TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC74VHC4066AF, TC74VHC4066AFT, TC74VHC4066AFK

Quad Bilateral Switch

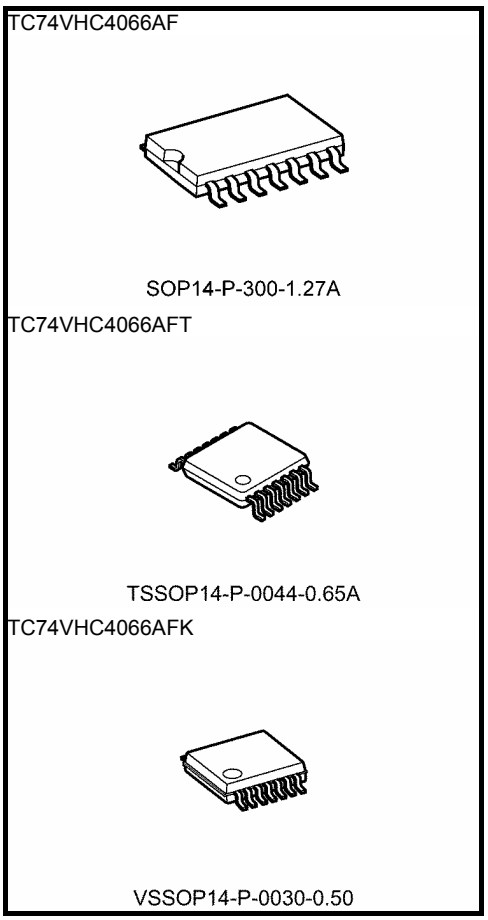
The TC74VHC4066A is high-speed, low-voltage drive QUAD BILATERAL SWITCH fabricated with silicon gate C^2MOS technology.

In 3 V and 5 V systems these can achieve high-speed operation with the low power dissipation that is a feature of CMOS.

It consists of four independent high speed switches capable of controlling either digital or analog signals while maintaining the CMOS low power dissipation.

The switches for each channel are turned ON by the control pin digital signals.

Control pin is equipped with a newly developed input protection circuit that avoids the need for a diode on the plus side (forward side from the input to the V_{CC}). As a result, for example, 5.5 V signals can be permitted on the inputs even when the power supply voltage to the circuits is off. As a result of this input power protection, the TC74VHC4066AFT can be used in a variety of applications, including in the system which has two power supplies, and in battery backup circuits.



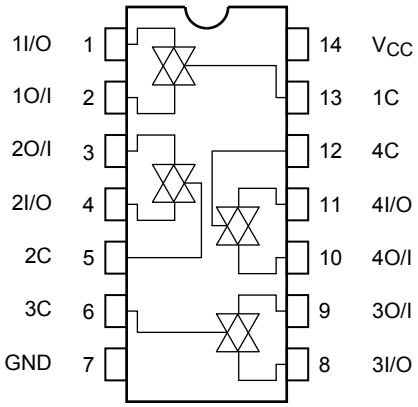
Weight

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

Features

- Low ON resistance: R_{on} = 45 Ω (typ.) (V_{CC} = 3.0 V)
  R_{on} = 24 Ω (typ.) (V_{CC} = 4.5 V)
- Low power dissipation: I_{CC} = 2.0 μA (max) (Ta = 25°C)
- Input level: V_{IL} = 0.8 V (max) (V_{CC} = 3 V)
  V_{IH} = 2.0 V (min) (V_{CC} = 3 V)
- Power down protection is provided on all control inputs

Pin Assignment (top view)

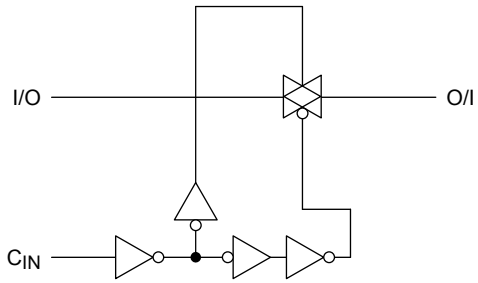


(top view)

Truth Table

Control	Switch Function
H	On
L	Off

System Diagram (1/4 Package)



Absolute Maximum Ratings (Note)

Characteristics	Symbol	Rating	Unit
Power supply voltage	V_{CC}	−0.5~7.0	V
Control input voltage	V_{IN}	−0.5~7.0	V
Switch I/O voltage	$V_{I/O}$	− 0.5~V_{CC} + 0.5	V
Input diode current	I_{IK}	−20	mA
I/O diode current	I_{IOK}	±25	mA
Switch through current	I_T	±25	mA
DC V_{CC} or ground current	I_{CC}	±50	mA
Power dissipation	P_D	180	mW
Storage temperature	T_{stg}	−65~150	°C

Note: Exceeding any of the absolute maximum ratings, even briefly, may 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).

Operating Ranges (Note)

Characteristics	Symbol	Rating	Unit
Power supply voltage	V_{CC}	2~5.5	V
Input voltage	V_{IN}	0~5.5	V
Switch I/O voltage	$V_{I/O}$	0~V_{CC}	V
Operating temperature	T_{opr}	−40~85	°C
Input rise and fall time	dt/dv	0~200 (V_{CC} = 2.5 ± 0.2 V) 0~100 (V_{CC} = 3.3 ± 0.3 V) 0~20 (V_{CC} = 5 ± 0.5 V)	ns/V

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

Electrical Characteristics

DC Electrical Characteristics

Characteristics		Symbol	Test Condition		Ta = 25°C			Ta = −40~85°C		Unit
				V_{CC} (V)	Min	Typ.	Max	Min	Max	
Input voltage	High level	V_{IH}	—	2.0	1.5	—	—	1.5	—	V
				3.0	2.0	—	—	2.0	—	
				4.5	3.15	—	—	3.15	—	
				5.5	3.85	—	—	3.85	—	
	Low level	V_{IL}	—	2.0	—	—	0.5	—	0.5	
				3.0	—	—	0.8	—	0.8	
				4.5	—	—	1.35	—	1.35	
				5.5	—	—	1.65	—	1.65	
ON resistance		R_{ON}	$V_{IN} = V_{IH}$ $V_{I/O} = V_{CC}$ to GND $I_{I/O}$ = 2 mA	2.3	—	200	—	—	—	Ω
				3.0	—	45	86	—	108	
				4.5	—	24	37	—	46	
			$V_{IN} = V_{IH}$ $V_{I/O} = V_{CC}$ or GND $I_{I/O}$ = 2 mA	2.3	—	28	73	—	84	
				3.0	—	22	38	—	44	
				4.5	—	17	27	—	31	
Difference of ON resistance between switches		ΔR_{ON}	$V_{IN} = V_{IH}$ $V_{I/O} = V_{CC}$ to GND $I_{I/O}$ = 2 mA	2.3	—	10	25	—	35	Ω
				3.0	—	5	15	—	20	
				4.5	—	5	13	—	18	
Input/Output leakage current (switch OFF)		I_{OFF}	$V_{OS} = V_{CC}$ or GND V_{IS} = GND to V_{CC} $V_{IN} = V_{IL}$	5.5	—	—	±0.1	—	±1.0	μA
Input/Output leakage current (switch ON, output open)		$I_{I/O}$	$V_{OS} = V_{CC}$ or GND $V_{IN} = V_{IH}$	5.5	—	—	±0.1	—	±1.0	μA
Control input current		I_{IN}	$V_{IN} = V_{CC}$ or GND	5.5	—	—	±0.1	—	±1.0	μA
Quiescent supply current		I_{CC}	$V_{IN} = V_{CC}$ or GND	5.5	—	—	2.0	—	20.0	μA

AC Electrical Characteristics (Input: $t_r = t_f = 3$ ns)

Characteristics	Symbol	Test Condition		V_{CC} (V)	Ta = 25°C Min	Ta = 25°C Typ.	Ta = 25°C Max	Ta = −40~85°C Min	Ta = −40~85°C Max	Unit
Phase difference between input and output	ϕI/O	C_L = 15 pF, R_L = 1 kΩ		2.5±0.2	—	1.2	10	—	16	ns
				3.3±0.3	—	0.8	6	—	10	
				5.0±0.5	—	0.3	4	—	7	
		C_L = 50 pF, R_L = 1 kΩ		2.5±0.2	—	2.6	12	—	18	
				3.3±0.3	—	1.5	9	—	12	
				5.0±0.5	—	0.6	6	—	8	
Output enable time	t_{pZL} t_{pZH}	C_L = 15 pF, R_L = 1 kΩ	Figure 1	2.5±0.2	—	3.3	15	—	20	ns
				3.3±0.3	—	2.3	11	—	15	
				5.0±0.5	—	1.6	7	—	10	
		C_L = 50 pF, R_L = 1 kΩ	Figure 1	2.5±0.2	—	4.2	25	—	32	
				3.3±0.3	—	3.0	18	—	22	
				5.0±0.5	—	2.1	12	—	16	
Output disable time	t_{pLZ} t_{pHZ}	C_L = 15 pF, R_L = 1 kΩ	Figure 1	2.5±0.2	—	6	15	—	23	ns
				3.3±0.3	—	4.5	11	—	15	
				5.0±0.5	—	3.2	7	—	10	
		C_L = 50 pF, R_L = 1 kΩ	Figure 1	2.5±0.2	—	9.6	25	—	32	
				3.3±0.3	—	7.2	18	—	22	
				5.0±0.5	—	5.1	12	—	16	
Control input capacitance	C_{IN}	All types		—	—	3	—	—	—	pF
SWITCH terminal capacitance	C_{OS}	Figure 2			—	5.5	—	—	—	pF
Feed through capacitance	C_{IOS}	Figure 2			—	0.5	—	—	—	pF
Power dissipation capacitance	C_{PD}	Figure 2 (Note)			—	4.5	—	—	—	pF

Note: C_{PD} is defined as the value of the internal equivalent capacitance of IC which is calculated from the operating current consumption without load.
Average operating current can be obtained by the equation:

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

Analog Switch Characteristics (Ta = 25°C) (Note)

Characteristics	Test Condition		V_{CC} (V)	Typ.	Unit
Sine Wave Distortion (T.H.D)	R_L = 10 kΩ, C_L = 50 pF, f_{IN} = 1 kHz	V_{IN} = 2.0 V_{p-p}	3.0	0.1	%
		V_{IN} = 4.0 V_{p-p}	4.5	0.03	
Frequency response (switch ON)	V_{IN} is centered at (V_{CC}/2). Adjust input for 0dBm. Increase f_{IN} frequency until dB meter reads −3dB. R_L = 50 Ω, C_L = 10 pF, sine wave Figure 3		3.0	250	MHz
			4.5	290	
Feed through attenuation (switch OFF)	V_{IN} is centered at (V_{CC}/2). Adjust input for 0dBm. R_L = 600 Ω, C_L = 50 pF, f_{IN} = 1 MHz, sine wave Figure 4		3.0	-45	dB
			4.5	-45	
	R_L = 50 Ω, C_L = 10 pF, f_{IN} = 1 MHz, sine wave		3.0	-65	
			4.5	-65	
Crosstalk (control input to signal output)	R_L = 600 Ω, C_L = 50 pF, f_{IN} = 1 MHz, square wave (t_r = t_f = 6 ns) Figure 5		3.0	60	mV
			4.5	100	
Crosstalk (between any switches)	VIN is centered at (VCC/2). Adjust input for 0dBm. R_L = 600 Ω, C_L = 50 pF, f_{IN} = 1 MHz, sine wave Figure 6		3.0	-45	dB
			4.5	-45	

Note: These characteristics are determined by design of devices.

AC Test Circuit

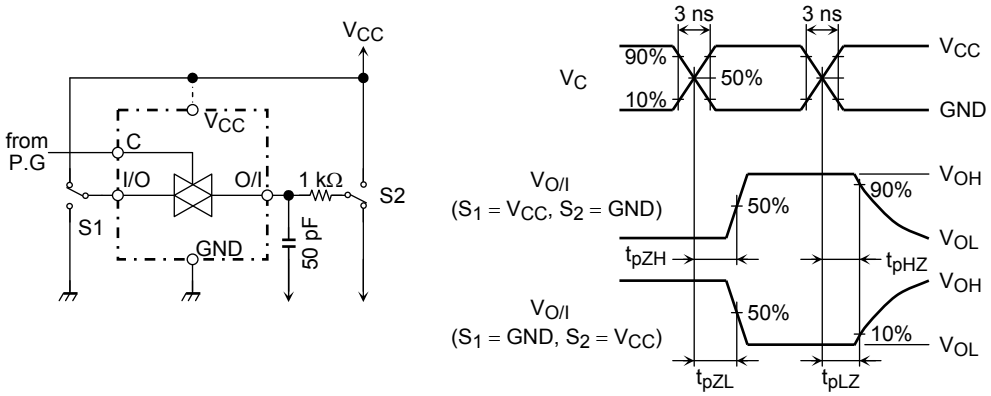


Figure 1 t_{pLZ}, t_{pHZ}, t_{pZL}, t_{pZH}

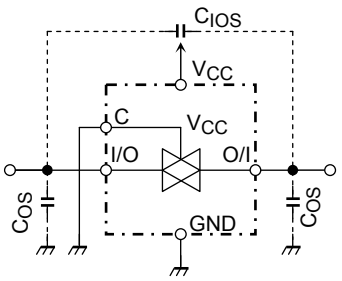


Figure 2 C_{IOS}, C_{OS}

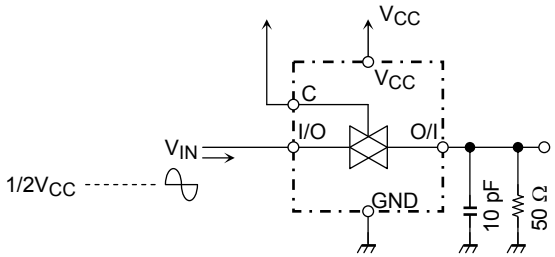


Figure 3 Frequency Response (switch on)

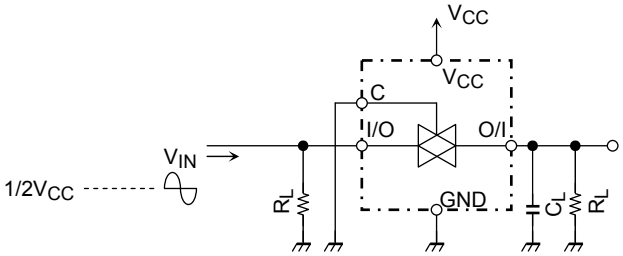


Figure 4 Feedthrough

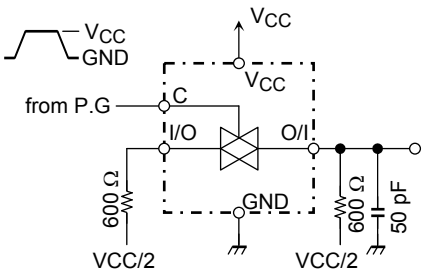


Figure 5 Cross Talk (control input to output signal)

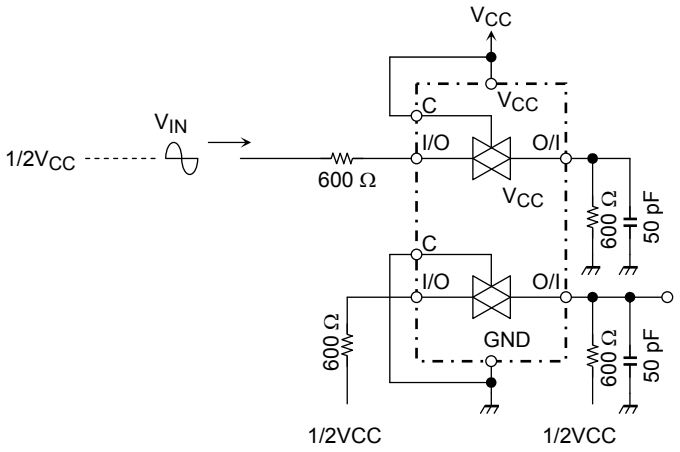
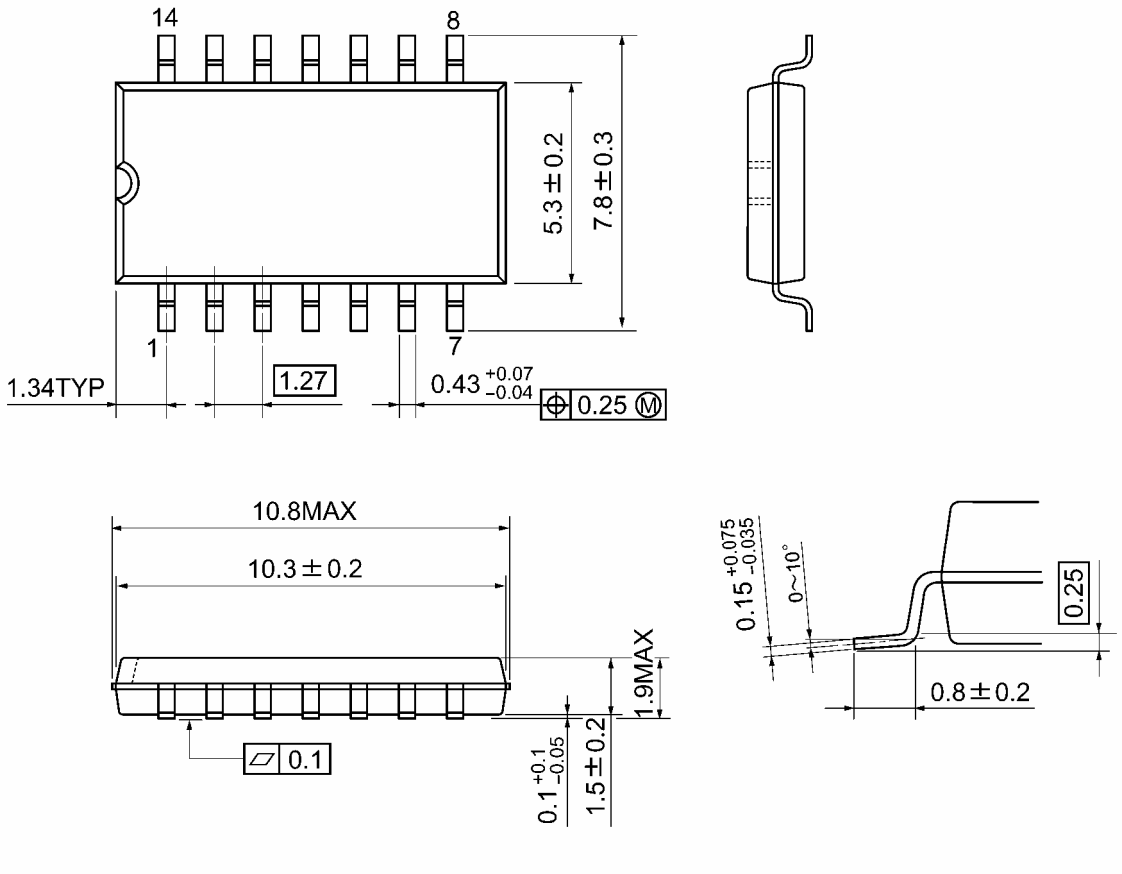


Figure 6 Cross Talk (between any two switches)

Package Dimensions

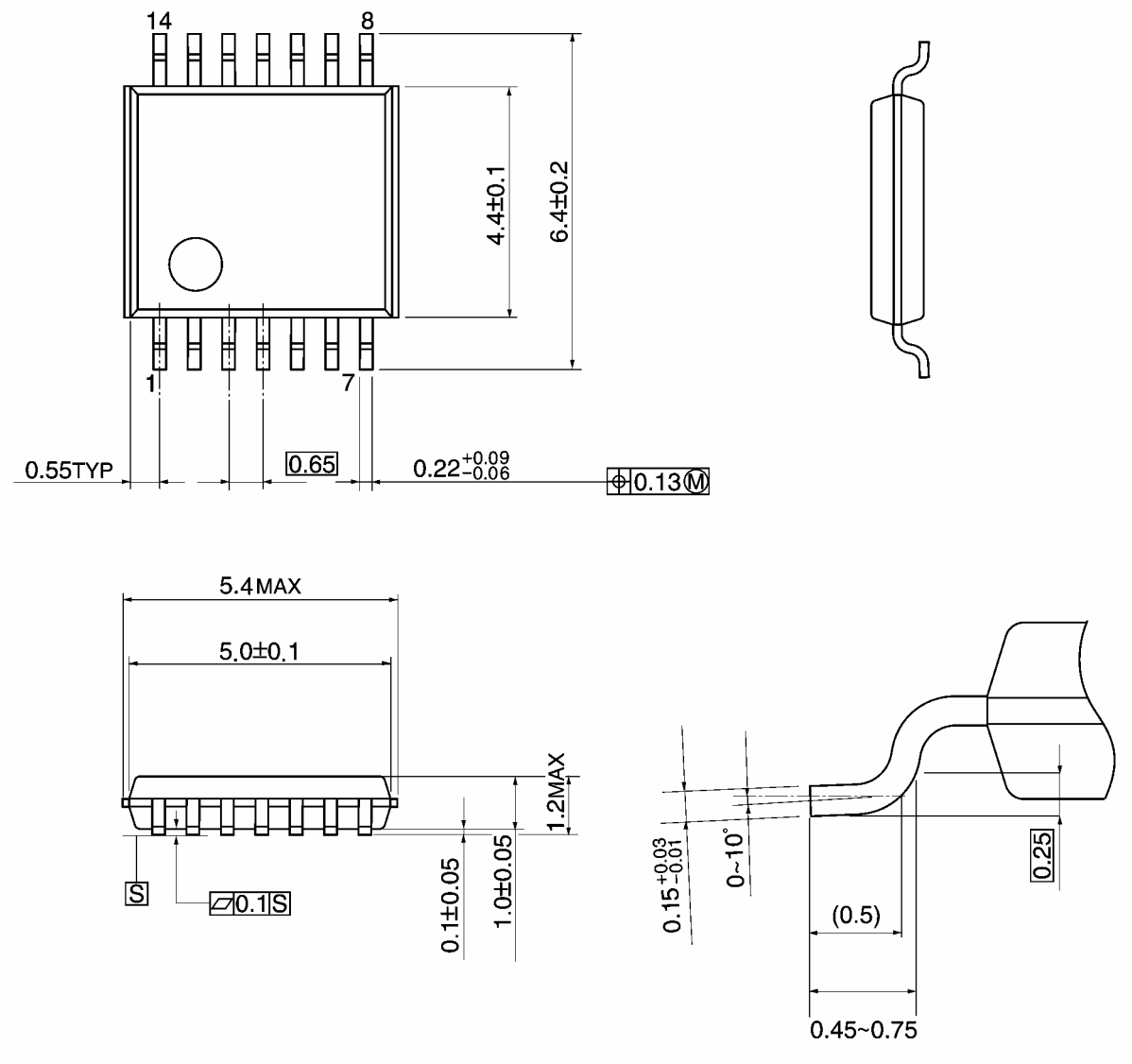
SOP14-P-300-1.27A Unit: mm



Weight: 0.18 g (typ.)

Package Dimensions

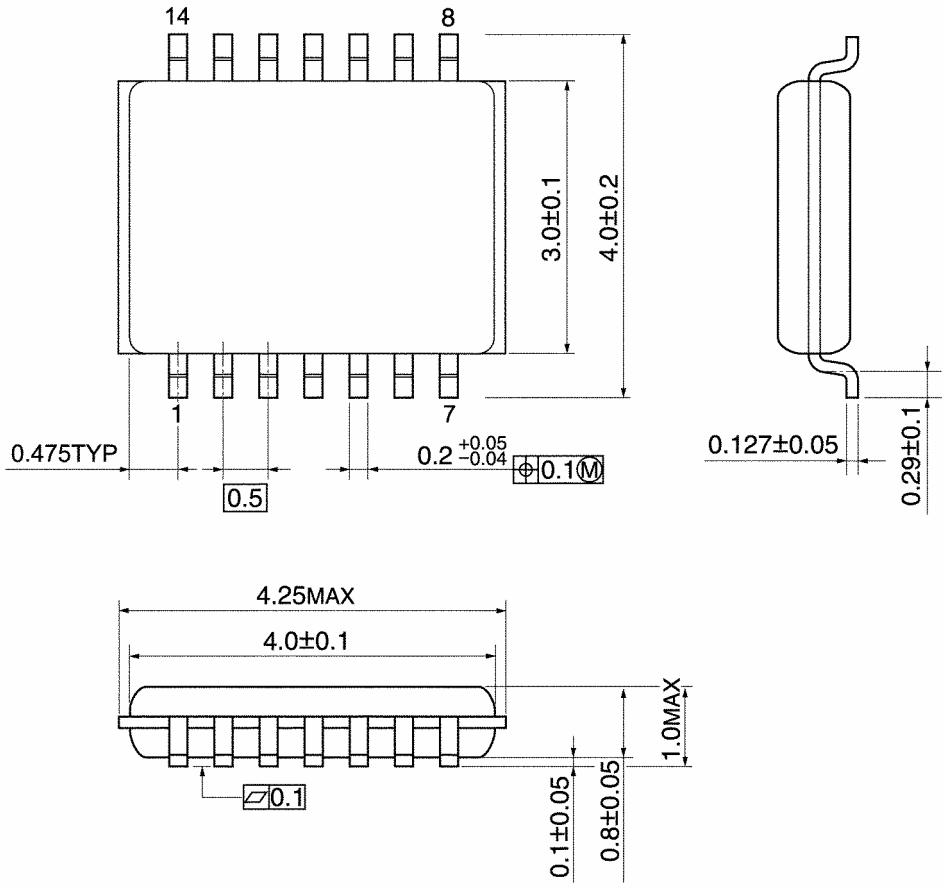
TSSOP14-P-0044-0.65A Unit: mm



Weight: 0.06 g (typ.)

Package Dimensions

VSSOP14-P-0030-0.50 Unit: mm



Weight: 0.02 g (typ.)

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