

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC74HC107AP, TC74HC107AF, TC74HC107AFN

Dual J-K Flip Flop with Clear

The TC74HC107A is a high speed CMOS DUAL J-K FLIP FLOP fabricated with silicon gate C²MOS 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 K inputs, the outputs change state on the negative going transition of the clock pulse.

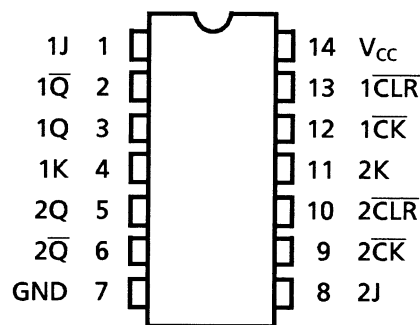
CLR is independent of the clock and is accomplished by a low logic level on the input.

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

Features

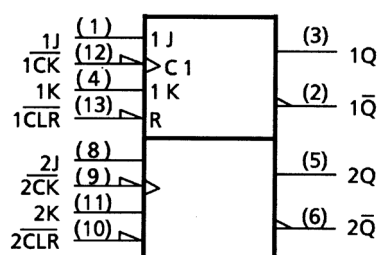
- High speed: $f_{max} = 75$ MHz (typ.) at $V_{CC} = 5$ V
- Low power dissipation: $I_{CC} = 2$ μ A (max) at $T_a = 25^\circ$ C
- High noise immunity: $V_{NIH} = V_{NIL} = 28\%$ V_{CC} (min)
- Output drive capability: 10 LSTTL loads
- Symmetrical output impedance: $|I_{OH}| = I_{OL} = 4$ mA (min)
- Balanced propagation delays: $t_{pLH} \approx t_{pHL}$
- Wide operating voltage range: V_{CC} (opr) = 2~6 V
- Pin and function compatible with 74LS107

Pin Assignment

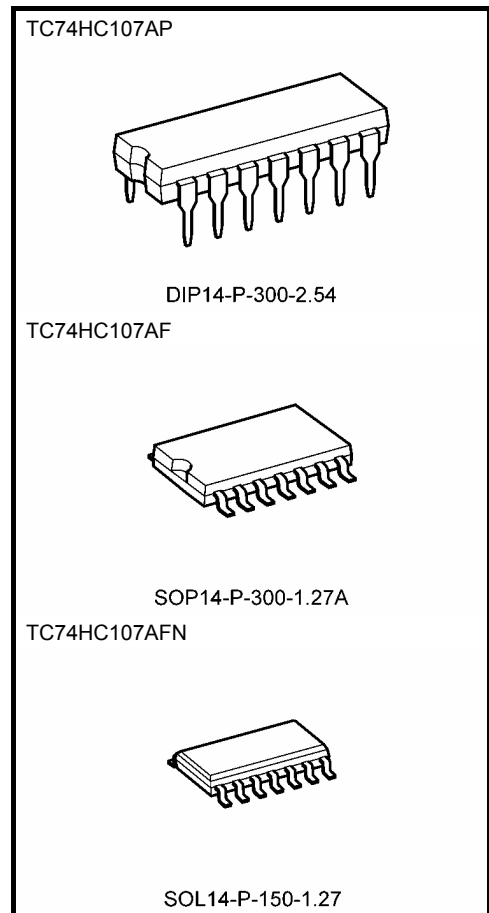


(TOP VIEW)

IEC Logic Symbol



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



Weight

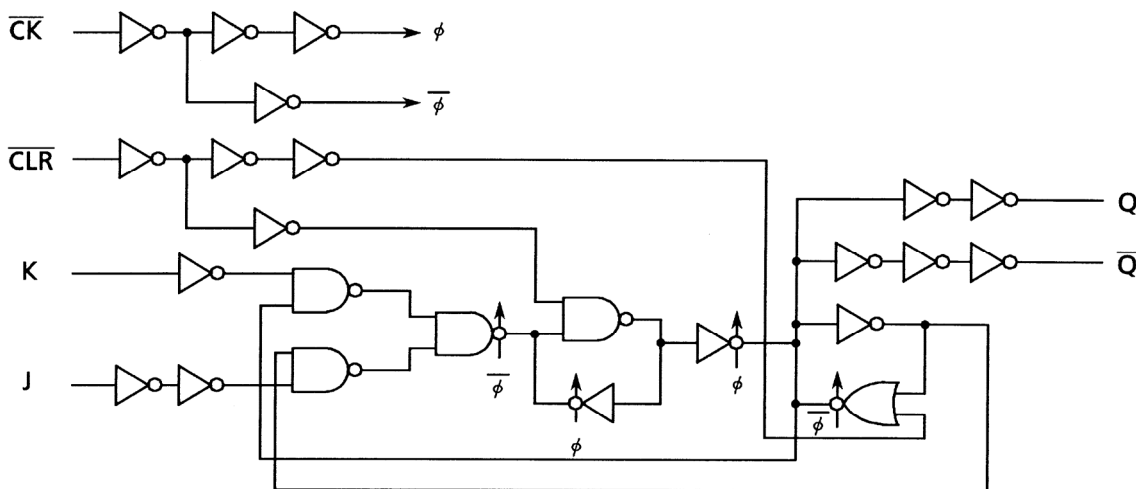
DIP14-P-300-2.54	: 0.96 g (typ.)
SOP14-P-300-1.27A	: 0.18 g (typ.)
SOL14-P-150-1.27	: 0.12 g (typ.)

Truth Table

Inputs				Outputs		Function
$\overline{\text{CLR}}$	J	K	$\overline{\text{CK}}$	Q	$\overline{\text{Q}}$	
L	X	X	X	L	H	Clear
H	L	L	\downarrow	Q_n	$\overline{\text{Q}}_n$	No Change
H	L	H	\downarrow	L	H	—
H	H	L	\downarrow	H	L	—
H	H	H	\downarrow	$\overline{\text{Q}}_n$	Q_n	Toggle
H	X	X	\uparrow	Q_n	$\overline{\text{Q}}_n$	No Change

X: Don't care

System Diagram



Absolute Maximum Ratings (Note 1)

Characteristics	Symbol	Rating	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) (Note 2)/180 (SOP)	mW
Storage temperature	T_{stg}	-65~150	$^{\circ}\text{C}$

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

Operating Ranges (Note)

Characteristics	Symbol	Rating	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 ($V_{CC} = 2.0$ V) 0~500 ($V_{CC} = 4.5$ V) 0~400 ($V_{CC} = 6.0$ V)	ns

Note: The operating ranges must be maintained to ensure the normal operation of the device.
Unused inputs must be tied to either V_{CC} or GND.

Electrical Characteristics

DC Characteristics

Characteristics	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
			$I_{OH} = -4 \text{ mA}$	4.5	4.4	4.5	—	4.4	—	
			$I_{OH} = -5.2 \text{ mA}$	6.0	5.9	6.0	—	5.9	—	
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
			$I_{OL} = 4 \text{ mA}$	4.5	—	0.0	0.1	—	0.1	
			$I_{OL} = 5.2 \text{ mA}$	6.0	—	0.0	0.1	—	0.1	
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	μA	

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

Characteristics	Symbol	Test Condition	Ta = 25°C			Ta = -40 ~85°C	Unit
			V _{CC} (V)	Typ.	Limit	Limit	
Minimum pulse width (\overline{CK})	t_W (L) t_W (H)	—	2.0	—	75	95	ns
			4.5	—	15	19	
			6.0	—	13	16	
Minimum pulse width (\overline{CLR})	t_W (L)	—	2.0	—	75	95	ns
			4.5	—	15	19	
			6.0	—	13	16	
Minimum set-up time	t_s	—	2.0	—	75	95	ns
			4.5	—	15	19	
			6.0	—	13	16	
Minimum hold time	t_h	—	2.0	—	0	0	ns
			4.5	—	0	0	
			6.0	—	0	0	
Minimum removal time (\overline{CLR})	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	—	31	25	
			6.0	—	37	30	

AC Characteristics ($C_L = 15$ pF, $V_{CC} = 5$ V, Ta = 25°C, input: $t_r = t_f = 6$ ns)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Output transition time	t_{TLH}	—	—	4	8	ns
	t_{THL}					
Propagation delay time (\overline{CK} -Q, \overline{Q})	t_{pLH}	—	—	11	21	ns
	t_{pHL}					
Propagation delay time (\overline{CLR} -Q, \overline{Q})	t_{pLH}	—	—	12	24	ns
	t_{pHL}					
Maximum clock frequency	f_{max}	—	34	75	—	MHz

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

Characteristics	Symbol	Test Condition	V _{CC} (V)	Ta = 25°C			Ta = -40~85°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 (\overline{CK} -Q, \overline{Q})	t_{pLH} t_{pHL}	—	2.0	—	48	125	—	155	ns
			4.5	—	14	25	—	31	
			6.0	—	12	21	—	26	
Propagation delay time (\overline{CLR} -Q, \overline{Q})	t_{pLH} t_{pHL}	—	2.0	—	52	140	—	175	ns
			4.5	—	15	28	—	35	
			6.0	—	13	24	—	30	
Maximum clock frequency	f_{max}	—	2.0	6	23	—	5	—	MHz
			4.5	31	70	—	25	—	
			6.0	37	80	—	30	—	
Input capacitance	C_{IN}	—	—	5	10	—	10	pF	
Power dissipation capacitance	C_{PD} (Note)	—	—	33	—	—	—	pF	

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

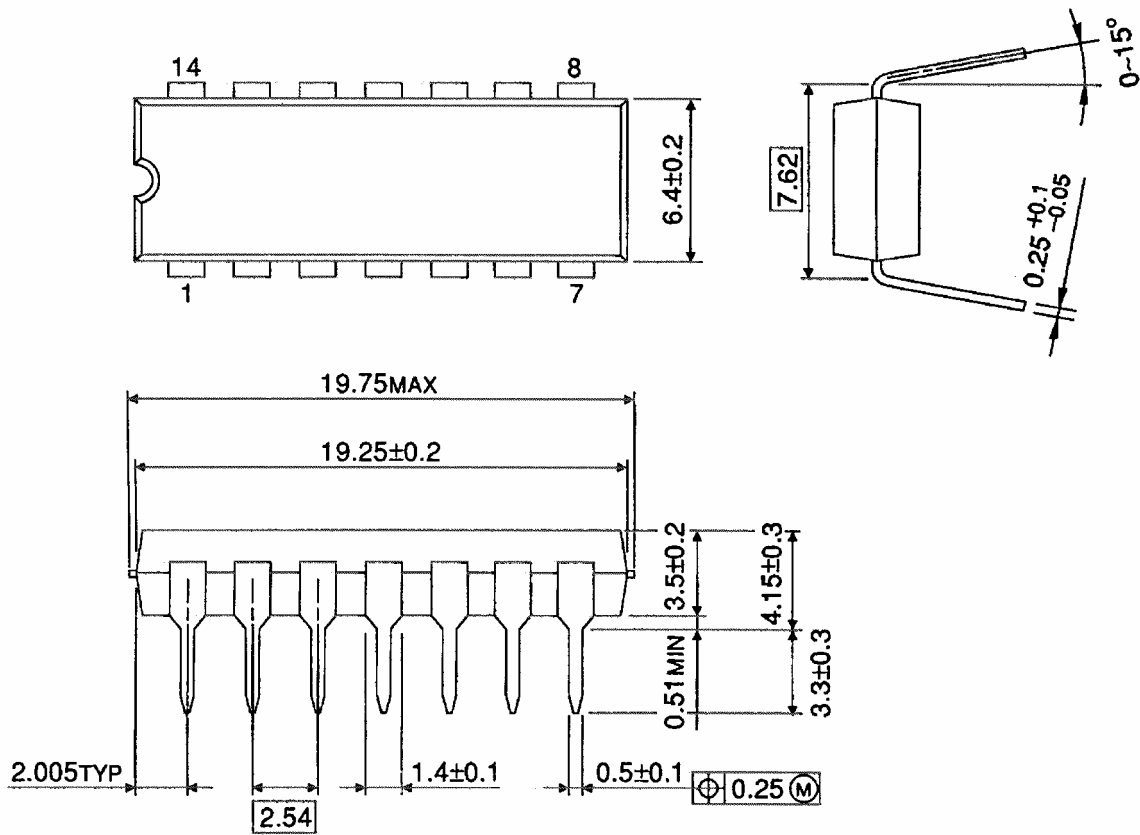
Average operating current can be obtained by the equation:

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

Package Dimensions

DIP14-P-300-2.54

Unit : mm

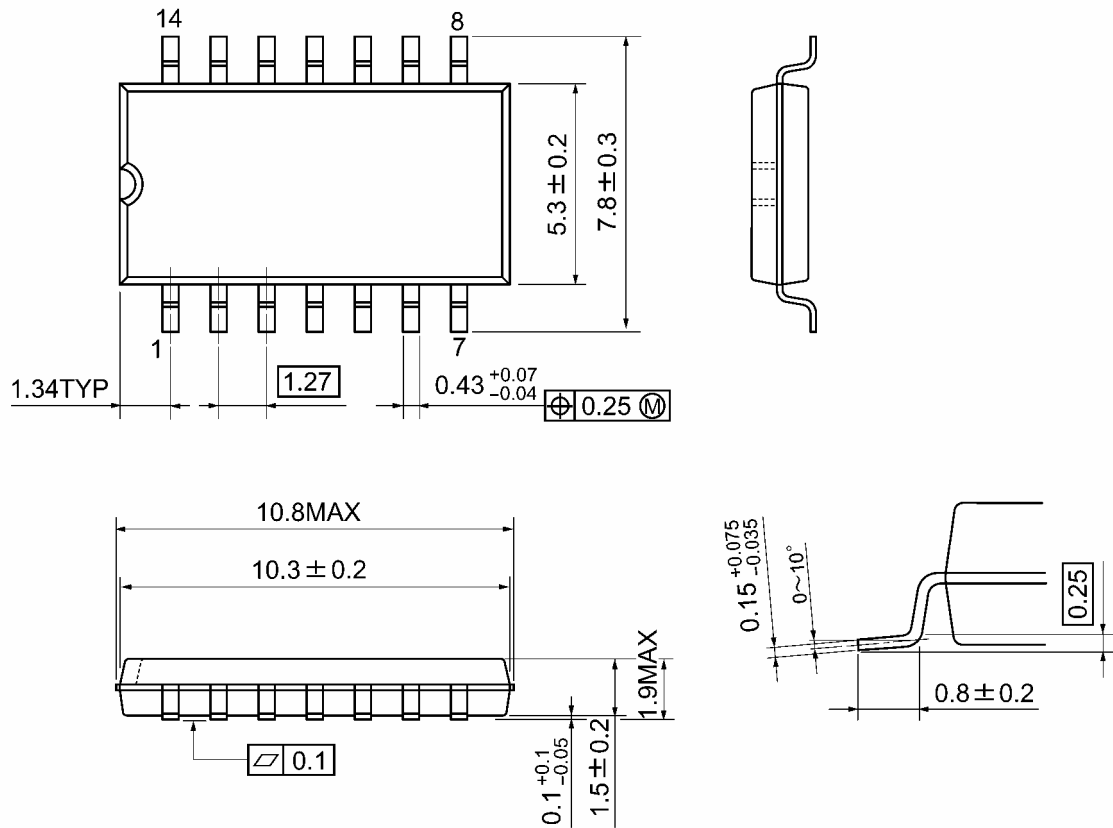


Weight: 0.96 g (typ.)

Package Dimensions

SOP14-P-300-1.27A

Unit: mm

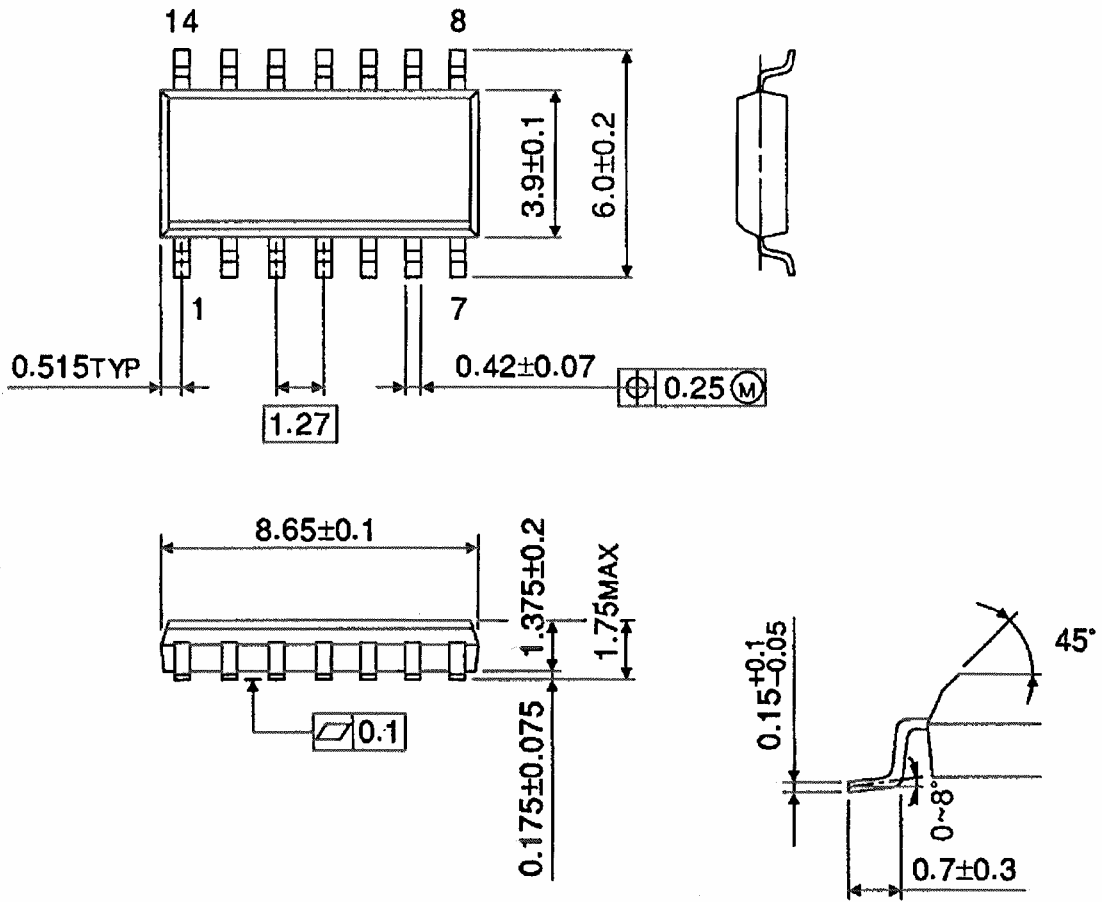


Weight: 0.18 g (typ.)

Package Dimensions (Note)

SOL14-P-150-1.27

Unit : mm



Note: This package is not available in Japan.

Weight: 0.12 g (typ.)

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20070701-EN GENERAL

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