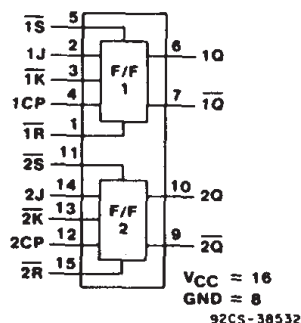




Data sheet acquired from Harris Semiconductor
SCHS282

CD54/74AC109, CD54/74AC112 CD54/74ACT109, CD54/74ACT112



CD54/74AC/ACT109
FUNCTIONAL DIAGRAM

Dual "J-K" Flip-Flop with Set and Reset

CD54/74AC/ACT109 - Positive-Edge-Triggered (J, $\bar{K}$)

CD54/74AC/ACT112 - Negative-Edge-Triggered (J, K)

Type Features:

- Buffered inputs
- Typical propagation delay:
4.8 ns @ $V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$, $C_L = 50\text{ pF}$

The RCA CD54/74AC109 and CD54/74AC112 and the CD54/74ACT109 and CD54/74ACT112 dual "J-K" flip-flops with set and reset use the RCA ADVANCED CMOS technology. These flip-flops have independent J, K (or $\bar{K}$), Set, Reset, and Clock inputs and Q and $\bar{Q}$ outputs. The CD54/74AC/ACT112 changes state on the negative-going transition of the clock pulse. The CD54/74AC/ACT109 changes state on the positive-going transition of the clock. Set and Reset are accomplished asynchronously by low-level inputs.

The CD74AC/ACT109 and CD74AC/ACT112 are supplied in 16-lead dual-in-line plastic packages (E suffix) and in 16-lead dual-in-line small-outline plastic packages (M suffix). Both package types are operable over the following temperature ranges: Commercial (0 to 70°C); Industrial (-40 to $+85^\circ\text{C}$); and Extended Industrial/Military (-55 to $+125^\circ\text{C}$).

The CD54AC/ACT109 and CD54AC/ACT112, available in chip form (H suffix), are operable over the -55 to $+125^\circ\text{C}$ temperature range.

Family Features:

- Exceeds 2-kV ESD Protection - MIL-STD-883, Method 3015
- SCR-Latchup-resistant CMOS process and circuit design
- Speed of bipolar FAST*/AS/S with significantly reduced power consumption
- Balanced propagation delays
- AC types feature 1.5-V to 5.5-V operation and balanced noise immunity at 30% of the supply
- $\pm 24\text{-mA}$ output drive current
 - Fanout to 15 FAST* ICs
 - Drives 50-ohm transmission lines

*FAST is a Registered Trademark of Fairchild Semiconductor Corp.

CD54/74AC/ACT109 TRUTH TABLE

INPUTS					OUTPUTS	
$\bar{S}$	$\bar{R}$	CP	J	$\bar{K}$	Q	$\bar{Q}$
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	NO CHANGE	
H	H		H	H	H	L
H	H	L	X	X	NO CHANGE	

*Unpredictable and unstable condition if both $\bar{S}$ and $\bar{R}$ go high simultaneously.

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This data sheet is applicable to the CD54/74AC109, CD54AC112, CD45ACT109, and CD54ACT112. See SCHS233 for information on the CD74AC112, CD74ACT109, and CD74ACT112.

File Number 1967

CD54/74AC109, CD54/74AC112 CD54/74ACT109, CD54/74ACT112

CD54/74AC/ACT112 TRUTH TABLE

INPUTS					OUTPUTS	
$\bar{S}$	$\bar{R}$	$\bar{CP}$	J	K	Q	$\bar{Q}$
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	NO CHANGE	NO CHANGE
H	H		H	L	H	L
H	H		L	H	L	H
H	H		H	H	TOGGLE	TOGGLE
H	H	H	X	X	NO CHANGE	NO CHANGE

*Output states unpredictable if $\bar{S}$ and $\bar{R}$ go High simultaneously after both being Low at the same time.

H = High steady state

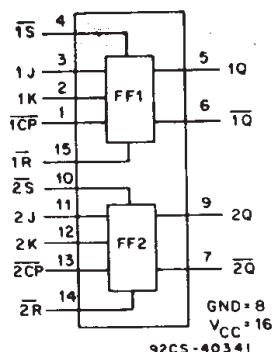
L = Low steady state

X = Irrelevant

= High-to-Low transition

= Low-to-High transition

CD54/74AC/ACT112
FUNCTIONAL DIAGRAM



MAXIMUM RATINGS, Absolute-Maximum Values:

DC SUPPLY-VOLTAGE (V_{CC})	-0.5 to 6 V
DC INPUT DIODE CURRENT, I_{IK} (for $V_I < -0.5$ V or $V_I > V_{CC} + 0.5$ V)	± 20 mA
DC OUTPUT DIODE CURRENT, I_{OK} (for $V_O < -0.5$ V or $V_O > V_{CC} + 0.5$ V)	± 50 mA
DC OUTPUT SOURCE OR SINK CURRENT per Output Pin, I_O (for $V_O > -0.5$ V or $V_O < V_{CC} + 0.5$ V)	± 50 mA
DC V_{CC} or GROUND CURRENT (I_{CC} or I_{GND})	± 100 mA*
POWER DISSIPATION PER PACKAGE (P_D):	
For $T_A = -55$ to $+100^\circ\text{C}$ (PACKAGE TYPE E)	500 mW
For $T_A = +100$ to $+125^\circ\text{C}$ (PACKAGE TYPE E)	Derate Linearly at 8 mW/ $^\circ\text{C}$ to 300 mW
For $T_A = -55$ to $+70^\circ\text{C}$ (PACKAGE TYPE M)	400 mW
For $T_A = +70$ to $+125^\circ\text{C}$ (PACKAGE TYPE M)	Derate Linearly at 6 mW/ $^\circ\text{C}$ to 70 mW
OPERATING-TEMPERATURE RANGE (T_A)	-55 to $+125^\circ\text{C}$
STORAGE TEMPERATURE (T_{stg})	-65 to $+150^\circ\text{C}$
LEAD TEMPERATURE (DURING SOLDERING):	
At distance $1/16 \pm 1/32$ in. (1.59 ± 0.79 mm) from case for 10 s maximum	$+265^\circ\text{C}$
Unit inserted into PC board min. thickness $1/16$ in. (1.59 mm) with solder contacting lead tips only	$+300^\circ\text{C}$

*For up to 4 outputs per device; add ± 25 mA for each additional output.

RECOMMENDED OPERATING CONDITIONS:

For maximum reliability, normal operating conditions should be selected so that operation is always within the following ranges:

CHARACTERISTICS	LIMITS		UNITS
	MIN.	MAX.	
Supply-Voltage Range, V_{CC} *, (For T_A = Full Package-Temperature Range)			
AC Types	1.5	5.5	V
ACT Types	4.5	5.5	V
DC Input or Output Voltage, V_I , V_O	0	V_{CC}	V
Operating Temperature, T_A	-55	+125	$^\circ\text{C}$
Input Rise and Fall Slew Rate, dt/dv			
at 1.5 V to 3 V (AC Types)	0	50	ns/V
at 3.6 V to 5.5 V (AC Types)	0	20	ns/V
at 4.5 V to 5.5 V (ACT Types)	0	10	ns/V

*Unless otherwise specified, all voltages are referenced to ground

CD54/74AC109, CD54/74AC112 CD54/74ACT109, CD54/74ACT112

STATIC ELECTRICAL CHARACTERISTICS: AC Series

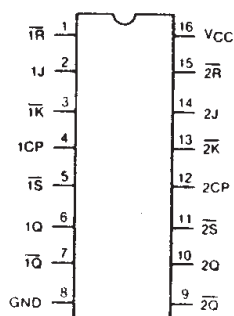
CHARACTERISTICS		TEST CONDITIONS		V _{cc} (V)	AMBIENT TEMPERATURE (T _A) - °C						UNITS
					+25		-40 to +85		-55 to +125		
		V _i (V)	I _o (mA)		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
High-Level Input Voltage	V _{IH}			1.5 3 5.5	1.2 2.1 3.85	— — —	1.2 2.1 3.85	— — —	1.2 2.1 3.85	— — —	V
Low-Level Input Voltage	V _{IL}			1.5 3 5.5	— — —	0.3 0.9 1.65	— — —	0.3 0.9 1.65	— — —	0.3 0.9 1.65	V
High-Level Output Voltage	V _{OH}	V _{IH} or V _{IL}	-0.05	1.5	1.4	—	1.4	—	1.4	—	V
			-0.05	3	2.9	—	2.9	—	2.9	—	
			-0.05	4.5	4.4	—	4.4	—	4.4	—	
			-4	3	2.58	—	2.48	—	2.4	—	
			-24	4.5	3.94	—	3.8	—	3.7	—	
		#, * {	-75	5.5	—	—	3.85	—	—	—	
			-50	5.5	—	—	—	—	3.85	—	
Low-Level Output Voltage	V _{OL}	V _{IH} or V _{IL}	0.05	1.5	—	0.1	—	0.1	—	0.1	V
			0.05	3	—	0.1	—	0.1	—	0.1	
			0.05	4.5	—	0.1	—	0.1	—	0.1	
			12	3	—	0.36	—	0.44	—	0.5	
			24	4.5	—	0.36	—	0.44	—	0.5	
		#, * {	75	5.5	—	—	—	1.65	—	—	
			50	5.5	—	—	—	—	—	1.65	
Input Leakage Current	I _i	V _{cc} or GND		5.5	—	±0.1	—	±1	—	±1	μA
Quiescent Supply Current, FF	I _{cc}	V _{cc} or GND	0	5.5	—	4	—	40	—	80	μA

#Test one output at a time for a 1-second maximum duration. Measurement is made by forcing current and measuring voltage to minimize power dissipation.

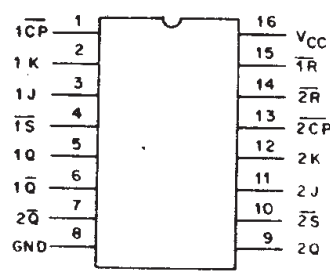
*Test verifies a minimum 50-ohm transmission-line-drive capability at +85°C, 75 ohms at +125°C.

9

TERMINAL ASSIGNMENT DIAGRAMS



CD54/74AC/ACT109



CD54/74AC/ACT112

CD54/74AC109, CD54/74AC112

CD54/74ACT109, CD54/74ACT112

STATIC ELECTRICAL CHARACTERISTICS: ACT Series

CHARACTERISTICS	TEST CONDITIONS		V _{CC} (V)	AMBIENT TEMPERATURE (T _A) - °C						UNITS
				+25		-40 to +85		-55 to +125		
	V _I (V)	I _O (mA)		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
High-Level Input Voltage V _{IH}			4.5 to 5.5	2	—	2	—	2	—	V
Low-Level Input Voltage V _{IL}			4.5 to 5.5	—	0.8	—	0.8	—	0.8	V
High-Level Output Voltage V _{OH}	V _{IH} or V _{IL} # , * }	-0.05	4.5	4.4	—	4.4	—	4.4	—	V
		-24	4.5	3.94	—	3.8	—	3.7	—	
		-75	5.5	—	—	3.85	—	—	—	
		-50	5.5	—	—	—	—	3.85	—	
Low-Level Output Voltage V _{OL}	V _{IH} or V _{IL} # , * }	0.05	4.5	—	0.10	—	0.10	—	0.10	V
		24	4.5	—	0.36	—	0.44	—	0.50	
		75	5.5	—	—	—	1.65	—	—	
		50	5.5	—	—	—	—	—	1.65	
Input Leakage Current I _I	V _{CC} or GND		5.5	—	±0.1	—	±1	—	±1	μA
Quiescent Supply Current, FF I _{CC}	V _{CC} or GND	0	5.5	—	4	—	40	—	80	μA
Additional Supply Current per Input Pin TTL Inputs High 1 Unit Load ΔI _{CC}	V _{CC} -2.1		4.5 to 5.5	—	2.4	—	2.8	—	3	mA

#Test one output at a time for a 1-second maximum duration. Measurement is made by forcing current and measuring voltage to minimize power dissipation.

*Test verifies a minimum 50-ohm transmission-line-drive capability at +85°C, 75 ohms at +125°C.

ACT INPUT LOADING TABLE

INPUT	UNIT LOADS*	
	109	112
J, CP, $\overline{CP}$	1	1
K	—	0.53
$\overline{K}$	0.53	—
$\overline{S}$, $\overline{R}$	0.58	0.58

*Unit load is ΔI_{CC} limit specified in Static Characteristics Chart, e.g., 2.4 mA max. @ 25°C.

CD54/74AC109, CD54/74AC112

CD54/74ACT109, CD54/74ACT112

PREREQUISITE FOR SWITCHING: AC Series

CHARACTERISTICS	SYMBOL	V _{CC} (V)	AMBIENT TEMPERATURE (T _A) - °C				UNITS
			-40 to +85		-55 to +125		
			MIN.	MAX.	MIN.	MAX.	
Maximum CP, ($\overline{CP}$) Frequency 109	f _{max}	1.5 3.3* 5†	9 81 114	— — —	8 71 100	— — —	MHz
112	f _{max}	1.5 3.3 5	9 81 114	— — —	8 71 100	— — —	MHz
CP, ($\overline{CP}$) Pulse Width	t _w	1.5 3.3 5	55 6 4.4	— — —	63 7 5	— — —	ns
$\overline{R}$, $\overline{S}$ Pulse Width	t _w	1.5 3.3 5	49 5.5 3.9	— — —	56 6.3 4.5	— — —	ns
Setup Time J, $\overline{K}$ to CP 109	t _{su}	1.5 3.3 5	61 6.8 4.8	— — —	69 7.7 5.5	— — —	ns
J, $\overline{K}$ to $\overline{CP}$ 112	t _{su}	1.5 3.3 5	44 4.9 3.5	— — —	50 5.6 4	— — —	ns
Hold Time J, $\overline{K}$ to CP 109	t _h	1.5 3.3 5	0 0 0	— — —	0 0 0	— — —	ns
J, $\overline{K}$ to $\overline{CP}$ 112	t _h	1.5 3.3 5	0 0 0	— — —	0 0 0	— — —	ns
Removal Time $\overline{R}$, $\overline{S}$ to CP, ($\overline{CP}$)	t _{rem}	1.5 3.1 5	27 3.1 2.2	— — —	31 3.5 2.5	— — —	ns

*3.3 V: min. is @ 3 V

†5 V: min is @ 4.5 V

SWITCHING CHARACTERISTICS: AC Series; t_r , t_f = 3 ns, C_L = 50 pF

CHARACTERISTICS	SYMBOL	V _{CC} (V)	AMBIENT TEMPERATURE (T _A) - °C				UNITS
			-40 to +85		-55 to +125		
			MIN.	MAX.	MIN.	MAX.	
Propagation Delays: CP, (CP) to Q, Q̄	t _{PLH} t _{PHL}	1.5 3.3* 5†	— 3.7 2.7	117 13.1 9.4	— 3.6 2.6	129 14.4 10.3	ns
S̄, R to Q, Q̄	t _{PLH} t _{PHL}	1.5 3.3 5	— 4.4 3.2	139 15.5 11.1	— 4.3 3.1	153 17.1 12.2	ns
Power Dissipation Capacitance	C _{PD} §	—	56 Typ.		56 Typ.		pF
Input Capacitance	C _I	—	—	10	—	10	pF

*3.3 V: min. is @ 3.6 V
max. is @ 3 V†5 V: min. is @ 5.5 V
max. is @ 4.5 V§ C_{PD} is used to determine the dynamic power consumption, per flip-flop.

$$P_D = C_{PD}V_{CC}^2 f_i + \Sigma (C_L V_{CC}^2 f_o) \text{ where } f_i = \text{input frequency}$$

 f_o = output frequency C_L = output load capacitance V_{CC} = supply voltage.

CD54/74AC109, CD54/74AC112 CD54/74ACT109, CD54/74ACT112

PREREQUISITE FOR SWITCHING: ACT Series

CHARACTERISTICS	SYMBOL	V _{CC} (V)	AMBIENT TEMPERATURE (T _A) - °C				UNITS
			-40 to +85		-55 to +125		
			MIN.	MAX.	MIN.	MAX.	
Maximum CP, ($\overline{CP}$) Frequency 109	f _{max}	5*	114	—	100	—	MHz
112			114	—	100	—	
CP, ($\overline{CP}$) Pulse Width	t _w	5	4.4	—	5	—	ns
R, $\overline{S}$ Pulse Width	t _w	5	4.8	—	5.5	—	ns
Setup Time J, $\overline{K}$ to CP (109)	t _{su}	5	4.8	—	5.5	—	ns
J, K to $\overline{CP}$ (112)			3.5	—	4	—	
Hold Time J, $\overline{K}$ to CP (109)	t _h	5	0	—	0	—	ns
J, K to $\overline{CP}$ (112)			1	—	1	—	
Removal Time R, $\overline{S}$ to CP, ($\overline{CP}$)	t _{rem}	5	2.2	—	2.5	—	ns

*5 V: min. is @ 4.5 V

SWITCHING CHARACTERISTICS: ACT Series; t_r , t_f = 3 ns, C_L = 50 pF

CHARACTERISTICS	SYMBOL	V _{CC} (V)	AMBIENT TEMPERATURE (T _A) - °C				UNITS
			-40 to +85		-55 to +125		
			MIN.	MAX.	MIN.	MAX.	
Propagation Delays CP, (CP) to Q, Q	t _{PLH} t _{PHL}	5*	2.7	9.4	2.6	10.3	ns
S, R, to Q, Q	t _{PLH} t _{PHL}	5	3.2	11.1	3.1	12.2	ns
Power Dissipation Capacitance	C _{PD} §	—	56 Typ.		56 Typ.		pF
Input Capacitance	C _i	—	—	10	—	10	pF

*5 V: min. is @ 5.5 V
max. is @ 4.5 V

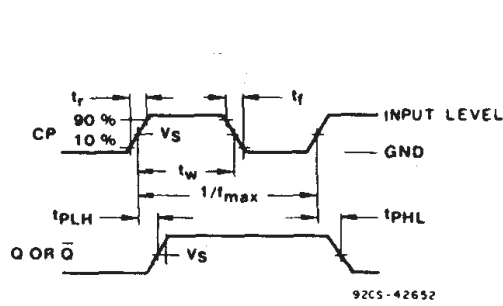
§ C_{PD} is used to determine the dynamic power consumption, per flip-flop.

$$P_D = C_{PD}V_{CC}^2 f_i + \Sigma (C_L V_{CC}^2 f_o) + V_{CC} \Delta t_{cc}$$

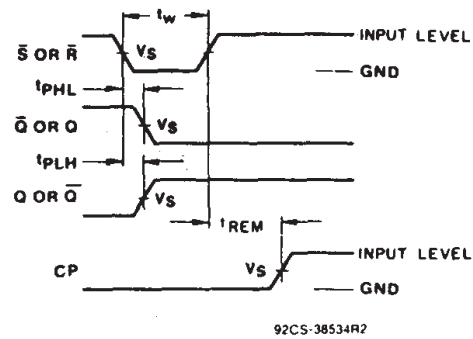
where f_i = input frequency
 f_o = output frequency
 C_L = output load capacitance
 V_{CC} = supply voltage.

CD54/74AC109, CD54/74AC112 CD54/74ACT109, CD54/74ACT112

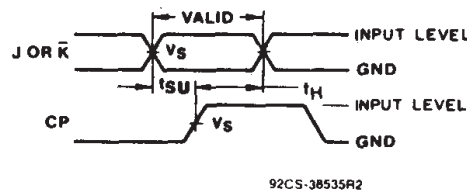
CD54/74AC/ACT109 Waveforms



Clock to output delays and clock pulse width.

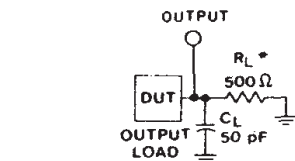
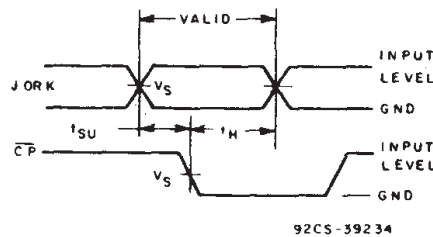
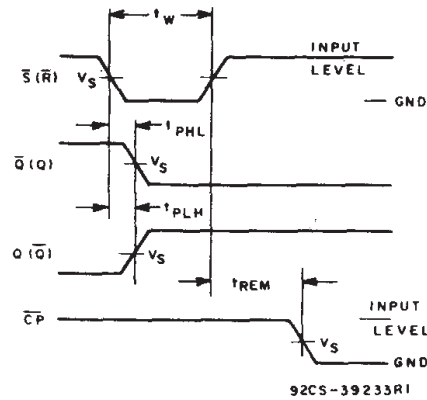
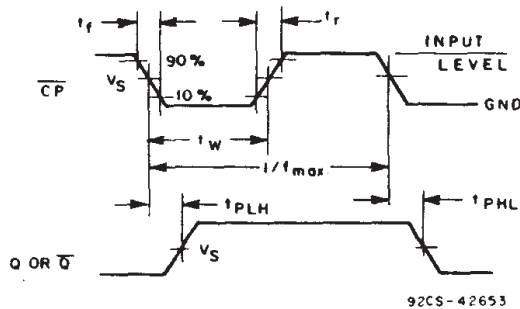


Reset or Set prerequisite and propagation delays.



Data setup and hold times.

CD54/74/AC/ACT112 Waveforms



*FOR AC SERIES ONLY: WHEN
 $V_{CC} = 1.5 \text{ V}$, $R_L = 1 \text{ k}\Omega$

92CS-42189

Test circuit.

Propagation delay times, and setup and hold times.

	CD54/74AC	CD54/74ACT
Input Level	V_{CC}	3 V
Input Switching Voltage, V_S	$0.5 V_{CC}$	1.5 V
Output Switching Voltage, V_S	$0.5 V_{CC}$	$0.5 V_{CC}$

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