

TC74HC123AP, TC74HC123AF, TC74HC123AFN

DUAL RETRIGGERABLE MONOSTABLE MULTIVIBRATOR

The TC74HC123A is a high speed CMOS MONOSTABLE MULTIVIBRATOR fabricated with silicon gate C²MOS technology.

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

There are two trigger inputs, $\overline{A}$ input (Negative edge), and B input (Positive edge). These inputs are valid for a slow rise/fall time signal ($t_r = t_f = 1\text{sec.}$) as they are schmitt trigger inputs. This device may also be triggered by using $\overline{\text{CLR}}$ input (Positive edge).

After triggering, the output stays in a MONOSTABLE state for a time period determined by the external resistor and capacitor (R_x , C_x). A low level at the $\overline{\text{CLR}}$ input breaks this state. In the MONOSTABLE state, if a new trigger is applied, it extends the MONOSTABLE period (retrigger mode).

Limits for C_x and R_x are:

External capacitor, C_x No limit

External resistor, R_x $V_{CC} = 2.0\text{V}$ more than $5\text{k}\Omega$
 $V_{CC} \geq 3.0\text{V}$ more than $1\text{k}\Omega$

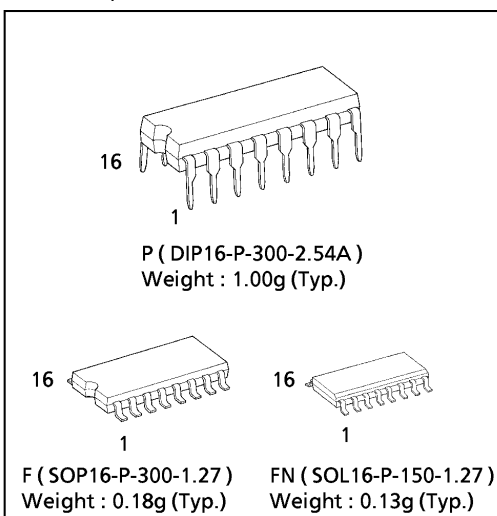
All inputs are equipped with protection circuits against static discharge or transient excess voltage.

FEATURES:

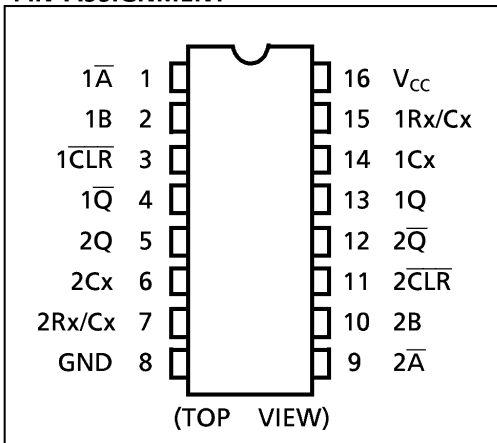
- High Speed..... $t_{pd} = 25\text{ns}$ (typ.) at $V_{CC} = 5\text{V}$
- Low Power Dissipation
 - Standby State..... $I_{CC} = 4\mu\text{A}$ (Max.) at $T_a = 25^\circ\text{C}$
 - Active State..... $I_{CC} = 700\mu\text{A}$ (Max.) at $T_a = 25^\circ\text{C}$
- High Noise Immunity..... $V_{NIH} = V_{NIL} = 28\% V_{CC}$ (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} (opr.) = $2\text{V} \sim 6\text{V}$
- Pin and Function Compatible with 74LS123

Note: In the case of using only one circuit, $\overline{\text{CLR}}$ should be tied to GND, $R_x/C_x \cdot C_x \cdot Q \cdot \overline{Q}$ should be tied to OPEN, the other inputs should be tied to V_{CC} or GND.

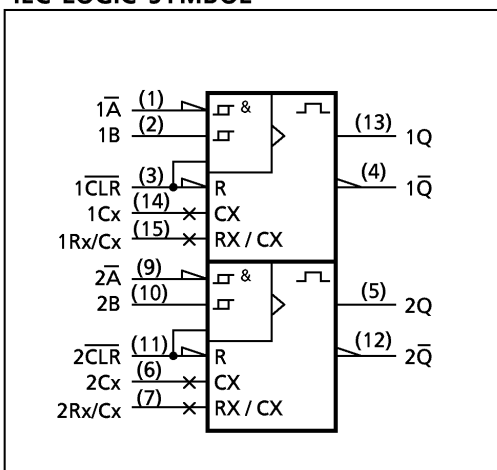
(Note) The JEDEC SOP (FN) is not available in Japan.



PIN ASSIGNMENT



IEC LOGIC SYMBOL



980508EBA2

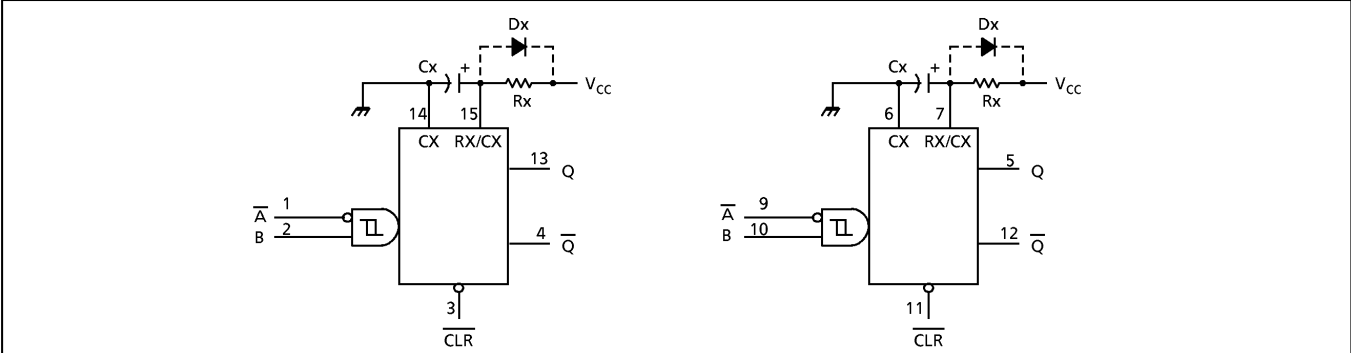
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TRUTH TABLE

INPUTS			OUTPUTS		FUNCTION
$\overline{A}$	B	CLR	Q	$\overline{Q}$	
	H	H			OUTPUT ENABLE
X	L	H	L	H	INHIBIT
H	X	H	L	H	INHIBIT
L		H			OUTPUT ENABLE
L	H				OUTPUT ENABLE
X	X	L	L	H	INHIBIT

X : Don't Care

BLOCK DIAGRAM



- Notes : (1) Cx, Rx, Dx are external
Capacitor, Resistor, and Diode, respectively.
- (2) External clamping diode, Dx ;

The external capacitor is charged to V_{CC} level in the wait state, i.e. when no trigger is applied.

If the supply voltage is turned off, Cx is discharges mainly through the internal (parasitic) diode. If Cx is sufficiently large and V_{CC} drops rapidly, there will be some possibility of damaging the IC through in rush current or latch-up. If the capacitance of the supply voltage filter is large enough and V_{CC} drops slowly, the in rush current is automatically limited and damage to the IC is avoided.

The maximum value of forward current through the parasitic diode is $\pm 20\text{mA}$.

In the case of a large Cx, the limit of fall time of the supply voltage is determined as follows:

$$t_f \geq (V_{CC} - 0.7) C_x / 20\text{mA}$$

(t_f is the time between the supply voltage turn off
and the supply voltage reaching $0.4 V_{CC}$.)

In the event a system does not satisfy the above condition, an external clamping diode (Dx) is needed to protect the IC from in rush current.

980508EBA2'

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The timing diagram illustrates the behavior of a 74VHC04 hex inverter. It shows the input signals $\overline{A}$, B , and $\overline{CLR}$ and the output signals Q and $\overline{Q}$. The voltage levels are defined as V_{CC} , V_{refH} , V_{refL} , GND , VOH , and VOL . The timing parameters are labeled as t_w (propagation delay), t_{rr} (rise time), and $t_w + t_{rr}$ (total delay).

FUNCTIONAL DESCRIPTION

(1)Stand-by State

The external capacitor (C_x) is fully charged to V_{CC} in the stand-by state. That means, before triggering, the Q_P and Q_N transistors which are connected to the R_x/C_x node are in the off state. Two comparators that relate to the timing of the output pulse, and two reference voltage supplies turn off. The total supply current is only leakage current.

(2)Trigger operation

Trigger operation is effective in any of the following three cases. First, the condition where the $\overline{A}$ input is low, and the B input has a rising signal; second, where the B input is high, and the $\overline{A}$ input has a falling signal; and third, where the $\overline{A}$ input is low and the B input is high, and the $\overline{CLR}$ input has a rising signal.

After a trigger becomes effective, comparators C1 and C2 start operating, and Q_N is turned on. The external capacitor discharges through Q_N . The voltage level at the R_x/C_x node drops. If the R_x/C_x voltage level falls to the internal reference voltage V_{refL} , the output of C1 becomes low. The flip-flop is then reset and Q_N turns off. At that moment C1 stops but C2 continues operating.

After Q_N turns off, the voltage at the R_x/C_x node starts rising at a rate determined by the time constant of external capacitor C_x and resistor R_x .

Upon triggering, output Q becomes high, following some delay time of the internal F/F and gates. It stays high even if the voltage of R_x/C_x changes from falling to rising. When R_x/C_x reaches the internal reference voltage V_{refH} , the output of C2 becomes low, the output Q goes low and C2 stops its operation. That means, after triggering, when the voltage level of the R_x/C_x node reaches V_{refH} , the IC returns to its MONOSTABLE state.

With large values of C_x and R_x , and ignoring the discharge time of the capacitor and internal delays of the IC, the width of the output pulse, t_w (OUT), is as follows:

$$t_w(\text{OUT}) = 1.0 C_x R_x$$

(3)Retrigger operation

When a new trigger is applied to either input $\overline{A}$ or B while in the MONOSTABLE state, it is effective only if the IC is charging C_x . The voltage level of the R_x/C_x node then falls to V_{refL} level again. Therefore the Q output stays high if the next trigger comes in before the time period set by C_x and R_x .

If the new trigger is very close to previous trigger, such as an occurrence during the discharge cycle, it will have no effect.

The minimum time for a trigger to be effective 2nd trigger, t_{rr} (Min.), depends on V_{CC} and C_x .

(4)Reset operation

In normal operation, the $\overline{CLR}$ input is held high. If $\overline{CLR}$ is low, a trigger has no effect because the Q output is held low and the trigger control F/F is reset. Also, Q_P turns on and C_x is charged rapidly to V_{CC} .

This means if $\overline{CLR}$ is set low, the IC goes into a wait state.

ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	VALUE	UNIT
Supply Voltage Range	V_{CC}	$-0.5 \sim 7$	V
DC Input Voltage	V_{IN}	$-0.5 \sim V_{CC} + 0.5$	V
DC Output Voltage	V_{OUT}	$-0.5 \sim V_{CC} + 0.5$	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)* / 180 (SOP)	mW
Storage Temperature	T_{stg}	$-65 \sim 150$	°C

*500mW in the range of $T_a = -40^\circ\text{C} \sim 65^\circ\text{C}$. From $T_a = 65^\circ\text{C}$ to 85°C a derating factor of $-10\text{mW}/^\circ\text{C}$ shall be applied until 300mW.

RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	VALUE	UNIT
Supply Voltage	V_{CC}	$2 \sim 6$	V
Input Voltage	V_{IN}	$0 \sim V_{CC}$	V
Output Voltage	V_{OUT}	$0 \sim V_{CC}$	V
Operating Temperature	T_{opr}	$-40 \sim 85$	°C
Input Rise and Fall Time (CLR Only)	t_r, t_f	$0 \sim 1000 (V_{CC} = 2.0\text{V})$ $0 \sim 500 (V_{CC} = 4.5\text{V})$ $0 \sim 400 (V_{CC} = 6.0\text{V})$	ns
External Capacitor	Cx	No Limitation *	F
External Resistor	Rx	$\geq 5\text{K} (V_{CC} = 2.0\text{V}) *$ $\geq 1\text{K} (V_{CC} \geq 3.0\text{V}) *$	Ω

* The maximum allowable values of Cx and Rx are a function of leakage of capacitor Cx, the leakage of TC74HC123A, and leakage due to board layout and surface resistance.
Susceptibility to externally induced noise signals may occur for $R_x > 1\text{M}\Omega$.

DC ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	TEST CONDITION		V _{CC} (V)	Ta = 25°C			Ta = -40~85°C		UNIT
					MIN.	TYP.	MAX.	MIN.	MAX.	
High - Level Input Voltage	V _{IH}			2.0 4.5 6.0	1.50 3.15 4.20	— — —	— — —	1.50 3.15 4.20	— — —	V
Low - Level Input Voltage	V _{IL}			2.0 4.5 6.0	— — —	— — —	0.50 1.35 1.80	— — —	0.50 1.35 1.80	V
High - Level Output Voltage (Q, $\bar{Q}$)	V _{OH}	V _{IN} = V _{IH} or V _{IL}	I _{OH} = -20 μ A	2.0 4.5 6.0	1.9 4.4 5.9	2.0 4.5 6.0	— — —	1.9 4.4 5.9	— — —	V
			I _{OH} = -4 mA	4.5 6.0	4.18 5.68	4.31 5.80	— —	4.13 5.63	— —	
			I _{OH} = -5.2 mA	4.5 6.0	4.18 5.68	4.31 5.80	— —	4.13 5.63	— —	
Low - Level Output Voltage (Q, $\bar{Q}$)	V _{OL}	V _{IN} = V _{IH} or V _{IL}	I _{OL} = 20 μ A	2.0 4.5 6.0	— — —	0.0 0.0 0.0	0.1 0.1 0.1	— — —	0.1 0.1 0.1	V
			I _{OL} = 4 mA	4.5 6.0	— —	0.17 0.18	0.26 0.26	— —	0.33 0.33	
			I _{OL} = 5.2 mA	4.5 6.0	— —	0.17 0.18	0.26 0.26	— —	0.33 0.33	
Input Leakage Current	I _{IN}	V _{IN} = V _{CC} or GND		6.0	—	—	±0.1	—	±1.0	μ A
Rx / Cx Terminal Off - State Current	I _{IN}	V _{IN} = V _{CC} or GND		6.0	—	—	±0.1	—	±1.0	
Quiescent Supply Current	I _{CC}	V _{IN} = V _{CC} or GND		6.0	—	—	4.0	—	40.0	
Active - State * Supply Current	I _{CC}	V _{IN} = V _{CC} or GND		2.0 4.5 6.0	— — —	45 400 0.7	200 500 1.0	— — —	260 650 1.3	μ A μ A mA
		Rx / Cx = 0.5 V _{CC}								

*: per circuit

TIMING REQUIREMENTS (Input t_r = t_f = 6ns)

PARAMETER	SYMBOL	TEST CONDITION		V _{CC} (V)	Ta = 25°C		Ta = -40~85°C		UNIT
					TYP.	LIMIT	LIMIT	LIMIT	
Minimum Pulse Width	t _{W(L)} t _{W(H)}			2.0 4.5 6.0	— — —	75 15 13	95 19 16		ns
				2.0 4.5 6.0	— — —	75 15 13	95 19 16		
				2.0 4.5 6.0	— — —	75 15 13	95 19 16		
Minimum Clear Width	t _{W(L)}			2.0 4.5 6.0	— — —	75 15 13	95 19 16		ns
				2.0 4.5 6.0	— — —	75 15 13	95 19 16		
				2.0 4.5 6.0	— — —	75 15 13	95 19 16		
Minimum Retrigger Time	t _{rr}	Rx = 1K Ω Cx = 100pF		2.0 4.5 6.0	325 108 78	— — —	— — —		μ s
		Rx = 1K Ω Cx = 0.01 μ F		2.0 4.5 6.0	5.0 1.4 1.2	— — —	— — —		

AC ELECTRICAL CHARACTERISTICS ($C_L = 15\text{pF}$, $V_{CC} = 5\text{V}$, $T_a = 25^\circ\text{C}$, Input $t_r = t_f = 6\text{ns}$)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Transition Time	t_{TLH} t_{THL}		—	4	8	ns
Propagation Delay Time ($\overline{A}$, B—Q, $\overline{Q}$)	t_{PLH} t_{PHL}		—	25	36	
Propagation Delay Time ($\overline{\text{CLR}}$ TRIGGER—Q, $\overline{Q}$)	t_{PLH} t_{PHL}		—	26	41	
Propagation Delay Time (CLR—Q, $\overline{Q}$)	t_{PLH} t_{PHL}		—	16	27	

AC ELECTRICAL CHARACTERISTICS ($C_L = 50\text{pF}$, Input $t_r = t_f = 6\text{ns}$)

PARAMETER	SYMBOL	TEST CONDITION	$T_a = 25^\circ\text{C}$			$T_a = -40\sim 85^\circ\text{C}$		UNIT
			$V_{CC}(\text{V})$	MIN.	TYP.	MAX.	MIN.	MAX.
Output Transition Time	t_{TLH} t_{THL}		2.0	—	30	75	—	95
			4.5	—	8	15	—	19
			6.0	—	7	13	—	16
Propagation Delay Time ($\overline{A}$, B—Q, $\overline{Q}$)	t_{PLH} t_{PHL}		2.0	—	102	210	—	265
			4.5	—	29	42	—	53
			6.0	—	22	36	—	45
Propagation Delay Time ($\overline{\text{CLR}}$ TRIGGER—Q, $\overline{Q}$)	t_{PLH} t_{PHL}		2.0	—	102	235	—	295
			4.5	—	31	47	—	59
			6.0	—	23	40	—	50
Propagation Delay Time (CLR—Q, $\overline{Q}$)	t_{PLH} t_{PHL}		2.0	—	68	160	—	200
			4.5	—	20	32	—	40
			6.0	—	16	27	—	34
Output Pulse Width	tw_{OUT}	$C_x = 28\text{pF}$ $R_x = 6\text{K}\Omega$ ($V_{CC} = 2\text{V}$) $R_x = 2\text{K}\Omega$ ($V_{CC} = 4.5\text{V}, 6\text{V}$)	2.0	—	700	2000	—	2500
			4.5	—	250	400	—	500
			6.0	—	210	340	—	425
		$C_x = 0.01\mu\text{F}$ $R_x = 10\text{K}\Omega$	2.0	90	110	130	90	130
			4.5	95	105	115	95	115
			6.0	95	105	115	95	115
		$C_x = 0.1\mu\text{F}$ $R_x = 10\text{K}\Omega$	2.0	0.9	1.0	1.2	0.9	1.2
			4.5	0.9	1.0	1.1	0.9	1.1
			6.0	0.9	1.0	1.1	0.9	1.1
Output Pulse Width Error Between Circuits (In same Package)	Δtw_{OUT}			—	± 1	—	—	—
Input Capacitance	C_{IN}			—	5	10	—	10
Power Dissipation Capacitance	$C_{PD}(1)$			—	162	—	—	—

Note (1) C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

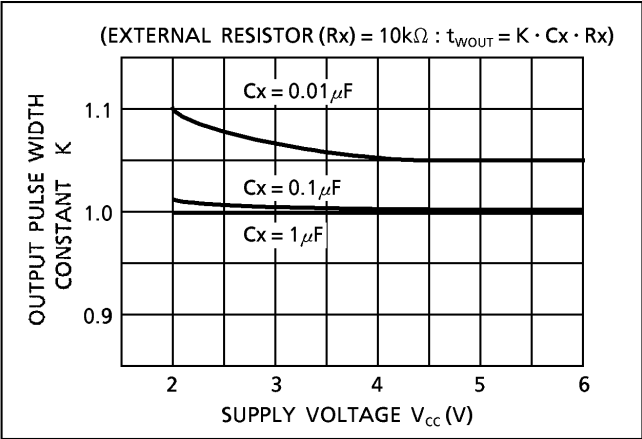
Average operating current can be obtained by the equation :

$$I_{CC}(\text{opr}) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}' \cdot \text{Duty} / 100 + I_{CC} / 2 \text{ (per circuit)}$$

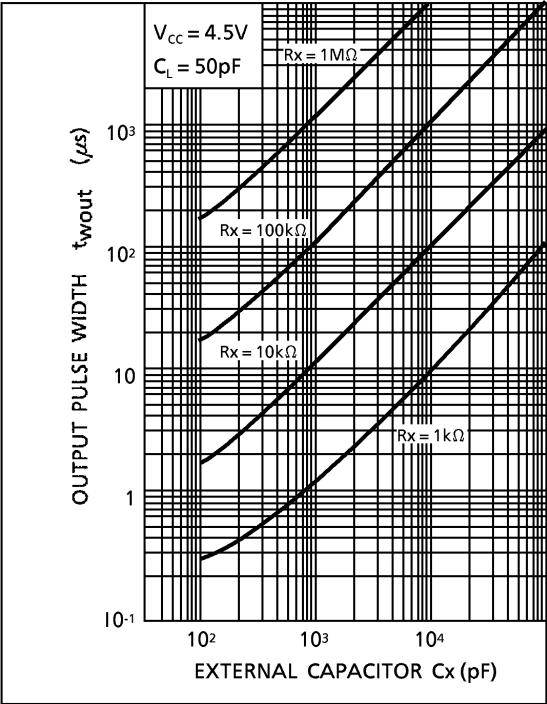
(I_{CC}' : Active Supply Current)

(Duty .%))

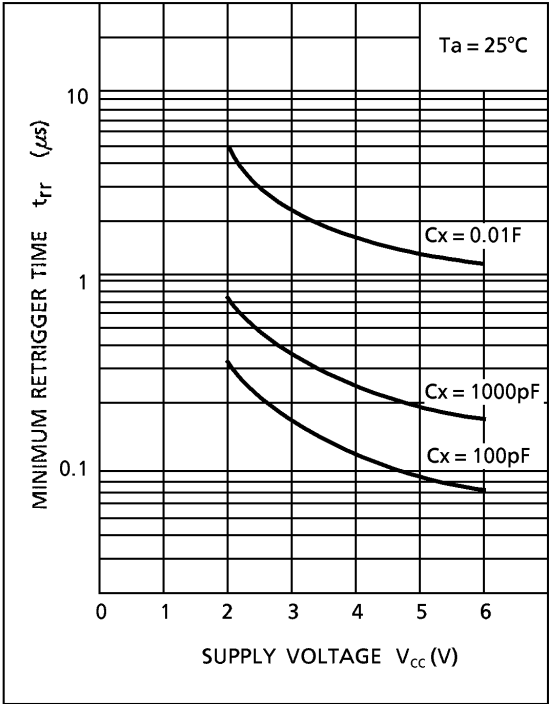
OUTPUT PULSE WIDTH CONSTANT K- SUPPLY VOLTAGE (TYPICAL)



t_{WOUT} - Cx CHARACTERISTICS (TYP.)

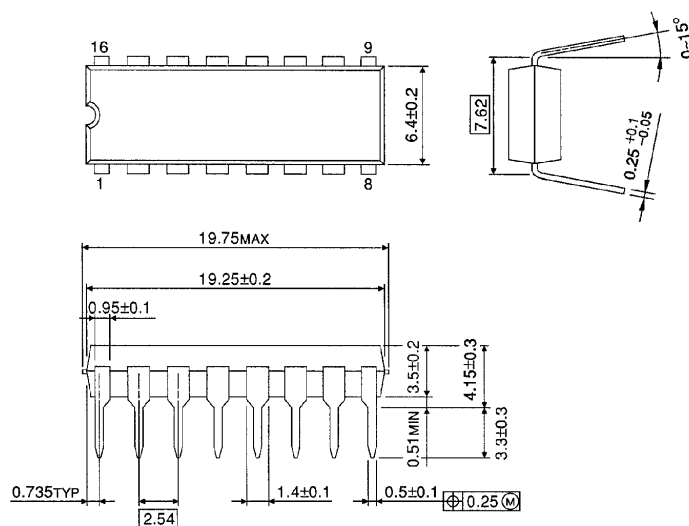


t_{rr} - V_{CC} CHARACTERISTICS (TYP.)



DIP 16PIN OUTLINE DRAWING (DIP16-P-300-2.54A)

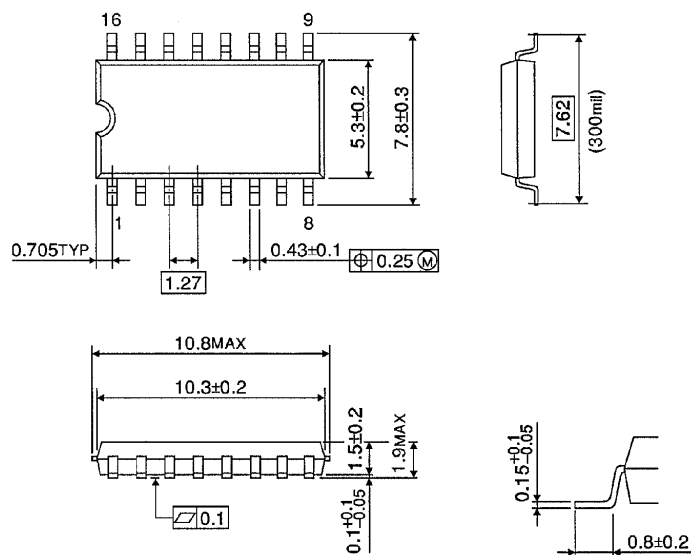
Unit in mm



Weight : 1.00g (Typ.)

SOP 16PIN (200mil BODY) OUTLINE DRAWING (SOP16-P-300-1.27)

Unit in mm

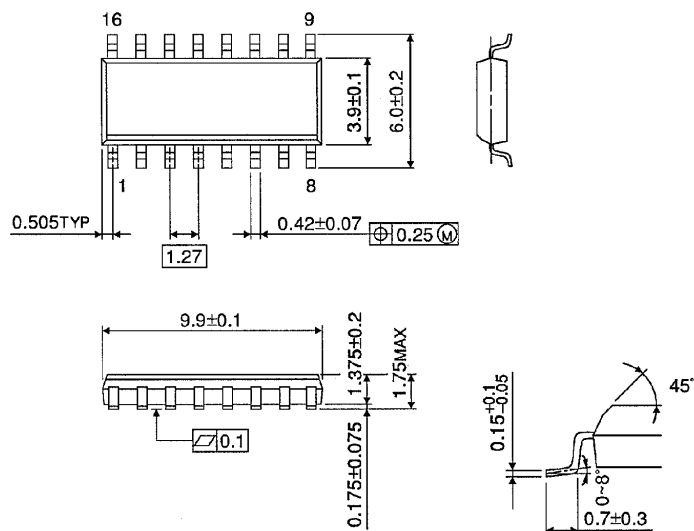


Weight : 0.18g (Typ.)

SOP 16PIN (150mil BODY) OUTLINE DRAWING (SOL16-P-150 -1.27)

Unit in mm

(Note) This package is not available in Japan.



Weight : 0.13g (Typ.)