

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

## TC74HC4066AP, TC74HC4066AF, TC74HC4066AFN, TC74HC4066AFT

### Quad Bilateral Switch

The TC74HC4066A is a high speed CMOS QUAD BILATERAL SWITCH fabricated with silicon gate C<sup>2</sup>MOS technology.

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

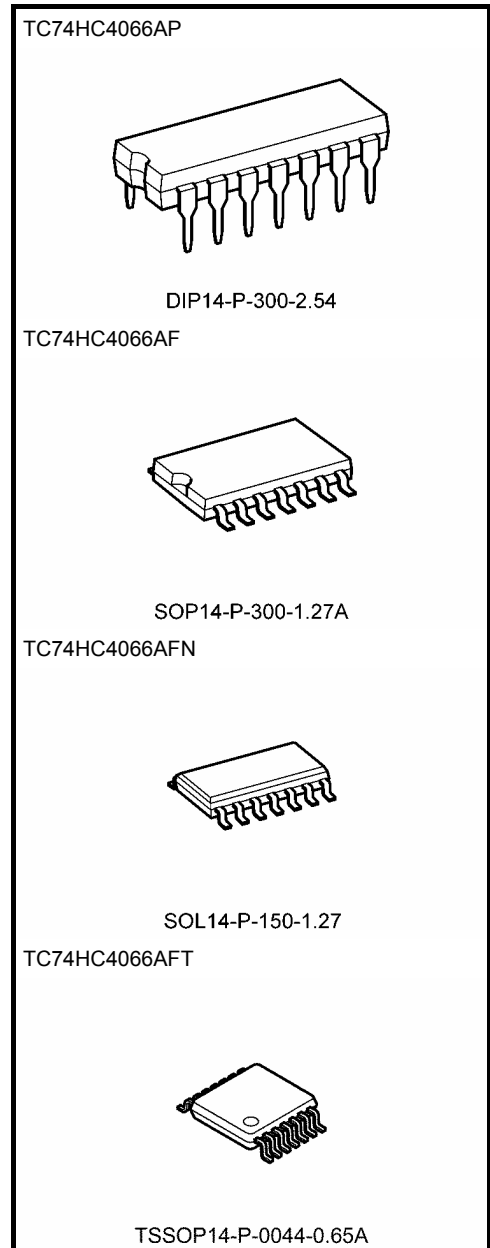
Control input (C) is provided to control the switch. The switch turns ON while the C input is high, and the switch turns OFF while low.

All inputs are equipped with protection circuits against static discharge or transient excess voltage.

### Features

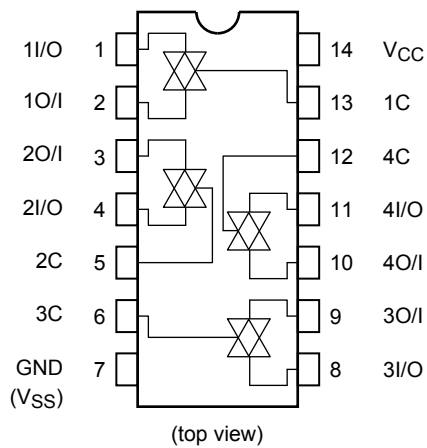
- High speed:  $t_{pd} = 7 \text{ ns (typ.)}$  at  $V_{CC} = 5 \text{ V}$
- Low power dissipation:  $I_{CC} = 1 \mu\text{A (max)}$  at  $T_a = 25^\circ\text{C}$
- High noise immunity:  $V_{NIH} = V_{NIL} = 28\% V_{CC}$  (min)
- Low on resistance:  $R_{ON} = 50 \Omega$  (typ.) at  $V_{CC} = 9 \text{ V}$
- High degree of linearity:  $\text{THD} = 0.05\%$  (typ.) at  $V_{CC} = 5 \text{ V}$
- Pin and function compatible with 4066B

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

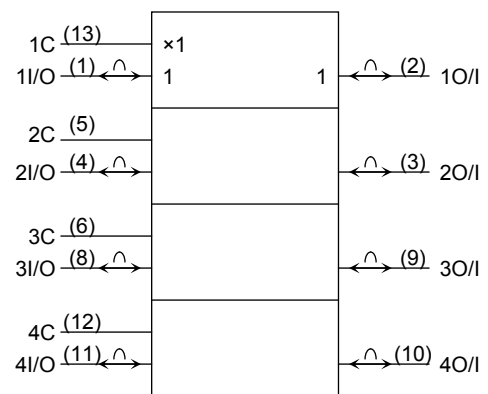


Weight	
DIP14-P-300-2.54	: 0.96 g (typ.)
SOP14-P-300-1.27A	: 0.18 g (typ.)
SOL14-P-150-1.27	: 0.12 g (typ.)
TSSOP14-P-0044-0.65A	: 0.06 g (typ.)

## Pin Assignment



## IEC Logic Symbol



## Truth Table

Control	Switch Function
H	On
L	Off

## Absolute Maximum Ratings (Note 1)

Characteristics	Symbol	Rating	Unit
Supply voltage range	$V_{CC}$	-0.5 to 13	V
Control input voltage	$V_{IN}$	-0.5 to $V_{CC} + 0.5$	V
Switch I/O voltage	$V_{I/O}$	-0.5 to $V_{CC} + 0.5$	V
Control input diode current	$I_{IK}$	$\pm 20$	mA
I/O diode current	$I_{OK}$	$\pm 20$	mA
Switch through Current	$I_{OUT}$	$\pm 25$	mA
DC $V_{CC}$ /ground current	$I_{CC}$	$\pm 50$	mA
Power dissipation	$P_D$	500 (DIP) (Note 2)/180 (SOP/TSSOP)	mW
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 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: 500 mW in the range of  $T_a = -40$  to  $65^{\circ}C$ . From  $T_a = 65$  to  $85^{\circ}C$  a derating factor of  $-10$  mW/ $^{\circ}C$  should be applied up to 300 mW.

## Operating Ranges (Note)

Characteristics	Symbol	Rating	Unit
Supply voltage	$V_{CC}$	2 to 12	V
Control input voltage	$V_{IN}$	0 to $V_{CC}$	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	$t_r, t_f$	0 to 1000 ( $V_{CC} = 2.0$ V) 0 to 500 ( $V_{CC} = 4.5$ V) 0 to 400 ( $V_{CC} = 6.0$ V) 0 to 250 ( $V_{CC} = 10.0$ V)	ns

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

## Electrical Characteristics

### DC Characteristics

Characteristics	Symbol	Test Condition	V <sub>CC</sub> (V)	Ta = 25°C			Ta = -40 to 85°C		Unit
				Min	Typ.	Max	Min	Max	
High-level control input voltage	V <sub>IHC</sub>	—	2.0	1.50	—	—	1.50	—	V
			4.5	3.15	—	—	3.15	—	
			9.0	6.30	—	—	6.30	—	
			12.0	8.40	—	—	8.40	—	
Low-level control input voltage	V <sub>ILC</sub>	—	2.0	—	—	0.50	—	0.50	V
			4.5	—	—	1.35	—	1.35	
			9.0	—	—	2.70	—	2.70	
			12.0	—	—	3.60	—	3.60	
On resistance	R <sub>ON</sub>	V <sub>IN</sub> = V <sub>IHC</sub> V <sub>I/O</sub> = V <sub>CC</sub> to GND I <sub>I/O</sub> ≤ 1 mA	4.5	—	96	170	—	200	Ω
			9.0	—	55	85	—	100	
			12.0	—	45	80	—	90	
		V <sub>IN</sub> = V <sub>IHC</sub> V <sub>I/O</sub> = V <sub>CC</sub> or GND I <sub>I/O</sub> ≤ 1 mA	2.0	—	160	—	—	—	
			4.5	—	70	100	—	130	
			9.0	—	50	75	—	95	
Difference of on resistance between switches	ΔR <sub>ON</sub>	V <sub>IN</sub> = V <sub>IHC</sub> V <sub>I/O</sub> = V <sub>CC</sub> to GND I <sub>I/O</sub> ≤ 1 mA	4.5	—	10	—	—	—	Ω
			9.0	—	5	—	—	—	
			12.0	—	5	—	—	—	
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 or V <sub>CC</sub> V <sub>IN</sub> = V <sub>ILC</sub>	12.0	—	—	±100	—	±1000	nA
Switch input leakage current (switch on, output open)	I <sub>Iz</sub>	V <sub>OS</sub> = V <sub>CC</sub> or GND V <sub>IN</sub> = V <sub>IHC</sub>	12.0	—	—	±100	—	±1000	nA
Control input current	I <sub>IN</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND	12.0	—	—	±100	—	±1000	nA
Quiescent supply current	I <sub>CC</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND	6.0	—	—	1.0	—	10.0	μA
			9.0	—	—	4.0	—	40.0	
			12.0	—	—	8.0	—	80.0	

## AC Characteristics ( $C_L = 50 \text{ pF}$ , input: $t_r = t_f = 6 \text{ ns}$ )

Characteristics	Symbol	Test Condition	Ta = 25°C			Ta = -40 to 85°C		Unit	
			VCC (V)	Min	Typ.	Max	Min		Max
Phase difference between input and output	$\phi_{I-O}$	—	2.0	—	10	50	—	65	pF
			4.5	—	4	10	—	13	
			9.0	—	3	8	—	10	
			12.0	—	3	7	—	9	
Output enable time	$t_{pZL}$ $t_{pZH}$	$R_L = 1 \text{ k}\Omega$	2.0	—	18	100	—	125	pF
			4.5	—	8	20	—	25	
			9.0	—	6	12	—	22	
			12.0	—	6	12	—	18	
Output disable time	$t_{pLZ}$ $t_{pHZ}$	$R_L = 1 \text{ k}\Omega$	2.0	—	20	115	—	145	pF
			4.5	—	10	23	—	29	
			9.0	—	8	20	—	25	
			12.0	—	8	18	—	22	
Maximum control input frequency		$R_L = 1 \text{ k}\Omega$ $C_L = 15 \text{ pF}$ $V_{OUT} = 1/2 V_{CC}$	2.0	—	30	—	—	—	MHz
			4.5	—	30	—	—	—	
			9.0	—	30	—	—	—	
			12.0	—	30	—	—	—	
Control input capacitance	$C_{IN}$	—	—	5	10	—	10	pF	
Switch terminal capacitance	$C_{I/O}$	—	—	6	—	—	—	pF	
Feed through capacitance	$C_{IOS}$	—	—	0.5	—	—	—	pF	
Power dissipation capacitance	$C_{PD}$	(Note)	—	15	—	—	—	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:

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

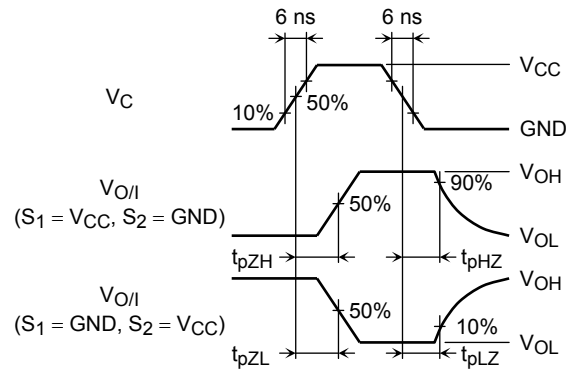
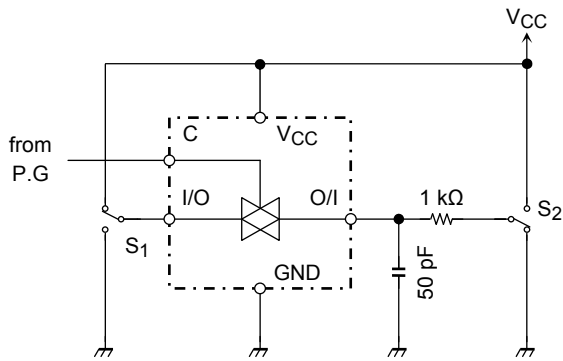
**Analog Switch Characteristics (GND = 0 V, Ta = 25°C) (Note)**

Characteristics	Symbol	Test Condition	V <sub>CC</sub>	Typ.	Unit
			(V)		
Sine wave distortion (T.H.D)		f <sub>IN</sub> = 1 kHz, V <sub>IN</sub> = 4 V <sub>p-p</sub> , @V <sub>CC</sub> = 4.5 V R <sub>L</sub> = 10 kΩ, V <sub>IN</sub> = 8 V <sub>p-p</sub> , @V <sub>CC</sub> = 9.0 V C <sub>L</sub> = 50 pF	4.5	0.05	%
			9.0	0.04	
Frequency response (switch on)	f <sub>max</sub>	Adjust f <sub>IN</sub> voltage to obtain 0dBm at V <sub>OS</sub> Increase f <sub>IN</sub> frequency until dB meter reads -3dB R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 10 pF f <sub>IN</sub> = 1 MHz, sine wave	4.5	200	MHz
			9.0	200	
Feedthrough 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	4.5	-60	dB
			9.0	-60	
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)	4.5	60	mV
			9.0	100	
Crosstalk (between any switches)		Adjust V <sub>IN</sub> to obtain 0dBm at input R <sub>L</sub> = 600 Ω, C <sub>L</sub> = 50 pF f <sub>IN</sub> = 1 MHz, sine wave	4.5	-60	dB
			9.0	-60	

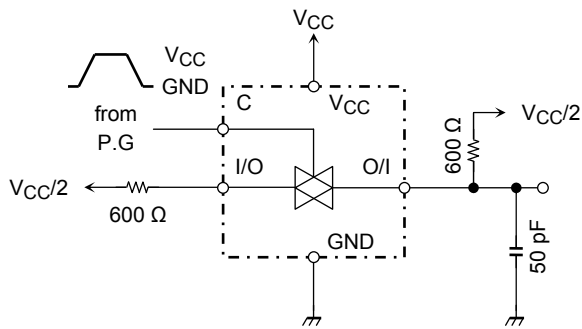
Note: These characteristics are determined by design of devices.

## Switching Characteristics Test Circuits

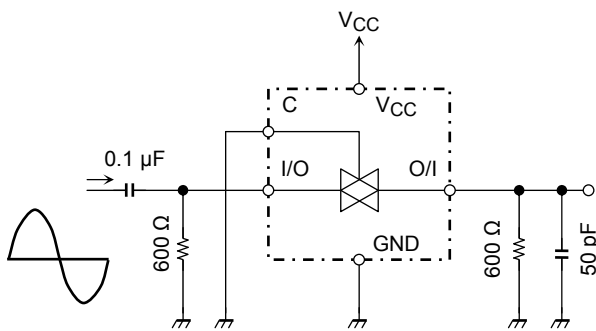
### 1. $t_{pLZ}$ , $t_{pHZ}$ , $t_{pZL}$ , $t_{pZH}$



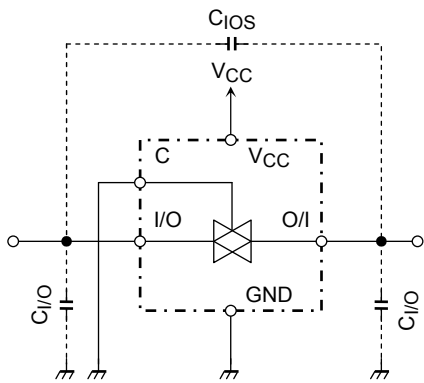
### 2. Cross Talk (control input-switch output) $f_{IN} = 1 \text{ MHz}$ duty = 50% $t_r = t_f = 6 \text{ ns}$



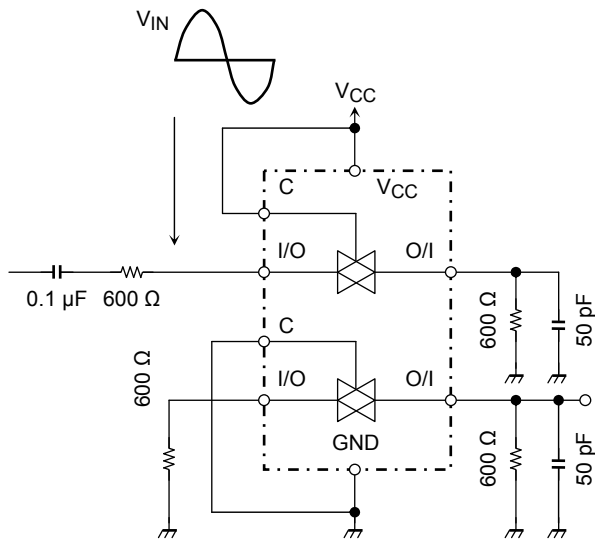
### 3. Feedthrough Attenuation



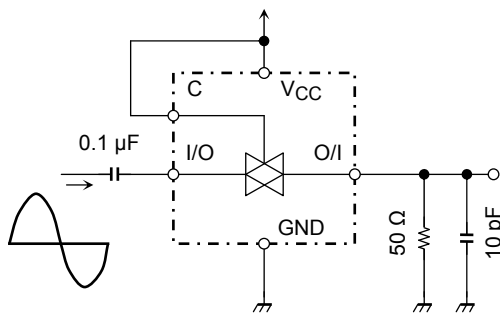
**4. C<sub>I/O</sub>, C<sub>I/O</sub>**



**5. Crosstalk (between any two switches)**



**6. Frequency Response (switch on)**

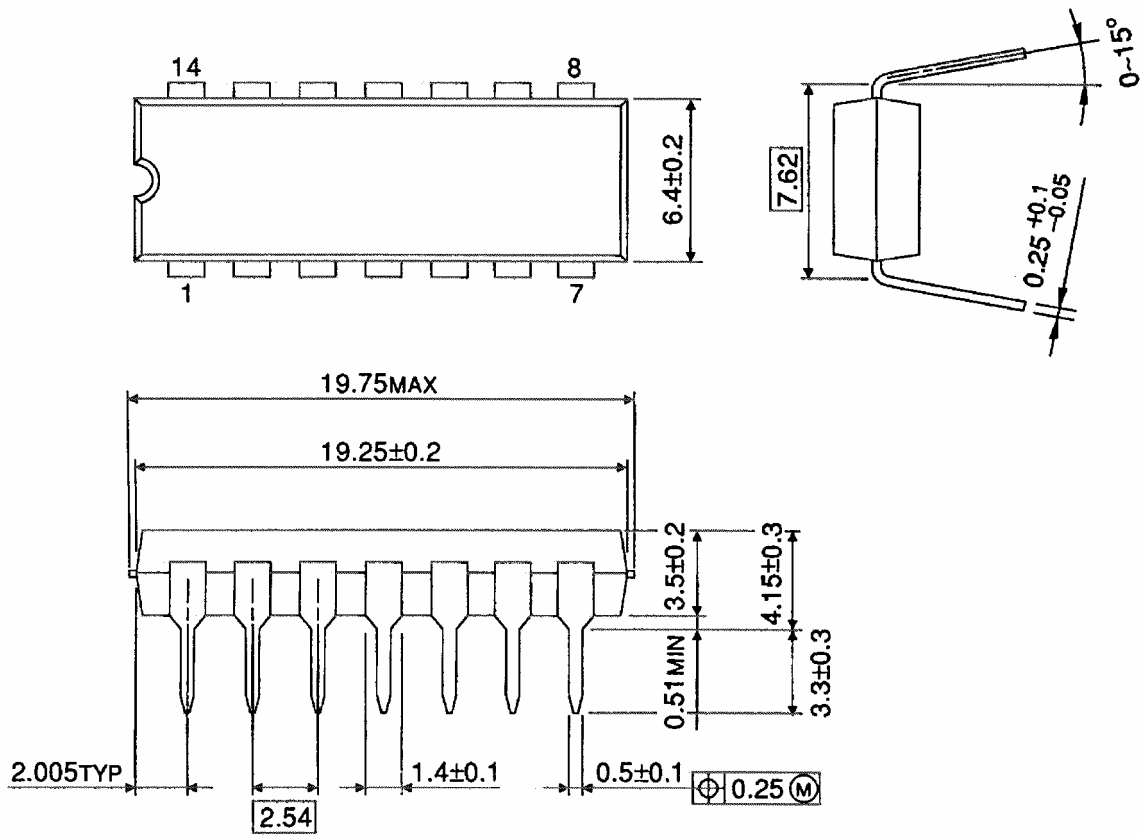




## Package Dimensions

DIP14-P-300-2.54

Unit : mm

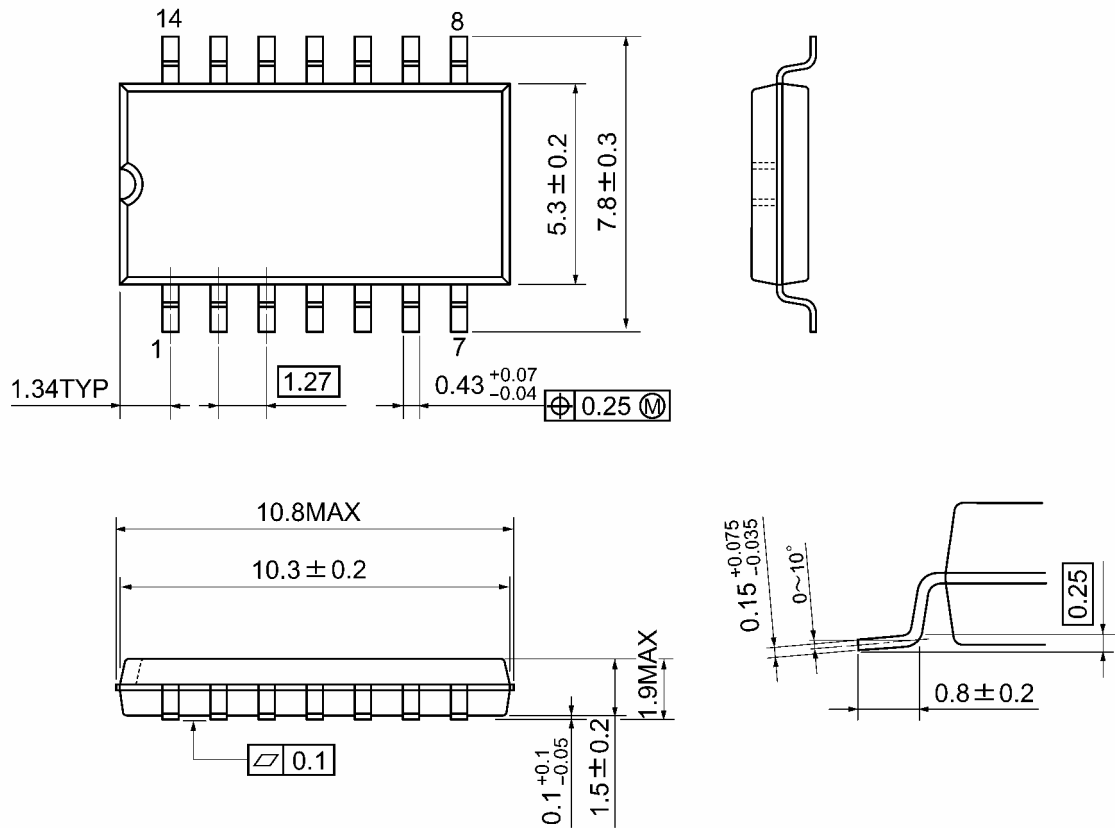


Weight: 0.96 g (typ.)

**Package Dimensions**

SOP14-P-300-1.27A

Unit: mm

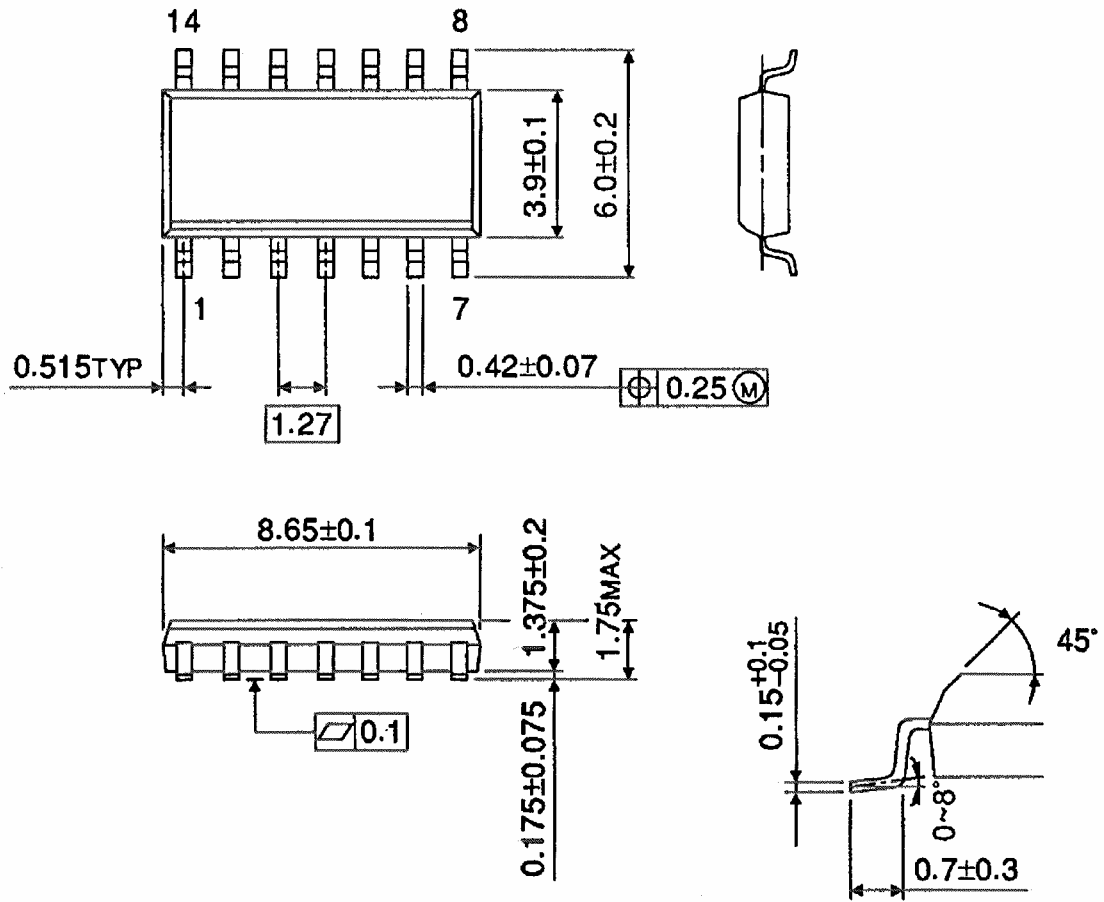


Weight: 0.18 g (typ.)

Package Dimensions (Note)

SOL14-P-150-1.27

Unit : mm



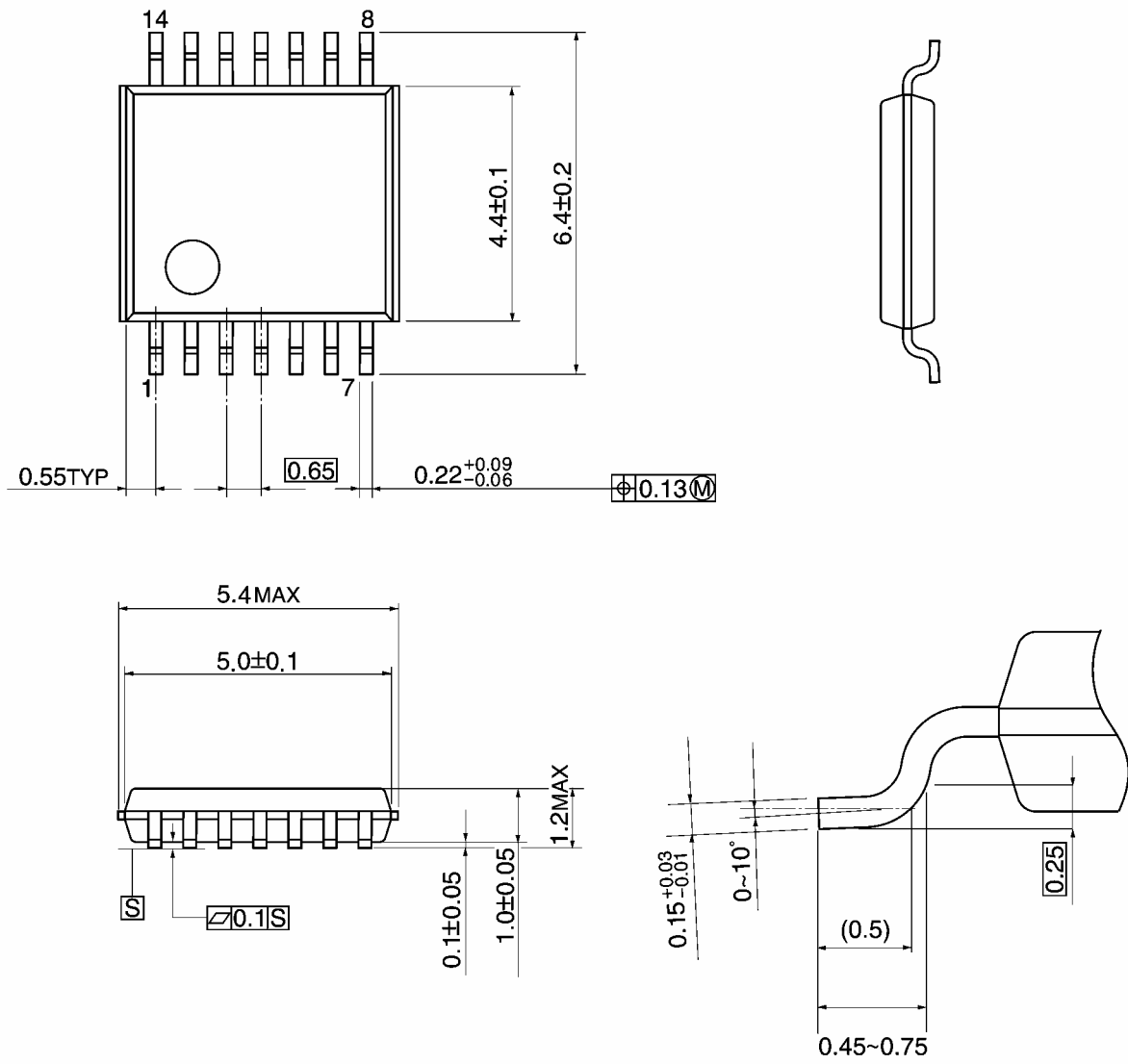
Note: This package is not available in Japan.

Weight: 0.12 g (typ.)

**Package Dimensions**

TSSOP14-P-0044-0.65A

Unit: mm



Weight: 0.06 g (typ.)

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20070701-EN GENERAL

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