



MC74AC113 MC74ACT113

Dual JK Negative Edge-Triggered Flip-Flop

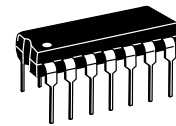
The MC74AC113/74ACT113 consists of two high-speed completely independent transition clocked JK flip-flops. The clocking operation is independent of rise and fall times of the clock waveform. The JK design allows operation as a D flip-flop (refer to MC74AC74/74ACT74 data sheet) by connecting the J and K inputs together.

Asynchronous Inputs:

- LOW input to $\overline{S_D}$ (Set) sets Q to HIGH level
- Set is independent of clock

- Outputs Source/Sink 24 mA
- 'ACT113 Has TTL Compatible Inputs

DUAL JK NEGATIVE
EDGE-TRIGGERED
FLIP-FLOP

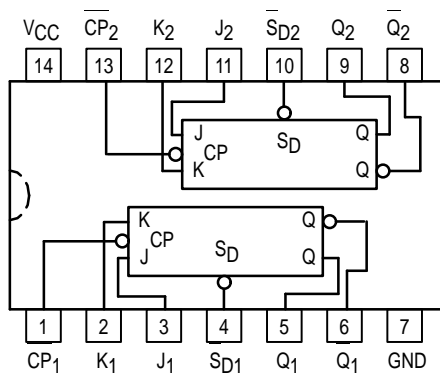


N SUFFIX
CASE 646-06
PLASTIC

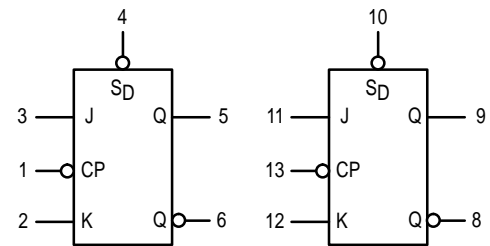


D SUFFIX
CASE 751A-03
PLASTIC

CONNECTION DIAGRAM



LOGIC SYMBOL



V_{CC} = PIN 14
GND = PIN 7

MODE SELECT — TRUTH TABLE

Operating Mode	Inputs			Outputs	
	$\overline{S_D}$	J	K	Q	\overline{Q}
Set	L	X	X	H	L
Toggle	H	h	h	q	q
Load "0" (Reset)	H	l	h	L	H
Load "1" (Set)	H	h	l	H	L
Hold	H	l	l	q	q

H, h = HIGH Voltage Level

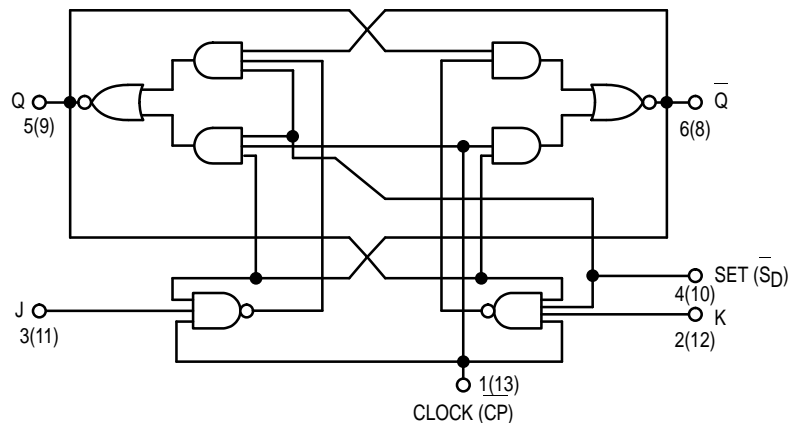
L, l = LOW Voltage Level

X = Don't Care

l, h (q) = Lower case letters indicate the state of the referenced input (or output) one set-up time prior to the HIGH to LOW clock transition.

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LOGIC DIAGRAM (Each Flip-Flop)



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	$^{\circ}C$

* 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	$^{\circ}C$	
T_A	Operating Ambient Temperature Range	-40	25	85	$^{\circ}C$	
I_{OH}	Output Current — High			-24	mA	
I_{OL}	Output Current — Low			24	mA	

- V_{in} from 30% to 70% V_{CC} ; see individual Data Sheets for devices that differ from the typical input rise and fall times.
- 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	145 145			125 125		MHz	3-3
t _{PLH}	Propagation Delay C _{Pn} to Q _n or Q _n	3.3 5.0	1.0 1.0		14.5 12.0	1.0 1.0	16.0 13.0	ns	3-6
t _{PHL}	Propagation Delay C _{Pn} to Q _n or Q _n	3.3 5.0	1.0 1.0		14.5 12.5	1.0 1.0	15.5 13.0	ns	3-6
t _{PLH}	Propagation Delay S _{Dn} to Q _n	3.3 5.0	1.0 1.0		10.0 9.0	1.0 1.0	11.0 9.5	ns	3-6
t _{PHL}	Propagation Delay S _{Dn} to Q _n	3.3 5.0	1.0 1.0		13.0 11.0	1.0 1.0	14.0 11.5	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	6.5	7.5	ns	3-9	
		5.0	4.5	5.0			
t _h	Hold Time, HIGH or LOW J _N or K _N to CP _N	3.3	0	0	ns	3-9	
		5.0	0	0			
t _w	Pulse Width Clock	3.3	5.0	5.5	ns	3-6	
		5.0	4.0	4.5			
t _w	Pulse Width S _{Dn}	3.3	5.5	6.0	ns	3-6	
		5.0	5.0	5.5			
t _{rec}	Recovery Time S _{Dn} to CP	3.3	0	0	ns	3-9	
		5.0	0	0			

* 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		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	2.0	V	V _{OUT} = 0.1 V or V _{CC} - 0.1 V	
		5.5	1.5	2.0	2.0			
V _{IL}	Maximum Low Level Input Voltage	4.5	1.5	0.8	0.8	V	V _{OUT} = 0.1 V or V _{CC} - 0.1 V	
		5.5	1.5	0.8	0.8			
V _{OH}	Minimum High Level Output Voltage	4.5	4.49	4.4	4.4	V	I _{OUT} = -50 μA	
		5.5	5.49	5.4	5.4			
		4.5		3.86	3.76	V	*V _{IN} = V _{IL} or V _{IH} -24 mA	
5.5		4.86	4.76			I _{OH} -24 mA		
V _{OL}	Maximum Low Level Output Voltage	4.5	0.001	0.1	0.1	V	I _{OUT} = 50 μA	
		5.5	0.001	0.1	0.1			
		4.5		0.36	0.44	V	*V _{IN} = V _{IL} or V _{IH} 24 mA	
5.5		0.36	0.44			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} - 2.1 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.

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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	1.0		14.0	1.0	15.5	ns	3-6
t _{PHL}	Propagation Delay CP _N to Q _N or Q _N	5.0	1.0		13.5	1.0	15.0	ns	3-6
t _{PLH}	Propagation Delay S _{DN} to Q _N	5.0	1.0		11.5	1.0	12.5	ns	3-6
t _{PHL}	Propagation Delay S _{DN} to Q _N	5.0	1.0		13.0	1.0	14.0	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 Clock	5.0		5.0	6.0		ns	3-6
t _w	Pulse Width S _{DN}	5.0		5.5	6.0		ns	3-6
t _{rec}	Recovery Time S _{DN} to CP	5.0		0	0		ns	3-9

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

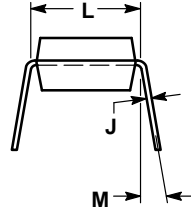
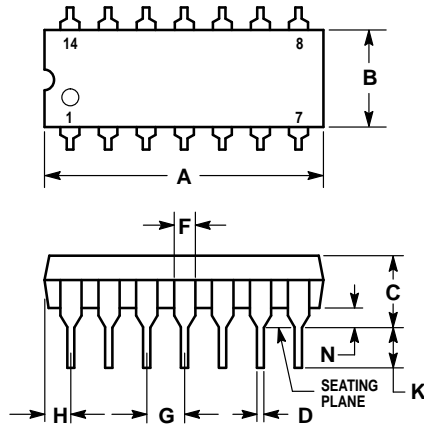
CAPACITANCE

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 646-06 ISSUE L

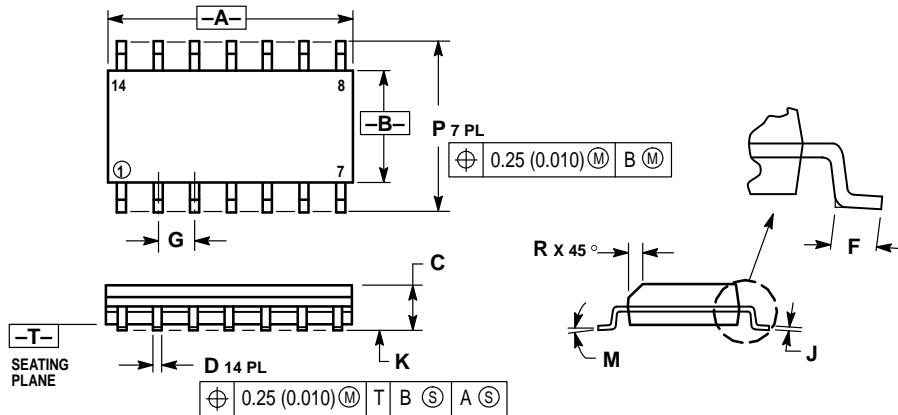


NOTES:

- LEADS WITHIN 0.13 (0.005) RADIUS OF TRUE POSITION AT SEATING PLANE AT MAXIMUM MATERIAL CONDITION.
- DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
- DIMENSION B DOES NOT INCLUDE MOLD FLASH.
- ROUNDED CORNERS OPTIONAL.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.715	0.770	18.16	19.56
B	0.240	0.260	6.10	6.60
C	0.145	0.185	3.69	4.69
D	0.015	0.021	0.38	0.53
F	0.040	0.070	1.02	1.78
G	0.100 BSC		2.54 BSC	
H	0.052	0.095	1.32	2.41
J	0.008	0.015	0.20	0.38
K	0.115	0.135	2.92	3.43
L	0.300 BSC		7.62 BSC	
M	0° - 10°		0° - 10°	
N	0.015	0.039	0.39	1.01


D SUFFIX PLASTIC SOIC PACKAGE CASE 751A-03 ISSUE F



NOTES:

- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
- CONTROLLING DIMENSION: MILLIMETER.
- DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
- MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
- 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	8.55	8.75	0.337	0.344
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	0.228	0.244
R	0.25	0.50	0.010	0.019

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MC74AC113/D

