

# TC74HC4511AP, TC74HC4511AF

## BCD-to-7 Segment Latch/Decoder/Driver

The TC74HC4511A is a high speed CMOS BCD-TO-7 SEGMENT LATCH/DECODER/DRIVER fabricated with silicon gate C<sup>2</sup>MOS technology.

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

The segment output driver, which is of CMOS construction, has a large IOH capability which permits the device to drive cathode common LED directly.

When lamp test (LT) is held low, all segment outputs will go high, and when the blanking input (BI) is held low and LT is held high, all segment outputs will go low. These functions are independent of other inputs and used to test the display.

BI is used to pulse - modulate the brightness of the display.

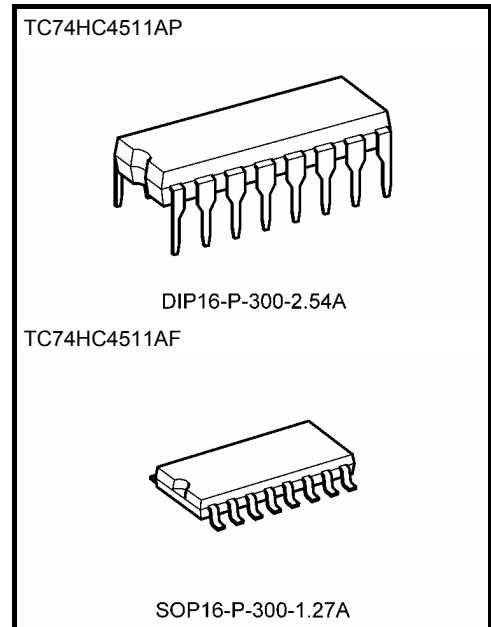
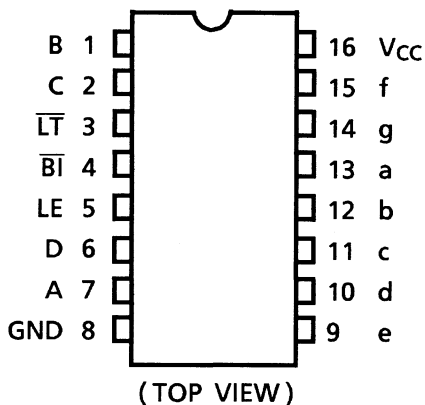
When error code (over 10) is applied to BCD inputs, all segment outputs will go to low (turn off).

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

### Features

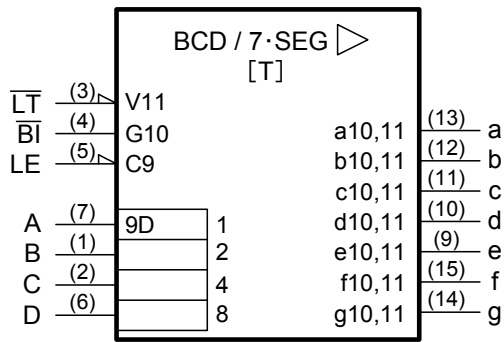
- High speed:  $t_{pd} = 28 \text{ ns (typ.)}$  at  $V_{CC} = 5 \text{ V}$
- Low power dissipation:  $I_{CC} = 4 \mu\text{A (max)}$  at  $T_a = 25^\circ\text{C}$
- High noise immunity:  $V_{NIH} = V_{NIL} = 28\% V_{CC} \text{ (min)}$
- Output drive capability: 10 LSTTL loads
- Symmetrical output impedance:  $|I_{OH}| = 20 \text{ mA}$
- Wide operating voltage range:  $V_{CC} \text{ (opr)} = 2 \text{ to } 6 \text{ V}$
- Pin and function compatible with TC4511B

### Pin Assignment



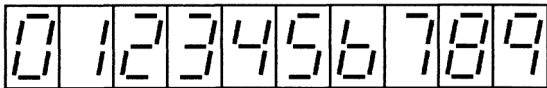
Weight	
DIP16-P-300-2.54A	: 1.00 g (typ.)
SOP16-P-300-1.27A	: 0.18 g (typ.)

## IEC Logic Symbol

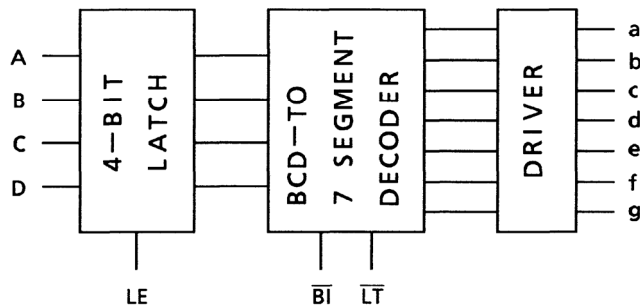


[T]: Truth Table

## Display Mode



## Block Diagram

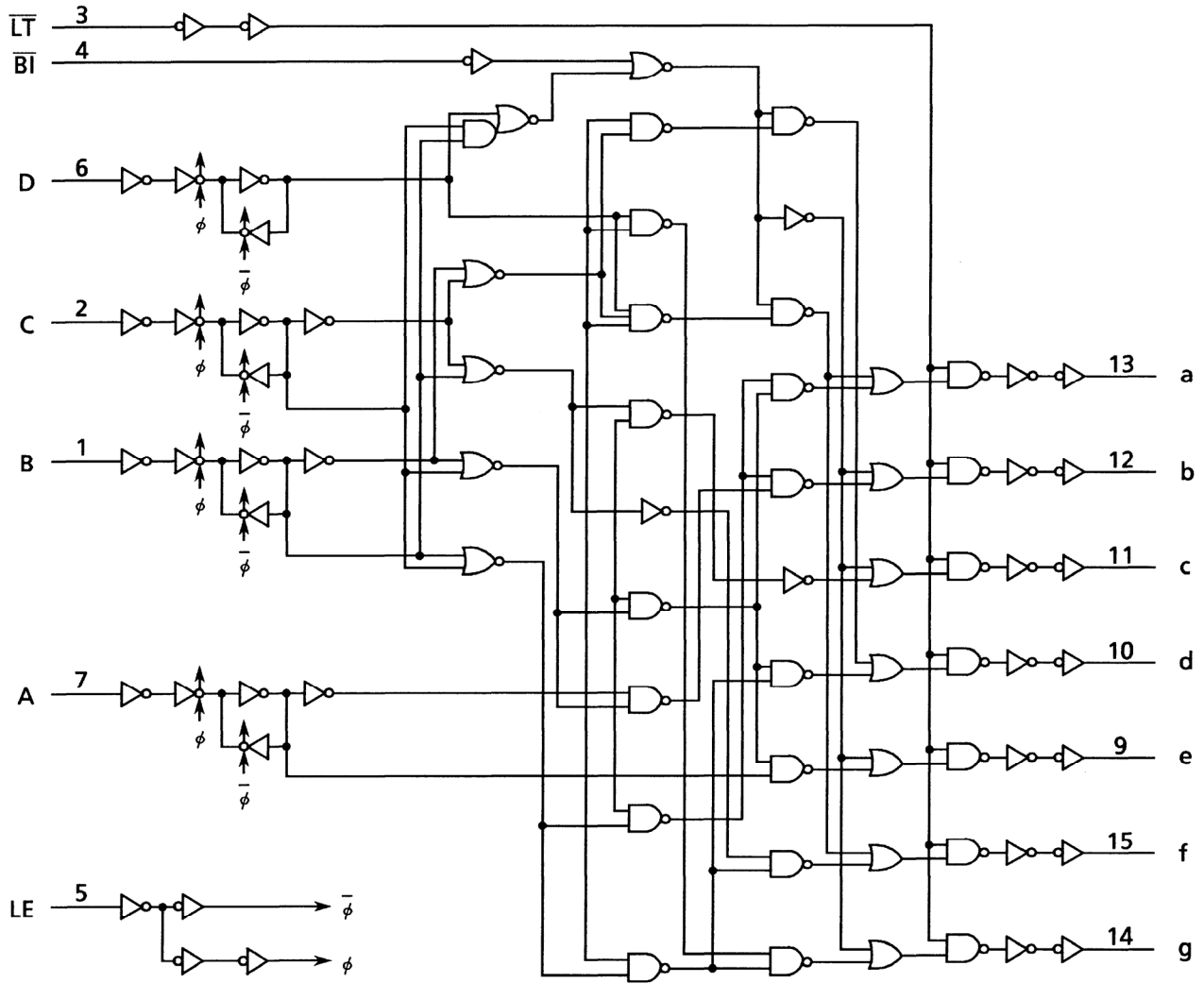


## Truth Table

Inputs							Outputs							Display Mode
LE	$\overline{BI}$	$\overline{LT}$	D	C	B	A	a	b	c	d	e	f	g	
*	*	L	*	*	*	*	H	H	H	H	H	H	H	8
*	L	H	*	*	*	*	L	L	L	L	L	L	L	Blank
L	H	H	L	L	L	L	H	H	H	H	H	H	L	0
L	H	H	L	L	L	H	L	H	H	L	L	L	L	1
L	H	H	L	L	H	L	H	H	L	H	H	L	H	2
L	H	H	L	L	H	H	H	H	H	H	L	L	H	3
L	H	H	L	H	L	L	L	H	H	L	L	H	H	4
L	H	H	L	H	L	H	H	L	H	H	L	H	H	5
L	H	H	L	H	H	L	L	L	H	H	H	H	H	6
L	H	H	L	H	H	H	H	H	H	L	L	L	L	7
L	H	H	H	L	L	L	H	H	H	H	H	H	H	8
L	H	H	H	L	L	H	H	H	H	L	L	H	H	9
L	H	H	H	L	H	*	L	L	L	L	L	L	L	Blank
L	H	H	H	H	*	*	L	L	L	L	L	L	L	Blank
H	H	H	*	*	*	*	Hold the stage at the leading edge of LE							

\*: Don't care

Logic Diagram



## Absolute Maximum Ratings (Note 1)

Characteristics	Symbol	Rating	Unit
Supply voltage range	$V_{CC}$	-0.5 to 7	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	$I_{OK}$	$\pm 20$	mA
DC output current	$I_{OUT}$	+25 (sink)/-35 (source)	mA
DC $V_{CC}$ /ground current	$I_{CC}$	+150 ( $I_{CC}$ )/-50 ( $I_{GND}$ )	mA
Power dissipation	$P_D$	500 (DIP) (Note 2)/180 (SOP)	mW
Storage temperature	$T_{stg}$	-65 to 150	°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  $65^\circ\text{C}$ . From  $T_a = 65$  to  $85^\circ\text{C}$  a derating factor of  $-10$  mW/°C shall be applied until 300 mW.

## Operating Ranges (Note)

Characteristics	Symbol	Rating	Unit
Supply voltage	$V_{CC}$	2 to 6	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	$t_r, t_f$	0 to 1000 ( $V_{CC} = 2.0$ V) 0 to 500 ( $V_{CC} = 4.5$ V) 0 to 400 ( $V_{CC} = 6.0$ V)	ns

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 <sub>IH</sub>	—		2.0	1.50	—	—	1.50	—	V
				4.5	3.15	—	—	3.15	—	
				6.0	4.20	—	—	4.20	—	
Low-level input voltage	V <sub>IL</sub>	—		2.0	—	—	0.50	—	0.50	V
				4.5	—	—	1.35	—	1.35	
				6.0	—	—	1.80	—	1.80	
High-level output voltage	V <sub>OH</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OH</sub> = -20 μA	2.0	1.9	2.0	—	1.9	—	V
				4.5	4.4	4.5	—	4.4	—	
				6.0	5.9	6.0	—	5.9	—	
			I <sub>OH</sub> = -6 mA	4.5	4.18	4.31	—	4.13	—	
				6.0	5.68	5.80	—	5.63	—	
Low-level output voltage	V <sub>OL</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OL</sub> = 20 μA	2.0	—	0.0	0.1	—	0.1	V
				4.5	—	0.0	0.1	—	0.1	
				6.0	—	0.0	0.1	—	0.1	
			I <sub>OL</sub> = 4 mA	4.5	—	0.17	0.26	—	0.33	
				6.0	—	0.18	0.26	—	0.33	
Input leakage current	I <sub>IN</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND		6.0	—	—	±0.1	—	±1.0	μA
Quiescent supply current	I <sub>CC</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND		6.0	—	—	4.0	—	40.0	μA

### Timing Requirements (input: t<sub>r</sub> = t<sub>f</sub> = 6 ns)

Characteristics	Symbol	Test Condition		Ta = 25°C		Ta = -40 to 85°C	Unit	
				V <sub>CC</sub> (V)	Typ.	Limit		Limit
Minimum pulse width (LE)	t <sub>W</sub> (L)	—		2.0	—	75	95	ns
				4.5	—	15	19	
				6.0	—	13	16	
Minimum set-up time	t <sub>s</sub>	—		2.0	—	75	95	ns
				4.5	—	15	19	
				6.0	—	13	16	
Minimum hold time	t <sub>h</sub>	—		2.0	—	0	0	ns
				4.5	—	0	0	
				6.0	—	0	0	

### AC Characteristics ( $C_L = 15 \text{ pF}$ , $V_{CC} = 5 \text{ V}$ , $T_a = 25^\circ\text{C}$ , input: $t_r = t_f = 6 \text{ ns}$ )

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Output transition time	$t_{TLH}$	—	—	4	8	ns
Output transition time	$t_{THL}$	—	—	4	8	ns
Propagation delay time (BCD-segment)	$t_{pLH}$ $t_{pHL}$	—	—	28	45	ns
Propagation delay time ( $\overline{\text{BI}}$ -segment)	$t_{pLH}$ $t_{pHL}$	—	—	18	31	ns
Propagation delay time ( $\overline{\text{LT}}$ -segment)	$t_{pLH}$ $t_{pHL}$	—	—	12	21	ns
Propagation delay time (LE-segment)	$t_{pLH}$ $t_{pHL}$	—	—	26	44	ns

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

Characteristics	Symbol	Test Condition	$T_a = 25^\circ\text{C}$			$T_a = -40 \text{ to } 85^\circ\text{C}$		Unit	
			$V_{CC}$ (V)	Min	Typ.	Max	Min		Max
Output transition time low to high	$t_{TLH}$	—	2.0	—	25	60	—	75	ns
			4.5	—	7	12	—	15	
			6.0	—	6	11	—	13	
Output transition time high to low	$t_{THL}$	—	2.0	—	30	75	—	95	ns
			4.5	—	8	15	—	19	
			6.0	—	7	13	—	16	
Propagation delay time (BCD-segment)	$t_{pLH}$ $t_{pHL}$	—	2.0	—	125	255	—	320	ns
			4.5	—	33	51	—	64	
			6.0	—	23	43	—	54	
Propagation delay time ( $\overline{\text{BI}}$ -segment)	$t_{pLH}$ $t_{pHL}$	—	2.0	—	70	175	—	220	ns
			4.5	—	22	35	—	44	
			6.0	—	17	30	—	37	
Propagation delay time ( $\overline{\text{LT}}$ -segment)	$t_{pLH}$ $t_{pHL}$	—	2.0	—	60	120	—	150	ns
			4.5	—	15	24	—	30	
			6.0	—	12	20	—	26	
Propagation delay time (LE-segment)	$t_{pLH}$ $t_{pHL}$	—	2.0	—	95	240	—	300	ns
			4.5	—	32	48	—	60	
			6.0	—	23	41	—	51	
Input capacitance	$C_{IN}$	—	—	5	10	—	10	pF	
Power dissipation capacitance	$C_{PD}$ (Note)	—	—	95	—	—	—	pF	

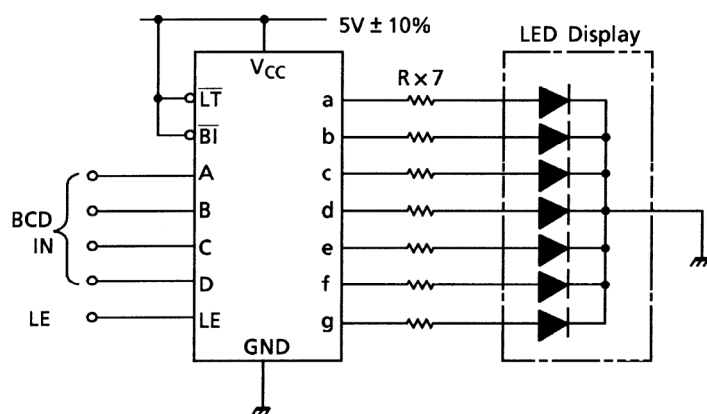
Note:  $C_{PD}$  is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation:

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

## Application Circuit

### Static Display Circuit



### Recommended Resistance R

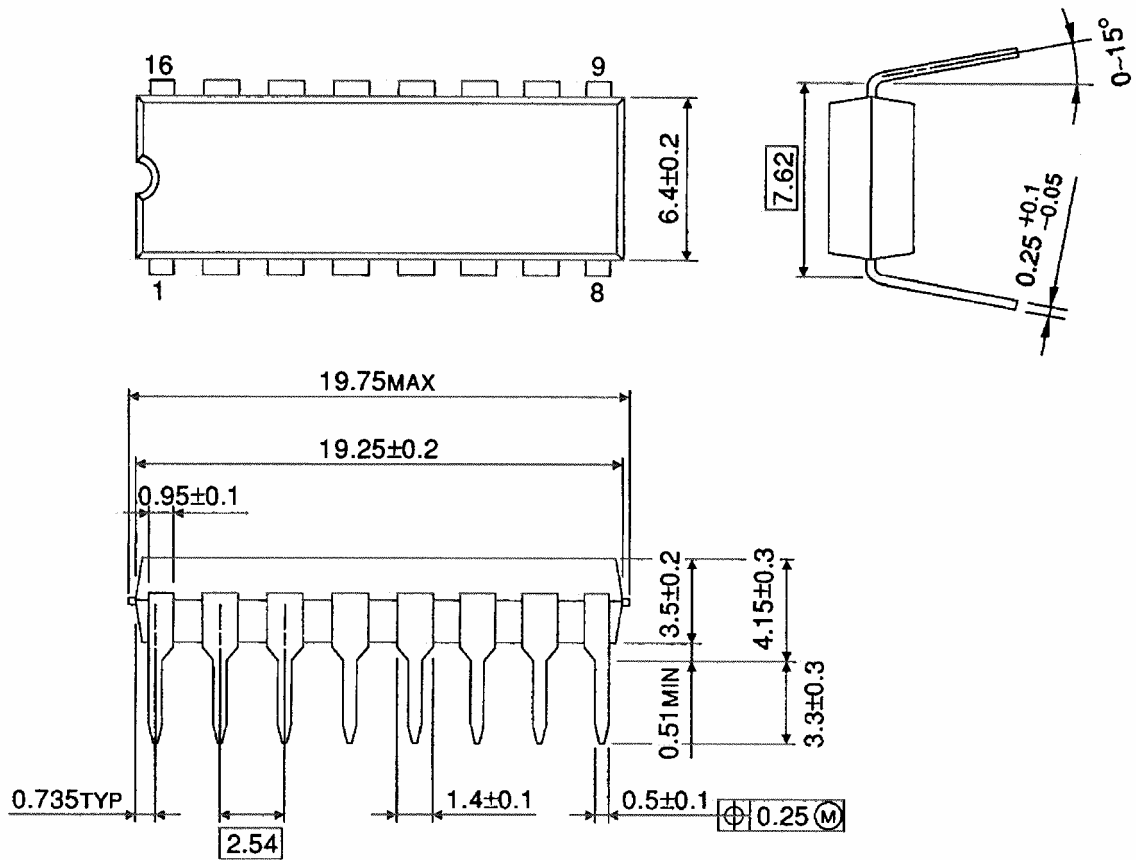
Display	Color	Letter Hight	R
TLR358T	Red	13.4 mm	390 Ω
TLR362T	Red	14.2	390 Ω
TLR332T	Red	7.6	390 Ω
TLR342T	Red	10.9	390 Ω
TLG358T	Green	13.4 mm	160 Ω
TLG362T	Green	14.2	160 Ω
TLG332T	Green	7.6	160 Ω
TLG342T	Green	10.9	160 Ω



## Package Dimensions

DIP16-P-300-2.54A

Unit : mm

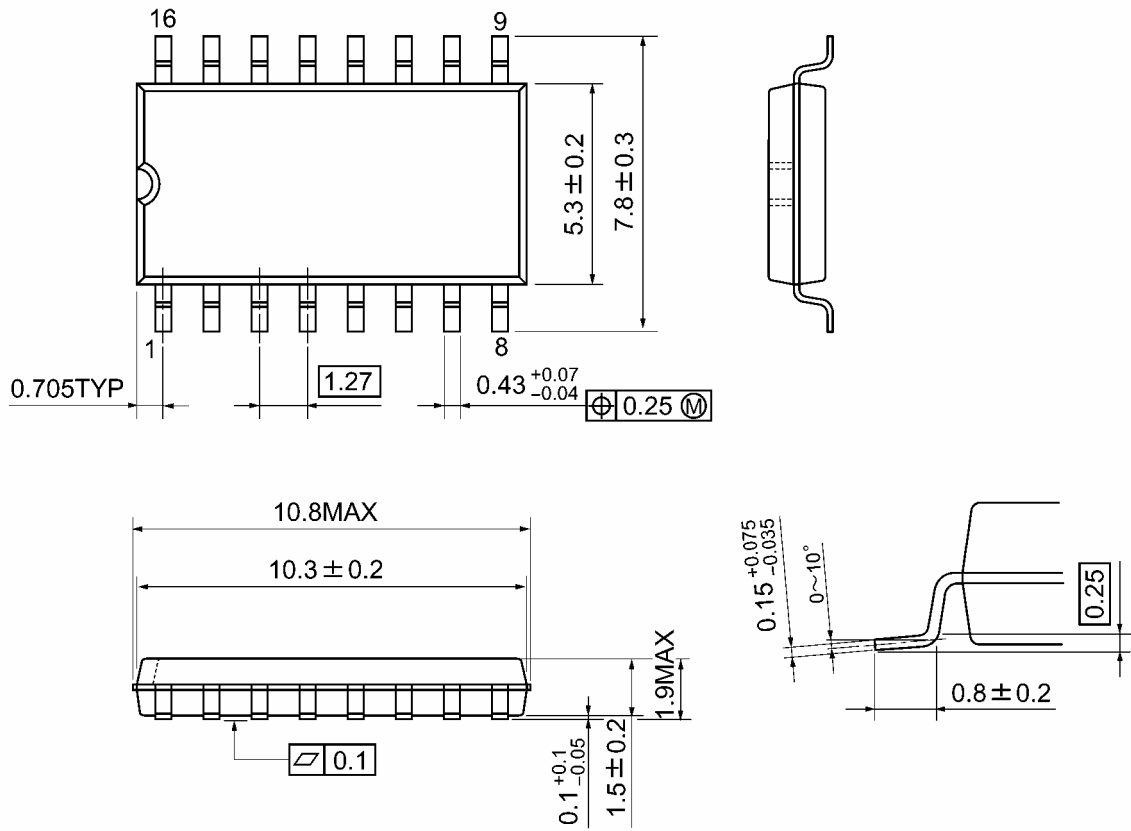


Weight: 1.00 g (typ.)

**Package Dimensions**

SOP16-P-300-1.27A

Unit: mm



Weight: 0.18 g (typ.)

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20070701-EN GENERAL

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