

## TC74AC164P, TC74AC164F, TC74AC164FN, TC74AC164FT

### 8-Bit Shift Register (S-IN, P-OUT)

The TC74AC164 is an advanced high speed CMOS 8-BIT SERIAL-IN PARALLEL-OUT SHIFT REGISTER fabricated with silicon gate and double-layer metal wiring C<sup>2</sup>MOS technology.

It achieves the high speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation.

It consists of a serial-in, parallel-out 8-bit shift register with a CLOCK input and an overriding  $\overline{\text{CLEAR}}$  input.

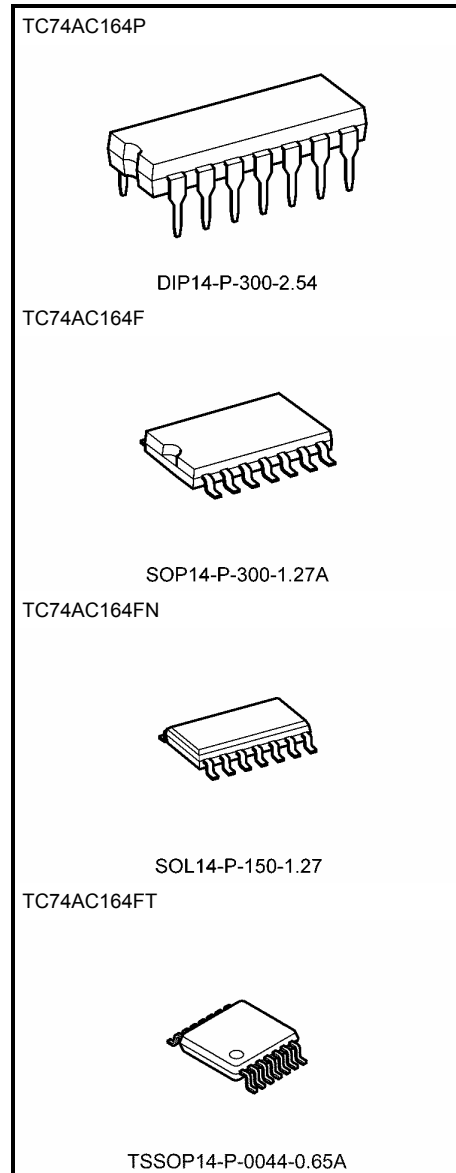
Two serial data inputs (A, B) are provided so that one may be used as a data enable.

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

### Features

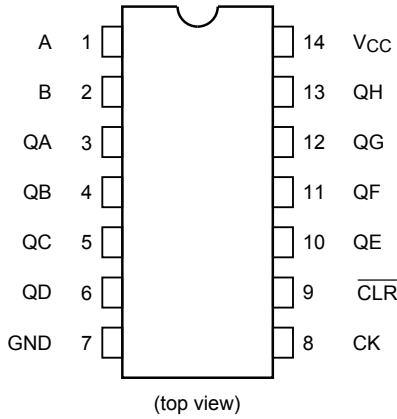
- High speed:  $f_{\text{max}} = 170 \text{ MHz}$  (typ.) at  $V_{\text{CC}} = 5 \text{ V}$
- Low power dissipation:  $I_{\text{CC}} = 8 \mu\text{A}$  (max) at  $T_a = 25^\circ\text{C}$
- High noise immunity:  $V_{\text{NIH}} = V_{\text{NIL}} = 28\% V_{\text{CC}}$  (min)
- Symmetrical output impedance:  
 $|I_{\text{OH}}| = I_{\text{OL}} = 24 \text{ mA}$  (min)  
 Capability of driving  $50 \Omega$  transmission lines.
- Balanced propagation delays:  $t_{\text{pLH}} \approx t_{\text{pHL}}$
- Wide operating voltage range:  $V_{\text{CC}} (\text{opr}) = 2 \text{ V}$  to  $5.5 \text{ V}$
- Pin and function compatible with 74F164

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

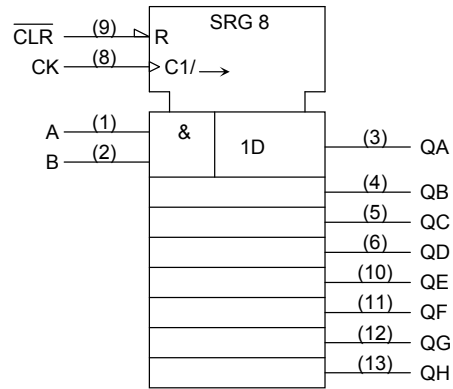


Weight	
DIP14-P-300-2.54	: 0.96 g (typ.)
SOP14-P-300-1.27A	: 0.18 g (typ.)
SOL14-P-150-1.27	: 0.12 g (typ.)
TSSOP14-P-0044-0.65A	: 0.06 g (typ.)

**Pin Assignment**



**IEC Logic Symbol**



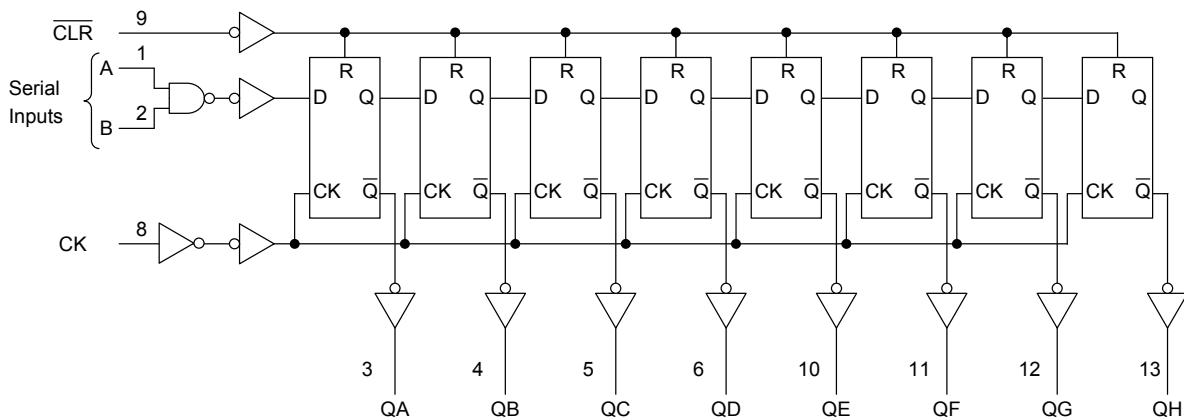
**Truth Table**

Inputs				Outputs			
$\overline{\text{CLR}}$	CK	Serial In		QA	QB	...	QH
		A	B				
L	X	X	X	L	L	...	L
H		X	X	No Change			
H		L	X	L	QA <sub>n</sub>	...	QG <sub>n</sub>
H		X	L	L	QA <sub>n</sub>	...	QG <sub>n</sub>
H		H	H	H	QA <sub>n</sub>	...	QG <sub>n</sub>

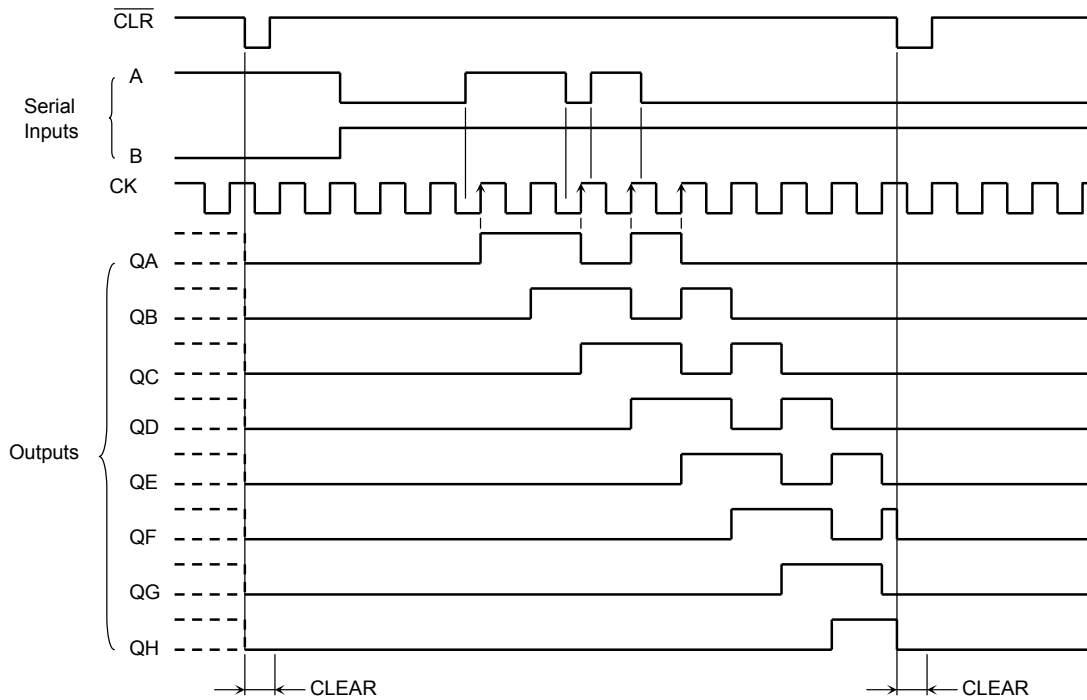
X: Don't care

QA<sub>n</sub> to QG<sub>n</sub>: The level of QA to QG, respectively, before the most recent positive edge of the clock.

**System Diagram**



**Timing Chart**



**Absolute Maximum Ratings (Note 1)**

Characteristics	Symbol	Rating	Unit
Supply voltage range	$V_{CC}$	-0.5 to 7.0	V
DC input voltage	$V_{IN}$	-0.5 to $V_{CC} + 0.5$	V
DC output voltage	$V_{OUT}$	-0.5 to $V_{CC} + 0.5$	V
Input diode current	$I_{IK}$	$\pm 20$	mA
Output diode current	$I_{OK}$	$\pm 50$	mA
DC output current	$I_{OUT}$	$\pm 50$	mA
DC $V_{CC}$ /ground current	$I_{CC}$	$\pm 200$	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  $T_a = -40^{\circ}C$  to  $65^{\circ}C$ . From  $T_a = 65^{\circ}C$  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	$V_{CC}$	2.0 to 5.5	V
Input voltage	$V_{IN}$	0 to $V_{CC}$	V
Output voltage	$V_{OUT}$	0 to $V_{CC}$	V
Operating temperature	$T_{opr}$	-40 to 85	°C
Input rise and fall time	dt/dV	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 inputs must be tied to either VCC or GND.

## Electrical Characteristics

### DC Characteristics

Characteristics	Symbol	Test Condition	Ta = 25°C			Ta = -40 to 85°C		Unit		
			V <sub>CC</sub> (V)	Min	Typ.	Max	Min		Max	
High-level input voltage	$V_{IH}$	—	2.0	1.50	—	—	1.50	—	V	
			3.0	2.10	—	—	2.10	—		
			5.5	3.85	—	—	3.85	—		
Low-level input voltage	$V_{IL}$	—	2.0	—	—	0.50	—	0.50	V	
			3.0	—	—	0.90	—	0.90		
			5.5	—	—	1.65	—	1.65		
High-level output voltage	$V_{OH}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OH} = -50 \mu A$	2.0	1.9	2.0	—	1.9	—	V
				3.0	2.9	3.0	—	2.9	—	
			$I_{OH} = -4$ mA	3.0	2.58	—	—	2.48	—	
				4.5	3.94	—	—	3.80	—	
$I_{OH} = -24$ mA	4.5	3.94	—	—	3.80	—				
	5.5	—	—	—	3.85	—				
$I_{OH} = -75$ mA (Note)	5.5	—	—	—	3.85	—				
	—	—	—	—	—	—				
Low-level output voltage	$V_{OL}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OL} = 50 \mu A$	2.0	—	0.0	0.1	—	0.1	V
				3.0	—	0.0	0.1	—	0.1	
			$I_{OL} = 12$ mA	3.0	—	—	0.36	—	0.44	
				4.5	—	—	0.36	—	0.44	
$I_{OL} = 24$ mA	4.5	—	—	0.36	—	0.44				
	5.5	—	—	—	—	1.65				
$I_{OL} = 75$ mA (Note)	5.5	—	—	—	—	1.65				
	—	—	—	—	—	—				
Input leakage 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	—	—	8.0	—	80.0	μA	

Note: This spec indicates the capability of driving 50 Ω transmission lines.

One output should be tested at a time for a 10 ms maximum duration.

**Timing Requirements (input:  $t_r = t_f = 3 \text{ ns}$ )**

Characteristics	Symbol	Test Condition	Ta = 25°C		Ta = -40 to 85°C		Unit
			V <sub>CC</sub> (V)	Limit	Limit	Limit	
Minimum pulse width (CK)	t <sub>w</sub> (L)	—	3.3 ± 0.3	9.0	10.0	ns	
	t <sub>w</sub> (H)		5.0 ± 0.5	5.0	6.0		
Minimum pulse width ( $\overline{\text{CLR}}$ )	t <sub>w</sub> (L)	—	3.3 ± 0.3 5.0 ± 0.5	9.0 5.0	10.0 6.0	ns	
Minimum set-up time	t <sub>s</sub>	—	3.3 ± 0.3 5.0 ± 0.5	7.0 4.0	7.0 4.0	ns	
Minimum hold time	t <sub>h</sub>	—	3.3 ± 0.3 5.0 ± 0.5	1.0 1.0	1.0 1.0	ns	
Minimum removal time ( $\overline{\text{CLR}}$ )	t <sub>rem</sub>	—	3.3 ± 0.3	8.5	8.5	ns	
			5.0 ± 0.5	5.0	5.0		

**AC Characteristics (C<sub>L</sub> = 50 pF, R<sub>L</sub> = 500 Ω, input:  $t_r = t_f = 3 \text{ ns}$ )**

Characteristics	Symbol	Test Condition	Ta = 25°C			Ta = -40 to 85°C		Unit	
			V <sub>CC</sub> (V)	Min	Typ.	Max	Min		Max
Propagation delay time (CK-Q)	t <sub>pLH</sub>	—	3.3 ± 0.3	—	9.6	16.3	1.0	18.6	ns
	t <sub>pHL</sub>		5.0 ± 0.5	—	6.6	9.8	1.0	11.2	
Propagation delay time ( $\overline{\text{CLR}}$ -Q)	t <sub>pHL</sub>	—	3.3 ± 0.3	—	8.0	15.4	1.0	17.5	ns
			5.0 ± 0.5	—	6.0	11.0	1.0	12.5	
Maximum clock frequency	f <sub>max</sub>	—	3.3 ± 0.3	45	100	—	45	—	MHz
			5.0 ± 0.5	85	150	—	80	—	
Input capacitance	C <sub>IN</sub>	—	—	5	10	—	10	pF	
Power dissipation capacitance	C <sub>PD</sub>	(Note)	—	110	—	—	—	pF	

Note: C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

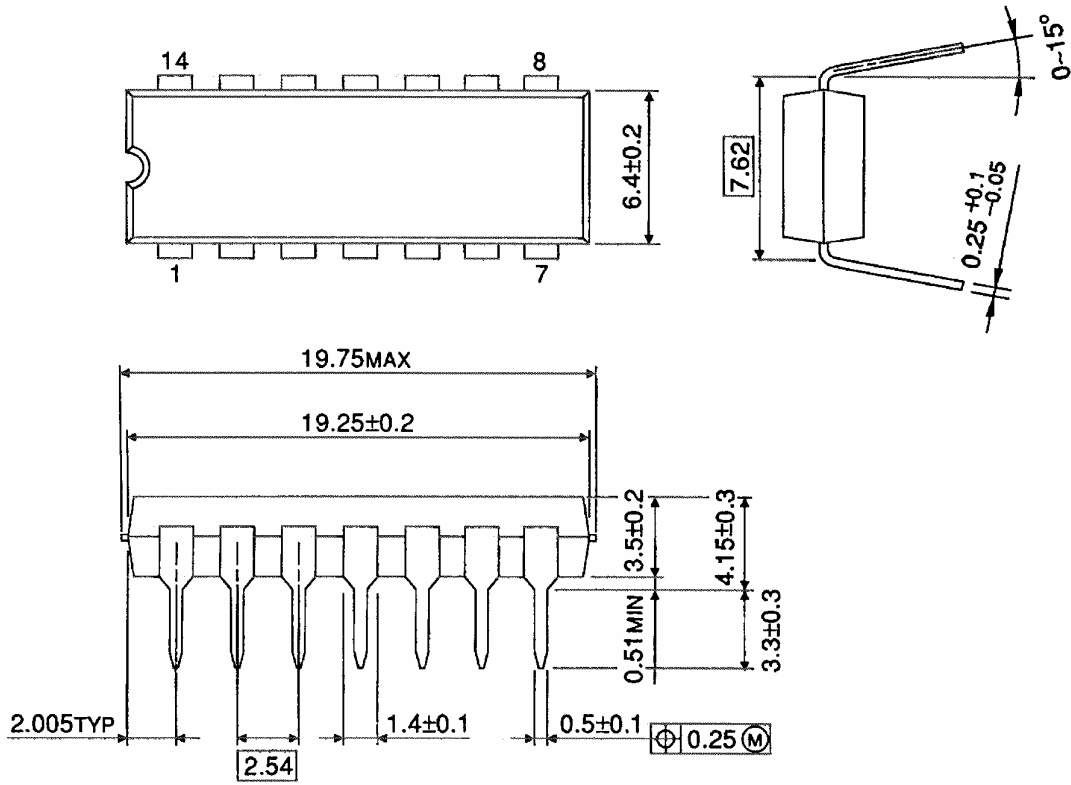
Average operating current can be obtained by the equation:

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

**Package Dimensions**

DIP14-P-300-2.54

Unit : mm

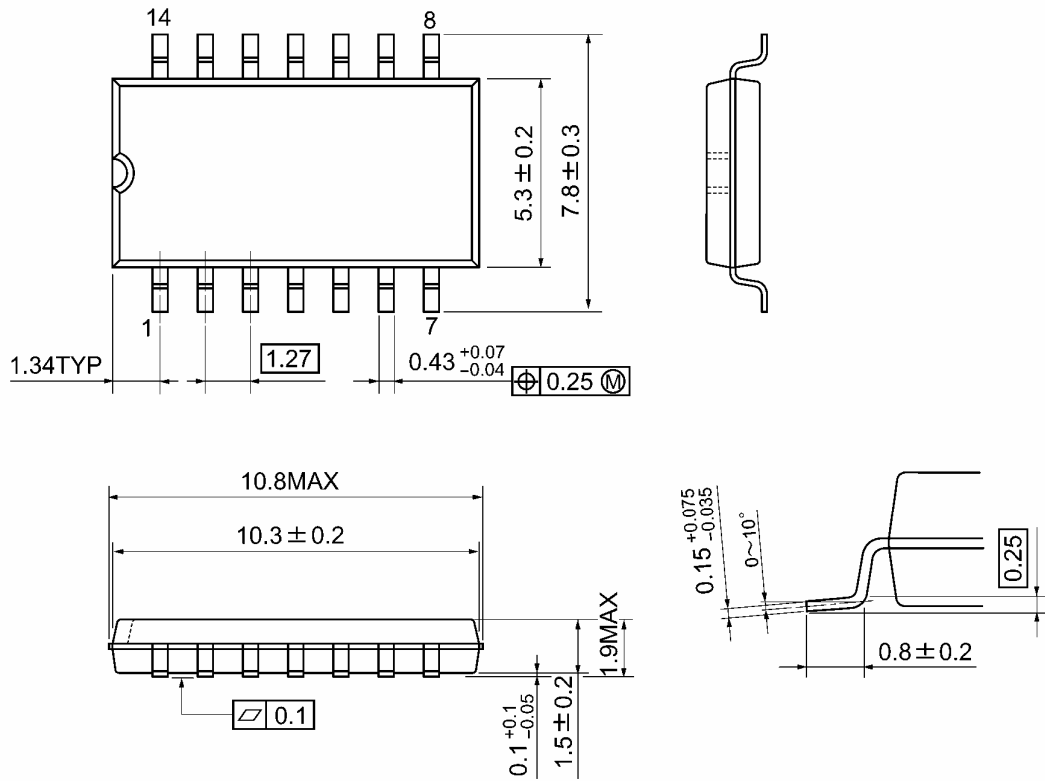


Weight: 0.96 g (typ.)

## Package Dimensions

SOP14-P-300-1.27A

Unit: mm

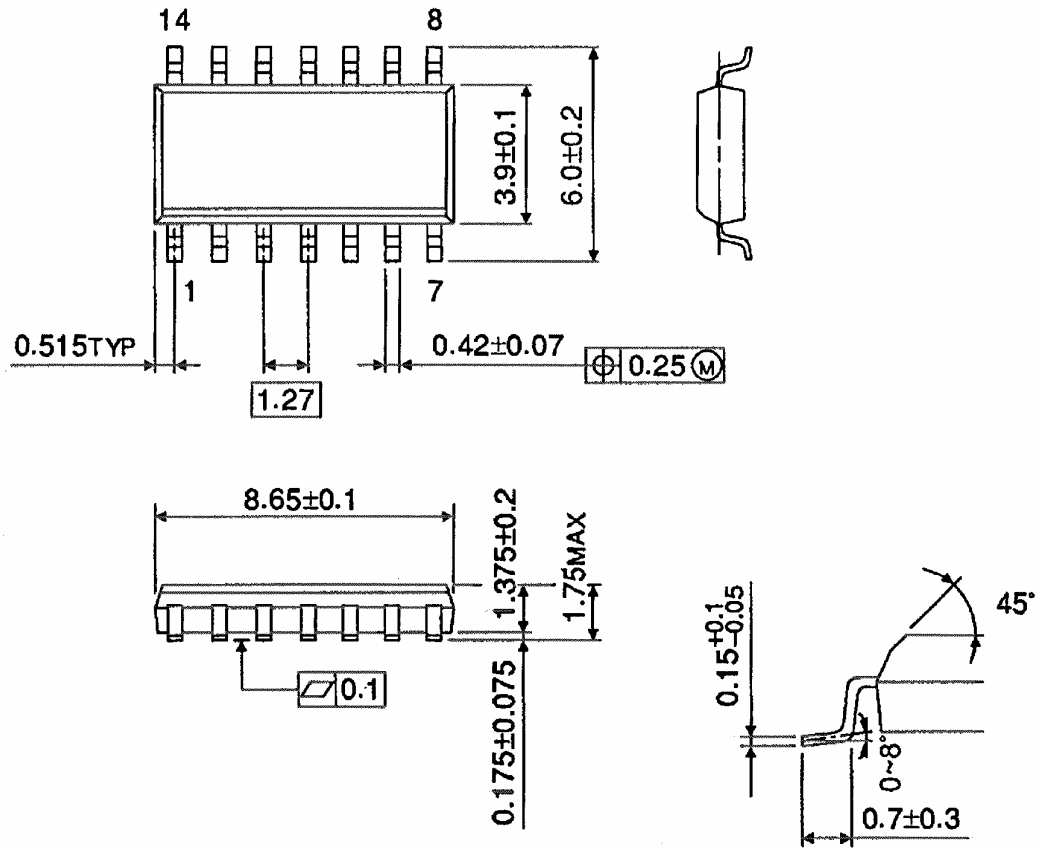


Weight: 0.18 g (typ.)

## Package Dimensions (Note)

SOL14-P-150-1.27

Unit : mm



Note: This package is not available in Japan.

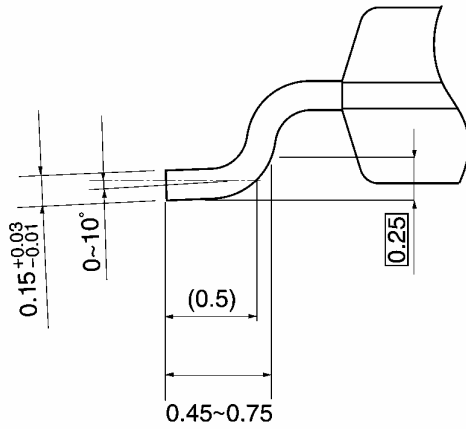
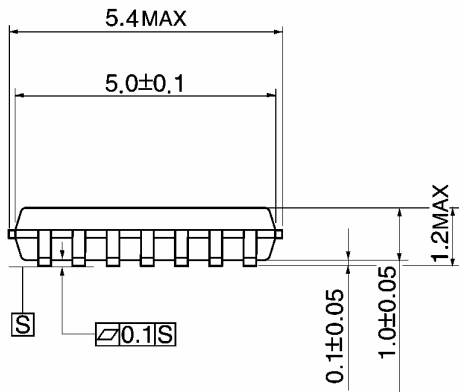
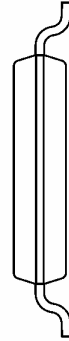
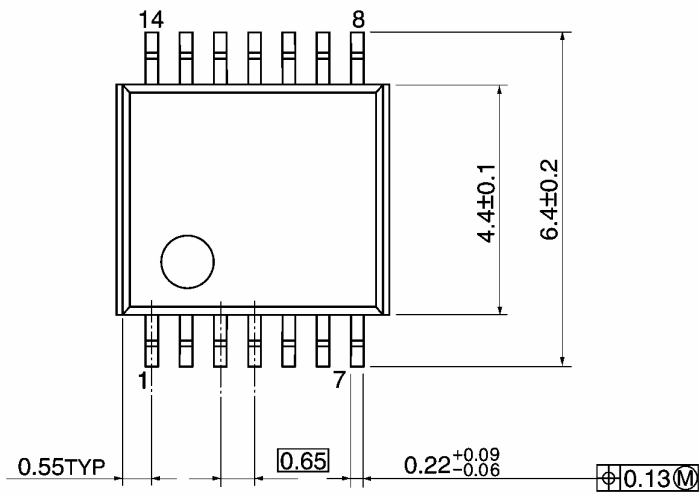
Weight: 0.12 g (typ.)



**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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