

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

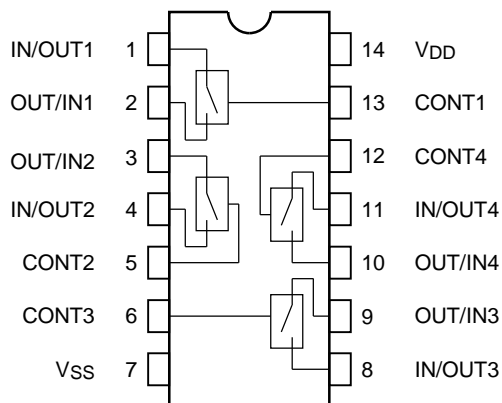
# TC4066BP, TC4066BF, TC4066BFT

## Quad Bilateral Switch

TC4066B contains four independent circuits of bidirectional switches. When control input CONT is set to "H" level, the impedance between input and output of the switch becomes low and when it is set to "L" level, the impedance becomes high. This can be applied for switching of analog signals and digital signals.

- ON-resistance,  $R_{on}$ 
  - 250  $\Omega$  (typ.) :  $V_{DD} - V_{SS} = 5\text{ V}$
  - 110  $\Omega$  (typ.) :  $V_{DD} - V_{SS} = 10\text{ V}$
  - 70  $\Omega$  (typ.) :  $V_{DD} - V_{SS} = 15\text{ V}$
- OFF-resistance,  $R_{off}$ 
  - $R_{off}$  (typ.)  $> 10^9\ \Omega$

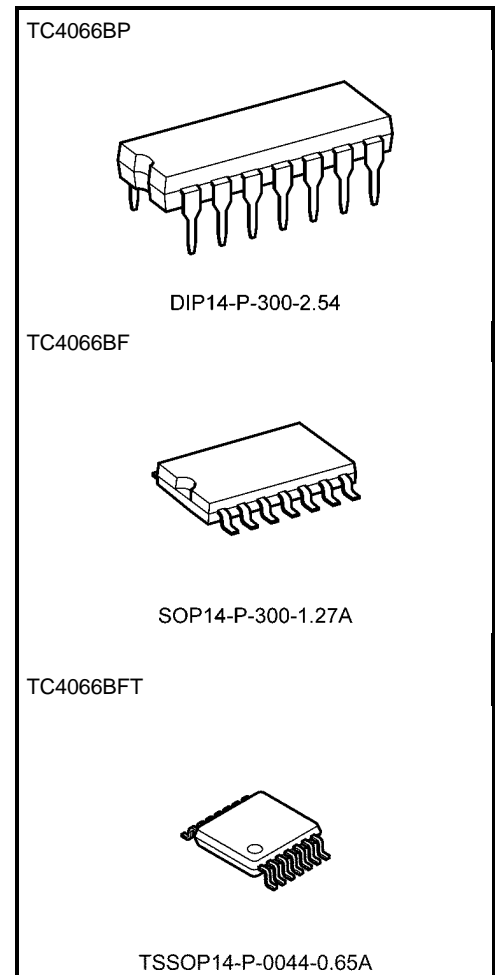
### Pin Assignment (top view)



### Truth Table

Control	Impedance between IN/OUT-OUT/IN (Note 1)
H	0.5 to $5 \times 10^2\ \Omega$
L	$> 10^9\ \Omega$

Note 1: See static electrical characteristics



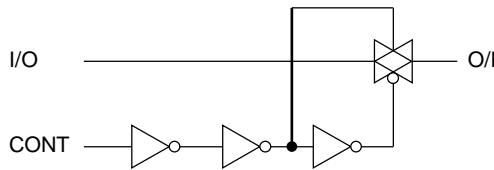
Weight

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

Start of commercial production  
1978-09

### Logic Diagram

1/4 TC4066B



### Absolute Maximum Ratings

Characteristics	Symbol	Rating	Unit
DC supply voltage	$V_{DD}$	$V_{SS} - 0.5$ to $V_{SS} + 20$	V
Control input voltage	$V_{CIN}$	$V_{SS} - 0.5$ to $V_{DD} + 0.5$	V
Switch I/O voltage	$V_I/V_O$	$V_{SS} - 0.5$ to $V_{DD} + 0.5$	V
Power dissipation	$P_D$	300 (DIP)/180 (SOP/TSSOP)	mW
Potential difference across I/O during ON	$V_I - V_O$	$\pm 0.5$	V
Control input current	$I_{CIN}$	$\pm 10$	mA
Operating temperature range	$T_{opr}$	-40 to 85	$^{\circ}C$
Storage temperature range	$T_{stg}$	-65 to 150	$^{\circ}C$

Note: 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.).

### Operating Ranges ( $V_{SS} = 0$ V)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
DC supply voltage	$V_{DD}$	—	3	—	18	V
Input/Output voltage	$V_{IN}/V_{OUT}$	—	0	—	$V_{DD}$	V

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

### Electrical Characteristics ( $V_{SS} = 0\text{ V}$ , unless specified otherwise)

Characteristics	Symbol	Test Condition	$V_{DD}$ (V)	-40°C		25°C			85°C		Unit	
				Min	Max	Min	Typ.	Max	Min	Max		
Control input high voltage	$V_{IH}$	$ I_{IS}  = 10\ \mu\text{A}$	5	3.5	—	3.5	2.75	—	3.5	—	V	
			10	7.0	—	7.0	5.50	—	7.0	—		
			15	11.0	—	11.0	8.25	—	11.0	—		
Control input low voltage	$V_{IL}$	$ I_{IS}  = 10\ \mu\text{A}$	5	—	1.5	—	2.25	1.5	—	1.5	V	
			10	—	3.0	—	4.50	3.0	—	3.0		
			15	—	4.0	—	6.75	4.0	—	4.0		
On-state resistance	$R_{ON}$	$0 \leq V_{IS} \leq V_{DD}$ $R_L = 10\ \text{k}\Omega$	5	—	800	—	290	950	—	1200	$\Omega$	
			10	—	210	—	120	250	—	300		
			15	—	140	—	85	160	—	200		
$\Delta$ On-state resistance (between any 2 switches)	$R_{ON\Delta}$	—	5	—	—	—	10	—	—	—	$\Omega$	
			10	—	—	—	6	—	—	—		
			15	—	—	—	4	—	—	—		
Input/output leakage current	$I_{OFF}$	$V_{IN} = 18\ \text{V}, V_{OUT} = 0\ \text{V}$	18	—	$\pm 100$	—	$\pm 0.1$	$\pm 100$	—	$\pm 1000$	nA	
		$V_{IN} = 0\ \text{V}, V_{OUT} = 18\ \text{V}$	18	—	$\pm 100$	—	$\pm 0.1$	$\pm 100$	—	$\pm 1000$		
Quiescent supply current	$I_{DD}$	$V_{IN} = V_{SS}, V_{DD}$ (Note 1)	5	—	0.25	—	0.001	0.25	—	7.5	$\mu\text{A}$	
			10	—	0.50	—	0.001	0.50	—	15.0		
			15	—	1.00	—	0.002	1.00	—	30.0		
Control Input current	"H" level	$I_{IH}$	$V_{IH} = 18\ \text{V}$	18	—	0.1	—	$10^{-5}$	0.1	—	1.0	$\mu\text{A}$
	"L" level	$I_{IL}$	$V_{IL} = 0\ \text{V}$	18	—	-0.1	—	$-10^{-5}$	-0.1	—	-1.0	

Note 1: All valid input combinations.

### Switching Characteristics (Ta = 25°C)

Characteristics	Symbol	Test Condition	Test Condition		Min	Typ.	Max	Unit
			V <sub>SS</sub> (V)	V <sub>DD</sub> (V)				
Phase difference between input to output	φ <sub>I-O</sub>	C <sub>L</sub> = 50 pF	0	5	—	15	40	ns
			0	10	—	8	20	
			0	15	—	5	15	
Propagation delay time (control-OUT)	t <sub>pZL</sub> t <sub>pZH</sub>	R <sub>L</sub> = 1 kΩ	0	5	—	55	120	ns
		C <sub>L</sub> = 50 pF	0	10	—	25	40	
			0	15	—	20	30	
Propagation delay time (control -OUT)	t <sub>pLZ</sub> t <sub>pHZ</sub>	R <sub>L</sub> = 1 kΩ	0	5	—	45	80	ns
		C <sub>L</sub> = 50 pF	0	10	—	30	70	
			0	15	—	25	60	
Max control input repetition rate	f <sub>max</sub> (C)	R <sub>L</sub> = 1 kΩ	0	5	—	10	—	MHz
		C <sub>L</sub> = 50 pF	0	10	—	12	—	
			0	15	—	12	—	
-3dB cutoff frequency	f <sub>max</sub> (I-O)	R <sub>L</sub> = 1 kΩ C <sub>L</sub> = 15 pF (Note 1)	-5	5	—	30	—	MHz
Total harmonic distortion	—	R <sub>L</sub> = 10 kΩ f = 1 kHz (Note 2)	-5	5	—	0.03	—	%
-50dB feed through frequency	—	R <sub>L</sub> = 1 kΩ (Note 3)	-5	5	—	600	—	kHz
-50dB crosstalk frequency	—	R <sub>L</sub> = 1 kΩ (Note 4)	-5	5	—	1	—	MHz
Crosstalk (control-OUT)	—	R <sub>IN</sub> = 1 kΩ R <sub>OUT</sub> = 10 kΩ C <sub>L</sub> = 15 pF	0	5	—	200	—	mV
			0	10	—	400	—	
			0	15	—	600	—	
Input capacitance	C <sub>IN</sub>	Control input	—	—	—	5	7.5	pF
		Switch I/O	—	—	—	10	—	
Feed through capacitance	C <sub>IN-OUT</sub>	—	—	—	—	0.5	—	pF

Note 1: Sine wave of ±2.5 V<sub>p-p</sub> shall be used for V<sub>IS</sub> and the frequency of  $20 \log_{10} \frac{V_{OS}}{V_{IS}} = -3 \text{ dB}$  shall be f<sub>max</sub>.

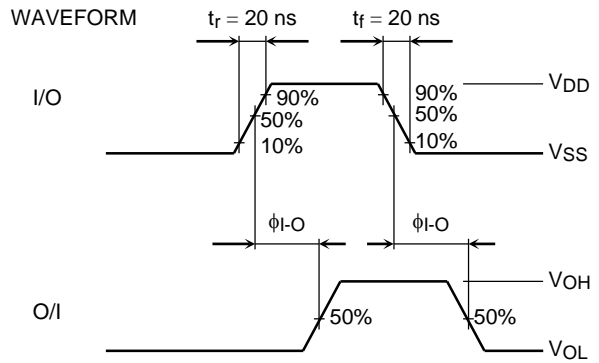
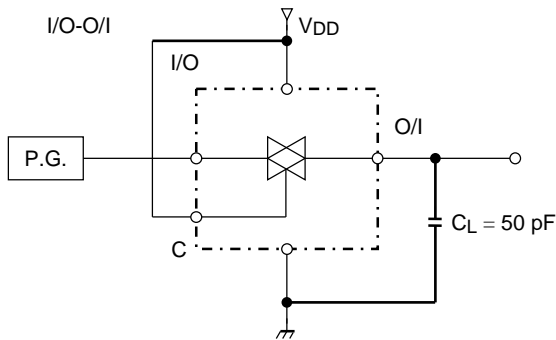
Note 2: V<sub>IS</sub> shall be sine wave of ±2.5 V<sub>p-p</sub>

Note 3: Sine wave of ±2.5 V<sub>p-p</sub> shall be used for V<sub>IS</sub> and the frequency of  $20 \log_{10} \frac{V_{OS}}{V_{IS}} = -50 \text{ dB}$  shall be feed-through.

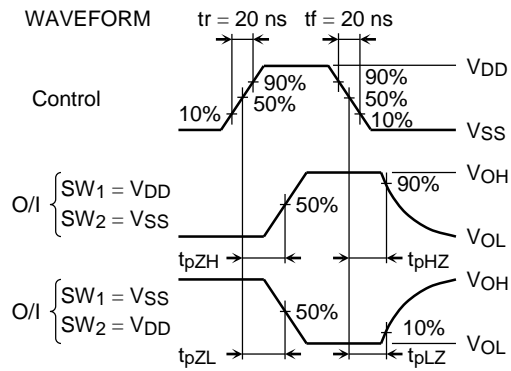
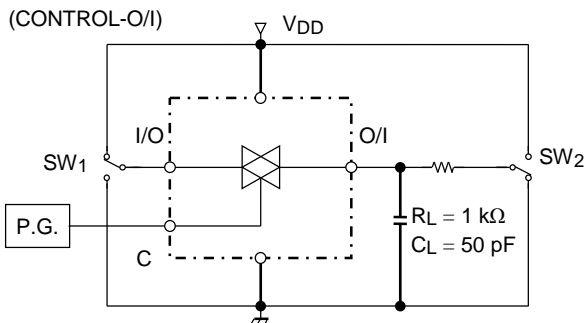
Note 4: Sine wave of ±2.5 V<sub>p-p</sub> shall be used for V<sub>IS</sub> and the frequency of  $20 \log_{10} \frac{V_{OS}}{V_{IS}} = -50 \text{ dB}$  shall be crosstalk.

### Circuit for Measurement of Electrical Characteristics

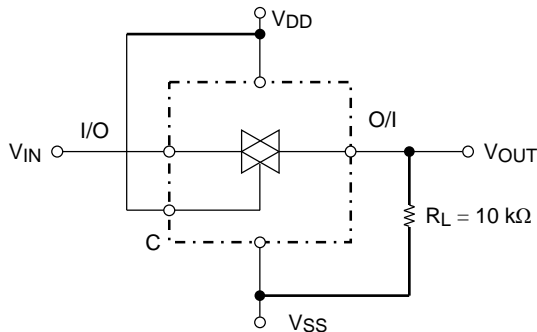
#### 1. $\phi$ I-O



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



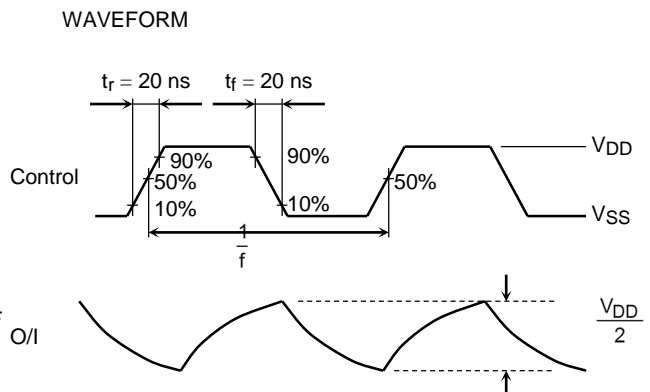
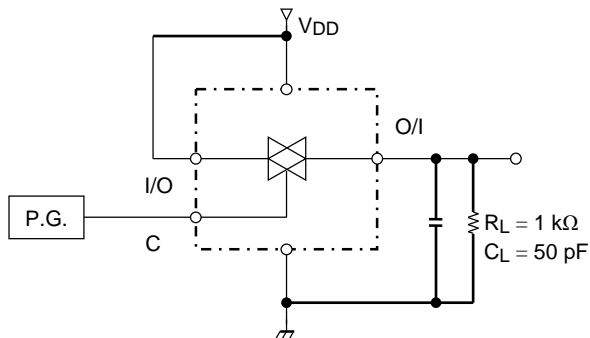
#### 3. RON



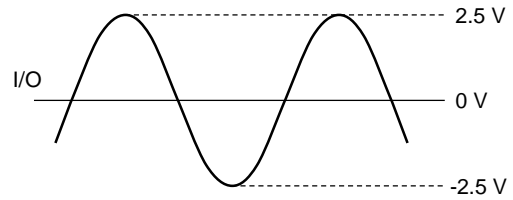
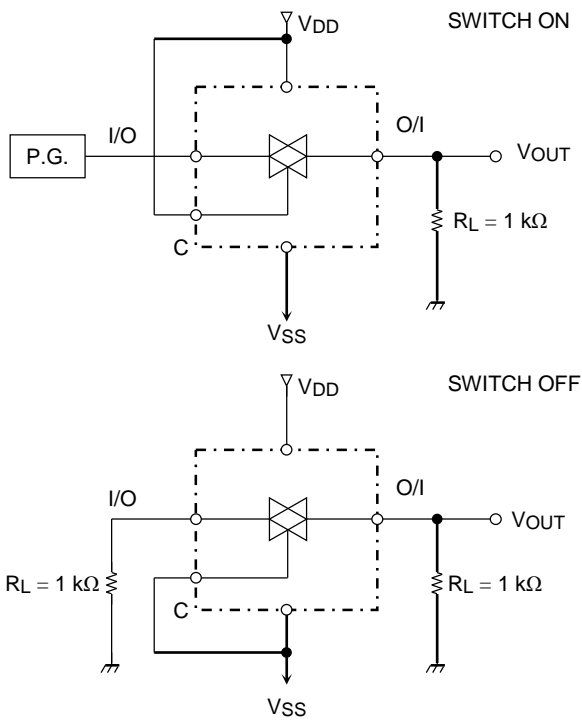
#### RON Calculation Method

$$R_{ON} = 10 \times \frac{(V_{IN} - V_{OUT})}{V_{OUT}} [k\Omega]$$

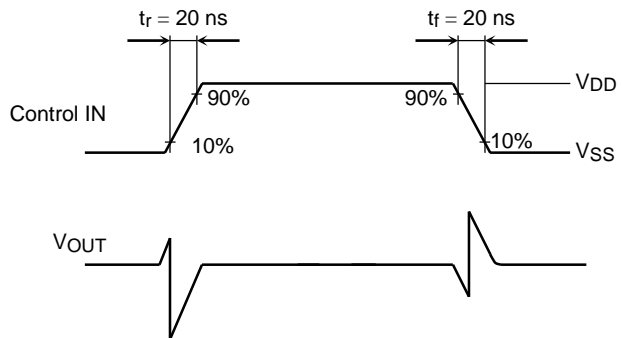
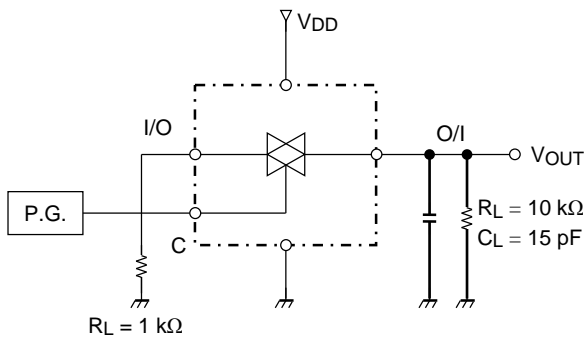
#### 4. $f_{max}(C)$



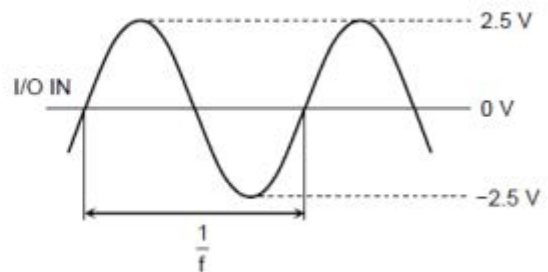
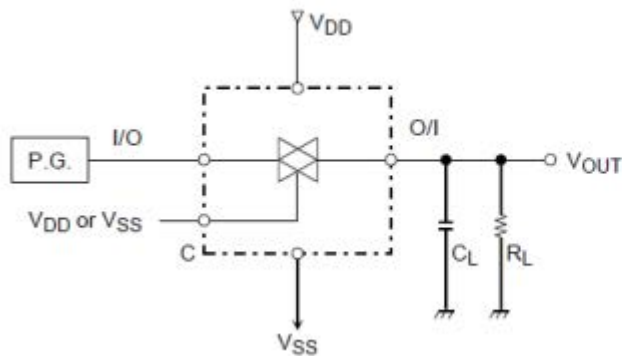
### 5. Crosstalk between Any Two Switches



### 6. Crosstalk, Control to Input



### 7. Total Harmonic Distortion, fmax (I-O), Feedthrough (Switch OFF)

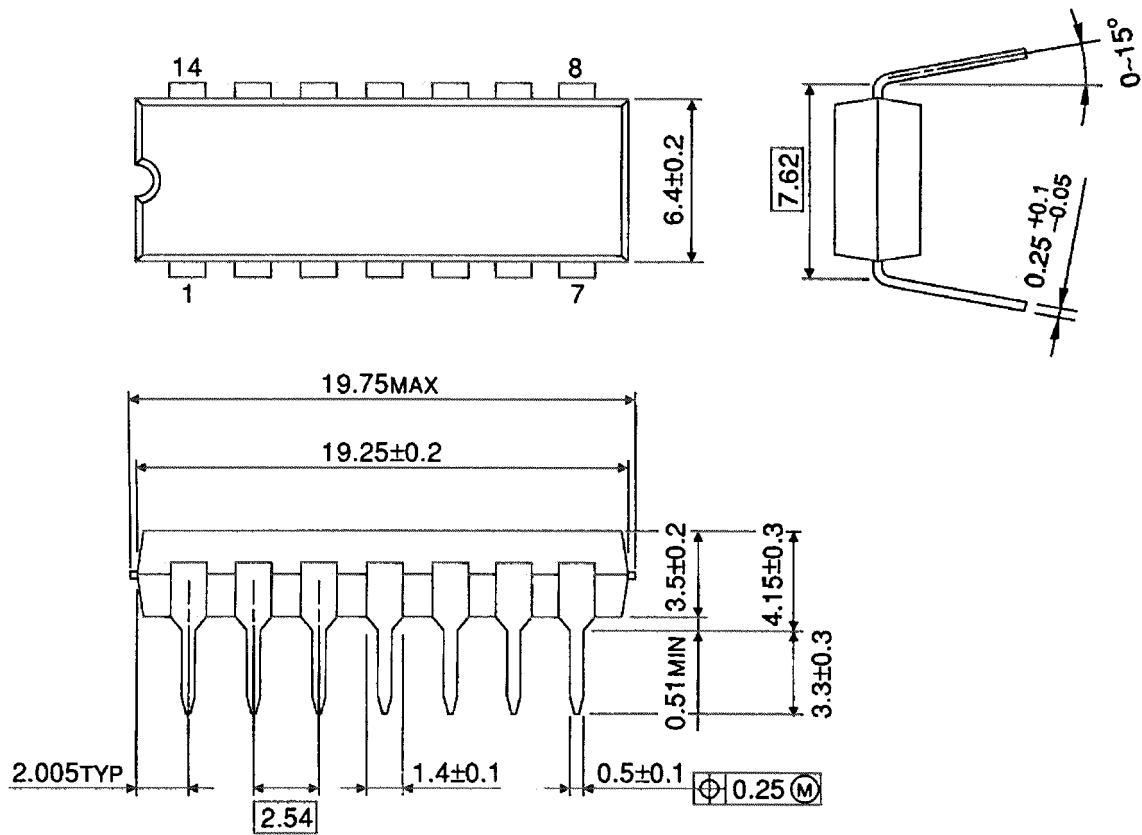


CL, RL: Reference to Test Condition

### Package Dimensions

DIP14-P-300-2.54

Unit : mm

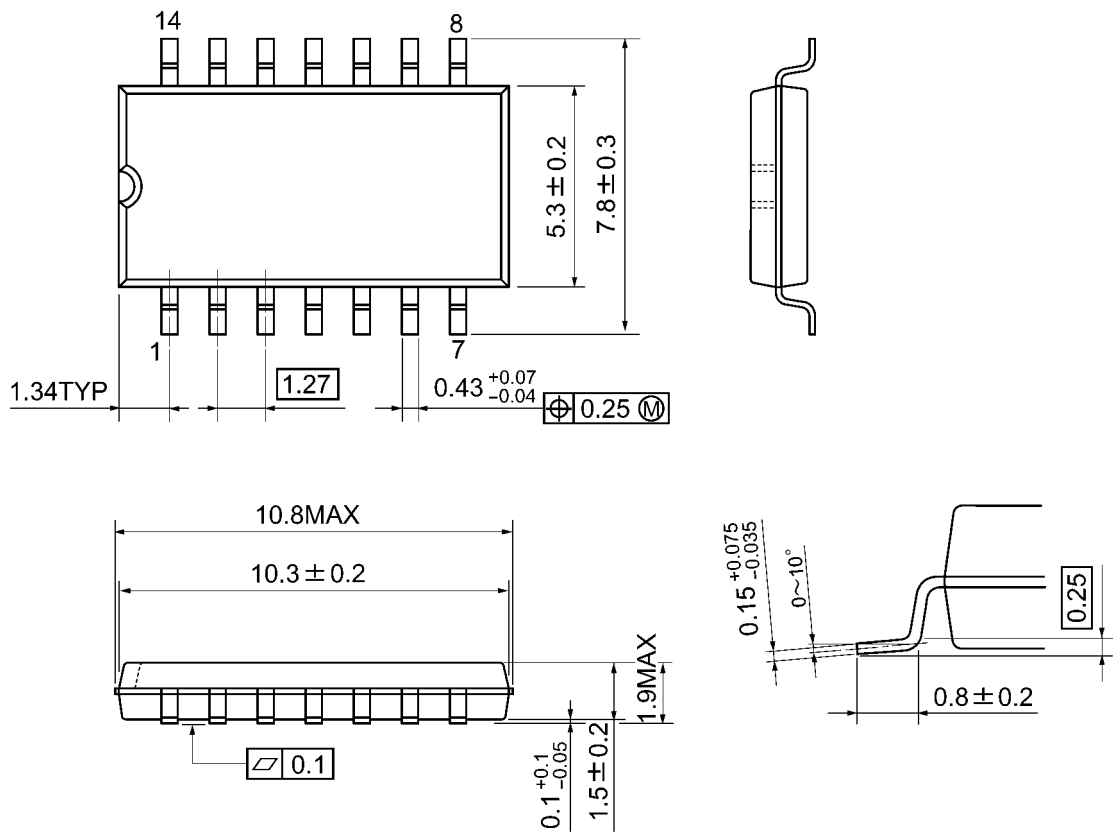


Weight: 0.96 g (typ.)

### Package Dimensions

SOP14-P-300-1.27A

Unit: mm



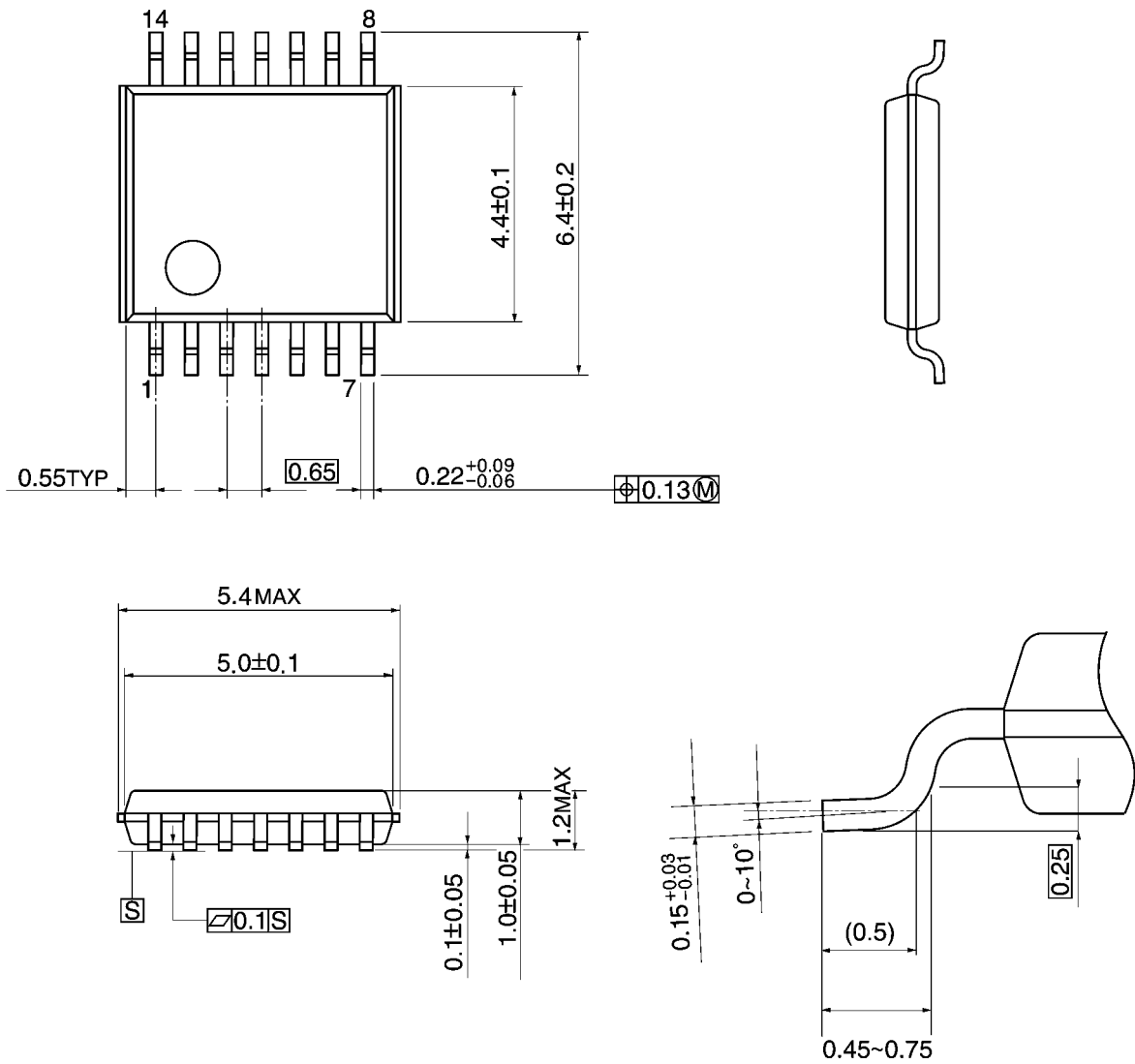
Weight: 0.18 g (typ.)



### Package Dimensions

TSSOP14-P-0044-0.65A

Unit: mm



Weight: 0.06 g (typ.)

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