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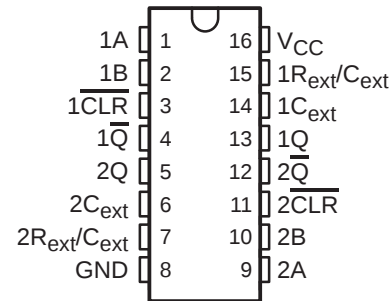
SN54221, SN54LS221, SN74221, **SN74LS221**

DUAL MONOSTABLE MULTIVIBRATORS WITH SCHMITT-TRIGGER INPUTS

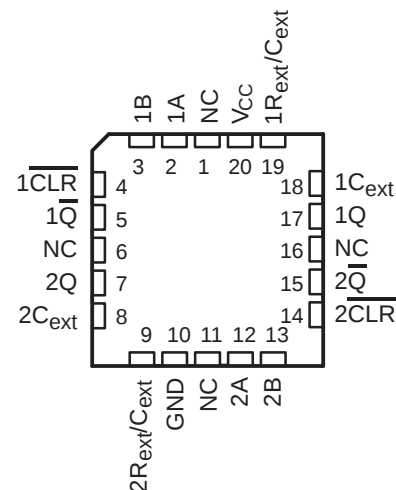
SDLS213A – DECEMBER 1983 – REVISED FEBRUARY 1998

- Dual Versions of Highly Stable SN54121 and SN74121 One Shots
- SN54221 and SN74221 Demonstrate Electrical and Switching Characteristics That Are Virtually Identical to the SN54121 and SN74121 One Shots
- Pinout Is Identical to the SN54123, SN74123, SN54LS123, and SN74LS123
- Overriding Clear Terminates Output Pulse
- Package Options Include Plastic Small-Outline (D), Shrink Small-Outline (DB) Packages, Ceramic Chip Carriers (FK) and Flat Packs (W), and Standard Plastic (N) and Ceramic (J) 300-mil DIPs

SN54221, SN54LS221 . . . J OR W PACKAGE
SN74221 . . . N PACKAGE
SN74LS221 . . . D, DB, OR N PACKAGE
(TOP VIEW)



SN54LS221 . . . FK PACKAGE
(TOP VIEW)



NC – No internal connection

TYPE	MAXIMUM OUTPUT PULSE LENGTH(S)
SN54221	21
SN74221	28
SN54LS221	49
SN74LS221	70

description

The '221 and 'LS221 devices are monolithic dual multivibrators with performance characteristics virtually identical to those of the '121 devices. Each multivibrator features a negative-transition-triggered input and a positive-transition-triggered input, either of which can be used as an inhibit input.

Pulse triggering occurs at a particular voltage level and is not directly related to the transition time of the input pulse. Schmitt-trigger input circuitry (TTL hysteresis) for B input allows jitter-free triggering from inputs with transition rates as slow as 1 V/s, providing the circuit with excellent noise immunity, typically of 1.2 V. A high immunity to V_{CC} noise, typically of 1.5 V, is also provided by internal latching circuitry.

Once fired, the outputs are independent of further transitions of the A and B inputs and are a function of the timing components, or the output pulses can be terminated by the overriding clear. Input pulses can be of any duration relative to the output pulse. Output pulse length can be varied from 35 ns to the maximums shown in the above table by choosing appropriate timing components. With $R_{ext} = 2 \text{ k}\Omega$ and $C_{ext} = 0$, an output pulse typically of 30 ns is achieved, which can be used as a dc-triggered reset signal. Output rise and fall times are TTL compatible and independent of pulse length. Typical triggering and clearing sequences are shown as a part of the switching characteristics waveforms.

Pulse-width stability is achieved through internal compensation and is virtually independent of V_{CC} and temperature. In most applications, pulse stability is limited only by the accuracy of external timing components.



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PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

**TEXAS
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SN54221, SN54LS221, SN74221, SN74LS221

DUAL MONOSTABLE MULTIVIBRATORS

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description (continued)

Jitter-free operation is maintained over the full temperature and V_{CC} ranges for more than six decades of timing capacitance (10 pF to 10 μ F) and more than one decade of timing resistance (2 k Ω to 30 k Ω for the SN54221, 2 k Ω to 40 k Ω for the SN74221, 2 k Ω to 70 k Ω for the SN54LS221, and 2 k Ω to 100 k Ω for the SN74LS221). Throughout these ranges, pulse width is defined by the relationship: $t_w(\text{out}) = C_{\text{ext}}R_{\text{ext}} \ln 2 \approx 0.7 C_{\text{ext}}R_{\text{ext}}$. In circuits where pulse cutoff is not critical, timing capacitance up to 1000 μ F and timing resistance as low as 1.4 k Ω can be used. Also, the range of jitter-free output pulse widths is extended if V_{CC} is held to 5 V and free-air temperature is 25°C. Duty cycles as high as 90% are achieved when using maximum recommended R_T . Higher duty cycles are available if a certain amount of pulse-width jitter is allowed.

The variance in output pulse width from device to device typically is less than $\pm 0.5\%$ for given external timing components. An example of this distribution for the '221 is shown in Figure 3. Variations in output pulse width versus supply voltage and temperature for the '221 are shown in Figures 4 and 5, respectively.

Pin assignments for these devices are identical to those of the SN54123/SN74123 or SN54LS123/SN74LS123 so that the '221 or 'LS221 devices can be substituted for those products in systems not using the retrigger by merely changing the value of R_{ext} and/or C_{ext} ; however, the polarity of the capacitor must be changed.

The SN54221 and SN54LS221 are characterized for operation over the full military temperature range of -55°C to 125°C . The SN74221 and SN74LS221 are characterized for operation from 0°C to 70°C .

FUNCTION TABLE
(each monostable multivibrator)

INPUTS			OUTPUTS	
$\overline{\text{CLR}}$	A	B	Q	$\overline{\text{Q}}$
L	X	X	L	H
X	H	X	L	H
X	X	L	L	H
H	L	$\uparrow$	$\text{pulsed}^\dagger$	$\text{pulsed}^\dagger$
H	$\downarrow$	H	$\text{pulsed}^\dagger$	$\text{pulsed}^\dagger$
$\uparrow^\ddagger$	L	H	$\text{pulsed}^\dagger$	$\text{pulsed}^\dagger$

† Pulsed-output patterns are tested during AC switching at 25°C with $R_{\text{ext}} = 2 \text{ k}\Omega$, and $C_{\text{ext}} = 80 \text{ pF}$.

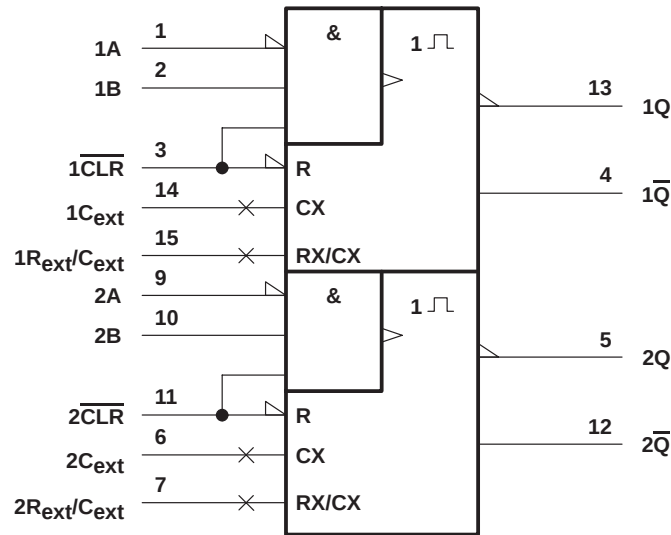
‡ This condition is true only if the output of the latch formed by the two NAND gates has been conditioned to the logic 1 state prior to $\overline{\text{CLR}}$ going high. This latch is conditioned by taking either A high or B low while $\overline{\text{CLR}}$ is inactive (high).

SN54221, SN54LS221, SN74221, SN74LS221

DUAL MONOSTABLE MULTIVIBRATORS WITH SCHMITT-TRIGGER INPUTS

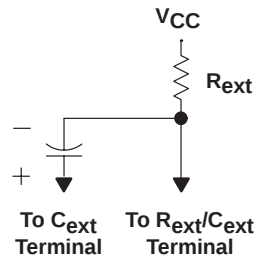
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logic symbol†



† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.
Pin numbers shown are for the D, DB, J, N, and W packages.

timing component connections



NOTE: Due to the internal circuit, the R_{ext}/C_{ext} terminal is never more positive than the C_{ext} terminal.

SN54221, SN54LS221, SN74221, SN74LS221

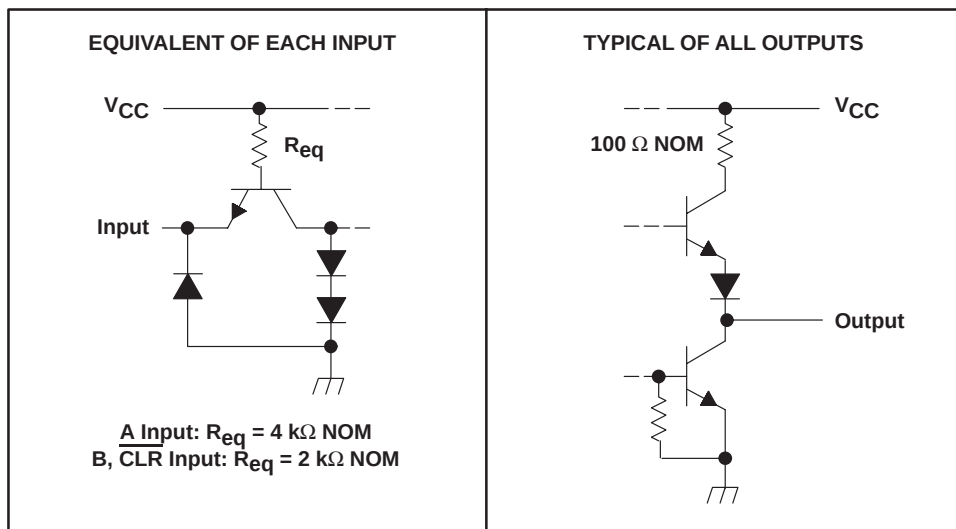
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WITH SCHMITT-TRIGGER INPUTS

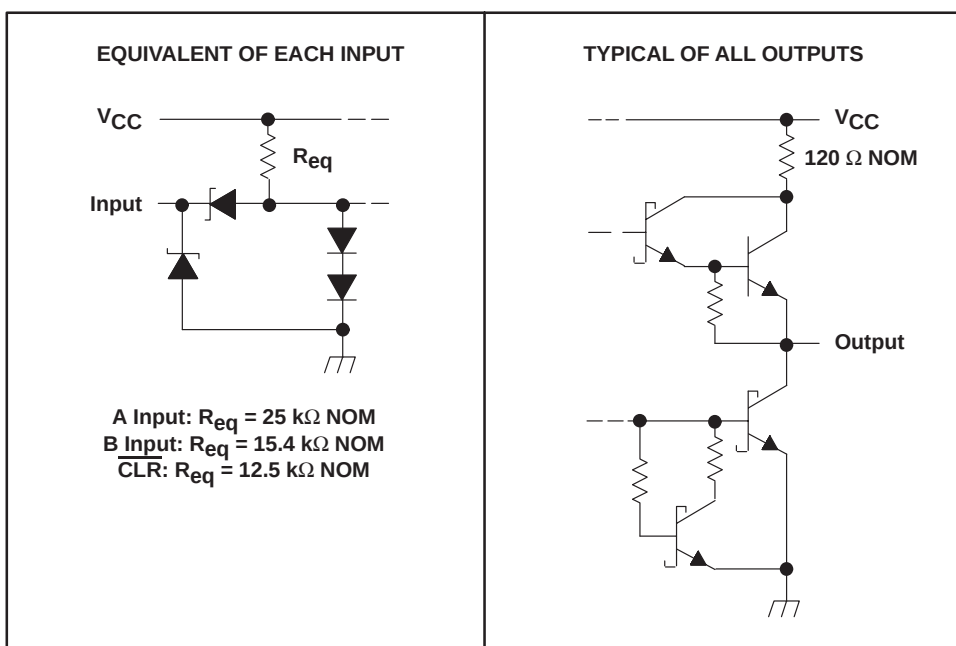
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schematics of inputs and outputs

SN54/74221



SN54/74LS221



SN54221, SN54LS221, SN74221, SN74LS221

DUAL MONOSTABLE MULTIVIBRATORS

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absolute maximum ratings over operating free-air temperature range (unless otherwise noted)[†]

Supply voltage range, V_{CC}	7 V
Input voltage range, V_I (see Note 1): 'LS221	7 V
'221	5.5 V
Package thermal impedance, θ_{JA} (see Note 2): D package	113°C/W
DB package	131°C/W
N package	78°C/W
Storage temperature range, T_{stg}	–65°C to 150°C

[†] Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTES: 1. The input and output negative-voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
2. The package thermal impedance is calculated in accordance with JE5D 51, except for through-hole packages, which use a trace length of zero

recommended operating conditions

		SN54221			SN74221			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
V_{CC}	Supply voltage	4.5	5	5.5	4.75	5	5.25	V
V_{IH}	High-level input voltage	2			2			V
V_{IL}	Low-level input voltage	0.8			0.8			V
I_{OH}	High-level output current	–800			–800			μA
I_{OL}	Low-level output current	16			16			mA
$\Delta V/\Delta t$	Rise or fall of input pulse rate	1*			1			V/s
		1*			1			V/μs
T_A	Operating free-air temperature	–55			0			°C

* On products compliant to MIL-PRF-38535, this parameter is not production tested.



SN54221, SN54LS221, SN74221, SN74LS221

DUAL MONOSTABLE MULTIVIBRATORS

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electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS†	SN54221			SN74221			UNIT
			MIN	TYP‡	MAX	MIN	TYP‡	MAX	
V_{T+}	Positive-going threshold voltage, B input	$V_{CC} = \text{MIN}$	1.55	2*		1.55	2		V
V_{T-}	Negative-going threshold voltage, B input	$V_{CC} = \text{MIN}$	0.8*	1.35		0.8	1.35		V
V_{IK}		$V_{CC} = \text{MIN}$, $I_I = -12 \text{ mA}$			-1.5			-1.5	V
V_{OH}		$V_{CC} = \text{MIN}$, $I_{OH} = -800 \mu\text{A}$	2.4	3.4		2.4	3.4		V
V_{OL}		$V_{CC} = \text{MIN}$, $I_{OL} = 16 \text{ mA}$	0.2	0.4		0.2	0.4		V
I_I		$V_{CC} = \text{MAX}$, $V_I = 5.5 \text{ V}$		1			1		mA
I_{IH}	A input	$V_{CC} = \text{MAX}$, $V_I = 2.4 \text{ V}$		40			40		μA
	$\overline{\text{CLR}}$, B input			80			80		
I_{IL}	A input	$V_{CC} = \text{MAX}$, $V_I = 0.4 \text{ V}$		-1.6			-1.6		mA
	$\overline{\text{CLR}}$, B input			-3.2			-3.2		
$I_{OS}^{\S}$		$V_{CC} = \text{MAX}$	-20		-55	-18		-55	mA
I_{CC}	Quiescent	$V_{CC} = \text{MAX}$	26	50*		26	50		mA
	Triggered		46	80*		46	80		

* On products compliant to MIL-PRF-38535, this parameter is not production tested.

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡ All typical values are at $V_{CC} = 5 \text{ V}$, $T_A = 25^\circ\text{C}$.

§ Not more than one output should be shorted at a time and the duration of the short circuit should not exceed one second.

timing requirements over recommended ranges of supply voltage and operating free-air temperature

			SN54221		SN74221		UNIT
			MIN	MAX	MIN	MAX	
t_w	Pulse duration	A or B input	50		50		ns
		$\overline{\text{CLR}}$	20		20		
t_{su}	Setup time, inactive-state¶	$\overline{\text{CLR}}$	15		15		ns
R_{ext}	External timing resistance		1.4*	30*	1.4	40	$k\Omega$
C_{ext}	External timing capacitance		0*	1000*	0	1000	μF
Output duty cycle		$R_{ext} = 2 \text{ k}\Omega$		67%		67%	
		$R_{ext} = \text{MAX } R_{ext}$		90%		90%	

* On products compliant to MIL-PRF-38535, this parameter is not production tested.

¶ Inactive-state setup time is also referred to as recovery time.

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switching characteristics $V_{CC} = 5\text{ V}$, $R_L = 400\ \Omega$, $T_A = 25^\circ\text{C}$ (see Figures 1 and 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	SN54221			SN74221			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
t _{PLH}	A	Q	C _{ext} = 80 pF, R _{ext} = 2 kΩ	45	70		45	70	ns	
	B			35	55		35	55		
t _{PHL}	A	Q̅		50	80		50	80		
	B			40	65		40	65		
t _{PHL}	CLR̅	Q		27			27	ns		
t _{PLH}		Q̅	40			40				
t _W	A or B	Q or Q̅	C _{ext} = 80 pF, R _{ext} = 2 kΩ	70	110	150	70	110	150	ns
			C _{ext} = 0, R _{ext} = 2 kΩ	17	30	50	17	30	50	
			C _{ext} = 100 pF, R _{ext} = 10 kΩ	650	700	750	650	700	750	
			C _{ext} = 1 μF, R _{ext} = 10 kΩ	6.5*	7	7.5*	6.5	7	7.5	ms

* On products compliant to MIL-PRF-38535, this parameter is not production tested.

recommended operating conditions

			SN54LS221			SN74LS221			UNIT
			MIN	NOM	MAX	MIN	NOM	MAX	
V_{CC}	Supply voltage		4.5	5	5.5	4.75	5	5.25	V
V_{IH}	High-level input voltage	A input	2			2			V
V_{IL}	Low-level input voltage	A input			0.7			0.8	V
I_{OH}	High-level output current				–400			–400	μA
I_{OL}	Low-level output current				4			8	mA
$\Delta V/\Delta t$	Rise or fall of input pulse rate	B input	1*			1			V/s
		A input	1*			1			V/ μs
T_A	Operating free-air temperature		–55		125	0		70	$^\circ\text{C}$

* On products compliant to MIL-PRF-38535, this parameter is not production tested.

SN54221, SN54LS221, SN74221, SN74LS221

DUAL MONOSTABLE MULTIVIBRATORS

WITH SCHMITT-TRIGGER INPUTS

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electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS†	SN54LS221			SN74LS221			UNIT
			MIN	TYP‡	MAX	MIN	TYP‡	MAX	
V _{T+}	Positive-going threshold voltage, B input	V _{CC} = MIN		1	2*	1	2	V	
V _{T–}	Negative-going threshold voltage, B input	V _{CC} = MIN		0.7*	0.9	0.8	0.9	V	
V _{IK}		V _{CC} = MIN, I _I = –18 mA		–1.5		–1.5		V	
V _{OH}		V _{CC} = MIN, I _{OH} = –400 μA		2.5	3.4	2.7	3.4	V	
V _{OL}		V _{CC} = MIN	I _{OL} = 4 mA	0.25	0.4	0.25	0.4	V	
			I _{OL} = 8 mA			0.35	0.5		
I _I		V _{CC} = MAX, V _I = 7 V		0.1		0.1		mA	
I _{IH}		V _{CC} = MAX, V _I = 2.7 V		20		20		μA	
I _{IL}	A input	V _{CC} = MAX, V _I = 0.4 V		–0.4		–0.4		mA	
	CLR, B input			–0.8		–0.8			
I _{OS} §		V _{CC} = MAX		–20	–100	–20	–100	mA	
I _{CC}	Quiescent	V _{CC} = MAX		4.7	11	4.7	11	mA	
	Triggered			19	27*	19	27		

* On products compliant to MIL-PRF-38535, this parameter is not production tested.

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡ All typical values are at $V_{CC} = 5 \text{ V}$, $T_A = 25^\circ\text{C}$.

§ Not more than one output should be shorted at a time and the duration of the short circuit should not exceed one second.

timing requirements over recommended ranges of supply voltage and operating free-air temperature

			SN54LS221		SN74LS221		UNIT
			MIN	MAX	MIN	MAX	
t_w	Pulse duration	A or B	50		50		ns
		$\overline{\text{CLR}}$	40		40		
t_{su}	Setup time, inactive state¶	$\overline{\text{CLR}}$	15		15		ns
R_{ext}	External timing resistance		1.4*	70*	1.4	100	k Ω
C_{ext}	External timing capacitance		0*	1000*	0	1000	μF
Output duty cycle		$R_T = 2 \text{ k}\Omega$		50%		50%	
		$R_T = \text{MAX } R_{ext}$		90%		90%	

* On products compliant to MIL-PRF-38535, this parameter is not production tested.

¶ Inactive-state setup time is also referred to as recovery time.



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switching characteristics $V_{CC} = 5\text{ V}$, $R_L = 2\text{ k}\Omega$, $T_A = 25^\circ\text{C}$ (see Figures 1 and 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	SN54LS221			SN74LS221			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
t_{PLH}	A	Q	$C_{ext} = 80\text{ pF}, \quad R_{ext} = 2\text{ k}\Omega$	45	70		45	70	ns	
	B			35	55		35	55		
t_{PHL}	A	$\overline{Q}$		50	80		50	80		
	B			40	65		40	65		
t_{PHL}	$\overline{CLR}$	$\overline{Q}$	$C_{ext} = 80\text{ pF}, \quad R_{ext} = 2\text{ k}\Omega$	35	55		35	55	ns	
t_{PLH}		$\overline{\overline{Q}}$		44	65		44	65		
t_w	A or B	Q or $\overline{Q}$	$C_{ext} = 80\text{ pF}, \quad R_{ext} = 2\text{ k}\Omega$	70	120	150	70	120	150	ns
			$C_{ext} = 0, \quad R_{ext} = 2\text{ k}\Omega$	20	47	70	20	47	70	
			$C_{ext} = 100\text{ pF}, \quad R_{ext} = 10\text{ k}\Omega$	670	740	810	670	740	810	
			$C_{ext} = 1\text{ }\mu\text{F}, \quad R_{ext} = 10\text{ k}\Omega$	6*	6.9	7.5*	6	6.9	7.5	ms

* On products compliant to MIL-PRF-38535, this parameter is not production tested.

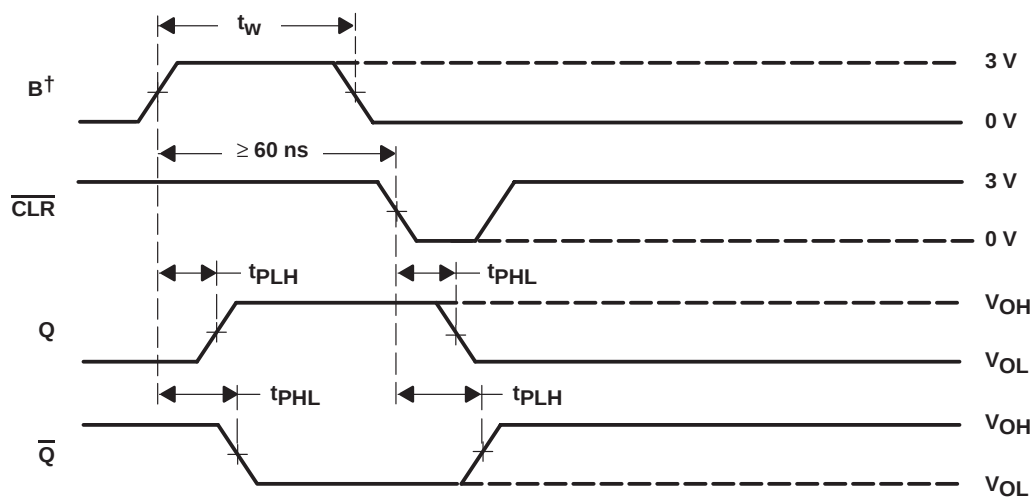
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DUAL MONOSTABLE MULTIVIBRATORS

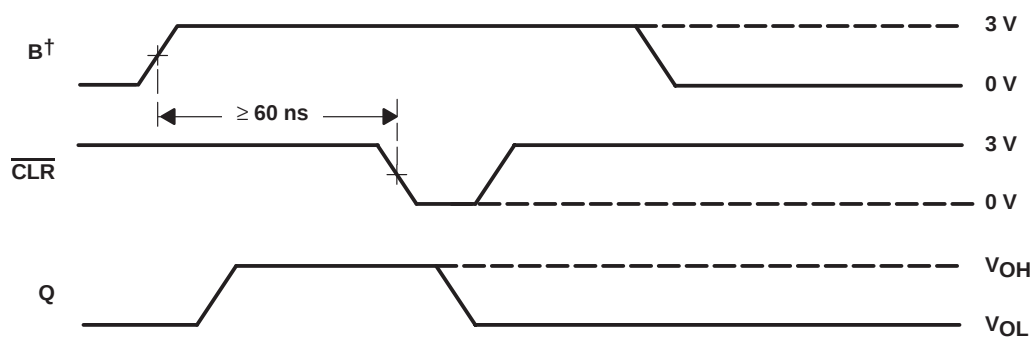
WITH SCHMITT-TRIGGER INPUTS

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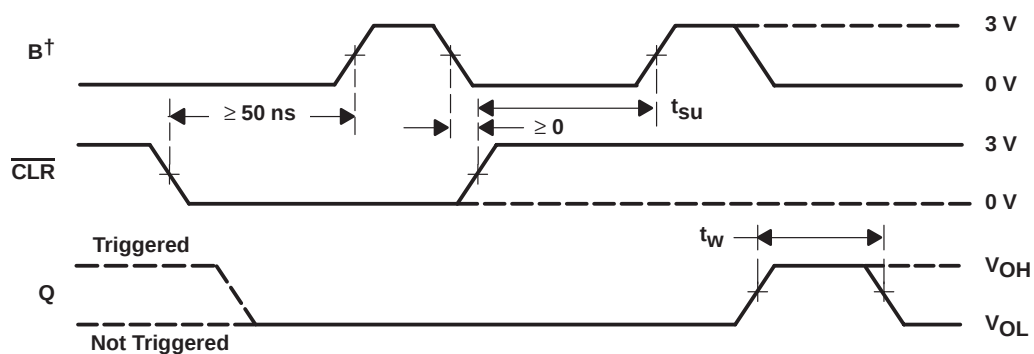
PARAMETER MEASUREMENT INFORMATION



CONDITION 1: TRIGGER FROM B, THEN $\overline{\text{CLR}}$



CONDITION 2: TRIGGER FROM B, THEN $\overline{\text{CLR}}$



CONDITION 3: $\overline{\text{CLR}}$ OVERRIDING B, THEN TRIGGER FROM B

† A is low.

Figure 1. Switching Characteristics

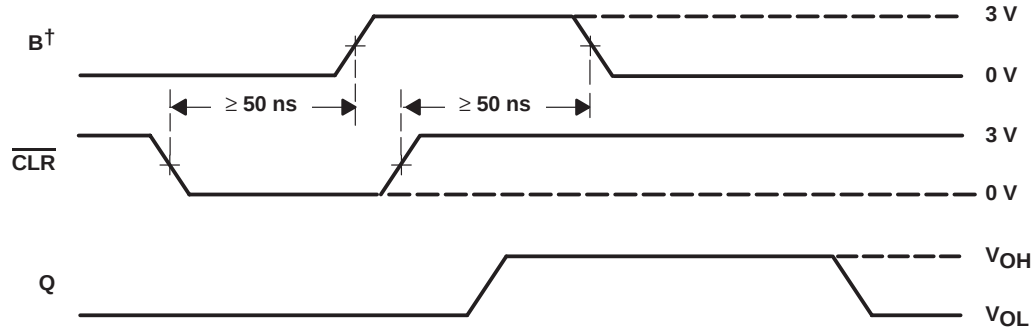


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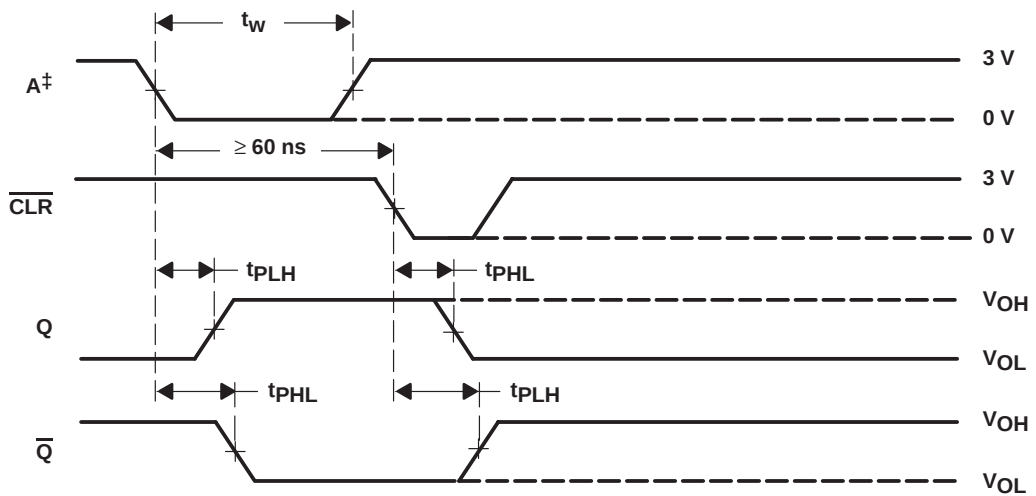
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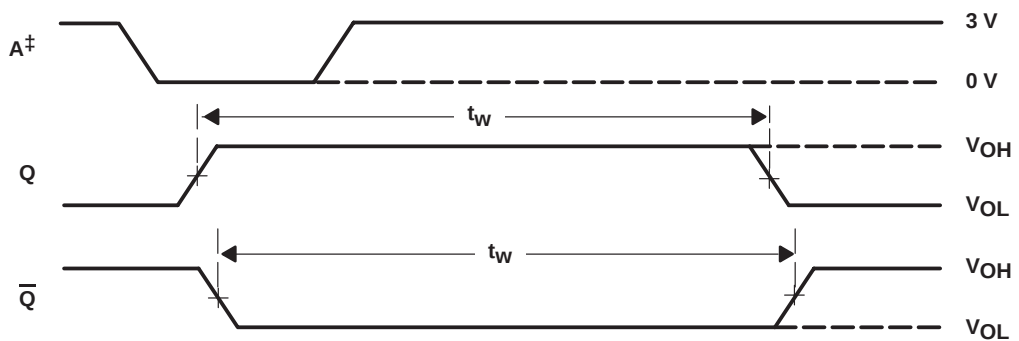
PARAMETER MEASUREMENT INFORMATION



CONDITION 4: TRIGGERING FROM POSITIVE TRANSITION OF $\overline{\text{CLR}}$



CONDITION 5: TRIGGER FROM A, THEN $\overline{\text{CLR}}$



CONDITION 6: TRIGGER FROM A

† A is low.

‡ B and $\overline{\text{CLR}}$ are high.

NOTES: A. Input pulses are supplied by generators having the following characteristics: $\text{PRR} \leq 1 \text{ MHz}$, $Z_O \approx 50 \Omega$; for SN54/74221, $t_r \leq 7 \text{ ns}$, $t_f \leq 7 \text{ ns}$, for SN54/74LS221, $t_r \leq 15 \text{ ns}$, $t_f \leq 6 \text{ ns}$.

B. All measurements are made between the 1.5-V points of the indicated transitions for the SN54/74221 or between the 1.3-V points for the SN54/74LS221.

Figure 1. Switching Characteristics (Continued)



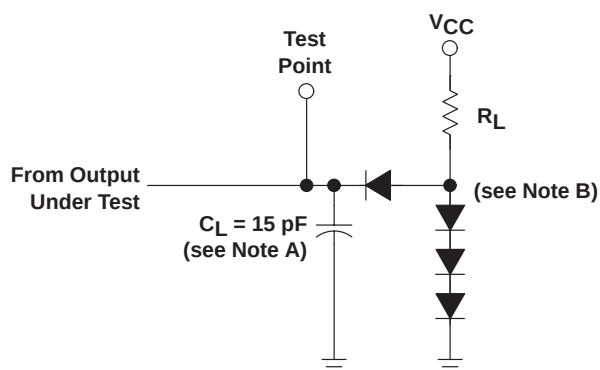
SN54221, SN54LS221, SN74221, SN74LS221

DUAL MONOSTABLE MULTIVIBRATORS

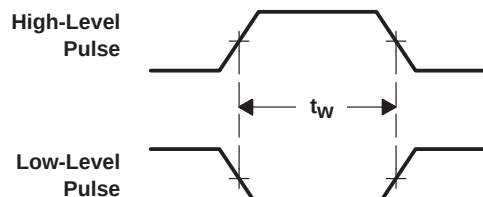
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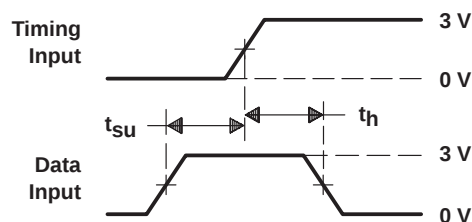
PARAMETER MEASUREMENT INFORMATION



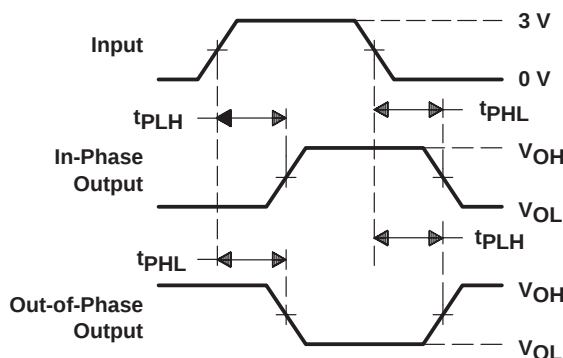
LOAD CIRCUIT FOR
BI-STATE
TOTEM-POLE OUTPUTS



VOLTAGE WAVEFORMS
PULSE DURATIONS



VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES

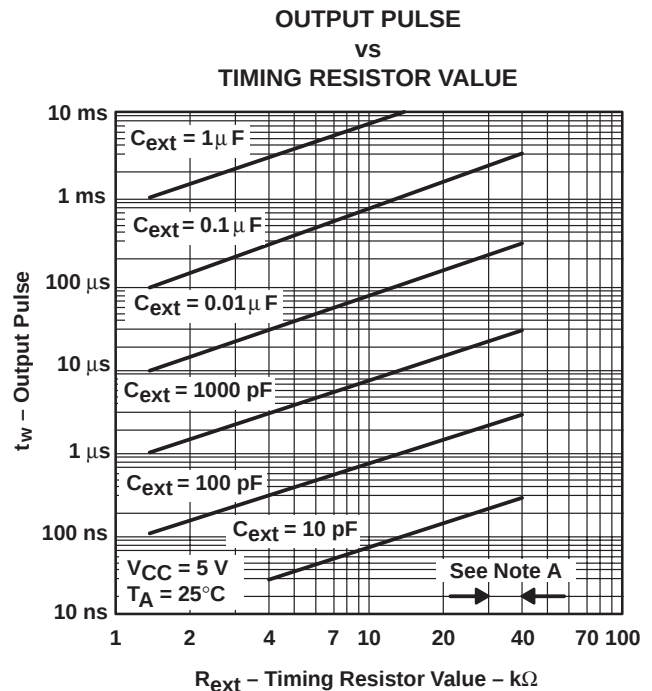
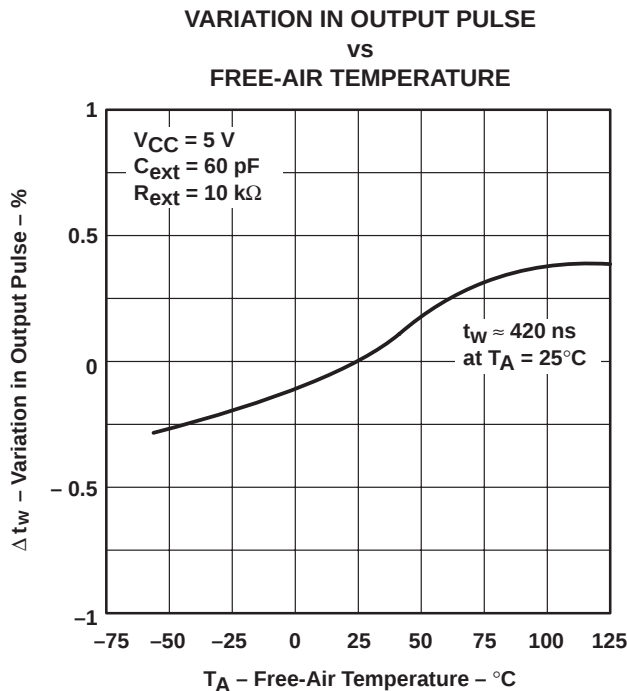
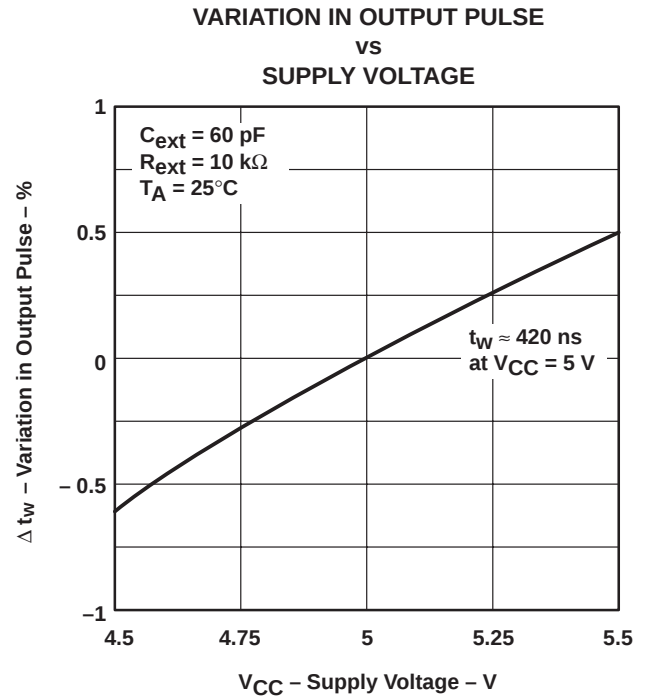
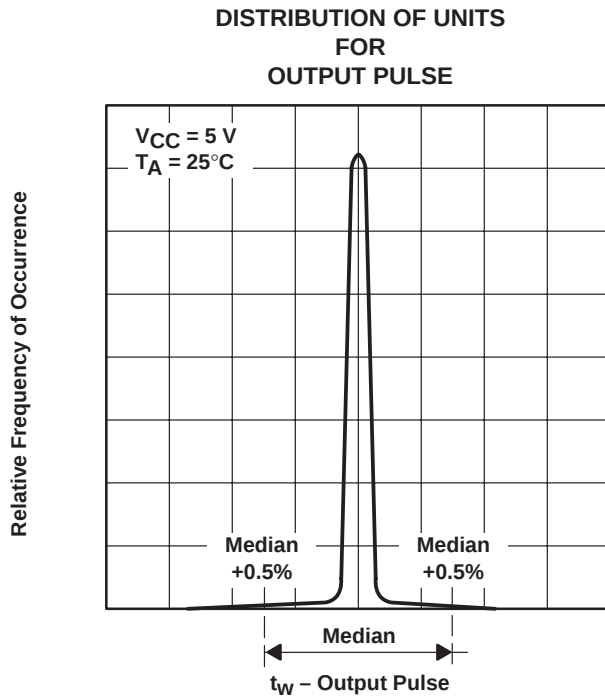
- NOTES:
- A. C_L includes probe and jig capacitance.
 - B. All diodes are 1N3064 or equivalent.
 - C. In the examples above, the phase relationships between inputs and outputs have been chosen arbitrarily.
 - D. All input pulses are supplied by generators having the following characteristics: $PRR \leq 1$ MHz, $Z_O \approx 50 \Omega$ and, for SN54/74221, $t_r \leq 7$ ns, $t_f \leq 7$ ns, for SN54/74LS221, $t_r \leq 15$ ns, $t_f \leq 6$ ns.
 - E. All measurements are made between the 1.5-V points of the indicated transitions for the SN54/74221 or between the 1.3-V points for the SN54/74LS221.

Figure 2. Load Circuits and Voltage Waveforms

SN54221, SN54LS221, SN74221, SN74LS221 DUAL MONOSTABLE MULTIVIBRATORS WITH SCHMITT-TRIGGER INPUTS

SDLS213A – DECEMBER 1983 – REVISED FEBRUARY 1998

TYPICAL CHARACTERISTICS (SN54/74221 ONLY)[†]



[†] Data for temperatures below 0°C and above 70°C, and for supply voltages below 4.75 V and above 5.25 V are applicable for the SN54221 only.
NOTE A: These values of resistance exceed the maximum recommended for use over the full military temperature range of the SN54221.

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