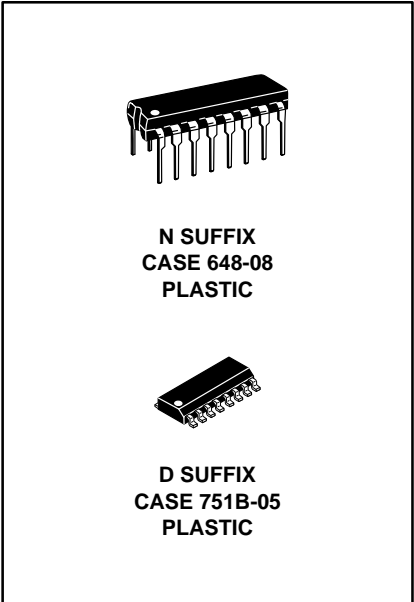




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DUAL JK POSITIVE
EDGE-TRIGGERED
FLIP-FLOP



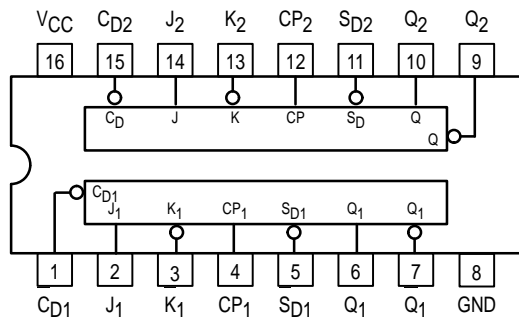
Dual JK Positive Edge-Triggered Flip-Flop

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

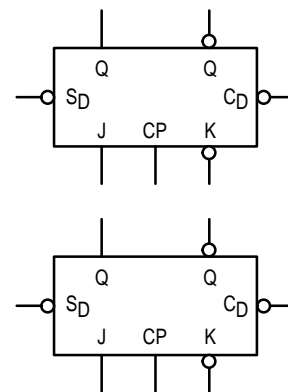
- Outputs Source/Sink 24 mA
- 'ACT109 Has TTL Compatible Inputs



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
- $\overline{CD_1}, \overline{CD_2}$ Direct Clear Inputs
- $\overline{SD_1}, \overline{SD_2}$ Direct Set Inputs
- $Q_1, Q_2, \overline{Q_1}, \overline{Q_2}$ Outputs

LOGIC SYMBOL



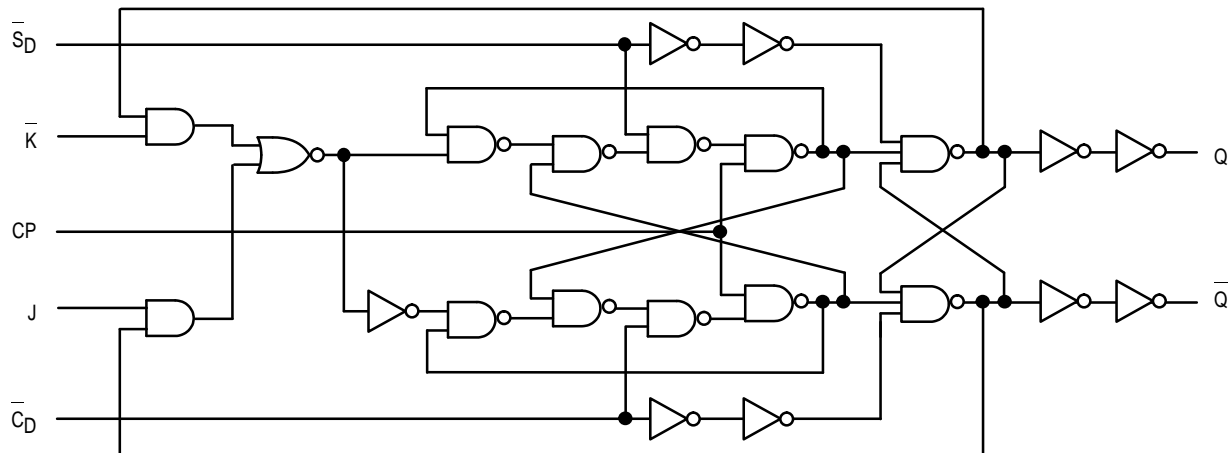
TRUTH TABLE

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	\lceil	L	L	L	H
H	H	\lceil	H	L	Toggle	
H	H	\lceil	L	H	Q_0	$\overline{Q_0}$
H	H	\lceil	H	H	H	\overline{L}
H	H	L	X	X	Q_0	$\overline{Q_0}$

H = HIGH Voltage Level
 L = LOW Voltage Level
 \lceil = 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 _{CC}	DC Supply Voltage (Referenced to GND)	-0.5 to +7.0	V
V _{in}	DC Input Voltage (Referenced to GND)	-0.5 to V _{CC} +0.5	V
V _{out}	DC Output Voltage (Referenced to GND)	-0.5 to V _{CC} +0.5	V
I _{in}	DC Input Current, per Pin	±20	mA
I _{out}	DC Output Sink/Source Current, per Pin	±50	mA
I _{CC}	DC V _{CC} or GND Current per Output Pin	±50	mA
T _{stg}	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 _{CC}	Supply Voltage	'AC	2.0	5.0	6.0	V
		'ACT	4.5	5.0	5.5	
V _{in} , V _{out}	DC Input Voltage, Output Voltage (Ref. to GND)	0		V _{CC}	V	
t _r , t _f	Input Rise and Fall Time (Note 1) 'AC Devices except Schmitt Inputs	V _{CC} @ 3.0 V		150		ns/V
		V _{CC} @ 4.5 V		40		
		V _{CC} @ 5.5 V		25		
t _r , t _f	Input Rise and Fall Time (Note 2) 'ACT Devices except Schmitt Inputs	V _{CC} @ 4.5 V		10		ns/V
		V _{CC} @ 5.5 V		8.0		
T _J	Junction Temperature (PDIP)			140	°C	
T _A	Operating Ambient Temperature Range	-40	25	85	°C	
I _{OH}	Output Current — High			-24	mA	
I _{OL}	Output Current — Low			24	mA	

1. V_{in} from 30% to 70% V_{CC}; see individual Data Sheets for devices that differ from the typical input rise and fall times.

2. V_{in} 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 _{CC} (V)	74AC		74AC		Unit	Conditions
			T _A = +25°C		T _A = -40°C to +85°C			
			Typ	Guaranteed Limits				
V _{IH}	Minimum High Level Input Voltage	3.0	1.5	2.1	2.1		V	V _{OUT} = 0.1 V or V _{CC} - 0.1 V
		4.5	2.25	3.15	3.15			
		5.5	2.75	3.85	3.85			
V _{IL}	Maximum Low Level Input Voltage	3.0	1.5	0.9	0.9		V	V _{OUT} = 0.1 V or V _{CC} - 0.1 V
		4.5	2.25	1.35	1.35			
		5.5	2.75	1.65	1.65			
V _{OH}	Minimum High Level Output Voltage	3.0	2.99	2.9	2.9		V	I _{OUT} = -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 _{IN} = V _{IL} or V _{IH} -12 mA I _{OH} -24 mA -24 mA
		4.5		3.86	3.76			
		5.5		4.86	4.76			
V _{OL}	Maximum Low Level Output Voltage	3.0	0.002	0.1	0.1		V	I _{OUT} = 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 _{IN} = V _{IL} or V _{IH} 12 mA I _{OL} 24 mA 24 mA
		4.5		0.36	0.44			
		5.5		0.36	0.44			
I _{IN}	Maximum Input Leakage Current	5.5		±0.1	±1.0		μA	V _I = V _{CC} , GND
I _{OLD}	†Minimum Dynamic Output Current	5.5			75		mA	V _{OLD} = 1.65 V Max
I _{OHD}		5.5			-75		mA	V _{OHD} = 3.85 V Min
I _{CC}	Maximum Quiescent Supply Current	5.5		4.0	40		μA	V _{IN} = V _{CC} 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_{IN} and I_{CC} @ 3.0 V are guaranteed to be less than or equal to the respective limit @ 5.5 V V_{CC}.

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

Symbol	Parameter	V _{CC} * (V)	74AC			74AC		Unit	Fig. No.
			T _A = +25°C C _L = 50 pF			T _A = -40°C to +85°C C _L = 50 pF			
			Min	Typ	Max	Min	Max		
f _{max}	Maximum Clock Frequency	3.3 5.0	125 150			100 125		MHz	3-3
t _{PLH}	Propagation Delay C _{Pn} to Q _n or Q _n	3.3 5.0	4.0 2.5		13.5 10.0	3.5 2.0	16.0 10.5	ns	3-6
t _{PHL}	Propagation Delay C _{Pn} to Q _n or Q _n	3.3 5.0	3.0 2.0		14.0 10.0	3.0 1.5	14.5 10.5	ns	3-6
t _{PLH}	Propagation Delay — C _{Dn} or S _{Dn} to Q _n or Q _n	3.3 5.0	3.0 2.5		12.0 9.0	2.5 2.0	13.0 10.0	ns	3-6
t _{PHL}	Propagation Delay — C _{Dn} or S _{Dn} to Q _n or Q _n	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 _{CC} * (V)	74AC		Unit	Fig. No.		
			T _A = +25°C C _L = 50 pF				T _A = -40°C to +85°C C _L = 50 pF	
			Typ	Guaranteed Minimum				
t _s	Set-up Time, HIGH or LOW J _N or K _N to CP _N	3.3 5.0		6.5 4.5	7.5 5.0	ns	3-9	
t _h	Hold Time, HIGH or LOW J _N or K _N to CP _N	3.3 5.0		0 0.5	0 0.5	ns	3-9	
t _w	Pulse Width CP _N or CD _N or SD _N	3.3 5.0		4.0 3.5	4.5 3.5	ns	3-6	
t _{rec}	Recovery Time CD _N or SD _N 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 _{CC} (V)	74ACT		Unit	Conditions		
			T _A = +25°C				T _A = -40°C to +85°C	
			Typ	Guaranteed Limits				
V _{IH}	Minimum High Level Input Voltage	4.5	1.5	2.0	V	V _{OUT} = 0.1 V or V _{CC} - 0.1 V		
		5.5	1.5	2.0				
V _{IL}	Maximum Low Level Input Voltage	4.5	1.5	0.8	V	V _{OUT} = 0.1 V or V _{CC} - 0.1 V		
		5.5	1.5	0.8				
V _{OH}	Minimum High Level Output Voltage	4.5	4.49	4.4	V	I _{OUT} = -50 μA		
		5.5	5.49	5.4				
		4.5		3.86	V	*V _{IN} = V _{IL} or V _{IH} -24 mA		
5.5		4.86		4.76		-24 mA		
V _{OL}	Maximum Low Level Output Voltage	4.5	0.001	0.1	V	I _{OUT} = 50 μA		
		5.5	0.001	0.1				
		4.5		0.36	V	*V _{IN} = V _{IL} or V _{IH} 24 mA		
5.5		0.36		0.44		24 mA		
I _{IN}	Maximum Input Leakage Current	5.5		±0.1	μA	V _I = V _{CC} , GND		
ΔI _{CCT}	Additional Max. I _{CC} /Input	5.5	0.6		mA	V _I = V _{CC} - 2.1 V		
I _{OLD}	†Minimum Dynamic Output Current	5.5			mA	V _{OLD} = 1.65 V Max		
I _{OHD}		5.5			mA	V _{OHD} = 3.85 V Min		
I _{CC}	Maximum Quiescent Supply Current	5.5		4.0	μA	V _{IN} = V _{CC} 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 _{CC} * (V)	74ACT			74ACT		Unit	Fig. No.
			T _A = +25°C C _L = 50 pF			T _A = -40°C to +85°C C _L = 50 pF			
			Min	Typ	Max	Min	Max		
f _{max}	Maximum Clock Frequency	5.0	145			125		MHz	3-3
t _{PLH}	Propagation Delay CP _n to Q _n or Q _n	5.0	4.0		11.0	3.5	13.0	ns	3-6
t _{PHL}	Propagation Delay CP _n to Q _n or Q _n	5.0	3.0		10.0	2.5	11.5	ns	3-6
t _{PLH}	Propagation Delay C _{Dn} or S _{Dn} to Q _n or Q _n	5.0	2.5		9.5	2.0	10.5	ns	3-6
t _{PHL}	Propagation Delay C _{Dn} or S _{Dn} to Q _n or Q _n	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 _{CC} * (V)	74ACT		74ACT		Unit	Fig. No.
			T _A = +25°C C _L = 50 pF		T _A = -40°C to +85°C C _L = 50 pF			
			Typ	Guaranteed Minimum				
t _s	Set-up Time, HIGH or LOW J _n or K _n to CP _n	5.0		2.0	2.5		ns	3-9
t _h	Hold Time, HIGH or LOW J _n or K _n to CP _n	5.0		2.0	2.0		ns	3-9
t _w	Pulse Width CP _n or C _{Dn} or S _{Dn}	5.0		5.0	6.0		ns	3-6
t _{rec}	Recovery Time C _{Dn} or S _{Dn} 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 _{IN}	Input Capacitance	4.5	pF	V _{CC} = 5.0 V
CPD	Power Dissipation Capacitance	35	pF	V _{CC} = 5.0 V

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OUTLINE DIMENSIONS

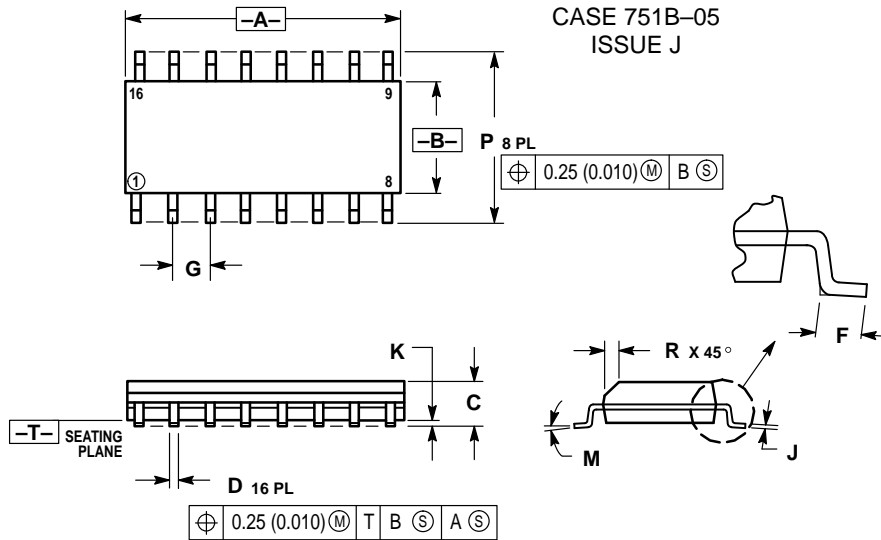
N SUFFIX PLASTIC DIP PACKAGE CASE 648-08 ISSUE R



- 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

