

TC74HC193AP, TC74HC193AF, TC74HC193AFN

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

SYNCHRONOUS UP/DOWN BINARY COUNTER

The TC74HC193A are high speed CMOS SYNCHRONOUS 4-BIT UP/DOWN COUNTER fabricated with silicon gate C²MOS technology.

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

They have a clear input (CLR), a load input ($\overline{\text{LOAD}}$), load data inputs (A ~ D), two clock inputs (COUNT UP, COUNT DOWN), four count data outputs (QA ~ QD), and other outputs ($\overline{\text{CARRY}}$, $\overline{\text{BORROW}}$).

CLEAR is active high and forces QA thru QD outputs low independent of the other inputs.

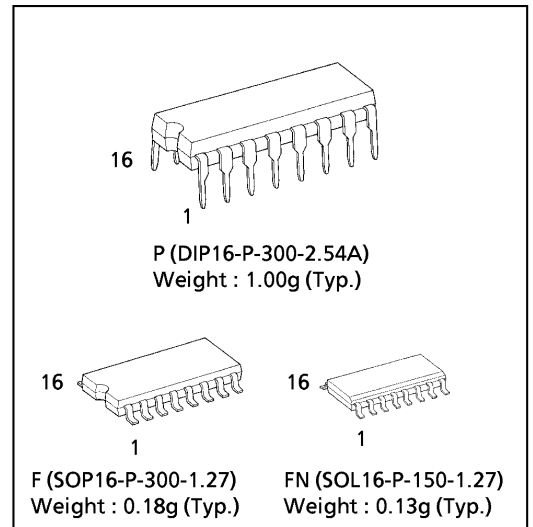
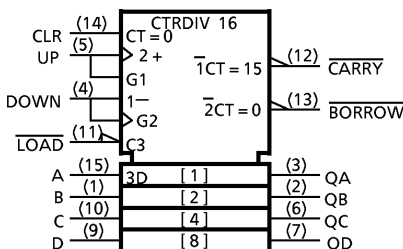
$\overline{\text{CARRY}}$ and $\overline{\text{BORROW}}$ outputs are provided in order to make a cascade connection without external circuitry.

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

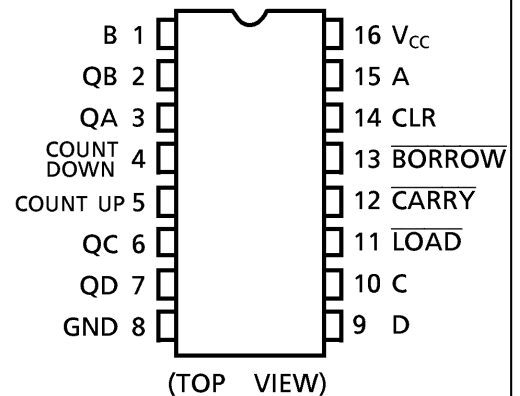
FEATURES:

- High Speed..... $f_{\text{MAX}} = 54\text{MHz}$ (typ.)
at $V_{\text{CC}} = 5\text{V}$
- Low Power Dissipation..... $I_{\text{CC}} = 4\mu\text{A}$ (Max.) at $T_a = 25^\circ\text{C}$
- High Noise Immunity..... $V_{\text{NIH}} = V_{\text{NIL}} = 28\% V_{\text{CC}}$ (Min.)
- Output drive Capability..... 10 LSTTL Loads
- Symmetrical Output Impedance... $|I_{\text{OH}}| = I_{\text{OL}} = 4\text{mA}$ (Min.)
- Balanced Propagation Delays..... $t_{\text{PLH}} \approx t_{\text{PHL}}$
- Wide Operating Voltage Range... V_{CC} (opr.) = 2V ~ 6V
- Pin and Function Compatible with 74LS193

IEC LOGIC SYMBOL



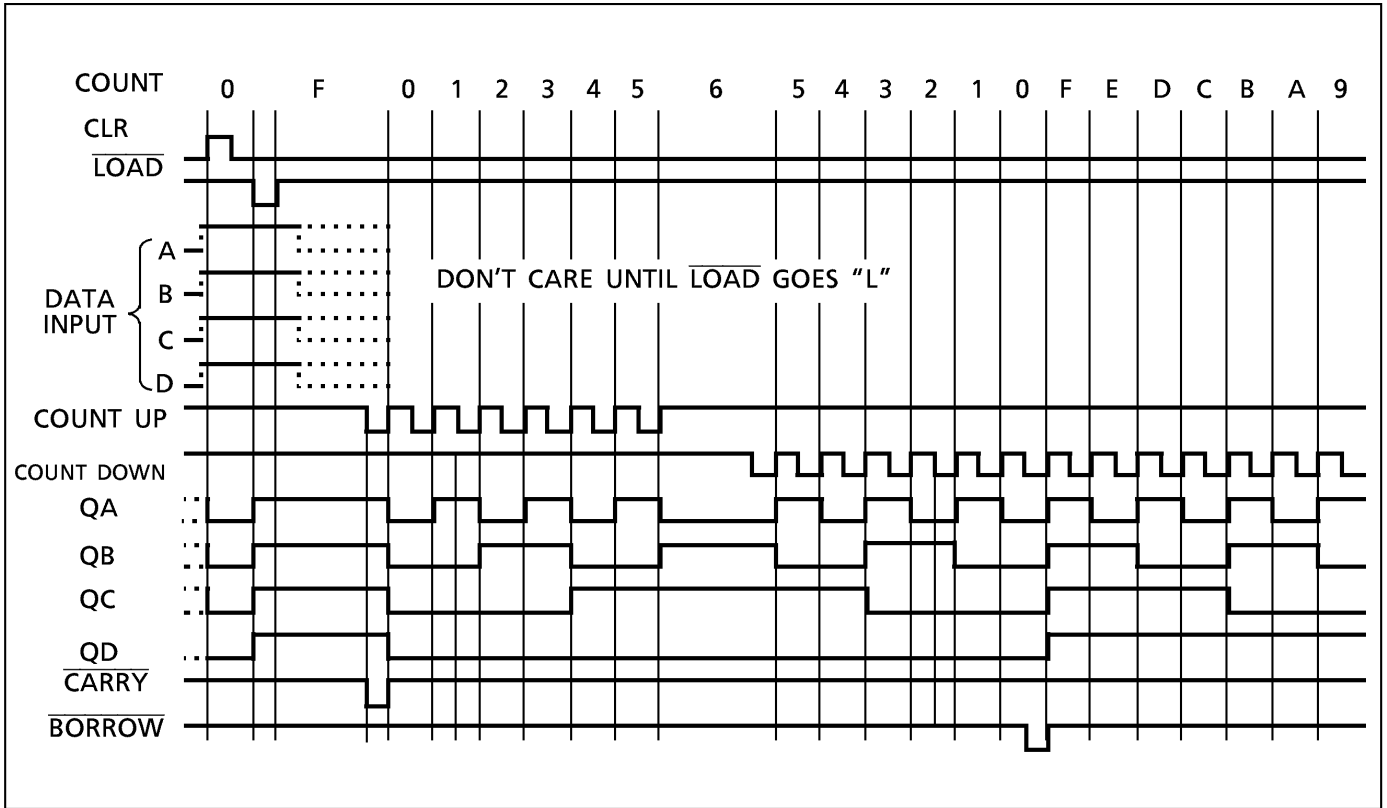
PIN ASSIGNMENT



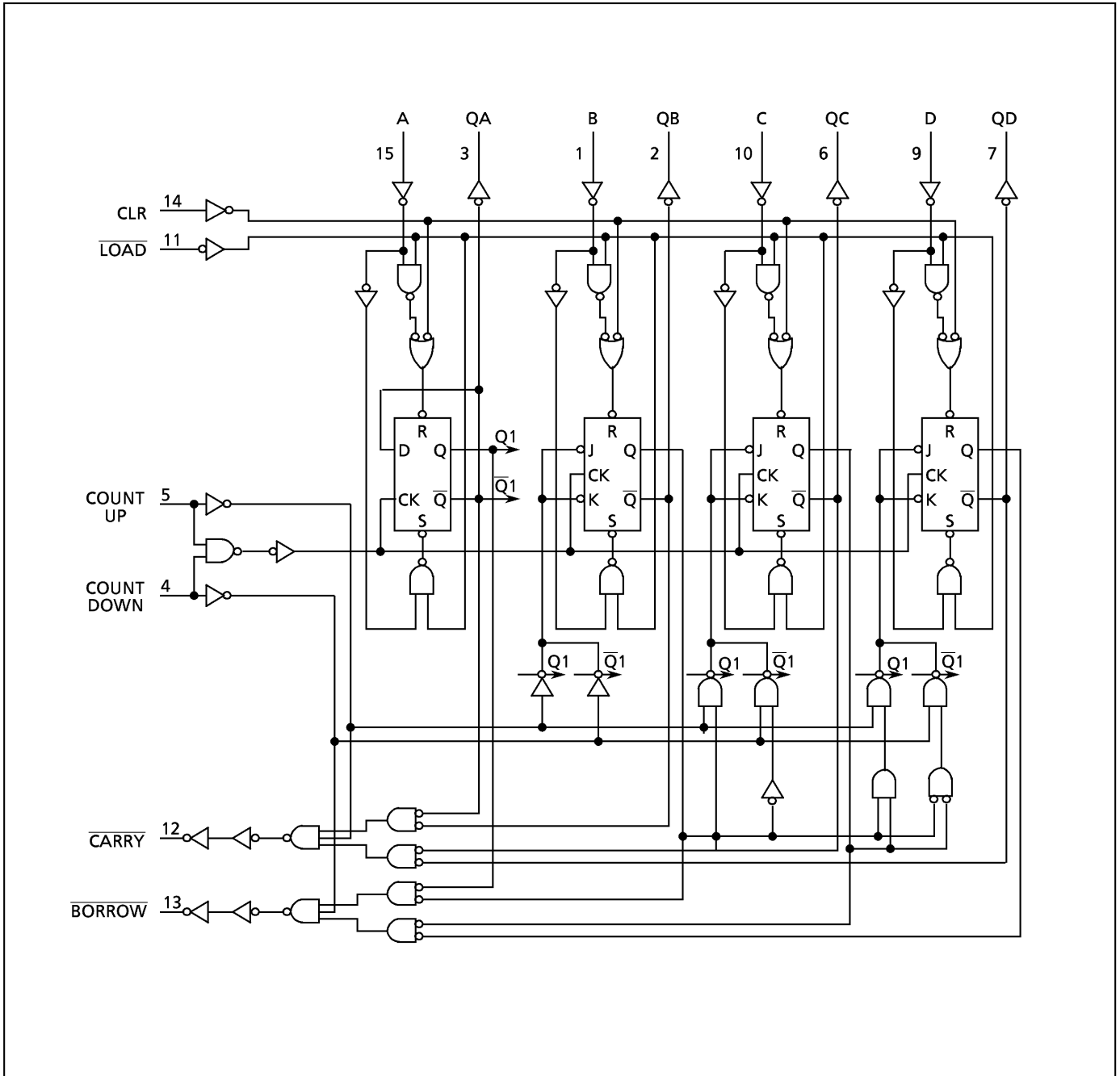
TRUTH TABLE

INPUTS				FUNCTION
COUNT UP	COUNT DOWN	$\overline{\text{LOAD}}$	CLR	
	H	H	L	COUNT UP
	H	H	L	NO COUNT
H		H	L	COUNT DOWN
H		H	L	NO COUNT
X	X	L	L	PRESET
X	X	X	H	RESET

TIMING CHART



SYSTEM DIAGRAM



ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	VALUE	UNIT
Supply Voltage Range	V_{CC}	-0.5~7	V
DC Input Voltage	V_{IN}	-0.5~ $V_{CC}+0.5$	V
DC Output Voltage	V_{OUT}	-0.5~ $V_{CC}+0.5$	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}	-65~150	°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}	2~6	V
Input Voltage	V_{IN}	0~ V_{CC}	V
Output Voltage	V_{OUT}	0~ V_{CC}	V
Operating Temperature	T_{opr}	-40~85	°C
Input Rise and Fall Time	t_r, t_f	0~1000 ($V_{CC} = 2.0\text{V}$) 0~500 ($V_{CC} = 4.5\text{V}$) 0~400 ($V_{CC} = 6.0\text{V}$)	ns

DC ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	TEST CONDITION	V_{CC} (V)	$T_a = 25^{\circ}\text{C}$			$T_a = -40 \sim 85^{\circ}\text{C}$		UNIT	
				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}	$I_{OH} = -20\mu\text{A}$	2.0	1.9	2.0	—	1.9	—	V
				4.5	4.4	4.5	—	4.4	—	
			4.5 $I_{OH} = -4\text{ mA}$ $I_{OH} = -5.2\text{ mA}$	6.0	5.9	6.0	—	5.9	—	
				6.0	4.18	4.31	—	4.13	—	
Low - Level Output Voltage	V_{OL}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OL} = 20\mu\text{A}$	2.0	—	0.0	0.1	—	0.1	V
				4.5	—	0.0	0.1	—	0.1	
			4.5 $I_{OL} = 4\text{ mA}$ $I_{OL} = 5.2\text{ mA}$	6.0	—	0.0	0.1	—	0.1	
				6.0	—	0.17	0.26	—	0.33	
			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		

TIMING REQUIREMENTS (Input $t_r = t_f = 6\text{ns}$)

PARAMETER	SYMBOL	TEST CONDITION	V_{CC} (V)	$T_a = 25^\circ\text{C}$		$T_a = -40\sim 85^\circ\text{C}$	UNIT
				TYP.	LIMIT	LIMIT	
Minimum Pulse Width (CK)	$t_{W(H)}$ $t_{W(L)}$		2.0	—	100	125	ns
			4.5	—	20	25	
			6.0	—	17	21	
Minimum Pulse Width (LOAD)	$t_{W(L)}$		2.0	—	75	95	
			4.5	—	15	19	
			6.0	—	13	16	
Minimum Hold Time (CLR)	$t_{W(H)}$		2.0	—	100	125	
			4.5	—	20	25	
			6.0	—	17	21	
Minimum Set-up Time (DATA—LOAD)	t_s		2.0	—	75	95	
			4.5	—	15	19	
			6.0	—	13	16	
Minimum Hold Time (DATA—LOAD)	t_h		2.0	—	0	0	
			4.5	—	0	0	
			6.0	—	0	0	
Minimum Removal Time (LOAD)	t_{rem}		2.0	—	50	65	
			4.5	—	10	13	
			6.0	—	9	10	
Minimum Removal Time (CLR)	t_{rem}		2.0	—	50	65	
			4.5	—	10	13	
			6.0	—	9	10	
Clock Frequency	f		2.0	—	5	4	MHz
			4.5	—	25	20	
			6.0	—	29	24	

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}		—	6	12	ns
Propagation Delay Time (UP, DOWN—Q)	t_{pLH} t_{pHL}		—	16	33	
Propagation Delay Time (UP— $\overline{\text{CARRY}}$)	t_{pLH} t_{pHL}		—	10	22	
Propagation Delay Time (DOWN— $\overline{\text{BORROW}}$)	t_{pLH} t_{pHL}		—	10	22	
Propagation Delay Time (LOAD—Q)	t_{pLH} t_{pHL}		—	21	38	
Propagation Delay Time (LOAD— $\overline{\text{CARRY}}$)	t_{pLH} t_{pHL}		—	25	44	
Propagation Delay Time (LOAD— $\overline{\text{BORROW}}$)	t_{pLH} t_{pHL}		—	26	44	
Propagation Delay Time (DATA IN—Q)	t_{pLH} t_{pHL}		—	21	33	
Propagation Delay Time (DATA IN— $\overline{\text{CARRY}}$)	t_{pLH} t_{pHL}		—	29	44	
Propagation Delay Time (DATA IN— $\overline{\text{BORROW}}$)	t_{pLH} t_{pHL}		—	26	44	
Propagation Delay Time (CLR—Q)	t_{pHL}		—	25	39	
Propagation Delay Time (CLR— $\overline{\text{CARRY}}$)	t_{pLH}		—	30	44	
Propagation Delay Time (CLR— $\overline{\text{BORROW}}$)	t_{pHL}		—	30	44	
Maximum Clock Frequency	f_{MAX}		27	52	—	MHz

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

PARAMETER	SYMBOL	TEST CONDITION	V_{CC} (V)	$T_a = 25^\circ\text{C}$			$T_a = -40\sim 85^\circ\text{C}$		UNIT
				MIN.	TYP.	MAX.	MIN.	MAX.	
Output Transition Time	t_{TLH} t_{THL}		2.0	—	30	75	—	95	ns
			4.5	—	8	15	—	19	
			6.0	—	7	13	—	16	
Propagation Delay Time (UP, DOWN—Q)	t_{pLH} t_{pHL}		2.0	—	65	190	—	240	
			4.5	—	20	38	—	48	
			6.0	—	16	32	—	41	
Propagation Delay Time (UP—CARRY)	t_{pLH} t_{pHL}		2.0	—	40	130	—	165	
			4.5	—	13	26	—	33	
			6.0	—	11	22	—	28	
Propagation Delay Time (DOWN—BORROW)	t_{pLH} t_{pHL}		2.0	—	40	130	—	165	
			4.5	—	13	26	—	33	
			6.0	—	11	22	—	28	
Propagation Delay Time (LOAD—Q)	t_{pLH} t_{pHL}		2.0	—	85	220	—	275	
			4.5	—	25	44	—	55	
			6.0	—	20	37	—	47	
Propagation Delay Time (LOAD—CARRY)	t_{pLH} t_{pHL}		2.0	—	110	250	—	315	
			4.5	—	30	50	—	63	
			6.0	—	25	43	—	54	
Propagation Delay Time (LOAD—BORROW)	t_{pLH} t_{pHL}		2.0	—	110	250	—	315	
			4.5	—	30	50	—	63	
			6.0	—	25	43	—	54	
Propagation Delay Time (DATA IN—Q)	t_{pLH} t_{pHL}		2.0	—	80	190	—	240	
			4.5	—	25	38	—	48	
			6.0	—	20	32	—	41	
Propagation Delay Time (DATA IN—CARRY)	t_{pLH} t_{pHL}		2.0	—	120	250	—	315	
			4.5	—	34	50	—	63	
			6.0	—	28	43	—	54	
Propagation Delay Time (DATA IN—BORROW)	t_{pLH} t_{pHL}		2.0	—	110	250	—	315	
			4.5	—	31	50	—	63	
			6.0	—	25	43	—	54	
Propagation Delay Time (CLR—Q)	t_{pHL}		2.0	—	100	225	—	280	
			4.5	—	30	45	—	56	
			6.0	—	25	38	—	48	
Propagation Delay Time (CLR—CARRY)	t_{pLH}		2.0	—	120	250	—	315	
			4.5	—	35	50	—	63	
			6.0	—	29	43	—	54	
Propagation Delay Time (CLR—BORROW)	t_{pHL}		2.0	—	120	250	—	315	
			4.5	—	35	50	—	63	
			6.0	—	29	43	—	54	
Maximum Clock Frequency	f_{MAX}		2.0	5	12	—	4	—	MHz
			4.5	25	48	—	20	—	
			6.0	29	55	—	24	—	
Input Capacitance	C_{IN}			—	5	10	—	10	pF
Power Dissipation Capacitance	C_{PD} (1)			—	67	—	—	—	

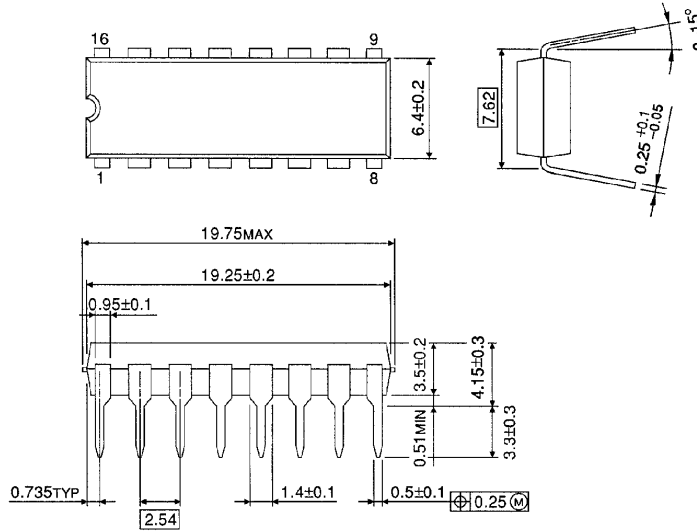
Note (1) C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation :

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

DIP 16PIN PACKAGE DIMENSIONS (DIP16-P-300-2.54A)

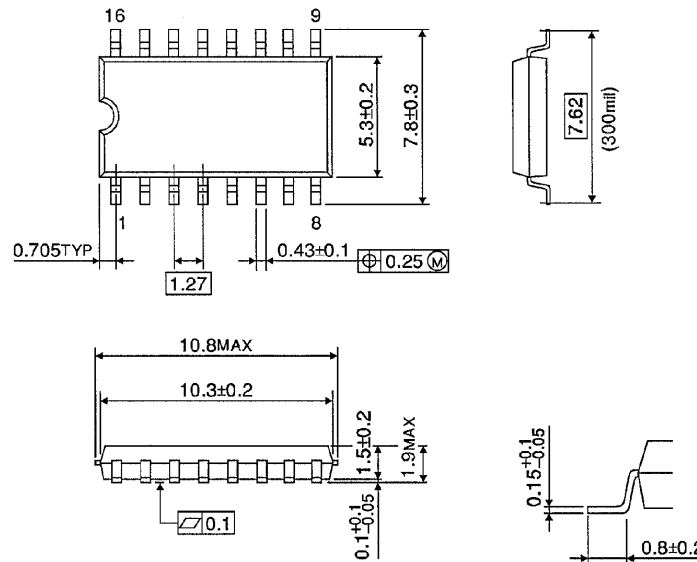
Unit in mm



Weight : 1.00g (Typ.)

SOP 16PIN (200mil BODY) PACKAGE DIMENSIONS (SOP16-P-300-1.27)

Unit in mm

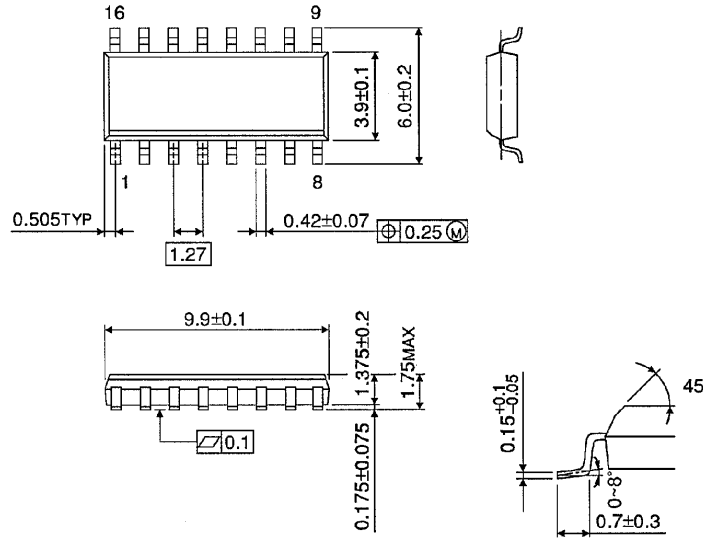


Weight : 0.18g (Typ.)

SOP 16PIN (150mil BODY) PACKAGE DIMENSIONS (SOL16-P-150 -1.27)

Unit in mm

(Note) This package is not available in Japan.



Weight : 0.13g (Typ.)

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