

TC74LCX125F, TC74LCX125FN, TC74LCX125FT, TC74LCX125FK

Low-Voltage Quad Bus Buffer with 5-V Tolerant Inputs and Outputs

The TC74LCX125 is a high-performance CMOS quad bus buffers. Designed for use in 3.3-V systems, it achieves high-speed operation while maintaining the CMOS low power dissipation.

The device is designed for low-voltage (3.3 V) VCC applications, but it could be used to interface to 5-V supply environment for inputs.

This device requires the 3-state control input $\overline{OE}$ to be set high to place the output into the high impedance state.

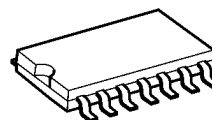
All inputs are equipped with protection circuits against static discharge.

Features

- Low-voltage operation: $V_{CC} = 1.65$ to 3.6 V
- High-speed operation: $t_{pd} = 6.0$ ns (max) ($V_{CC} = 3.0$ to 3.6 V)
- Output current: $|I_{OH}|/I_{OL} = 24$ mA (min) ($V_{CC} = 3.0$ V)
- Latch-up performance: $> \pm 500$ mA
- Available in JEDEC SOP, JEITA SOP, TSSOP and VSSOP (US)
- Power-down protection is provided on all inputs and outputs
- Pin and function compatible with the 74 series (74AC/VHC/HC/F/ALS/LS etc.) 125 type

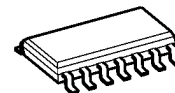
Note: xxxFN (JEDEC SOP) is not available in Japan.

TC74LCX125F



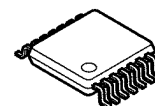
SOP14-P-300-1.27A

TC74LCX125FN



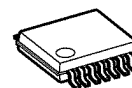
SOL14-P-150-1.27

TC74LCX125FT



TSSOP14-P-0044-0.65A

TC74LCX125FK



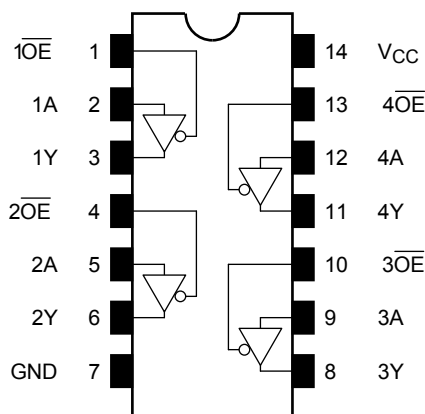
VSSOP14-P-0030-0.50

Weight

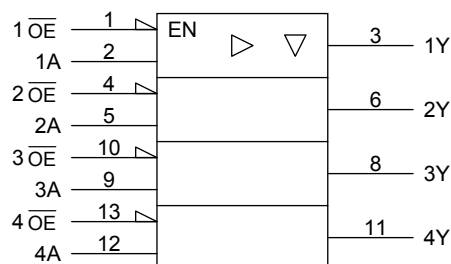
SOP14-P-300-1.27A	: 0.18 g (typ.)
SOL14-P-150-1.27	: 0.12 g (typ.)
TSSOP14-P-0044-0.65A	: 0.06 g (typ.)
VSSOP14-P-0030-0.50	: 0.02 g (typ.)

Note: The Electrical Characteristics of $V_{CC}=1.8\pm0.15$ V is only applicable for products which manufactured from January 2009 onward.

Pin Assignment (top view)



IEC Logic Symbol



Truth Table

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

X: Don't care

Z: High impedance

Absolute Maximum Ratings (Note 1)

Characteristics	Symbol	Rating	Unit
Power supply voltage	V_{CC}	-0.5 to 7.0	V
DC input voltage	V_{IN}	-0.5 to 7.0	V
DC output voltage	V_{OUT}	-0.5 to 7.0 (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	$^{\circ}C$

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 range (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: Output in OFF state

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}	1.65 to 3.6	V
		1.5 to 3.6 (Note 2)	
Input voltage	V_{IN}	0 to 5.5	V
Output voltage	V_{OUT}	0 to 5.5 (Note 3)	V
		0 to V_{CC} (Note 4)	
Output current	I_{OH}/I_{OL}	± 24 (Note 5)	mA
		± 12 (Note 6)	
Operating temperature	T_{opr}	-40 to 85	°C
Input rise and fall time	dt/dv	0 to 10 (Note 7)	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: Data retention only

Note 3: Output in OFF state

Note 4: High or low state

Note 5: $V_{CC} = 3.0$ to 3.6 V

Note 6: $V_{CC} = 2.7$ to 3.0 V

Note 7: $V_{IN} = 0.8$ to 2.0 V, $V_{CC} = 3.0$ V

Electrical Characteristics
DC Characteristics (Ta = -40 to 85°C)

Characteristics		Symbol	Test Condition			Min	Max	Unit
					V _{CC} (V)			
Input voltage	H-level	V _{IH}	—		1.65 to 2.3	V _{CC} × 0.9	—	V
					2.3 to 2.7	1.7	—	
					2.7 to 3.6	2.0	—	
	L-level	V _{IL}	—		1.65 to 2.3	—	V _{CC} × 0.1	
					2.3 to 2.7	—	0.7	
					2.7 to 3.6	—	0.8	
Output voltage	H-level	V _{OH}	V _{IN} = V _{IH} or V _{IL}	I _{OH} = −100 μA	1.65 to 3.6	V _{CC} −0.2	—	V
				I _{OH} = −4 mA	1.65	1.05	—	
				I _{OH} = −8 mA	2.3	1.7	—	
				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 _{IH} or V _{IL}	I _{OL} = 100 μA	1.65 to 3.6	—	0.2	
				I _{OL} = 4 mA	1.65	—	0.45	
				I _{OL} = 8 mA	2.3	—	0.7	
				I _{OL} = 12 mA	2.7	—	0.4	
				I _{OL} = 16 mA	3.0	—	0.4	
				I _{OL} = 24 mA	3.0	—	0.55	
Input leakage current		I _{IN}	V _{IN} = 0 to 5.5 V	1.65 to 3.6	—	±5.0	μA	
3-state output OFF state current		I _{OZ}	V _{IN} = V _{IH} or V _{IL} V _{OUT} = 0 to 5.5 V	1.65 to 3.6	—	±5.0	μA	
Power-off leakage current		I _{OFF}	V _{IN} /V _{OUT} = 5.5 V	0	—	10.0	μA	
Quiescent supply current		I _{CC}	V _{IN} = V _{CC} or GND	1.65 to 3.6	—	10.0	μA	
			V _{IN} /V _{OUT} = 3.6 to 5.5 V	1.65 to 3.6	—	±10.0		
Increase in I _{CC} per input		ΔI _{CC}	V _{IH} = V _{CC} − 0.6 V	2.7 to 3.6	—	500		

AC Characteristics (Ta = -40 to 85°C)

Characteristics	Symbol	Test Condition	V _{CC} (V)	Min	Max	Unit
Propagation delay time	t _{pLH} t _{pHL}	Figure 1, Figure 2	1.8 ± 0.15	—	20.0	ns
			2.5 ± 0.2	—	7.5	
			2.7	—	6.5	
			3.3 ± 0.3	1.5	6.0	
Output enable time	t _{pZL} t _{pZH}	Figure 1, Figure 3	1.8 ± 0.15	—	30.0	ns
			2.5 ± 0.2	—	15.0	
			2.7	—	8.0	
			3.3 ± 0.3	1.5	7.0	
Output disable time	t _{pLZ} t _{pHZ}	Figure 1, Figure 3	1.8 ± 0.15	—	28.0	ns
			2.5 ± 0.2	—	14.0	
			2.7	—	7.0	
			3.3 ± 0.3	1.5	6.0	
Output to output skew	t _{osLH} t _{osHL}	(Note)	2.7	—	—	ns
			3.3 ± 0.3	—	1.0	

Note: Parameter guaranteed by design.
(t_{osLH} = |t_{pLHm} - t_{pLHn}|, t_{osHL} = |t_{pHLm} - t_{pHLn}|)

Dynamic Switching Characteristics (Ta = 25°C, input: t_r = t_f = 2.5 ns, C_L = 50 pF, R_L = 500 Ω)

Characteristics	Symbol	Test Condition	V _{CC} (V)	Typ.	Unit
Quiet output maximum dynamic V _{OL}	V _{OLP}	V _{IH} = 3.3 V, V _{IL} = 0 V	3.3	0.8	V
Quiet output minimum dynamic V _{OL}	V _{OLV}	V _{IH} = 3.3 V, V _{IL} = 0 V	3.3	0.8	V

Capacitive Characteristics (Ta = 25°C)

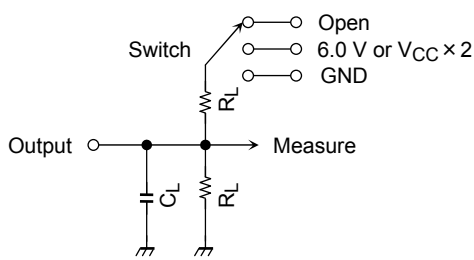
Characteristics	Symbol	Test Condition	V _{CC} (V)	Typ.	Unit
Input capacitance	C _{IN}	—	3.3	7	pF
Output capacitance	C _{OUT}	—	3.3	8	pF
Power dissipation capacitance	C _{PD}	f _{IN} = 10 MHz (Note)	3.3	25	pF

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:

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

AC Test Circuit



Parameter	Switch
t_{pLH}, t_{pHL}	Open
t_{pLZ}, t_{pZL}	6.0 V @ $V_{CC} = 3.3 \pm 0.3V$ @ $V_{CC} = 2.7V$
	$V_{CC} \times 2$ @ $V_{CC} = 2.5 \pm 0.2V$ @ $V_{CC} = 1.8 \pm 0.15V$
t_{pHZ}, t_{pZH}	GND

Figure 1

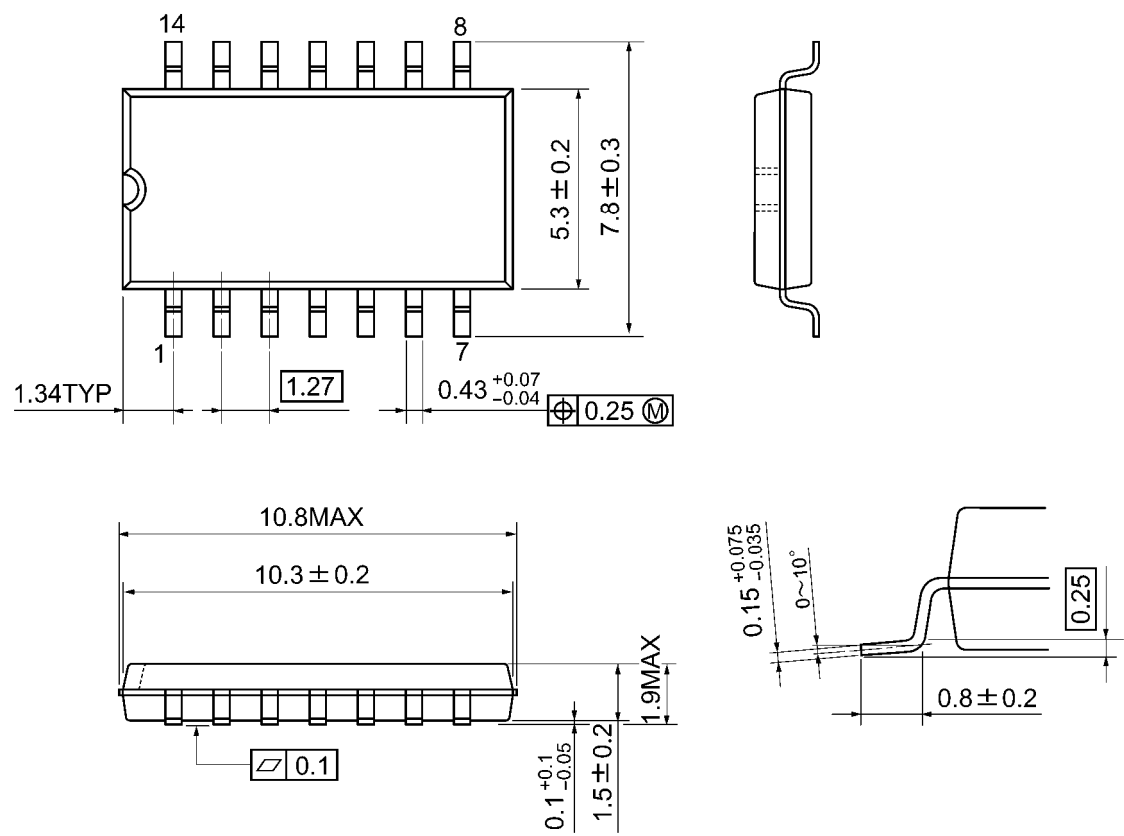
Timing diagram for the 74VHC04 inverter with tri-state outputs. The diagram shows three signals: Output Enable ($\overline{OE}$), Output (Y) Low to Off to Low, and Output (Y) High to Off to High. The Output Enable signal transitions from high to low (enabling outputs) and back to high (disabling outputs). The output signals show the transition from their active state to a high-impedance state (V_{IM}) and back. Key timing parameters are labeled: t_r (rise time of $\overline{OE}$), t_{pLZ} (propagation delay low-to-high), t_{pZH} (propagation delay high-to-high), t_{pLH} (propagation delay low-to-low), t_{pZH} (propagation delay high-to-low), t_{pLZ} (propagation delay low-to-low), and t_{pZH} (propagation delay high-to-high). Voltage levels V_{OH} , V_{OL} , V_{OH} , and V_{OL} are indicated for the output signals.

	Symbol	V _{CC}		
		3.3 ± 0.3 V 2.7V	2.5 ± 0.2 V	1.8 ± 0.15 V
Input	V _{IH}	2.7V	V _{CC}	V _{CC}
	V _{IM}	1.5V	V _{CC} /2	V _{CC} /2
	tr,tf	2.5ns	2.0ns	2.0ns
Output	V _{OM}	1.5V	V _{OH} /2	V _{OH} /2
	V _X	V _{OL} +0.3V	V _{OL} +0.15V	V _{OL} +0.15V
	V _Y	V _{OH} -0.3V	V _{OH} -0.15V	V _{OH} -0.15V
Load	C _L	50pF	30pF	30pF
	R _L	500Ω	500Ω	1kΩ

Package Dimensions

SOP14-P-300-1.27A

Unit: mm

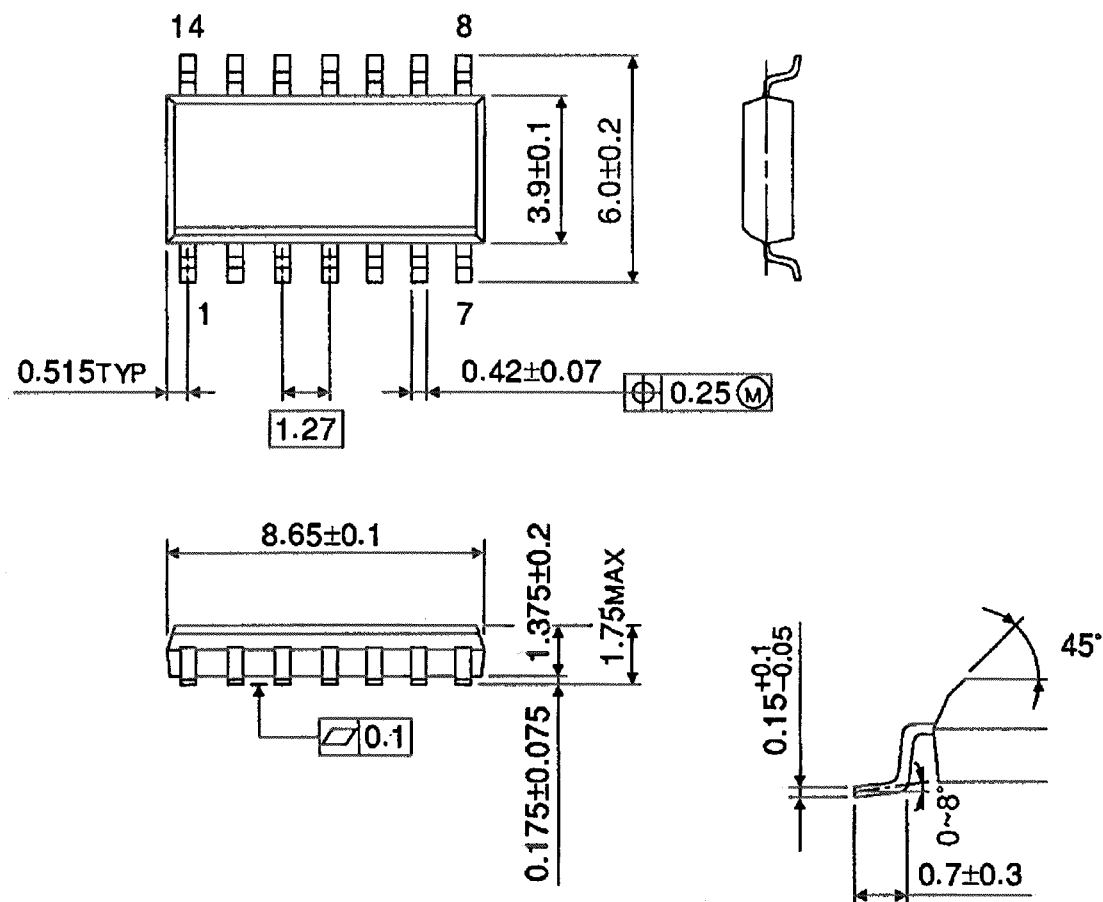


Weight: 0.18 g (typ.)

Package Dimensions (Note)

SOL14-P-150-1.27

Unit : mm



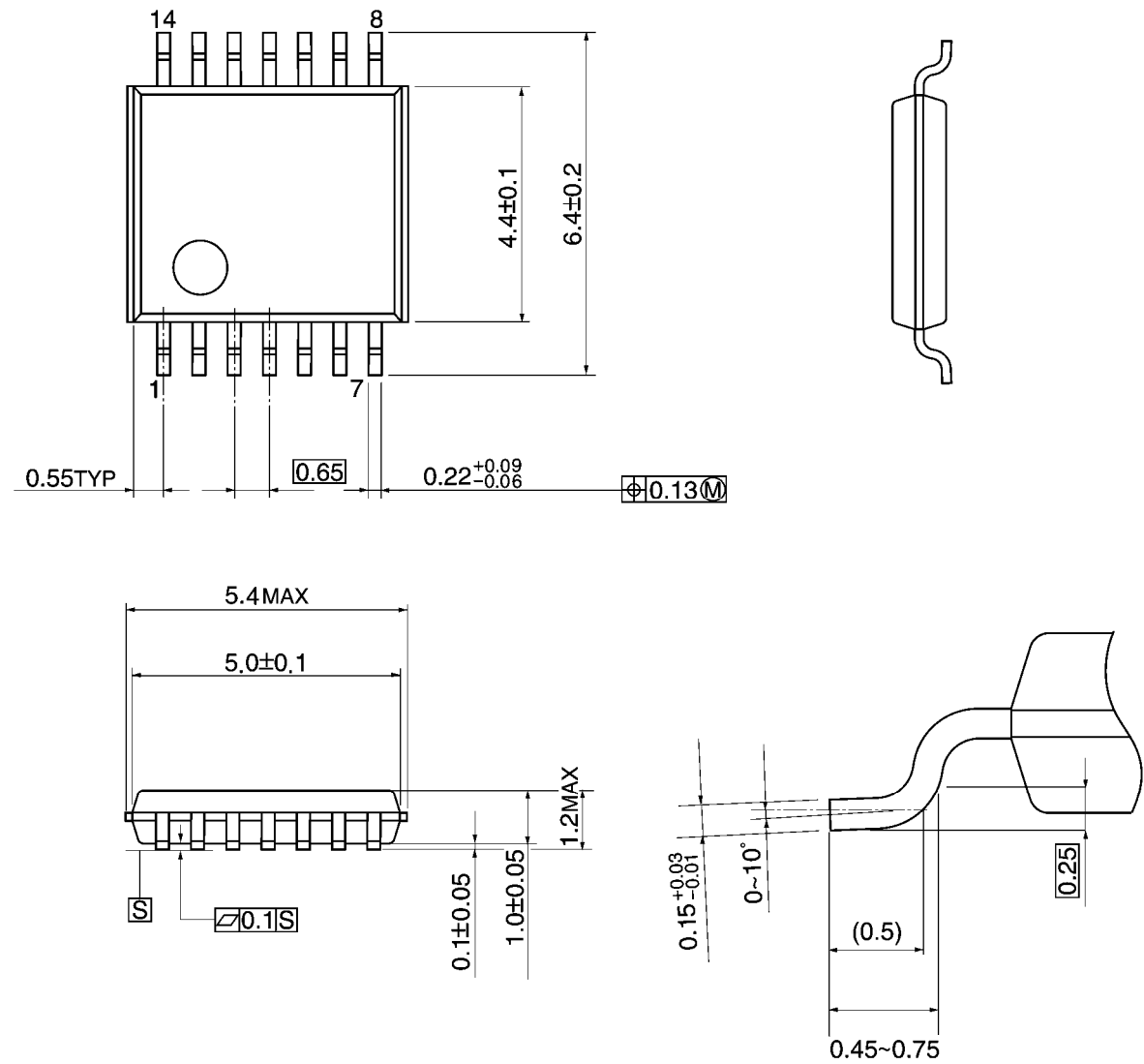
Note: This package is not available in Japan.

Weight: 0.12 g (typ.)

Package Dimensions

TSSOP14-P-0044-0.65A

Unit: mm

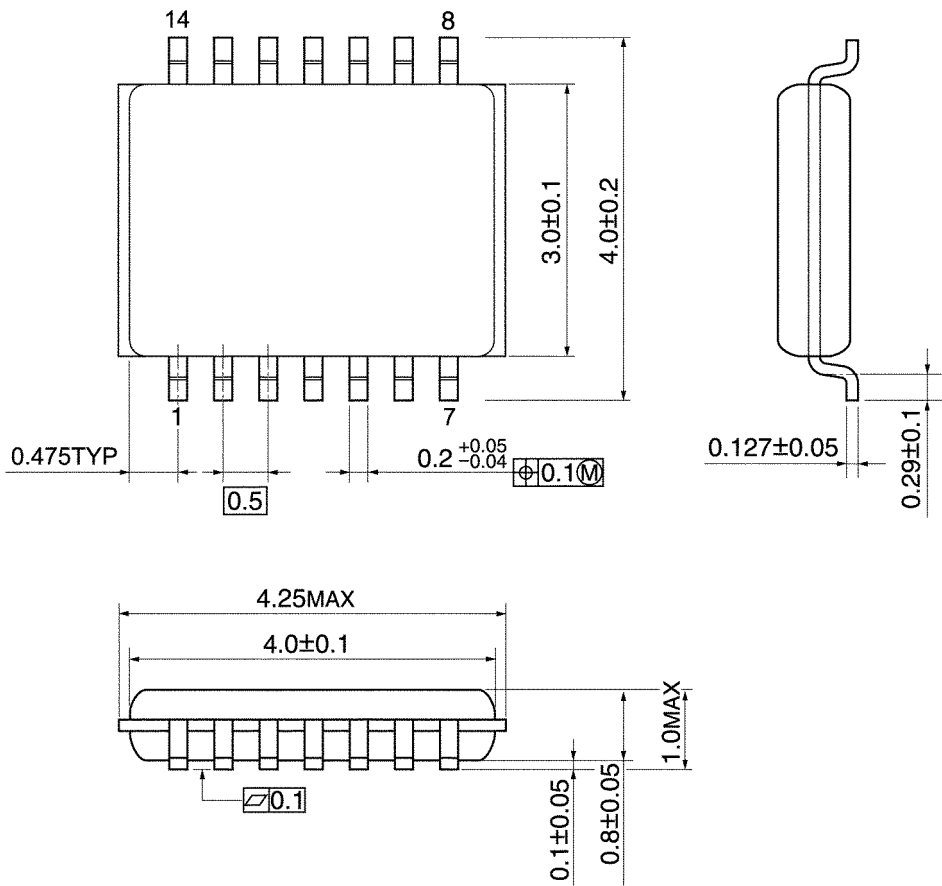


Weight: 0.06 g (typ.)

Package Dimensions

VSSOP14-P-0030-0.50

Unit: mm



Weight: 0.02 g (typ.)

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