National Semiconductor

MM54C221/MM74C221 Dual Monostable Multivibrator

General Description

The MM54C221/MM74C221 dual monostable multivibrator is a monolithic complementary MOS integrated circuit. Each multivibrator features a negative-transtion-triggered input and a positive-transition-triggered input, either of which can be used as an inhibit input, and a clear input.

Once fired, the output pulses are independent of further transitions of the A and B inputs and are a function of the external timing components C_{EXT} and R_{EXT}. The pulse width is stable over a wide range of temperature and V_{CC}.

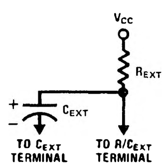
Pulse stability will be limited by the accuracy of external timing components. The pulse width is approximately defined by the relationship $t_{W(OUT)} \approx C_{EXT} R_{EXT}$. For further information and applications, see AN-138.

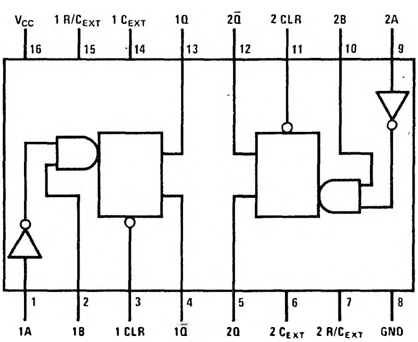
Features

- Wide supply voltage range — 4.5V to 15V
- Guaranteed noise margin — 1.0V
- High noise immunity — 0.45 V_{CC} (typ.)
- Low power TTL compatibility — fan out of 2 driving 74L

Connection Diagrams

Timing Component





TOP VIEW

Truth Table

INPUTS			OUTPUTS	
CLEAR	A	B	Q	$\bar{Q}$
L	X	X	L	H
X	H	X	L	H
X	X	L	L	H
H	L	↑	⎍	⊔
H	↓	H	⎍	⊔

H = High level
L = Low level
↑ = Transition from low to high
↓ = Transition from high to low
⎍ = One high level pulse
⊔ = One low level pulse
X = Irrelevant

Absolute Maximum Ratings (Note 1)

Voltage at Any Pin	−0.3 V to V_{CC} + 0.3 V
Operating Temperature Range	
MM54C221	−55°C to +125°C
MM74C221	−40°C to +85°C
Storage Temperature Range	−65°C to +150°C
Package Dissipation	500 mW
Operating V_{CC} Range	4.5 V to 15 V
Absolute Maximum V_{CC}	18 V
$R_{EXT} \geq 80 V_{CC}$ (Ω)	
Lead Temperature (Soldering, 10 sec.)	300°C

DC Electrical Characteristics Max./min. limits apply across temperature range, unless otherwise noted.

Parameter		Conditions	Min.	Typ.	Max.	Units
	CMOS to CMOS					
$V_{IN(1)}$	Logical "1" Input Voltage	V_{CC} = 5.0 V V_{CC} = 10 V	3.5 8.0			V V
$V_{IN(0)}$	Logical "0" Input Voltage	V_{CC} = 5.0 V V_{CC} = 10 V			1.5 2.0	V V
$V_{OUT(1)}$	Logical "1" Output Voltage	V_{CC} = 5.0 V, I_O = −10 μA V_{CC} = 10 V, I_O = −10 μA	4.5 9.0			V V
$V_{OUT(0)}$	Logical "0" Output Voltage	V_{CC} = 5.0 V, I_O = +10 μA V_{CC} = 10 V, I_O = +10 μA			0.5 1.0	V V
$I_{IN(1)}$	Logical "1" Input Current	V_{CC} = 15 V, V_{IN} = 15 V		0.005	1.0	μA
$I_{IN(0)}$	Logical "0" Input Current	V_{CC} = 15 V, V_{IN} = 0 V	−1.0	−0.005		μA
I_{CC}	Supply Current (Standby)	V_{CC} = 15 V, R_{EXT} = ∞, Q1, Q2 = Logic "0" (Note 3)		0.05	300	μA
I_{CC}	Supply Current (During Output Pulse)	V_{CC} = 15 V, Q1 = Logic "1", Q2 = Logic "0" (Figure 4)		15		mA
		V_{CC} = = 5.0 V, Q1 = Logic "1", Q2 = Logic "0" (Figure 4)		2.0		mA
	Leakage Current at R/C_{EXT} Pin	V_{CC} = 15 V, V_{CEXT} = 5.0 V		0.01	3.0	μA
	CMOS/LPTTL Interface					
$V_{IN(1)}$	Logical "1" Input Voltage	54C V_{CC} = 4.5 V 74C V_{CC} = 4.75 V	V_{CC} − 1.5 V_{CC} − 1.5			V V
$V_{IN(0)}$	Logical "0" Input Voltage	54C V_{CC} = 4.5 V 74C V_{CC} = 4.75 V			0.8 0.8	V V
$V_{OUT(1)}$	Logical "1" Output Voltage	54C V_{CC} = 4.5 V, I_O = −360 μA 74C V_{CC} = 4.75 V, I_O = −360 μA	2.4 2.4			V V
$V_{OUT(0)}$	Logical "0" Output Voltage	54C V_{CC} = 4.5 V, I_O = 360 μA 74C V_{CC} = 4.75 V, I_O = 360 μA			0.4 0.4	V V
	Output Drive (See 54C/74C Family Characteristics Data Sheet) (Short Circuit Current)					
I_{SOURCE}	Output Source Current (P-Channel)	V_{CC} = 5.0 V T_A = 25°C, V_{OUT} = 0 V	−1.75			mA
I_{SOURCE}	Output Source Current (P-channel)	V_{CC} = 10 V T_A = 25°C, V_{OUT} = 0 V	−8.0			mA
I_{SINK}	Output Sink Current (N-channel)	V_{CC} = 5.0 V T_A = 25°C, V_{OUT} = V_{CC}	1.75			mA
I_{SINK}	Output Sink Current (N-channel)	V_{CC} = 10 V T_A = 25°C, V_{OUT} = V_{CC}	8.0			mA

AC Electrical Characteristics $T_A = 25°C$, $C_L = 50\,pF$, unless otherwise noted.

Parameter		Conditions	Min.	Typ.	Max.	Units
$t_{pd\ A,B}$	Propagation Delay from Trigger Input (A,B) to Output Q, $\overline{Q}$	$V_{CC} = 5.0\,V$		250	500	ns
		$V_{CC} = 10\,V$		120	250	ns
$t_{pd\ CL}$	Propagation Delay from Clear Input (CL) to Output Q, $\overline{Q}$	$V_{CC} = 5.0\,V$		250	500	ns
		$V_{CC} = 10\,V$		120	250	ns
t_S	Time Prior to Trigger Input (A,B) that Clear must be Set	$V_{CC} = 5.0\,V$	150	50		ns
		$V_{CC} = 10\,V$	60	20		ns
$t_{W(A,B)}$	Trigger Input (A,B) Pulse Width	$V_{CC} = 5.0\,V$	150	50		ns
		$V_{CC} = 10\,V$	70	30		ns
$t_{W(CL)}$	Clear Input (CL) Pulse Width	$V_{CC} = 5.0\,V$	150	50		ns
		$V_{CC} = 10\,V$	70	30		ns
$t_{W(OUT)}$	Q or $\overline{Q}$ Output Pulse Width	$V_{CC} = 5.0\,V$, $R_{EXT} = 10k$, $C_{EXT} = 0\,pF$		900		ns
		$V_{CC} = 10\,V$, $R_{EXT} = 10k$, $C_{EXT} = 0\,pF$		350		ns
		$V_{CC} = 15\,V$, $R_{EXT} = 10k$, $C_{EXT} = 0\,pF$		320		ns
		$V_{CC} = 5.0\,V$, $R_{EXT} = 10k$, $C_{EXT} = 1000\,pF$ (Fig. 1)	9.0	10.6	12.2	μs
		$V_{CC} = 10\,V$, $R_{EXT} = 10k$, $C_{EXT} = 1000\,pF$ (Fig. 1)	9.0	10	11	μs
		$V_{CC} = 15\,V$, $R_{EXT} = 10k$, $C_{EXT} = 1000\,pF$ (Fig. 1)	8.9	9.8	10.8	μs
		$V_{CC} = 5.0\,V$, $R_{EXT} = 10k$, $C_{EXT} = 0.1\,\mu F$ (Fig. 2)	900	1020	1200	μs
		$V_{CC} = 10\,V$, $R_{EXT} = 10k$, $C_{EXT} = 0.1\,\mu F$ (Fig. 2)	900	1000	1100	μs
		$V_{CC} = 15\,V$, $R_{EXT} = 10k$, $C_{EXT} = 0.1\,\mu F$ (Fig. 2)	900	990	1100	μs
R_{ON}	ON Resistance of Transistor between R/C_{EXT} to C_{EXT}	$V_{CC} = 5.0\,V$ (Note 4)		50	150	Ω
		$V_{CC} = 10\,V$ (Note 4)		25	65	Ω
		$V_{CC} = 15\,V$ (Note 4)		16.7	45	Ω
	Output Duty Cycle	$R = 10k$, $C = 1000\,pF$			90	%
		$R = 10k$, $C = 0.1\,\mu F$ (Note 5)			90	%
C_{IN}	Input Capacitance	R/C_{EXT} Input (Note 2)		15	25	pF
		Any Other Input (Note 2)		5.0		pF

Note 1: "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. Except for "Operating Temperature Range" they are not meant to imply that the devices should be operated at these limits. The table of "Electrical Characteristics" provides conditions for actual device operation.

Note 2: Capacitance is guaranteed by periodic testing.

Note 3: In Standby (Q = Logic "0") the power dissipated equals the leakage current plus V_{CC}/R_{EXT}.

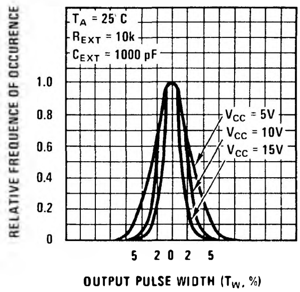
Note 4: See AN-138 for detailed explanation of R_{ON}.

Note 5: Maximum output duty cycle = $R_{EXT} / R_{EXT} + 1000$.

Typical Performance Characteristics

Figure 1

Typical Distribution of Units for Output Pulse Width

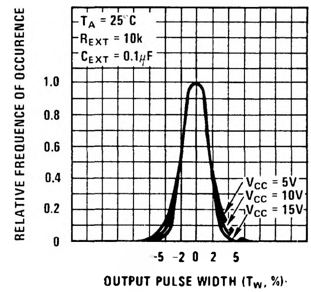


0% Point pulse width:
At V_{CC} = 5V, T_W = 10.6μs
At V_{CC} = 10V, T_W = 10μs
At V_{CC} = 15V, T_W = 9.8μs

Percentage of units within ±4%:
At V_{CC} = 5V, 90% of units
At V_{CC} = 10V, 95% of units
At V_{CC} = 15V, 98% of units

Figure 2

Typical Distribution of Units for Output Pulse Width



0% Point pulse width:
At V_{CC} = 5V, T_W = 1020μs
At V_{CC} = 10V, T_W = 1000μs
At V_{CC} = 15V, T_W = 982μs

Percentage of units within ±4%:
At V_{CC} = 5V, 95% of units
At V_{CC} = 10V, 97% of units
At V_{CC} = 15V, 98% of units

Figure 3

Typical Variation in Output Pulse Width vs Temperature

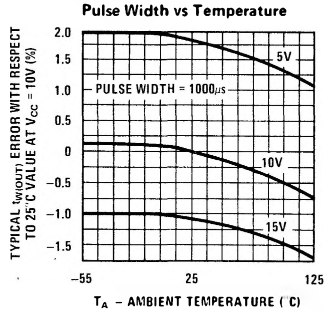
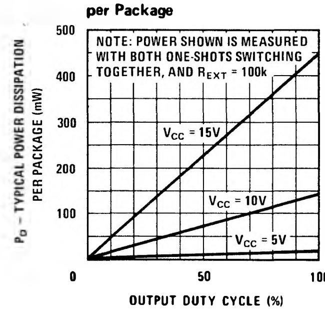


Figure 4

Typical Power Dissipation per Package



Switching Time Waveforms