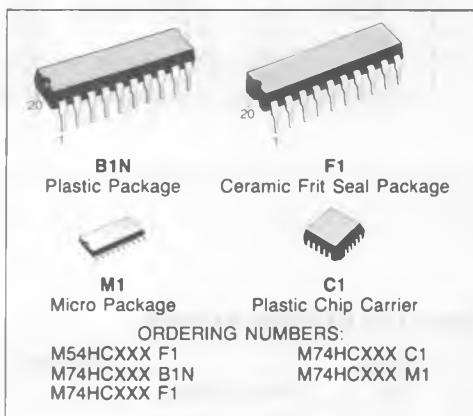


OCTAL D-TYPE FLIP FLOP WITH 3-STATE OUTPUT HC534/HC564 INVERTING - HC374/HC574 NON-INVERTING

PRELIMINARY DATA

- **HIGH SPEED**
 $f_{MAX} = 55 \text{ MHz (Typ) at } V_{CC} = 5V$
- **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**
 15 LSTTL LOADS
- **SYMMETRICAL OUTPUT IMPEDANCE**
 $|I_{OH}| = |I_{OL}| = 6 \text{ mA (MIN.)}$
- **BALANCED PROPAGATION DELAYS**
 $t_{PLH} = t_{PHL}$
- **WIDE OPERATING VOLTAGE RANGE**
 $V_{CC} \text{ (OPR)} = 2V \text{ to } 6V$
- **PIN AND FUNCTION COMPATIBLE**
 WITH 54/74LS374/534/564/574

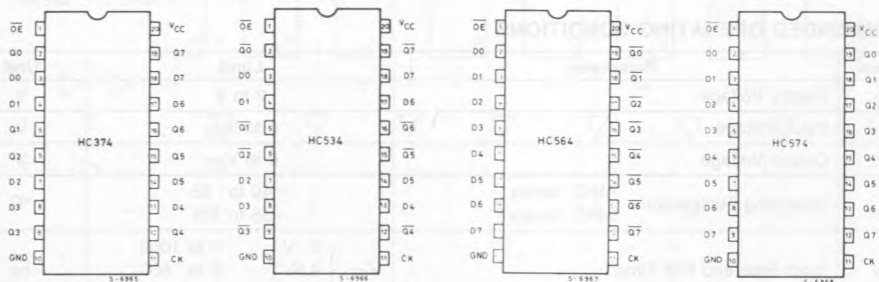


DESCRIPTION

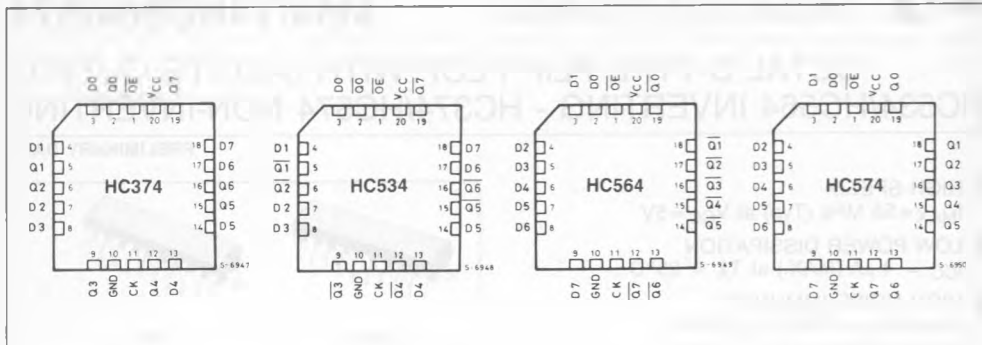
The M54/74HC374, M54/74HC534, M54/74HC564 and M54/74HC574 are high speed CMOS OCTAL D-TYPE FLIP FLOP WITH 3-STATE OUTPUTS fabricated with in silicon gate C²MOS technology. They have the same high speed performance of LSTTL combined with true CMOS low power consumption. These 8-bit D-type flip-flops are controlled by a clock input (CK) and an output enable input ($\overline{OE}$). On the positive transition of the clock, the Q outputs will be set to the logic state that were set-up at the D inputs (HC374 and HC574) or their complements (HC534 and HC564) While the $\overline{OE}$ input is low, the eight outputs will

be in a normal logic state (high or low logic level), and while high level, the outputs will be in a high impedance state. The output control does not affect the internal operation of flip-flops. That is, the old data can be retained or the new data can be entered even while the outputs are off. The application engineer has a choice of combination of inverting and non-inverting outputs, symmetrical and neighbouring input/output pin layout. The HC374 and HC574 are identical, apart from pin layout as are the HC534 and HC564. The 3-state output configuration and the wide choice of outline make bus-organized systems simple. All inputs are equipped with protection circuits against static discharge and transient excess voltage.

PIN CONNECTION (top view)



CHIP CARRIER



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	± 35	mA
I_{CC} or I_{GND}	DC V_{CC} or Ground Current	± 70	mA
P_D	Power Dissipation	500 (*)	mW
T_{stg}	Storage Temperature	- 65 to 150	$^{\circ}\text{C}$

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

(*) 500 mW: $\cong 65^{\circ}\text{C}$ derate to 300 mW by 10 mW/ $^{\circ}\text{C}$: 65°C to 85°C

RECOMMENDED OPERATING CONDITIONS

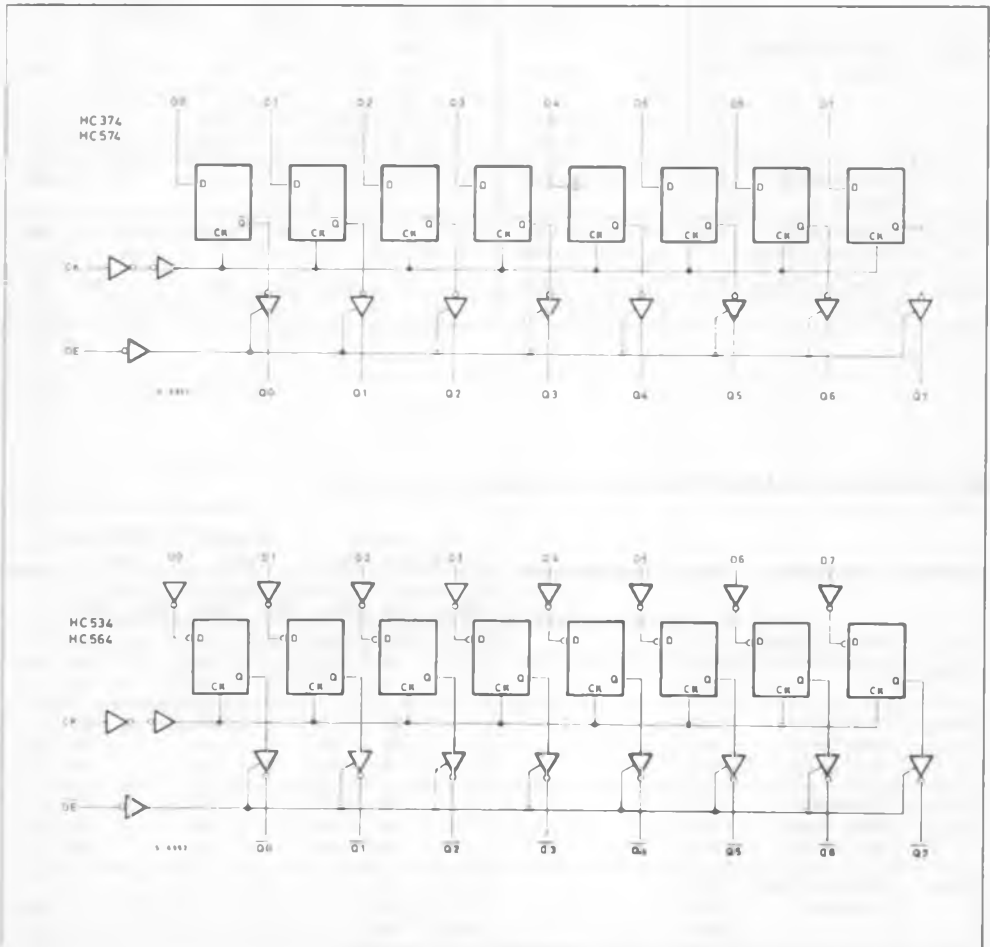
Symbol	Parameter	Limit	Unit
V_{CC}	Supply Voltage	2 to 6	V
V_I	Input Voltage	0 to V_{CC}	V
V_O	Output Voltage	0 to V_{CC}	V
T_A	Operating Temperature 74HC Series 54HC Series	- 40 to 85 - 55 to 125	$^{\circ}\text{C}$
t_r, t_f	Input Rise and Fall Time	$V_{CC} \begin{cases} 2 \text{ V} & 0 \text{ to } 1000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

TRUTH TABLE

INPUTS			OUTPUTS	
$\overline{OE}$	CK	D	Q (HC374, HC574)	$\overline{Q}$ (HC534, HC564)
H	X	X	Z	Z
L		X	NO CHANGE	NO CHANGE
L		L	L	H
L		H	H	L

X: DON'T CARE Z: HIGH IMPEDANCE

LOGIC DIAGRAM



DC ELECTRICAL CHARACTERISTICS

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	— 1.35 1.8	0.5 1.35 1.8	— 1.35 1.8	— 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		4.4	4.5	—	4.4	—	4.4	
		6.0	V _{IL}		5.9	6.0	—	5.9	—	5.9	
		4.5 6.0			4.18 5.68	4.31 5.8	— —	4.13 5.63	— —	4.10 5.60	
V _{OL}	Low Level Output Voltage	2.0	V _{IH} or V _{IL}	20 µA 6.0 mA 7.8 mA	—	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 6.0			—	0.17 0.18	0.26 0.26	— —	0.33 0.33	— —	
I _I	Input Leakage Current	6.0	V _I = V _{CC} or GND		—	—	± 0.1	—	± 1.0	—	µA
I _{OZ}	3-State Output Off-State Current	6.0	V _I = V _{IH} or V _{IL} V _O = V _{CC} or GND		—	—	± 0.5	—	± 5.0	—	µA
I _{CC}	Quiescent Supply Current	6.0	V _I = V _{CC} or GND I _O = 0		—	—	4.0	—	40	—	80 µA

AC ELECTRICAL CHARACTERISTICS (C_L = 50pF, Input t_r = t_f = 6ns)

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.	
t _{TLH} t _{THL}	Output Transition Time	2.0 4.5 6.0		— — —	24 8 6	60 12 10	— — —	75 15 13		90 18 15	ns
t _{PLH} t _{PHL}	Propagation Delay Time* (CK - Q, $\bar{Q}$)	2.0 4.5 6.0		— — —	88 22 19	175 35 30	— — —	220 44 37		265 53 44	ns
t _{PLH} t _{PHL}	Propagation Delay Time** (CK - Q, $\bar{Q}$)	2.0 4.5 6.0		— — —	76 19 16	150 30 26	— — —	190 38 33		225 45 38	ns
f _{MAX}	Maximum Clock Frequency	2.0 4.5 6.0		6 30 35	12 50 59	— — —	5 24 28	— — —	4 20 24	— — —	MHz

AC ELECTRICAL CHARACTERISTICS (Continued)

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.	
t _{W(H)} t _{W(L)}	Minimum Pulse Width (CK)	2.0		—	30	75	—	95		110	ns
		4.5		—	8	15	—	19		22	
		6.0		—	7	13	—	16		19	
t _s	Minimum Set-up Time*	2.0		—	40	100	—	125		150	ns
		4.5		—	10	20	—	25		30	
		6.0		—	9	17	—	21		26	
t _s	Minimum Set-up Time**	2.0		—	30	79	—	95		110	ns
		4.5		—	8	15	—	19		22	
		6.0		—	7	13	—	16		19	
t _h	Minimum Hold Time*	2.0		—	—	5	—	5		5	ns
		4.5		—	—	5	—	5		5	
		6.0		—	—	5	—	5		5	
t _h	Minimum Hold Time**	2.0		—	—	0	—	0		0	ns
		4.5		—	—	0	—	0		0	
		6.0		—	—	0	—	0		0	
t _{pZL} t _{pZH}	Output Enable Time*	2.0	R _L = 1KΩ	—	72	150	—	190		225	ns
		4.5		—	18	30	—	38		45	
		6.0		—	15	26	—	33		38	
t _{pZL} t _{pZH}	Output Enable Time**	2.0	R _L = 1KΩ	—	64	140	—	175		210	ns
		4.5		—	16	28	—	35		42	
		6.0		—	14	24	—	30		36	
t _{pZL} t _{pZH}	Output Disable Time*	2.0	R _L = 1KΩ	—	84	150	—	190		225	ns
		4.5		—	21	30	—	38		45	
		6.0		—	18	26	—	33		38	
t _{pZL} t _{pZH}	Output Disable Time**	2.0	R _L = 1KΩ	—	84	150	—	190		225	ns
		4.5		—	21	30	—	38		45	
		6.0		—	18	26	—	33		38	
C _{IN}	Input Capacitance			—	5	10	—	10	—	10	pF
C _{PD} (1)	Power Dissipation Capacitance			—	51	—	—	—	—	—	pF

Note (1) C_{PD} is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit)

Average operating current can be obtained by the following equation:

$$I_{CC(Oper.)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/8 \text{ (per Flip-Flop)}$$

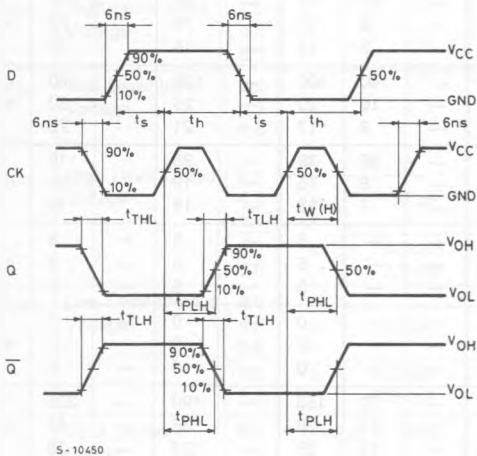
And the C_{PD} when N pcs of FLIP-FLOP operate, can be gained by the following equation.

$$C_{PD(TOTAL)} = 34 + 17 \times N \text{ [pF]}$$

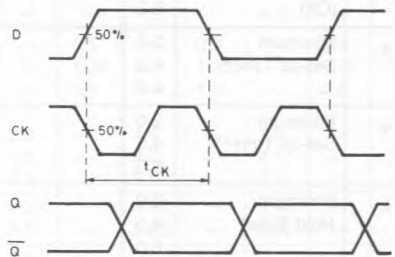
*: for HC374/534

**: for HC564/574

SWITCHING CHARACTERISTICS TEST WAVEFORM

 t_{PLH} , t_{PHL} , t_s , t_h , t_w 

S-10450

 f_{MAX} 

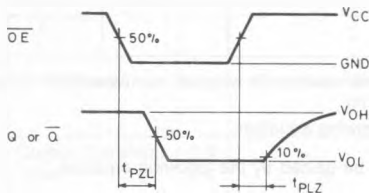
S-10451

CK DUTY: 50%

$$f_{MAX} = \frac{1}{t_{CK}}$$

 t_{PLZ} , t_{PZL}

The $1K\Omega$ load resistors should be connected between outputs and V_{CC} line and the $50pF$ load capacitors should be connected between outputs and GND line. All inputs except $\overline{OE}$ input should be connected to V_{CC} line or GND line such that outputs will be in low logic level while $\overline{OE}$ input is held low.

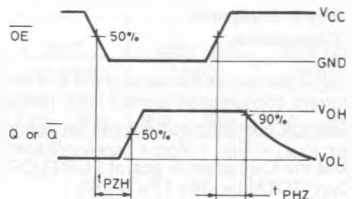


S-10429

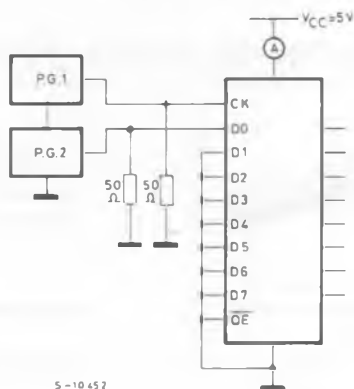
 t_{PHZ} , t_{PZH}

The $1K\Omega$ load resistors and the $50pF$ load capacitors should be connected between each output and GND line.

All inputs except $\overline{OE}$ input should be connected to V_{CC} or GND line such that output will be in high logic level while $\overline{OE}$ input is held low.



S-10430

TEST CIRCUIT I_{CC} (Opr.)

INPUT WAVEFORM IS THE SAME AS THAT IN CASE OF SWITCHING CHARACTERISTICS TEST.