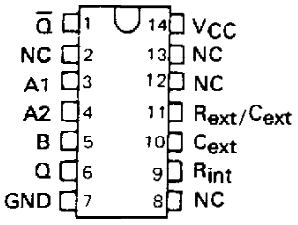
SDLS042

SN54121, SN74121
MONOSTABLE MULTIVIBRATORS WITH SCHMITT-TRIGGER INPUTS

MAY 1983 – REVISED MARCH 1988

- Programmable Output Pulse Width
  With R_{int} . . . 35 ns Typ
  With R_{ext}/C_{ext} . . . 40 ns to 28 Seconds
- Internal Compensation for Virtual Temperature Independence
- Jitter-Free Operation up to 90% Duty Cycle
- Inhibit Capability

SN54121 . . . J OR W PACKAGE
SN74121 . . . N PACKAGE
(TOP VIEW)



NC – No internal connection.

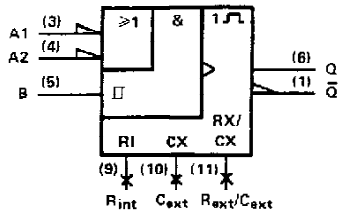
FUNCTION TABLE

INPUTS			OUTPUTS	
A1	A2	B	Q	$\overline{Q}$
L	X	H	L	H
X	L	H	L†	H†
X	X	L	L†	H†
H	H	X	L†	H†
H	↓	H	⊓	⊔
↓	H	H	⊓	⊔
↓	↓	H	⊓	⊔
L	X	↑	⊓	⊔
X	L	↑	⊓	⊔

For explanation of function table symbols, see page

† These lines of the function table assume that the indicated steady-state conditions at the A and B inputs have been setup long enough to complete any pulse started before the setup.

logic symbol‡



‡This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

description

These multivibrators feature dual negative-transition-triggered inputs and a single positive-transition-triggered input which can be used as an inhibit input. Complementary output pulses are provided.

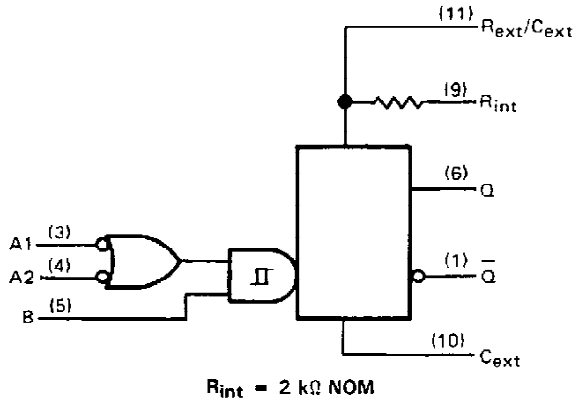
Pulse triggering occurs at a particular voltage level and is not directly related to the transition time of the input pulse. Schmitt-trigger input circuitry (TTL hysteresis) for the B input allows jitter-free triggering from inputs with transition rates as slow as 1 volt/second, providing the circuit with an 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 inputs and are a function only of the timing components. Input pulses may be of any duration relative to the output pulse. Output pulse length may be varied from 40 nanoseconds to 28 seconds by choosing appropriate timing components. With no external timing components (i.e., R_{int} connected to V_{CC}, C_{ext} and R_{ext}/C_{ext} open), an output pulse of typically 30 or 35 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.

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 μF) and more than one decade of timing resistance (2 kΩ to 30 kΩ for the SN54121 and 2 kΩ to 40 kΩ for the SN74121). Throughout these ranges, pulse width is defined by the relationship $t_{w(out)} = C_{ext}R_T\ln 2 \approx 0.7\ C_{ext}R_T$. In circuits where pulse cutoff is not critical, timing capacitance up to 1000 μF and timing resistance as low as 1.4 kΩ 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.

logic diagram (positive logic)



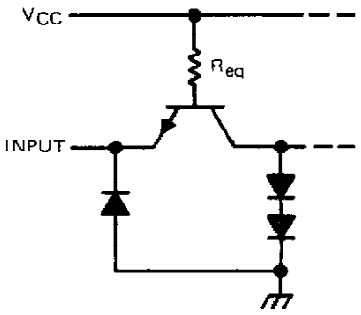
R_{int} = 2 kΩ NOM

Pin numbers shown on logic notation are for J or N packages.

NOTES: 1. An external capacitor may be connected between C_{ext} (positive) and R_{ext}/C_{ext}.
2. To use the internal timing resistor, connect R_{int} to V_{CC}. For improved pulse width accuracy and repeatability, connect an external resistor between R_{ext}/C_{ext} and V_{CC} with R_{int} open-circuited.

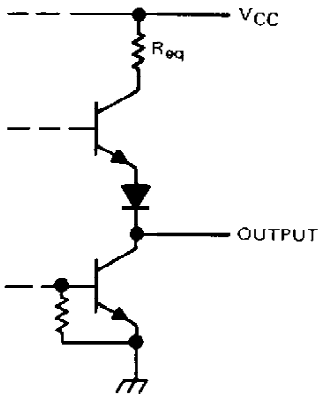
schematics of inputs and outputs

EQUIVALENT OF EACH INPUT



INPUT	R_{eq} NOM
A1	4 kΩ
A2	4 kΩ
B	2 kΩ

TYPICAL OF BOTH OUTPUTS



R_{eq} = 130 Ω NOM

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

Supply voltage, V_{CC} (see Note 3) . . . . . 7 V
Input voltage . . . . . 5.5 V
Operating free-air temperature range: SN54121 . . . . . −55°C to 125°C
SN74121 . . . . . 0°C to 70°C
Storage temperature range . . . . . −65°C to 150°C

NOTE 3: Voltage values are with respect to network ground terminal.

recommended operating conditions

				MIN	NOM	MAX	UNIT
V_{CC}	Supply voltage		54 Family	4.5	5	5.5	V
			74 Family	4.75	5	5.25	
I_{OH}	High-level output current					−0.4	mA
I_{OL}	Low-level output current					16	mA
dv/dt	Rate of rise or fall of input pulse	Schmitt input, B		1			V/s
		Logic inputs, A1, A2		1			V/μs
$t_{w(in)}$	Input pulse width			50			ns
R_{ext}	External timing capacitance		54 Family	1.4		30	kΩ
			74 Family	1.4		40	
C_{ext}	External timing capacitance			0		1000	μF
	Duty cycle	R_T = 2 kΩ				67	%
		R_T = MAX R_{ext}				90	
T_A	Operating free-air temperature		54 Family	−55		125	°C
			74 Family	0		70	

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

PARAMETER		TEST CONDITIONS†		MIN	TYP‡	MAX	UNIT
V_{IH}	High-level input voltage at B input	V_{CC} = MIN		2			V
V_{IL}	Low-level input voltage at A input	V_{CC} = MIN				0.8	V
V_{T+}	Positive-going threshold voltage at B input	V_{CC} = MIN			1.55	2	V
V_{T-}	Negative-going threshold voltage at B input	V_{CC} = MIN		0.8	1.35		V
V_{IK}	Input clamp voltage	V_{CC} = MIN,	I_I = −12 mA			−1.5	V
I_{OH}	High-level output voltage	V_{CC} = MIN,	I_{OH} = MAX	2.4	3.4		V
V_{OL}	Low-level output voltage	V_{CC} = MIN,	I_{OL} = MAX		0.2	0.4	V
I_I	Input current at maximum input voltage	V_{CC} = MAX,	V_I = 5.5 V			1	mA
I_{IH}	High-level input current	V_{CC} = MAX, V_I = 2.4 V	A1 or A2			40	μA
			B			80	
I_{IL}	Low-level input current	V_{CC} = MAX, V_I = 0.4 V	A1 or A2			−1.6	mA
			B			−3.2	
I_{OS}	Short-circuit output current§	V_{CC} = MAX	54 Family	−20		−55	mA
			74 Family	−18		−55	
I_{CC}	Supply current	V_{CC} = MAX	Quiescent		13	25	mA
			Triggered		23	40	

†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°C.
§Not more than one output should be shorted at a time.

switching characteristics, V_{CC} = 5 V, T_A = 25°C

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
t_{PLH}	Propagation delay time, low-to-high-level Q output from either A input	C_L = 15 pF, R_L = 400 Ω, See Note 4	C_{ext} = 80 pF, R_{int} to V_{CC}		45	70	ns
t_{PLH}	Propagation delay time, low-to-high-level Q output from B input				35	55	ns
t_{PHL}	Propagation delay time, high-to-low level $\overline{Q}$ output from either A input				50	80	ns
t_{PHL}	Propagation delay time, high-to-low level $\overline{Q}$ output from B input				40	65	ns
$t_{w(out)}$	Pulse width obtained using internal timing resistor		C_{ext} = 80 pF, R_{int} to V_{CC}	70	110	150	ns
$t_{w(out)}$	Pulse width obtained with zero timing capacitance		C_{ext} = 0, R_{int} to V_{CC}		30	50	ns
$t_{w(out)}$	Pulse width obtained using external timing resistor		C_{ext} = 100 pF, R_T = 10 kΩ	600	700	800	ns
			C_{ext} = 1 μF, R_T = 10 kΩ	6	7	8	ms

NOTE 4: Load circuits and voltage waveforms are shown in Section 1.

TYPICAL CHARACTERISTICS†

DISTRIBUTION OF UNITS
for
OUTPUT PULSE WIDTH

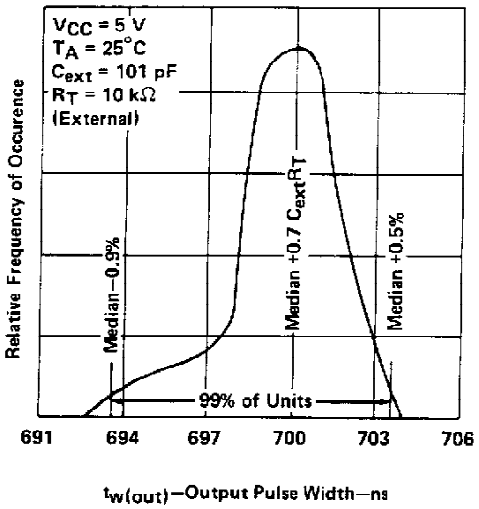


FIGURE 1

VARIATION IN INTERNAL TIMING RESISTOR VALUE
vs
FREE-AIR TEMPERATURE

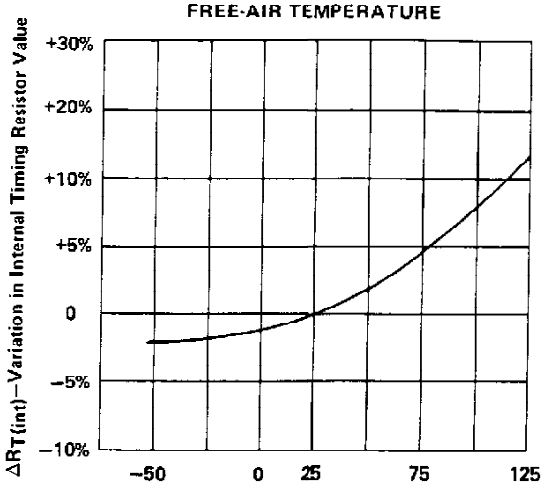


FIGURE 2

VARIATION IN OUTPUT PULSE WIDTH
vs
SUPPLY VOLTAGE

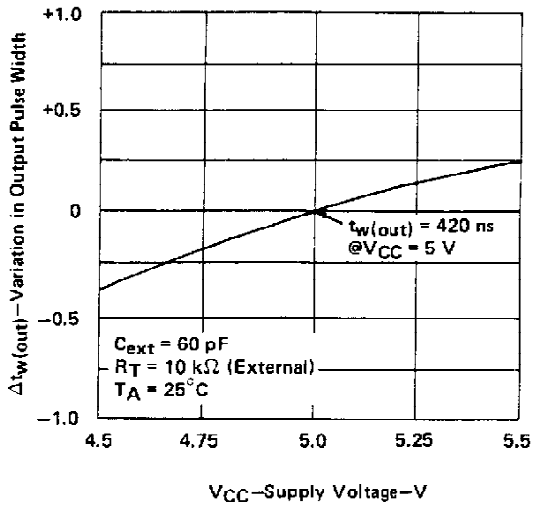


FIGURE 3

SCHMITT TRIGGER THRESHOLD VOLTAGE
vs
FREE-AIR TEMPERATURE

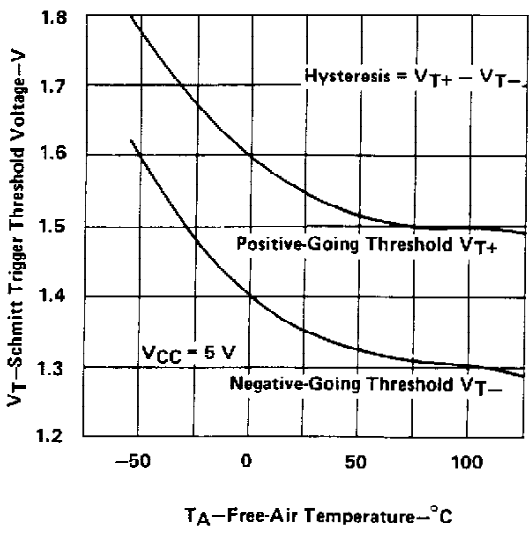


FIGURE 4

†Data for temperatures below 0°C and above 70°C are applicable for SN54121.

TYPICAL CHARACTERISTICS† (continued)

VARIATION IN OUTPUT PULSE WIDTH
vs
FREE-AIR TEMPERATURE

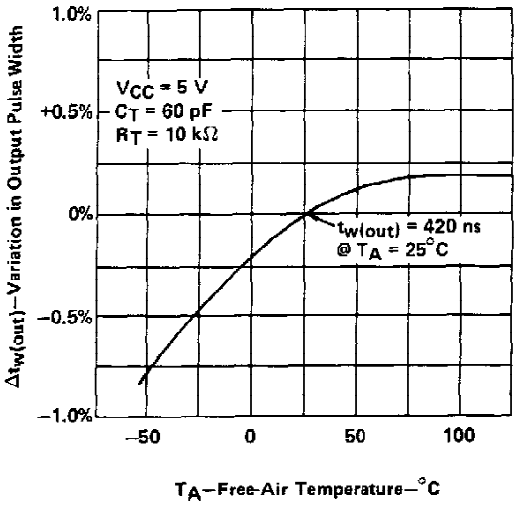


FIGURE 5

OUTPUT PULSE WIDTH
vs
TIMING RESISTOR VALUE

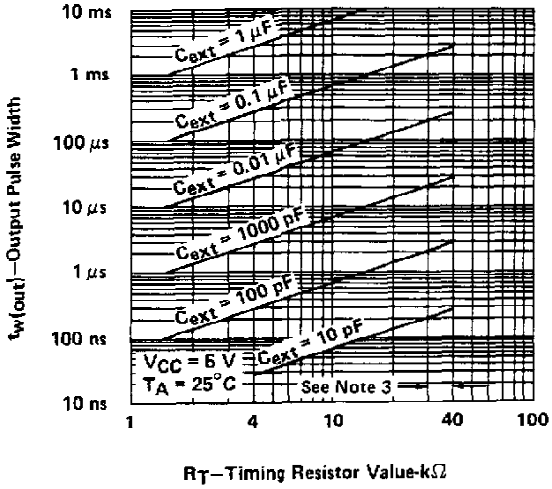


FIGURE 6

OUTPUT PULSE WIDTH
vs
EXTERNAL CAPACITANCE

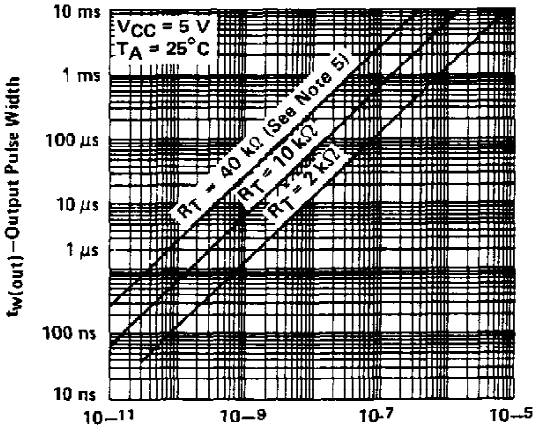


FIGURE 7

NOTE 5: These values of resistance exceed the maximum recommended use over the full temperature range of the SN54121.
†Data for temperatures below 0°C and above 70°C are applicable for SN54121.

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