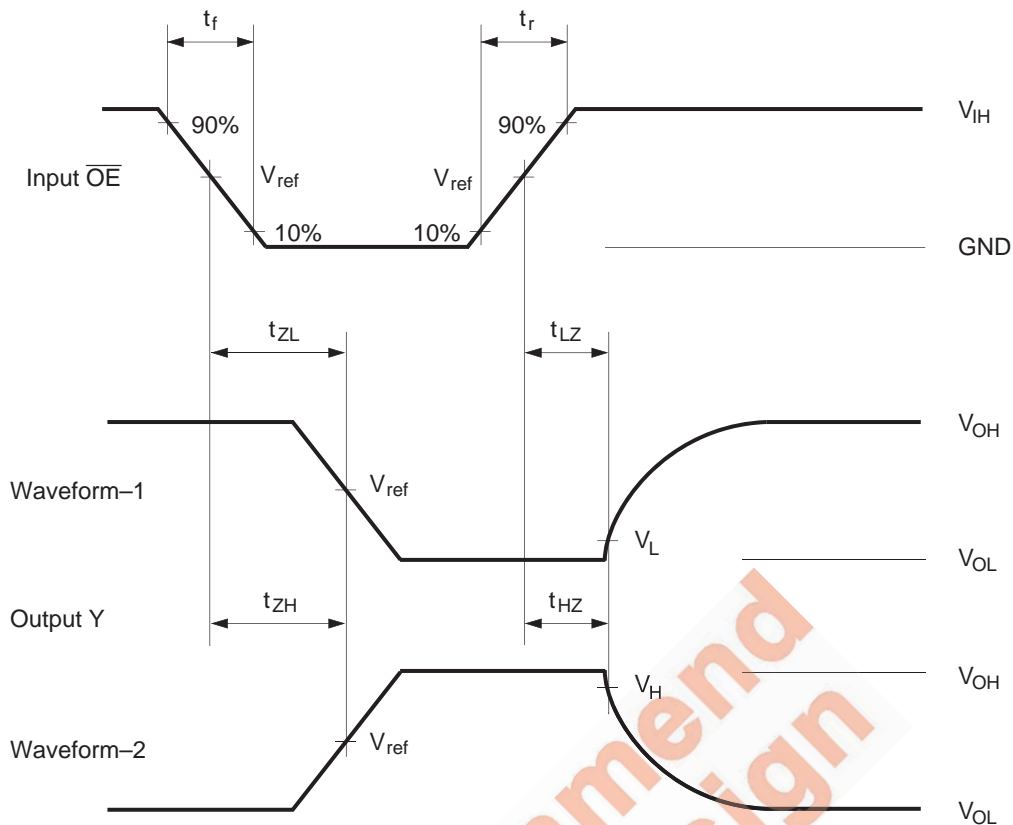
Note: C_L includes probe and jig capacitance.

Waveforms



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

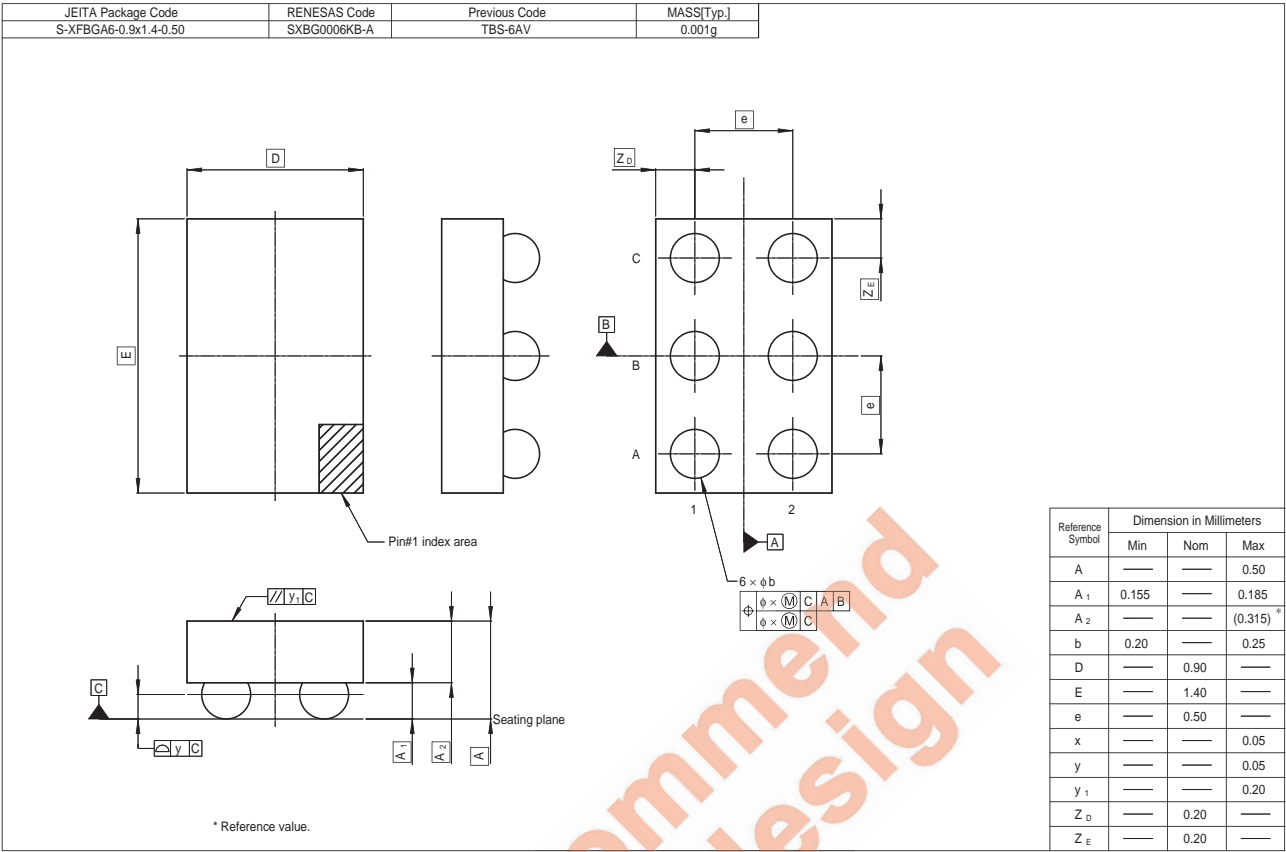
Note: Input waveform : $PRR \leq 10 \text{ MHz}$, $Z_O = 50 \Omega$, duty cycle 50%



Symbol	$V_{CC} = 1.2\text{ V}, 1.5 \pm 0.1\text{ V}$	$V_{CC} = 1.8 \pm 0.15\text{ V}$	$V_{CC} = 2.5 \pm 0.2\text{ V}$	$V_{CC} = 3.3 \pm 0.3\text{ V}$
t_r / t_f	2.0 ns	2.0 ns	2.0 ns	2.0 ns
V_{IH}	V_{CC}	V_{CC}	V_{CC}	V_{CC}
V_{ref}	$1/2 V_{CC}$	$1/2 V_{CC}$	$1/2 V_{CC}$	$1/2 V_{CC}$
V_H / V_L	$V_H = V_{OH} - 0.1\text{ V}$ $V_L = V_{OL} + 0.1\text{ V}$	$V_H = V_{OH} - 0.15\text{ V}$ $V_L = V_{OL} + 0.15\text{ V}$	$V_H = V_{OH} - 0.15\text{ V}$ $V_L = V_{OL} + 0.15\text{ V}$	$V_H = V_{OH} - 0.3\text{ V}$ $V_L = V_{OL} + 0.3\text{ V}$

- Notes:
1. Input waveform : $PRR \leq 10\text{ MHz}$, $Z_o = 50\ \Omega$, duty cycle 50%.
 2. Waveform – 1 is for an output with internal conditions such that the output is low except when disabled by the output control.
 3. Waveform – 2 is for an output with internal conditions such that the output is high except when disabled by the output control.
 4. The output are measured one at a time with one transition per measurement.

Package Dimensions



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Keep safety first in your circuit designs!

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