

TC74HC393AP, TC74HC393AF, TC74HC393AFN

Dual Binary Counter

The TC74HC393A is a high speed CMOS 4-BIT BINARY COUNTER fabricated with silicon gate C²MOS technology.

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

It contains two independent counter circuits in one package, so that counting or frequency division of eight binary bits can be achieved with one IC.

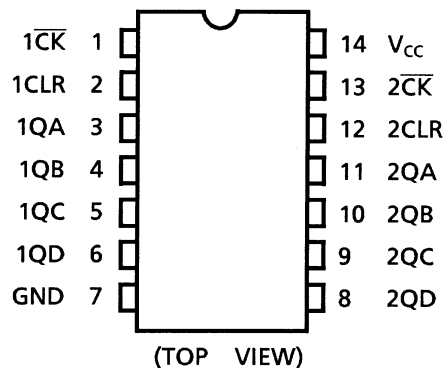
This device changes state on the negative going transition of the \overline{CK} pulse. The counter can be reset to "0" (QA to QD = "L") by a high at the CLR input regardless of other inputs.

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

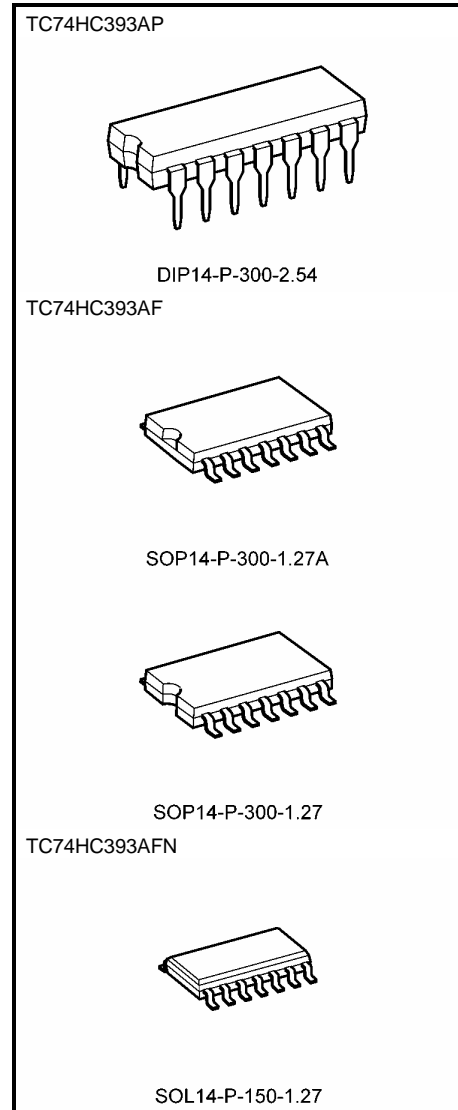
Features

- High speed: $f_{max} = 72 \text{ MHz (typ.)}$ 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: $|I_{OH}| = I_{OL} = 4 \text{ mA (min)}$
- Balanced propagation delays: $t_{pLH} \approx t_{pHL}$
- Wide operating voltage range: $V_{CC} \text{ (opr)} = 2 \text{ to } 6 \text{ V}$
- Pin and function compatible with 74LS393

Pin Assignment

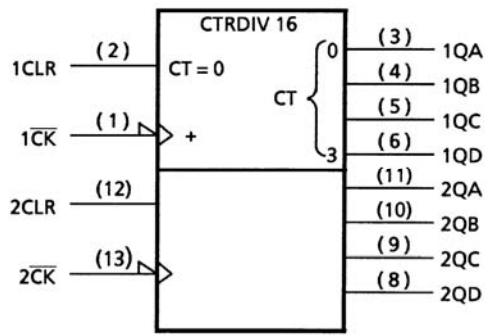


Note: xxxFN (JEDEC SOP) is not available in Japan.



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

IEC Logic Symbol

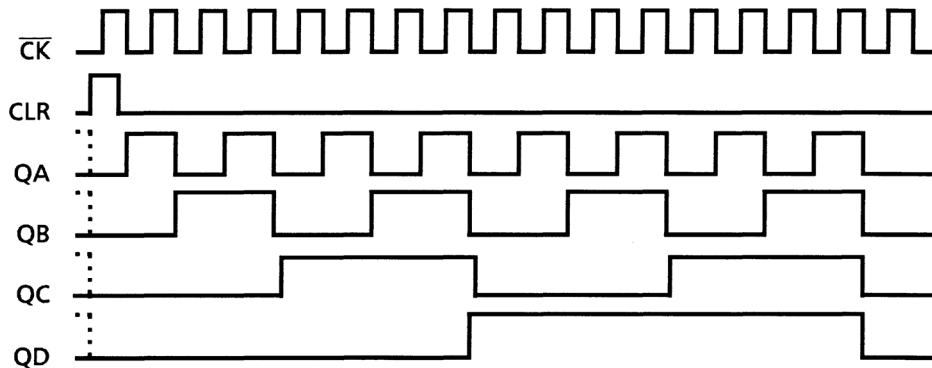


Truth Table

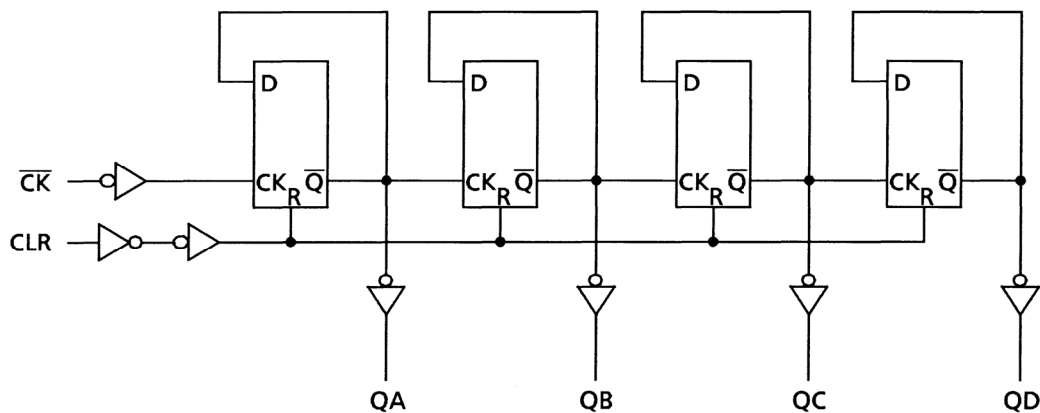
Inputs		Outputs			
\overline{CK}	CLR	QA	QB	QC	QD
X	H	L	L	L	L
\downarrow	L	Count Up			
\uparrow	L	No Change			

X: Don't care

Timing Chart



System 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}	± 20	mA
Output diode current	I_{OK}	± 20	mA
DC output current	I_{OUT}	± 25	mA
DC V_{CC} /ground current	I_{CC}	± 50	mA
Power dissipation	P_D	500 (DIP) (Note 2)/180 (SOP)	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.

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/ $^{\circ}C$ shall be applied until 300 mW.

Recommended Operating Conditions (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	$^{\circ}C$
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)	ns

Note: The recommended operating conditions are required 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 _{CC} (V)	Min	Typ.	Max	Min		Max
High-level input voltage	V _{IH}	—		2.0	1.50	—	—	1.50	—	V
				4.5	3.15	—	—	3.15	—	
				6.0	4.20	—	—	4.20	—	
Low-level input voltage	V _{IL}	—		2.0	—	—	0.50	—	0.50	V
				4.5	—	—	1.35	—	1.35	
				6.0	—	—	1.80	—	1.80	
High-level output voltage	V _{OH}	V _{IN} = V _{IH} or V _{IL}	I _{OH} = -20 μA	2.0	1.9	2.0	—	1.9	—	V
				4.5	4.4	4.5	—	4.4	—	
			I _{OH} = -4 mA	4.5	4.18	4.31	—	4.13	—	
			I _{OH} = -5.2 mA	6.0	5.68	5.80	—	5.63	—	
Low-level output voltage	V _{OL}	V _{IN} = V _{IH} or V _{IL}	I _{OL} = 20 μA	2.0	—	0.0	0.1	—	0.1	V
				4.5	—	0.0	0.1	—	0.1	
			I _{OL} = 4 mA	4.5	—	0.17	0.26	—	0.33	
			I _{OL} = 5.2 mA	6.0	—	0.18	0.26	—	0.33	
Input leakage current	I _{IN}	V _{IN} = V _{CC} or GND		6.0	—	—	±0.1	—	±1.0	μA
Quiescent supply current	I _{CC}	V _{IN} = V _{CC} or GND		6.0	—	—	4.0	—	40.0	μA

Timing Requirements (input: t_r = t_f = 6 ns)

Characteristics	Symbol	Test Condition		Ta = 25°C		Ta = -40 to 85°C	Unit	
				V _{CC} (V)	Typ.	Limit		Limit
Minimum pulse width (CK)	t _W (H) t _W (L)	—		2.0	—	75	95	ns
				4.5	—	15	19	
				6.0	—	13	16	
Minimum pulse width (CLR)	t _W (H)	—		2.0	—	75	95	ns
				4.5	—	15	19	
				6.0	—	13	16	
Minimum removal time	t _{rem}	—		2.0	—	25	30	ns
				4.5	—	5	6	
				6.0	—	5	5	
Clock frequency	f	—		2.0	—	6	5	MHz
				4.5	—	32	27	
				6.0	—	38	32	

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} t_{THL}	—	—	4	8	ns
Propagation delay time (\overline{CK} -QA)	t_{pLH} t_{pHL}	—	—	12	20	ns
Propagation delay time (\overline{CK} -QB)	t_{pLH} t_{pHL}	—	—	16	31	ns
Propagation delay time (\overline{CK} -QC)	t_{pLH} t_{pHL}	—	—	21	38	ns
Propagation delay time (\overline{CK} -QD)	t_{pLH} t_{pHL}	—	—	25	46	ns
Propagation delay time (CLR-Qn)	t_{pHL}	—	—	15	26	ns
Maximum clock frequency	f_{max}	—	35	72	—	MHz

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

Characteristics	Symbol	Test Condition	V_{CC} (V)	$T_a = 25^\circ\text{C}$			$T_a = -40 \text{ to } 85^\circ\text{C}$		Unit
				Min	Typ.	Max	Min	Max	
Output transition time	t_{TLH} t_{THL}	—	2.0	—	25	75	—	95	ns
			4.5	—	7	15	—	19	
			6.0	—	6	13	—	16	
Propagation delay time ($\overline{\text{CK}}$ -QA)	t_{pLH} t_{pHL}	—	2.0	—	45	120	—	150	ns
			4.5	—	15	24	—	30	
			6.0	—	13	20	—	26	
Propagation delay time ($\overline{\text{CK}}$ -QB)	t_{pLH} t_{pHL}	—	2.0	—	60	180	—	225	ns
			4.5	—	20	36	—	45	
			6.0	—	17	31	—	38	
Propagation delay time ($\overline{\text{CK}}$ -QC)	t_{pLH} t_{pHL}	—	2.0	—	80	220	—	275	ns
			4.5	—	25	44	—	55	
			6.0	—	21	37	—	47	
Propagation delay time ($\overline{\text{CK}}$ -QD)	t_{pLH} t_{pHL}	—	2.0	—	100	260	—	325	ns
			4.5	—	30	52	—	65	
			6.0	—	26	44	—	55	
Propagation delay time (CLR-Qn)	t_{pHL}	—	2.0	—	55	150	—	190	ns
			4.5	—	18	30	—	38	
			6.0	—	15	26	—	33	
Maximum clock frequency	f_{max}	—	2.0	6	22	—	5	—	MHz
			4.5	32	67	—	27	—	
			6.0	38	77	—	32	—	
Input capacitance	C_{IN}	—	—	5	10	—	10	pF	
Power dissipation capacitance (Note)	C_{PD}	—	—	40	—	—	—	pF	

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

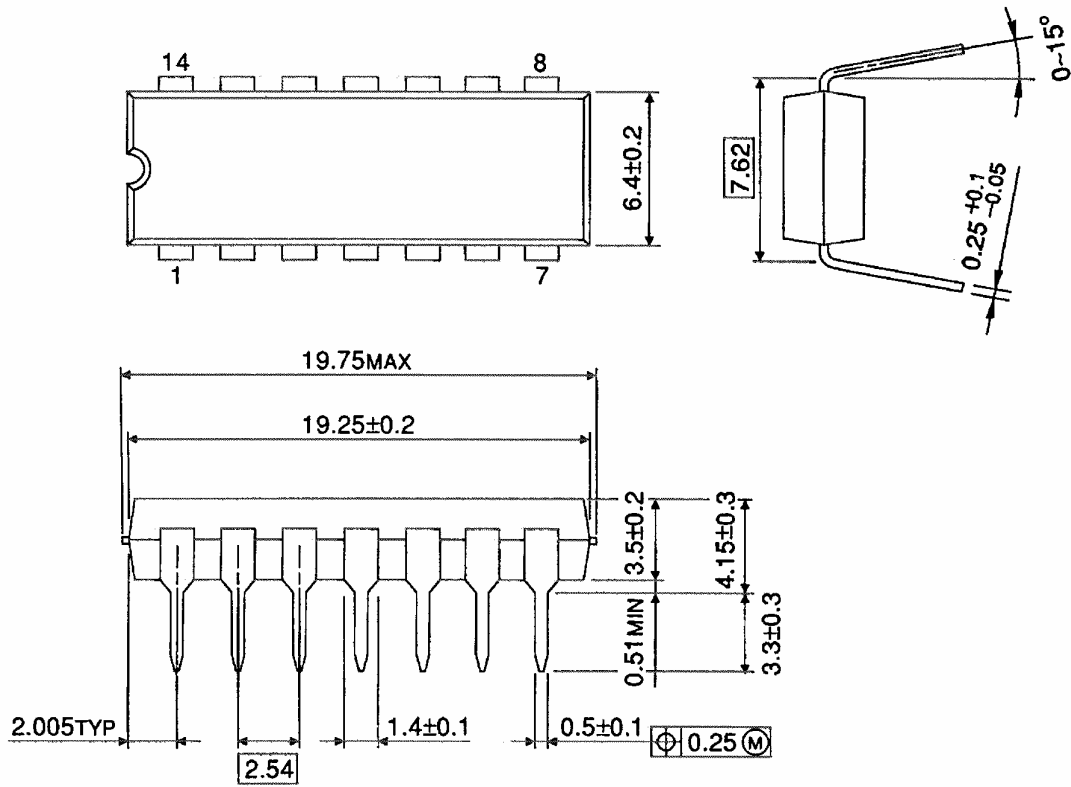
Average operating current can be obtained by the equation:

$$I_{CC}(\text{opr}) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/2 \text{ (per counter)}$$

Package Dimensions

DIP14-P-300-2.54

Unit : mm

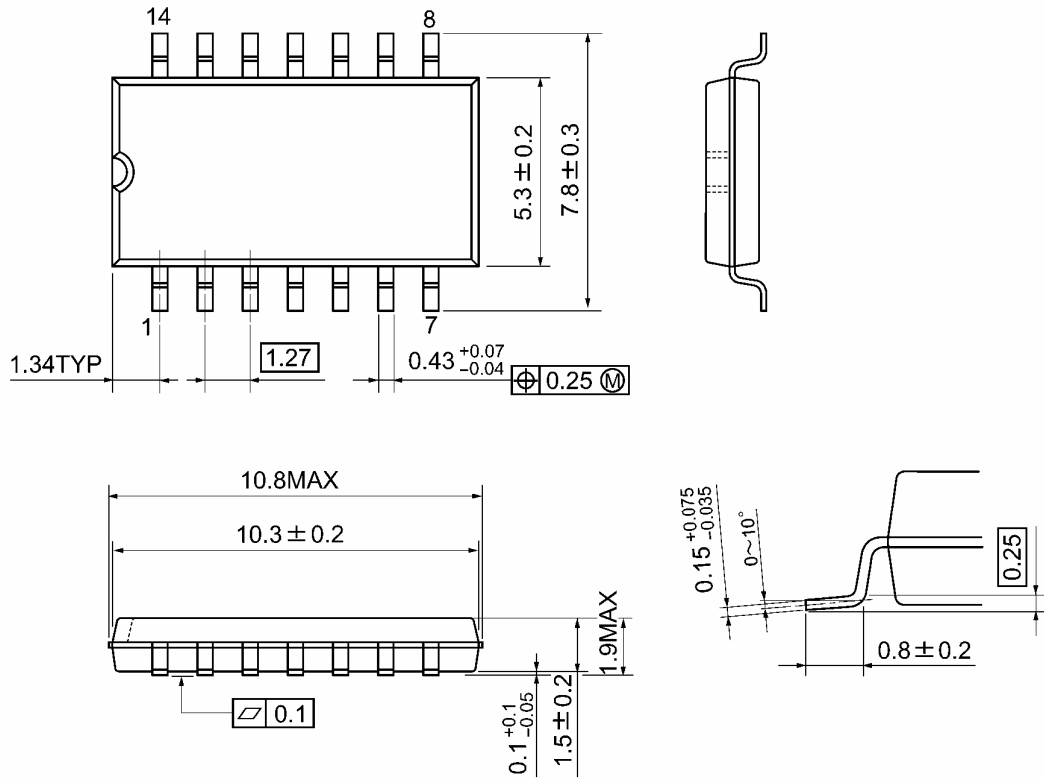


Weight: 0.96 g (typ.)

Package Dimensions

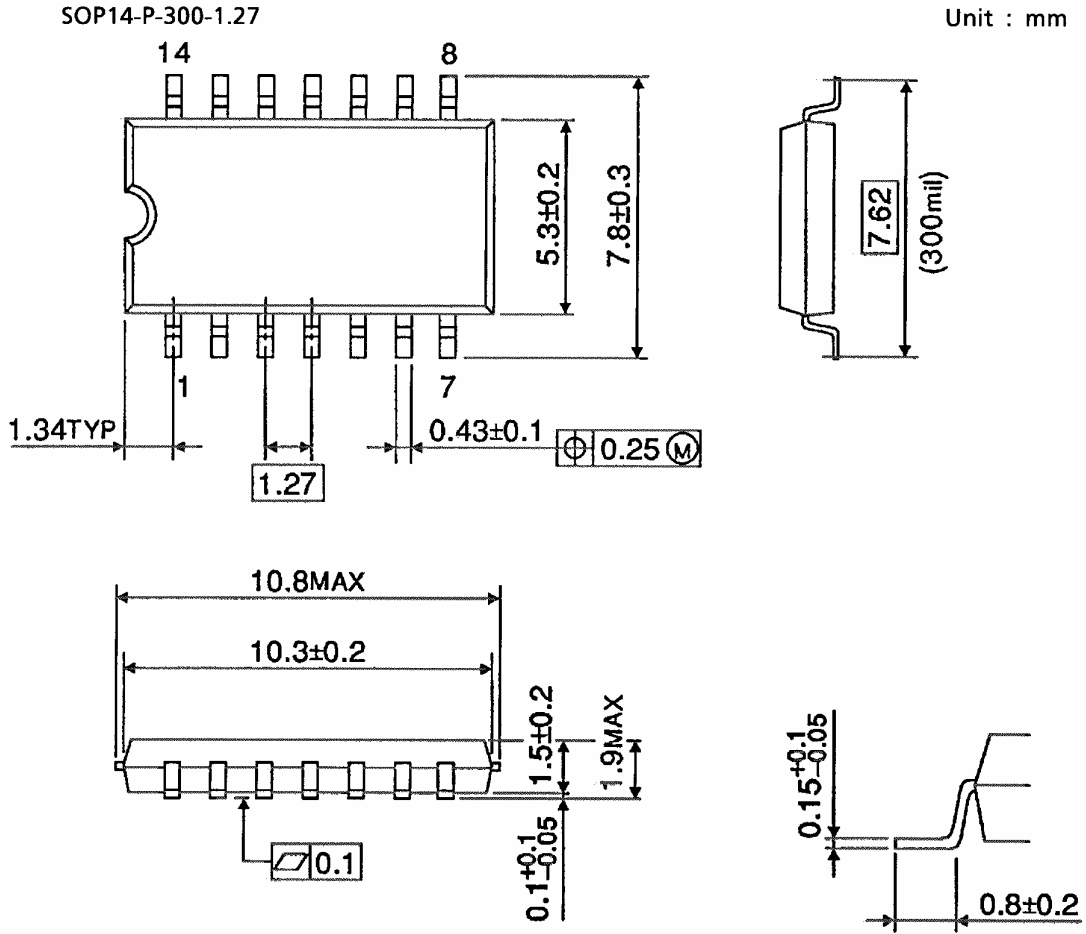
SOP14-P-300-1.27A

Unit: mm



Weight: 0.18 g (typ.)

Package Dimensions

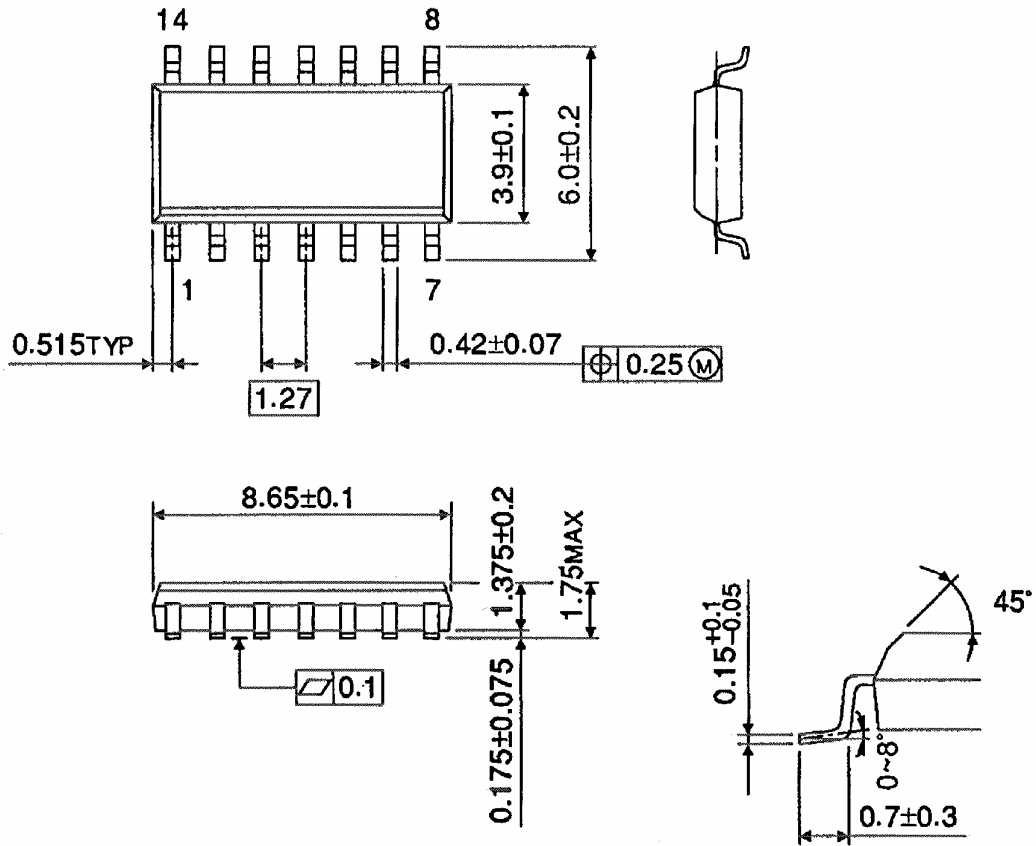


Weight: 0.18 g (typ.)

Package Dimensions (Note)

SOL14-P-150-1.27

Unit : mm



Note: This package is not available in Japan.

Weight: 0.12 g (typ.)

Note: Lead (Pb)-Free Packages**DIP14-P-300-2.54 SOP14-P-300-1.27A SOL14-P-150-1.27****RESTRICTIONS ON PRODUCT USE**

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