

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC7MP97FT, TC7MP97FK TC7MP98FT, TC7MP98FK

Low Voltage Triple Configurable Multiple Function Gate with 3.6 V Tolerant Inputs and Outputs

The TC7MP97,98 is a high performance CMOS multiple Function Gate which is guaranteed to operate from 1.2-V to 3.6-V. Designed for use in 1.5 V, 1.8 V, 2.5 V or 3.3 V systems, it achieves high speed operation while maintaining the CMOS low power dissipation.

It is also designed with over voltage tolerant inputs and outputs up to 3.6 V.

It independently consists of three circuits for Multiple Function Gate.

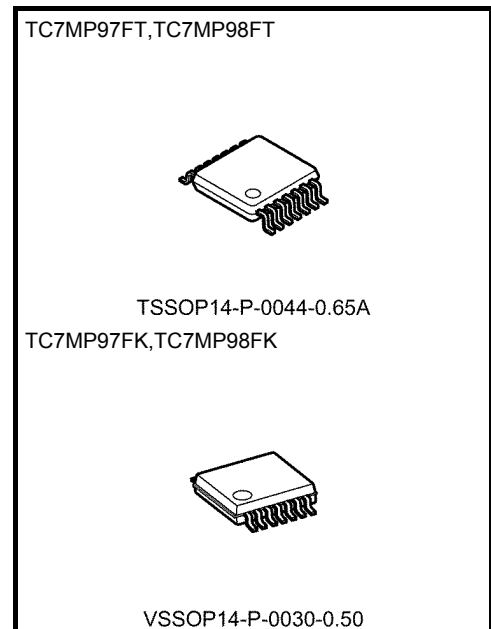
The output state is determined by seven patterns of 3-inputs.

The user can choose the functions of Multiplexer, AND, OR, NAND, Schmitt Inverter, and Schmitt Buffer.

All inputs are equipped with protection circuits against static discharge.

Features

- Low-voltage operation : $V_{CC} = 1.2$ to 3.6 V
- High-speed operation : $t_{pd} = 8.5$ ns (max) ($V_{CC} = 3.0$ to 3.6 V)
: $t_{pd} = 12.0$ ns (max) ($V_{CC} = 2.3$ to 2.7 V)
- Output current : $|I_{OH}|/I_{OL} = \pm 8$ mA (min) ($V_{CC} = 3.0$ V)
: $|I_{OH}|/I_{OL} = \pm 4$ mA (min) ($V_{CC} = 2.3$ V)
: $|I_{OH}|/I_{OL} = \pm 1.5$ mA (min) ($V_{CC} = 1.65$ V)
- Latch-up performance : -300 mA
- ESD performance : Machine model $\geq \pm 200$ V
Human body model $\geq \pm 2000$ V
- Package : VSSOP14 (US14), TSSOP14
- Power-down protection is provided on all inputs and outputs

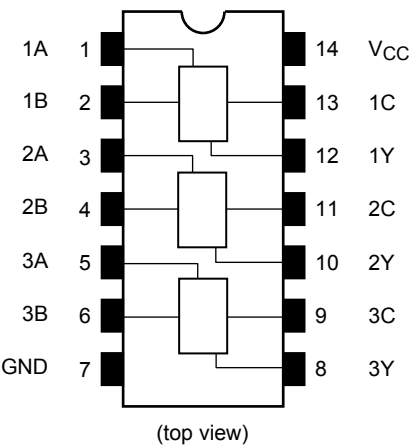


Weight:

TSSOP14-P-0044-0.65A : 0.06 g(typ)

VSSOP14-P-0030-0.50 : 0.02 g(typ)

Pin Assignment (top view)

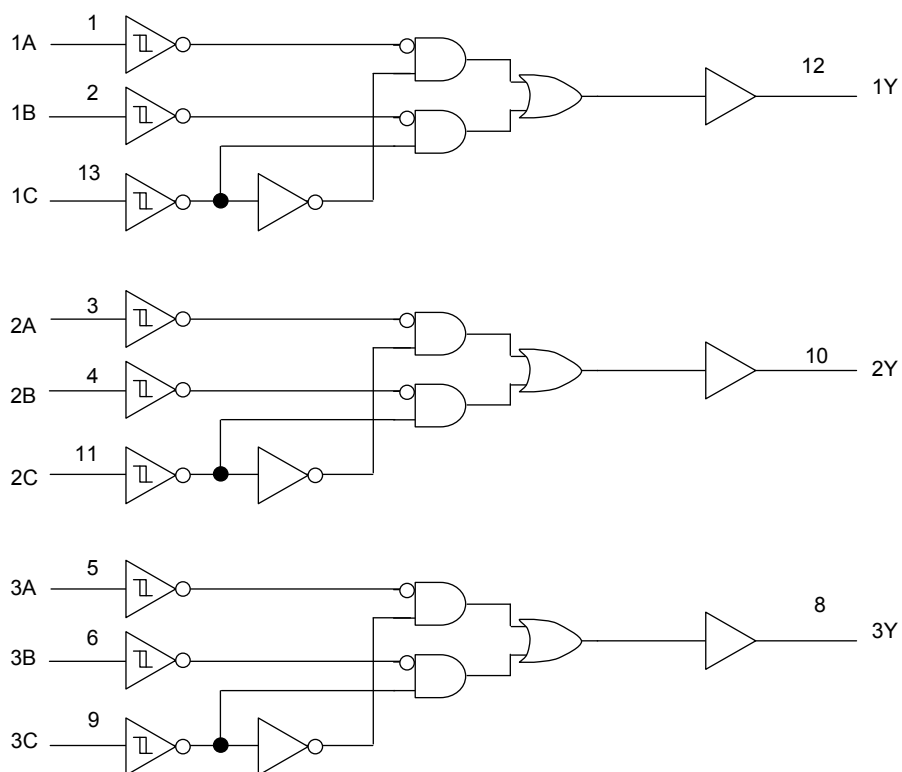


Truth Table

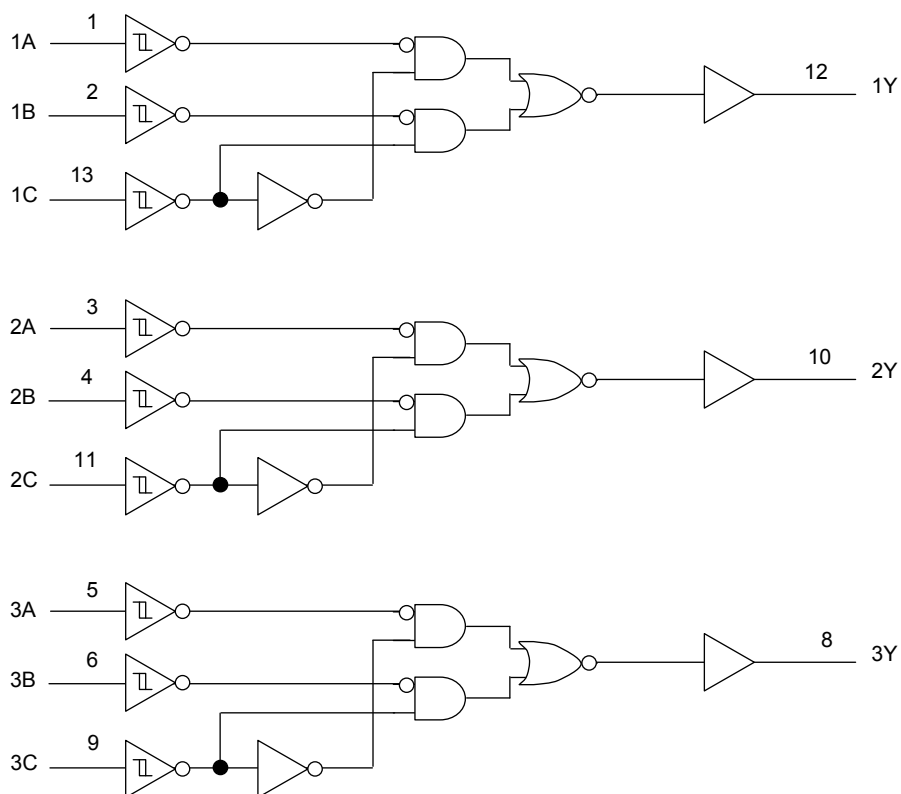
INPUTS			OUTPUT	
			TC7MP97	TC7MP98
A	B	C	Y	Y
L	L	L	L	H
L	L	H	L	H
L	H	L	H	L
L	H	H	L	H
H	L	L	L	H
H	L	H	H	L
H	H	L	H	L
H	H	H	H	L

System Diagram

TC7MP97



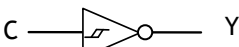
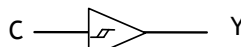
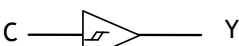
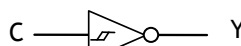
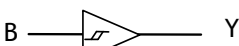
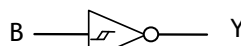
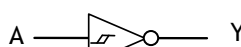
TC7MP98



Logic configurations(1/2)

Function	Input Condition	TC7MP97 Logic symbol	TC7MP98 Logic symbol	FUNCTION TABLE																																															
MP97 AND	A=INPUT B=L-Level C=INPUT Y=OUTPUT			<table><tr><th rowspan="2">A</th><th rowspan="2">B</th><th rowspan="2">C</th><th colspan="2">Y</th></tr><tr><th>97</th><th>98</th></tr><tr><td>L</td><td>L</td><td>L</td><td>L</td><td>H</td></tr><tr><td>L</td><td>L</td><td>H</td><td>L</td><td>H</td></tr><tr><td>H</td><td>L</td><td>L</td><td>L</td><td>H</td></tr><tr><td>H</td><td>L</td><td>H</td><td>H</td><td>L</td></tr></table>	A	B	C	Y		97	98	L	L	L	L	H	L	L	H	L	H	H	L	L	L	H	H	L	H	H	L																				
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MP98 NAND																																																			
MP97 OR	A=H-Level B=INPUT C=INPUT Y=OUTPUT			<table><tr><th rowspan="2">A</th><th rowspan="2">B</th><th rowspan="2">C</th><th colspan="2">Y</th></tr><tr><th>97</th><th>98</th></tr><tr><td>H</td><td>L</td><td>L</td><td>L</td><td>H</td></tr><tr><td>H</td><td>L</td><td>H</td><td>H</td><td>L</td></tr><tr><td>H</td><td>H</td><td>L</td><td>H</td><td>L</td></tr><tr><td>H</td><td>H</td><td>H</td><td>H</td><td>L</td></tr></table>	A	B	C	Y		97	98	H	L	L	L	H	H	L	H	H	L	H	H	L	H	L	H	H	H	H	L																				
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MP98 NOR																																																			
MP97 Schmitt INV+NOR or Schmitt INV+AND	A=L-Level B=INPUT C=INPUT Y=OUTPUT	 OR 	 OR 	<table><tr><th rowspan="2">A</th><th rowspan="2">B</th><th rowspan="2">C</th><th colspan="2">Y</th></tr><tr><th>97</th><th>98</th></tr><tr><td>L</td><td>L</td><td>L</td><td>L</td><td>H</td></tr><tr><td>L</td><td>L</td><td>H</td><td>L</td><td>H</td></tr><tr><td>L</td><td>H</td><td>L</td><td>H</td><td>L</td></tr><tr><td>L</td><td>H</td><td>H</td><td>L</td><td>H</td></tr></table>	A	B	C	Y		97	98	L	L	L	L	H	L	L	H	L	H	L	H	L	H	L	L	H	H	L	H																				
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MP97 2 to 1 Selector	A=INPUT B=INPUT C=Select Y=OUTPUT			<table><tr><th rowspan="2">A</th><th rowspan="2">B</th><th rowspan="2">C</th><th colspan="2">Y</th></tr><tr><th>97</th><th>98</th></tr><tr><td>L</td><td>L</td><td>L</td><td>L</td><td>H</td></tr><tr><td>L</td><td>H</td><td>L</td><td>H</td><td>L</td></tr><tr><td>H</td><td>L</td><td>L</td><td>L</td><td>H</td></tr><tr><td>H</td><td>H</td><td>L</td><td>H</td><td>L</td></tr><tr><td>L</td><td>L</td><td>H</td><td>L</td><td>H</td></tr><tr><td>L</td><td>H</td><td>H</td><td>L</td><td>H</td></tr><tr><td>H</td><td>L</td><td>H</td><td>H</td><td>L</td></tr><tr><td>H</td><td>H</td><td>H</td><td>H</td><td>L</td></tr></table>	A	B	C	Y		97	98	L	L	L	L	H	L	H	L	H	L	H	L	L	L	H	H	H	L	H	L	L	L	H	L	H	L	H	H	L	H	H	L	H	H	L	H	H	H	H	L
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MP98 2 to 1 Selector+INV																																																			

Logic configurations(2/2)

Function	Input Condition	TC7MP97 Logic symbol	TC7MP98 Logic symbol	FUNCTION TABLE																	
MP97 Schmitt INV	A=L-Level B=H-Level C=INPUT Y=OUTPUT			<table><tr><th rowspan="2">A</th><th rowspan="2">B</th><th rowspan="2">C</th><th colspan="2">Y</th></tr><tr><th>97</th><th>98</th></tr><tr><td>L</td><td>H</td><td>L</td><td>H</td><td>L</td></tr><tr><td>L</td><td>H</td><td>H</td><td>L</td><td>H</td></tr></table>	A	B	C	Y		97	98	L	H	L	H	L	L	H	H	L	H
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MP98 Schmitt Buffer																					
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A	B	C	Y																		
			97	98																	
L	L	H	L	H																	
H	L	H	H	L																	
MP98 Schmitt INV																					

Absolute Maximum Ratings (Note 1)

Characteristics	Symbol	Rating	Unit
Power supply voltage	V_{CC}	-0.5 to 4.6	V
DC input voltage	V_{IN}	-0.5 to 4.6	V
DC output voltage	V_{OUT}	-0.5 to 4.6 (Note 2)	V
		-0.5 to $V_{CC} + 0.5$ (Note 3)	
Input diode current	I_{IK}	-20	mA
Output diode current	I_{OK}	± 20 (Note 4)	mA
DC output current	I_{OUT}	± 25	mA
Power dissipation	P_D	180	mW
DC V_{CC} /ground current	I_{CC}/I_{GND}	± 25	mA
Storage temperature	T_{stg}	-65~150	°C

Note 1: 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 2: $V_{CC} = 0$ V

Note 3: High or Low state. I_{OUT} absolute rating must be observed.

Note 4: $V_{OUT} < GND$, $V_{OUT} > V_{CC}$

Operating Ranges (Note 1)

Characteristics	Symbol	Rating	Unit
Supply voltage	V_{CC}	1.2~3.6	V
Input voltage	V_{IN}	-0.3~3.6	V
Output voltage	V_{OUT}	0~3.6 (Note 2)	V
		0~ V_{CC} (Note 3)	
Output current	I_{OH}/I_{OL}	± 8.0 (Note 4)	mA
		± 4.0 (Note 5)	
		± 1.5 (Note 6)	
Operating temperature	T_{opr}	-40~85	°C

Note 1: The operating ranges must be maintained to ensure the normal operation of the device.
Unused inputs must be tied to either V_{CC} or GND.

Note 2: $V_{CC} = 0$ V

Note 3: High or low state

Note 4: $V_{CC} = 3.0\sim 3.6$ V

Note 5: $V_{CC} = 2.3\sim 2.7$ V

Note 6: $V_{CC} = 1.65\sim 1.8$ V

Electrical Characteristics

DC Characteristics (Ta = -40 to 85°C)

Characteristics		Symbol	Test Condition		V _{CC} (V)	Min	Max	Unit
Input voltage	H-level	V _P	—		1.2		1.10	V
					1.4		1.20	
					1.65		1.35	
					2.3		1.70	
					3.0		2.00	
					3.6		2.20	
	L-level	V _N	—		1.2	0.10		V
					1.4	0.20		
					1.65	0.30		
					2.3	0.50		
					3.0	0.70		
					3.6	0.80		
Hysteresis voltage		V _H	—		1.2	0.2	0.9	V
					1.4	0.2	0.9	
					1.65	0.2	0.95	
					2.3	0.3	1.0	
					3.0	0.3	1.2	
					3.6	0.3	1.2	
Output voltage	H-level	V _{OH}	V _{IN} = V _{IH} or V _{IL}	I _{OH} = −100 μA	1.2~1.3	V _{CC} - 0.1	—	V
				I _{OH} = −500 μA	1.4~1.6	V _{CC} - 0.2	—	
				I _{OH} = −1.5 mA	1.65~1.95	V _{CC} - 0.3	—	
				I _{OH} = −4.0 mA	2.3~2.7	V _{CC} - 0.4	—	
				I _{OH} = −8.0 mA	3.0~3.6	2.40	—	
	L-level	V _{OL}	V _{IN} = V _{IH} or V _{IL}	I _{OL} = 100 μA	1.2~1.3	—	0.10	
				I _{OL} = 500 μA	1.4~1.6	—	0.20	
				I _{OL} = 3.0 mA	1.65~1.95	—	0.25	
				I _{OL} = 4.0 mA	2.3~2.7	—	0.40	
				I _{OL} = 8.0 mA	3.0~3.6	—	0.40	
Input leakage current		I _{IN}	V _{IN} = 0~3.6 V		1.2~3.6	—	±5.0	μA
Power-off leakage current		I _{OFF}	V _{IN} , V _{OUT} = 0~3.6 V		0	—	10.0	μA
Quiescent supply current		I _{CC}	V _{IN} = V _{CC} or GND		1.2~3.6	—	20.0	μA
			V _{CC} ≤ V _{IN} ≤ 3.6 V		1.2~3.6	—	±20.0	
Increase in I _{CC} per input		ΔI _{CC}	V _{IH} = V _{CC} − 0.6 V		2.7~3.6	—	750	

AC Characteristics (Ta = -40 to 85°C, input: tr = tf = 3.0 ns)

Characteristics	Symbol	Test Condition	V _{CC} (V)	Min	Max	Unit
Propagation delay time (A, B, C-Y)	t _{pLH} t _{pHL}	Figure 1, Figure 2 CL = 10pF, RL = 1M Ω	1.8 ± 0.15	1.0	21.0	ns
			2.5 ± 0.2	0.8	10.0	
			3.3 ± 0.3	0.6	7.0	
	t _{pLH} t _{pHL}	Figure 1, Figure 2 CL = 15pF, RL = 1M Ω	1.8 ± 0.15	1.0	23.0	ns
			2.5 ± 0.2	0.8	11.0	
			3.3 ± 0.3	0.6	7.7	
	t _{pLH} t _{pHL}	Figure 1, Figure 2 CL = 30pF, RL = 1M Ω	1.8 ± 0.15	1.0	27.0	ns
			2.5 ± 0.2	0.8	12.0	
			3.3 ± 0.3	0.6	8.5	

Dynamic Switching Characteristics (Ta = 25°C, input: tr = tf = 3.0 ns, CL = 30 pF)

Characteristics	Symbol	Test Condition	V _{CC} (V)	Typ.	Unit
Quiet output maximum dynamic V _{OL}	V _{OLP}	V _{IH} = 1.8 V, V _{IL} = 0 V (Note)	1.8	0.25	V
		V _{IH} = 2.5 V, V _{IL} = 0 V (Note)	2.5	0.6	
		V _{IH} = 3.3 V, V _{IL} = 0 V (Note)	3.3	0.8	
Quiet output minimum dynamic V _{OL}	V _{OLV}	V _{IH} = 1.8 V, V _{IL} = 0 V (Note)	1.8	-0.25	V
		V _{IH} = 2.5 V, V _{IL} = 0 V (Note)	2.5	-0.6	
		V _{IH} = 3.3 V, V _{IL} = 0 V (Note)	3.3	-0.8	
Quiet output minimum dynamic V _{OH}	V _{OHV}	V _{IH} = 1.8 V, V _{IL} = 0 V (Note)	1.8	1.5	V
		V _{IH} = 2.5 V, V _{IL} = 0 V (Note)	2.5	1.9	
		V _{IH} = 3.3 V, V _{IL} = 0 V (Note)	3.3	2.2	

Note: Parameter guaranteed by design.

Capacitive Characteristics (Ta = 25°C)

Characteristics	Symbol	Test Condition	V _{CC} (V)	Typ.	Unit
Input capacitance	C _{IN}	—	1.8, 2.5, 3.3	6	pF
Power dissipation capacitance	C _{PD}	f _{IN} = 10 MHz (Note)	1.8, 2.5, 3.3	30	pF

Note: C_{PD} 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

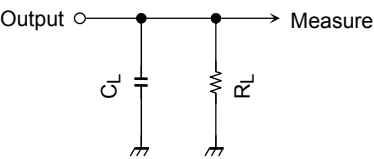


Figure 1

AC Waveform

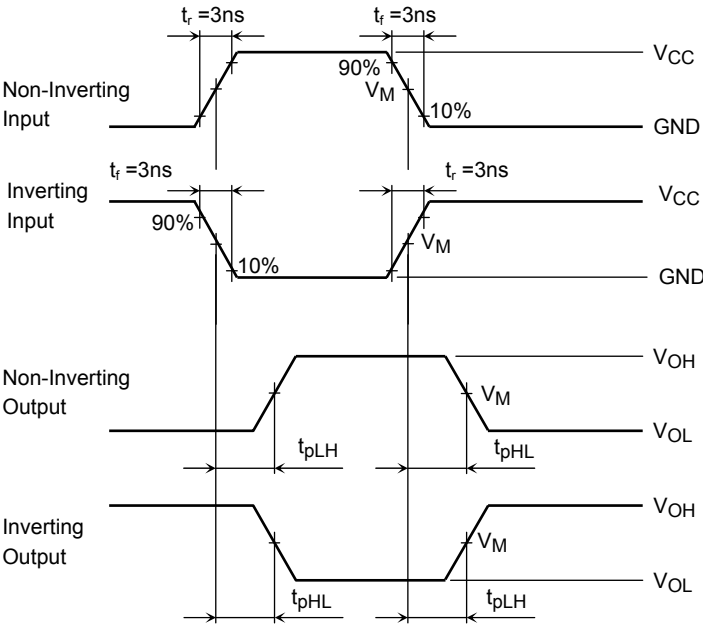


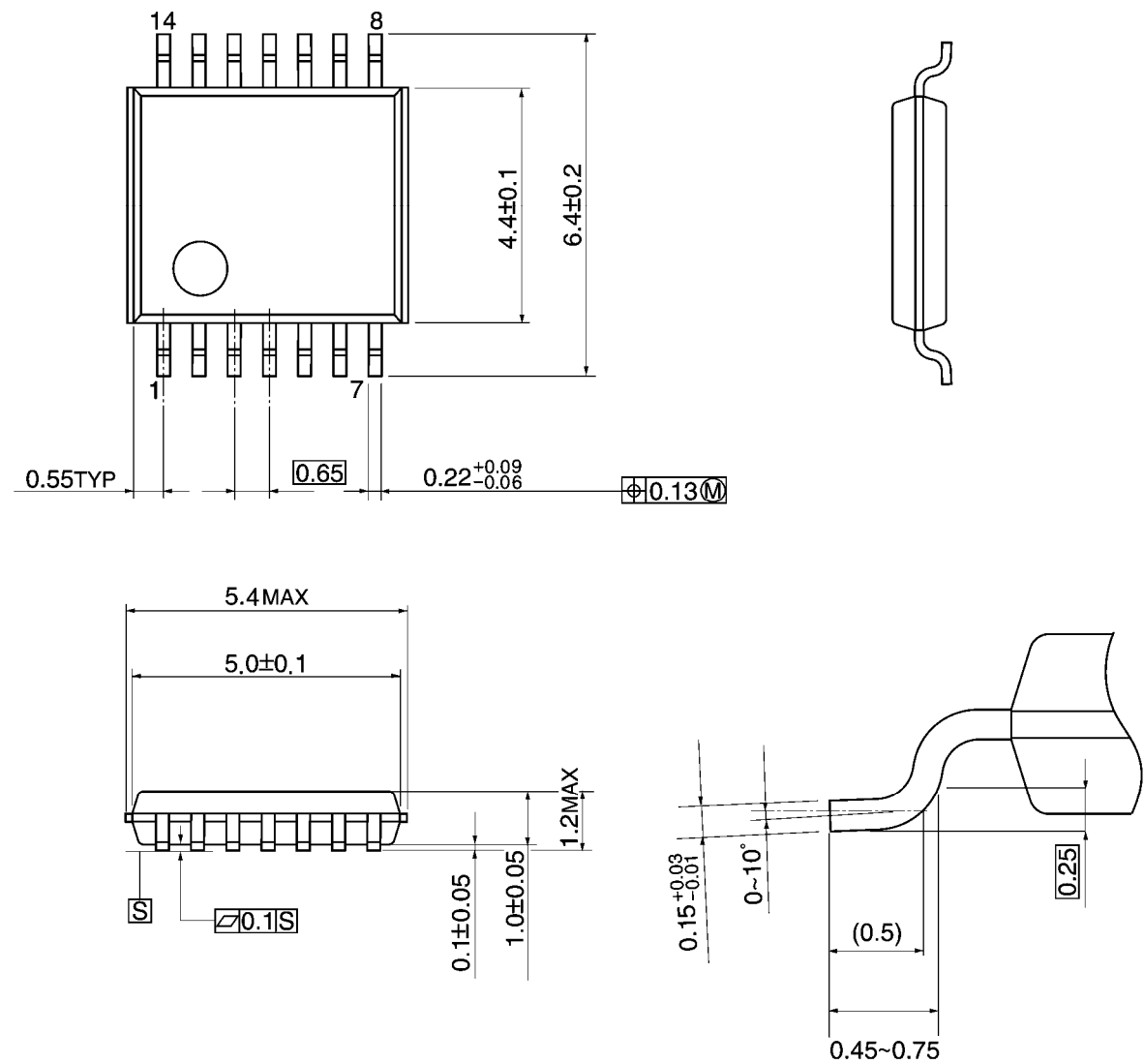
Figure 2 t_{pLH} , t_{pHL}

Symbol	V_{CC}		
	$3.3 \pm 0.3 \text{ V}$	$2.5 \pm 0.2 \text{ V}$	$1.8 \text{ V} \pm 0.15 \text{ V}$
V_{IN}	V_{CC}	V_{CC}	V_{CC}
V_M	1.5 V	$V_{CC}/2$	$V_{CC}/2$

Package Dimensions

TSSOP14-P-0044-0.65A

Unit: mm

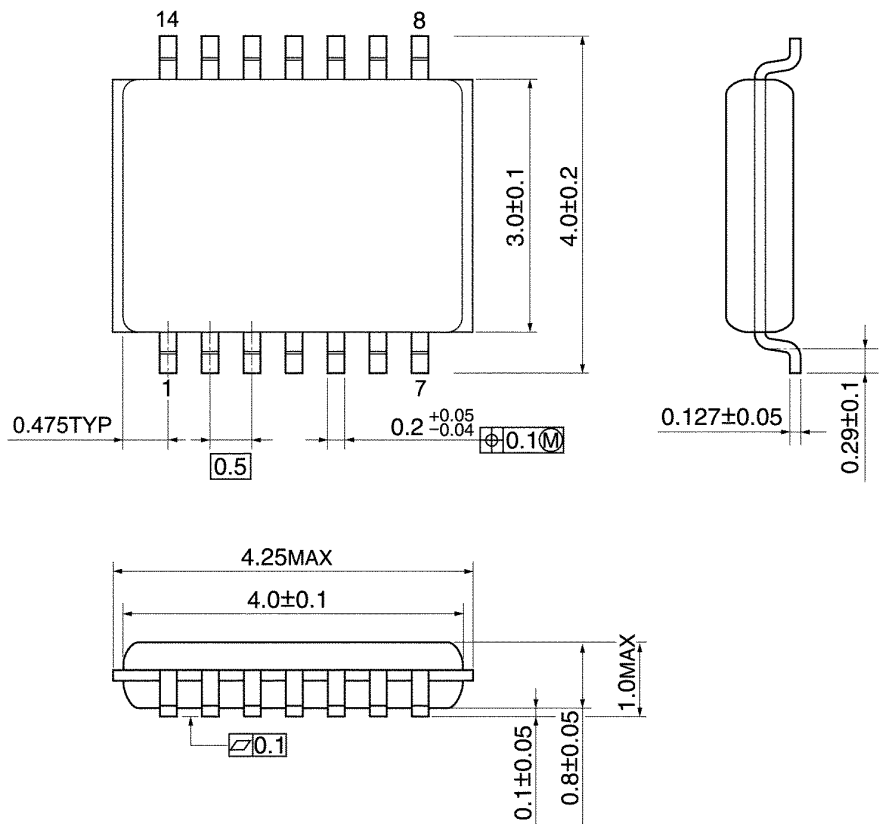


Weight: 0.06 g (typ.)

Package Dimensions

VSSOP14-P-0030-0.50

Unit: mm



Weight: 0.02 g (typ.)

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