

## TC74VHC4066AF, TC74VHC4066AFT, TC74VHC4066AFK

### Quad Bilateral Switch

The TC74VHC4066A is high-speed, low-voltage drive QUAD BILATERAL SWITCH fabricated with silicon gate C<sup>2</sup>MOS 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.

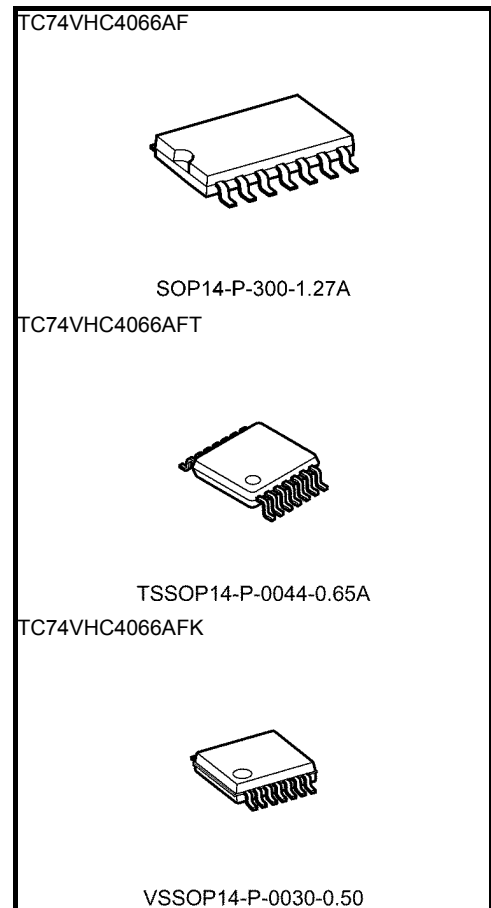
It consists of four independent high speed switches capable of controlling either digital or analog signals while maintaining the CMOS low power dissipation.

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<sub>CC</sub>). 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.

### Features

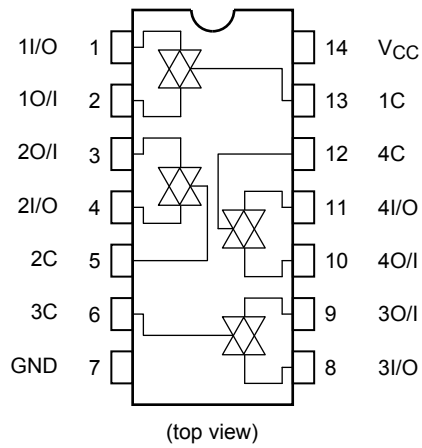
- Low ON resistance:  $R_{on} = 45 \Omega$  (typ.) ( $V_{CC} = 3.0 V$ )  
 $R_{on} = 24 \Omega$  (typ.) ( $V_{CC} = 4.5 V$ )
- Low power dissipation:  $I_{CC} = 2.0 \mu A$  (max) ( $T_a = 25^\circ C$ )
- Input level:  $V_{IL} = 0.8 V$  (max) ( $V_{CC} = 3 V$ )  
 $V_{IH} = 2.0 V$  (min) ( $V_{CC} = 3 V$ )
- Power down protection is provided on all control inputs



#### 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.)

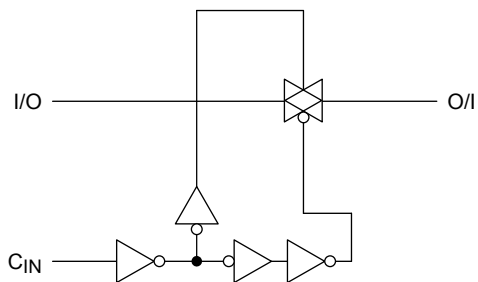
## Pin Assignment (top view)



## 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 to 7.0	V
Control input voltage	$V_{IN}$	-0.5 to 7.0	V
Switch I/O voltage	$V_{I/O}$	-0.5 to $V_{CC} + 0.5$	V
Input diode current	$I_{IK}$	-20	mA
I/O diode current	$I_{I/OK}$	$\pm 25$	mA
Switch through current	$I_T$	$\pm 25$	mA
DC $V_{CC}$ or ground current	$I_{CC}$	$\pm 50$	mA
Power dissipation	$P_D$	180	mW
Storage temperature	$T_{stg}$	-65 to 150	$^{\circ}C$

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 to 5.5	V
Input voltage	$V_{IN}$	0 to 5.5	V
Switch I/O voltage	$V_{I/O}$	0 to $V_{CC}$	V
Operating temperature	$T_{opr}$	-40 to 85	$^{\circ}C$
Input rise and fall time	dt/dv	0 to 200 ( $V_{CC} = 2.5 \pm 0.2$ V) 0 to 100 ( $V_{CC} = 3.3 \pm 0.3$ V) 0 to 20 ( $V_{CC} = 5 \pm 0.5$ 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 to 85°C		Unit	
				V <sub>CC</sub> (V)	Min	Typ.	Max	Min		Max
Input voltage	High level	V <sub>IH</sub>	—	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 <sub>IL</sub>	—	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 <sub>ON</sub>	V <sub>IN</sub> = V <sub>IH</sub> V <sub>I/O</sub> = V <sub>CC</sub> to GND I <sub>I/O</sub> = 2 mA	2.3	—	200	—	—	—	Ω	
			3.0	—	45	86	—	108		
			4.5	—	24	37	—	46		
		V <sub>IN</sub> = V <sub>IH</sub> V <sub>I/O</sub> = V <sub>CC</sub> or GND I <sub>I/O</sub> = 2 mA	2.3	—	28	73	—	84		
			3.0	—	22	38	—	44		
			4.5	—	17	27	—	31		
Difference of ON resistance between switches	ΔR <sub>ON</sub>	V <sub>IN</sub> = V <sub>IH</sub> V <sub>I/O</sub> = V <sub>CC</sub> to GND I <sub>I/O</sub> = 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 <sub>OFF</sub>	V <sub>OS</sub> = V <sub>CC</sub> or GND V <sub>IS</sub> = GND to V <sub>CC</sub> V <sub>IN</sub> = V <sub>IL</sub>	5.5	—	—	±0.1	—	±1.0	μA	
Input/Output leakage current (switch ON, output open)	I <sub>I/O</sub>	V <sub>OS</sub> = V <sub>CC</sub> or GND V <sub>IN</sub> = V <sub>IH</sub>	5.5	—	—	±0.1	—	±1.0	μA	
Control input current	I <sub>IN</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND	5.5	—	—	±0.1	—	±1.0	μA	
Quiescent supply current	I <sub>CC</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND	5.5	—	—	2.0	—	20.0	μA	

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

Characteristics	Symbol	Test Condition	Ta = 25°C			Ta = -40 to 85°C		Unit		
			V <sub>CC</sub> (V)	Min	Typ.	Max	Min		Max	
Phase difference between input and output	$\phi$ I/O	C <sub>L</sub> = 15 pF R <sub>L</sub> = 1 k $\Omega$	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 <sub>L</sub> = 50 pF R <sub>L</sub> = 1 k $\Omega$	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 <sub>L</sub> = 15 pF R <sub>L</sub> = 1 k $\Omega$	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 <sub>L</sub> = 50 pF R <sub>L</sub> = 1 k $\Omega$	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 <sub>L</sub> = 15 pF R <sub>L</sub> = 1 k $\Omega$	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 <sub>L</sub> = 50 pF R <sub>L</sub> = 1 k $\Omega$	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 <sub>IN</sub>	All types	—	—	3	—	—	—	pF	
SWITCH terminal capacitance	C <sub>OS</sub>	Figure 2	—	—	5.5	—	—	—	pF	
Feed through capacitance	C <sub>IOS</sub>	Figure 2	—	—	0.5	—	—	—	pF	
Power dissipation capacitance	C <sub>PD</sub>	Figure 2 (Note )	—	—	4.5	—	—	—	pF	

Note: C<sub>PD</sub> 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:

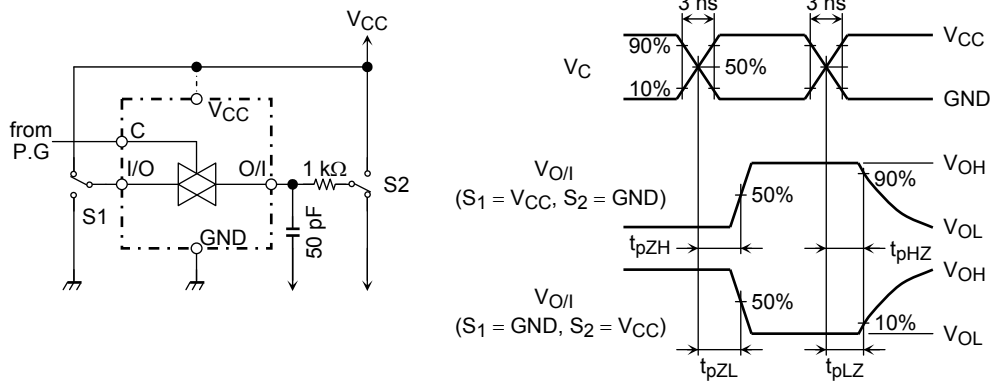
$$I_{CC (opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$$

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

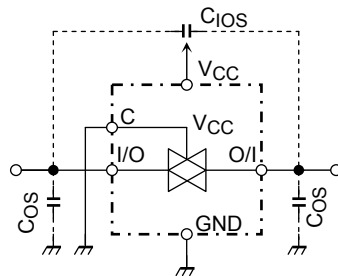
Characteristics	Test Condition	V <sub>CC</sub> (V)	Typ.	Unit	
Sine Wave Distortion (T.H.D)	R <sub>L</sub> = 10 kΩ, C <sub>L</sub> = 50 pF, f <sub>IN</sub> = 1 kHz	V <sub>IN</sub> = 2.0 V <sub>p-p</sub>	3.0	0.1	%
		V <sub>IN</sub> = 4.0 V <sub>p-p</sub>	4.5	0.03	
Frequency response (switch ON)	V <sub>IN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

Note: These characteristics are determined by design of devices.

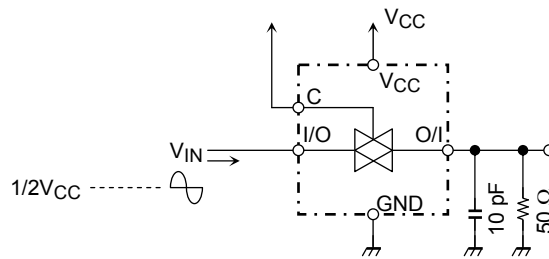
**AC Test Circuit**



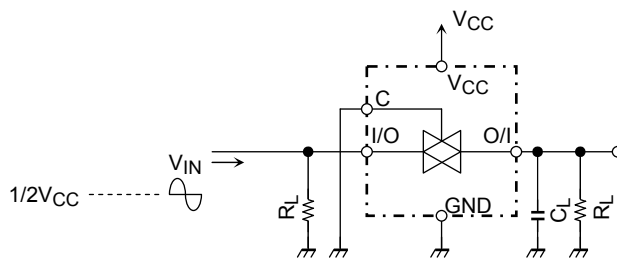
**Figure 1**  $t_{pLZ}$ ,  $t_{pHZ}$ ,  $t_{pZL}$ ,  $t_{pZH}$



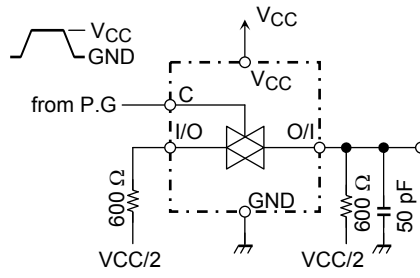
**Figure 2**  $C_{10S}$ ,  $C_{0S}$



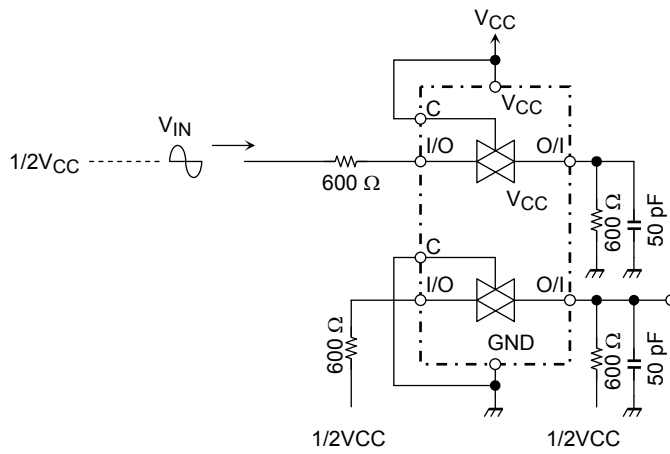
**Figure 3** Frequency Response (switch on)



**Figure 4** Feedthrough



**Figure 5 Cross Talk (control input to output signal)**



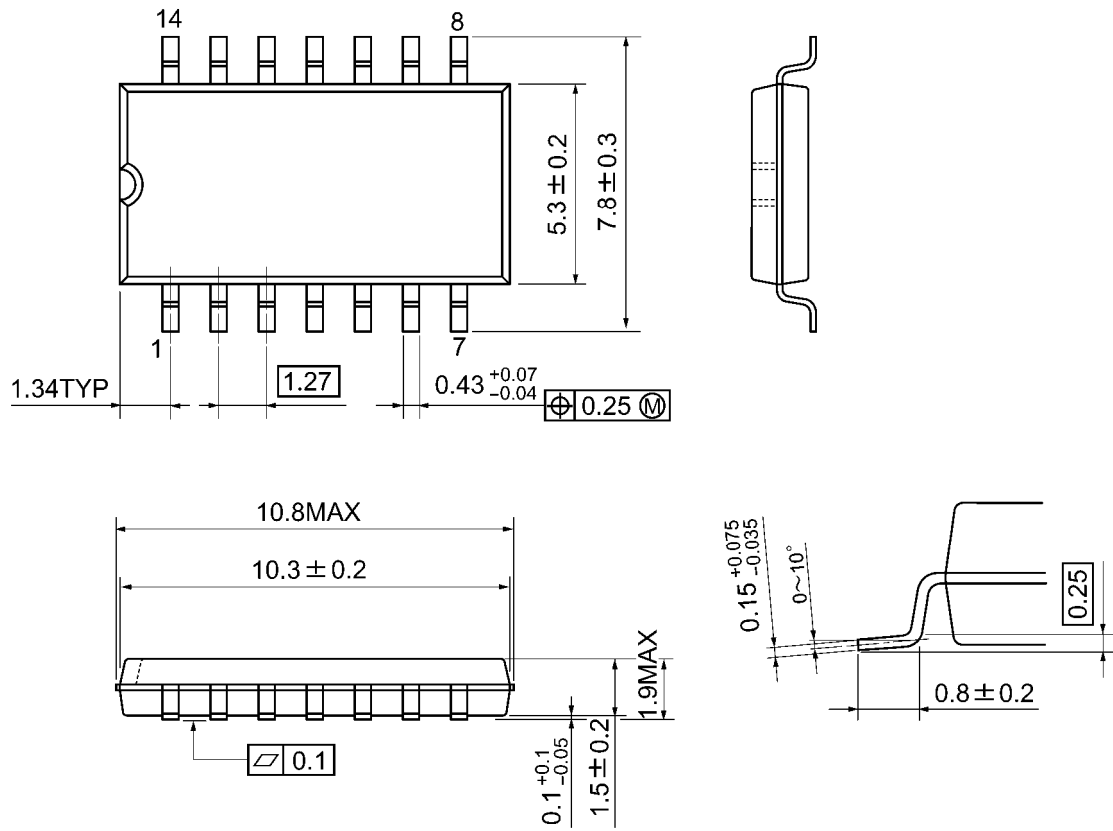
**Figure 6 Cross Talk (between any two switches)**



## Package Dimensions

SOP14-P-300-1.27A

Unit: mm

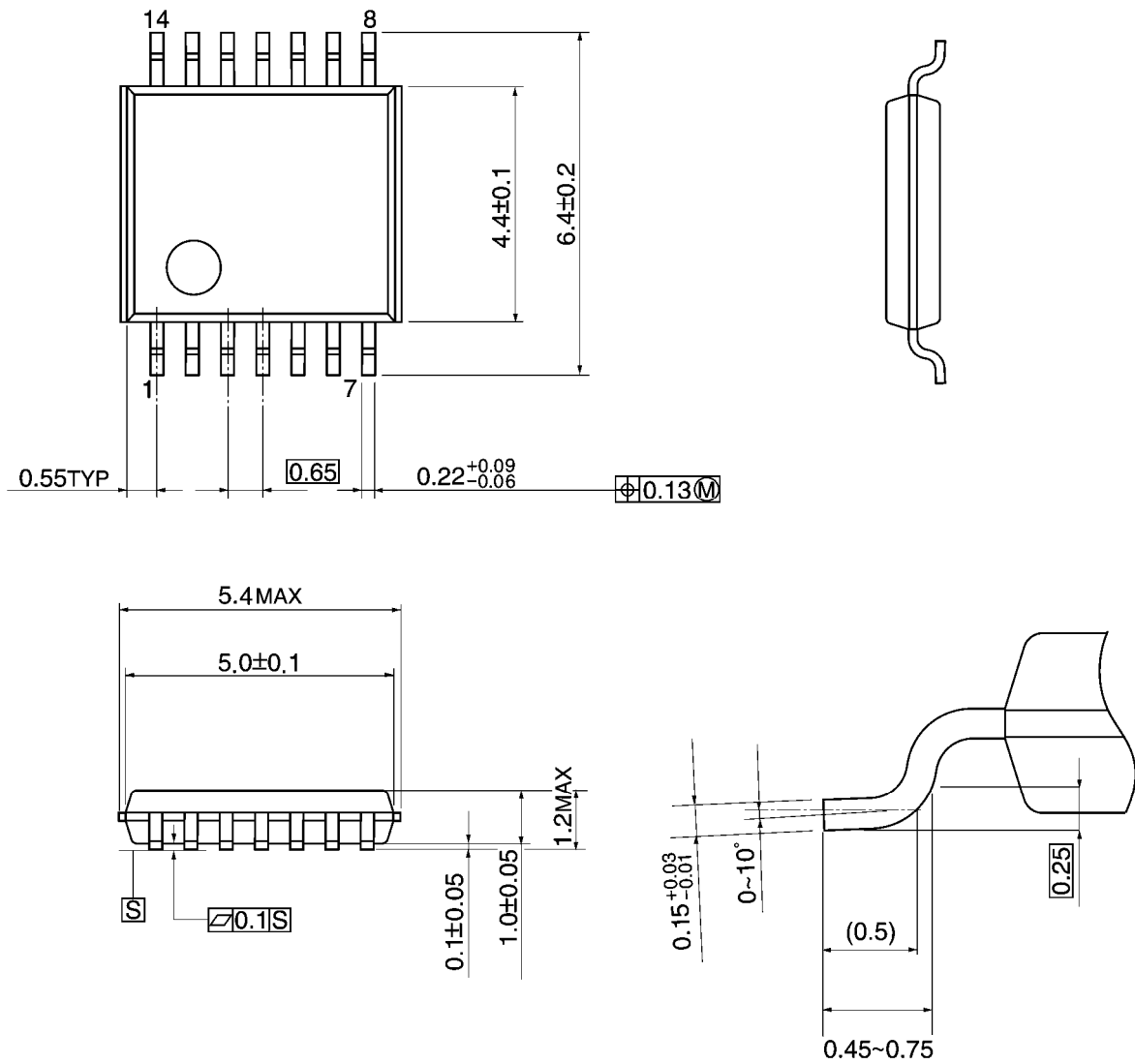


Weight: 0.18 g (typ.)

**Package Dimensions**

TSSOP14-P-0044-0.65A

Unit: mm

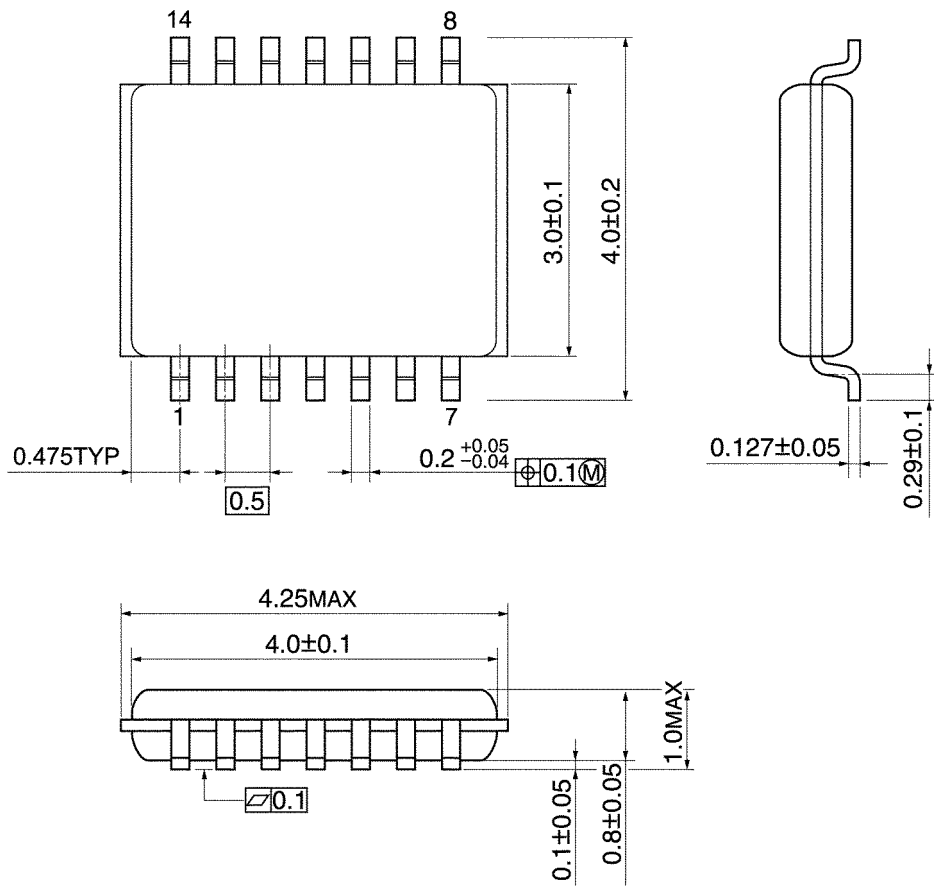


Weight: 0.06 g (typ.)

## Package Dimensions

VSSOP14-P-0030-0.50

Unit: mm



Weight: 0.02 g (typ.)

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