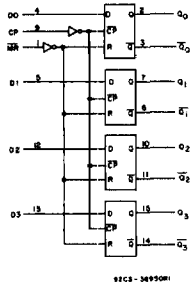


High-Speed CMOS Logic



FUNCTIONAL DIAGRAM

Quad D Flip-Flop with Reset

Type Features:

- Common Clock and Asynchronous Reset on four D-Type Flip-Flops
- Positive-edge pulse triggering
- Complementary Outputs
- Buffered Inputs
- Typical $f_{MAX} = 50 \text{ MHz}$ @ $V_{CC} = 5 \text{ V}$, $C_L = 15 \text{ pF}$, $T_A = 25^\circ \text{ C}$

The RCA CD54/74HC175 and the CD54/74HCT175 are high speed Quad D-Type Flip-Flops with individual D-inputs and Q, \bar{Q} complementary outputs. The devices are fabricated using silicon gate CMOS technology. They have the low power consumption advantage of standard CMOS ICs and the ability to drive 10 LSTTL devices.

Information at the D input is transferred to the Q and \bar{Q} outputs on the positive-going edge of the clock pulse. All four Flip-Flops are controlled by a common clock (CP) and a common reset (\overline{MR}). Resetting is accomplished by a low voltage level independent of the clock. All four Q outputs are reset to a logic 0 and all four \bar{Q} outputs to a logic 1.

The CD54HC175 and CD54HCT175 are supplied in 16-lead dual-in-line ceramic packages (F suffix) and the CD74HC175 and CD74HCT175 are supplied in 16-lead dual-in-line plastic packages (E suffix) and in 16-lead dual-in-line surface mount plastic packages (M suffix). Both types are also available in chip form (H suffix).

Family Features:

- Fanout (Over Temperature Range):
Standard Outputs - 10 LSTTL Loads
Bus Driver Outputs - 15 LSTTL Loads
- Wide Operating Temperature Range:
CD74HC/HCT: -40 to $+85^\circ \text{ C}$
- Balanced Propagation Delay and Transition Times
- Significant Power Reduction Compared to LSTTL Logic ICs
- Alternate Source is Philips/Signetics
- CD54HC/CD74HC Types:
2 to 6 V Operation
High Noise Immunity: $N_{IL} = 30\%$, $N_{IH} = 30\%$ of V_{CC} ; @ $V_{CC} = 5 \text{ V}$
- CD54HCT/CD74HCT Types:
4.5 to 5.5 V Operation
Direct LSTTL Input Logic Compatibility
 $V_{IL} = 0.8 \text{ V Max.}$, $V_{IH} = 2 \text{ V Min.}$
CMOS Input Compatibility
 $I_i \leq 1 \mu\text{A}$ @ V_{OL} , V_{OH}

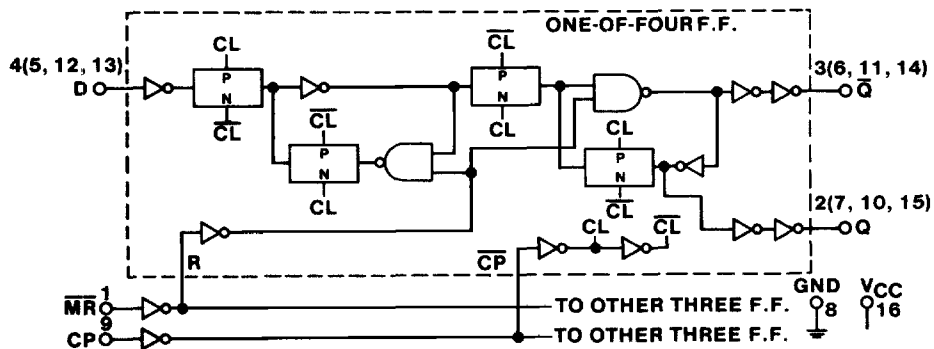


Fig. 1 - Logic block diagram.

92CM-36949R1

CD54/74HC175 CD54/74HCT175

MAXIMUM RATINGS, Absolute-Maximum Values:

DC SUPPLY-VOLTAGE, (V_{CC}):

(Voltages referenced to ground) -0.5 to + 7 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 CURRENT, I_{OK} (FOR $V_o < -0.5$ V OR $V_o > V_{CC} + 0.5$ V) ± 20 mA

DC DRAIN CURRENT, PER OUTPUT (I_o) (FOR -0.5 V $< V_o < V_{CC} + 0.5$ V) ± 25 mA

DC V_{CC} OR GROUND CURRENT (I_{CC}) ± 50 mA

POWER DISSIPATION PER PACKAGE (P_D):

For $T_A = -40$ to $+60^\circ$ C (PACKAGE TYPE E) 500 mW

For $T_A = +60$ to $+85^\circ$ C (PACKAGE TYPE E) Derate Linearly at 8 mW/ $^\circ$ C to 300 mW

For $T_A = -55$ to $+100^\circ$ C (PACKAGE TYPE F, H) 500 mW

For $T_A = +100$ to $+125^\circ$ C (PACKAGE TYPE F, H) Derate Linearly at 8 mW/ $^\circ$ C to 300 mW

For $T_A = -40$ to $+70^\circ$ C (PACKAGE TYPE M) 400 mW

For $T_A = +70$ to $+125^\circ$ C (PACKAGE TYPE M) Derate Linearly at 6 mW/ $^\circ$ C to 70 mW

OPERATING-TEMPERATURE RANGE (T_A):

PACKAGE TYPE F, H -55 to $+125^\circ$ C

PACKAGE TYPE E, M -40 to $+85^\circ$ C

STORAGE TEMPERATURE (T_{STG}) -65 to $+150^\circ$ C

LEAD TEMPERATURE (DURING SOLDERING):

At distance $1/16 \pm 1/32$ in. (1.59 ± 0.79 mm) from case for 10 s max. $+265^\circ$ C

Unit inserted into a PC Board (min. thickness $1/16$ in., 1.59 mm) with solder contacting lead tips only $+300^\circ$ C

RECOMMENDED OPERATING CONDITIONS:

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

CHARACTERISTIC	LIMITS		UNITS
	MIN.	MAX.	
Supply Voltage Range (For T_A = Full Package Temperature Range) V_{CC} :* CD54/74HC Types CD54/74HCT Types	2 4.5	6 5.5	V V
DC Input or Output Voltage V_{IN}, V_{OUT}	0	V_{CC}	V
Operating Temperature T_A : CD74 Types CD54 Types	-40 -55	+85 +125	$^\circ$ C $^\circ$ C
Input Rise and Fall Times, t_r, t_f at 2 V at 4.5 V at 6 V	0 0 0	1000 500 400	ns ns ns

*Unless otherwise specified, all voltages are referenced to Ground.

**TRUTH TABLE
(EACH FLIP-FLOP)**

INPUTS			OUTPUTS	
RESET (MR)	CLOCK CP	DATA D_n	Q_n	$\overline{Q_n}$
L	X	X	L	H
H		H	H	L
H		L	L	H
H	L	X	Q_0	$\overline{Q_0}$

H = High Level (Steady State)

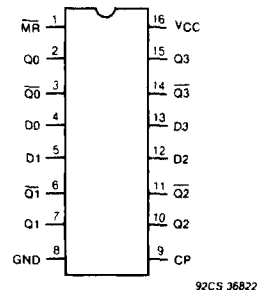
L = Low Level (Steady State)

X = Irrelevant

= Transition from Low to High Level

$Q_0, \overline{Q_0}$ = Levels Before the Indicated Steady-State

Input Conditions were Established



92CS 36822

TERMINAL ASSIGNMENT

CD54/74HC175 CD54/74HCT175

STATIC ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	CD74HC175/CD54HC175										CD74HCT175/CD54HCT175								UNITS			
	TEST CONDITIONS			74HC/54HC TYPES			74HC TYPES		54HC TYPES		TEST CONDITIONS		74HCT/54HCT TYPES			74HCT TYPES		54HCT TYPES				
	V _I V	I _O mA	V _{CC} V	+25° C			-40/ +85° C		-55/ +125° C		V _I V	V _{CC} V	+25° C			-40/ +85° C		-55/ +125° C				
				Min	Typ	Max	Min	Max	Min	Max			Min	Typ	Max	Min	Max	Min		Max		
High-Level Input Voltage V _{IH}			2	1.5	—	—	1.5	—	1.5	—	—	4.5									V	
			4.5	3.15	—	—	3.15	—	3.15	—	—	to	2	—	—	2	—	2	—	—	V	
			6	4.2	—	—	4.2	—	4.2	—	—	5.5									V	
Low-Level Input Voltage V _{IL}			2	—	—	0.5	—	0.5	—	0.5	—	4.5									V	
			4.5	—	—	1.35	—	1.35	—	1.35	—	to	—	—	0.8	—	0.8	—	0.8	—	V	
			6	—	—	1.8	—	1.8	—	1.8	—	5.5									V	
High-Level Output Voltage V _{OH} CMOS Loads	V _{IL}	-0.02	2	1.9	—	—	1.9	—	1.9	—	V _{IL}	4.5	4.4	—	—	4.4	—	4.4	—	—	V	
	or		4.5	4.4	—	—	4.4	—	4.4	—	or		4.4	—	—	4.4	—	4.4	—	—	V	
	V _{IH}		6	5.9	—	—	5.9	—	5.9	—	V _{IH}											V
TTL Loads	V _{IL}										V _{IL}	4.5	3.98	—	—	3.84	—	3.7	—	—	V	
	or	-4	4.5	3.98	—	—	3.84	—	3.7	—	or		4.5	3.98	—	—	3.84	—	3.7	—	V	
	V _{IH}	-5.2	6	5.48	—	—	5.34	—	5.2	—	V _{IH}										V	
Low-Level Output Voltage V _{OL} CMOS Loads	V _{IL}	0.02	2	—	—	0.1	—	0.1	—	0.1	V _{IL}	4.5	—	—	0.1	—	0.1	—	0.1	—	V	
	or		4.5	—	—	0.1	—	0.1	—	0.1	—		or	4.5	—	—	0.1	—	0.1	—	0.1	V
	V _{IH}		6	—	—	0.1	—	0.1	—	0.1	—		V _{IH}									V
TTL Loads	V _{IL}										V _{IL}	4.5	—	—	0.26	—	0.33	—	0.4	—	V	
	or	4	4.5	—	—	0.26	—	0.33	—	0.4	or		4.5	—	—	0.26	—	0.33	—	0.4	V	
	V _{IH}	5.2	6	—	—	0.26	—	0.33	—	0.4	V _{IH}										V	
Input Leakage Current I _I	V _{CC} or Gnd		6	—	—	±0.1	—	±1	—	±1	Any Voltage Between V _{CC} & Gnd	5.5	—	—	±0.1	—	±1	—	±1	—	μA	
Quiescent Device Current I _{CC}	V _{CC} or Gnd	0	6	—	—	8	—	80	—	160	V _{CC} or Gnd	5.5	—	—	8	—	80	—	160	—	μA	
Additional Quiescent Device Current per input pin: 1 unit load ΔI _{CC} *											V _{CC} -2.1	4.5 to 5.5	— 100	— 360	— —	450 —	— —	490 —	— —	μA		

*For dual-supply systems theoretical worst case (V_I = 2.4 V, V_{CC} = 5.5 V) specification is 1.8 mA.

HCT Input Loading Table

Input	Unit Loads*
\overline{MR}	1.0
D	0.15
CP	0.6

*Unit Load is ΔI_{CC} limit specified in Static Characteristic Chart, e.g., 360 μA max. @ 25° C.

CD54/74HC175 CD54/74HCT175

PRE-REQUISITE FOR SWITCHING FUNCTION 54/74HC SERIES AND 54/74HCT SERIES

CHARACTERISTIC	TEST CONDITION	LIMITS												UNITS	
		25° C				-40° C to +85° C				-55° C to +125° C					
		HC		HCT		74HC		74HCT		54HC		54HCT			
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.		
Clock Pulse Width Fig. 3	t_w	2	80	—	—	—	100	—	—	—	120	—	—	—	ns
	V_{CC}	4.5	16	—	20	—	20	—	25	—	24	—	30	—	
	V	6	14	—	—	—	17	—	—	—	20	—	—	—	
\overline{MR} Pulse Width Fig. 4	t_w	2	80	—	—	—	100	—	—	—	120	—	—	—	ns
	V_{CC}	4.5	16	—	20	—	20	—	25	—	24	—	30	—	
	V	6	14	—	—	—	17	—	—	—	20	—	—	—	
Setup Time Data to Clock Fig. 5	t_{su}	2	80	—	—	—	100	—	—	—	120	—	—	—	ns
	V_{CC}	4.5	16	—	20	—	20	—	25	—	24	—	30	—	
	V	6	14	—	—	—	17	—	—	—	20	—	—	—	
Hold Time Data to Clock Fig. 5	t_H	2	5	—	—	—	5	—	—	—	5	—	—	—	ns
	V_{CC}	4.5	5	—	5	—	5	—	5	—	5	—	5	—	
	V	6	5	—	—	—	5	—	—	—	5	—	—	—	
Removal Time \overline{MR} to Clock Fig. 4	t_{REM}	2	5	—	—	—	5	—	—	—	5	—	—	—	ns
	V_{CC}	4.5	5	—	5	—	5	—	5	—	5	—	5	—	
	V	6	5	—	—	—	5	—	—	—	5	—	—	—	
Clock Frequency	f_{max}	2	6	—	—	—	5	—	—	—	4	—	—	—	MHz
	V_{CC}	4.5	30	—	25	—	25	—	20	—	20	—	16	—	
	V	6	35	—	—	—	29	—	—	—	23	—	—	—	

SWITCHING CHARACTERISTICS (C_L = 50 pF, Input t_v, t_r = 6 ns)

CHARACTERISTIC	TEST CONDITION	LIMITS												UNITS	
		25° C				-40° C to +85° C				-55° C to +125° C					
		HC		HCT		74HC		74HCT		54HC		54HCT			
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.		
Propagation Delay Clock to Q or \overline{Q} Fig. 3	t_{PLH}	2	—	175	—	—	—	220	—	—	—	265	—	—	ns
	t_{PHL}	4.5	—	35	—	33	—	44	—	41	—	53	—	50	
	V_{CC}	6	—	30	—	—	—	37	—	—	—	45	—	—	
Propagation Delay \overline{MR} to Q or \overline{Q} Fig. 4	t_{PLH}	2	—	175	—	—	—	220	—	—	—	265	—	—	ns
	t_{PHL}	4.5	—	35	—	35	—	44	—	44	—	53	—	53	
	V_{CC}	6	—	30	—	—	—	37	—	—	—	45	—	—	
Output Transition Time Fig. 6	t_{TLH}	2	—	75	—	—	—	95	—	—	—	110	—	—	ns
	t_{THL}	4.5	—	15	—	15	—	19	—	19	—	22	—	22	
	V_{CC}	6	—	13	—	—	—	16	—	—	—	19	—	—	
Input Capacitance	C_i		—	10	—	10	—	10	—	10	—	10	—	10	pF

CD54/74HC175 CD54/74HCT175

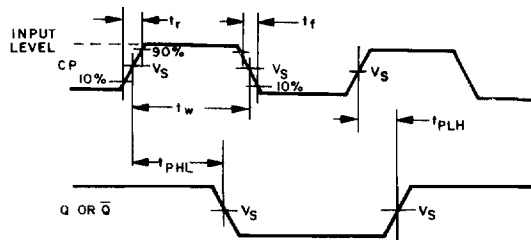
SWITCHING CHARACTERISTICS ($V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{ C}$, Input $t_r, t_f = 6\text{ ns}$)

CHARACTERISTIC	t	C_L pF	Typical		Units
			HC	HCT	
Propagation Delay- Clock to Q or \bar{Q} , Fig. 3	t_{PLH} t_{PHL}	15	14	13	ns
Propagation Delay MR to Q or \bar{Q} , Fig. 4	t_{PHL} t_{PLH}	15	14	17	ns
Power Dissipation Capacitance*	C_{PD}	—	65	67	pF

*CPD is used to determine the dynamic power consumption, per flip-flop.

$$PD = CPDV_{CC}2f_i + \sum CLV_{CC}2f_o \quad \text{where } f_i = \text{input frequency, } f_o = \text{output frequency,}$$

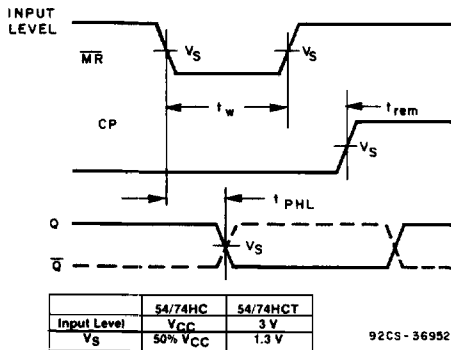
$CL = \text{output load capacitance, } V_{CC} = \text{supply voltage}$



	54/74HC	54/74HCT
Input Level	V_{CC}	3 V
V_S	50% V_{CC}	1.3 V

92CS-36951

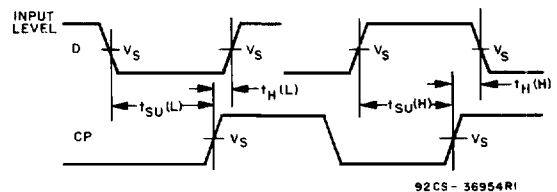
Fig. 3 - Propagation delay times and clock pulse width.



	54/74HC	54/74HCT
Input Level	V_{CC}	3 V
V_S	50% V_{CC}	1.3 V

92CS-36952

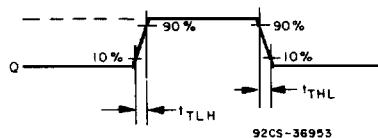
Fig. 4 - Pre-requisite and propagation delay times for master reset.



	54/74HC	54/74HCT
Input Level	V_{CC}	3 V
V_S	50% V_{CC}	1.3 V

92CS-36954R1

Fig. 5 - Pre-requisite for clock.



92CS-36953

Fig. 6 - Transition times.