TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC7SA32F,TC7SA32FU

### 2-Input OR Gate

### **Features**

Low voltage operation: V<sub>CC</sub> = 1.8 to 3.6 V

• High speed operation :  $t_{pd}$  = 2.8 ns (max) ( $V_{CC}$  = 3.0 to 3.6 V)

:  $t_{pd}$  = 3.7 ns (max) (V<sub>CC</sub> = 2.3 to 2.7 V)

:  $t_{pd} = 7.4 \text{ ns (max) (V}_{CC} = 1.8 \text{ V)}$ 

• High output current :  $I_{OH}/I_{OL} = \pm 24 \text{ mA (min)} (V_{CC} = 3.0 \text{ V})$ 

 $: I_{OH}/I_{OL} = \pm 18 \text{ mA (min) (V}_{CC} = 2.3 \text{ V)}$ 

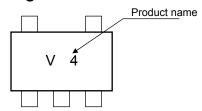
 $: I_{OH}/I_{OL} = \pm 6 \text{ mA (min)} (V_{CC} = 1.8 \text{ V})$ 

3.6-V tolerant inputs.

• 3.6-V power down protection output.

TC74VCX32FT equivalent.

### Marking



### **Absolute Maximum Ratings (Ta = 25°C)**

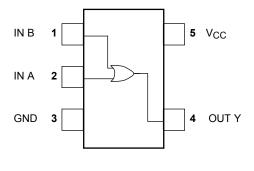
Characteristics	Symbol	Rating	Unit
Supply voltage	$V_{CC}$	−0.5 to 4.6	V
DC input voltage	V <sub>IN</sub>	-0.5 to 4.6	V
DC output voltage	\/a=	-0.5 to 4.6 (Note 1)	V
DC output voltage	V <sub>OUT</sub>	-0.5 to V <sub>CC</sub> +0.5 (Note 2)	
Input diode current	I <sub>IK</sub>	-50	mA
Output diode current	lok	-50 (Note 3)	mA
DC output current	lout	±50	mA
Power dissipation	$P_{D}$	200	mW
DC V <sub>CC</sub> /ground current	I <sub>CC</sub>	±100	mA
Storage temperature range	T <sub>stg</sub>	-65 to 150	°C

# TC7SA32F SSOP5-P-0.95 (SMV) TC7SA32FU SSOP5-P-0.65A (USV)

Weight

SSOP5-P-0.95 : 0.016 g (typ.) SSOP5-P-0.65A : 0.006 g (typ.)

### Pin Assignment (top view)



Note: 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:  $V_{CC} = 0 V$ 

Note 2: High or Low State. IOUT absolute maximum rating must be observed.

Note 3: V<sub>OUT</sub> < GND

# **IEC Logic Symbol**



### **Truth Table**

Α	В	Υ
L	L	L
L	Н	Н
Н	L	Н
Н	Н	Н

# **Operating Ranges**

Characteristics	Symbol	Rating	Unit	
Supply voltage	V <sub>CC</sub>	1.8 to 3.6	V	
Supply voltage	VCC	1.2 to 3.6 (Note 4)	V	
Input voltage	V <sub>IN</sub>	-0.3 to 3.6	V	
Output voltage	Vout	0 to 3.6 (Note 5)	V	
Output voltage	VOU1	0 to V <sub>CC</sub> (Note 6)	V	
		± 24 (Note 7)		
Output current	I <sub>OH</sub> /I <sub>OL</sub>	± 18 (Note 8)	mA	
		± 6 (Note 9)		
Operating temperature range	T <sub>opr</sub>	-40 to 85	°C	
Input rise and fall time	dt/dv	0 to 10 (Note 10)	ns/V	

Note 4: Data retention only

Note 5:  $V_{CC} = 0 V$ 

Note 6: High or low state

Note 7:  $V_{CC} = 3.0 \text{ to } 3.6 \text{ V}$ 

Note 8:  $V_{CC} = 2.3 \text{ to } 2.7 \text{ V}$ 

Note 9:  $V_{CC} = 1.8 \text{ V}$ 

Note 10:  $V_{IN} = 0.8$  to 2.0 V,  $V_{CC} = 3.0$  V

# **Electrical Characteristics**

# DC Characteristics (Ta = -40 to $85^{\circ}$ C, 2.7 V < $V_{CC} \le 3.6$ V)

Characteristics		Symbol Test Condition			Min	Max	Unit					
Onara	cicristics	Oymboi	rest containon		V <sub>CC</sub> (V)	141111	IVIOX	Offic				
Input voltage	High level	V <sub>IH</sub>	-	_	2.7 to 3.6	2.0		V				
input voltage	Low level	$V_{IL}$	-	_	2.7 to 3.6	_	0.8	٧				
				I <sub>OH</sub> = -100 μA	2.7 to 3.6	V <sub>CC</sub> - 0.2	ı					
	High level	V <sub>OH</sub>	VOR VIN VIR P	$I_{OH} = -12 \text{ mA}$	2.7	2.2						
				$I_{OH} = -18 \text{ mA}$	3.0	2.4						
Output voltage			$I_{OH} = -24 \text{ mA}$	3.0	2.2		V					
		V <sub>OL</sub>		$I_{OL} = 100 \mu A$	2.7 to 3.6	_	0.2					
	Low level		V	\/a.	Va	Voi	$V_{IN} = V_{IL}$	I <sub>OL</sub> = 12 mA	2.7	_	0.4	
	Low level		VIN - VIL	I <sub>OL</sub> = 18 mA	3.0	_	0.4					
				I <sub>OL</sub> = 24 mA	3.0	_	0.55					
Input leakage curr	ent	I <sub>IN</sub>	V <sub>IN</sub> = 0 to 3.6 V		2.7 to 3.6	_	±5.0	μА				
Power off leakage current		l <sub>OFF</sub>	V <sub>IN</sub> , V <sub>OUT</sub> = 0 to 3.6 V		0	_	10.0	μА				
Quiescent supply current		Icc	V <sub>IN</sub> = V <sub>CC</sub> or GND		2.7 to 3.6	_	20.0					
Quiescent suppry	Quiescent supply current		$V_{CC} \le (V_{IN}, V_{OUT}) \le 3.6 \text{ V}$		2.7 to 3.6	_	±20.0	μА				
Increase in I <sub>CC</sub> pe	r input	Δl <sub>CC</sub>	$V_{IH} = V_{CC} - 0.6 V$	′	2.7 to 3.6	_	750					

# DC Characteristics (Ta = -40 to $85^{\circ}$ C, 2.3 V $\leq$ V<sub>CC</sub> $\leq$ 2.7 V)

Charac	cteristics	Symbol	Test C	condition	V <sub>CC</sub> (V)	Min	Max	Unit	
Input voltage	High level	V <sub>IH</sub>	-	_	2.3 to 2.7	1.6	_	V	
input voltage	Low level	V <sub>IL</sub>	-		2.3 to 2.7	_	0.7	V	
			OH VIN = VIH or VIL	I <sub>OH</sub> = -100 μA	2.3 to 2.7	V <sub>CC</sub> - 0.2	_		
	High level	V <sub>OH</sub>		V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OH</sub> = -6 mA	2.3	2.0	_	
		-		I <sub>OH</sub> = -12 mA	2.3	1.8	_		
Output voltage				I <sub>OH</sub> = -18 mA	2.3	1.7	_	V	
			V <sub>OL</sub> V <sub>IN</sub> = V <sub>IL</sub>	I <sub>OL</sub> = 100 μA	2.3 to 2.7	_	0.2		
	Low level	$V_{OL}$		$V_{IN} = V_{IL}$	I <sub>OL</sub> = 12 mA	2.3	_	0.4	
				I <sub>OL</sub> = 18 mA	2.3	_	0.6		
Input leakage curre	ent	I <sub>IN</sub>	V <sub>IN</sub> = 0 to 3.6 V		2.3 to 2.7	_	±5.0	μА	
Power off leakage	current	l <sub>OFF</sub>	V <sub>IN</sub> , V <sub>OUT</sub> = 0 to 3.6 V		0	_	10.0	μА	
		la a	V <sub>IN</sub> = V <sub>CC</sub> or GND		2.3 to 2.7	_	20.0		
Quiescent supply of	urrent	Icc	V <sub>CC</sub> ≤ (V <sub>IN</sub> , V <sub>OUT</sub>	-) ≦ 3.6 V	2.3 to 2.7	_	±20.0	μА	

# DC Characteristics (Ta = -40 to $85^{\circ}$ C, $1.8 \text{ V} \le \text{V}_{CC} < 2.3 \text{ V}$ )

Charac	teristics	Symbol	Test Condition		V <sub>CC</sub> (V)	Min	Max	Unit		
Input voltage	High level	V <sub>IH</sub>	-	_	1.8 to 2.3	V <sub>CC</sub> × 0.7	_	V		
Input voltage	Low level	V <sub>IL</sub>	_		1.8 to 2.3	_	V <sub>CC</sub> × 0.2	V		
	High level	V <sub>OH</sub>	VIN = VIH or VIL	I <sub>OH</sub> = -100 μA	1.8	V <sub>CC</sub> - 0.2	_			
Output voltage		<b>.</b>	Ic	I <sub>OH</sub> = -6 mA	1.8	1.4	_	V		
	Low level	Vai	V V V-	I <sub>OL</sub> = 100 μA	1.8	_	0.2			
	Low level	$V_{OL}$	$V_{IN} = V_{IL}$	I <sub>OL</sub> = 6 mA	1.8	_	0.3			
Input leakage curre	ent	I <sub>IN</sub>	V <sub>IN</sub> = 0 to 3.6 V		1.8	_	±5.0	μА		
Power off leakage	current	l <sub>OFF</sub>	$V_{IN}$ , $V_{OUT} = 0$ to 3.6 V		V <sub>IN</sub> , V <sub>OUT</sub> = 0 to 3.6 V		0		10.0	μΑ
Quiescent supply current		loo	V <sub>IN</sub> = V <sub>CC</sub> or GND		1.8	_	20.0	^		
Quiescent supply o	unciil	Icc	$V_{CC} \le (V_{IN}, V_{OUT})$	-) ≦ 3.6 V	1.8	_	±20.0	μΑ		

### AC Characteristics (Ta = -40 to 85°C, input: $t_r = t_f = 2.0$ ns, $C_L = 30$ pF, $R_L = 500$ $\Omega$ )

Characteristics	Symbol	Test Condition	V <sub>CC</sub> (V)	Min	Max	Unit
	<b>+</b>		1.8	1.5	7.4	
Propagation delay time	t <sub>pLH</sub>	Figure 1, Figure 2	$2.5 \pm 0.2$	1.0	3.7	ns
	<sup>t</sup> pHL		$3.3 \pm 0.3$	8.0	2.8	

For  $C_L = 50 \ pF$ , add approximately 300 ps to the AC maximum specification.

## **Capacitive Characteristics (Ta = 25°C)**

Characteristics	Symbol	Test Condition		V <sub>CC</sub> (V)	Тур.	Unit	
Input capacitance	C <sub>IN</sub>		_		1.8, 2.5, 3.3	6	pF
Power dissipation capacitance	C <sub>PD</sub>	f <sub>IN</sub> = 10 MHz		(Note 11)	1.8, 2.5, 3.3	20	pF

Note 11: C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation.

 $I_{CC (opr.)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$ 

### **AC Test Circuit**

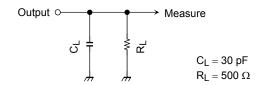
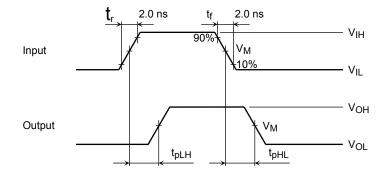


Figure 1

# **AC Wareform**



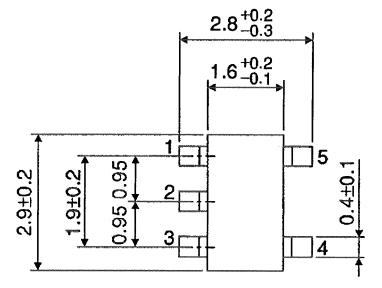
Symbol	Vcc							
Syllibol	$3.3\pm0.3~\textrm{V}$	$2.5\pm0.2~\textrm{V}$	1.8 V					
V <sub>IH</sub>	2.7 V	V <sub>CC</sub>	V <sub>CC</sub>					
V <sub>M</sub>	1.5 V	V <sub>CC</sub> /2	V <sub>CC</sub> /2					

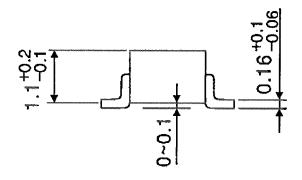
Figure 2 t<sub>pLH</sub>, t<sub>pHL</sub>

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# **Package Dimensions**

SSOP5-P-0.95 Unit: mm

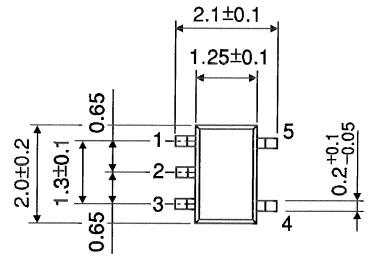


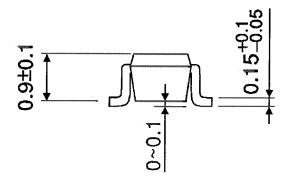


Weight: 0.016 g (typ.)

# **Package Dimensions**

SSOP5-P-0.65A Unit: mm





Weight: 0.006 g (typ.)

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