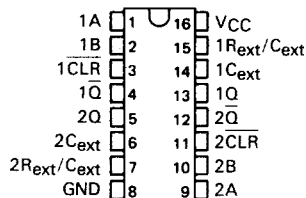


TYPES SN54221, SN54LS221, SN74221, SN74LS221 DUAL MONOSTABLE MULTIVIBRATORS WITH SCHMITT-TRIGGER INPUTS

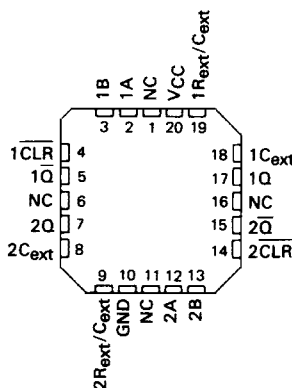
REVISED DECEMBER 1983

- **SN54221, SN54LS221, SN74221 and SN74LS221** Are Dual Versions of Highly Stable SN54121, SN74121 One-Shots on a Monolithic Chip
- **SN54221 and SN74221 Demonstrate Electrical and Switching Characteristics That Are Virtually Identical to the SN54121, SN74121 One-Shots**
- **Pin-Out Is Identical to the SN54123, SN74123, SN54LS123, SN74LS123**
- **Overriding Clear Terminates Output Pulse**

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



SN54LS221 . . . FK PACKAGE
SN74LS221 . . . FN PACKAGE
(TOP VIEW)



TYPE	TYPICAL POWER DISSIPATION	MAXIMUM OUTPUT PULSE LENGTH
SN54221	130 mW	21 s
SN74221	130 mW	28 s
SN54LS221	23 mW	49 s
SN74LS221	23 mW	70 s

description

The '221 and 'LS221 are monolithic dual multivibrators with performance characteristics virtually identical to those of the '121. 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 volt/second, providing the circuit with excellent noise immunity of typically 1.2 volts. A high immunity to V_{CC} noise of typically 1.5 volts 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 may be of any duration relative to the output pulse. Output pulse length may be varied from 35 nanoseconds 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 of typically 30 nanoseconds is achieved which may be used as a d-c-triggered reset signal. Output rise and fall times are TTL compatible and independent of pulse length. Typical triggering and clearing sequences are illustrated as a part of the switching characteristics waveforms.

FUNCTION TABLE
(EACH MONOSTABLE)

INPUTS		OUTPUTS	
CLEAR	A	Q	\bar{Q}
L	X	X	L H
X	H	X	L H
X	X	L	L H
H	L	↑	↓
H	↓	H	↓
↑*	L	H	↓

Also see description and switching characteristics

* This condition is true only if the output of the latch formed by the two NAND gates has been conditioned to the logical "1" state prior to CLR going high. This latch is conditioned by taking either A high or B low which CLR is in the inactive state.

PRODUCTION DATA

This document contains information 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.

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3-805

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

description (continued)

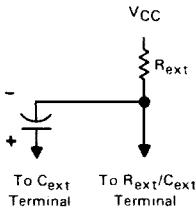
Pulse width stability is achieved through internal compensation and is virtually independent of V_{CC} and temperature. In most applications, pulse stability will only be limited by the accuracy of external timing components.

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 may be used. Also, the range of jitter-free output pulse widths is extended if V_{CC} is held to 5 volts 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 is typically less than $\pm 0.5\%$ for given external timing components. An example of this distribution for the '221 is shown in Figure 2. Variations in output pulse width versus supply voltage and temperature for the '221 are shown in Figure 3 and 4, respectively.

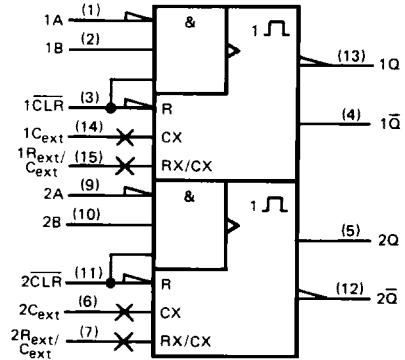
Pin assignments for these devices are identical to those of the SN54123/SN74123 or SN54LS123/SN74LS123 so that the '221 or 'LS221 can be substituted for those products in systems not using the retrigger by merely changing the value of R_{ext} and/or C_{ext} , however the polarity of the capacitor will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

TIMING COMPONENT CONNECTIONS

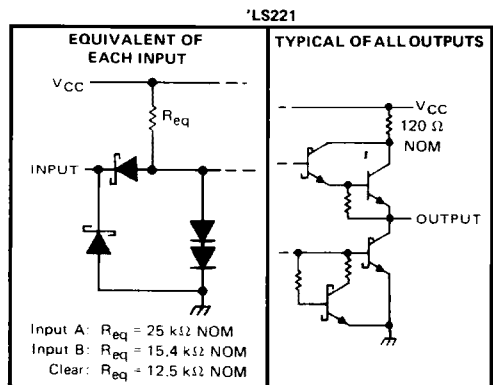
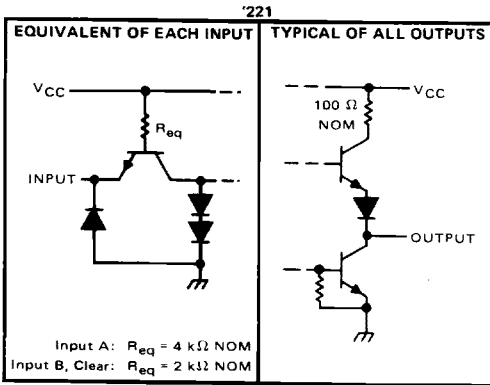


NOTE: Due to the internal circuit, the $R_{\text{ext}}/C_{\text{ext}}$ pin will never be more positive than the C_{ext} pin.
Pin numbers shown on logic notation are for D, J or N packages.

LOGIC SYMBOL



schematics of inputs and outputs



TYPES SN54221, SN74221 DUAL MONOSTABLE MULTIVIBRATORS WITH SCHMITT-TRIGGER INPUTS

recommended operating conditions

		SN54221			SN74221			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
Supply voltage, V_{CC}		4.5	5	5.5	4.75	5	5.25	V
High-level output current, I_{OH}		-800			-800			μ A
Low-level output current, I_{OL}		16			16			mA
Rate of rise or fall of input pulse, dv/dt		Schmitt input, B		1	1		V/s	
		Logic input, A		1	1		V/ μ s	
Input pulse width		A or B, $t_{w(n)}$		50	50		ns	
		Clear, $t_{w(clear)}$		20	20			
Clear-inactive-state setup time, t_{su}		15			15			ns
External timing resistance, R_{ext}		1.4		30	1.4		40	k Ω
External timing capacitance, C_{ext}		0		1000	0		1000	μ F
Output duty cycle		$R_{ext} = 2\text{ k}\Omega$		67		67		%
		$R_{ext} = \text{MAX } R_{ext}$		90		90		
Operating free-air temperature, T_A		-55		125	0		70	$^{\circ}$ C

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

PARAMETER		TEST CONDITIONS [†]	MIN	TYP [‡]	MAX	UNIT
V_{T+}	Positive-going threshold voltage at A input	V_{CC} MIN		1.4	2	V
V_{T-}	Negative-going threshold voltage at A input	$V_{CC} = \text{MIN}$	0.8	1.4		V
V_{T+}	Positive-going threshold voltage at B input	$V_{CC} = \text{MIN}$		1.55	2	V
V_{T-}	Negative-going threshold voltage at B input	$V_{CC} = \text{MIN}$	0.8	1.35		V
V_{IK}	Input clamp voltage	$V_{CC} = \text{MIN}$, $I_I = -12\text{ mA}$			-1.5	V
V_{OH}	High-level output voltage	$V_{CC} = \text{MIN}$, $I_{OH} = -800\text{ }\mu\text{A}$	2.4	3.4		V
V_{OL}	Low-level output voltage	$V_{CC} = \text{MIN}$, $I_{OL} = 16\text{ mA}$		0.2	0.4	V
I_I	Input current at maximum input voltage	$V_{CC} = \text{MAX}$, $V_I = 5.5\text{ V}$			1	mA
I_{IH}	High-level input current	$V_{CC} = \text{MAX}$, $V_I = 2.4\text{ V}$	Input A		40	μ A
			Input B, Clear		80	
I_{IL}	Low-level input current	$V_{CC} = \text{MAX}$, $V_I = 0.4\text{ V}$	Input A		-1.6	mA
			Input B, Clear		-3.2	
I_{OS}	Short-circuit output current [§]	$V_{CC} = \text{MAX}$	SN54221		-20	mA
			SN74221		-18	
I_{CC}	Supply current	$V_{CC} = \text{MAX}$	Quiescent		26	mA
			Triggered		46	

[†]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.

switching characteristics, $V_{CC} = 5\text{ V}$, $T_A = 25^{\circ}\text{C}$

PARAMETER [¶]	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT		
t_{PLH}	A	Q	$C_L = 15\text{ pF}$, $R_L = 400\text{ }\Omega$, See Figure 1 and Note 2	$C_{ext} = 80\text{ pF}$, $R_{ext} = 2\text{ k}\Omega$	45	70	ns		
	B	Q			35	55			
t_{PHL}	A	\bar{Q}			50	80	ns		
	B	\bar{Q}			40	65			
t_{PHL}	Clear	Q					27	ns	
t_{PLH}	Clear	\bar{Q}					40	ns	
$t_{w(out)}$	A or B	Q or \bar{Q}			$C_{ext} = 80\text{ pF}$, $R_{ext} = 2\text{ k}\Omega$	70	110	150	ns
					$C_{ext} = 0$, $R_{ext} = 2\text{ k}\Omega$	20	30	50	
			$C_{ext} = 100\text{ pF}$, $R_{ext} = 10\text{ k}\Omega$	650	700	750			
			$C_{ext} = 1\text{ }\mu\text{F}$, $R_{ext} = 10\text{ k}\Omega$	6.5	7	7.5	ms		

[¶] t_{PLH} = Propagation delay time, low to high-level output

t_{PHL} = Propagation delay time, high to low-level output

$t_{w(out)}$ = Output pulse width

NOTE 2: See General Information Section for load circuits and voltage waveforms

TYPES SN54LS221, SN74LS221 DUAL MONOSTABLE MULTIVIBRATORS WITH SCHMITT-TRIGGER INPUTS

recommended operating conditions

	SN54LS221			SN74LS221			UNIT
	MIN	NOM	MAX	MIN	NOM	MAX	
Supply voltage, V_{CC}	4.5	5	5.5	4.75	5	5.25	V
High-level output current, I_{OH}	-400			-400			μ A
Low-level output current, I_{OL}	4			8			mA
Rate of rise or fall of input pulse, dv/dt	Schmitt, B	1		1			V/s
	Logic input, A	1		1			V/ μ s
Input pulse width	A or B, $t_{W(in)}$	50		50			ns
	Clear, $t_{W(clear)}$	40		40			
Clear-inactive-state setup time, t_{su}	15		15			ns	
External timing resistance, R_{ext}	1.4		70	1.4		100	k Ω
External timing capacitance, C_{ext}	0		1000	0		1000	μ F
Output duty cycle	$R_T = 2$ k Ω	50		50			%
	$R_T = \text{MAX } R_{ext}$	90		90			
Operating free-air temperature, T_A	-55		125	0		70	$^{\circ}$ C

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 at A input	$V_{CC} = \text{MIN}$	1.0		2	1.0		2	V
V_{T-} Negative-going threshold voltage at A input	$V_{CC} = \text{MIN}$	0.7	1.0		0.8	1.0		V
V_{T+} Positive-going threshold voltage at B input	$V_{CC} = \text{MIN}$	1.0		2	1.0		2	V
V_{T-} Negative-going threshold voltage at B input	$V_{CC} = \text{MIN}$	0.7	0.9		0.8	0.9		V
V_{IK} Input clamp voltage	$V_{CC} = \text{MIN}$, $I_I = -18$ mA			-1.5			-1.5	V
V_{OH} High-level output voltage	$V_{CC} = \text{MIN}$, $I_{OH} = -400$ μ A	2.5	3.4		2.7	3.4		V
V_{OL} Low-level output voltage	$V_{CC} = \text{MIN}$	$I_{OL} = 4$ mA		0.25	0.4		V	
		$I_{OL} = 8$ mA		0.35		0.5		
I_I Input current at maximum input voltage	$V_{CC} = \text{MAX}$, $V_I = 7$ V			0.1			0.1	mA
I_{IH} High-level input current	$V_{CC} = \text{MAX}$, $V_I = 2.7$ V			20			20	μ A
I_{IL} Low-level input current	Input A			-0.4			-0.4	mA
	Input B	$V_{CC} = \text{MAX}$, $V_I = 0.4$ V		-0.8			-0.8	
	Clear			-0.8			-0.8	
I_{OS} Short-circuit output current [§]	$V_{CC} = \text{MAX}$	-20	-100		-20	-100		mA
I_{CC} Supply current	$V_{CC} = \text{MAX}$	Quiescent		4.7	11		mA	
		Triggered		19	27			

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

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

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

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

switching characteristics, $V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$

PARAMETER [†]	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS			MIN	TYP	MAX	UNIT
t_{PLH}	A	Q	$C_L = 15\text{ pF}$, $R_L = 2\text{ k}\Omega$, See Figure 1 and Note 3	$C_{ext} = 80\text{ pF}$, $R_{ext} = 2\text{ k}\Omega$	45	70	ns		
	B	Q			35	55			
t_{PHL}	A	\bar{Q}			50	80	ns		
	B	\bar{Q}			40	65			
t_{PHL}	Clear	Q			35	55	ns		
t_{PLH}	Clear	\bar{Q}			44	65	ns		
$t_{w(out)}$	A or B	Q or \bar{Q}			$C_{ext} = 80\text{ pF}$, $R_{ext} = 2\text{ k}\Omega$	70	120	150	ms
					$C_{ext} = 0$, $R_{ext} = 2\text{ k}\Omega$	20	47	70	
			$C_{ext} = 100\text{ pF}$, $R_{ext} = 10\text{ k}\Omega$	670	740	810			
			$C_{ext} = 1\text{ }\mu\text{F}$, $R_{ext} = 10\text{ k}\Omega$	6	6.9	7.5			

[†] t_{PLH} = Propagation delay time, low-to-high-level output
 t_{PHL} = Propagation delay time, high-to-low-level output
 $t_{w(out)}$ = Output pulse width

NOTE 3: See General Information Section for load circuits and voltage waveforms.

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

PARAMETER MEASUREMENT INFORMATION

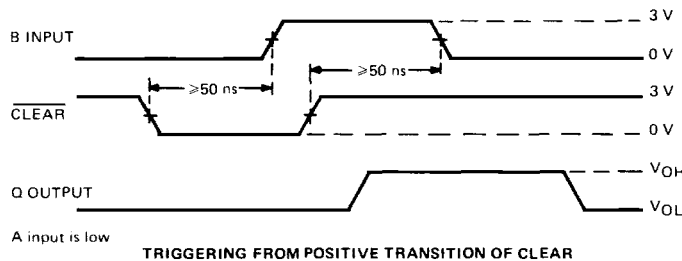
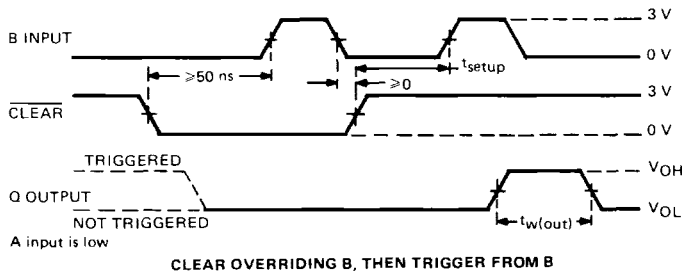
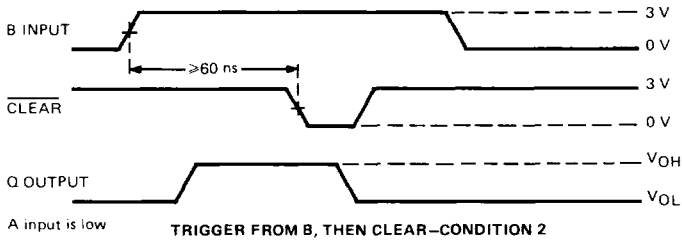
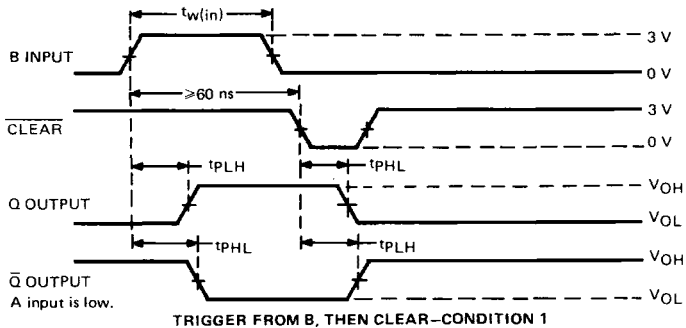
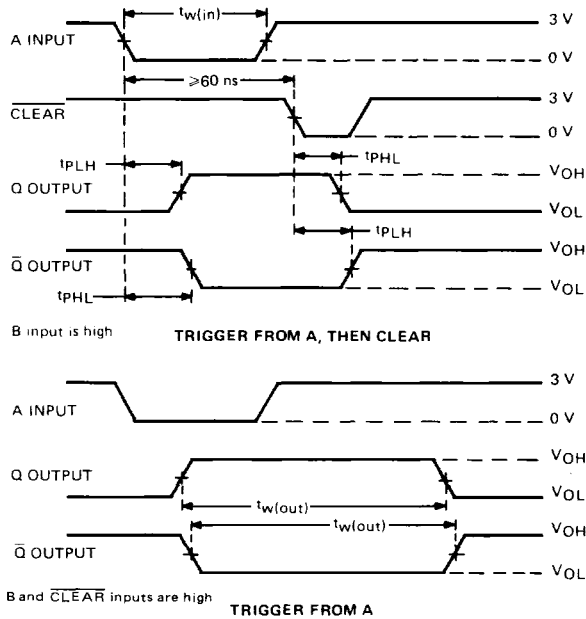


FIGURE 1—SWITCHING CHARACTERISTICS

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

PARAMETER MEASUREMENT INFORMATION



NOTES: A. Input pulses are supplied by generators having the following characteristics: PRR \leq 1 MHz, $Z_{out} \approx 50 \Omega$; for '221, $t_r \leq 7$ ns, $t_f \leq 7$ ns, for 'LS221, $t_r \leq 15$ ns, $t_f \leq 6$ ns.
 B. All measurements are made between the 1.5 V points of the indicated transitions for the '221 or between the 1.3 V points for the 'LS221.

FIGURE 1—SWITCHING CHARACTERISTICS (CONTINUED)

TYPES SN54221, SN74221
DUAL MONOSTABLE MULTIVIBRATORS
WITH SCHMITT-TRIGGER INPUTS

TYPICAL CHARACTERISTICS ('221 ONLY)†

DISTRIBUTION OF UNITS
 for
 OUTPUT PULSE WIDTH

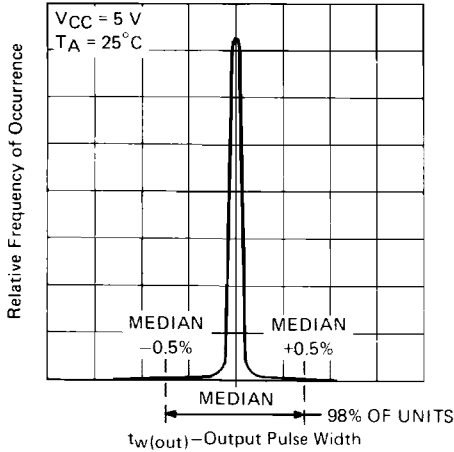


FIGURE 2

VARIATION IN OUTPUT PULSE WIDTH
 vs
 SUPPLY VOLTAGE

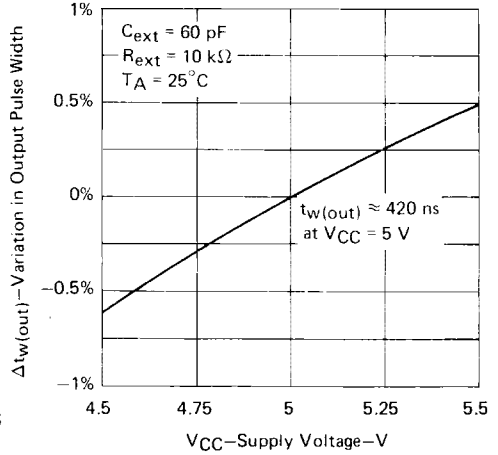


FIGURE 3

VARIATION IN OUTPUT PULSE WIDTH
 vs
 FREE-AIR TEMPERATURE

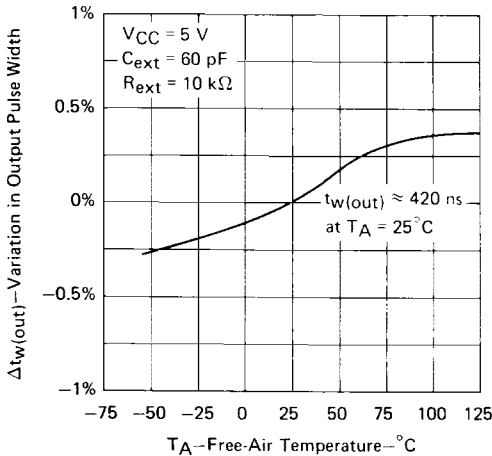


FIGURE 4

OUTPUT PULSE WIDTH
 vs
 TIMING RESISTOR VALUE

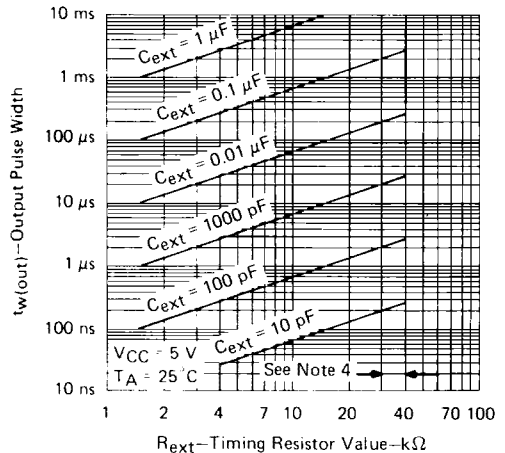


FIGURE 5

NOTE 4: These values of resistance exceed the maximum recommended for use over the full temperature range of the SN54221.

†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.

3

TTL DEVICES