



MOTOROLA

**MC74AC74
MC74ACT74**

**Dual D-Type Positive
Edge-Triggered Flip-Flop**

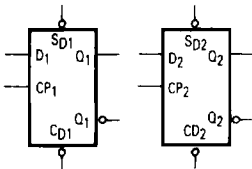
The MC74AC74/74ACT74 is a dual D-type flip-flop with Asynchronous Clear and Set inputs and complementary (Q , \bar{Q}) outputs. Information at the input is transferred to the outputs on the positive edge of the clock pulse. Clock triggering occurs at a voltage level of the clock pulse and is not directly 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

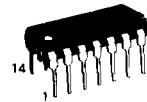
- D_1, D_2 Data Inputs
- CP_1, CP_2 Clock Pulse Inputs
- \bar{C}_D1, \bar{C}_D2 Direct Clear Inputs
- \bar{S}_D1, \bar{S}_D2 Direct Set Inputs
- $Q_1, \bar{Q}_1, Q_2, \bar{Q}_2$ Outputs

TRUTH TABLE (Each Half)

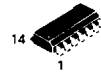
Inputs				Outputs	
\bar{S}_D	\bar{C}_D	CP	D	Q	\bar{Q}
L	H	X	X	H	L
H	L	X	X	L	H
L	L	X	X	H	H
H	H	\uparrow	H	H	L
H	H	\uparrow	L	L	H
H	H	L	X	Q_0	\bar{Q}_0

- H - HIGH Voltage Level
- L - LOW Voltage Level
- X - Immaterial
- \uparrow - LOW-to-HIGH Clock Transition
- $Q_0(\bar{Q}_0)$ - Previous $Q(\bar{Q})$ before LOW-to-HIGH Transition of Clock

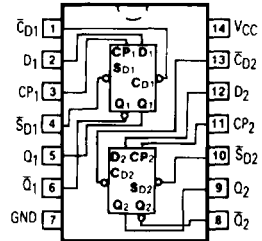
**DUAL D-TYPE POSITIVE
EDGE-TRIGGERED
FLIP-FLOP**



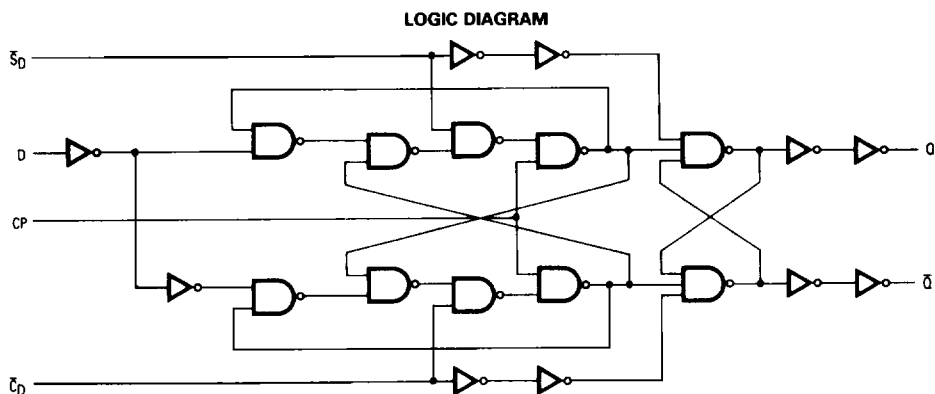
**N SUFFIX
CASE 646-06
PLASTIC**



**D SUFFIX
CASE 751A-02
PLASTIC**



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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.

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} (a 3.0 V)		150	ns/V	
		V _{CC} (a 4.5 V)		40		
		V _{CC} (a 5.5 V)		25		
t _r , t _f	Input Rise and Fall Time (Note 2) 'ACT Devices except Schmitt Inputs	V _{CC} (a 4.5 V)		10	ns/V	
		V _{CC} (a 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.

FACT DATA

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DC CHARACTERISTICS

Symbol	Parameter	VCC (V)	74AC		74ACT		Units	Conditions
			TA = +25°C		TA = -40°C to +85°C			
			Typ	Guaranteed Limits				
VIH	Minimum High Level Input Voltage	3.0	1.5	2.1	2.1	V	VOUT = 0.1 V or VCC - 0.1 V	
		4.5	2.25	3.15	3.15			
		5.5	2.75	3.85	3.85			
VIL	Maximum Low Level Input Voltage	3.0	1.5	0.9	0.9	V	VOUT = 0.1 V or VCC - 0.1 V	
		4.5	2.25	1.35	1.35			
		5.5	2.75	1.65	1.65			
VOH	Minimum High Level Output Voltage	3.0	2.99	2.9	2.9	V	IOUT = 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	*VIN = VIL or VIH - 12 mA IOH - 24 mA - 24 mA	
		4.5		3.86	3.76			
		5.5		4.86	4.76			
VOL	Maximum Low Level Output Voltage	3.0	0.002	0.1	0.1	V	IOUT = 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	*VIN = VIL or VIH 12 mA IOL 24 mA 24 mA	
		4.5		0.36	0.44			
		5.5		0.36	0.44			
IIN	Maximum Input Leakage Current	5.5		+ 0.1	+ 1.0	µA	VI = VCC, GND	
IOLD	†Minimum Dynamic Output Current	5.5			75	mA	VOLD = 1.65 V Max	
IOHD		5.5			75	mA	VOHD = 3.85 V Min	
ICC	Maximum Quiescent Supply Current	5.5		4.0	40	µA	VIN = VCC 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: IIN and ICC at 3.0 V are guaranteed to be less than or equal to the respective limit at 5.5 V VCC.

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DC CHARACTERISTICS

Symbol	Parameter	VCC (V)	74ACT		74ACT		Units	Conditions
			TA = +25°C		TA = -40°C to +85°C			
			Typ	Guaranteed Limits				
VIH	Minimum High Level Input Voltage	4.5	1.5	2.0	2.0		V	VOUT or VCC 0.1 V
		5.5	1.5	2.0	2.0			
VIL	Maximum Low Level Input Voltage	4.5	1.5	0.8	0.8		V	VOUT or VCC 0.1 V
		5.5	1.5	0.8	0.8			
VOH	Minimum High Level Output Voltage	4.5	4.49	4.4	4.4		V	IOUT 50 μA
		5.5	5.49	5.4	5.4			
		4.5		3.86	3.76		V	*VIN VIL or VIH 24 mA IOH 24 mA
		5.5		4.86	4.76			
VOL	Maximum Low Level Output Voltage	4.5	0.001	0.1	0.1		V	IOUT 50 μA
		5.5	0.001	0.1	0.1			
		4.5		0.36	0.44		V	*VIN VIL or VIH 24 mA IOL 24 mA
		5.5		0.36	0.44			
IIN	Maximum Input Leakage Current	5.5		0.1	1.0		μA	VI VCC, GND
ΔICCT	Additional Max. ICC Input	5.5	0.6		1.5		mA	VI VCC 2.1 V
IOLD	†Minimum Dynamic Output Current	5.5			75		mA	VOID 1.65 V Max
IOHD		5.5			75		mA	VOHD 3.85 V Min
ICC	Maximum Quiescent Supply Current	5.5		4.0	40		μA	VIN VCC 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	VCC* (V)	74AC			74AC		Units	Fig. No.
			TA = +25°C CL = 50 pF			TA = -40°C to +85°C CL = 50 pF			
			Min	Typ	Max	Min	Max		
fmax	Maximum Clock Frequency	3.3	100	125	95		MHz	3-3	
		5.0	140	160	125				
tPLH	Propagation Delay CDn or SDn to Qn or Qn	3.3	5.0	8.0	12.0	4.0	13.0	ns	3-6
		5.0	3.5	6.0	9.0	3.0	10.0		
tPHL	Propagation Delay CDn or SDn to Qn or Qn	3.3	4.0	10.5	12.0	3.5	13.5	ns	3-6
		5.0	3.0	8.0	9.5	2.5	10.5		
tPLH	Propagation Delay CPn to Qn or Qn	3.3	4.5	8.0	13.5	4.0	16.0	ns	3-6
		5.0	3.5	6.0	10.0	3.0	10.5		
tPHL	Propagation Delay CPn to Qn or Qn	3.3	3.5	8.0	14.0	3.5	14.5	ns	3-6
		5.0	2.5	6.0	10.0	2.5	10.5		

*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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FACT DATA

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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 C _{Dn} or 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 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 C _{Dn} or S _{Dn} to Q _n or Q̄ _n	5.0	3.0	5.5	9.5	2.5	10.5	ns	3-6
t _{PHL}	Propagation Delay C _{Dn} or S _{Dn} to Q _n or Q̄ _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 Q̄ _n	5.0	4.0	7.5	11.0	4.0	13.0	ns	3-6
t _{PHL}	Propagation Delay CP _n to Q _n or Q̄ _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 C _{Dn} or S _{Dn} Pulse Width	5.0	3.0	5.0	6.0	ns	3-6	
t _{rec}	Recovery Time C _{Dn} or 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

FACT DATA