



MOTOROLA

**MC74AC74
MC74ACT74**

Dual D-Type Positive Edge-Triggered Flip-Flop

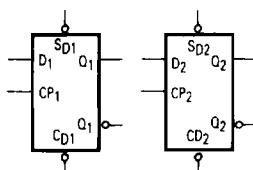
The MC74AC74/74ACT74 is a dual D-type flip-flop with Asynchronous Clear and Set inputs and complementary (Q , \bar{Q}) outputs. Information at the input is transferred to the outputs on the positive edge of the clock pulse. Clock triggering occurs at a voltage level of the clock pulse and is not directly related to the transition time of the positive-going pulse. After the Clock Pulse input threshold voltage has been passed, the Data input is locked out and information present will not be transferred to the outputs until the next rising edge of the Clock Pulse input.

Asynchronous Inputs:

- LOW input to \bar{S}_D (Set) sets Q to HIGH level
- LOW input to \bar{C}_D (Clear) sets Q to LOW level
- Clear and Set are independent of clock
- Simultaneous LOW on \bar{C}_D and \bar{S}_D makes both Q and \bar{Q} HIGH

- Outputs Source/Sink 24 mA
- 'ACT74 Has TTL Compatible Inputs

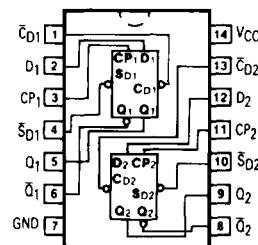
LOGIC SYMBOL



PIN NAMES

\bar{S}_D , S_D	Data Inputs
\bar{C}_D , C_D	Clock Pulse Inputs
\bar{C}_D , C_D	Direct Clear Inputs
\bar{S}_D , S_D	Direct Set Inputs
Q_1 , \bar{Q}_1 , Q_2 , \bar{Q}_2	Outputs

DUAL D-TYPE POSITIVE EDGE-TRIGGERED FLIP-FLOP



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TRUTH TABLE (Each Half)

Inputs				Outputs	
\bar{S}_D	\bar{C}_D	CP	D	Q	\bar{Q}
L	H	X	X	H	L
H	L	X	X	L	H
L	L	X	X	H	H
H	H	↑	H	H	L
H	H	↑	L	L	H
H	H	L	X	Q_0	\bar{Q}_0

H = HIGH Voltage Level

L = LOW Voltage Level

X = Immaterial

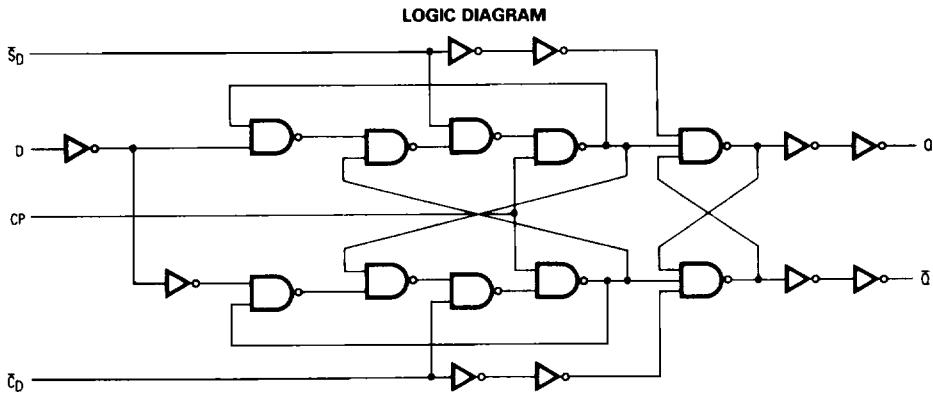
↑ = LOW-to-HIGH Clock Transition

$Q_0(\bar{Q}_0)$ - Previous $Q(\bar{Q})$ before

LOW-to-HIGH Transition of Clock

FACT DATA

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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.

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RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Typ	Max	Unit
V _{CC}	Supply Voltage	'AC	2.0	5.0	6.0
		'ACT	4.5	5.0	5.5
V _{in} , V _{out}	DC Input Voltage, Output Voltage (Ref. to GND)	0	V _{CC}	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		Units	Conditions		
			T _A = +25°C					
			Typ	Guaranteed Limits				
V _{IH}	Minimum High Level Input Voltage	3.0 4.5 5.5	1.5 2.25 2.75	2.1 3.15 3.85	2.1 3.15 3.85	V V _{OUT} = 0.1 V or V _{CC} - 0.1 V		
V _{IL}	Maximum Low Level Input Voltage	3.0 4.5 5.5	1.5 2.25 2.75	0.9 1.35 1.65	0.9 1.35 1.65	V V _{OUT} = 0.1 V or V _{CC} - 0.1 V		
V _{OH}	Minimum High Level Output Voltage	3.0 4.5 5.5	2.99 4.49 5.49	2.9 4.4 5.4	2.9	I _{OUT} = 50 μA		
		3.0 4.5 5.5		2.56 3.86 4.86	2.46 3.76 4.76	V *V _{IN} = V _{IL} or V _{IH} - 12 mA I _{OH} - 24 mA - 24 mA		
V _{OL}	Maximum Low Level Output Voltage	3.0 4.5 5.5	0.002 0.001 0.001	0.1 0.1 0.1	0.1	V I _{OUT} = 50 μA		
		3.0 4.5 5.5		0.36 0.36 0.36	0.44 0.44 0.44	V *V _{IN} = V _{IL} or V _{IH} 12 mA I _{OL} 24 mA 24 mA		
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} in 3.0 V are guaranteed to be less than or equal to the respective limit in 5.5 V V_{CC}.

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DC CHARACTERISTICS

Symbol	Parameter	V _{CC} (V)	74ACT		74ACT		Units	Conditions		
			T _A = +25°C		T _A = -40°C to +85°C					
			Typ	Guaranteed Limits						
V _{IH}	Minimum High Level Input Voltage	4.5 5.5	1.5 1.5	2.0 2.0	2.0 2.0	V	V _{OUT} 0.1 V or V _{CC} 0.1 V			
V _{IL}	Maximum Low Level Input Voltage	4.5 5.5	1.5 1.5	0.8 0.8	0.8 0.8	V	V _{OUT} 0.1 V or V _{CC} 0.1 V			
V _{OH}	Minimum High Level Output Voltage	4.5 5.5	4.49 5.49	4.4 5.4	4.4 5.4	V	I _{OUT} 50 μA			
		4.5 5.5		3.86 4.86	3.76 4.76	V	*V _{IN} V _{IL} or V _{IH} 24 mA I _{OH} 24 mA			
		4.5 5.5		0.36 0.36	0.44 0.44	V	*V _{IN} V _{IL} or V _{IH} 24 mA I _{OL} 24 mA			
V _{OL}	Maximum Low Level Output Voltage	4.5 5.5	0.001 0.001	0.1 0.1	0.1 0.1	V	I _{OUT} 50 μA			
		4.5 5.5		0.36 0.36	0.44 0.44	V	*V _{IN} V _{IL} or V _{IH} 24 mA I _{OL} 24 mA			
I _{IN}	Maximum Input Leakage Current	5.5		0.1	1.0	μA	V _I V _{CC} , GND			
ΔI _{CCT}	Additional Max. I _{CC} Input	5.5	0.6		1.5	mA	V _I V _{CC} 21 V			
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

AC CHARACTERISTICS (Figures and Waveforms — See Section 3)

Symbol	Parameter	V _{CC} * (V)	74AC			74AC		Units	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				
t _{max}	Maximum Clock Frequency	3.3 5.0	100 140	125 160		95 125		MHz	3-3		
t _{PLH}	Propagation Delay C _{Dn} or S _{Dn} to Q _n or \bar{Q}_n	3.3 5.0	5.0 3.5	8.0 6.0	12.0 9.0	4.0 3.0	13.0 10.0	ns	3-6		
t _{PHL}	Propagation Delay \bar{C}_{Dn} or \bar{S}_{Dn} to Q _n or \bar{Q}_n	3.3 5.0	4.0 3.0	10.5 8.0	12.0 9.5	3.5 2.5	13.5 10.5	ns	3-6		
t _{PLH}	Propagation Delay C _{Pn} to Q _n or \bar{Q}_n	3.3 5.0	4.5 3.5	8.0 6.0	13.5 10.0	4.0 3.0	16.0 10.5	ns	3-6		
t _{PHL}	Propagation Delay C _{Pn} to Q _n or \bar{Q}_n	3.3 5.0	3.5 2.5	8.0 6.0	14.0 10.0	3.5 2.5	14.5 10.5	ns	3-6		

*Voltage Range 3.3 is 3.3 V ± 0.3 V

Voltage Range 5.0 is 5.0 V ± 0.5 V

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AC OPERATING REQUIREMENTS

Symbol	Parameter	V _{CC} * (V)	74AC		74AC		Units	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 D _n to CP _n	3.3 5.0	1.5 1.0	4.0 3.0	4.5 3.0		ns	3-9		
t _h	Hold Time, HIGH or LOW D _n to CP _n	3.3 5.0	2.0 1.5	0.5 0.5	0.5 0.5		ns	3-9		
t _w	CP _n or \bar{C}_{Dn} or \bar{S}_{Dn} Pulse Width	3.3 5.0	3.0 2.5	5.5 4.5	7.0 5.0		ns	3-6		
t _{rec}	Recovery Time C _{Dn} or \bar{S}_{Dn} to CP	3.3 5.0	2.5 2.0	0 0	0 0		ns	3-9		

*Voltage Range 3.3 is 3.3 V - 0.3 V

Voltage Range 5.0 is 5.0 V - 0.5 V

AC CHARACTERISTICS (Figures and Waveforms — See Section 3)

Symbol	Parameter	V _{CC} * (V)	74ACT			74ACT		Units	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	210		125		MHz	3-3		
t _{PLH}	Propagation Delay \bar{C}_{Dn} or \bar{S}_{Dn} to Q _n or \bar{Q}_n	5.0	3.0	5.5	9.5	2.5	10.5	ns	3-6		
t _{PHL}	Propagation Delay \bar{C}_{Dn} or \bar{S}_{Dn} to \bar{Q}_n or Q _n	5.0	3.0	6.0	10.0	3.0	11.5	ns	3-6		
t _{PLH}	Propagation Delay CP _n to Q _n or \bar{Q}_n	5.0	4.0	7.5	11.0	4.0	13.0	ns	3-6		
t _{PHL}	Propagation Delay CP _n to \bar{Q}_n or Q _n	5.0	3.5	6.0	10.0	3.0	11.5	ns	3-6		

*Voltage Range 5.0 is 5.0 V - 0.5 V

AC OPERATING REQUIREMENTS

Symbol	Parameter	V _{CC} * (V)	74ACT		74ACT		Units	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 D _n to CP _n	5.0	1.0	3.0	3.5		ns	3-9		
t _h	Hold Time, HIGH or LOW D _n to CP _n	5.0	0.5	1.0	1.0		ns	3-9		
t _w	CP _n or \bar{C}_{Dn} or \bar{S}_{Dn} Pulse Width	5.0	3.0	5.0	6.0		ns	3-6		
t _{rec}	Recovery Time C _{Dn} or \bar{S}_{Dn} to CP	5.0	2.5	0	0		ns	3-9		

*Voltage Range 5.0 is 5.0 V - 0.5 V

CAPACITANCE

Symbol	Parameter	Value Typ	Units	Test Conditions	
C _{IN}	Input Capacitance	4.5	pF	V _{CC}	5.0 V
C _{PD}	Power Dissipation Capacitance	35	pF	V _{CC}	5.0 V