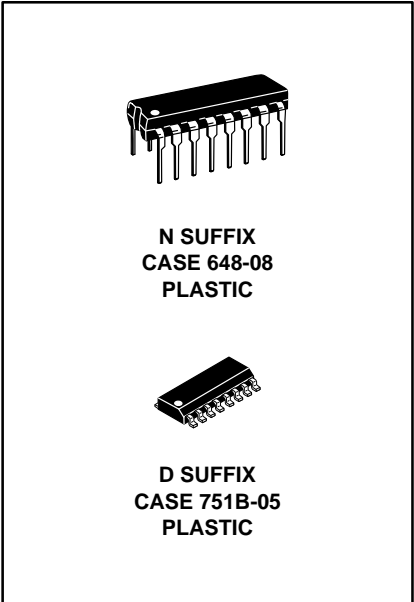




# MC74AC109 MC74ACT109

DUAL JK POSITIVE  
EDGE-TRIGGERED  
FLIP-FLOP



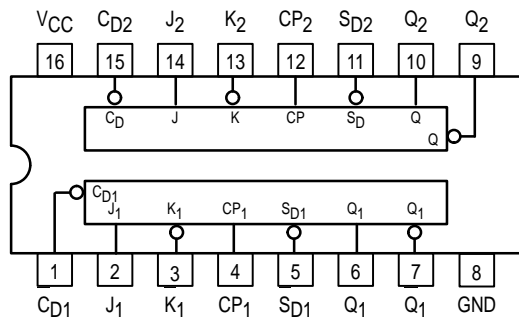
## Dual JK Positive Edge-Triggered Flip-Flop

The MC74AC109/74ACT109 consists of two high-speed completely independent transition clocked JK flip-flops. The clocking operation is independent of rise and fall times of the clock waveform. The JK design allows operation as a D flip-flop (refer to MC74AC74/74ACT74 data sheet) by connecting the J and K inputs together.

### Asynchronous Inputs:

- LOW input to  $\overline{S_D}$  (Set) sets Q to HIGH level
- LOW input to  $\overline{C_D}$  (Clear) sets Q to LOW level
- Clear and Set are independent of clock
- Simultaneous LOW on  $\overline{C_D}$  and  $\overline{S_D}$  makes both Q and  $\overline{Q}$  HIGH

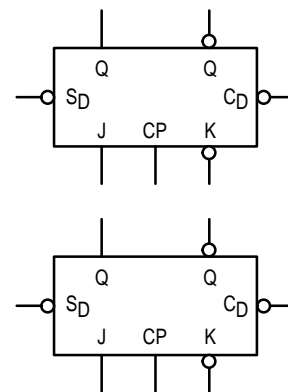
- Outputs Source/Sink 24 mA
- 'ACT109 Has TTL Compatible Inputs



### PIN NAMES

- $\overline{J_1}, \overline{J_2}, \overline{K_1}, \overline{K_2}$  Data Inputs
- $\overline{CP_1}, \overline{CP_2}$  Clock Pulse Inputs
- $\overline{C_{D1}}, \overline{C_{D2}}$  Direct Clear Inputs
- $\overline{S_{D1}}, \overline{S_{D2}}$  Direct Set Inputs
- $Q_1, Q_2, \overline{Q_1}, \overline{Q_2}$  Outputs

### LOGIC SYMBOL



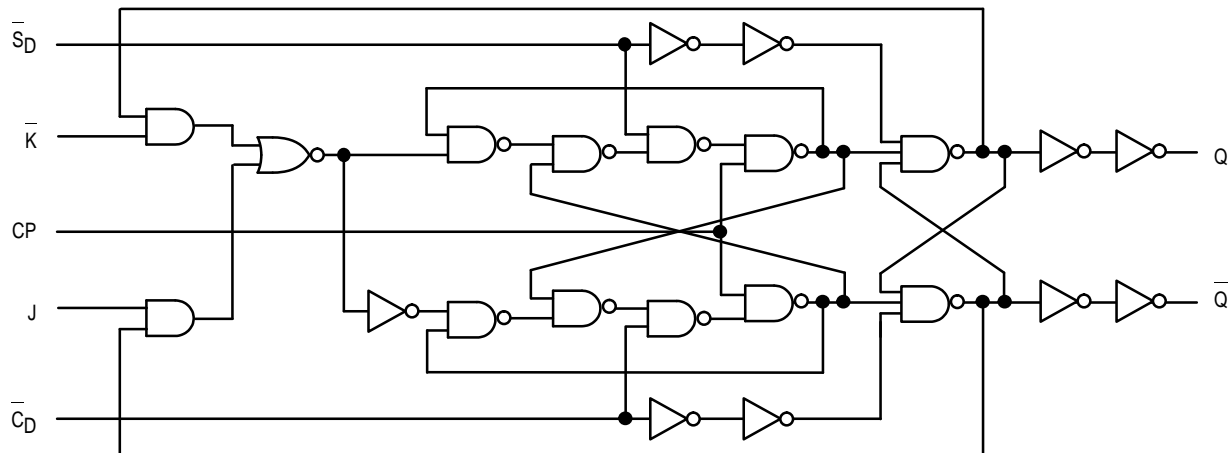
### TRUTH TABLE

Inputs					Outputs	
$\overline{S_D}$	$\overline{C_D}$	CP	J	K	Q	$\overline{Q}$
L	H	X	X	X	H	L
H	L	X	X	X	L	H
L	L	X	X	X	H	H
H	H	┐	L	L	L	H
H	H	┐	H	L	Toggle	
H	H	┐	L	H	$Q_0$	$\overline{Q_0}$
H	H	┐	H	H	H	$\overline{L}$
H	H	┐	X	X	$Q_0$	$\overline{Q_0}$

H = HIGH Voltage Level  
 L = LOW Voltage Level  
 ┐ = LOW-to-HIGH Clock Transition  
 X = Immaterial  
 $Q_0(\overline{Q_0})$  = Previous  $Q_0(\overline{Q_0})$  before  
 LOW-to-HIGH Transition of Clock

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LOGIC DIAGRAM (one half shown)



Please note that this diagram is provided only for the understanding of logic operations and should not be used to estimate propagation delays.

## MAXIMUM RATINGS\*

Symbol	Parameter	Value	Unit
V <sub>CC</sub>	DC Supply Voltage (Referenced to GND)	-0.5 to +7.0	V
V <sub>in</sub>	DC Input Voltage (Referenced to GND)	-0.5 to V <sub>CC</sub> +0.5	V
V <sub>out</sub>	DC Output Voltage (Referenced to GND)	-0.5 to V <sub>CC</sub> +0.5	V
I <sub>in</sub>	DC Input Current, per Pin	±20	mA
I <sub>out</sub>	DC Output Sink/Source Current, per Pin	±50	mA
I <sub>CC</sub>	DC V <sub>CC</sub> or GND Current per Output Pin	±50	mA
T <sub>stg</sub>	Storage Temperature	-65 to +150	°C

\* Maximum Ratings are those values beyond which damage to the device may occur. Functional operation should be restricted to the Recommended Operating Conditions.

## RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Typ	Max	Unit	
V <sub>CC</sub>	Supply Voltage	'AC	2.0	5.0	6.0	V
		'ACT	4.5	5.0	5.5	
V <sub>in</sub> , V <sub>out</sub>	DC Input Voltage, Output Voltage (Ref. to GND)	0		V <sub>CC</sub>	V	
t <sub>r</sub> , t <sub>f</sub>	Input Rise and Fall Time (Note 1) 'AC Devices except Schmitt Inputs	V <sub>CC</sub> @ 3.0 V		150		ns/V
		V <sub>CC</sub> @ 4.5 V		40		
		V <sub>CC</sub> @ 5.5 V		25		
t <sub>r</sub> , t <sub>f</sub>	Input Rise and Fall Time (Note 2) 'ACT Devices except Schmitt Inputs	V <sub>CC</sub> @ 4.5 V		10		ns/V
		V <sub>CC</sub> @ 5.5 V		8.0		
T <sub>J</sub>	Junction Temperature (PDIP)			140	°C	
T <sub>A</sub>	Operating Ambient Temperature Range	-40	25	85	°C	
I <sub>OH</sub>	Output Current — High			-24	mA	
I <sub>OL</sub>	Output Current — Low			24	mA	

1. V<sub>in</sub> from 30% to 70% V<sub>CC</sub>; see individual Data Sheets for devices that differ from the typical input rise and fall times.

2. V<sub>in</sub> from 0.8 V to 2.0 V; see individual Data Sheets for devices that differ from the typical input rise and fall times.

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## DC CHARACTERISTICS

Symbol	Parameter	V <sub>CC</sub> (V)	74AC		74AC		Unit	Conditions
			T <sub>A</sub> = +25°C		T <sub>A</sub> = -40°C to +85°C			
			Typ	Guaranteed Limits				
V <sub>IH</sub>	Minimum High Level Input Voltage	3.0	1.5	2.1	2.1		V	V <sub>OUT</sub> = 0.1 V or V <sub>CC</sub> - 0.1 V
		4.5	2.25	3.15	3.15			
		5.5	2.75	3.85	3.85			
V <sub>IL</sub>	Maximum Low Level Input Voltage	3.0	1.5	0.9	0.9		V	V <sub>OUT</sub> = 0.1 V or V <sub>CC</sub> - 0.1 V
		4.5	2.25	1.35	1.35			
		5.5	2.75	1.65	1.65			
V <sub>OH</sub>	Minimum High Level Output Voltage	3.0	2.99	2.9	2.9		V	I <sub>OUT</sub> = -50 μA
		4.5	4.49	4.4	4.4			
		5.5	5.49	5.4	5.4			
		3.0		2.56	2.46		V	*V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> -12 mA I <sub>OH</sub> -24 mA -24 mA
		4.5		3.86	3.76			
		5.5		4.86	4.76			
V <sub>OL</sub>	Maximum Low Level Output Voltage	3.0	0.002	0.1	0.1		V	I <sub>OUT</sub> = 50 μA
		4.5	0.001	0.1	0.1			
		5.5	0.001	0.1	0.1			
		3.0		0.36	0.44		V	*V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> 12 mA I <sub>OL</sub> 24 mA 24 mA
		4.5		0.36	0.44			
		5.5		0.36	0.44			
I <sub>IN</sub>	Maximum Input Leakage Current	5.5		±0.1	±1.0		μA	V <sub>I</sub> = V <sub>CC</sub> , GND
I <sub>OLD</sub>	†Minimum Dynamic Output Current	5.5			75		mA	V <sub>OLD</sub> = 1.65 V Max
I <sub>OHD</sub>		5.5			-75		mA	V <sub>OHD</sub> = 3.85 V Min
I <sub>CC</sub>	Maximum Quiescent Supply Current	5.5		4.0	40		μA	V <sub>IN</sub> = V <sub>CC</sub> or GND

\* All outputs loaded; thresholds on input associated with output under test.

† Maximum test duration 2.0 ms, one output loaded at a time.

Note: I<sub>IN</sub> and I<sub>CC</sub> @ 3.0 V are guaranteed to be less than or equal to the respective limit @ 5.5 V V<sub>CC</sub>.

## AC CHARACTERISTICS (For Figures and Waveforms — See Section 3)

Symbol	Parameter	V <sub>CC</sub> * (V)	74AC			74AC		Unit	Fig. No.
			T <sub>A</sub> = +25°C C <sub>L</sub> = 50 pF			T <sub>A</sub> = -40°C to +85°C C <sub>L</sub> = 50 pF			
			Min	Typ	Max	Min	Max		
f <sub>max</sub>	Maximum Clock Frequency	3.3 5.0	125 150			100 125		MHz	3-3
t <sub>PLH</sub>	Propagation Delay C <sub>Pn</sub> to Q <sub>n</sub> or Q <sub>n</sub>	3.3 5.0	4.0 2.5		13.5 10.0	3.5 2.0	16.0 10.5	ns	3-6
t <sub>PHL</sub>	Propagation Delay C <sub>Pn</sub> to Q <sub>n</sub> or Q <sub>n</sub>	3.3 5.0	3.0 2.0		14.0 10.0	3.0 1.5	14.5 10.5	ns	3-6
t <sub>PLH</sub>	Propagation Delay — C <sub>Dn</sub> or S <sub>Dn</sub> to Q <sub>n</sub> or Q <sub>n</sub>	3.3 5.0	3.0 2.5		12.0 9.0	2.5 2.0	13.0 10.0	ns	3-6
t <sub>PHL</sub>	Propagation Delay — C <sub>Dn</sub> or S <sub>Dn</sub> to Q <sub>n</sub> or Q <sub>n</sub>	3.3 5.0	3.0 2.0		12.0 9.5	3.0 2.0	13.5 10.5	ns	3-6

\* Voltage Range 3.3 V is 3.3 V ±0.3 V.

Voltage Range 5.0 V is 5.0 V ±0.5 V.

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## AC OPERATING REQUIREMENTS

Symbol	Parameter	V <sub>CC</sub> * (V)	74AC		Unit	Fig. No.		
			T <sub>A</sub> = +25°C C <sub>L</sub> = 50 pF				T <sub>A</sub> = -40°C to +85°C C <sub>L</sub> = 50 pF	
			Typ	Guaranteed Minimum				
t <sub>s</sub>	Set-up Time, HIGH or LOW J <sub>N</sub> or K <sub>N</sub> to CP <sub>N</sub>	3.3 5.0		6.5 4.5	7.5 5.0	ns	3-9	
t <sub>h</sub>	Hold Time, HIGH or LOW J <sub>N</sub> or K <sub>N</sub> to CP <sub>N</sub>	3.3 5.0		0 0.5	0 0.5	ns	3-9	
t <sub>w</sub>	Pulse Width CP <sub>N</sub> or CD <sub>N</sub> or SD <sub>N</sub>	3.3 5.0		4.0 3.5	4.5 3.5	ns	3-6	
t <sub>rec</sub>	Recovery Time CD <sub>N</sub> or SD <sub>N</sub> to CP	3.3 5.0		0 0	0 0	ns	3-9	

\* Voltage Range 3.3 V is 3.3 V ±0.3 V.  
Voltage Range 5.0 V is 5.0 V ±0.5 V.

## DC CHARACTERISTICS

Symbol	Parameter	V <sub>CC</sub> (V)	74ACT		Unit	Conditions		
			T <sub>A</sub> = +25°C				T <sub>A</sub> = -40°C to +85°C	
			Typ	Guaranteed Limits				
V <sub>IH</sub>	Minimum High Level Input Voltage	4.5	1.5	2.0	V	V <sub>OUT</sub> = 0.1 V or V <sub>CC</sub> - 0.1 V		
		5.5	1.5	2.0				
V <sub>IL</sub>	Maximum Low Level Input Voltage	4.5	1.5	0.8	V	V <sub>OUT</sub> = 0.1 V or V <sub>CC</sub> - 0.1 V		
		5.5	1.5	0.8				
V <sub>OH</sub>	Minimum High Level Output Voltage	4.5	4.49	4.4	V	I <sub>OUT</sub> = -50 μA		
		5.5	5.49	5.4				
		4.5		3.86	V	*V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> -24 mA		
5.5		4.86		4.76		-24 mA		
V <sub>OL</sub>	Maximum Low Level Output Voltage	4.5	0.001	0.1	V	I <sub>OUT</sub> = 50 μA		
		5.5	0.001	0.1				
		4.5		0.36	V	*V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> 24 mA		
5.5		0.36		0.44		24 mA		
I <sub>IN</sub>	Maximum Input Leakage Current	5.5		±0.1	μA	V <sub>I</sub> = V <sub>CC</sub> , GND		
ΔI <sub>CCT</sub>	Additional Max. I <sub>CC</sub> /Input	5.5	0.6		mA	V <sub>I</sub> = V <sub>CC</sub> - 2.1 V		
I <sub>OLD</sub>	†Minimum Dynamic Output Current	5.5			mA	V <sub>OLD</sub> = 1.65 V Max		
I <sub>OHD</sub>		5.5			mA	V <sub>OHD</sub> = 3.85 V Min		
I <sub>CC</sub>	Maximum Quiescent Supply Current	5.5		4.0	μA	V <sub>IN</sub> = V <sub>CC</sub> or GND		

\* All outputs loaded; thresholds on input associated with output under test.

† Maximum test duration 2.0 ms, one output loaded at a time.

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## AC CHARACTERISTICS (For Figures and Waveforms — See Section 3)

Symbol	Parameter	V <sub>CC</sub> * (V)	74ACT			74ACT		Unit	Fig. No.
			T <sub>A</sub> = +25°C C <sub>L</sub> = 50 pF			T <sub>A</sub> = -40°C to +85°C C <sub>L</sub> = 50 pF			
			Min	Typ	Max	Min	Max		
f <sub>max</sub>	Maximum Clock Frequency	5.0	145			125		MHz	3-3
t <sub>PLH</sub>	Propagation Delay CP <sub>n</sub> to Q <sub>n</sub> or Q <sub>n</sub>	5.0	4.0		11.0	3.5	13.0	ns	3-6
t <sub>PHL</sub>	Propagation Delay CP <sub>n</sub> to Q <sub>n</sub> or Q <sub>n</sub>	5.0	3.0		10.0	2.5	11.5	ns	3-6
t <sub>PLH</sub>	Propagation Delay C <sub>Dn</sub> or S <sub>Dn</sub> to Q <sub>n</sub> or Q <sub>n</sub>	5.0	2.5		9.5	2.0	10.5	ns	3-6
t <sub>PHL</sub>	Propagation Delay C <sub>Dn</sub> or S <sub>Dn</sub> to Q <sub>n</sub> or Q <sub>n</sub>	5.0	2.5		10.0	2.0	11.5	ns	3-6

\* Voltage Range 5.0 V is 5.0 V ± 0.5 V.

## AC OPERATING REQUIREMENTS

Symbol	Parameter	V <sub>CC</sub> * (V)	74ACT		74ACT		Unit	Fig. No.
			T <sub>A</sub> = +25°C C <sub>L</sub> = 50 pF		T <sub>A</sub> = -40°C to +85°C C <sub>L</sub> = 50 pF			
			Typ	Guaranteed Minimum				
t <sub>s</sub>	Set-up Time, HIGH or LOW J <sub>n</sub> or K <sub>n</sub> to CP <sub>n</sub>	5.0		2.0	2.5	ns	3-9	
t <sub>h</sub>	Hold Time, HIGH or LOW J <sub>n</sub> or K <sub>n</sub> to CP <sub>n</sub>	5.0		2.0	2.0	ns	3-9	
t <sub>w</sub>	Pulse Width CP <sub>n</sub> or C <sub>Dn</sub> or S <sub>Dn</sub>	5.0		5.0	6.0	ns	3-6	
t <sub>rec</sub>	Recovery Time C <sub>Dn</sub> or S <sub>Dn</sub> to CP	5.0		0	0	ns	3-9	

\* Voltage Range 5.0 V is 5.0 V ± 0.5 V.

## CAPACITANCE

Symbol	Parameter	Value Typ	Unit	Test Conditions
C <sub>IN</sub>	Input Capacitance	4.5	pF	V <sub>CC</sub> = 5.0 V
CPD	Power Dissipation Capacitance	35	pF	V <sub>CC</sub> = 5.0 V

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## OUTLINE DIMENSIONS

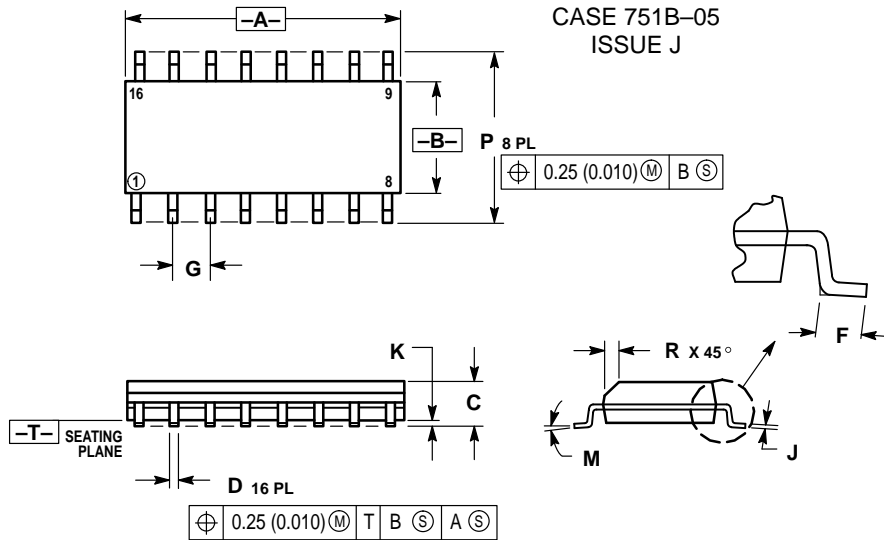
### N SUFFIX PLASTIC DIP PACKAGE CASE 648-08 ISSUE R



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.
  3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
  4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
  5. ROUNDED CORNERS OPTIONAL.


DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.740	0.770	18.80	19.55
B	0.250	0.270	6.35	6.85
C	0.145	0.175	3.69	4.44
D	0.015	0.021	0.39	0.53
F	0.040	0.70	1.02	1.77
G	0.100 BSC		2.54 BSC	
H	0.050 BSC		1.27 BSC	
J	0.008	0.015	0.21	0.38
K	0.110	0.130	2.80	3.30
L	0.295	0.305	7.50	7.74
M	0°	10°	0°	10°
S	0.020	0.040	0.51	1.01

### D SUFFIX PLASTIC SOIC PACKAGE CASE 751B-05 ISSUE J



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: MILLIMETER.
  3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
  4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
  5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	9.80	10.00	0.386	0.393
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.054	0.068
D	0.35	0.49	0.014	0.019
F	0.40	1.25	0.016	0.049
G	1.27 BSC		0.050 BSC	
J	0.19	0.25	0.008	0.009
K	0.10	0.25	0.004	0.009
M	0°	7°	0°	7°
P	5.80	6.20	0.229	0.244
R	0.25	0.50	0.010	0.019

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MC74AC109/D

