TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

TC74HC109AP, TC74HC109AF, TC74HC109AFN

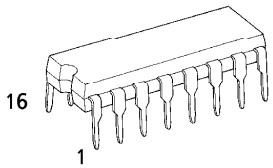
DUAL J – $\overline{K}$ FLIP – FLOP WITH PRESET AND CLEAR

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

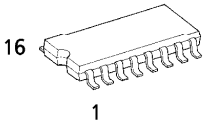
The TC74HC109A is a high speed CMOS J - $\overline{K}$ FLIP FLOP fabricated with silicon gate C^2MOS technology.
It achieves the high speed operation similar to equivalent LSTTL while maintaining the CMOS low power dissipation.
In accordance with the logic levels applied to the J and $\overline{K}$ inputs, the outputs change state on the positive going transition of the clock pulse.
$\overline{CLR}$ and $\overline{PR}$ are independent of the clock and are accomplished by a low logic level on the corresponding input.
All inputs are equipped with protection circuits against static discharge or transient excess voltage.

FEATURES :

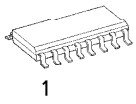
- High Speed ····· f_{MAX} = 63MHz (typ.) at V_{CC} = 5V
- Low Power Dissipation ····· I_{CC} = 4μA(Max.) at Ta = 25°C
- High Noise Immunity ····· $V_{NIH} = V_{NIL}$ = 28% V_{CC} (Min.)
- Output Drive Capability ····· 10 LSTTL Loads
- Symmetrical Output Impedance ··· $|I_{OH}| = I_{OL}$ = 4mA(Min.)
- Balanced Propagation Delays ····· $t_{pLH} \simeq t_{pHL}$
- Wide Operating Voltage Range ···· V_{CC} (opr.) = 2V ~ 6V
- Pin and Function Compatible with 74LS109



P (DIP16-P-300-2.54A)
Weight : 1.00g (Typ.)

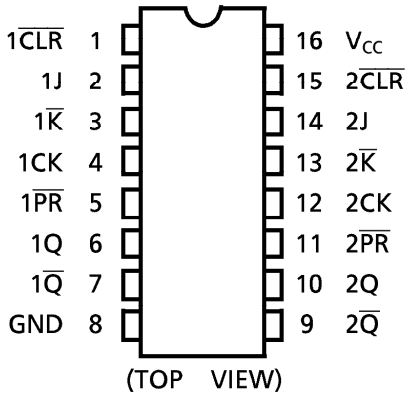


F (SOP16-P-300-1.27)
Weight : 0.18g (Typ.)



FN (SOL16-P-150-1.27)
Weight : 0.13g (Typ.)

PIN ASSIGNMENT

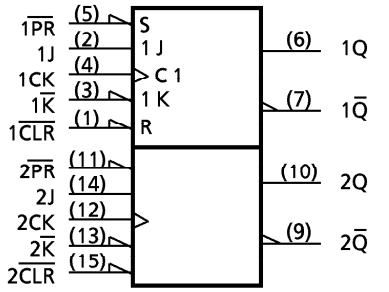


TRUTH TABLE

INPUTS					OUTPUTS		FUNCTION
$\overline{CLR}$	$\overline{PR}$	J	$\overline{K}$	CK	Q	$\overline{Q}$	
L	H	X	X	X	L	H	CLEAR
H	L	X	X	X	H	L	PRESET
L	L	X	X	X	H	H	
H	H	L	H	↑	Q_n	$\overline{Q}_n$	NO CHANGE
H	H	L	L	↑	L	L	
H	H	H	H	↑	H	L	
H	H	H	L	↑	$\overline{Q}_n$	Q_n	TOGGLE
H	H	X	X	↓	Q_n	$\overline{Q}_n$	NO CHANGE

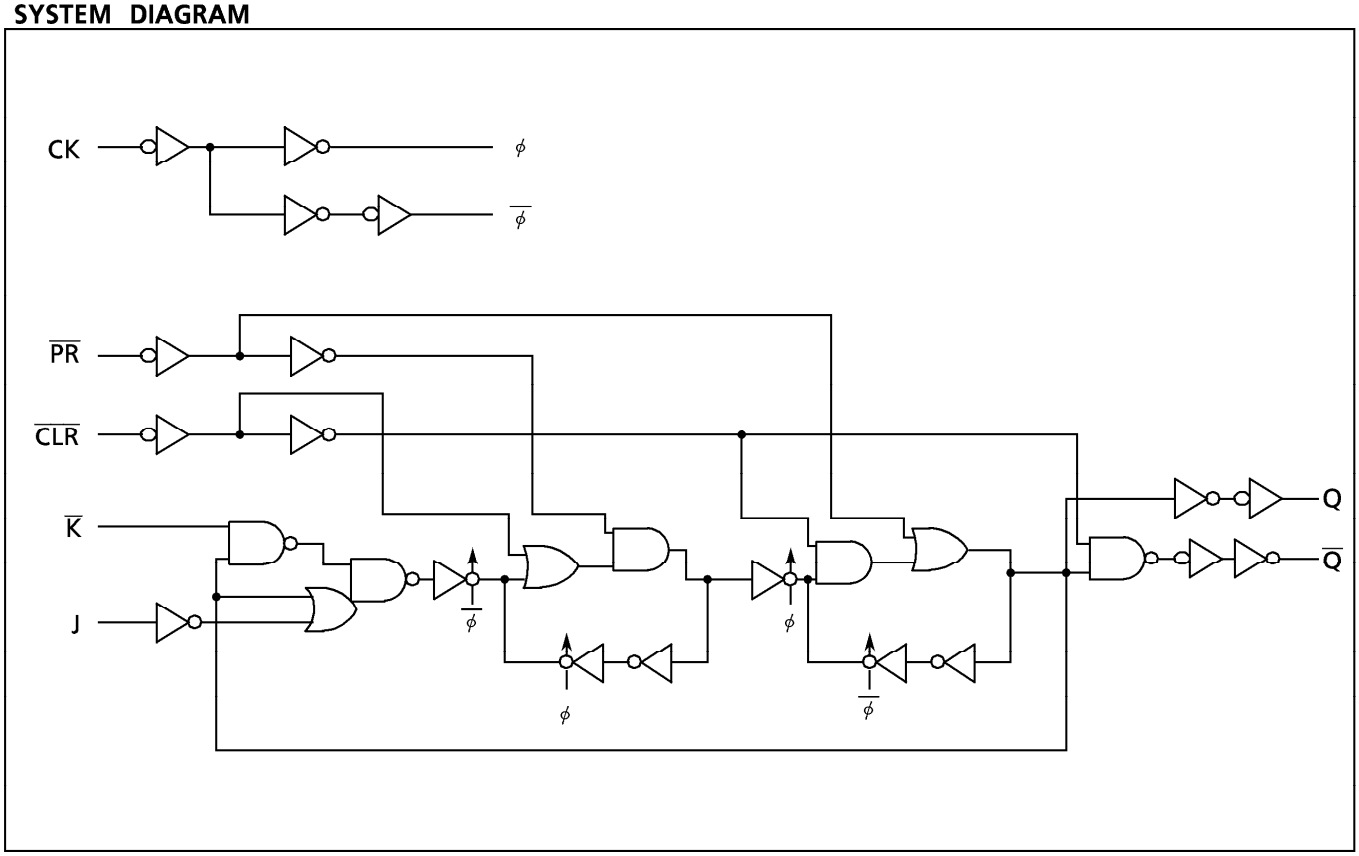
X : Don't Care

IEC LOGIC SYMBOL



961001EBA2

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 Ta= −40°C~65°C. From Ta=65°C to 85 °C a derating factor of −10mW/ °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} = 2.0V) 0~ 500 (V_{CC} = 4.5V) 0~ 400 (V_{CC} = 6.0V)	ns

DC ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	TEST CONDITION		V_{CC} (V)	Ta = 25°C MIN.	Ta = 25°C TYP.	Ta = 25°C MAX.	Ta = −40~85°C MIN.	Ta = −40~85°C MAX.	UNIT
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	V_{OH}	V_{IN} = V_{IH} or V_{IL}	I_{OH} = −20μA	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 I_{OH} = −5.2mA	4.5 6.0	4.18 5.68	4.31 5.80	− −	4.13 5.63	− −	
Low - Level Output Voltage	V_{OL}	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 20μA	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 I_{OL} = 5.2mA	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	μA
Quiescent Supply Current	I_{CC}	V_{IN} = V_{CC} or GND		6.0	−	−	2.0	−	20.0	

TIMING REQUIREMENTS (Input $t_r = t_f = 6ns$)

PARAMETER	SYMBOL	TEST CONDITION	V_{CC} (V)	Ta = 25°C TYP.	Ta = 25°C LIMIT	Ta = −40~85°C LIMIT	UNIT
Minimum Pulse Width (CK)	$t_{W(L)}$ $t_{W(H)}$		2.0	—	75	95	ns
			4.5	—	15	19	
			6.0	—	13	16	
Minimum Pulse Width ($\overline{PR}$, $\overline{CLR}$)	$t_{W(L)}$		2.0	—	75	95	
			4.5	—	15	19	
			6.0	—	13	16	
Minimum Set−up Time	t_s		2.0	—	75	95	
			4.5	—	15	19	
			6.0	—	13	16	
Minimum Hold Time	t_h		2.0	—	0	0	
			4.5	—	0	0	
			6.0	—	0	0	
Minimum Removal Time ($\overline{PR}$, $\overline{CLR}$)	t_{rem}		2.0	—	50	65	
			4.5	—	10	13	
			6.0	—	9	11	
Clock Frequency	f		2.0	—	6	5	MHz
			4.5	—	31	25	
			6.0	—	36	29	

AC ELECTRICAL CHARACTERISTICS ($C_L = 15pF$, $V_{CC} = 5V$, Ta = 25°C, Input $t_r = t_f = 6ns$)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Transition Time	t_{TLH} t_{THL}		—	6	12	ns
Propagation Delay Time (CK−Q, $\overline{Q}$)	t_{pLH} t_{pHL}		—	13	26	
Propagation Delay Time ($\overline{PR}$, $\overline{CLR}$−Q, $\overline{Q}$)	t_{pLH} t_{pHL}		—	13	26	
Maximum Clock Frequency	f_{MAX}		33	63	—	MHz

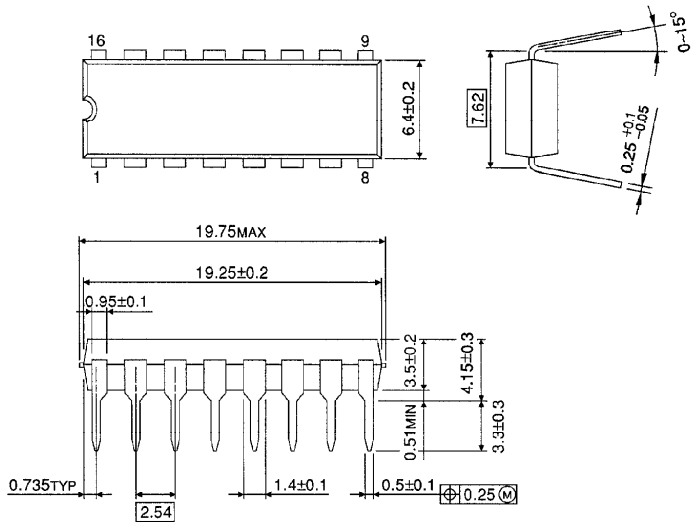
AC ELECTRICAL CHARACTERISTICS ($C_L = 50pF$, Input $t_r = t_f = 6ns$)

PARAMETER	SYMBOL	TEST CONDITION	V_{CC} (V)	Ta = 25°C MIN.	Ta = 25°C TYP.	Ta = 25°C MAX.	Ta = −40~85°C MIN.	Ta = −40~85°C MAX.	UNIT
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 (CK−Q, $\overline{Q}$)	t_{pLH} t_{pHL}		2.0	—	50	150	—	190	
			4.5	—	16	30	—	38	
			6.0	—	13	26	—	32	
Propagation Delay Time ($\overline{PR}$, $\overline{CLR}$−Q, $\overline{Q}$)	t_{pLH} t_{pHL}		2.0	—	50	150	—	190	
			4.5	—	16	30	—	38	
			6.0	—	13	26	—	32	
Maximum Clock Frequency	f_{MAX}		2.0	6	17	—	5	—	MHz
			4.5	31	59	—	25	—	
			6.0	36	67	—	29	—	
Input Capacitance	C_{IN}			—	5	10	—	10	pF
Power Dissipation Capacitance	C_{PD} (1)			—	41	—	—	—	

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:

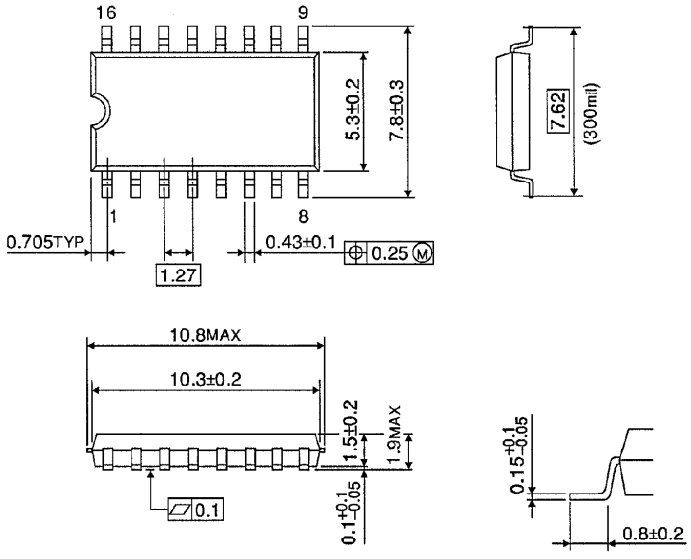
$$I_{CC}(opr) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC} / 2 \text{ (per F / F)}$$

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



Weight : 1.00g (Typ.)

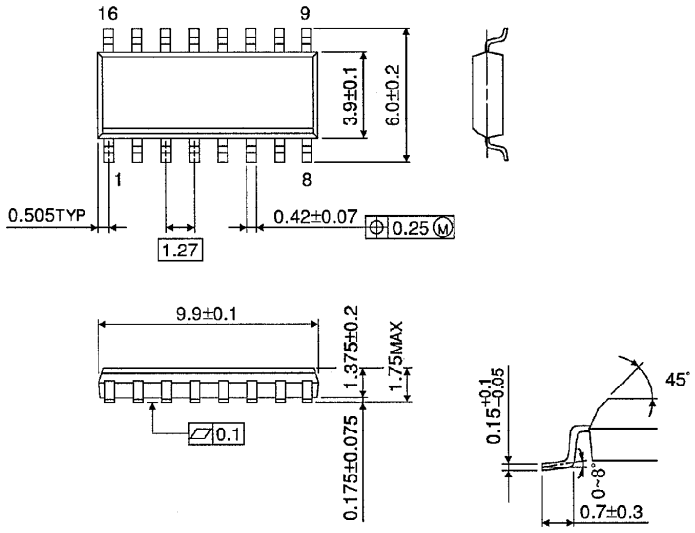
SOP 16PIN (200mil BODY) OUTLINE DRAWING (SOP16-P-300-1.27) Unit in mm



Weight : 0.18g (Typ.)

SOP 16PIN (150mil BODY) OUTLINE DRAWING (SOL14-P-150 -1.27) Unit in mm

(Note) This package is not available in Japan.



Weight : 0.13g (Typ.)