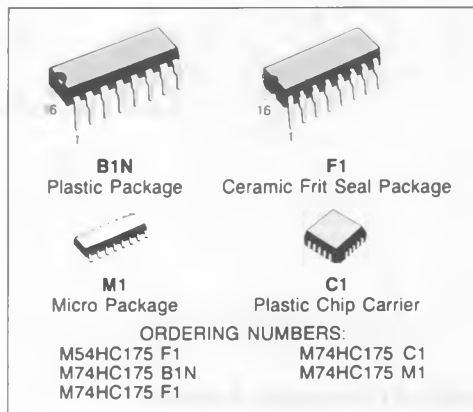


QUAD D-TYPE FLIP-FLOP WITH CLEAR

- **HIGH SPEED**
 $t_{PD} = 18 \text{ ns (TYP.) at } V_{CC} = 5V$
- **LOW POWER DISSIPATION**
 $I_{CC} = 4 \mu A \text{ (MAX.) at } T_A = 25^\circ C$
- **HIGH NOISE IMMUNITY**
 $V_{NIH} = V_{NIL} = 28\% V_{CC} \text{ (MIN.)}$
- **OUTPUT DRIVE CAPABILITY**
 10 LSTTL LOADS
- **SYMMETRICAL OUTPUT IMPEDANCE**
 $|I_{OH}| = I_{OL} = 4 \text{ mA (MIN.)}$
- **BALANCED PROPAGATION DELAYS**
 $t_{PLH} = t_{PHL}$
- **WIDE OPERATING VOLTAGE RANGE**
 $V_{CC} \text{ (OPR)} = 2V \text{ to } 6V$
- **PIN AND FUNCTION COMPATIBLE**
 WITH 54/74LS175



DESCRIPTION

The M54/74HC175 is a high speed CMOS QUAD D-TYPE FLIP-FLOP WITH CLEAR fabricated in silicon gate CMOS technology. It has the same high speed performance of LSTTL combined with true CMOS low power consumption.

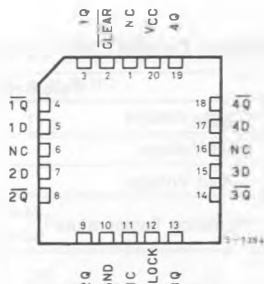
These four flip-flops are controlled by a clock input (CLOCK) and a clear input (CLEAR). The information data applied to the D inputs (1D to 4D) are transferred to the outputs (1Q to 4Q and $\overline{1Q}$ to $\overline{4Q}$) on the positive-going edge of the clock pulse. The reset function is accomplished when the clear input is taken low and all Q outputs are kept low regardless of other input conditions. All inputs are equipped with protection circuits against static discharge and transient excess voltage.

TRUTH TABLE

INPUTS			OUTPUTS		FUNCTION
CLEAR	D	CLOCK	Q	$\overline{Q}$	
L	X	X	L	H	CLEAR
H	L		L	H	—
H	H		H	L	—
H	X		Qn	$\overline{Qn}$	NO CHANGE

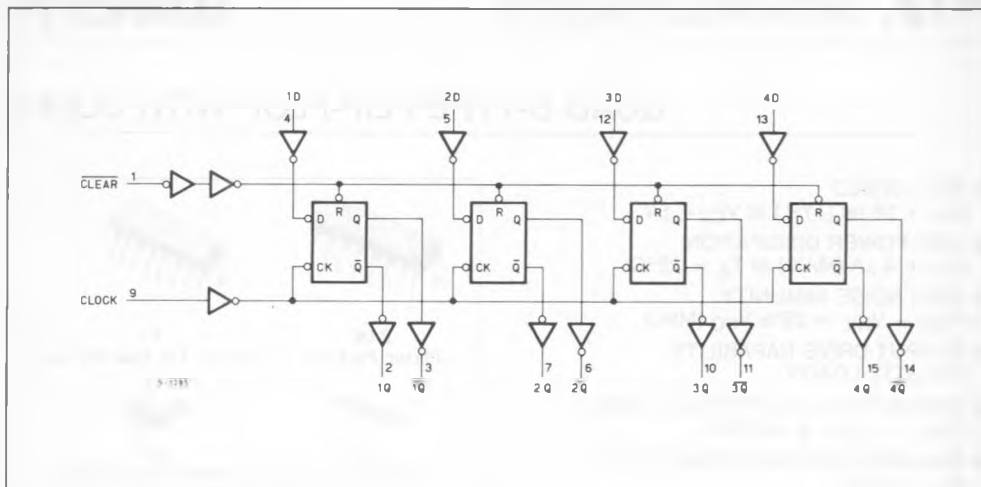
X: DON'T CARE

PIN CONNECTIONS (top view)



NC =
No Internal
Connection

LOGIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage	- 0.5 to 7	V
V_I	DC Input Voltage	- 0.5 to $V_{CC} + 0.5$	V
V_O	DC Output Voltage	- 0.5 to $V_{CC} + 0.5$	V
I_{IK}	DC Input Diode Current	± 20	mA
I_{OK}	DC Output Diode Current	± 20	mA
I_O	DC Output Source Sink Current Per Output Pin	± 25	mA
I_{CC} or I_{GND}	DC V_{CC} or Ground Current	± 50	mA
P_D	Power Dissipation	500 (*)	mW
T_{stg}	Storage Temperature	- 65 to 150	°C

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these condition is not implied.

(*) 500 mW: $\cong$ 65°C derate to 300 mW by 10 mW/°C: 65°C to 85°C.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage	2 to 6	V
V_I	Input Voltage	0 to V_{CC}	V
V_O	Output Voltage	0 to V_{CC}	V
T_A	Operating Temperature 74HC Series 54HC Series	- 40 to 85 - 55 to 125	°C
t_r, t_f	Input Rise and Fall Time	$V_{CC} \begin{cases} 2 \text{ V} & 0 \text{ to } 1000 \\ 4.5 \text{ V} & 0 \text{ to } 500 \\ 6 \text{ V} & 0 \text{ to } 400 \end{cases}$	ns

DC SPECIFICATIONS

Symbol	Parameter	V _{CC}	Test Condition	T _A = 25°C 54HC and 74HC			– 40 to 85°C 74HC		– 55 to 125°C 54HC		Unit
				Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
V _{IH}	High Level Input Voltage	2.0 4.5 6.0		1.5 3.15 4.2	— — —	— — —	1.5 3.15 4.2	— — —	1.5 3.15 4.2	— — —	V
V _{IL}	Low Level Input Voltage	2.0 4.5 6.0		— — —	— — —	0.5 1.35 1.8	— — —	0.5 1.35 1.8	— — —	0.5 1.35 1.8	V
V _{OH}	High Level Output Voltage	2.0	V _I	I _O	1.9	2.0	—	1.9	—	1.9	V
		4.5	V _{IH} or V _{IL}	– 20 µA	4.4	4.5	—	4.4	—	4.4	
		6.0			5.9	6.0	—	5.9	—	5.9	
		4.5		– 4.0 mA	4.18	4.31	—	4.13	—	4.10	
		6.0		– 5.2 mA	5.68	5.8	—	5.63	—	5.60	
V _{OL}	Low Level Output Voltage	2.0	V _{IH} or V _{IL}	20 µA	—	0.0	0.1	—	0.1	—	V
		4.5			—	0.0	0.1	—	0.1	—	
		6.0			—	0.0	0.1	—	0.1	—	
		4.5		4.0 mA	—	0.17	0.26	—	0.33	—	
		6.0		5.2 mA	—	0.18	0.26	—	0.33	—	
I _I	Input Leakage Current	6.0	V _I = V _{CC} or GND		—	—	± 0.1	—	± 1.0	—	µA
I _{CC}	Quiescent Supply Current	6.0	V _I = V _{CC} or GND		—	—	4	—	40	—	80 µA

AC ELECTRICAL CHARACTERISTICS (V_{CC} = 5V, T_A = 25°C, C_L = 15pF, Input t_r = t_f = 6ns)

Symbol	Parameter	54HC and 74HC			Unit
		Min.	Typ.	Max.	
t _{TLH} t _{THL}	Output Transition Time		4	8	ns
t _{PLH} t _{PHL}	Propagation Delay Time (CLOCK-Q, $\bar{Q}$)		18	28	ns
t _{PHL}	Propagation Delay Time ($\bar{C}$ LEAR-Q, $\bar{Q}$)		20	32	ns
f _{MAX}	Maximum Clock Frequency	33	53		MHz

AC ELECTRICAL CHARACTERISTICS ($C_L = 50\text{pF}$, Input $t_r = t_f = 6\text{ns}$)

Symbol	Parameter	V_{CC}	Test Condition	$T_A = 25^\circ\text{C}$ 54HC and 74HC			- 40 to 85°C 74HC		- 55 to 125°C 54HC		Unit
				Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
t_{TLH} t_{THL}	Output Transition Time	2.0 4.5 6.0		— — —	30 8 7	75 15 13	— — —	95 19 16	— — —	110 22 19	ns
t_{PLH} t_{PHL}	Propagation Delay Time (CLOCK-Q, $\bar{Q}$)	2.0 4.5 6.0		— — —	105 21 18	165 33 28	— — —	205 41 35	— — —	250 50 43	ns
t_{PLH} t_{PHL}	Propagation Delay Time ($\bar{\text{CLEAR}}$ -Q, $\bar{Q}$)	2.0 4.5 6.0		— — —	115 23 20	185 37 31	— — —	230 46 39	— — —	280 56 48	ns
f_{MAX}	Maximum Clock Frequency	2.0 4.5 6.0		6 30 35	12 48 56	— — —	4.8 24 28	— — —	4 20 24	— — —	MHz
$t_{W(H)}$ $t_{W(L)}$	Minimum Pulse Width (CLOCK)	2.0 4.5 6.0		— — —	30 8 7	75 15 13	— — —	95 19 16	— — —	110 22 19	ns
$t_{W(L)}$	Minimum Pulse Width $\bar{\text{CLEAR}}$	2.0 4.5 6.0		— — —	30 8 7	75 15 13	— — —	95 19 16	— — —	110 22 19	ns
t_s	Minimum Set-up Time	2.0 4.5 6.0		— — —	10 3 3	50 10 9	— — —	65 13 11	— — —	75 15 13	ns
t_h	Minimum Hold Time	2.0 4.5 6.0		— — —	— — —	0 0 0	— — —	0 0 0	— — —	0 0 0	ns
t_{REM}	Minimum Removal Time ($\bar{\text{CLEAR}}$)	2.0 4.5 6.0		— — —	0 0 0	75 15 13	— — —	95 19 16	— — —	110 22 19	ns
C_{IN}	Input Capacitance			—	5	10	—	10	—	10	pF
$C_{PD} (*)$	Power Dissipation Capacitance			—	71	—	—	—	—	—	pF

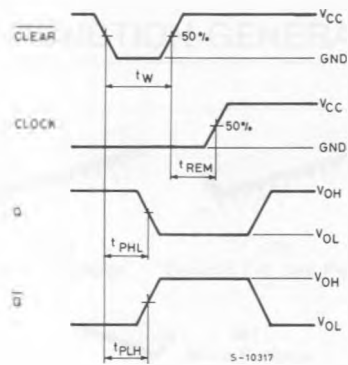
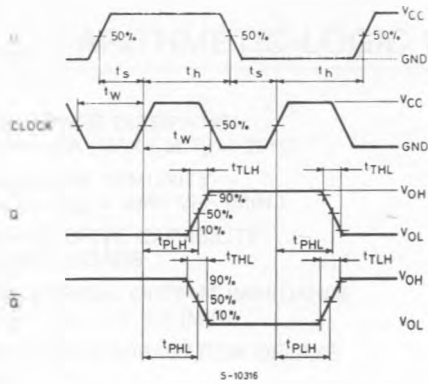
Note (*) C_{PD} is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the following equation.

$$I_{CC(opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/4 \text{ (for Flip/Flop).}$$

And the total C_{PD} at the time when n pcs of Flip-Flop operate can be gained $C_{PD}(\text{total}) = 43 + 28 \times n$

SWITCHING CHARACTERISTICS TEST WAVEFORM

TEST CIRCUIT I_{CC} (Opr.)