MOTOROLA

Military 54LS122

Retriggerable Monostable Multivibrator (with Clear)

ELECTRICALLY TESTED PER:
MIL-M-38510/31403

This DC triggered multivibrator features pulse width control by three methods. The basic pulse width is programmed by selection of external resistance and capacitance values. The 'LS122 has an internal timing resistor that allows the circuit to be used with only an external capacitor. Once triggered, the basic pulse width may be extended by retriggering the gated low-level-active (A) or high-level-active (B) inputs, or be reduced by use of the overriding clear.

The 'LS122 has a Schmitt trigger input to ensure jitter-free triggering from the B input with transition rates as slow as 0.1 millivolt per nanosecond.

- Overriding Clear Terminates Output Pulse
- Compensated for V_{CC} and Temperature Variations
- DC Triggered from Active-High or Active-Low Gated Logic Inputs
- Retriggerable for Very Long Output Pulses, up to 100% Duty Cycle
- Internal Timing Resistors

AVAILABLE AS:

1) JAN: JM38510/31403BXA
2) SMD: 7600301
3) 883: 54LS122/BXAJC

X = CASE OUTLINE AS FOLLOWS:
PACKAGE: CERDIP: C
CERFLAT: D
LCC: 2

THE LETTER "M" APPEARS BEFORE THE / ON LCC.

'LS122 FUNCTION TABLE

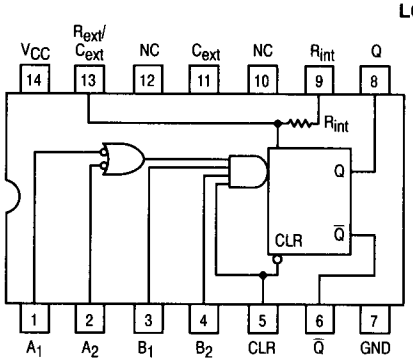
Inputs					Outputs	
CLEAR	A_1	A_2	B_1	B_2	Q	$\overline{Q}$
L	X	X	X	X	L	H
X	H	H	X	X	L	H
X	X	X	L	X	L	H
X	X	X	X	L	L	H
H	L	X	↑	H	⎍	⎎
H	L	X	H	↑	⎍	⎎
H	X	L	↑	H	⎍	⎎
H	X	L	H	↑	⎍	⎎
H	H	↓	H	H	⎍	⎎
H	↓	↓	H	H	⎍	⎎
H	↓	H	H	H	⎍	⎎
↑	L	X	H	H	⎍	⎎
↑	X	L	H	H	⎍	⎎

PIN ASSIGNMENTS

FUNCT.	DIL 632-08	FLATS 717-04	LCC 756A-02	BURN-IN (COND. A)
A_1	1	1	2	V_{CC}
A_2	2	2	3	V_{CC}
B_1	3	3	4	V_{CC}
B_2	4	4	6	V_{CC}
CLR	5	5	8	GND
$\overline{Q}$	6	6	9	V_{CC}
GND	7	7	10	GND
Q	8	8	12	OPEN
R_{int}	9	9	13	V_{CC}
NC	10	10	14	V_{CC}
C_{ext}	11	11	16	GND
NC	12	12	18	V_{CC}
R_{ext}/C_{ext}	13	13	19	OPEN
V_{CC}	14	14	20	V_{CC}

BURN-IN CONDITIONS:
V_{CC} = 5.0 V MIN/6.0 V MAX

LOGIC DIAGRAM



(SEE NOTES 1 THRU 4)

NOTES:
1. An external timing capacitor may be connected between C_{ext} and R_{ext}/C_{ext} (positive).
2. To use the internal timing resistor of the 'LS122, connect R_{int} to V_{CC}.
3. For improved pulse width accuracy connect an external resistor between R_{ext}/C_{ext} and V_{CC} with R_{int} open-circuited.
4. To obtain variable pulse widths, connect an external variable resistance between R_{int}/C_{ext} and V_{CC}.

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TYPICAL APPLICATION DATA

The output pulse tp is a function of the external components, C_{ext} and R_{ext} or C_{ext} and R_{int} on the 'LS122. For values of C_{ext} ≥ 1000 pF, the output pulse at V_{CC} = 5.0 V and V_{RC} = 5.0 V is given by $t_P = K R_{ext}/C_{ext}$ where K is nominally 0.45.

If C_{ext} is in pF and R_{ext} is in kΩ then tp is in nanoseconds.

The C_{ext} terminal of the 'LS122 and 'LS123 is an internal connection to ground, however for the best system performance C_{ext} should be hardwired to ground.

Care should be taken to keep R_{ext} and C_{ext} as close to the monostable as possible with a minimum amount of inductance between the R_{ext}/C_{ext} junction and the R_{ext}/C_{ext} pin. Good groundplane and adequate bypassing should be designed into the system for optimum performance to ensure that no false triggering occurs.

It should be noted that the C_{ext} pin is internally connected to ground on the 'LS122 and 'LS123, but not on the 'LS221. Therefore, if C_{ext} is hardwired externally to ground, substitution of a 'LS221 onto a 'LS123 socket will cause the 'LS221 to become non-functional.

The switching diode is not needed for electrolytic capacitance application and should not be used on the 'LS122 and 'LS123.

To find the value of K for C_{ext} ≥ 1000 pF, refer to Figure 4. Variations on V_{CC} or V_{RC} can cause the value of K to change, as can the temperature of the 'LS123, 'LS122. Figures 5 and 6 show the behavior of the circuit shown in Figures 1 and 2 if separate power supplies are used for V_{CC} and V_{RC}. If V_{CC} is tied to V_{RC}, Figure 7 shows how K will vary with V_{CC} and temperature. Remember, the changes in R_{ext} and C_{ext} with temperature are not calculated and included in the graph.

As long as C_{ext} ≥ 1000 pF and 5.0 k ≤ R_{ext} ≤ 160 k (54LS122/123), the change in K with respect to R_{ext} is negligible.

If C_{ext} ≤ 1000 pF the graph shown on Figure 8 can be used to determine the output pulse width. Figure 9 shows how K will change for C_{ext} ≤ 1000 pF if V_{CC} and V_{RC} are connected to the same power supply. The pulse width tp in nanoseconds is approximated by

$$t_P = 6.0 + 0.05\ C_{ext}\ (pF) + 0.45\ R_{ext}\ (k\Omega)\ C_{ext} + 11.6\ R_{ext}$$

In order to trim the output pulse width, it is necessary to include a variable resistor between V_{CC} and the R_{ext}/C_{ext} pin or between V_{CC} and the R_{ext} pin of the 'LS122. Figures 10, 11 and 12 show how it can be done. R_{ext} remote should be kept as close to the monostable as possible.

Retriggering of the part, as shown in Figure 3, must not occur before C_{ext} is discharged or the retrigger will not have any effect. The discharge time of C_{ext} in nanoseconds is guaranteed to be less than 0.22 C_{ext} (pF) and is typically 0.05 C_{ext} (pF).

For the smallest possible deviation in output pulse widths from various devices, it is suggested that C_{ext} be kept ≥ 1000 pF.

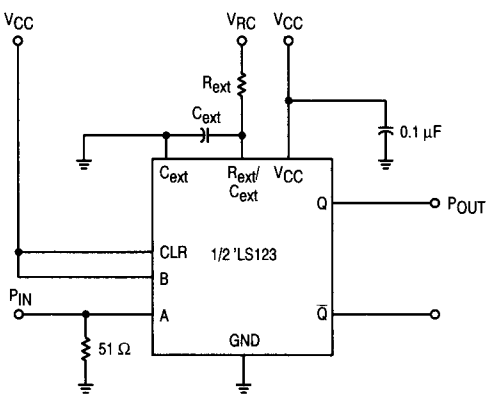


Figure 1

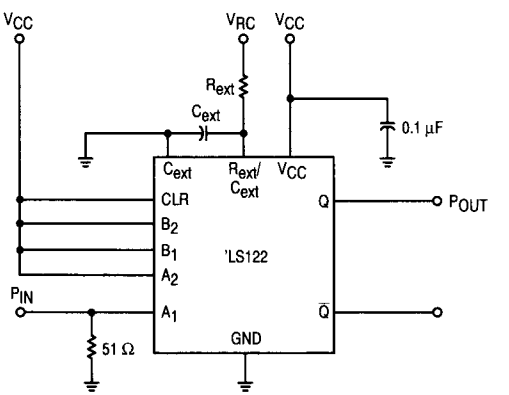
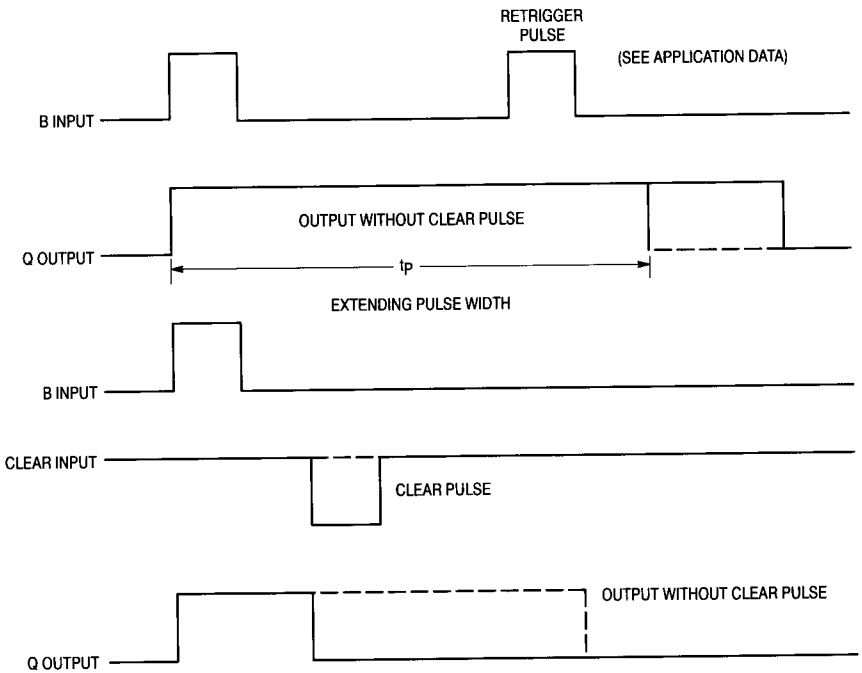


Figure 2

WAVEFORMS



Overriding The Output Pulse

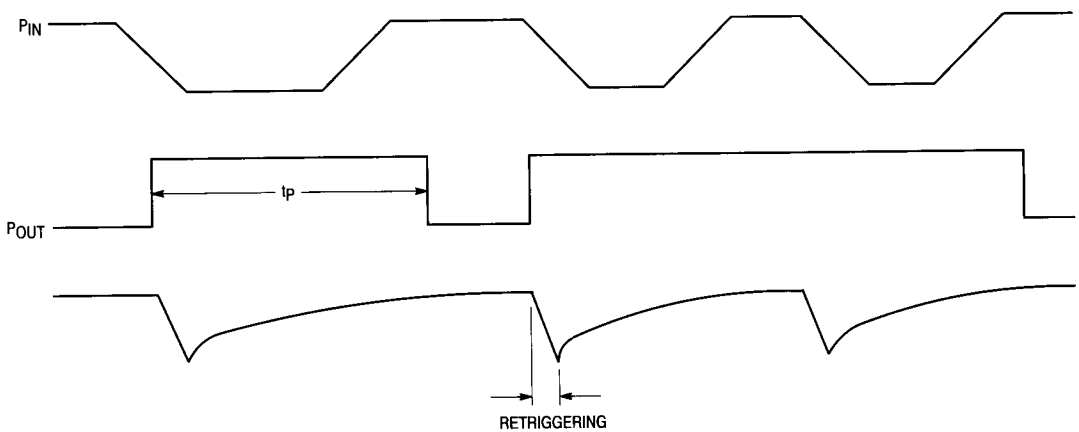


Figure 3

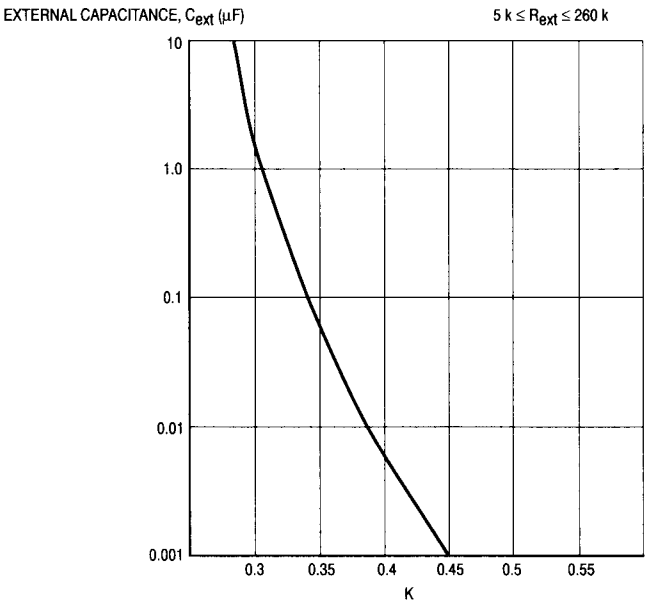


Figure 4

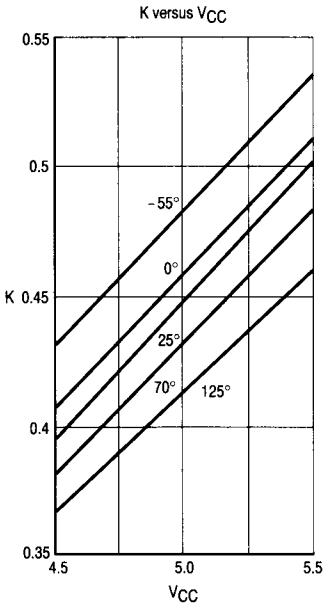


Figure 5

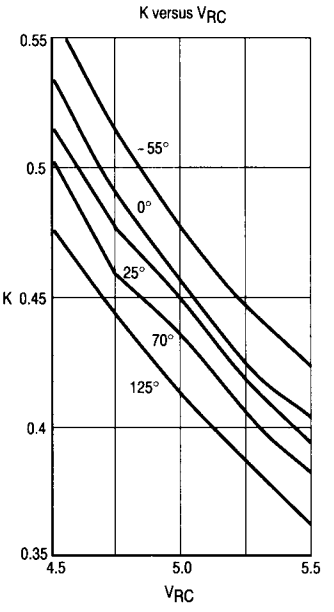


Figure 6

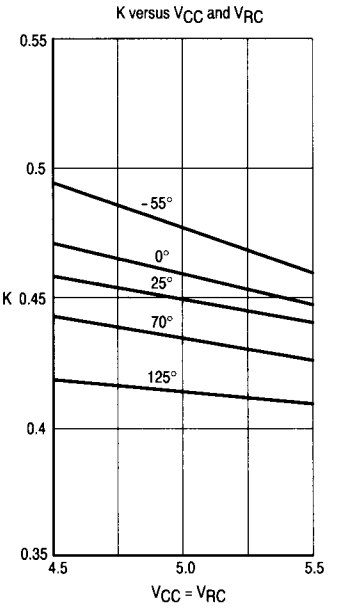


Figure 7

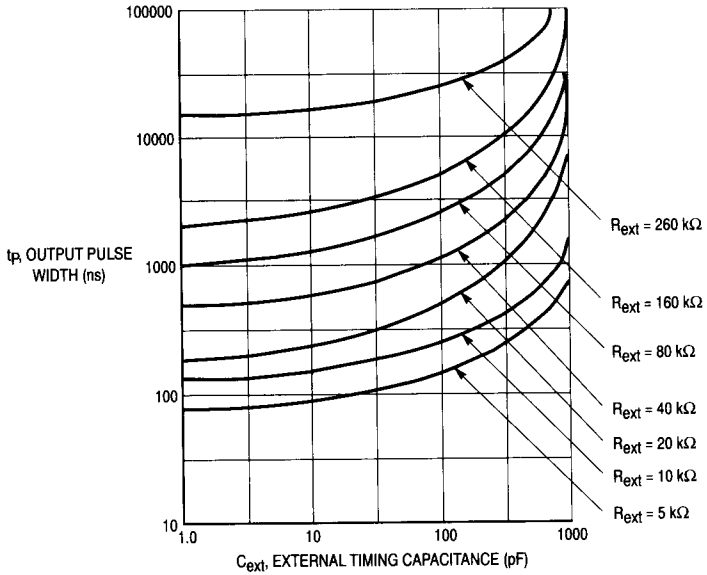


Figure 8

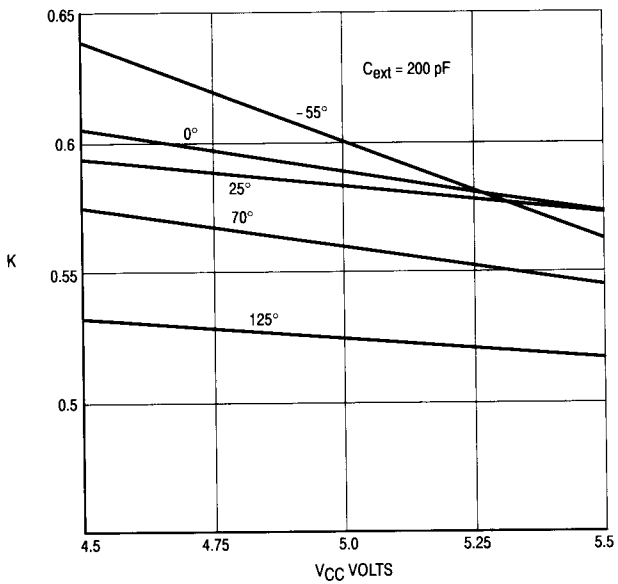


Figure 9

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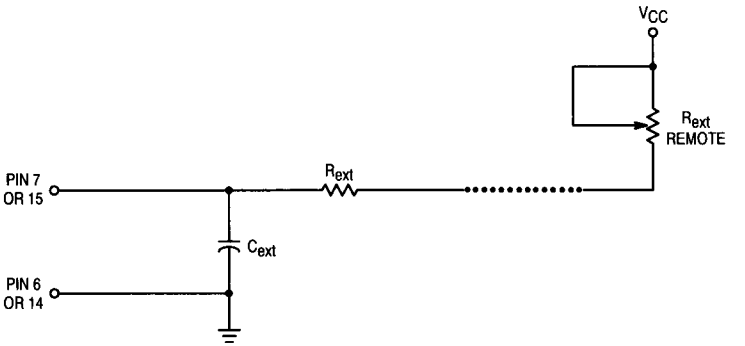


Figure 10. 'LS123 Remote Trimming Circuit

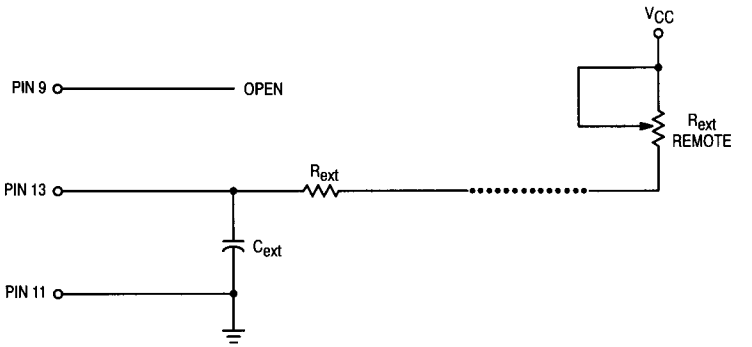


Figure 11. 'LS122 Remote Trimming Circuit Without R_{ext}

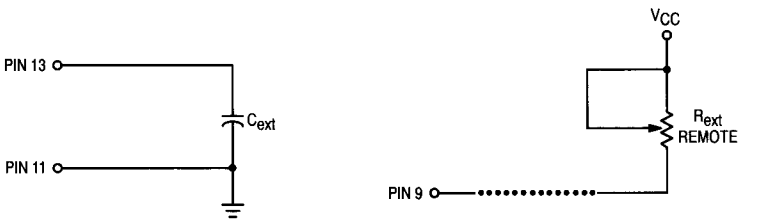
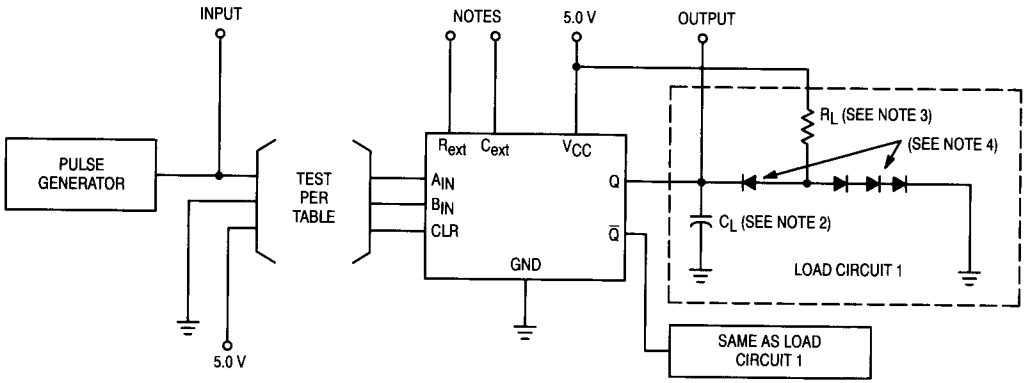


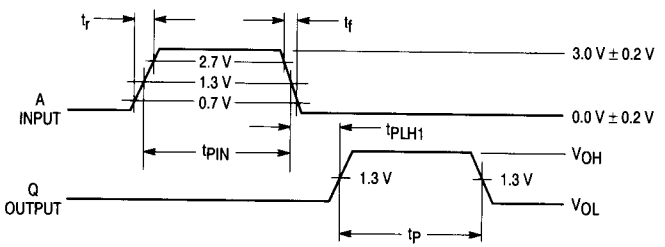
Figure 12. 'LS122 Remote Trimming Circuit With R_{INT}

LOAD FOR OUTPUT UNDER TEST

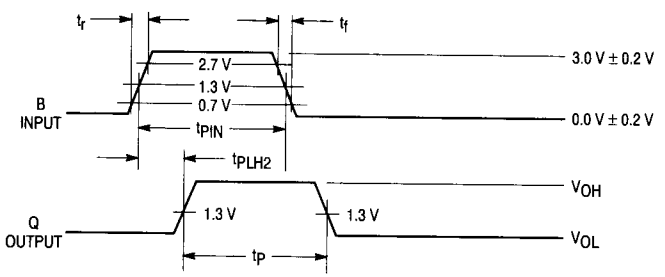


SWITCHING WAVEFORMS

t_{PLH1} and t_P Waveforms



t_{PLH2} and t_P Waveforms



NOTES:

1. Pulse generator has the following characteristics: PRR ≤ 1.0 MHz, t_r ≤ 15 ns, t_f ≤ 6.0 ns, t_{PIN} ≥ 40 ns and Z_{OUT} = 50 Ω.
2. C_L = 50 pF ± 10%, including scope probe, wiring and stray capacitance without package in test fixture.
3. R_L = 2.0 kΩ ± 5.0%.
4. All diodes are 1N3064 or 1N916 or equivalent.
5. The limits specified for C_L = 15 pF are guaranteed but not tested.
6. t_{setup} (max) shall be ≤ 50% of the typical output pulse width for the actual C_{ext} used.
7. C_{ext} connected to R_{ext}/C_{ext} through a 1,000 pF ± 10% capacitor.
8. R_{ext}/C_{ext} connected to V_{CC} through a 5.0 kΩ ± 10% resistor.
9. R_{ext}/C_{ext} connected to V_{CC} through a 5.0 kΩ to 180 kΩ resistor, and C_{ext} connected to R_{ext}/C_{ext} through a ≤ 1,000 pF capacitor.
10. R_{ext}/C_{ext} connected to V_{CC} through a 10 kΩ ± 10% resistor.
11. C_{ext} connected to R_{ext}/C_{ext} through a ≥ 45 pF capacitor, R_{ext}/C_{ext} connected to V_{CC} through a 10 kΩ ± 10% resistor.

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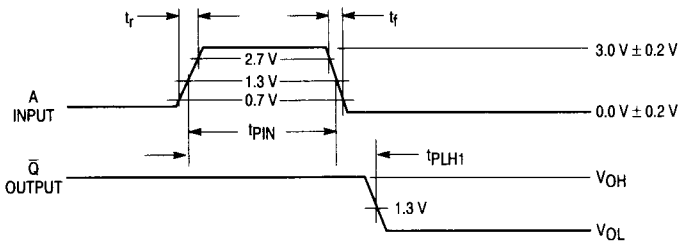
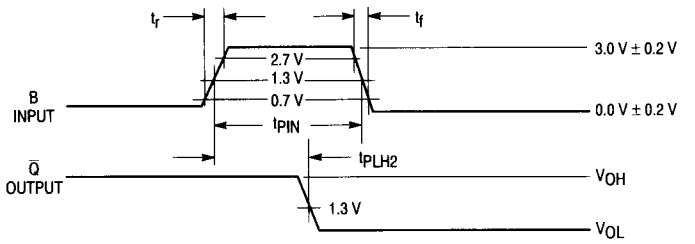
SWITCHING WAVEFORMS

t_{PLH1} Waveforms



t_{PLH2} Waveforms



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Symbol	Parameter	Limits						Unit	Test Condition (Unless Otherwise Specified)
		+ 25°C		+ 125°C		− 55°C			
	Static Parameters:	Subgroup 1		Subgroup 2		Subgroup 3			
		Min	Max	Min	Max	Min	Max		
V_{OH}	Logical "1" Output Voltage	2.5		2.5		2.5		V	V_{CC} = 4.5 V, I_{OH} = −0.4 mA, V_{IH} = 2.0 V, other input = 0.7 V, B_2 = (See Note 1) or 0.7 V, R_{int} = GND or 4.5 V, R_{ext} = GND, CLR = 4.5 V.
V_{OL}	Logical "0" Output Voltage		0.4		0.4		0.4	V	V_{CC} = 4.5 V, I_{OH} = 4.0 mA, V_{IH} = 2.0 V, other input = 0.7 V, B_2 = (See Note 1) or 0.7 V, R_{int} = GND or 4.5 V, R_{ext} = GND, CLR = 4.5 V.
V_{IC}	Input Clamping Voltage		−1.5					V	V_{CC} = 4.5 V, I_{IN} = −18 mA, other inputs are open.
I_{IH}	Logical "1" Input Current		20		20		20	µA	V_{CC} = 5.5 V, V_{IH} = 2.7 V, other input is GND, CLR = 2.7 V.
I_{IHH}	Logical "1" Input Current		100		100		100	µA	V_{CC} = 5.5 V, V_{IHH} = 5.5 V, other input is GND, CLR = 5.5 V.
I_{IL}	Logical "0" Input Current	−120	−360	−120	−360	−120	−360	µA	V_{CC} = 5.5 V, V_{IN} = 4.5 V, other inputs = 0.4 V.
I_{OS}	Output Short Circuit Current	−15	−100	−15	−100	−15	−100	mA	V_{CC} = 5.5 V, V_{IN} = 4.5 V, B_2 = (See Note 1) or GND, CLR = 4.5 V, R_{int} = GND or 4.5 V, other inputs = GND, V_{OUT} = GND.
I_{CCH}	Power Supply Current		11		11		11	mA	V_{CC} = 5.5 V, V_{IN} = 5.5 V, A = (See Note 1), R_{int} = 5.5 V, R_{ext} = 0.9 V.
I_{CCL}	Power Supply Current		11		11		11	mA	V_{CC} = 5.5 V, V_{IN} = 5.5 V, B = GND, R_{int} = 5.5 V.
V_{IH}	Logical "1" Input Voltage	2.0		2.0		2.0		V	V_{CC} = 4.5 V.
V_{IL}	Logical "0" Input Voltage		0.7		0.7		0.7	V	V_{CC} = 4.5 V.
	Functional Tests	Subgroup 7		Subgroup 8A		Subgroup 8B			per Truth Table with V_{CC} = 5.0 V, V_{INL} = 0.4 V, and V_{INH} = 2.5 V.

NOTE:
1. Apply input pulse: 2.5 V minimum to 5.5 V maximum; 0.0 V

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Symbol	Parameter	Limits						Unit	Test Condition (Unless Otherwise Specified)
	Switching Parameters:	+ 25°C		+ 125°C		− 55°C			
		Subgroup 9		Subgroup 10		Subgroup 11			
		Min	Max	Min	Max	Min	Max		
t_{PHL1} t_{PHL1}	Propagation Delay /Data-Output Output High-Low	5.0 —	50 45	5.0 —	75 70	5.0 —	75 70	ns	V_{CC} = 5.0 V, C_L = 50 pF, R_L = 2.0 kΩ. V_{CC} = 5.0 V, C_L = 15 pF, R_L = 2.0 kΩ. R_{ext} = 5.0 kΩ.
t_{PLH1} t_{PLH1}	Propagation Delay /Data-Output Output Low-High	5.0 —	38 33	5.0 —	57 52	5.0 —	57 52	ns	V_{CC} = 5.0 V, C_L = 50 pF, R_L = 2.0 kΩ. V_{CC} = 5.0 V, C_L = 15 pF, R_L = 2.0 kΩ. R_{ext} = 5.0 kΩ.
t_{PHL2} t_{PHL2}	Propagation Delay /Data-Output Output High-Low	5.0 —	61 56	5.0 —	92 87	5.0 —	92 87	ns	V_{CC} = 5.0 V, C_L = 50 pF, R_L = 2.0 kΩ. V_{CC} = 5.0 V, C_L = 15 pF, R_L = 2.0 kΩ. R_{ext} = 5.0 kΩ.
t_{PLH2} t_{PLH2}	Propagation Delay /Data-Output Output Low-High	5.0 —	49 44	5.0 —	74 69	5.0 —	74 69	ns	V_{CC} = 5.0 V, C_L = 50 pF, R_L = 2.0 kΩ. V_{CC} = 5.0 V, C_L = 15 pF, R_L = 2.0 kΩ. R_{ext} = 5.0 kΩ.
t_{PHL3} t_{PHL3}	Propagation Delay /Data-Output Output High-Low	5.0 —	32 27	5.0 —	48 43	5.0 —	48 43	ns	V_{CC} = 5.0 V, C_L = 50 pF, R_L = 2.0 kΩ. V_{CC} = 5.0 V, C_L = 15 pF, R_L = 2.0 kΩ. R_{ext} = 5.0 kΩ.
t_{PLH3} t_{PLH3}	Propagation Delay /Data-Output Output Low-High	5.0 —	50 45	5.0 —	75 70	5.0 —	75 70	ns	V_{CC} = 5.0 V, C_L = 50 pF, R_L = 2.0 kΩ. V_{CC} = 5.0 V, C_L = 15 pF, R_L = 2.0 kΩ. R_{ext} = 5.0 kΩ.
$t_{P(min)}$	A or B to Q		205 200	5.0 —		5.0 —		ns	V_{CC} = 5.0 V, C_L = 50 pF, R_L = 2.0 kΩ. V_{CC} = 5.0 V, C_L = 15 pF, R_L = 2.0 kΩ. R_{ext} = 5.0 kΩ.
t_{PQ}	A to B to Q	5.0 4.0	6.0 6.0	3.0 —	6.25 —	3.0 —	6.25 —	ns	V_{CC} = 5.0 V, C_L = 50 pF, R_L = 2.0 kΩ. V_{CC} = 5.0 V, C_L = 15 pF, R_L = 2.0 kΩ. R_{ext} = 10 kΩ, C_{ext} = 1000 pF.