SN74AHC123A-EP
DUAL RETRIGGERABLE MONOSTABLE MULTIVIBRATOR

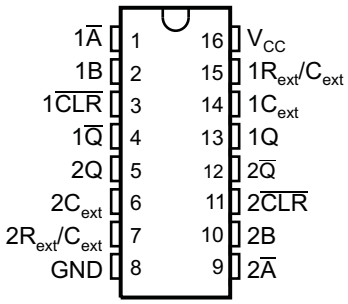
SCLS703A – JULY 2006 – REVISED MARCH 2007

FEATURES

- **Controlled Baseline**
  - **One Assembly Site**
  - **One Test Site**
  - **One Fabrication Site**
- **Extended Temperature Performance of –55°C to 125°C**
- **Enhanced Diminishing Manufacturing Sources (DMS) Support**
- **Enhanced Product-Change Notification**
- **Qualification Pedigree** (1)
- **Operating Range 2-V to 5.5-V V_{CC}**
- **Schmitt-Trigger Circuitry On $\overline{A}$, B, and $\overline{CLR}$ Inputs for Slow Input Transition Rates**
- **Edge Triggered From Active-High or Active-Low Gated Logic Inputs**
- **Retriggerable for Long Output Pulses**
- **Overriding Clear Terminates Output Pulse**
- **Glitch-Free Power-Up Reset On Outputs**
- **Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II**
- **ESD Protection Exceeds JESD 22**
  - **2000-V Human-Body Model (A114-A)**
  - **200-V Machine Model (A115-A)**
  - **1000-V Charged-Device Model (C101)**

(1) Component qualification in accordance with JEDEC and industry standards to ensure reliable operation over an extended temperature range. This includes, but is not limited to, Highly Accelerated Stress Test (HAST) or biased 85/85, temperature cycle, autoclave or unbiased HAST, electromigration, bond intermetallic life, and mold compound life. Such qualification testing should not be viewed as justifying use of this component beyond specified performance and environmental limits.

D PACKAGE
(TOP VIEW)



DESCRIPTION/ORDERING INFORMATION

The SN74AHC123A device is a dual retriggerable monostable multivibrator designed for 2-V to 5.5-V V_{CC} operation.

This edge-triggered multivibrator features output pulse-duration control by three methods. In the first method, the $\overline{A}$ input is low, and the B input goes high. In the second method, the B input is high, and the $\overline{A}$ input goes low. In the third method, the $\overline{A}$ input is low, the B input is high, and the clear ($\overline{CLR}$) input goes high.

The output pulse duration is programmed by selecting external resistance and capacitance values. The external timing capacitor must be connected between C_{ext} and R_{ext}/C_{ext} (positive) and an external resistor connected between R_{ext}/C_{ext} and V_{CC}. To obtain variable pulse durations, connect an external variable resistance between R_{ext}/C_{ext} and V_{CC}. The output pulse duration can be reduced by taking $\overline{CLR}$ low.

Pulse triggering occurs at a particular voltage level and is not directly related to the transition time of the input pulse. The $\overline{A}$, B, and $\overline{CLR}$ inputs have Schmitt triggers with sufficient hysteresis to handle slow input transition rates with jitter-free triggering at the outputs.

Once triggered, the basic pulse duration can be extended by retriggering the gated low-level-active ($\overline{A}$) or high-level-active (B) input. Pulse duration can be reduced by taking $\overline{CLR}$ low. $\overline{CLR}$ can be used to override $\overline{A}$ or B inputs. The input/output timing diagram illustrates pulse control by retriggering the inputs and early clearing.

The variance in output pulse duration from device to device is less than ±0.5% (typ) for given external timing components. An example of this distribution for the SN74AHC123A is shown in Figure 10. Variations in output pulse duration versus supply voltage and temperature are shown in Figure 6.

DESCRIPTION/ORDERING INFORMATION (CONTINUED)

During power up, Q outputs are in the low state and $\overline{Q}$ outputs are in the high state. The outputs are glitch free, without applying a reset pulse.

For additional application information on multivibrators, see the application report *Designing With the SN74AHC123A and SN74AHCT123A*, literature number SCLA014.

ORDERING INFORMATION(1)

T_A	PACKAGE(2)		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–55°C to 125°C	SOIC – D	Tape and reel	SN74AHC123AMDREP	AHC123A-EP

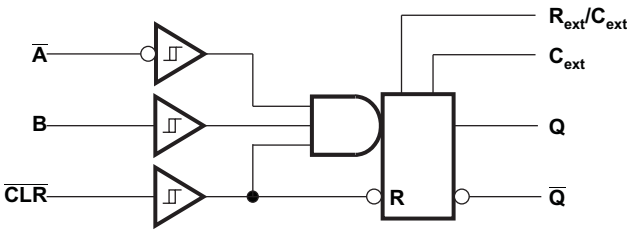
(1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI Web site at www.ti.com.
(2) Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

FUNCTION TABLE (each multivibrator)

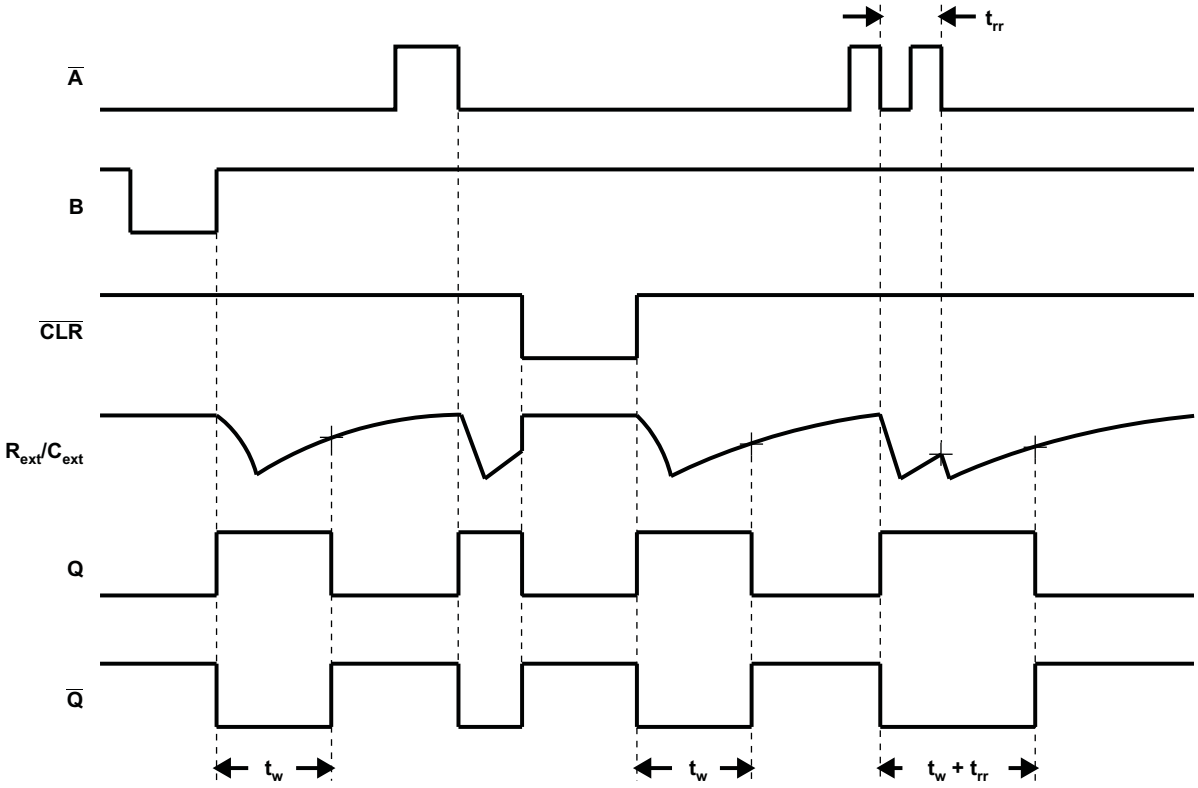
INPUTS			OUTPUTS	
$\overline{CLR}$	$\overline{A}$	B	Q	$\overline{Q}$
L	X	X	L	H
X	H	X	L(1)	H(1)
X	X	L	L(1)	H(1)
H	L	↑	⎍	⎎
H	↓	H	⎍	⎎
↑	L	H	⎍	⎎

(1) These outputs are based on the assumption that the indicated steady-state conditions at the $\overline{A}$ and B inputs have been set up long enough to complete any pulse started before the setup.

LOGIC DIAGRAM, EACH MULTIVIBRATOR (POSITIVE LOGIC)



INPUT/OUTPUT TIMING DIAGRAM



Absolute Maximum Ratings(1)

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

			MIN	MAX	UNIT
V_{CC}	Supply voltage range(2)		–0.5	7	V
V_I	Input voltage range(3)		–0.5	7	V
V_O	Output voltage range in high or low state(2)		–0.5	V_{CC} + 0.5	V
V_O	Output voltage range in power-off state(2)		–0.5	7	V
I_{IK}	Input clamp current	V_I < 0 V		–20	mA
I_{OK}	Output clamp current	V_O < 0 V or V_O < V_{CC}		±20	mA
I_O	Continuous output current	V_O = 0 V to V_{CC}		±25	mA
	Continuous current through V_{CC} or GND			±50	mA
θ_{JA}	Package thermal impedance(4)			73	°C/W
T_{stg}	Storage temperature range		–65	150	°C

(1) 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.
(2) Voltage values are with respect to the network ground terminal.
(3) The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
(4) The package thermal impedance is calculated in accordance with JESD 51-7.

Recommended Operating Conditions[1]

			MIN	MAX	UNIT
V_{CC}	Supply voltage		2	5.5	V
V_{IH}	High-level input voltage	V_{CC} = 2 V	1.5		V
		V_{CC} = 3 V	2.1		
		V_{CC} = 5.5 V	3.85		
V_{IL}	Low-level input voltage	V_{CC} = 2 V		0.5	V
		V_{CC} = 3 V		0.9	
		V_{CC} = 5.5 V		1.65	
V_I	Input voltage		0	5.5	V
V_O	Output voltage		0	V_{CC}	V
I_{OH}	High-level output current	V_{CC} = 2 V		–50	μA
		V_{CC} = 3.3 V ± 0.3 V		–4	mA
		V_{CC} = 5 V ± 0.5 V		–8	
I_{OL}	Low-level output current	V_{CC} = 2 V		50	μA
		V_{CC} = 3.3 V ± 0.3 V		4	mA
		V_{CC} = 5 V ± 0.5 V		8	
R_{ext}	External timing resistance	V_{CC} = 2 V	5		kΩ
		V_{CC} > 3 V	1		
$\Delta t/\Delta V_{CC}$	Power-up ramp rate		1		ms/V
T_A	Operating free-air temperature		–55	125	°C

(1) Unused R_{ext}/C_{ext} terminals should be left unconnected. All remaining unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation. See the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

Electrical Characteristics

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

PARAMETER		TEST CONDITIONS	V_{CC}	T_A = 25°C			MIN	MAX	UNIT
				MIN	TYP	MAX			
V_{OH}		I_{OH} = –50 μA	2 V	1.9	2		1.9		V
			3 V	2.9	3		2.9		
			4.5 V	4.4	4.5		4.4		
		I_{OH} = –4 mA	3 V	2.58			2.48		
		I_{OH} = –8 mA	4.5 V	3.94			3.8		
V_{OL}		I_{OL} = 50 μA	2 V			0.1		0.1	V
			3 V			0.1		0.1	
			4.5 V			0.1		0.1	
		I_{OL} = 4 mA	3 V			0.36		0.44	
		I_{OL} = 8 mA	4.5 V			0.36		0.44	
I_I	R_{ext}/C_{ext}[1]	V_I = V_{CC} or GND	5.5 V			±0.25		±2.5	μA
	$\overline{A}$, B, and $\overline{CLR}$	V_I = V_{CC} or GND	0 V to 5.5 V			±0.1		±1[2]	
I_{CC}	Quiescent	V_I = V_{CC} or GND, I_O = 0	5.5 V			4		40	μA
I_{CC}	Active state (per circuit)	V_I = V_{CC} or GND, R_{ext}/C_{ext} = 0.5 V_{CC}	3 V		160	250		280	μA
			4.5 V		280	500		650	
			5.5 V		360	750		975	
C_i		V_I = V_{CC} or GND	5 V		1.9	10		10	pF

(1) This test is performed with the terminal in the off-state condition.
(2) On products compliant to MIL-PRF-38535, this parameter is not production tested at V_{CC} = 0 V.

Timing Requirements

over recommended operating free-air temperature range, V_{CC} = 3.3 V ± 0.3 V (unless otherwise noted) (see Figure 1)

PARAMETER			TEST CONDITIONS	T_A = 25°C			MIN	MAX	UNIT
				MIN	TYP	MAX			
t_w	Pulse duration	$\overline{CLR}$		5			5		ns
		$\overline{A}$ or B trigger		5			5		
t_{rr}	Pulse retirgger time		R_{ext} = 1 kΩ, C_{ext} = 100 pF	(1)	76		(1)		ns
			R_{ext} = 1 kΩ, C_{ext} = 0.01 µF	(1)	1.8		(1)		µs

(1) See retriggering data in the application information section.

Timing Requirements

over recommended operating free-air temperature range, V_{CC} = 5 V ± 0.5 V (unless otherwise noted) (see Figure 1)

PARAMETER			TEST CONDITIONS	T_A = 25°C			MIN	MAX	UNIT
				MIN	TYP	MAX			
t_w	Pulse duration	$\overline{CLR}$		5			5		ns
		$\overline{A}$ or B trigger		5			5		
t_{rr}	Pulse retirgger time		R_{ext} = 1 kΩ, C_{ext} = 100 pF	(1)	59		(1)		ns
			R_{ext} = 1 kΩ, C_{ext} = 0.01 µF	(1)	1.5		(1)		µs

(1) See retriggering data in the application information section.

Switching Characteristics

over recommended operating free-air temperature range, V_{CC} = 3.3 V ± 0.3 V (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	T_A = 25°C			MIN	MAX	UNIT
				MIN	TYP	MAX			
t_{PLH}	$\overline{A}$ or B	Q or $\overline{Q}$	C_L = 15 pF		9.5(1)	20.6(1)	1(1)	24(1)	ns
t_{PHL}					10.2(1)	20.6(1)	1(1)	24(1)	
t_{PLH}	$\overline{CLR}$	Q or $\overline{Q}$	C_L = 15 pF		7.5(1)	15.8(1)	1(1)	18.5(1)	ns
t_{PHL}					9.3(1)	15.8(1)	1(1)	18.5(1)	
t_{PLH}	$\overline{CLR}$ trigger	Q or $\overline{Q}$	C_L = 15 pF		10(1)	22.4(1)	1(1)	26(1)	ns
t_{PHL}					10.6(1)	22.4(1)	1(1)	26(1)	
t_{PLH}	$\overline{A}$ or B	Q or $\overline{Q}$	C_L = 50 pF		10.5	24.1	1	27.5	ns
t_{PHL}					11.8	24.1	1	27.5	
t_{PLH}	$\overline{CLR}$	Q or $\overline{Q}$	C_L = 50 pF		8.9	19.3	1	22	ns
t_{PHL}					10.5	19.3	1	22	
t_{PLH}	$\overline{CLR}$ trigger	Q or $\overline{Q}$	C_L = 50 pF		11	25.9	1	29.5	ns
t_{PHL}					12.3	25.9	1	29.5	
t_w(2)		Q or $\overline{Q}$	C_L = 50 pF, C_{ext} = 28 µF, R_{ext} = 2 kΩ		182	240		300	ns
			C_L = 50 pF, C_{ext} = 0.01 µF, R_{ext} = 10 kΩ	90	100	110	90	110	µs
			C_L = 50 pF, C_{ext} = 0.1 µF, R_{ext} = 10 kΩ	0.9	1	1.1	0.9	1.1	ms
Δt_w(3)					±1%				

(1) On products compliant to MIL-PRF-38535, this parameter is not production tested.
(2) t_w = Pulse duration at Q and $\overline{Q}$ outputs
(3) Δt_w = Output pulse-duration variation (Q and $\overline{Q}$) between circuits in same package

Switching Characteristics

over recommended operating free-air temperature range, V_{CC} = 5 V ± 0.5 V (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	T_A = 25°C			MIN	MAX	UNIT
				MIN	TYP	MAX			
t_{PLH}	$\overline{A}$ or B	Q or $\overline{Q}$	C_L = 15 pF		6.5(1)	12(1)	1(1)	14(1)	ns
t_{PHL}					7.1(1)	12(1)	1(1)	14(1)	
t_{PLH}	$\overline{CLR}$	Q or $\overline{Q}$	C_L = 15 pF		5.3(1)	9.4(1)	1(1)	11(1)	ns
t_{PHL}					6.5(1)	9.4(1)	1(1)	11(1)	
t_{PLH}	$\overline{CLR}$ trigger	Q or $\overline{Q}$	C_L = 15 pF		6.9(1)	12.9(1)	1(1)	15(1)	ns
t_{PHL}					7.4(1)	12.9(1)	1(1)	15(1)	
t_{PLH}	$\overline{A}$ or B	Q or $\overline{Q}$	C_L = 50 pF		7.3	14	1	16	ns
t_{PHL}					8.3	14	1	16	
t_{PLH}	$\overline{CLR}$	Q or $\overline{Q}$	C_L = 50 pF		6.3	11.4	1	13	ns
t_{PHL}					7.4	11.4	1	13	
t_{PLH}	$\overline{CLR}$ trigger	Q or $\overline{Q}$	C_L = 50 pF		7.6	14.9	1	17	ns
t_{PHL}					8.7	14.9	1	17	
t_w(2)		Q or $\overline{Q}$	C_L = 50 pF, C_{ext} = 28 µF, R_{ext} = 2 kΩ		167	200		240	ns
			C_L = 50 pF, C_{ext} = 0.01 µF, R_{ext} = 10 kΩ	90	100	110	90	110	µs
			C_L = 50 pF, C_{ext} = 0.1 µF, R_{ext} = 10 kΩ	0.9	1	1.1	0.9	1.1	ms
Δt_w(3)					±1%				

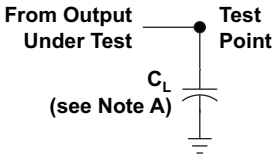
(1) On products compliant to MIL-PRF-38535, this parameter is not production tested.
(2) t_w = Pulse duration at Q and $\overline{Q}$ outputs
(3) Δt_w = Output pulse-duration variation (Q and $\overline{Q}$) between circuits in same package

Operating Characteristics

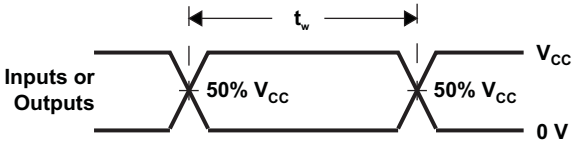
V_{CC} = 5 V, T_A = 25°C

PARAMETER		TEST CONDITIONS	TYP	UNIT
C_{pd}	Power dissipation capacitance	No load	29	pF

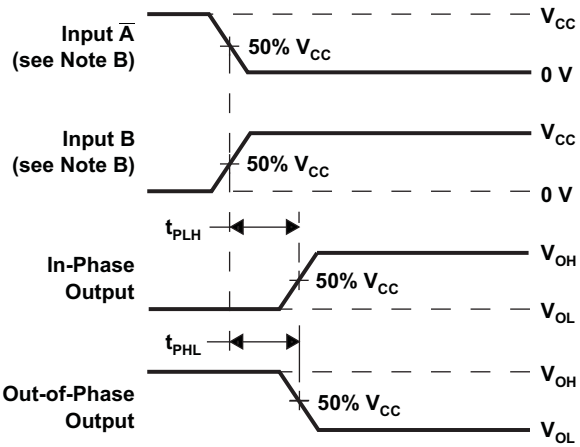
PARAMETER MEASUREMENT INFORMATION



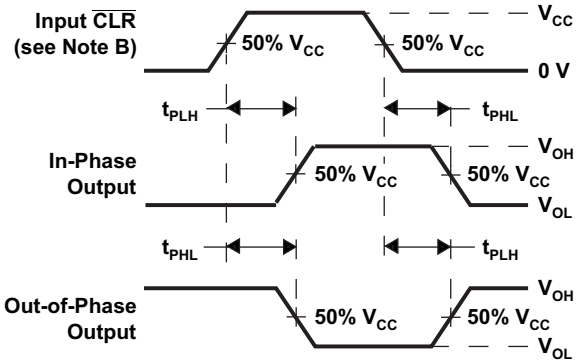
LOAD CIRCUIT



VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
DELAY TIMES



VOLTAGE WAVEFORMS
DELAY TIMES

NOTES: A. C_L includes probe and jig capacitance.
B. All input pulses are supplied by generators having the following characteristics: Z_O = 50 Ω, t_r = 3 ns, t_f = 3 ns.
C. The outputs are measured one at a time, with one input transition per measurement.

Figure 1. Load Circuit and Voltage Waveforms

APPLICATION INFORMATION

Caution in Use

To prevent malfunctions due to noise, connect a high-frequency capacitor between V_{CC} and GND, and keep the wiring between the external components and C_{ext} and R_{ext}/C_{ext} terminals as short as possible.

Powerdown Considerations

Large values of C_{ext} can cause problems when powering down the SN74AHC123A devices because of the amount of energy stored in the capacitor. When a system containing this device is powered down, the capacitor can discharge from V_{CC} through the protection diodes at pin 2 or pin 14. Current through the input protection diodes must be limited to 30 mA; therefore, the turn-off time of the V_{CC} power supply must not be faster than $t = V_{CC} \times C_{ext}/30$ mA. For example, if V_{CC} = 5 V and C_{ext} = 15 pF, the V_{CC} supply must turn off no faster than $t = (5\ V) \times (15\ pF)/30\ mA = 2.5$ ns. Usually, this is not a problem because power supplies are heavily filtered and cannot discharge at this rate. When a more rapid decrease of V_{CC} to zero occurs, the SN74AHC123A can sustain damage. To avoid this possibility, use external clamping diodes.

Output Pulse Duration

The output pulse duration (t_w) is determined primarily by the values of the external capacitance (C_T) and timing resistance (R_T). The timing components are connected as shown in Figure 2.

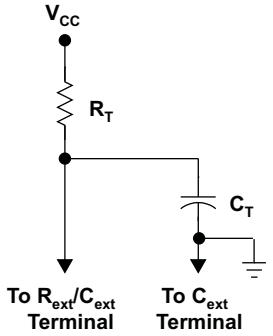


Figure 2. Timing-Component Connections

The pulse duration is given by:

$$t_w = K \times R_T \times C_T \quad (1)$$

if C_T is ≥ 1000 pF, K = 1 or

if C_T is < 1000 pF, K can be determined from Figure 9

where:

t_w = pulse duration in ns

R_T = external timing resistance in kΩ

C_T = external capacitance in pF

K = multiplier factor

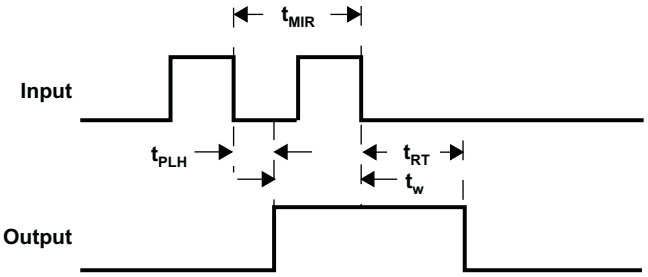
Equation 1 and Figure 3 can be used to determine values for pulse duration, external resistance, and external capacitance.

APPLICATION INFORMATION (continued)

Retriggering Data

NOTE: Operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied.

The minimum input retriggering time (t_{MIR}) is the minimum time required after the initial signal before retriggering the input. After t_{MIR}, the device retriggers the output. Experimentally, it also can be shown that to retrigger the output pulse, the two adjacent input signals should be t_{MIR} apart, where $t_{MIR} = 0.3 \times t_w$. The retrigger pulse duration is calculated as shown in Figure 3.



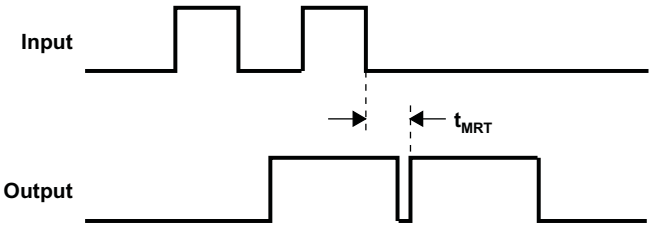
$t_{RT} = t_w + t_{PLH} = (K \times R_T \times C_T) + t_{PLH}$

Where:

t_{MIR} = Minimum Input Retriggering Time
t_{PLH} = Propagation Delay
t_{RT} = Retrigger Time
t_w = Output Pulse Duration Before Retriggering

Figure 3. Retrigger Pulse Duration

The minimum value from the end of the input pulse to the beginning of the retriggered output should be approximately 15 ns to ensure a retriggered output (see Figure 4).



t_{MRT} = Minimum Time Between the End of the Second Input Pulse and the Beginning of the Retriggered Output
t_{MRT} = 15 ns

Figure 4. Input/Output Requirements

APPLICATION INFORMATION (continued)

NOTE: Operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied.

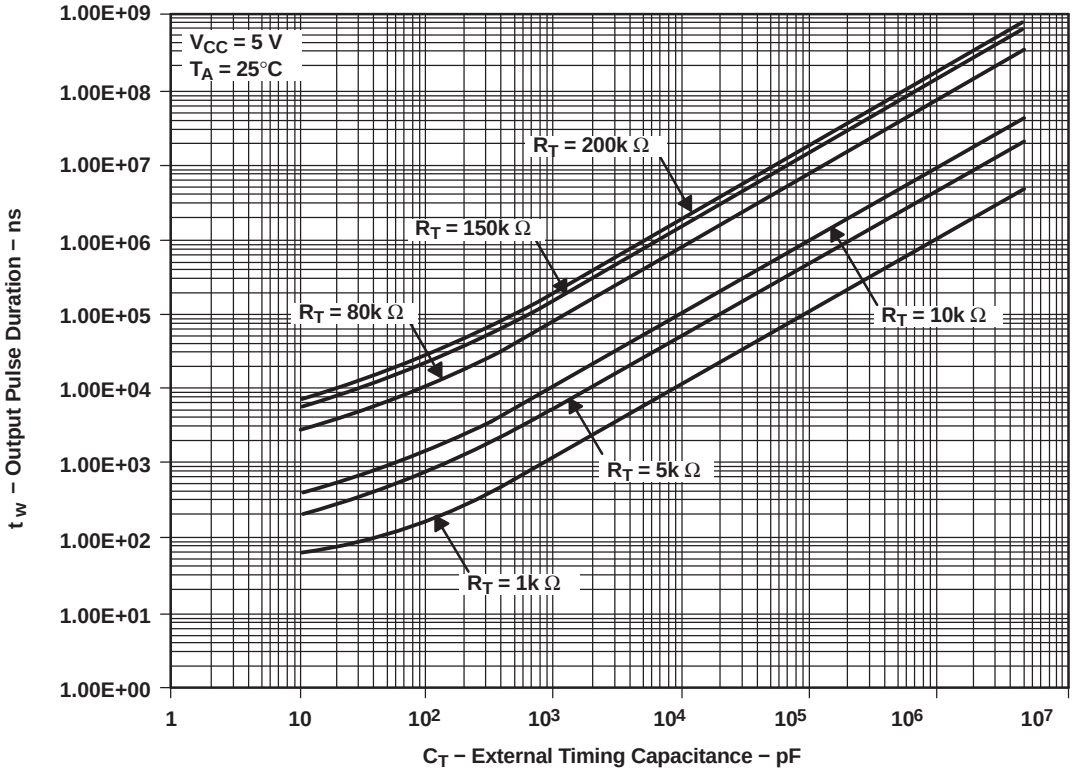


Figure 5. Output Pulse Duration vs External Timing Capacitance

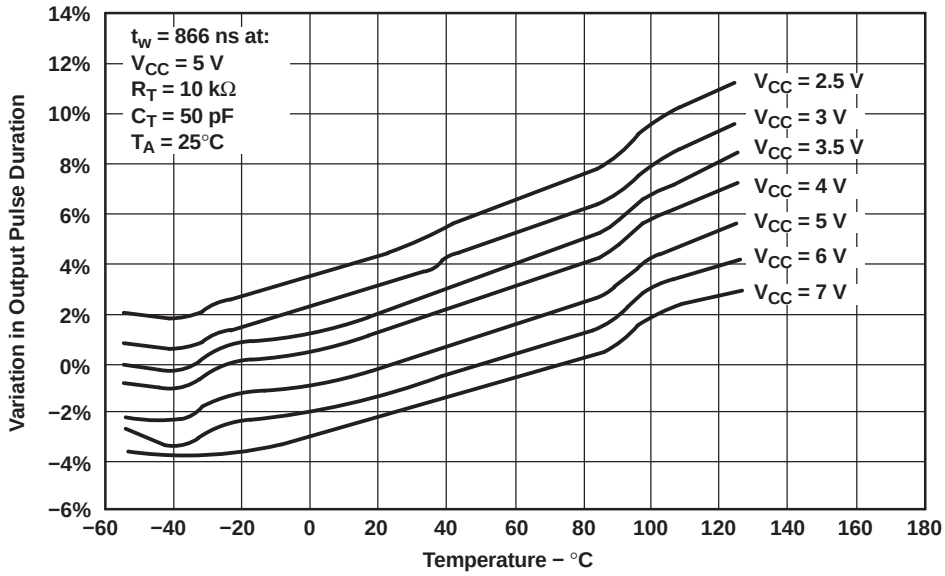


Figure 6. Variations in Output Pulse Duration vs Temperature

APPLICATION INFORMATION (continued)

NOTE: Operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied.

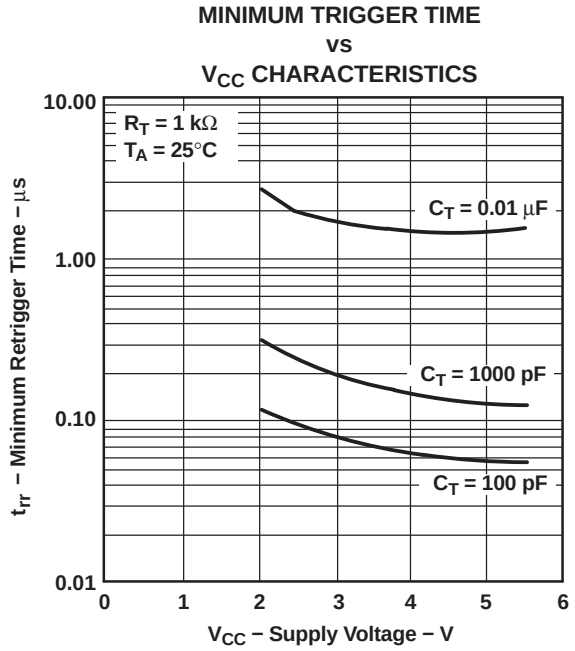


Figure 7.

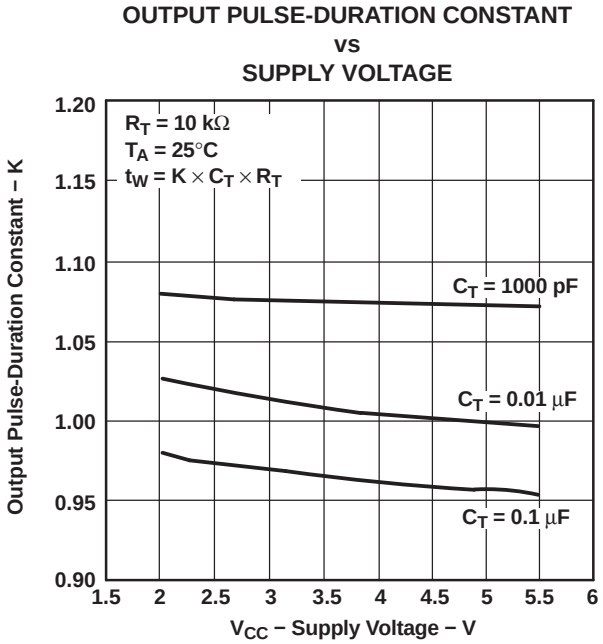


Figure 8.

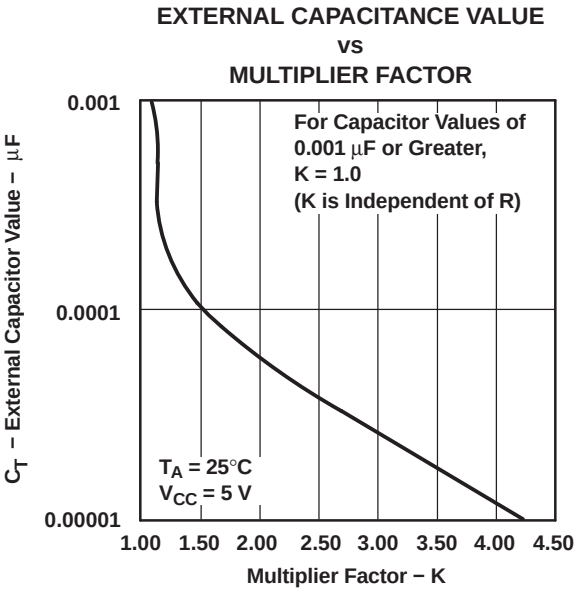


Figure 9.

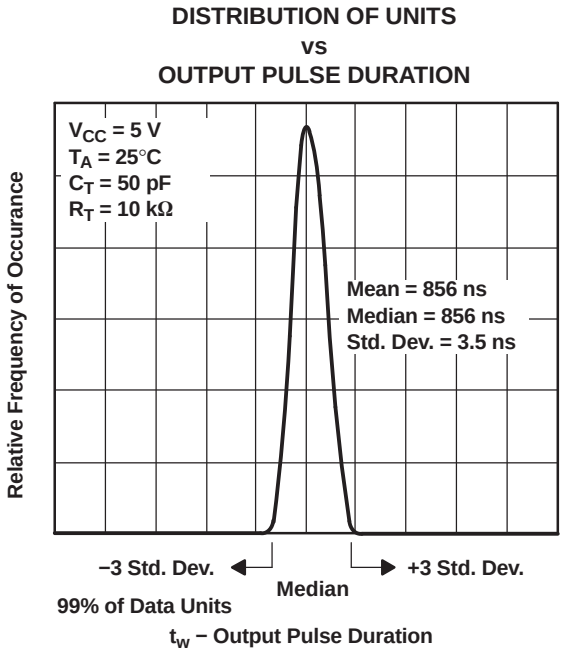


Figure 10.

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package | Pins	Package qty | Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
SN74AHC123AMDREP	Active	Production	SOIC (D) | 16	2500 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	AHC123AEP
SN74AHC123AMDREP.A	Active	Production	SOIC (D) | 16	2500 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	AHC123AEP
SN74AHC123AMDREPG4	Active	Production	SOIC (D) | 16	2500 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	AHC123AEP
V62/06665-01XE	Active	Production	SOIC (D) | 16	2500 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	AHC123AEP

(1) **Status:** For more details on status, see our product life cycle.

(2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the TI RoHS Statement for additional information and value definition.

(4) **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

(6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

OTHER QUALIFIED VERSIONS OF SN74AHC123A-EP :

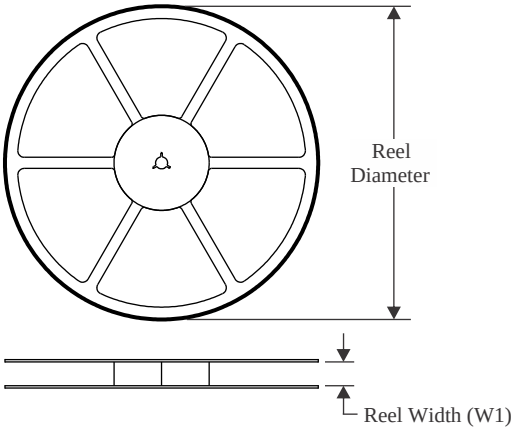
- Catalog : SN74AHC123A
- Military : SN54AHC123A

NOTE: Qualified Version Definitions:

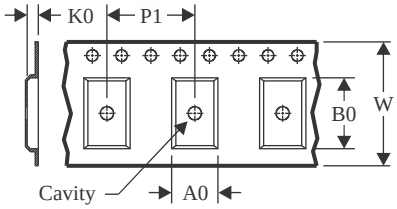
- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications

TAPE AND REEL INFORMATION

REEL DIMENSIONS

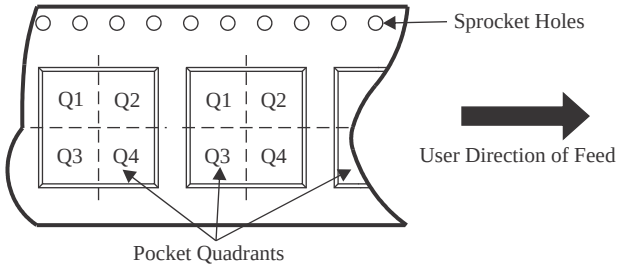


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

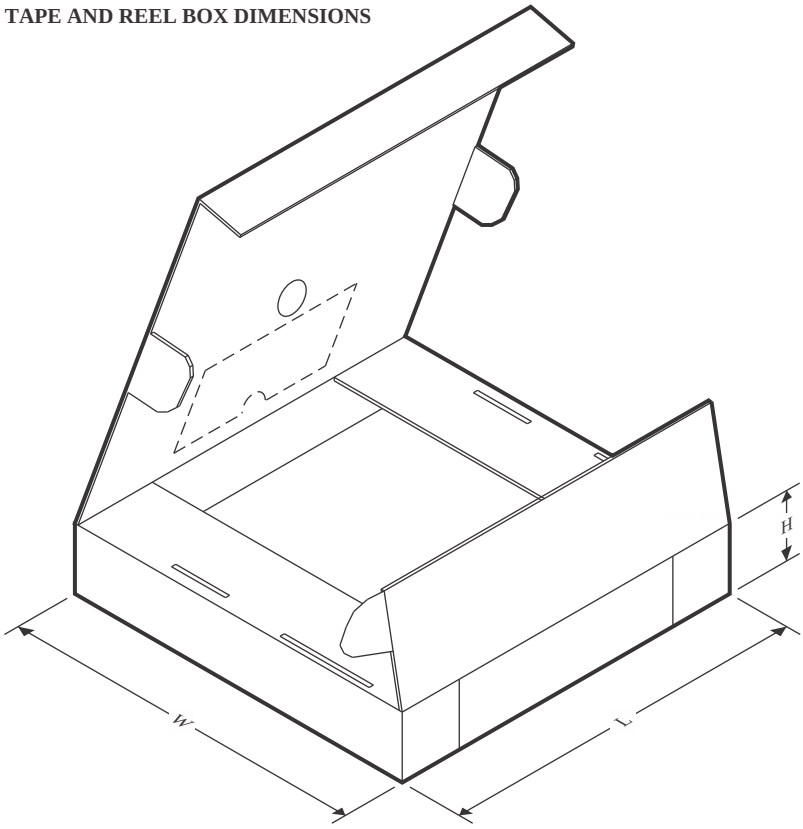
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN74AHC123AMDREP	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1

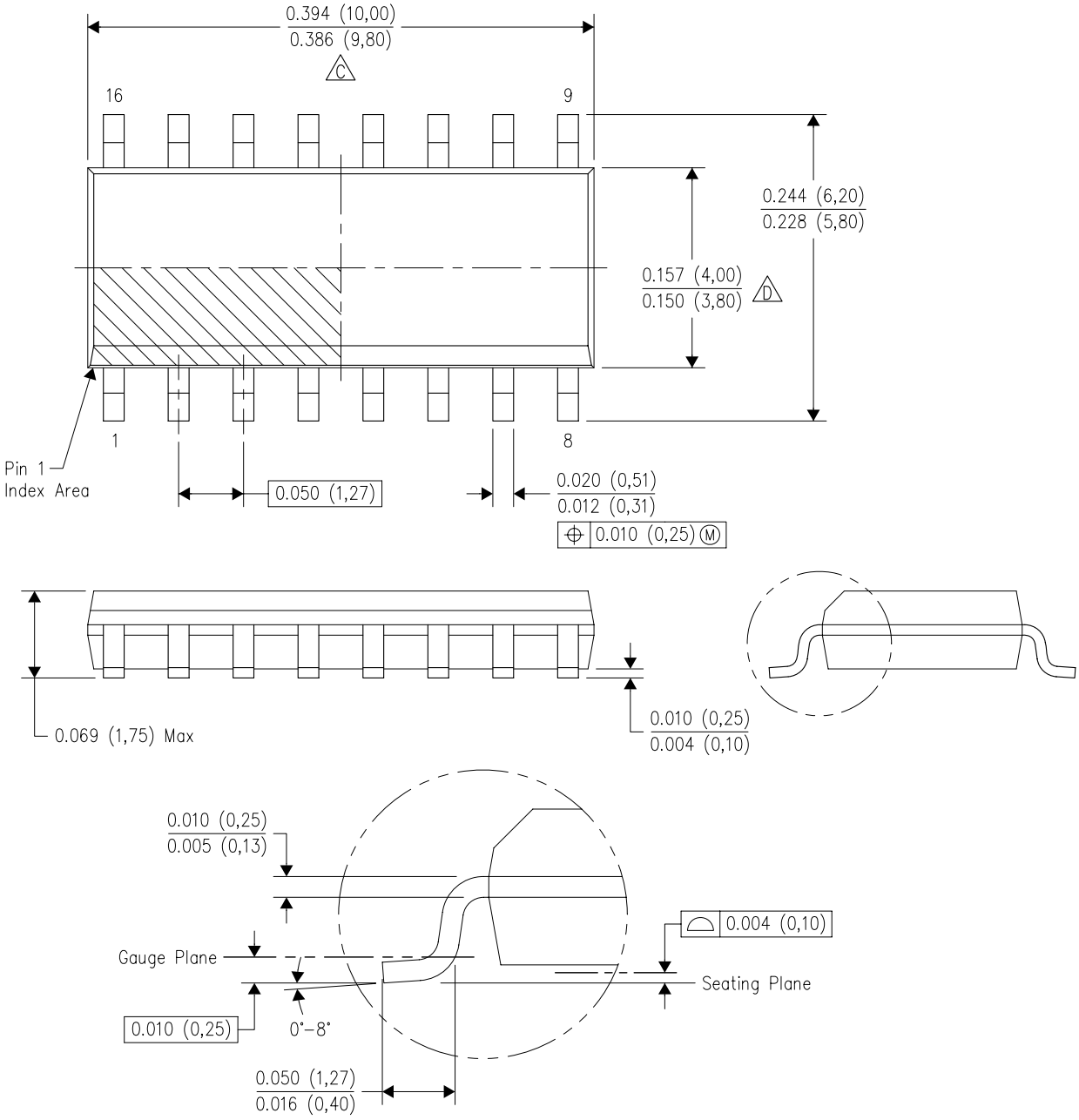
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74AHC123AMDREP	SOIC	D	16	2500	353.0	353.0	32.0

D (R–PDSO–G16) PLASTIC SMALL OUTLINE



NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
E. Reference JEDEC MS–012 variation AC.

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