National Semiconductor

January 1988

MM54HCT76/MM74HCT76/ MM54HCT112/MM74HCT112 Dual J-K Flip-Flops with Preset and Clear

General Description

These flip-flops utilize advanced silicon-gate CMOS technology. They have input threshold and output drive similar to LS-TTL with the low standby power of CMOS.

These flip-flops have independent J, K, preset, clear and clock inputs and Q and $\overline{Q}$ outputs. The flip-flops are edge-triggered and change state on the negative-going transition of the clock pulse. Preset and clear are independent of the clock and accomplished by a low logic level on the corresponding input.

All inputs to this device are protected from damage due to electrostatic discharge by diodes to V_{CC} and ground.

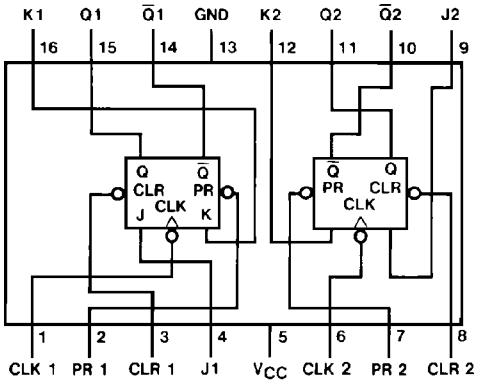
MM54HCT/MM74HCT devices are intended to interface TTL and NMOS components to CMOS components. When there is a LS-TTL equivalent, these parts can be used as plug-in replacements to reduce system power consumption in existing designs.

Features

- Typical propagation delay: 20 ns
- Low quiescent current: 80 μA maximum (74HCT series)
- Fanout of 10 LS-TTL loads

Connection Diagram

'HCT76
Dual-In-Line Package



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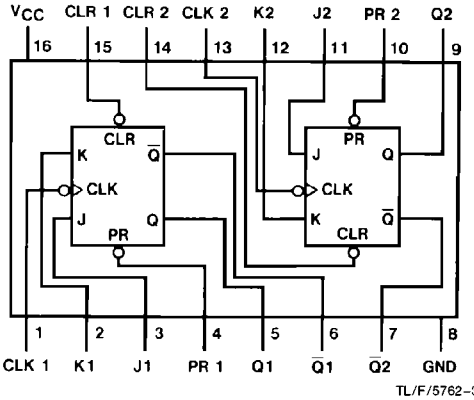
'HCT112
Dual-In-Line Package



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Order Number MM54HCT76/T112 or MM74HCT76/T112

Truth Table

Inputs					Outputs	
PR	CLR	CLK	J	K	Q	$\overline{Q}$
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	Q0	$\overline{Q}$0
H	H	↓	H	L	H	L
H	H	↓	L	H	L	H
H	H	↓	H	H	Toggle	
H	H	H	X	X	Q0	$\overline{Q}$0

Note: Q0 = the level of Q before the indicated input conditions were established.

*This configuration is nonstable; that is, it will not persist when preset and clear inputs return to their inactive (high) level.

Absolute Maximum Ratings (Notes 1 and 2)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Supply Voltage (V_{CC})	−0.5V to +7.0V
DC Input Voltage (V_{IN})	−1.5V to V_{CC} +1.5V
DC Output Voltage (V_{OUT})	−0.5V to V_{CC} +0.5V
Clamp Diode Current (I_{IK}, I_{OK})	±20 mA
DC Output Current, per Pin (I_{OUT})	±25 mA
DC V_{CC} or GND Current, per Pin (I_{CC})	±50 mA
Storage Temperature Range (T_{STG})	−65°C to +150°C
Power Dissipation (P_D)	
(Note 3)	600 mW
S.O. Package only	500 mW
Lead Temperature (T_L)	
(Soldering, 10 seconds)	260°C

Operating Conditions

	Min	Max	Units
Supply Voltage (V_{CC})	4.5	5.5	V
DC Input or Output Voltage			
(V_{IN}, V_{OUT})	0	V_{CC}	V
Operating Temp. Range (T_A)			
MM74HCT	−40	+85	°C
MM54HCT	−55	+125	°C
Input Rise or Fall Times			
(t_r, t_f)		500	ns

DC Electrical Characteristics V_{CC} = 5V ±10% unless otherwise specified

Symbol	Parameter	Conditions	T_A = 25°C	74HCT T_A = −40°C to 85°C	54HCT T_A = −55°C to 125°C	Units
			Typ	Guaranteed Limits		
V_{IH}	Minimum High Level Input Voltage			2.0	2.0	2.0	V
V_{IL}	Maximum Low Level Input Voltage			0.8	0.8	0.8	V
V_{OH}	Minimum High Level Output Voltage	V_{IN} = V_{IH} or V_{IL}					
		$\|I_{OUT}\|$ = 20 μA	V_{CC}	V_{CC} −0.1	V_{CC} −0.1	V_{CC} −0.1	V
		$\|I_{OUT}\|$ = 4.0 mA, V_{CC} = 4.5V	4.2	3.98	3.84	3.7	V
		$\|I_{OUT}\|$ = 4.8 mA, V_{CC} = 5.5V	5.2	4.98	4.84	4.7	V
V_{OL}	Maximum Low Level Voltage	V_{IN} = V_{IH} or V_{IL}					
		$\|I_{OUT}\|$ = 20 μA	0	0.1	0.1	0.1	V
		$\|I_{OUT}\|$ = 4.0 mA, V_{CC} = 4.5V	0.2	0.26	0.33	0.4	V
		$\|I_{OUT}\|$ = 4.8 mA, V_{CC} = 5.5V	0.2	0.26	0.33	0.4	V
I_{IN}	Maximum Input Current	V_{IN} = V_{CC} or GND, V_{IH} or V_{IL}		±0.1	±1.0	±1.0	μA
I_{CC}	Maximum Quiescent Supply Current	V_{IN} = V_{CC} or GND, I_{OUT} = 0 μA		4.0	40	80	μA
		V_{IN} = 2.4V or 0.5V (Note 4)		0.3	0.4	0.5	mA

Note 1: Absolute Maximum Ratings are those values beyond which damage to the device may occur.

Note 2: Unless otherwise specified all voltages are referenced to ground.

Note 3: Power dissipation temperature derating—plastic "N" package: −12 mW/°C from 65°C to 85°C; ceramic "J" package: −12 mW/°C from 100°C to 125°C.

Note 4: Measured per pin, all other inputs held at V_{CC} or GND.

AC Electrical Characteristics V_{CC} = 5V, T_A = 25°C, C_L = 15 pF, t_r = t_f = 6 ns

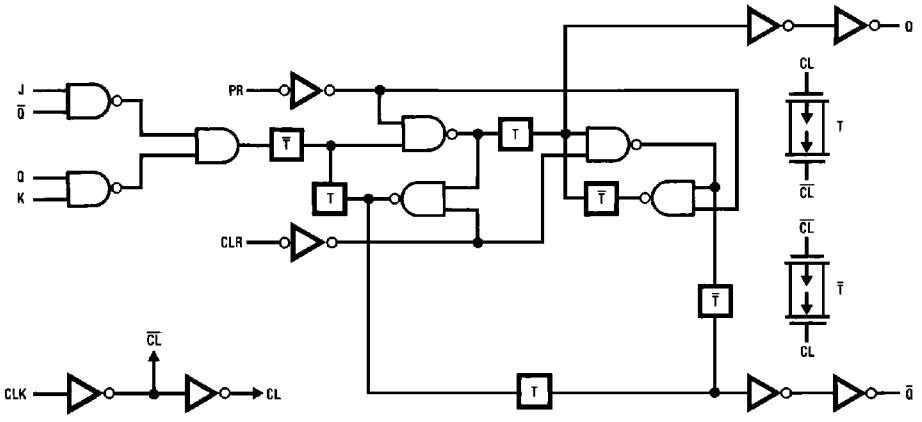
Symbol	Parameter	Conditions	Typ	Guaranteed Limit	Units
f_{MAX}	Maximum Operating Frequency		50	30	MHz
t_{PHL}, t_{PLH}	Maximum Propagation Delay from Clock to Q or $\overline{Q}$		18	30	ns
t_{PHL}, t_{PLH}	Maximum Propagation Delay from Preset or Clear to Q or $\overline{Q}$		18	30	ns
t_{REM}	Minimum Removal Time, Preset or Clear to Clock			20	ns
t_S	Minimum Set-Up Time J or K Clock		10	20	ns
t_H	Minimum Hold Time Clock to J or K		−3	0	ns
t_W	Minimum Pulse Width Clock, Preset or Clear		8	16	ns

AC Electrical Characteristics $V_{CC} = 5V \pm 10\%$, $C_L = 50$ pF, $t_r = t_f = 6$ ns unless otherwise specified

Symbol	Parameter	Conditions	$T_A = 25°C$	74HCT $T_A = -40°C$ to $85°C$	54HCT $T_A = -55°C$ to $125°C$	Units
			Typ	Guaranteed Limits		
f_{MAX}	Maximum Operating Frequency			27	22	18	MHz
t_{PHL}, t_{PLH}	Maximum Propagation Delay from Clock to Q or $\overline{Q}$		22	35	44	52	ns
t_{PHL}, t_{PLH}	Maximum Propagation Delay from Preset or Clear to Q or $\overline{Q}$		22	35	44	52	ns
t_{REM}	Minimum Removal Time Preset or Clear to Clock			20	25	30	ns
t_S	Minimum Setup Time J or K to Clock		10	20	25	30	ns
t_H	Minimum Hold Time Clock to J or K		−3	0	0	0	ns
t_W	Minimum Pulse Width Clock, Preset or Clear			16	20	24	ns
t_r, t_f	Maximum Clock Input Rise and Fall Time			500	500	500	ns
t_{THL}, t_{TLH}	Maximum Output Rise and Fall Time			15	19	22	ns
C_{PD}	Power Dissipation Capacitance (Note 5)	(Per Flip-Flop)	35				pF
C_{IN}	Maximum Input Capacitance		5	10	10	10	pF

Note 5: C_{PD} determines the no load dynamic power consumption, $P_D = C_{PD} V_{CC}^2 f + I_{CC} V_{CC}$, and the no load dynamic current consumption, $I_S = C_{PD} V_{CC} f + I_{CC}$.

Logic Diagram



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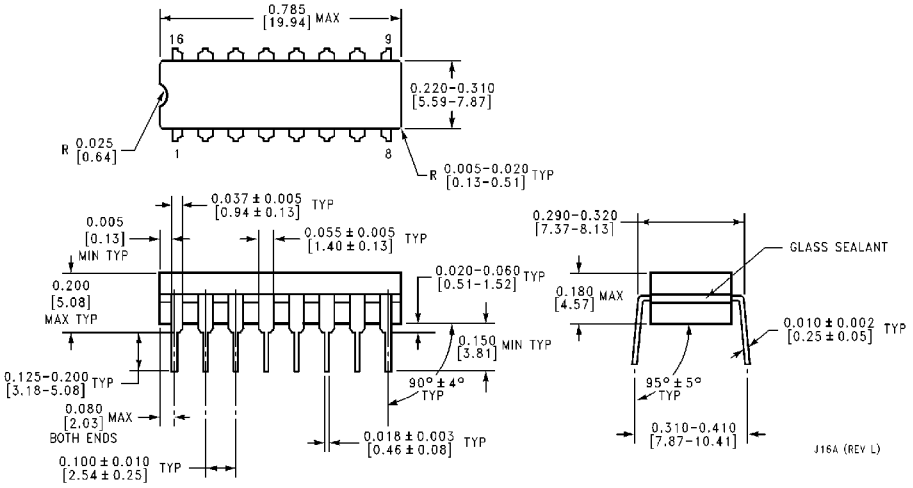
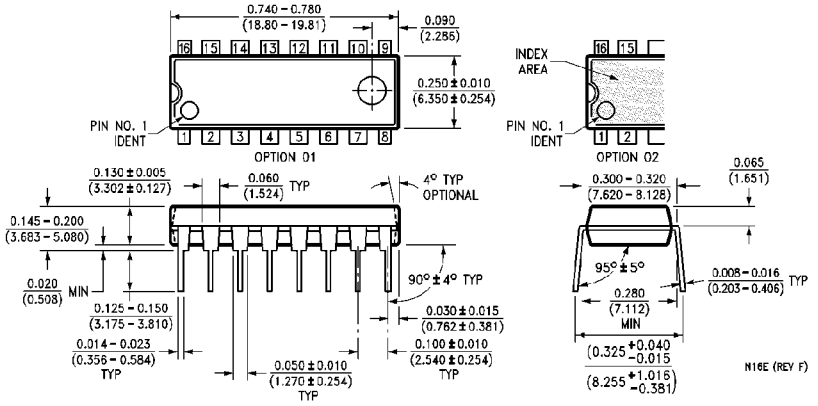
Physical Dimensions inches (millimeters)



Order Number MM54HCT76J, MM74HCT76J, MM54HCT112J or MM74HCT112J
NS Package J16A



Order Number MM74HCT76N or MM74HCT112N
NS Package N16E

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