

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

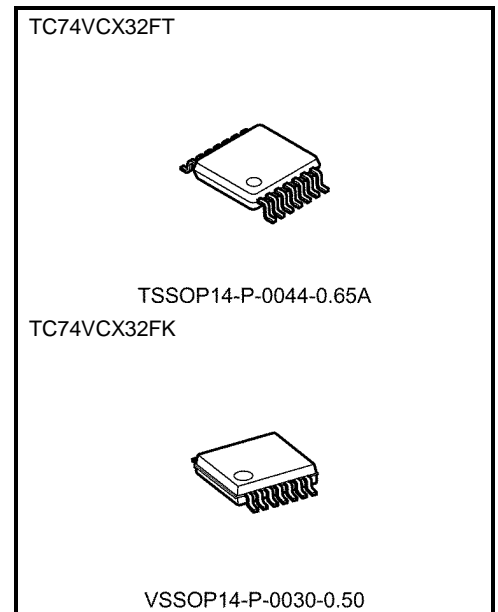
TC74VCX32FT, TC74VCX32FK

Low-Voltage Quad 2-Input OR Gate with 3.6-V Tolerant Inputs and Outputs

The TC74VCX32FT/FK is a high-performance CMOS 2-input OR 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 overvoltage tolerant inputs and outputs up to 3.6 V. All inputs are equipped with protection circuits against static discharge.

Features

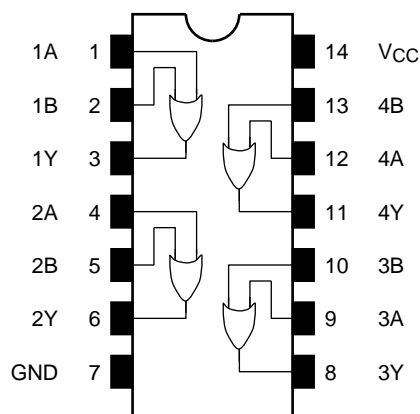
- Low-voltage operation: $V_{CC} = 1.2$ to 3.6 V
- High-speed operation : $t_{pd} = 2.8$ ns (max) ($V_{CC} = 3.0$ to 3.6 V)
 : $t_{pd} = 3.7$ ns (max) ($V_{CC} = 2.3$ to 2.7 V)
 : $t_{pd} = 7.4$ ns (max) ($V_{CC} = 1.65$ to 1.95 V)
 : $t_{pd} = 14.8$ ns (max) ($V_{CC} = 1.4$ to 1.6 V)
 : $t_{pd} = 37.0$ ns (max) ($V_{CC} = 1.2$ V)
- Output current : $I_{OH}/I_{OL} = \pm 24$ mA (min) ($V_{CC} = 3.0$ V)
 : $I_{OH}/I_{OL} = \pm 18$ mA (min) ($V_{CC} = 2.3$ V)
 : $I_{OH}/I_{OL} = \pm 6$ mA (min) ($V_{CC} = 1.65$ V)
 : $I_{OH}/I_{OL} = \pm 2$ mA (min) ($V_{CC} = 1.4$ V)
- Latch-up performance: -300 mA
- ESD performance: Machine model $\geq \pm 200$ V
 Human body model $\geq \pm 2000$ V
- Package: TSSOP and VSSOP (US)
- 3.6 V tolerant function and power-down protection provided on all inputs and outputs



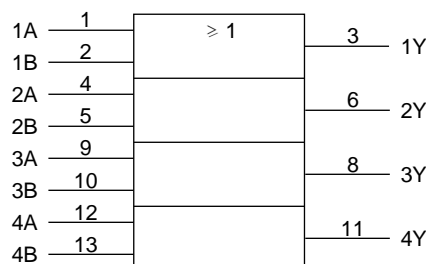
Weight
 TSSOP14-P-0044-0.65A : 0.06 g (typ.)
 VSSOP14-P-0030-0.50 : 0.02 g (typ.)

Start of commercial production
 1998-11

Pin Assignment (top view)



IEC Logic Level



Truth Table

Inputs		Outputs
A	B	Y
L	L	L
L	H	H
H	L	H
H	H	H

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}	−50	mA
Output diode current	I _{OK}	±50 (Note 4)	mA
DC output current	I _{OUT}	±50	mA
Power dissipation	P _D	180	mW
DC V _{CC} /ground current	I _{CC} /I _{GND}	±100	mA
Storage temperature	T _{stg}	−65 to 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 maximum rating must be observed.

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

Operating Ranges (Note 1)

Characteristics	Symbol	Rating	Unit
Power supply voltage	V _{CC}	1.2 to 3.6	V
Input voltage	V _{IN}	−0.3 to 3.6	V
Output voltage	V _{OUT}	0 to 3.6 (Note 2)	V
		0 to V _{CC} (Note 3)	
Output current	I _{OH} /I _{OL}	±24 (Note 4)	mA
		±18 (Note 5)	
		±6 (Note 6)	
		±6 (Note 7)	
Operating temperature	T _{opr}	−40 to 85	°C
Input rise and fall time	dt/dv	0 to 10 (Note 8)	ns/V

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 to 3.6 V

Note 5: V_{CC} = 2.3 to 2.7 V

Note 6: V_{CC} = 1.65 to 1.95 V

Note 7: V_{CC} = 1.4 to 1.6 V

Note 8: V_{IN} = 0.8 to 2.0 V, V_{CC} = 3.0 V

Electrical Characteristics

DC Characteristics (T_a = −40 to 85°C, 2.7 V < V_{CC} ≤ 3.6 V)

Characteristics		Symbol	Test Condition		V _{CC} (V)	Min	Max	Unit
Input voltage	H-level	V _{IH}	—		2.7 to 3.6	2.0	—	V
	L-level	V _{IL}	—		2.7 to 3.6	—	0.8	
Output voltage	H-level	V _{OH}	V _{IN} = V _{IH} or V _{IL}	I _{OH} = −100 μA	2.7 to 3.6	V _{CC} − 0.2	—	V
				I _{OH} = −12 mA	2.7	2.2	—	
				I _{OH} = −18 mA	3.0	2.4	—	
				I _{OH} = −24 mA	3.0	2.2	—	
	L-level	V _{OL}	V _{IN} = V _{IL}	I _{OL} = 100 μA	2.7 to 3.6	—	0.2	
				I _{OL} = 12 mA	2.7	—	0.4	
				I _{OL} = 18 mA	3.0	—	0.4	
				I _{OL} = 24 mA	3.0	—	0.55	
Input leakage current		I _{IN}	V _{IN} = 0 to 3.6 V		2.7 to 3.6	—	±5.0	μA
Power-off leakage current		I _{OFF}	V _{IN} , V _{OUT} = 0 to 3.6 V		0	—	10.0	μA
Quiescent supply current		I _{CC}	V _{IN} = V _{CC} or GND		2.7 to 3.6	—	20.0	μA
			V _{CC} ≤ V _{IN} ≤ 3.6 V		2.7 to 3.6	—	±20.0	
Quiescent supply current		ΔI _{CC}	V _{IH} = V _{CC} − 0.6 V (per input)		2.7 to 3.6	—	750	μA

DC Characteristics ($T_a = -40$ to 85°C , $2.3\text{ V} \leq V_{CC} \leq 2.7\text{ V}$)

Characteristics		Symbol	Test Condition		V _{CC} (V)	Min	Max	Unit
Input voltage	H-level	V _{IH}	—		2.3 to 2.7	1.6	—	V
	L-level	V _{IL}	—		2.3 to 2.7	—	0.7	
Output voltage	H-level	V _{OH}	V _{IN} = V _{IH} or V _{IL}	I _{OH} = −100 μA	2.3 to 2.7	V _{CC} − 0.2	—	V
				I _{OH} = −6 mA	2.3	2.0	—	
				I _{OH} = −12 mA	2.3	1.8	—	
				I _{OH} = −18 mA	2.3	1.7	—	
	L-level	V _{OL}	V _{IN} = V _{IL}	I _{OL} = 100 μA	2.3 to 2.7	—	0.2	
				I _{OL} = 12 mA	2.3	—	0.4	
				I _{OL} = 18 mA	2.3	—	0.6	
Input leakage current		I _{IN}	V _{IN} = 0 to 3.6 V		2.3 to 2.7	—	±5.0	μA
Power-off leakage current		I _{OFF}	V _{IN} , V _{OUT} = 0 to 3.6 V		0	—	10.0	μA
Quiescent supply current		I _{CC}	V _{IN} = V _{CC} or GND		2.3 to 2.7	—	20.0	μA
			V _{CC} ≤ V _{IN} ≤ 3.6 V		2.3 to 2.7	—	±20.0	

DC Characteristics ($T_a = -40$ to 85°C , $1.65\text{ V} \leq V_{CC} < 2.3\text{ V}$)

Characteristics		Symbol	Test Condition		V _{CC} (V)	Min	Max	Unit
Input voltage	H-level	V _{IH}	—		1.65 to 2.3	0.65 × V _{CC}	—	V
	L-level	V _{IL}	—		1.65 to 2.3	—	0.2 × V _{CC}	
Output voltage	H-level	V _{OH}	V _{IN} = V _{IH} or V _{IL}	I _{OH} = −100 μA	1.65 to 2.3	V _{CC} − 0.2	—	V
				I _{OH} = −6 mA	1.65	1.25	—	
	L-level	V _{OL}	V _{IN} = V _{IL}	I _{OL} = 100 μA	1.65 to 2.3	—	0.2	
				I _{OL} = 6 mA	1.65	—	0.3	
Input leakage current		I _{IN}	V _{IN} = 0 to 3.6 V		1.65 to 2.3	—	±5.0	μA
Power-off leakage current		I _{OFF}	V _{IN} , V _{OUT} = 0 to 3.6 V		0	—	10.0	μA
Quiescent supply current		I _{CC}	V _{IN} = V _{CC} or GND		1.65 to 2.3	—	20.0	μA
			V _{CC} ≤ V _{IN} ≤ 3.6 V		1.65 to 2.3	—	±20.0	

DC Characteristics (Ta = -40 to 85°C, 1.4 V ≤ VCC < 1.65 V)

Characteristics		Symbol	Test Condition		V _{CC} (V)	Min	Max	Unit
Input voltage	H-level	V _{IH}	—		1.4 to 1.65	0.65 × V _{CC}	—	V
	L-level	V _{IL}	—		1.4 to 1.65	—	0.05 × V _{CC}	
Output voltage	H-level	V _{OH}	V _{IN} = V _{IH} or V _{IL}	I _{OH} = −100 μA	1.4 to 1.65	V _{CC} − 0.2	—	V
				I _{OH} = −2 mA	1.4	1.05	—	
	L-level	V _{OL}	V _{IN} = V _{IL}	I _{OL} = 100 μA	1.4 to 1.65	—	0.05	
				I _{OL} = 2 mA	1.4	—	0.35	
Input leakage current		I _{IN}	V _{IN} = 0 to 3.6 V		1.4 to 1.65	—	±5.0	μA
Power-off leakage current		I _{OFF}	V _{IN} , V _{OUT} = 0 to 3.6 V		0	—	10.0	μA
Quiescent supply current		I _{CC}	V _{IN} = V _{CC} or GND		1.4 to 1.65	—	20.0	μA
			V _{CC} ≤ V _{IN} ≤ 3.6 V		1.4 to 1.65	—	±20.0	

DC Characteristics (Ta = -40 to 85°C, 1.2 V ≤ VCC < 1.4 V)

Characteristics		Symbol	Test Condition		Min	Max	Unit
Input voltage	H-level	V _{IH}	—	1.2 to 1.4	0.8 × V _{CC}	—	V
	L-level	V _{IL}	—	1.2 to 1.4	—	0.05 × V _{CC}	
Output voltage	H-level	V _{OH}	V _{IN} = V _{IH} or V _{IL}	I _{OH} = -100 μA	1.2	V _{CC} - 0.1	V
	L-level	V _{OL}	V _{IN} = V _{IL}	I _{OL} = 100 μA	1.2	0.05	
Input leakage current		I _{IN}	V _{IN} = 0 to 3.6 V	1.2	—	±5.0	μA
Power-off leakage current		I _{OFF}	V _{IN} , V _{OUT} = 0 to 3.6 V	0	—	10.0	μA
Quiescent supply current		I _{CC}	V _{IN} = V _{CC} or GND	1.2	—	20.0	μA
			V _{CC} ≤ V _{IN} ≤ 3.6 V	1.2	—	±20.0	

AC Characteristics (Ta = -40 to 85°C, input: tr = tf = 2.0 ns) (Note 1)

Characteristics	Symbol	Test Condition		VCC (V)	Min	Max	Unit
Propagation delay time	tpLH tpHL	Figure 1, Figure 2	CL = 15 pF, RL = 2 kΩ	1.2	3.0	37.0	ns
				1.5 ± 0.1	2.0	14.8	
			CL = 30 pF, RL = 500 Ω	1.8 ± 0.15	1.5	7.4	
				2.5 ± 0.2	0.8	3.7	
				3.3 ± 0.3	0.6	2.8	
Output to output skew	tosLH tosHL	(Note 2)	CL = 15 pF, RL = 2 kΩ	1.2	—	1.5	ns
				1.5 ± 0.1	—	1.5	
			CL = 30 pF, RL = 500 Ω	1.8 ± 0.15	—	0.5	
				2.5 ± 0.2	—	0.5	
				3.3 ± 0.3	—	0.5	

Note 1: For CL = 50 pF, add approximately 300 ps to the AC maximum specification.

Note 2: Parameter guaranteed by design.

(tosLH = |tpLHm - tpLHn|, tosHL = |tpHLm - tpHLn|)

Dynamic Switching Characteristics (Ta = 25°C, input: tr = tf = 2.0 ns, CL = 30 pF)

Characteristics	Symbol	Test Condition		VCC (V)	Typ.	Unit
Quiet output maximum dynamic VOL	VOLP	VIH = 1.8 V, VIL = 0 V	(Note)	1.8	0.25	V
		VIH = 2.5 V, VIL = 0 V	(Note)	2.5	0.6	
		VIH = 3.3 V, VIL = 0 V	(Note)	3.3	0.8	
Quiet output minimum dynamic VOL	VOLV	VIH = 1.8 V, VIL = 0 V	(Note)	1.8	-0.25	V
		VIH = 2.5 V, VIL = 0 V	(Note)	2.5	-0.6	
		VIH = 3.3 V, VIL = 0 V	(Note)	3.3	-0.8	
Quiet output minimum dynamic VOH	VOHV	VIH = 1.8 V, VIL = 0 V	(Note)	1.8	1.5	V
		VIH = 2.5 V, VIL = 0 V	(Note)	2.5	1.9	
		VIH = 3.3 V, VIL = 0 V	(Note)	3.3	2.2	

Note: Parameter guaranteed by design.

Capacitive Characteristics (Ta = 25°C)

Characteristics	Symbol	Test Condition		VCC (V)	Typ.	Unit
Input capacitance	CIN	—		1.8, 2.5, 3.3	6	pF
Power dissipation capacitance	CPD	fIN = 10 MHz	(Note)	1.8, 2.5, 3.3	20	pF

Note: CPD 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:

$$I_{CC}(\text{opr}) = CPD \cdot V_{CC} \cdot f_{IN} + I_{CC}/4 \text{ (per gate)}$$

AC Test Circuit

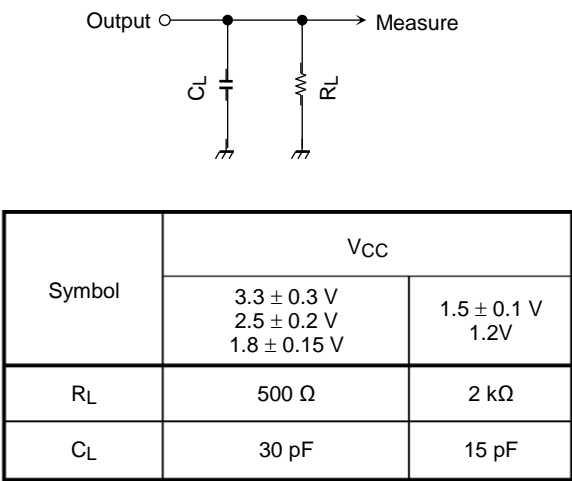
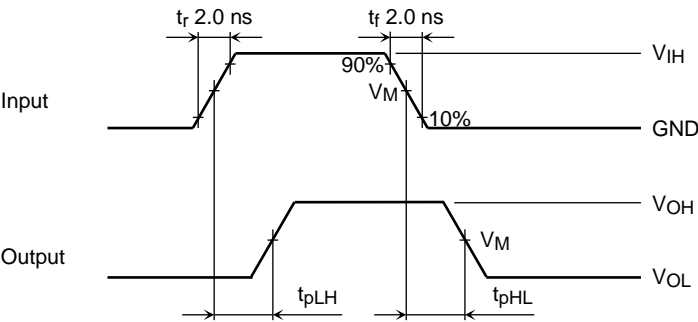


Figure 1

AC Waveform



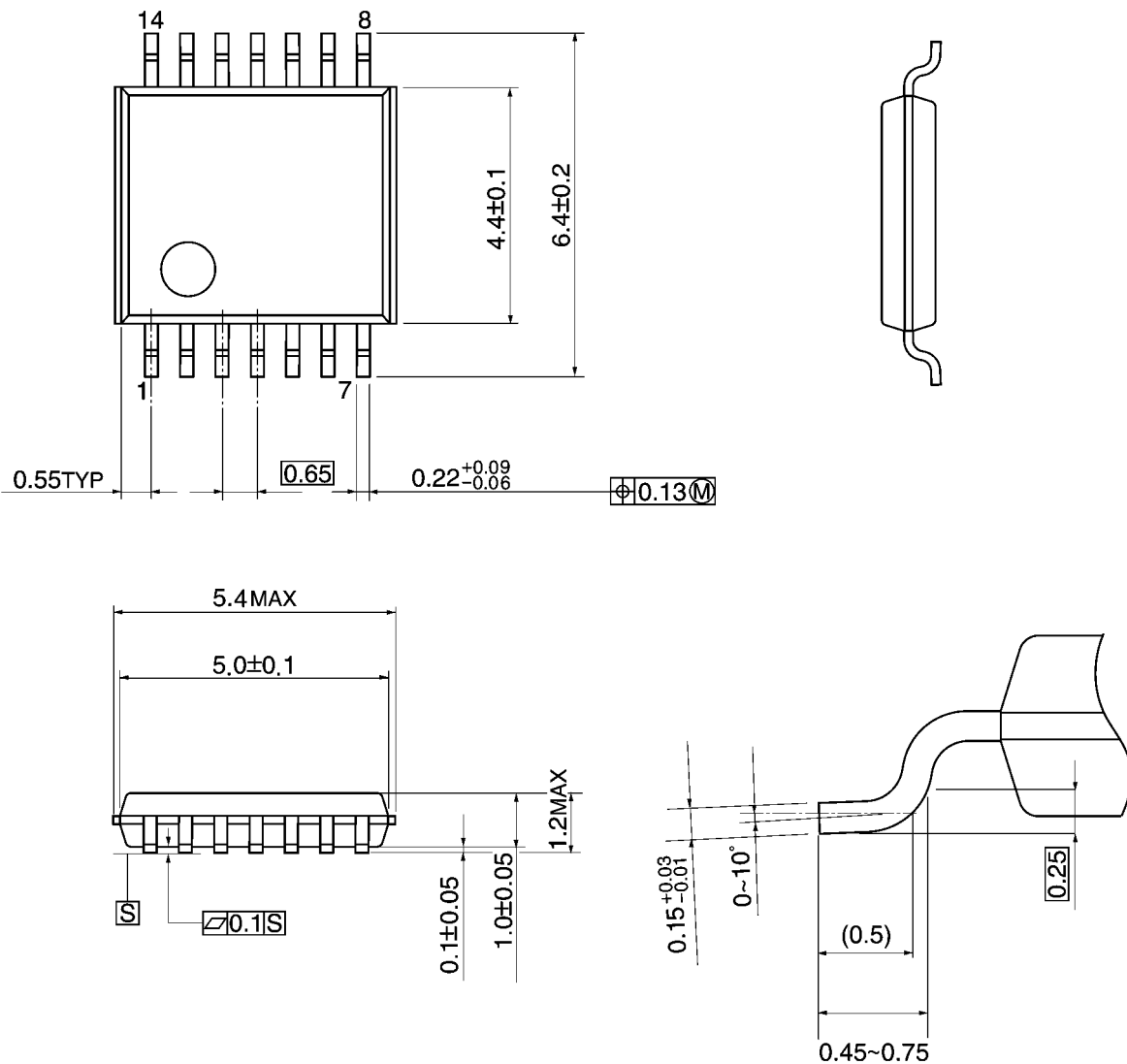
Symbol	V_{CC}				
	$3.3 \pm 0.3 \text{ V}$	$2.5 \pm 0.2 \text{ V}$	$1.8 \pm 0.15 \text{ V}$	$1.5 \pm 0.1 \text{ V}$	1.2 V
V_{IH}	2.7 V	V_{CC}	V_{CC}	V_{CC}	V_{CC}
V_M	1.5 V	$V_{CC}/2$	$V_{CC}/2$	$V_{CC}/2$	$V_{CC}/2$

Figure 2 t_{pLH} , t_{pHL}

Package Dimensions

TSSOP14-P-0044-0.65A

Unit: mm

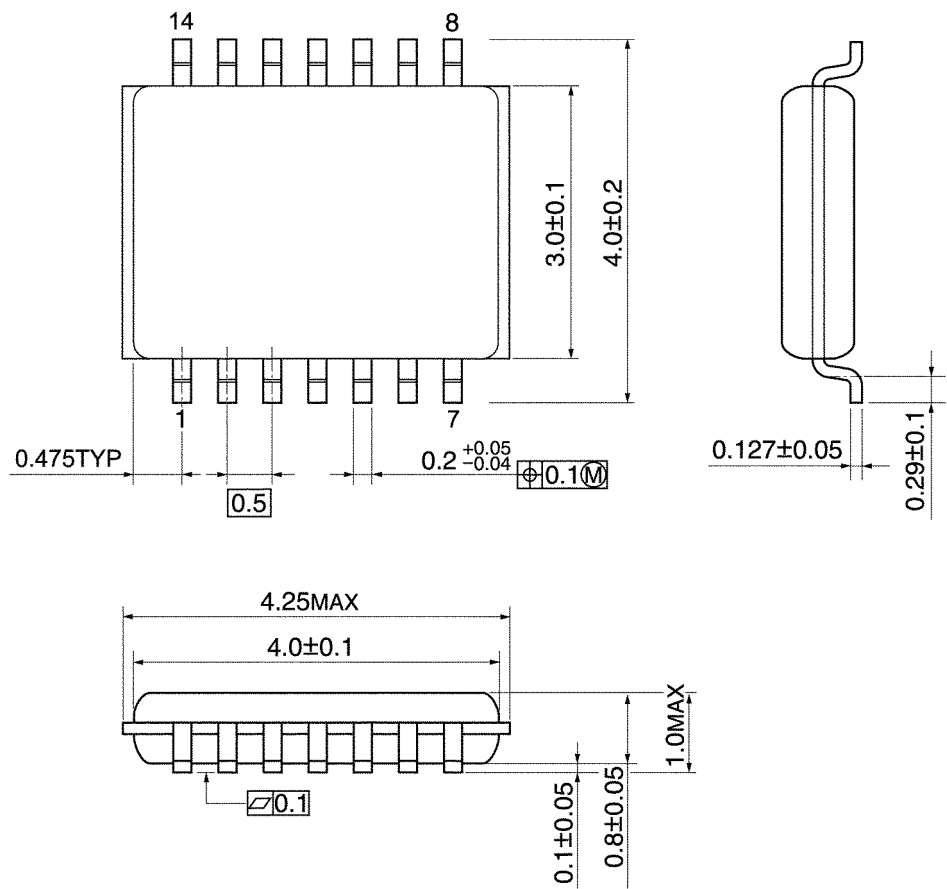


Weight: 0.06 g (typ.)

Package Dimensions

VSSOP14-P-0030-0.50

Unit: mm



Weight: 0.02 g (typ.)

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